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1.2 monaco-vim 0.4.0

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```
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* Version - 0.4.0  
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* License - MIT  
*/
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1.3 fontconfig 2.12.6

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1.4 vx-shape 0.0.199

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%% promise-polyfill version 8.1.0 (<https://github.com/taylorhakes/promise-polyfill>)

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%% typescript version 2.7.2 (<https://github.com/Microsoft/TypeScript>)

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1.5 wayland-protocols 1.25

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2.4.109/radeon/radeon_surface.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/vcn_tests.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/syncobj_tests.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/ras_tests.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/deadlock_tests.c
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/vm_tests.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/libkms/intel.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/libkms/api.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/libkms/dumb.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/libkms/libkms.h

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* Authors:

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2.4.109/etnaviv/etnaviv_gpu.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/tests/etnaviv/etnaviv_cmd_stream_test.c

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* Authors:

* Ben Widawsky <ben@bwidawsk.net>

*

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2.4.109/intel/intel_debug.h

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/* xf86drmRandom.c -- "Minimal Standard" PRNG Implementation

* Created: Mon Apr 19 08:28:13 1999 by faith@precisioninsight.com

*

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*

* Authors: Rickard E. (Rik) Faith <faith@valinux.com>

*

* DESCRIPTION

*

* This file contains a simple, straightforward implementation of the Park
* & Miller "Minimal Standard" PRNG [PM88, PMS93], which is a Lehmer
* multiplicative linear congruential generator (MLCG) with a period of
* $2^{31}-1$.

*

* This implementation is intended to provide a reliable, portable PRNG
* that is suitable for testing a hash table implementation and for
* implementing skip lists.

*

* FUTURE ENHANCEMENTS

*

* If initial seeds are not selected randomly, two instances of the PRNG
* can be correlated. [Knuth81, pp. 32-33] describes a shuffling technique
* that can eliminate this problem.

*

* If PRNGs are used for simulation, the period of the current
* implementation may be too short. [LE88] discusses methods of combining
* MLCGs to produce much longer periods, and suggests some alternative
* values for A and M. [LE90 and Sch92] also provide information on
* long-period PRNGs.

*

* REFERENCES

*

* [Knuth81] Donald E. Knuth. The Art of Computer Programming. Volume 2:
* Seminumerical Algorithms. Reading, Massachusetts: Addison-Wesley, 1981.

*

* [LE88] Pierre L'Ecuyer. "Efficient and Portable Combined Random Number
* Generators". CACM 31(6), June 1988, pp. 742-774.

*

* [LE90] Pierre L'Ecuyer. "Random Numbers for Simulation". CACM 33(10),
* October 1990, pp. 85-97.

*

* [PM88] Stephen K. Park and Keith W. Miller. "Random Number Generators:

* Good Ones are Hard to Find". CACM 31(10), October 1988, pp. 1192-1201.

*

* [Sch92] Bruce Schneier. "Pseudo-Ransom Sequence Generator for 32-Bit
* CPUs". Dr. Dobbs's Journal 17(2), February 1992, pp. 34, 37-38, 40.

*

* [PMS93] Stephen K. Park, Keith W. Miller, and Paul K. Stockmeyer. In
* "Technical Correspondence: Remarks on Choosing and Implementing Random
* Number Generators". CACM 36(7), July 1993, pp. 105-110.

*

*/

Found in path(s):

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/xf86drmRandom.c

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*

* Authors:

* Chris Wilson <chris@chris-wilson.co.uk>

*

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2.4.109/xf86atomic.h

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```

/* amdgpu_drm.h -- Public header for the amdgpu driver -*- linux-c -*-
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*   Kevin E. Martin <martin@valinux.com>
*   Gareth Hughes <gareth@valinux.com>
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/include/drm/amdgpu_drm.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/nouveau/pushbuf.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/nouveau/bufctx.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/nouveau/abi16.c

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/* exynos.c

*

* Copyright 2009 Samsung Electronics Co., Ltd.

* Authors:

* SooChan Lim <sc1.lim@samsung.com>

* Sangjin LEE <lsj119@samsung.com>

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/* xf86drmSL.c -- Skip list support

* Created: Mon May 10 09:28:13 1999 by faith@precisioninsight.com

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*
* Authors: Rickard E. (Rik) Faith <faith@valinux.com>
*

* DESCRIPTION

* This file contains a straightforward skip list implementation.n
*

* FUTURE ENHANCEMENTS

* REFERENCES

* [Pugh90] William Pugh. Skip Lists: A Probabilistic Alternative to
* Balanced Trees. CACM 33(6), June 1990, pp. 668-676.
*

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/amdgpu_internal.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/amdgpu_bo.c

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* Christian Gmeiner <christian.gmeiner@gmail.com>

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* GLX Hardware Device Driver common code

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/* exynos_drm.h

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* Authors:

* Inki Dae <inki.dae@samsung.com>

* Joonyoung Shim <jy0922.shim@samsung.com>

* Seung-Woo Kim <sw0312.kim@samsung.com>

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* Eric Anholt <eric@anholt.net>

*

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/*

* Arm Framebuffer Compression (AFBC) modifiers

*

* AFBC is a proprietary lossless image compression protocol and format.
* It provides fine-grained random access and minimizes the amount of data
* transferred between IP blocks.

*

* AFBC has several features which may be supported and/or used, which are
* represented using bits in the modifier. Not all combinations are valid,
* and different devices or use-cases may support different combinations.

*

* Further information on the use of AFBC modifiers can be found in
* Documentation/gpu/afbc.rst

*/

/*

* Arm Fixed-Rate Compression (AFRC) modifiers

*

* AFRC is a proprietary fixed rate image compression protocol and format,
* designed to provide guaranteed bandwidth and memory footprint
* reductions in graphics and media use-cases.

*

* AFRC buffers consist of one or more planes, with the same components
* and meaning as an uncompressed buffer using the same pixel format.

*

* Within each plane, the pixel/luma/chroma values are grouped into
* "coding unit" blocks which are individually compressed to a
* fixed size (in bytes). All coding units within a given plane of a buffer

- * store the same number of values, and have the same compressed size.
- *
- * The coding unit size is configurable, allowing different rates of compression.
- *
- * The start of each AFRC buffer plane must be aligned to an alignment granule which depends on the coding unit size.
- *

* Coding Unit Size Plane Alignment

* -----

* 16 bytes 1024 bytes

* 24 bytes 512 bytes

* 32 bytes 2048 bytes

*

- * Coding units are grouped into paging tiles. AFRC buffer dimensions must be aligned to a multiple of the paging tile dimensions.

- * The dimensions of each paging tile depend on whether the buffer is optimised for scanline (SCAN layout) or rotated (ROT layout) access.

*

* Layout Paging Tile Width Paging Tile Height

* -----

* SCAN 16 coding units 4 coding units

* ROT 8 coding units 8 coding units

*

- * The dimensions of each coding unit depend on the number of components in the compressed plane and whether the buffer is optimised for scanline (SCAN layout) or rotated (ROT layout) access.

*

* Number of Components in Plane Layout Coding Unit Width Coding Unit Height

* -----

* 1 SCAN 16 samples 4 samples

* Example: 16x4 luma samples in a 'Y' plane

* 16x4 chroma 'V' values, in the 'V' plane of a fully-planar YUV buffer

* -----

* 1 ROT 8 samples 8 samples

* Example: 8x8 luma samples in a 'Y' plane

* 8x8 chroma 'V' values, in the 'V' plane of a fully-planar YUV buffer

* -----

* 2 DONT CARE 8 samples 4 samples

* Example: 8x4 chroma pairs in the 'UV' plane of a semi-planar YUV buffer

* -----

* 3 DONT CARE 4 samples 4 samples

* Example: 4x4 pixels in an RGB buffer without alpha

* -----

* 4 DONT CARE 4 samples 4 samples

* Example: 4x4 pixels in an RGB buffer with alpha

*/

/*

- * Amlogic Video Framebuffer Compression modifiers

```

*
* Amlogic uses a proprietary lossless image compression protocol and format
* for their hardware video codec accelerators, either video decoders or
* video input encoders.
*
* It considerably reduces memory bandwidth while writing and reading
* frames in memory.
*
* The underlying storage is considered to be 3 components, 8bit or 10-bit
* per component YCbCr 420, single plane :
* - DRM_FORMAT_YUV420_8BIT
* - DRM_FORMAT_YUV420_10BIT
*
* The first 8 bits of the mode defines the layout, then the following 8 bits
* defines the options changing the layout.
*
* Not all combinations are valid, and different SoCs may support different
* combinations of layout and options.
*/
/*
* 64K_S is the same for GFX9/GFX10/GFX10_RBPLUS and hence has GFX9 as canonical
* version.
*/

```

Found in path(s):

```

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
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```

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/radeon/bof.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/amdgpu_vm.c

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/* mga_drm.h -- Public header for the Matrox g200/g400 driver -*- linux-c -*-

* Created: Tue Jan 25 01:50:01 1999 by jhartmann@precisioninsight.com

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/* savage_drm.h -- Public header for the savage driver

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/xf86drmHash.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/tmtest/src/xf86dri.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/tmtest/src/xf86dri.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/kgsl/kgsl_pipe.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/msm/msm_device.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/kgsl/kgsl_bo.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/kgsl/kgsl_ringbuffer.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/msm/msm_priv.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/msm/msm_ringbuffer.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/msm/msm_pipe.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/kgsl/kgsl_priv.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/kgsl/kgsl_device.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/include/drm/virtgpu_drm.h
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```

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/exynos/exynos_fimg2d.c
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/exynos/exynos_fimg2d.h

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/exynos/fimg2d_reg.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/meson_options.txt
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/modetest/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/radeon/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tegra/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/proptest/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/intel/meson.build
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/radeon/meson.build
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/libkms/meson.build

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/exynos/meson.build
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kmstest/meson.build
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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/man/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/nouveau/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/modeprint/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/vbltest/meson.build
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/nouveau/meson.build

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*
* Authors:
* Gareth Hughes <gareth@valinux.com>
* Frank C. Earl <fearl@airmail.net>
* Leif Delgass <ldelgass@retinalburn.net>
*/

Found in path(s):

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/include/drm/mach64_drm.h

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/* xf86drmHash.c -- Small hash table support for integer -> integer mapping

* Created: Sun Apr 18 09:35:45 1999 by faith@precisioninsight.com

*

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*

* Authors: Rickard E. (Rik) Faith <faith@valinux.com>

*

* DESCRIPTION

```

*
* This file contains a straightforward implementation of a fixed-sized
* hash table using self-organizing linked lists [Knuth73, pp. 398-399] for
* collision resolution. There are two potentially interesting things
* about this implementation:
*
* 1) The table is power-of-two sized. Prime sized tables are more
* traditional, but do not have a significant advantage over power-of-two
* sized table, especially when double hashing is not used for collision
* resolution.
*
* 2) The hash computation uses a table of random integers [Hanson97,
* pp. 39-41].
*
* FUTURE ENHANCEMENTS
*
* With a table size of 512, the current implementation is sufficient for a
* few hundred keys. Since this is well above the expected size of the
* tables for which this implementation was designed, the implementation of
* dynamic hash tables was postponed until the need arises. A common (and
* naive) approach to dynamic hash table implementation simply creates a
* new hash table when necessary, rehashes all the data into the new table,
* and destroys the old table. The approach in [Larson88] is superior in
* two ways: 1) only a portion of the table is expanded when needed,
* distributing the expansion cost over several insertions, and 2) portions
* of the table can be locked, enabling a scalable thread-safe
* implementation.
*
* REFERENCES
*
* [Hanson97] David R. Hanson. C Interfaces and Implementations:
* Techniques for Creating Reusable Software. Reading, Massachusetts:
* Addison-Wesley, 1997.
*
* [Knuth73] Donald E. Knuth. The Art of Computer Programming. Volume 3:
* Sorting and Searching. Reading, Massachusetts: Addison-Wesley, 1973.
*
* [Larson88] Per-Ake Larson. "Dynamic Hash Tables". CACM 31(4), April
* 1988, pp. 446-457.
*
*/

```

Found in path(s):

```

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/tests/hash.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/xf86drmHash.c

```

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/radeon/radeon_cs_gem.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/handle_table.h

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/handle_table.c

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*

* Authors:

* Paulo Zandoni <paulo.r.zandoni@intel.com>

*

*/

Found in path(s):

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/proptest/proptest.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/kms-steal-crtc.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/libkms-test-screen.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/kms-universal-planes.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/libkms-test-device.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/libkms-test-plane.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/libkms-test-framebuffer.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/kms/libkms-test.h

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Contributing to libdrm

=====

Submitting Patches

Patches should be sent to dri-devel@lists.freedesktop.org, using git send-email. For patches only touching driver specific code one of the driver mailing lists (like amd-gfx@lists.freedesktop.org) is also appropriate. See git documentation for help:

<http://git-scm.com/documentation>

Since dri-devel is a very busy mailing list please use --subject-prefix="PATCH libdrm" to make it easier to find libdrm patches. This is best done by running

```
git config --local format.subjectprefix "PATCH libdrm"
```

The first line of a commit message should contain a prefix indicating what part is affected by the patch followed by one sentence that describes the change. For examples:

```
amdgpu: Use uint32_t i in amdgpu_find_bo_by_cpu_mapping
```

The body of the commit message should describe what the patch changes and why, and also note any particular side effects. For a recommended reading on writing commit messages, see:

<http://who-t.blogspot.de/2009/12/on-commit-messages.html>

Your patches should also include a Signed-off-by line with your name and email address. If you're not the patch's original author, you should also gather S-o-b's by them (and/or whomever gave the patch to you.) The significance of this is that it certifies that you created the patch, that it was created under an appropriate open source license, or provided to you under those terms. This lets us indicate a chain of responsibility for the copyright status of the code. For more details:

<https://developercertificate.org/>

We won't reject patches that lack S-o-b, but it is strongly recommended.

Review and Merging

Patches should have at least one positive review (Reviewed-by: tag) or indication of approval (Acked-by: tag) before merging. For any code shared between drivers this is mandatory.

Please note that kernel/userspace API header files have special rules, see include/drm/README.

Coding style in the project loosely follows the CodingStyle of the linux kernel:

<https://www.kernel.org/doc/html/latest/process/coding-style.html?highlight=coding%20style>

Commit Rights

Commit rights will be granted to anyone who requests them and fulfills the below criteria:

- Submitted a few (5-10 as a rule of thumb) non-trivial (not just simple spelling fixes and whitespace adjustment) patches that have been merged already. Since libdrm is just a glue library between the kernel and userspace drivers, merged patches to those components also count towards the commit criteria.
- Are actively participating on discussions about their work (on the mailing list or IRC). This should not be interpreted as a requirement to review other peoples patches but just make sure that patch submission isn't one-way communication. Cross-review is still highly encouraged.
- Will be regularly contributing further patches. This includes regular contributors to other parts of the open source graphics stack who only do the oddball rare patch within libdrm itself.
- Agrees to use their commit rights in accordance with the documented merge criteria, tools, and processes.

To apply for commit rights ("Developer" role in gitlab) send a mail to dri-devel@lists.freedesktop.org and please ping the maintainers if your request is stuck.

Committers are encouraged to request their commit rights get removed when they no longer contribute to the project. Commit rights will be reinstated when they come back to the project.

Maintainers and committers should encourage contributors to request commit rights, as especially junior contributors tend to underestimate their skills.

Code of Conduct

Please be aware the fd.o Code of Conduct also applies to libdrm:

<https://www.freedesktop.org/wiki/CodeOfConduct/>

See the gitlab project owners for contact details of the libdrm maintainers.

Abuse of commit rights, like engaging in commit fights or willfully pushing patches that violate the documented merge criteria, will also be handled through the Code of Conduct enforcement process.

Happy hacking!

Found in path(s):

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/CONTRIBUTING.rst

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* Author: Rob Clark <robdclark@gmail.com>

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/* drmsl.c -- Skip list test

* Created: Mon May 10 09:28:13 1999 by faith@precisioninsight.com

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 *
 * Authors: Rickard E. (Rik) Faith <faith@valinux.com>
 *
 * DESCRIPTION
 *
 * This file contains a straightforward skip list implementation.n
 *
 * FUTURE ENHANCEMENTS
 *
 * REFERENCES
 *
 * [Pugh90] William Pugh. Skip Lists: A Probabilistic Alternative to
 * Balanced Trees. CACM 33(6), June 1990, pp. 668-676.
 *
 */

Found in path(s):

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/drmsl.c

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The release criteria for libdrm is essentially "if you need a release, make one". There is no designated release engineer or maintainer. Anybody is free to make a release if there's a certain feature or bug fix they need in a released version of libdrm.

When new ioctl definitions are merged into drm-next, we will add support to libdrm, at which point we typically create a new release. However, this is up to whoever is driving the feature in question.

Follow these steps to release a new version of libdrm:

- 1) Bump the version number in meson.build. We seem to have settled for 2.4.x as the versioning scheme for libdrm, so just bump the micro version.
- 2) Run ``ninja -C builddir/ dist`` to generate the tarballs. Make sure that the version number of the tarball name in `builddir/meson-dist/` matches the number you bumped to. Move that tarball to the libdrm repo root for the release script to pick up.
- 3) Push the updated master branch with the bumped version number:

```
git push origin master
```

assuming the remote for the upstream libdrm repo is called origin.

- 4) Use the `release.sh` script from the `xorg/util/modular` repo to upload the tarballs to the `freedesktop.org` download area and create an announce email template. The script takes one argument: the path to the libdrm checkout. So, if a checkout of modular is at the same level than the libdrm repo:

```
./modular/release.sh libdrm
```

This copies the two tarballs to `freedesktop.org` and creates `libdrm-2.4.16.announce` which has a detailed summary of the changes, links to the tarballs, MD5 and SHA1 sums and pre-filled out email headers. Fill out the blank between the email headers and the list of changes with a brief message of what changed or what prompted this release. Send out the email and you're done!

Found in path(s):

```
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/RELEASING
```

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```
/* Autogenerated file, DO NOT EDIT manually!
```

This file was generated by the `rules-ng-ng headergen` tool in this git repository:

```
http://0x04.net/cgit/index.cgi/rules-ng-ng
git clone git://0x04.net/rules-ng-ng
```

The `rules-ng-ng` source files this header was generated from are:

- `cmdstream.xml` (12621 bytes, from 2016-09-06 14:44:16)
- `copyright.xml` (1597 bytes, from 2016-09-06 14:44:16)
- `common.xml` (20583 bytes, from 2016-09-06 14:14:12)

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/etnaviv/cmdstream.xml.h

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/* radeon_drm.h -- Public header for the radeon driver -*- linux-c -*-

*

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* Authors:

* Kevin E. Martin <martin@valinux.com>
* Gareth Hughes <gareth@valinux.com>
* Keith Whitwell <keith@tungstengraphics.com>

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/include/drm/radeon_drm.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_priv.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_bo.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_drmif.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_pipe.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_ringbuffer.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_ringbuffer.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/freedreno/freedreno_device.c
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2.4.109/intel/intel_decode.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/amdgpu_device.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/amdgpu.h

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/amdgpu/amdgpu_vamgr.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/etnaviv/etnaviv_bo.c

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2.4.109/exynos/exynos_drmif.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-
2.4.109/exynos/exynos_drm.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-

2.4.109/tests/modetest/modetest.c

* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/etnaviv/etnaviv_bo_cache_test.c

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- * /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/radeon/radeon_bo.c
- * /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/radeon/radeon_bo_gem.c

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- * /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/xf86drmMode.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/radeon/rbo.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/radeon/radeon_ttm.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/Android.mk
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/util/Android.mk

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/tegra/openclose.c

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* DRM based vblank test program

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* Jesse Barnes <jesse.barnes@intel.com>

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/vce_ib.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/vce_tests.c

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/omap/omap_drmif.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/amdgpu/hotunplug_tests.c

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The rules-ng-ng source files this header was generated from are:

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- common.xml (20583 bytes, from 2016-09-06 14:14:12)
- state_hi.xml (25653 bytes, from 2016-09-06 14:45:17)
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* DRM based mode setting test program

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* Authors:
* Christian Gmeiner <christian.gmeiner@gmail.com>
*/

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/etnaviv/etnaviv_pipe.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/etnaviv/etnaviv_priv.h
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/tests/etnaviv/etnaviv_2d_test.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/etnaviv/etnaviv_cmd_stream.c
* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/etnaviv/etnaviv_drmif.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/include/drm/nouveau_drm.h

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* /opt/cola/permits/1725715225_1687421426.7863286/0/mesa-drm-libdrm-2-4-109-tar-gz/mesa-drm-libdrm-2.4.109/radeon/radeon_cs_space.c

1.7 libzip 1.2.0

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1.8 kmod 29

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1.9 libunwind v1.6-stable-1

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1.10 protobuf 3.7.1

1.11 babel-runtime-corejs2 7.22.5

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1.12 c-ares 1.19.1

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1.13 libaom 1.0.0

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1.14 openssl 1.1.1u

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```

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```
/* number.c: Implements arbitrary precision numbers. */
```

```
/*
```

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```
*****/
```

```
#include <stdio.h>
```

```
#include <config.h>
```

```
#include <number.h>
```

```
#include <assert.h>
```

```
#include <stdlib.h>
```

```
#include <string.h>
```

```
#include <ctype.h> /* Prototypes needed for external utility routines. */
```

```
#define bc_rt_warn rt_warn
```

```
#define bc_rt_error rt_error
```

```
#define bc_out_of_memory out_of_memory
```

```
_PROTOTYPE(void rt_warn, (char *mesg, ...));
```

```
_PROTOTYPE(void rt_error, (char *mesg, ...));
```

```
_PROTOTYPE(void out_of_memory, (void));
```

```
/* Storage used for special numbers. */
```

```

bc_num _zero_;
bc_num _one_;
bc_num _two_;

static bc_num _bc_Free_list = NULL;

/* new_num allocates a number and sets fields to known values. */

bc_num
bc_new_num (length, scale)
    int length, scale;
{
    bc_num temp;

    if (_bc_Free_list != NULL) {
        temp = _bc_Free_list;
        _bc_Free_list = temp->n_next;
    } else {
        temp = (bc_num) malloc (sizeof(bc_struct));
        if (temp == NULL) bc_out_of_memory ();
    }
    temp->n_sign = PLUS;
    temp->n_len = length;
    temp->n_scale = scale;
    temp->n_refs = 1;
    temp->n_ptr = (char *) malloc (length+scale);
    if (temp->n_ptr == NULL) bc_out_of_memory();
    temp->n_value = temp->n_ptr;
    memset (temp->n_ptr, 0, length+scale);
    return temp;
}

/* "Frees" a bc_num NUM. Actually decreases reference count and only
    frees the storage if reference count is zero. */

void
bc_free_num (num)
    bc_num *num;
{
    if (*num == NULL) return;
    (*num)->n_refs--;
    if ((*num)->n_refs == 0) {
        if ((*num)->n_ptr)
            free ((*num)->n_ptr);
        (*num)->n_next = _bc_Free_list;
        _bc_Free_list = *num;
    }
    *num = NULL;
}

```

```

}

/* Initialize the number package! */

void
bc_init_numbers ()
{
    _zero_ = bc_new_num (1,0);
    _one_ = bc_new_num (1,0);
    _one_->n_value[0] = 1;
    _two_ = bc_new_num (1,0);
    _two_->n_value[0] = 2;
}

/* Make a copy of a number! Just increments the reference count! */

bc_num
bc_copy_num (num)
    bc_num num;
{
    num->n_refs++;
    return num;
}

/* Initialize a number NUM by making it a copy of zero. */

void
bc_init_num (num)
    bc_num *num;
{
    *num = bc_copy_num (_zero_);
}

/* For many things, we may have leading zeros in a number NUM.
   _bc_rm_leading_zeros just moves the data "value" pointer to the
   correct place and adjusts the length. */

static void
_bc_rm_leading_zeros (num)
    bc_num num;
{
    /* We can move n_value to point to the first non zero digit! */
    while (*num->n_value == 0 && num->n_len > 1) {
        num->n_value++;
        num->n_len--;
    }
}

```

```

}
}

/* Compare two bc numbers. Return value is 0 if equal, -1 if N1 is less
than N2 and +1 if N1 is greater than N2. If USE_SIGN is false, just
compare the magnitudes. */

static int
_bc_do_compare (n1, n2, use_sign, ignore_last)
    bc_num n1, n2;
    int use_sign;
    int ignore_last;
{
    char *n1ptr, *n2ptr;
    int count;

    /* First, compare signs. */
    if (use_sign && n1->n_sign != n2->n_sign)
    {
        if (n1->n_sign == PLUS)
            return (1); /* Positive N1 > Negative N2 */
        else
            return (-1); /* Negative N1 < Positive N1 */
    }

    /* Now compare the magnitude. */
    if (n1->n_len != n2->n_len)
    {
        if (n1->n_len > n2->n_len)
        {
            /* Magnitude of n1 > n2. */
            if (!use_sign || n1->n_sign == PLUS)
                return (1);
            else
                return (-1);
        }
        else
        {
            /* Magnitude of n1 < n2. */
            if (!use_sign || n1->n_sign == PLUS)
                return (-1);
            else
                return (1);
        }
    }

    /* If we get here, they have the same number of integer digits.

```

```

    check the integer part and the equal length part of the fraction. */
count = n1->n_len + MIN (n1->n_scale, n2->n_scale);
n1ptr = n1->n_value;
n2ptr = n2->n_value;

while ((count > 0) && (*n1ptr == *n2ptr))
{
    n1ptr++;
    n2ptr++;
    count--;
}
if (ignore_last && count == 1 && n1->n_scale == n2->n_scale)
    return (0);
if (count != 0)
{
    if (*n1ptr > *n2ptr)
    {
        /* Magnitude of n1 > n2. */
        if (!use_sign || n1->n_sign == PLUS)
            return (1);
        else
            return (-1);
    }
    else
    {
        /* Magnitude of n1 < n2. */
        if (!use_sign || n1->n_sign == PLUS)
            return (-1);
        else
            return (1);
    }
}

/* They are equal up to the last part of the equal part of the fraction. */
if (n1->n_scale != n2->n_scale)
{
    if (n1->n_scale > n2->n_scale)
    {
        for (count = n1->n_scale-n2->n_scale; count>0; count--)
            if (*n1ptr++ != 0)
            {
                /* Magnitude of n1 > n2. */
                if (!use_sign || n1->n_sign == PLUS)
                    return (1);
                else
                    return (-1);
            }
    }
}

```

```

    else
    {
    for (count = n2->n_scale-n1->n_scale; count>0; count--)
        if (*n2ptr++ != 0)
            {
            /* Magnitude of n1 < n2. */
            if (!use_sign || n1->n_sign == PLUS)
                return (-1);
            else
                return (1);
            }
        }
    }

    /* They must be equal! */
    return (0);
}

/* This is the "user callable" routine to compare numbers N1 and N2. */

int
bc_compare (n1, n2)
    bc_num n1, n2;
{
    return _bc_do_compare (n1, n2, TRUE, FALSE);
}

/* In some places we need to check if the number is negative. */

char
bc_is_neg (num)
    bc_num num;
{
    return num->n_sign == MINUS;
}

/* In some places we need to check if the number NUM is zero. */

char
bc_is_zero (num)
    bc_num num;
{
    int count;
    char *nptr;

    /* Quick check. */
    if (num == _zero_) return TRUE;

```

```

/* Initialize */
count = num->n_len + num->n_scale;
nptr = num->n_value;

/* The check */
while ((count > 0) && (*nptr++ == 0)) count--;

if (count != 0)
    return FALSE;
else
    return TRUE;
}

/* In some places we need to check if the number NUM is almost zero.
Specifically, all but the last digit is 0 and the last digit is 1.
Last digit is defined by scale. */

char
bc_is_near_zero (num, scale)
    bc_num num;
    int scale;
{
    int count;
    char *nptr;

/* Error checking */
if (scale > num->n_scale)
    scale = num->n_scale;

/* Initialize */
count = num->n_len + scale;
nptr = num->n_value;

/* The check */
while ((count > 0) && (*nptr++ == 0)) count--;

if (count != 0 && (count != 1 || *--nptr != 1))
    return FALSE;
else
    return TRUE;
}

/* Perform addition: N1 is added to N2 and the value is
returned. The signs of N1 and N2 are ignored.
SCALE_MIN is to set the minimum scale of the result. */

```



```

static bc_num
_bc_do_add (n1, n2, scale_min)
    bc_num n1, n2;
    int scale_min;
{
    bc_num sum;
    int sum_scale, sum_digits;
    char *n1ptr, *n2ptr, *sumptr;
    int carry, n1bytes, n2bytes;
    int count;

    /* Prepare sum. */
    sum_scale = MAX (n1->n_scale, n2->n_scale);
    sum_digits = MAX (n1->n_len, n2->n_len) + 1;
    sum = bc_new_num (sum_digits, MAX(sum_scale, scale_min));

    /* Zero extra digits made by scale_min. */
    if (scale_min > sum_scale)
    {
        sumptr = (char *) (sum->n_value + sum_scale + sum_digits);
        for (count = scale_min - sum_scale; count > 0; count--)
            *sumptr++ = 0;
    }

    /* Start with the fraction part. Initialize the pointers. */
    n1bytes = n1->n_scale;
    n2bytes = n2->n_scale;
    n1ptr = (char *) (n1->n_value + n1->n_len + n1bytes - 1);
    n2ptr = (char *) (n2->n_value + n2->n_len + n2bytes - 1);
    sumptr = (char *) (sum->n_value + sum_scale + sum_digits - 1);

    /* Add the fraction part. First copy the longer fraction.*/
    if (n1bytes != n2bytes)
    {
        if (n1bytes > n2bytes)
            while (n1bytes > n2bytes)
                { *sumptr-- = *n1ptr--; n1bytes--;}
            else
                while (n2bytes > n1bytes)
                    { *sumptr-- = *n2ptr--; n2bytes--;}
    }

    /* Now add the remaining fraction part and equal size integer parts. */
    n1bytes += n1->n_len;
    n2bytes += n2->n_len;
    carry = 0;
    while ((n1bytes > 0) && (n2bytes > 0))
    {

```

```

    *sumptr = *n1ptr-- + *n2ptr-- + carry;
    if (*sumptr > (BASE-1))
    {
        carry = 1;
        *sumptr -= BASE;
    }
    else
carry = 0;
    sumptr--;
    n1bytes--;
    n2bytes--;
}

/* Now add carry the longer integer part. */
if (n1bytes == 0)
    { n1bytes = n2bytes; n1ptr = n2ptr; }
while (n1bytes-- > 0)
    {
        *sumptr = *n1ptr-- + carry;
        if (*sumptr > (BASE-1))
        {
            carry = 1;
            *sumptr -= BASE;
        }
        else
carry = 0;
        sumptr--;
    }

/* Set final carry. */
if (carry == 1)
    *sumptr += 1;

/* Adjust sum and return. */
_bc_rm_leading_zeros (sum);
return sum;
}

/* Perform subtraction: N2 is subtracted from N1 and the value is
returned. The signs of N1 and N2 are ignored. Also, N1 is
assumed to be larger than N2. SCALE_MIN is the minimum scale
of the result. */

static bc_num
_bc_do_sub (n1, n2, scale_min)
    bc_num n1, n2;
    int scale_min;

```

```

{
bc_num diff;
int diff_scale, diff_len;
int min_scale, min_len;
char *n1ptr, *n2ptr, *diffptr;
int borrow, count, val;

/* Allocate temporary storage. */
diff_len = MAX (n1->n_len, n2->n_len);
diff_scale = MAX (n1->n_scale, n2->n_scale);
min_len = MIN (n1->n_len, n2->n_len);
min_scale = MIN (n1->n_scale, n2->n_scale);
diff = bc_new_num (diff_len, MAX(diff_scale, scale_min));

/* Zero extra digits made by scale_min. */
if (scale_min > diff_scale)
{
diffptr = (char *) (diff->n_value + diff_len + diff_scale);
for (count = scale_min - diff_scale; count > 0; count--)
*diffptr++ = 0;
}

/* Initialize the subtract. */
n1ptr = (char *) (n1->n_value + n1->n_len + n1->n_scale - 1);
n2ptr = (char *) (n2->n_value + n2->n_len + n2->n_scale - 1);
diffptr = (char *) (diff->n_value + diff_len + diff_scale - 1);

/* Subtract the numbers. */
borrow = 0;

/* Take care of the longer scaled number. */
if (n1->n_scale != min_scale)
{
/* n1 has the longer scale */
for (count = n1->n_scale - min_scale; count > 0; count--)
*diffptr-- = *n1ptr--;
}
else
{
/* n2 has the longer scale */
for (count = n2->n_scale - min_scale; count > 0; count--)
{
val = - *n2ptr-- - borrow;
if (val < 0)
{
val += BASE;
borrow = 1;
}
}
}
}

```

```

else
    borrow = 0;
    *diffptr-- = val;
}
}

/* Now do the equal length scale and integer parts. */

for (count = 0; count < min_len + min_scale; count++)
{
    val = *n1ptr-- - *n2ptr-- - borrow;
    if (val < 0)
    {
        val += BASE;
        borrow = 1;
    }
    else
        borrow = 0;
    *diffptr-- = val;
}

/* If n1 has more digits than n2, we now do that subtract. */
if (diff_len != min_len)
{
    for (count = diff_len - min_len; count > 0; count--)
    {
        val = *n1ptr-- - borrow;
        if (val < 0)
        {
            val += BASE;
            borrow = 1;
        }
        else
            borrow = 0;
        *diffptr-- = val;
    }
}

/* Clean up and return. */
_bc_rm_leading_zeros (diff);
return diff;
}

/* Here is the full subtract routine that takes care of negative numbers.
N2 is subtracted from N1 and the result placed in RESULT. SCALE_MIN
is the minimum scale for the result. */

```

```

void
bc_sub (n1, n2, result, scale_min)
    bc_num n1, n2, *result;
    int scale_min;
{
    bc_num diff = NULL;
    int cmp_res;
    int res_scale;

    if (n1->n_sign != n2->n_sign)
    {
        diff = _bc_do_add (n1, n2, scale_min);
        diff->n_sign = n1->n_sign;
    }
    else
    {
        /* subtraction must be done. */
        /* Compare magnitudes. */
        cmp_res = _bc_do_compare (n1, n2, FALSE, FALSE);
        switch (cmp_res)
        {
        case -1:
            /* n1 is less than n2, subtract n1 from n2. */
            diff = _bc_do_sub (n2, n1, scale_min);
            diff->n_sign = (n2->n_sign == PLUS ? MINUS : PLUS);
            break;
        case 0:
            /* They are equal! return zero! */
            res_scale = MAX (scale_min, MAX(n1->n_scale, n2->n_scale));
            diff = bc_new_num (1, res_scale);
            memset (diff->n_value, 0, res_scale+1);
            break;
        case 1:
            /* n2 is less than n1, subtract n2 from n1. */
            diff = _bc_do_sub (n1, n2, scale_min);
            diff->n_sign = n1->n_sign;
            break;
        }
    }

    /* Clean up and return. */
    bc_free_num (result);
    *result = diff;
}

/* Here is the full add routine that takes care of negative numbers.
   N1 is added to N2 and the result placed into RESULT. SCALE_MIN

```

```

is the minimum scale for the result. */

void
bc_add (n1, n2, result, scale_min)
    bc_num n1, n2, *result;
    int scale_min;
{
    bc_num sum = NULL;
    int cmp_res;
    int res_scale;

    if (n1->n_sign == n2->n_sign)
    {
        sum = _bc_do_add (n1, n2, scale_min);
        sum->n_sign = n1->n_sign;
    }
    else
    {
        /* subtraction must be done. */
        cmp_res = _bc_do_compare (n1, n2, FALSE, FALSE); /* Compare magnitudes. */
        switch (cmp_res)
        {
        case -1:
            /* n1 is less than n2, subtract n1 from n2. */
            sum = _bc_do_sub (n2, n1, scale_min);
            sum->n_sign = n2->n_sign;
            break;
        case 0:
            /* They are equal! return zero with the correct scale! */
            res_scale = MAX (scale_min, MAX(n1->n_scale, n2->n_scale));
            sum = bc_new_num (1, res_scale);
            memset (sum->n_value, 0, res_scale+1);
            break;
        case 1:
            /* n2 is less than n1, subtract n2 from n1. */
            sum = _bc_do_sub (n1, n2, scale_min);
            sum->n_sign = n1->n_sign;
        }
    }

    /* Clean up and return. */
    bc_free_num (result);
    *result = sum;
}

/* Recursive vs non-recursive multiply crossover ranges. */
#ifdef(MULDIGITS)
#include "muldigits.h"

```

```

#else
#define MUL_BASE_DIGITS 80
#endif

int mul_base_digits = MUL_BASE_DIGITS;
#define MUL_SMALL_DIGITS mul_base_digits/4

/* Multiply utility routines */

static bc_num
new_sub_num (length, scale, value)
    int length, scale;
    char *value;
{
    bc_num temp;

    if (_bc_Free_list != NULL) {
        temp = _bc_Free_list;
        _bc_Free_list = temp->n_next;
    } else {
        temp = (bc_num) malloc (sizeof(bc_struct));
        if (temp == NULL) bc_out_of_memory ();
    }
    temp->n_sign = PLUS;
    temp->n_len = length;
    temp->n_scale = scale;
    temp->n_refs = 1;
    temp->n_ptr = NULL;
    temp->n_value = value;
    return temp;
}

static void
_bc_simp_mul (bc_num n1, int n1len, bc_num n2, int n2len, bc_num *prod,
    int full_scale)
{
    char *n1ptr, *n2ptr, *pvptr;
    char *n1end, *n2end; /* To the end of n1 and n2. */
    int indx, sum, prodlen;

    prodlen = n1len+n2len+1;

    *prod = bc_new_num (prodlen, 0);

    n1end = (char *) (n1->n_value + n1len - 1);
    n2end = (char *) (n2->n_value + n2len - 1);
    pvptr = (char *) ((*prod)->n_value + prodlen - 1);
    sum = 0;

```

```

/* Here is the loop... */
for (indx = 0; indx < prodlen-1; indx++)
{
    n1ptr = (char *) (n1end - MAX(0, indx-n2len+1));
    n2ptr = (char *) (n2end - MIN(indx, n2len-1));
    while ((n1ptr >= n1->n_value) && (n2ptr <= n2end))
sum += *n1ptr-- * *n2ptr++;
    *pvptr-- = sum % BASE;
    sum = sum / BASE;
}
*pvptr = sum;
}

/* A special adder/subtractor for the recursive divide and conquer
multiply algorithm. Note: if sub is called, accum must
be larger than what is being subtracted. Also, accum and val
must have n_scale = 0. (e.g. they must look like integers. *) */
static void
_bc_shift_addsub (bc_num accum, bc_num val, int shift, int sub)
{
    signed char *accp, *valp;
    int count, carry;

    count = val->n_len;
    if (val->n_value[0] == 0)
        count--;
    assert (accum->n_len+accum->n_scale >= shift+count);

    /* Set up pointers and others */
    accp = (signed char *) (accum->n_value +
        accum->n_len + accum->n_scale - shift - 1);
    valp = (signed char *) (val->n_value + val->n_len - 1);
    carry = 0;

    if (sub) {
        /* Subtraction, carry is really borrow. */
        while (count--) {
            *accp -= *valp-- + carry;
            if (*accp < 0) {
                carry = 1;
                *accp-- += BASE;
            } else {
                carry = 0;
            }
        }
    }
}

```



```

while (carry) {
    *accp -= carry;
    if (*accp < 0)
*accp-- += BASE;
    else
carry = 0;
}
} else {
/* Addition */
while (count--) {
    *accp += *valp-- + carry;
    if (*accp > (BASE-1)) {
carry = 1;
        *accp-- -= BASE;
    } else {
carry = 0;
accp--;
    }
}
while (carry) {
    *accp += carry;
    if (*accp > (BASE-1))
*accp-- -= BASE;
    else
carry = 0;
}
}
}

/* Recursive divide and conquer multiply algorithm.
Based on
Let u = u0 + u1*(b^n)
Let v = v0 + v1*(b^n)
Then uv = (B^2n+B^n)*u1*v1 + B^n*(u1-u0)*(v0-v1) + (B^n+1)*u0*v0

B is the base of storage, number of digits in u1,u0 close to equal.
*/
static void
_bc_rec_mul (bc_num u, int ulen, bc_num v, int vlen, bc_num *prod,
            int full_scale)
{
    bc_num u0, u1, v0, v1;
    int u0len, v0len;
    bc_num m1, m2, m3, d1, d2;
    int n, prodlen, m1zero;
    int d1len, d2len;

/* Base case? */

```

```

if ((ulen+vlen) < mul_base_digits
    || ulen < MUL_SMALL_DIGITS
    || vlen < MUL_SMALL_DIGITS ) {
    _bc_simp_mul (u, ulen, v, vlen, prod, full_scale);
    return;
}

/* Calculate n -- the u and v split point in digits. */
n = (MAX(ulen, vlen)+1) / 2;

/* Split u and v. */
if (ulen < n) {
    u1 = bc_copy_num (_zero_);
    u0 = new_sub_num (ulen,0, u->n_value);
} else {
    u1 = new_sub_num (ulen-n, 0, u->n_value);
    u0 = new_sub_num (n, 0, u->n_value+ulen-n);
}
if (vlen < n) {
    v1 = bc_copy_num (_zero_);
    v0 = new_sub_num (vlen,0, v->n_value);
} else {
    v1 = new_sub_num (vlen-n, 0, v->n_value);
    v0 = new_sub_num (n, 0, v->n_value+vlen-n);
}
_bc_rm_leading_zeros (u1);
_bc_rm_leading_zeros (u0);
u0len = u0->n_len;
_bc_rm_leading_zeros (v1);
_bc_rm_leading_zeros (v0);
v0len = v0->n_len;

m1zero = bc_is_zero(u1) || bc_is_zero(v1);

/* Calculate sub results ... */

bc_init_num(&d1);
bc_init_num(&d2);
bc_sub (u1, u0, &d1, 0);
d1len = d1->n_len;
bc_sub (v0, v1, &d2, 0);
d2len = d2->n_len;

/* Do recursive multiplies and shifted adds. */
if (m1zero)
    m1 = bc_copy_num (_zero_);
else

```

```

    _bc_rec_mul (u1, u1->n_len, v1, v1->n_len, &m1, 0);

if (bc_is_zero(d1) || bc_is_zero(d2))
    m2 = bc_copy_num (_zero_);
else
    _bc_rec_mul (d1, d1len, d2, d2len, &m2, 0);

if (bc_is_zero(u0) || bc_is_zero(v0))
    m3 = bc_copy_num (_zero_);
else
    _bc_rec_mul (u0, u0->n_len, v0, v0->n_len, &m3, 0);

/* Initialize product */
prodlen = ulen+vlen+1;
*prod = bc_new_num(prodlen, 0);

if (!m1zero) {
    _bc_shift_addsub (*prod, m1, 2*n, 0);
    _bc_shift_addsub (*prod, m1, n, 0);
}
_bc_shift_addsub (*prod, m3, n, 0);
_bc_shift_addsub (*prod, m3, 0, 0);
_bc_shift_addsub (*prod, m2, n, d1->n_sign != d2->n_sign);

/* Now clean up! */
bc_free_num (&u1);
bc_free_num (&u0);
bc_free_num (&v1);
bc_free_num (&m1);
bc_free_num (&v0);
bc_free_num (&m2);
bc_free_num (&m3);
bc_free_num (&d1);
bc_free_num (&d2);
}

/* The multiply routine. N2 times N1 is put int PROD with the scale of
the result being MIN(N2 scale+N1 scale, MAX (SCALE, N2 scale, N1 scale)).
*/

void
bc_multiply (n1, n2, prod, scale)
    bc_num n1, n2, *prod;
    int scale;
{
    bc_num pval;
    int len1, len2;
    int full_scale, prod_scale;

```

```

/* Initialize things. */
len1 = n1->n_len + n1->n_scale;
len2 = n2->n_len + n2->n_scale;
full_scale = n1->n_scale + n2->n_scale;
prod_scale = MIN(full_scale,MAX(scale,MAX(n1->n_scale,n2->n_scale)));

/* Do the multiply */
_bc_rec_mul (n1, len1, n2, len2, &pval, full_scale);

/* Assign to prod and clean up the number. */
pval->n_sign = ( n1->n_sign == n2->n_sign ? PLUS : MINUS );
pval->n_value = pval->n_ptr;
pval->n_len = len2 + len1 + 1 - full_scale;
pval->n_scale = prod_scale;
_bc_rm_leading_zeros (pval);
if (bc_is_zero (pval))
    pval->n_sign = PLUS;
bc_free_num (prod);
*prod = pval;
}

/* Some utility routines for the divide: First a one digit multiply.
NUM (with SIZE digits) is multiplied by DIGIT and the result is
placed into RESULT. It is written so that NUM and RESULT can be
the same pointers. */

static void
_one_mult (num, size, digit, result)
    unsigned char *num;
    int size, digit;
    unsigned char *result;
{
    int carry, value;
    unsigned char *nptr, *rptr;

    if (digit == 0)
        memset (result, 0, size);
    else
        {
            if (digit == 1)
                memcpy (result, num, size);
            else
                {
                    /* Initialize */
                    nptr = (unsigned char *) (num+size-1);
                    rptr = (unsigned char *) (result+size-1);
                    carry = 0;

```

```

while (size-- > 0)
{
    value = *nptr-- * digit + carry;
    *rptr-- = value % BASE;
    carry = value / BASE;
}

if (carry != 0) *rptr = carry;
}
}
}

```

/* The full division routine. This computes N1 / N2. It returns 0 if the division is ok and the result is in QUOT. The number of digits after the decimal point is SCALE. It returns -1 if division by zero is tried. The algorithm is found in Knuth Vol 2. p237. */

```

int
bc_divide (n1, n2, quot, scale)
    bc_num n1, n2, *quot;
    int scale;
{
    bc_num qval;
    unsigned char *num1, *num2;
    unsigned char *ptr1, *ptr2, *n2ptr, *qptr;
    int scale1, val;
    unsigned int len1, len2, scale2, qdigits, extra, count;
    unsigned int qdig, qguess, borrow, carry;
    unsigned char *mval;
    char zero;
    unsigned int norm;

    /* Test for divide by zero. */
    if (bc_is_zero (n2)) return -1;

    /* Test for divide by 1. If it is we must truncate. */
    if (n2->n_scale == 0)
    {
        if (n2->n_len == 1 && *n2->n_value == 1)
        {
            qval = bc_new_num (n1->n_len, scale);
            qval->n_sign = (n1->n_sign == n2->n_sign ? PLUS : MINUS);
            memset (&qval->n_value[n1->n_len], 0, scale);
            memcpy (qval->n_value, n1->n_value,
                n1->n_len + MIN(n1->n_scale, scale));
            bc_free_num (quot);

```

```

    *quot = qval;
}
}

/* Set up the divide. Move the decimal point on n1 by n2's scale.
   Remember, zeros on the end of num2 are wasted effort for dividing. */
scale2 = n2->n_scale;
n2ptr = (unsigned char *) n2->n_value+n2->n_len+scale2-1;
while ((scale2 > 0) && (*n2ptr-- == 0)) scale2--;

len1 = n1->n_len + scale2;
scale1 = n1->n_scale - scale2;
if (scale1 < scale)
    extra = scale - scale1;
else
    extra = 0;
num1 = (unsigned char *) malloc (n1->n_len+n1->n_scale+extra+2);
if (num1 == NULL) bc_out_of_memory();
memset (num1, 0, n1->n_len+n1->n_scale+extra+2);
memcpy (num1+1, n1->n_value, n1->n_len+n1->n_scale);

len2 = n2->n_len + scale2;
num2 = (unsigned char *) malloc (len2+1);
if (num2 == NULL) bc_out_of_memory();
memcpy (num2, n2->n_value, len2);
*(num2+len2) = 0;
n2ptr = num2;
while (*n2ptr == 0)
{
    n2ptr++;
    len2--;
}

/* Calculate the number of quotient digits. */
if (len2 > len1+scale)
{
    qdigits = scale+1;
    zero = TRUE;
}
else
{
    zero = FALSE;
    if (len2>len1)
qdigits = scale+1; /* One for the zero integer part. */
    else
qdigits = len1-len2+scale+1;
}

```

```

/* Allocate and zero the storage for the quotient. */
qval = bc_new_num (qdigits-scale,scale);
memset (qval->n_value, 0, qdigits);

/* Allocate storage for the temporary storage mval. */
mval = (unsigned char *) malloc (len2+1);
if (mval == NULL) bc_out_of_memory ();

/* Now for the full divide algorithm. */
if (!zero)
{
    /* Normalize */
    norm = 10 / ((int)*n2ptr + 1);
    if (norm != 1)
    {
        _one_mult (num1, len1+scale1+extra+1, norm, num1);
        _one_mult (n2ptr, len2, norm, n2ptr);
    }

    /* Initialize divide loop. */
    qdig = 0;
    if (len2 > len1)
    qptr = (unsigned char *) qval->n_value+len2-len1;
    else
    qptr = (unsigned char *) qval->n_value;

    /* Loop */
    while (qdig <= len1+scale-len2)
    {
        /* Calculate the quotient digit guess. */
        if (*n2ptr == num1[qdig])
            qguess = 9;
        else
            qguess = (num1[qdig]*10 + num1[qdig+1]) / *n2ptr;

        /* Test qguess. */
        if (n2ptr[1]*qguess >
            (num1[qdig]*10 + num1[qdig+1] - *n2ptr*qguess)*10
            + num1[qdig+2])
        {
            qguess--;
            /* And again. */
            if (n2ptr[1]*qguess >
                (num1[qdig]*10 + num1[qdig+1] - *n2ptr*qguess)*10
                + num1[qdig+2])
                qguess--;
        }
    }
}

```

```

/* Multiply and subtract. */
borrow = 0;
if (qguess != 0)
{
    *mval = 0;
    _one_mult (n2ptr, len2, qguess, mval+1);
    ptr1 = (unsigned char *) num1+qdig+len2;
    ptr2 = (unsigned char *) mval+len2;
    for (count = 0; count < len2+1; count++)
    {
        val = (int) *ptr1 - (int) *ptr2-- - borrow;
        if (val < 0)
        {
            val += 10;
            borrow = 1;
        }
        else
            borrow = 0;
        *ptr1-- = val;
    }
}

/* Test for negative result. */
if (borrow == 1)
{
    qguess--;
    ptr1 = (unsigned char *) num1+qdig+len2;
    ptr2 = (unsigned char *) n2ptr+len2-1;
    carry = 0;
    for (count = 0; count < len2; count++)
    {
        val = (int) *ptr1 + (int) *ptr2-- + carry;
        if (val > 9)
        {
            val -= 10;
            carry = 1;
        }
        else
            carry = 0;
        *ptr1-- = val;
    }
    if (carry == 1) *ptr1 = (*ptr1 + 1) % 10;
}

/* We now know the quotient digit. */
*qptr++ = qguess;
qdig++;
}

```



```

    }

    /* Clean up and return the number. */
    qval->n_sign = ( n1->n_sign == n2->n_sign ? PLUS : MINUS );
    if (bc_is_zero (qval)) qval->n_sign = PLUS;
    _bc_rm_leading_zeros (qval);
    bc_free_num (quot);
    *quot = qval;

    /* Clean up temporary storage. */
    free (mval);
    free (num1);
    free (num2);

    return 0; /* Everything is OK. */
}

/* Division *and* modulo for numbers. This computes both NUM1 / NUM2 and
   NUM1 % NUM2 and puts the results in QUOT and REM, except that if QUOT
   is NULL then that store will be omitted.
*/

int
bc_divmod (num1, num2, quot, rem, scale)
    bc_num num1, num2, *quot, *rem;
    int scale;
{
    bc_num quotient = NULL;
    bc_num temp;
    int rscale;

    /* Check for correct numbers. */
    if (bc_is_zero (num2)) return -1;

    /* Calculate final scale. */
    rscale = MAX (num1->n_scale, num2->n_scale+scale);
    bc_init_num(&temp);

    /* Calculate it. */
    bc_divide (num1, num2, &temp, scale);
    if (quot)
        quotient = bc_copy_num (temp);
    bc_multiply (temp, num2, &temp, rscale);
    bc_sub (num1, temp, rem, rscale);
    bc_free_num (&temp);

    if (quot)

```

```

    {
        bc_free_num (quot);
        *quot = quotient;
    }

return 0; /* Everything is OK. */
}

/* Modulo for numbers. This computes NUM1 % NUM2 and puts the
result in RESULT. */

int
bc_modulo (num1, num2, result, scale)
    bc_num num1, num2, *result;
    int scale;
{
    return bc_divmod (num1, num2, NULL, result, scale);
}

/* Raise BASE to the EXPO power, reduced modulo MOD. The result is
placed in RESULT. If a EXPO is not an integer,
only the integer part is used. */

int
bc_raisemod (base, expo, mod, result, scale)
    bc_num base, expo, mod, *result;
    int scale;
{
    bc_num power, exponent, parity, temp;
    int rscale;

    /* Check for correct numbers. */
    if (bc_is_zero(mod)) return -1;
    if (bc_is_neg(expo)) return -1;

    /* Set initial values. */
    power = bc_copy_num (base);
    exponent = bc_copy_num (expo);
    temp = bc_copy_num (_one_);
    bc_init_num(&parity);

    /* Check the base for scale digits. */
    if (base->n_scale != 0)
        bc_rt_warn ("non-zero scale in base");

    /* Check the exponent for scale digits. */
    if (exponent->n_scale != 0)

```

```

    {
        bc_rt_warn ("non-zero scale in exponent");
        bc_divide (exponent, _one_, &exponent, 0); /*truncate */
    }

/* Check the modulus for scale digits. */
if (mod->n_scale != 0)
    bc_rt_warn ("non-zero scale in modulus");

/* Do the calculation. */
rscale = MAX(scale, base->n_scale);
while ( !bc_is_zero(exponent) )
    {
        (void) bc_divmod (exponent, _two_, &exponent, &parity, 0);
        if ( !bc_is_zero(parity) )
        {
            bc_multiply (temp, power, &temp, rscale);
            (void) bc_modulo (temp, mod, &temp, scale);
        }

        bc_multiply (power, power, &power, rscale);
        (void) bc_modulo (power, mod, &power, scale);
    }

/* Assign the value. */
bc_free_num (&power);
bc_free_num (&exponent);
bc_free_num (result);
*result = temp;
return 0; /* Everything is OK. */
}

/* Raise NUM1 to the NUM2 power. The result is placed in RESULT.
Maximum exponent is LONG_MAX. If a NUM2 is not an integer,
only the integer part is used. */

void
bc_raise (num1, num2, result, scale)
    bc_num num1, num2, *result;
    int scale;
{
    bc_num temp, power;
    long exponent;
    int rscale;
    int pwrscale;
    int calcscale;
    char neg;

```

```

/* Check the exponent for scale digits and convert to a long. */
if (num2->n_scale != 0)
    bc_rt_warn ("non-zero scale in exponent");
exponent = bc_num2long (num2);
if (exponent == 0 && (num2->n_len > 1 || num2->n_value[0] != 0))
    bc_rt_error ("exponent too large in raise");

/* Special case if exponent is a zero. */
if (exponent == 0)
{
    bc_free_num (result);
    *result = bc_copy_num (_one_);
    return;
}

/* Other initializations. */
if (exponent < 0)
{
    neg = TRUE;
    exponent = -exponent;
    rscale = scale;
}
else
{
    neg = FALSE;
    rscale = MIN (num1->n_scale*exponent, MAX(scale, num1->n_scale));
}

/* Set initial value of temp. */
power = bc_copy_num (num1);
pwrscale = num1->n_scale;
while ((exponent & 1) == 0)
{
    pwrscale = 2*pwrscale;
    bc_multiply (power, power, &power, pwrscale);
    exponent = exponent >> 1;
}
temp = bc_copy_num (power);
calcscale = pwrscale;
exponent = exponent >> 1;

/* Do the calculation. */
while (exponent > 0)
{
    pwrscale = 2*pwrscale;
    bc_multiply (power, power, &power, pwrscale);
    if ((exponent & 1) == 1) {
        calcscale = pwrscale + calcscale;
    }
}

```

```

bc_multiply (temp, power, &temp, calcscale);
    }
    exponent = exponent >> 1;
}

/* Assign the value. */
if (neg)
{
    bc_divide (_one_, temp, result, rscale);
    bc_free_num (&temp);
}
else
{
    bc_free_num (result);
    *result = temp;
    if ((*result)->n_scale > rscale)
(*result)->n_scale = rscale;
}
bc_free_num (&power);
}

/* Take the square root NUM and return it in NUM with SCALE digits
after the decimal place. */

int
bc_sqrt (num, scale)
    bc_num *num;
    int scale;
{
    int rscale, cmp_res, done;
    int cscale;
    bc_num guess, guess1, point5, diff;

/* Initial checks. */
    cmp_res = bc_compare (*num, _zero_);
    if (cmp_res < 0)
        return 0; /* error */
    else
    {
        if (cmp_res == 0)
        {
            bc_free_num (num);
            *num = bc_copy_num (_zero_);
            return 1;
        }
    }
    cmp_res = bc_compare (*num, _one_);
    if (cmp_res == 0)

```

```

{
    bc_free_num (num);
    *num = bc_copy_num (_one_);
    return 1;
}

/* Initialize the variables. */
rscale = MAX (scale, (*num)->n_scale);
bc_init_num(&guess);
bc_init_num(&guess1);
bc_init_num(&diff);
point5 = bc_new_num (1,1);
point5->n_value[1] = 5;

/* Calculate the initial guess. */
if (cmp_res < 0)
{
    /* The number is between 0 and 1. Guess should start at 1. */
    guess = bc_copy_num (_one_);
    cscale = (*num)->n_scale;
}
else
{
    /* The number is greater than 1. Guess should start at 10^(exp/2). */
    bc_int2num (&guess,10);

    bc_int2num (&guess1,(*num)->n_len);
    bc_multiply (guess1, point5, &guess1, 0);
    guess1->n_scale = 0;
    bc_raise (guess, guess1, &guess, 0);
    bc_free_num (&guess1);
    cscale = 3;
}

/* Find the square root using Newton's algorithm. */
done = FALSE;
while (!done)
{
    bc_free_num (&guess1);
    guess1 = bc_copy_num (guess);
    bc_divide (*num, guess, &guess, cscale);
    bc_add (guess, guess1, &guess, 0);
    bc_multiply (guess, point5, &guess, cscale);
    bc_sub (guess, guess1, &diff, cscale+1);
    if (bc_is_near_zero (diff, cscale))
    {
        if (cscale < rscale+1)

```

```

    cscale = MIN (cscale*3, rscale+1);
else
    done = TRUE;
}
}

/* Assign the number and clean up. */
bc_free_num (num);
bc_divide (guess,_one_,num,rscale);
bc_free_num (&guess);
bc_free_num (&guess1);
bc_free_num (&point5);
bc_free_num (&diff);
return 1;
}

/* The following routines provide output for bcd numbers package
using the rules of POSIX bc for output. */

/* This structure is used for saving digits in the conversion process. */
typedef struct stk_rec {
    long digit;
    struct stk_rec *next;
} stk_rec;

/* The reference string for digits. */
static char ref_str[] = "0123456789ABCDEF";

/* A special output routine for "multi-character digits." Exactly
SIZE characters must be output for the value VAL. If SPACE is
non-zero, we must output one space before the number. OUT_CHAR
is the actual routine for writing the characters. */

void
bc_out_long (val, size, space, out_char)
    long val;
    int size, space;
#ifdef __STDC__
    void (*out_char)(int);
#else
    void (*out_char)();
#endif
{
    char digits[40];
    int len, ix;

```

```

if (space) (*out_char) (' ');
sprintf (digits, "%ld", val);
len = strlen (digits);
while (size > len)
{
    (*out_char) ('0');
    size--;
}
for (ix=0; ix < len; ix++)
    (*out_char) (digits[ix]);
}

/* Output of a bcd number. NUM is written in base O_BASE using OUT_CHAR
as the routine to do the actual output of the characters. */

void
bc_out_num (num, o_base, out_char, leading_zero)
    bc_num num;
    int o_base;
#ifdef __STDC__
    void (*out_char)(int);
#else
    void (*out_char)();
#endif
    int leading_zero;
{
    char *nptr;
    int index, fdigit, pre_space;
    stk_rec *digits, *temp;
    bc_num int_part, frac_part, base, cur_dig, t_num, max_o_digit;

    /* The negative sign if needed. */
    if (num->n_sign == MINUS) (*out_char) ('-');

    /* Output the number. */
    if (bc_is_zero (num))
        (*out_char) ('0');
    else
        if (o_base == 10)
            {
                /* The number is in base 10, do it the fast way. */
                nptr = num->n_value;
                if (num->n_len > 1 || *nptr != 0)
                    for (index=num->n_len; index>0; index--)
                        (*out_char) (BCD_CHAR(*nptr++));
                else
                    nptr++;
            }

```



```

if (leading_zero && bc_is_zero (num))
    (*out_char) ('0');

/* Now the fraction. */
if (num->n_scale > 0)
    {
    (*out_char) ('. ');
    for (index=0; index<num->n_scale; index++)
        (*out_char) (BCD_CHAR(*nptr++));
    }
    }
else
    {
/* special case ... */
if (leading_zero && bc_is_zero (num))
    (*out_char) ('0');

/* The number is some other base. */
digits = NULL;
bc_init_num (&int_part);
bc_divide (num, _one_, &int_part, 0);
bc_init_num (&frac_part);
bc_init_num (&cur_dig);
bc_init_num (&base);
bc_sub (num, int_part, &frac_part, 0);
/* Make the INT_PART and FRAC_PART positive. */
int_part->n_sign = PLUS;
frac_part->n_sign = PLUS;
bc_int2num (&base, o_base);
bc_init_num (&max_o_digit);
bc_int2num (&max_o_digit, o_base-1);

/* Get the digits of the integer part and push them on a stack. */
while (!bc_is_zero (int_part))
    {
    bc_modulo (int_part, base, &cur_dig, 0);
    temp = (stk_rec *) malloc (sizeof(stk_rec));
    if (temp == NULL) bc_out_of_memory();
    temp->digit = bc_num2long (cur_dig);
    temp->next = digits;
    digits = temp;
    bc_divide (int_part, base, &int_part, 0);
    }

/* Print the digits on the stack. */
if (digits != NULL)
    {

```

```

    /* Output the digits. */
    while (digits != NULL)
    {
        temp = digits;
        digits = digits->next;
        if (o_base <= 16)
            (*out_char) (ref_str[ (int) temp->digit]);
        else
            bc_out_long (temp->digit, max_o_digit->n_len, 1, out_char);
        free (temp);
    }
}

/* Get and print the digits of the fraction part. */
if (num->n_scale > 0)
{
    (*out_char) ('. ');
    pre_space = 0;
    t_num = bc_copy_num (_one_);
    while (t_num->n_len <= num->n_scale) {
        bc_multiply (frac_part, base, &frac_part, num->n_scale);
        fdigit = bc_num2long (frac_part);
        bc_int2num (&int_part, fdigit);
        bc_sub (frac_part, int_part, &frac_part, 0);
        if (o_base <= 16)
            (*out_char) (ref_str[fdigit]);
        else {
            bc_out_long (fdigit, max_o_digit->n_len, pre_space, out_char);
            pre_space = 1;
        }
        bc_multiply (t_num, base, &t_num, 0);
    }
    bc_free_num (&t_num);
}

/* Clean up. */
bc_free_num (&int_part);
bc_free_num (&frac_part);
bc_free_num (&base);
bc_free_num (&cur_dig);
bc_free_num (&max_o_digit);
}
}

/* Convert a number NUM to a long. The function returns only the integer
part of the number. For numbers that are too large to represent as
a long, this function returns a zero. This can be detected by checking
the NUM for zero after having a zero returned. */

```

```

long
bc_num2long (num)
    bc_num num;
{
    long val;
    char *nptr;
    int index;

    /* Extract the int value, ignore the fraction. */
    val = 0;
    nptr = num->n_value;
    for (index=num->n_len; (index>0) && (val<=(LONG_MAX/BASE)); index--)
        val = val*BASE + *nptr++;

    /* Check for overflow. If overflow, return zero. */
    if (index>0) val = 0;
    if (val < 0) val = 0;

    /* Return the value. */
    if (num->n_sign == PLUS)
        return (val);
    else
        return (-val);
}

```

```

/* Convert an integer VAL to a bc number NUM. */

```

```

void
bc_int2num (num, val)
    bc_num *num;
    int val;
{
    char buffer[30];
    char *bptr, *vptr;
    int ix = 1;
    char neg = 0;

    /* Sign. */
    if (val < 0)
    {
        neg = 1;
        val = -val;
    }

    /* Get things going. */
    bptr = buffer;
    *bptr++ = val % BASE;

```

```

val = val / BASE;

/* Extract remaining digits. */
while (val != 0)
{
    *bptr++ = val % BASE;
    val = val / BASE;
    ix++; /* Count the digits. */
}

/* Make the number. */
bc_free_num (num);
*num = bc_new_num (ix, 0);
if (neg) (*num)->n_sign = MINUS;

/* Assign the digits. */
vptr = (*num)->n_value;
while (ix-- > 0)
    *vptr++ = *--bptr;
}

/* Convert a numbers to a string. Base 10 only.*/

char
*num2str (num)
    bc_num num;
{
    char *str, *sptr;
    char *nptr;
    int index, signch;

    /* Allocate the string memory. */
    signch = ( num->n_sign == PLUS ? 0 : 1 ); /* Number of sign chars. */
    if (num->n_scale > 0)
        str = (char *) malloc (num->n_len + num->n_scale + 2 + signch);
    else
        str = (char *) malloc (num->n_len + 1 + signch);
    if (str == NULL) bc_out_of_memory();

    /* The negative sign if needed. */
    sptr = str;
    if (signch) *sptr++ = '-';

    /* Load the whole number. */
    nptr = num->n_value;
    for (index=num->n_len; index>0; index--)
        *sptr++ = BCD_CHAR(*nptr++);
}

```

```

/* Now the fraction. */
if (num->n_scale > 0)
{
    *sptr++ = '.';
    for (index=0; index<num->n_scale; index++)
        *sptr++ = BCD_CHAR(*nptr++);
}

/* Terminate the string and return it! */
*sptr = '\0';
return (str);
}

/* Convert strings to bc numbers. Base 10 only.*/

void
bc_str2num (num, str, scale)
    bc_num *num;
    char *str;
    int scale;
{
    int digits, strscale;
    char *ptr, *nptr;
    char zero_int;

    /* Prepare num. */
    bc_free_num (num);

    /* Check for valid number and count digits. */
    ptr = str;
    digits = 0;
    strscale = 0;
    zero_int = FALSE;
    if ((*ptr == '+') || (*ptr == '-')) ptr++; /* Sign */
    while (*ptr == '0') ptr++; /* Skip leading zeros. */
    while (isdigit((int)*ptr)) ptr++, digits++; /* digits */
    if (*ptr == '.') ptr++; /* decimal point */
    while (isdigit((int)*ptr)) ptr++, strscale++; /* digits */
    if ((*ptr != '\0') || (digits+strscale == 0))
    {
        *num = bc_copy_num (_zero_);
        return;
    }

    /* Adjust numbers and allocate storage and initialize fields. */
    strscale = MIN(strscale, scale);
    if (digits == 0)
    {
        zero_int = TRUE;

```

```

    digits = 1;
}
*num = bc_new_num (digits, strscale);

/* Build the whole number. */
ptr = str;
if (*ptr == '-')
{
    (*num)->n_sign = MINUS;
    ptr++;
}
else
{
    (*num)->n_sign = PLUS;
    if (*ptr == '+') ptr++;
}
while (*ptr == '0') ptr++; /* Skip leading zeros. */
nptr = (*num)->n_value;
if (zero_int)
{
    *nptr++ = 0;
    digits = 0;
}
for (;digits > 0; digits--)
    *nptr++ = CH_VAL(*ptr++);

/* Build the fractional part. */
if (strscale > 0)
{
    ptr++; /* skip the decimal point! */
    for (;strscale > 0; strscale--)
        *nptr++ = CH_VAL(*ptr++);
}

/* pn prints the number NUM in base 10. */

static void
out_char (int c)
{
    putchar(c);
}

void
pn (num)
    bc_num num;

```

```

{
bc_out_num (num, 10, out_char, 0);
out_char ('\n');
}

/* pv prints a character array as if it was a string of bcd digits. */
void
pv (name, num, len)
    char *name;
    unsigned char *num;
    int len;
{
int i;
printf ("%s=", name);
for (i=0; i<len; i++) printf ("%c",BCD_CHAR(num[i]));
printf ("\n");
}

```

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1.16 pvr-omap4 1.9.0.8.1.1

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Xavier Boudet <x-boudet@ti.com> on Wed, 28 Mar 2012 10:45:01 +0200

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1.17 libdrm 2.4.101

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1.18 pam 1.3.1

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1.19 json-c 0.12.1-5

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1.20 history 5.3.0

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```

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```
## Commands to generate dependency files
```

```
GEN_DEPS.c= $(CC) -E -MM $(DEFS) $(CPPFLAGS)
```

```
GEN_DEPS.cc= $(CXX) -E -MM $(DEFS) $(CPPFLAGS)
```

```
## Flags for position independent code
```

```
SHAREDLIBCFLAGS = -fPIC
```

```
SHAREDLIBCXXFLAGS = -fPIC
```

```
SHAREDLIBCPPFLAGS = -DPIC
```

```

## Additional flags when building libraries and with threads
THREADSCPPFLAGS = -D_REENTRANT
LIBCPPFLAGS =

## Compiler switch to embed a runtime search path
LD_RPATH=
LD_RPATH_PRE= -Wl,-rpath,

## Compiler switch to embed a library name
LD_SONAME = -Wl,-soname -Wl,$(notdir $(MIDDLE_SO_TARGET))

## Shared library options
LD_SOOPTIONS= -Wl,-Bsymbolic

## Shared object suffix
SO = so
## Non-shared intermediate object suffix
STATIC_O = ao

## Compilation rules
%.${STATIC_O): $(srcdir)/%.c
$(COMPILE.c) $(STATICCPPFLAGS) $(STATICCFLAGS) -o $@ $<
%.o: $(srcdir)/%.c
$(COMPILE.c) $(DYNAMICCPPFLAGS) $(DYNAMICCFLAGS) -o $@ $<

%.${STATIC_O): $(srcdir)/%.cpp
$(COMPILE.cc) $(STATICCPPFLAGS) $(STATICCXXFLAGS) -o $@ $<
%.o: $(srcdir)/%.cpp
$(COMPILE.cc) $(DYNAMICCPPFLAGS) $(DYNAMICCXXFLAGS) -o $@ $<

## Dependency rules
%.d: $(srcdir)/%.c
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.c) $< \
| sed "s^\($*\)\.o[ :]*^1.o $@ :/g\" > $@; \
[ -s $@ ] || rm -f $@'

%.d: $(srcdir)/%.cpp
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.cc) $< \
| sed "s^\($*\)\.o[ :]*^1.o $@ :/g\" > $@; \
[ -s $@ ] || rm -f $@'

## Versioned libraries rules

%.${SO}.${SO_TARGET_VERSION_MAJOR): %.${SO}.${SO_TARGET_VERSION)
$(RM) $@ && ln -s ${<F} $@

```

```
%. $(SO): %. $(SO). $(SO_TARGET_VERSION_MAJOR)
$(RM) $@ && ln -s ${*F}. $(SO). $(SO_TARGET_VERSION) $@
```

```
## Bind internal references
```

```
# LDflags that pkgdata will use
BIR_LDFLAGS= -Wl,-Bsymbolic
```

```
# Dependencies [i.e. map files] for the final library
BIR_DEPS=
```

```
## Remove shared library 's'
STATIC_PREFIX_WHEN_USED =
STATIC_PREFIX =
```

```
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Npcap OEM

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Source: <https://github.com/nmap/npcap/blob/v1.10/docs/Npcap-Third-Party-Open-Source.pdf>

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Npcap OEM

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Source: <https://github.com/nmap/npcap/blob/v1.10/docs/Npcap-Third-Party-Open-Source.pdf>

Libpcap Portable Packet Capturing Library

****Description****: Libpcap is a popular reference implementation of the pcap packet capturing API. It is produced by The Tcpdump Group and supports Linux and Mac OS X systems (among others). Npcap implements this API for Microsoft Windows by combining the high-level open source libpcap API code with our own custom Windows driver that implements the low-level network operations. Our wpcap.dll library file is mostly Libpcap code. We occasionally make our own fixes and changes to the libpcap code, but we have a great relationship with The Tcpdump Group and try to submit all of our changes to them for incorporation in future libpcap releases.

****Software URL****: <<http://www.tcpdump.org/>>

****Version used****: 1.9.1

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Winpcap Windows Packet Capturing Library

****Description****: Winpcap is an earlier (now abandoned) open source implementation of the pcap API for Windows. The last Winpcap release was made in March 2013. We created Npcap by starting with that abandoned code and updating it to support modern Windows NDIS API's and fixing well-known bugs and security issues. While Npcap has diverged substantially over the years, it still contains a substantial amount of original Winpcap code, so the Winpcap license must be followed. is used by Nmap on Windows for raw packet reading during host discovery, port scanning, and OS detection. It is a derivative of LibPcap, so that license (see Libpcap section) must be followed as well. It is only needed and used on Windows.

****Software URL****: <<https://www.winpcap.org/>>

****Version used****: 4.1.3

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The ieee80211_radiotap.h Header File

****Description****: This is just a short header file defining data structures for the IEEE 802.11 radio capture header

****Software URL****:

<<http://web.mit.edu/~mkgray/afs/bar/afs/sipb.mit.edu/project/freebsd/head/contrib/wpa/src/utils/radiotap.h>>

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This is from a comment near the top of [the ieee80211_radiotap.h file itself](https://github.com/nmap/npcap/blob/master/packetWin7/npf/npf/ieee80211_radiotap.h):

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1.26 backbone 1.4.1

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1.29 pixman 0.34.0

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1.31 reselect 4.1.8

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1.32 binutils 2.35.50

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```
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```

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+++++

Dean Elsner wrote the original gas for vax. [more details?]

Jay Fenlason maintained gas for a while, adding support for gdb-specific debug information and the 68k series machines, most of the preprocessing pass, and extensive changes in messages.c, input-file.c, write.c.

K. Richard Pixley maintained gas for a while, adding various enhancements and many bug fixes, including merging support for several processors, breaking gas up to handle multiple object file format backends (including heavy rewrite, testing, an integration of the coff and b.out backends), adding configuration including heavy testing and verification of cross assemblers and file splits and renaming, converted gas to strictly ansi C including full prototypes, added support for m680[34]0 & cpu32, considerable work on i960 including a coff port (including considerable amounts of reverse engineering), a sparc opcode file rewrite, decstation, rs6000, and hp300hpux host ports, updated "know" assertions and made them work, much other reorganization, cleanup, and lint.

Ken Raeburn wrote the high-level BFD interface code to replace most of the code in format-specific I/O modules.

The original Vax-VMS support was contributed by David L. Kashtan. Eric Youngdale and Pat Rankin have done much work with it since.

The Intel 80386 machine description was written by Eliot Dresselhaus.

Minh Tran-Le at IntelliCorp contributed some AIX 386 support.

The Motorola 88k machine description was contributed by Devon Bowen of Buffalo University and Torbjorn Granlund of the Swedish Institute of Computer Science.

Keith Knowles at the Open Software Foundation wrote the original MIPS back end (tc-mips.c, tc-mips.h), and contributed Rose format support

that hasn't been merged in yet. Ralph Campbell worked with the MIPS code to support a.out format.

Support for the Zilog Z8k and Hitachi H8/300, H8/500 and SH processors (tc-z8k, tc-h8300, tc-h8500, tc-sh), and IEEE 695 object file format (obj-ieee), was written by Steve Chamberlain of Cygnus Solutions. Steve also modified the COFF back end (obj-coffbfd) to use BFD for some low-level operations, for use with the Hitachi, 29k and Zilog targets.

John Gilmore built the AMD 29000 support, added .include support, and simplified the configuration of which versions accept which pseudo-ops. He updated the 68k machine description so that Motorola's opcodes always produced fixed-size instructions (e.g. jsr), while synthetic instructions remained shrinkable (jbsr). John fixed many bugs, including true tested cross-compilation support, and one bug in relaxation that took a week and required the proverbial one-bit fix.

Ian Lance Taylor of Cygnus Solutions merged the Motorola and MIT syntaxes for the 68k, completed support for some COFF targets (68k, i386 SVR3, and SCO Unix), wrote the ECOFF support based on Michael Meissner's mips-tfile program, wrote the PowerPC and RS/6000 support, and made a few other minor patches. He handled the binutils releases for versions 2.7 through 2.9.

David Edelsohn contributed fixes for the PowerPC and AIX support.

Steve Chamberlain made gas able to generate listings.

Support for the HP9000/300 was contributed by Glenn Engel of HP.

Support for ELF format files has been worked on by Mark Eichin of Cygnus Solutions (original, incomplete implementation), Pete Hoogenboom at the University of Utah (HPPA mainly), Michael Meissner of the Open Software Foundation (i386 mainly), and Ken Raeburn of Cygnus Solutions (sparc, initial 64-bit support).

Several engineers at Cygnus Solutions have also provided many small bug fixes and configuration enhancements.

The initial Alpha support was contributed by Carnegie-Mellon University. Additional work was done by Ken Raeburn of Cygnus Solutions. Richard Henderson then rewrote much of the Alpha support.

Ian Dall updated the support code for the National Semiconductor 32000 series, and added support for Mach 3 and NetBSD running on the PC532.

Klaus Kaempf ported the assembler and the binutils to openVMS/Alpha.

Steve Haworth contributed the support for the Texas Instruction c30 (tms320c30).

H.J. Lu has contributed many patches and much testing.

Alan Modra reworked much of the i386 backend, improving the error checking, updating the code, and improving the 16 bit support, using patches from the work of Martynas Kunigelis and H.J. Lu.

Many others have contributed large or small bugfixes and enhancements. If you've contributed significant work and are not mentioned on this list, and want to be, let us know. Some of the history has been lost; we aren't intentionally leaving anyone out.

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// Original can be found at:

// <https://bitbucket.org/lindenlab/llsd>

// Modifications by Joshua Bell inexorabletaash@gmail.com

// <https://github.com/inexorabletaash/polyfill>


```
// ES3/ES5 implementation of the Khronos Typed Array Specification
// Ref: http://www.khronos.org/registry/typedarray/specs/latest/
// Date: 2011-02-01
//
// Variations:
// * Allows typed_array.get/set() as alias for subscripts (typed_array[])
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```

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],
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  'RC4_ASM',
  'MD5_ASM',
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  'AESNI_ASM',
  'VPAES_ASM',
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  'POLY1305_ASM',
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  'libraries': ['<@(openssl_ex_libs_BSD-x86)'],
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}
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- Layout tests, located in test/mjsunit/third_party/object-keys. These are
based on layout tests from webkit.org which are copyrighted by
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- Strongtalk assembler, the basis of the files assembler-arm-inl.h,
assembler-arm.cc, assembler-arm.h, assembler-ia32-inl.h,
assembler-ia32.cc, assembler-ia32.h, assembler-x64-inl.h,
assembler-x64.cc, assembler-x64.h, assembler-mips-inl.h,
assembler-mips.cc, assembler-mips.h, assembler.cc and assembler.h.
This code is copyrighted by Sun Microsystems Inc. and released
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- Valgrind client API header, located at src/third_party/valgrind/valgrind.h
This is released under the BSD license.

- The Wasm C/C++ API headers, located at third_party/wasm-api/wasm.{h,hh}
This is released under the Apache license. The API's upstream prototype
implementation also formed the basis of V8's implementation in
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spdx-license-ids

[![npm version](https://img.shields.io/npm/v/spdx-license-ids.svg)](https://www.npmjs.com/package/spdx-license-ids)

[![Github Actions](https://action-badges.now.sh/shinnn/spdx-license-ids)](https://wdp9fww0r9.execute-api.us-west-2.amazonaws.com/production/results/shinnn/spdx-license-ids)

A list of [SPDX license](https://spdx.org/licenses/) identifiers

Installation

[Download JSON directly](https://raw.githubusercontent.com/shinnn/spdx-license-ids/master/index.json), or [use](https://docs.npmjs.com/cli/install) [npm](https://docs.npmjs.com/about-npm/):

...

```
npm install spdx-license-ids
```

...

[Node.js](https://nodejs.org/) API

```
### require('spdx-license-ids')
```

Type: `string[]`

All license IDs except for the currently deprecated ones.

```
```javascript
```

```
const ids = require('spdx-license-ids');
```

```
//=> ['0BSD', 'AAL', 'ADSL', 'AFL-1.1', 'AFL-1.2', 'AFL-2.0', 'AFL-2.1', 'AFL-3.0', 'AGPL-1.0-only', ...]
```

```
ids.includes('BSD-3-Clause'); //=> true
```

```
ids.includes('CC-BY-1.0'); //=> true
```

```
ids.includes('GPL-3.0'); //=> false
```

```
...
```

```
require('spdx-license-ids/deprecated')
```

```
Type: `string[]`
```

Deprecated license IDs.

```
````javascript
```

```
const deprecatedIds = require('spdx-license-ids/deprecated');
```

```
//=> ['AGPL-1.0', 'AGPL-3.0', 'GFDL-1.1', 'GFDL-1.2', 'GFDL-1.3', 'GPL-1.0', 'GPL-2.0', ...]
```

```
deprecatedIds.includes('BSD-3-Clause'); //=> false
```

```
deprecatedIds.includes('CC-BY-1.0'); //=> false
```

```
deprecatedIds.includes('GPL-3.0'); //=> true
```

```
...
```

```
## License
```

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```
{  
'variables': {  
  'openssl_defines_BSD-x86_64': [  

```

```

'NDEBUG',
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'OPENSSL_PIC',
'OPENSSL_CPUID_OBJ',
'OPENSSL_IA32_SSE2',
'OPENSSL_BN_ASM_MONT',
'OPENSSL_BN_ASM_MONT5',
'OPENSSL_BN_ASM_GF2m',
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'SHA256_ASM',
'SHA512_ASM',
'KECCAK1600_ASM',
'RC4_ASM',
'MD5_ASM',
'AESNI_ASM',
'VPAES_ASM',
'GHASH_ASM',
'ECP_NISTZ256_ASM',
'X25519_ASM',
'POLY1305_ASM',
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'-Wall -O3',
'-pthread',
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'openssl/apps/gendsa.c',
'openssl/apps/genpkey.c',

```

```

'openssl/apps/genrsa.c',
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'openssl/apps/x509.c',
'openssl/apps/app_rand.c',
'openssl/apps/apps.c',
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'openssl/apps/opt.c',
'openssl/apps/s_cb.c',
'openssl/apps/s_socket.c',
],
},
'defines': ['<@(openssl_defines_BSD-x86_64)'],
'include_dirs': [
  './include',
],
'cflags': ['<@(openssl_cflags_BSD-x86_64)'],
'libraries': ['<@(openssl_ex_libs_BSD-x86_64)'],
'sources': ['<@(openssl_cli_srcs_BSD-x86_64)'],
}

```

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A. HISTORY OF THE SOFTWARE

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands

as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

All Python releases are Open Source (see <http://www.opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

Release	Derived from	Year	Owner	GPL-compatible? (1)
0.9.0 thru 1.2		1991-1995	CWI	yes
1.3 thru 1.5.2	1.2	1995-1999	CNRI	yes
1.6	1.5.2	2000	CNRI	no
2.0	1.6	2000	BeOpen.com	no
1.6.1	1.6	2001	CNRI	yes (2)
2.1	2.0+1.6.1	2001	PSF	no
2.0.1	2.0+1.6.1	2001	PSF	yes
2.1.1	2.1+2.0.1	2001	PSF	yes
2.1.2	2.1.1	2002	PSF	yes
2.1.3	2.1.2	2002	PSF	yes
2.2 and above	2.1.1	2001-now	PSF	yes

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wcwidth.js: JavaScript Porting of Markus Kuhn's wcwidth() Implementation

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```

Minizlib was created by Isaac Z. Schlueter.

It is a derivative work of the Node.js project.

""""

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""""

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'openssl/crypto/x509v3/v3_pku.c',
'openssl/crypto/x509v3/v3_pmaps.c',
'openssl/crypto/x509v3/v3_prn.c',
'openssl/crypto/x509v3/v3_purp.c',
'openssl/crypto/x509v3/v3_skey.c',
'openssl/crypto/x509v3/v3_sxnet.c',
'openssl/crypto/x509v3/v3_tlsf.c',
'openssl/crypto/x509v3/v3_utl.c',
'openssl/crypto/x509v3/v3err.c',
'openssl/engines/e_capi.c',
'openssl/engines/e_padlock.c',
],
'openssl_sources_BSD-x86_64': [
],
'openssl_defines_BSD-x86_64': [
'NDEBUG',
'L_ENDIAN',
'OPENSSL_PIC',
],
'openssl_cflags_BSD-x86_64': [
'-Wall -O3',
'-pthread',
'-Wall -O3',
],
'openssl_ex_libs_BSD-x86_64': [
'-pthread',
],
},
'include_dirs': [
'',
'./include',
'./crypto',
'./crypto/include/internal',
],

```

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'defines': ['<@(openssl_defines_BSD-x86_64)'],
'cflags' : ['<@(openssl_cflags_BSD-x86_64)'],
'libraries': ['<@(openssl_ex_libs_BSD-x86_64)'],
'sources': ['<@(openssl_sources)', '<@(openssl_sources_BSD-x86_64)'],
}
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```

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Version 2, December 2004

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'./config/archs/BSD-x86_64/asm_avx2/crypto/bn/x86_64-mont.s',
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'OPENSSL_BN_ASM_MONT5',
'OPENSSL_BN_ASM_GF2m',
'SHA1_ASM',
'SHA256_ASM',
'SHA512_ASM',
'KECCAK1600_ASM',
'RC4_ASM',
'MD5_ASM',
'AESNI_ASM',
'VPAES_ASM',
'GHASH_ASM',
'ECP_NISTZ256_ASM',
'X25519_ASM',
'POLY1305_ASM',

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'openssl_cflags_BSD-x86_64': [

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'-Wa,--noexecstack',
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  './crypto',
  './crypto/include/internal',
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'sources': ['<@(openssl_sources)', '<@(openssl_sources_BSD-x86_64)'],
}
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<one line to give the program's name and a brief idea of what it does.>

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```
Gnomovision version 69, Copyright (C) 19yy name of author
Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.
```

The hypothetical commands ``show w'` and ``show c'` should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than ``show w'` and ``show c'`; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

```
Yoyodyne, Inc., hereby disclaims all copyright interest in the program
`Gnomovision' (which makes passes at compilers) written by James Hacker.
```

```
<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
```

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```
{
'variables': {
'openssl_defines_BSD-x86': [
'NDEBUG',
'L_ENDIAN',
'OPENSSL_PIC',
'OPENSSL_CPUID_OBJ',
'OPENSSL_BN_ASM_PART_WORDS',
'OPENSSL_IA32_SSE2',
'OPENSSL_BN_ASM_MONT',
'OPENSSL_BN_ASM_GF2m',
'SHA1_ASM',
'SHA256_ASM',
'SHA512_ASM',
'RC4_ASM',
'MD5_ASM',
```

```
'RMD160_ASM',
'AESNI_ASM',
'VPAES_ASM',
'WHIRLPOOL_ASM',
'GHASH_ASM',
'ECP_NISTZ256_ASM',
'POLY1305_ASM',
],
'openssl_cflags_BSD-x86': [
'-Wa,--noexecstack',
'-Wall -O3 -fomit-frame-pointer',
'-pthread',
'-Wall -O3 -fomit-frame-pointer',
],
'openssl_ex_libs_BSD-x86': [
'-pthread',
],
'openssl_cli_srcs_BSD-x86': [
'openssl/apps/asn1pars.c',
'openssl/apps/ca.c',
'openssl/apps/ciphers.c',
'openssl/apps/cms.c',
'openssl/apps/crl.c',
'openssl/apps/cr12p7.c',
'openssl/apps/dgst.c',
'openssl/apps/dhparam.c',
'openssl/apps/dsa.c',
'openssl/apps/dsaparam.c',
'openssl/apps/ec.c',
'openssl/apps/ecparam.c',
'openssl/apps/enc.c',
'openssl/apps/engine.c',
'openssl/apps/errstr.c',
'openssl/apps/gendsa.c',
'openssl/apps/genpkey.c',
'openssl/apps/genrsa.c',
'openssl/apps/nseq.c',
'openssl/apps/ocsp.c',
'openssl/apps/openssl.c',
'openssl/apps/passwd.c',
'openssl/apps/pkcs12.c',
'openssl/apps/pkcs7.c',
'openssl/apps/pkcs8.c',
'openssl/apps/pkey.c',
'openssl/apps/pkeyparam.c',
'openssl/apps/pkeyutl.c',
'openssl/apps/prime.c',
'openssl/apps/rand.c',
```



```

'openssl/apps/rehash.c',
'openssl/apps/req.c',
'openssl/apps/rsa.c',
'openssl/apps/rsautl.c',
'openssl/apps/s_client.c',
'openssl/apps/s_server.c',
'openssl/apps/s_time.c',
'openssl/apps/sess_id.c',
'openssl/apps/smime.c',
'openssl/apps/speed.c',
'openssl/apps/spkac.c',
'openssl/apps/srp.c',
'openssl/apps/storeutl.c',
'openssl/apps/ts.c',
'openssl/apps/verify.c',
'openssl/apps/version.c',
'openssl/apps/x509.c',
'openssl/apps/app_rand.c',
'openssl/apps/apps.c',
'openssl/apps/bf_prefix.c',
'openssl/apps/opt.c',
'openssl/apps/s_cb.c',
'openssl/apps/s_socket.c',
],
},
'defines': ['<@(openssl_defines_BSD-x86)'],
'include_dirs': [
'./include',
],
'cflags' : ['<@(openssl_cflags_BSD-x86)'],
'libraries': ['<@(openssl_ex_libs_BSD-x86)'],
'sources': ['<@(openssl_cli_srcs_BSD-x86)'],
}

```

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```
{
'variables': {
'openssl_sources': [
'openssl/ssl/bio_ssl.c',
'openssl/ssl/d1_lib.c',
'openssl/ssl/d1_msg.c',
'openssl/ssl/d1_srtp.c',
'openssl/ssl/methods.c',
'openssl/ssl/packet.c',
'openssl/ssl/pqueue.c',
'openssl/ssl/record/dtls1_bitmap.c',
'openssl/ssl/record/rec_layer_d1.c',
'openssl/ssl/record/rec_layer_s3.c',
'openssl/ssl/record/ssl3_buffer.c',
'openssl/ssl/record/ssl3_record.c',
'openssl/ssl/record/ssl3_record_tls13.c',
'openssl/ssl/s3_cbc.c',
'openssl/ssl/s3_enc.c',
'openssl/ssl/s3_lib.c',
'openssl/ssl/s3_msg.c',
'openssl/ssl/ssl_asn1.c',
'openssl/ssl/ssl_cert.c',
'openssl/ssl/ssl_ciph.c',
'openssl/ssl/ssl_conf.c',
'openssl/ssl/ssl_err.c',
'openssl/ssl/ssl_init.c',
'openssl/ssl/ssl_lib.c',
'openssl/ssl/ssl_mcnf.c',
'openssl/ssl/ssl_rsa.c',
'openssl/ssl/ssl_sess.c',
'openssl/ssl/ssl_stat.c',
'openssl/ssl/ssl_txt.c',
'openssl/ssl/ssl_utst.c',
'openssl/ssl/statem/extensions.c',
'openssl/ssl/statem/extensions_clnt.c',
'openssl/ssl/statem/extensions_cust.c',
'openssl/ssl/statem/extensions_srvr.c',
'openssl/ssl/statem/statem.c',
'openssl/ssl/statem/statem_clnt.c',
'openssl/ssl/statem/statem_dtls.c',
'openssl/ssl/statem/statem_lib.c',
'openssl/ssl/statem/statem_srvr.c',
```

'openssl/ssl/t1_enc.c',
'openssl/ssl/t1_lib.c',
'openssl/ssl/t1_trce.c',
'openssl/ssl/tls13_enc.c',
'openssl/ssl/tls_srp.c',
'openssl/crypto/aes/aes_cbc.c',
'openssl/crypto/aes/aes_cfb.c',
'openssl/crypto/aes/aes_core.c',
'openssl/crypto/aes/aes_ecb.c',
'openssl/crypto/aes/aes_ige.c',
'openssl/crypto/aes/aes_misc.c',
'openssl/crypto/aes/aes_ofb.c',
'openssl/crypto/aes/aes_wrap.c',
'openssl/crypto/aria/aria.c',
'openssl/crypto/asn1/a_bitstr.c',
'openssl/crypto/asn1/a_d2i_fp.c',
'openssl/crypto/asn1/a_digest.c',
'openssl/crypto/asn1/a_dup.c',
'openssl/crypto/asn1/a_gentm.c',
'openssl/crypto/asn1/a_i2d_fp.c',
'openssl/crypto/asn1/a_int.c',
'openssl/crypto/asn1/a_mbstr.c',
'openssl/crypto/asn1/a_object.c',
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'openssl/crypto/asn1/asn1_item_list.c',
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'openssl/crypto/asn1/asn_pack.c',
'openssl/crypto/asn1/bio_asn1.c',
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'openssl/crypto/asn1/f_int.c',
'openssl/crypto/asn1/f_string.c',
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'openssl/crypto/asn1/i2d_pu.c',
'openssl/crypto/asn1/n_pkey.c',
'openssl/crypto/asn1/nsseq.c',
'openssl/crypto/asn1/p5_pbe.c',
'openssl/crypto/asn1/p5_pbev2.c',
'openssl/crypto/asn1/p5_scrypt.c',
'openssl/crypto/asn1/p8_pkey.c',
'openssl/crypto/asn1/t_bitst.c',
'openssl/crypto/asn1/t_pkey.c',
'openssl/crypto/asn1/t_spki.c',
'openssl/crypto/asn1/tasn_dec.c',
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'openssl/crypto/asn1/tasn_prn.c',
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'openssl/crypto/asn1/x_int64.c',
'openssl/crypto/asn1/x_long.c',
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'openssl/crypto/asn1/x_spki.c',
'openssl/crypto/asn1/x_val.c',
'openssl/crypto/async/arch/async_null.c',
'openssl/crypto/async/arch/async_posix.c',
'openssl/crypto/async/arch/async_win.c',
'openssl/crypto/async/async.c',
'openssl/crypto/async/async_err.c',
'openssl/crypto/async/async_wait.c',
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'openssl/crypto/bf/bf_enc.c',
'openssl/crypto/bf/bf_ofb64.c',
'openssl/crypto/bf/bf_skey.c',
'openssl/crypto/bio/b_addr.c',
'openssl/crypto/bio/b_dump.c',
'openssl/crypto/bio/b_print.c',
'openssl/crypto/bio/b_sock.c',
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'openssl/crypto/bio/bf_buff.c',
'openssl/crypto/bio/bf_lbuf.c',

'openssl/crypto/bio/bf_nbio.c',
'openssl/crypto/bio/bf_null.c',
'openssl/crypto/bio/bio_cb.c',
'openssl/crypto/bio/bio_err.c',
'openssl/crypto/bio/bio_lib.c',
'openssl/crypto/bio/bio_meth.c',
'openssl/crypto/bio/bss_acpt.c',
'openssl/crypto/bio/bss_bio.c',
'openssl/crypto/bio/bss_conn.c',
'openssl/crypto/bio/bss_dgram.c',
'openssl/crypto/bio/bss_fd.c',
'openssl/crypto/bio/bss_file.c',
'openssl/crypto/bio/bss_log.c',
'openssl/crypto/bio/bss_mem.c',
'openssl/crypto/bio/bss_null.c',
'openssl/crypto/bio/bss_sock.c',
'openssl/crypto/blake2/blake2b.c',
'openssl/crypto/blake2/blake2s.c',
'openssl/crypto/blake2/m_blake2b.c',
'openssl/crypto/blake2/m_blake2s.c',
'openssl/crypto/bn/asm/x86_64-gcc.c',
'openssl/crypto/bn/bn_add.c',
'openssl/crypto/bn/bn_blind.c',
'openssl/crypto/bn/bn_const.c',
'openssl/crypto/bn/bn_ctx.c',
'openssl/crypto/bn/bn_depr.c',
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'openssl/crypto/x509v3/v3_extku.c',
'openssl/crypto/x509v3/v3_genn.c',
'openssl/crypto/x509v3/v3_ia5.c',
'openssl/crypto/x509v3/v3_info.c',
'openssl/crypto/x509v3/v3_int.c',
'openssl/crypto/x509v3/v3_lib.c',
'openssl/crypto/x509v3/v3_ncons.c',
'openssl/crypto/x509v3/v3_pci.c',
'openssl/crypto/x509v3/v3_pcia.c',

```

'openssl/crypto/x509v3/v3_pcons.c',
'openssl/crypto/x509v3/v3_pku.c',
'openssl/crypto/x509v3/v3_pmaps.c',
'openssl/crypto/x509v3/v3_prn.c',
'openssl/crypto/x509v3/v3_purp.c',
'openssl/crypto/x509v3/v3_skey.c',
'openssl/crypto/x509v3/v3_sxnet.c',
'openssl/crypto/x509v3/v3_tlsf.c',
'openssl/crypto/x509v3/v3_utl.c',
'openssl/crypto/x509v3/v3err.c',
'openssl/engines/e_capi.c',
'openssl/engines/e_padlock.c',
],
'openssl_sources_BSD-x86_64': [
'./config/archs/BSD-x86_64/asm/crypto/aes/aesni-mb-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/aes/aesni-sha1-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/aes/aesni-sha256-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/aes/aesni-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/aes/vpaes-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/bn/rsaz-avx2.s',
'./config/archs/BSD-x86_64/asm/crypto/bn/rsaz-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/bn/x86_64-gf2m.s',
'./config/archs/BSD-x86_64/asm/crypto/bn/x86_64-mont.s',
'./config/archs/BSD-x86_64/asm/crypto/bn/x86_64-mont5.s',
'./config/archs/BSD-x86_64/asm/crypto/camellia/cmll-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/chacha/chacha-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/ec/ecp_nistz256-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/ec/x25519-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/md5/md5-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/modes/aesni-gcm-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/modes/ghash-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/poly1305/poly1305-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/rc4/rc4-md5-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/rc4/rc4-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/sha/keccak1600-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/sha/sha1-mb-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/sha/sha1-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/sha/sha256-mb-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/sha/sha256-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/sha/sha512-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/whrlpool/wp-x86_64.s',
'./config/archs/BSD-x86_64/asm/crypto/x86_64cpuid.s',
'./config/archs/BSD-x86_64/asm/engines/e_padlock-x86_64.s',
],
'openssl_defines_BSD-x86_64': [
'NDEBUG',
'L_ENDIAN',
'OPENSSL_PIC',

```



```

'OPENSSL_CPUID_OBJ',
'OPENSSL_IA32_SSE2',
'OPENSSL_BN_ASM_MONT',
'OPENSSL_BN_ASM_MONT5',
'OPENSSL_BN_ASM_GF2m',
'SHA1_ASM',
'SHA256_ASM',
'SHA512_ASM',
'KECCAK1600_ASM',
'RC4_ASM',
'MD5_ASM',
'AESNI_ASM',
'VPAES_ASM',
'GHASH_ASM',
'ECP_NISTZ256_ASM',
'X25519_ASM',
'POLY1305_ASM',
],
'openssl_cflags_BSD-x86_64': [
'-Wa,--noexecstack',
'-Wall -O3',
'-pthread',
'-Wall -O3',
],
'openssl_ex_libs_BSD-x86_64': [
'-pthread',
],
},
'include_dirs': [
'',
'./include',
'./crypto',
'./crypto/include/internal',
],
'defines': ['<@(openssl_defines_BSD-x86_64)'],
'cflags': ['<@(openssl_cflags_BSD-x86_64)'],
'libraries': ['<@(openssl_ex_libs_BSD-x86_64)'],
'sources': ['<@(openssl_sources)', '<@(openssl_sources_BSD-x86_64)'],
}

```

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validate-npm-package-license

=====

Give me a string and I'll tell you if it's a valid npm package license string.

```
```javascript
var valid = require('validate-npm-package-license');
```
```

SPDX license identifiers are valid license strings:

```
```javascript

var assert = require('assert');
var validSPDXExpression = {
 validForNewPackages: true,
 validForOldPackages: true,
 spdx: true
};

assert.deepEqual(valid('MIT'), validSPDXExpression);
assert.deepEqual(valid('BSD-2-Clause'), validSPDXExpression);
assert.deepEqual(valid('Apache-2.0'), validSPDXExpression);
assert.deepEqual(valid('ISC'), validSPDXExpression);
```
```

The function will return a warning and suggestion for nearly-correct license identifiers:

```
```javascript
assert.deepEqual(
 valid('Apache 2.0'),
 {
 validForOldPackages: false,
 validForNewPackages: false,
 warnings: [
 'license should be ' +

```

```

 'a valid SPDX license expression (without "LicenseRef"), ' +
 "'UNLICENSED', or ' +
 "'SEE LICENSE IN <filename>'",
 'license is similar to the valid expression "Apache-2.0"
]
}
);
```

```

SPDX expressions are valid, too ...

```

```javascript
// Simple SPDX license expression for dual licensing
assert.deepEqual(
 valid('(GPL-3.0-only OR BSD-2-Clause)'),
 validSPDXExpression
);
```

```

... except if they contain `LicenseRef`:

```

```javascript
var warningAboutLicenseRef = {
 validForOldPackages: false,
 validForNewPackages: false,
 spdx: true,
 warnings: [
 'license should be ' +
 'a valid SPDX license expression (without "LicenseRef"), ' +
 "'UNLICENSED', or ' +
 "'SEE LICENSE IN <filename>'",
]
};

assert.deepEqual(
 valid('LicenseRef-Made-Up'),
 warningAboutLicenseRef
);

assert.deepEqual(
 valid('(MIT OR LicenseRef-Made-Up)'),
 warningAboutLicenseRef
);
```

```

If you can't describe your licensing terms with standardized SPDX identifiers, put the terms in a file in the package and point users there:

```

```javascript
assert.deepEqual(
 valid('SEE LICENSE IN LICENSE.txt'),
 {
 validForNewPackages: true,
 validForOldPackages: true,
 inFile: 'LICENSE.txt'
 }
);

assert.deepEqual(
 valid('SEE LICENSE IN license.md'),
 {
 validForNewPackages: true,
 validForOldPackages: true,
 inFile: 'license.md'
 }
);
```

```

If there aren't any licensing terms, use `UNLICENSED`:

```

```javascript
var unlicensed = {
 validForNewPackages: true,
 validForOldPackages: true,
 unlicensed: true
};
assert.deepEqual(valid('UNLICENSED'), unlicensed);
assert.deepEqual(valid('UNLICENCED'), unlicensed);
```

```

1.34 mmc-utils

b4fe0c8c0e57a74c01755fa9362703b60d7ee49d

1.34.1 Available under license :

No license file was found, but licenses were detected in source scan.

```

/*
 * HMAC-SHA-224/256/384/512 implementation
 * Last update: 06/15/2005
 * Issue date: 06/15/2005
 *
 * Since this code has been incorporated into a GPLv2 project, it is

```

```

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*/

```

Found in path(s):

```

* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/3rdparty/hmac_sha/hmac_sha2.c
* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/3rdparty/hmac_sha/hmac_sha2.h

```

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```

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*
* Modified to add field firmware update support,
* those modifications are Copyright (c) 2016 SanDisk Corp.
*
* (This code is based on btrfs-progs/btrfs.c.)
*/

Found in path(s):

* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/mmc.c

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* Free Software Foundation, Inc., 59 Temple Place - Suite 330,
* Boston, MA 02110-1307, USA.
*
* Modified to add field firmware update support,
* those modifications are Copyright (c) 2016 SanDisk Corp.
*/

Found in path(s):

* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/mmc.h

* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/mmc_cmds.c

* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/mmc_cmds.h

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```
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* FIPS 180-2 SHA-224/256/384/512 implementation
* Last update: 02/02/2007
* Issue date: 04/30/2005
*
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* SUCH DAMAGE.
*/
```

Found in path(s):

```
* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/3rdparty/hmac_sha/sha2.c
* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/3rdparty/hmac_sha/sha2.h
```

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```
/*
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* Author: Sebastian Rasmussen <sebastian.rasmussen@stericsson.com>
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*/
```

Found in path(s):

```
* /opt/cola/permits/1724496559_1687282121.8723054/0/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d-tar-gz/mmc-utils-
b4fe0c8c0e57a74c01755fa9362703b60d7ee49d/lsmmc.c
```

1.35 jpeg 9d

1.35.1 Available under license :

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IJG JPEG LIBRARY: SYSTEM ARCHITECTURE

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This file provides an overview of the architecture of the IJG JPEG software; that is, the functions of the various modules in the system and the interfaces between modules. For more precise details about any data structure or calling convention, see the include files and comments in the source code.

We assume that the reader is already somewhat familiar with the JPEG standard. The README file includes references for learning about JPEG. The file libjpeg.txt describes the library from the viewpoint of an application programmer using the library; it's best to read that file before this one. Also, the file coderules.txt describes the coding style conventions we use.

In this document, JPEG-specific terminology follows the JPEG standard:

- A "component" means a color channel, e.g., Red or Luminance.
- A "sample" is a single component value (i.e., one number in the image data).
- A "coefficient" is a frequency coefficient (a DCT transform output number).
- A "block" is an array of samples or coefficients.
- An "MCU" (minimum coded unit) is an interleaved set of blocks of size determined by the sampling factors, or a single block in a noninterleaved scan.

We do not use the terms "pixel" and "sample" interchangeably. When we say pixel, we mean an element of the full-size image, while a sample is an element of the downsampled image. Thus the number of samples may vary across components while the number of pixels does not. (This terminology is not used rigorously throughout the code, but it is used in places where confusion would otherwise result.)

*** System features ***

The IJG distribution contains two parts:

- * A subroutine library for JPEG compression and decompression.
- * cjpeg/djpeg, two sample applications that use the library to transform JFIF JPEG files to and from several other image formats.

cjpeg/djpeg are of no great intellectual complexity: they merely add a simple command-line user interface and I/O routines for several uncompressed image formats. This document concentrates on the library itself.

We desire the library to be capable of supporting all JPEG baseline, extended sequential, and progressive DCT processes. The library does not support the hierarchical or lossless processes defined in the standard.

Within these limits, any set of compression parameters allowed by the JPEG spec should be readable for decompression. (We can be more restrictive about

what formats we can generate.) Although the system design allows for all parameter values, some uncommon settings are not yet implemented and may never be; nonintegral sampling ratios are the prime example. Furthermore, we treat 8-bit vs. 12-bit data precision as a compile-time switch, not a run-time option, because most machines can store 8-bit pixels much more compactly than 12-bit.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, libtiff uses this library to implement JPEG compression within the TIFF file format.)

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. This code can be omitted if not needed.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

*** Portability issues ***

Portability is an essential requirement for the library. The key portability issues that show up at the level of system architecture are:

1. Memory usage. We want the code to be able to run on PC-class machines with limited memory. Images should therefore be processed sequentially (in strips), to avoid holding the whole image in memory at once. Where a full-image buffer is necessary, we should be able to use either virtual memory or temporary files.
2. Near/far pointer distinction. To run efficiently on 80x86 machines, the code should distinguish "small" objects (kept in near data space) from "large" ones (kept in far data space). This is an annoying restriction, but fortunately it does not impact code quality for less brain-damaged machines, and the source code clutter turns out to be minimal with sufficient use of pointer typedefs.
3. Data precision. We assume that "char" is at least 8 bits, "short" and

"int" at least 16, "long" at least 32. The code will work fine with larger data sizes, although memory may be used inefficiently in some cases. However, the JPEG compressed datastream must ultimately appear on external storage as a sequence of 8-bit bytes if it is to conform to the standard. This may pose a problem on machines where char is wider than 8 bits. The library represents compressed data as an array of values of typedef JOCTET. If no data type exactly 8 bits wide is available, custom data source and data destination modules must be written to unpack and pack the chosen JOCTET datatype into 8-bit external representation.

*** System overview ***

The compressor and decompressor are each divided into two main sections: the JPEG compressor or decompressor proper, and the preprocessing or postprocessing functions. The interface between these two sections is the image data that the official JPEG spec regards as its input or output: this data is in the colorspace to be used for compression, and it is downsampled to the sampling factors to be used. The preprocessing and postprocessing steps are responsible for converting a normal image representation to or from this form. (Those few applications that want to deal with YCbCr downsampled data can skip the preprocessing or postprocessing step.)

Looking more closely, the compressor library contains the following main elements:

Preprocessing:

- * Color space conversion (e.g., RGB to YCbCr).
- * Edge expansion and downsampling. Optionally, this step can do simple smoothing --- this is often helpful for low-quality source data.

JPEG proper:

- * MCU assembly, DCT, quantization.
- * Entropy coding (sequential or progressive, Huffman or arithmetic).

In addition to these modules we need overall control, marker generation, and support code (memory management & error handling). There is also a module responsible for physically writing the output data --- typically this is just an interface to fwrite(), but some applications may need to do something else with the data.

The decompressor library contains the following main elements:

JPEG proper:

- * Entropy decoding (sequential or progressive, Huffman or arithmetic).
- * Dequantization, inverse DCT, MCU disassembly.

Postprocessing:

- * Upsampling. Optionally, this step may be able to do more general rescaling of the image.

- * Color space conversion (e.g., YCbCr to RGB). This step may also provide gamma adjustment [currently it does not].
 - * Optional color quantization (e.g., reduction to 256 colors).
 - * Optional color precision reduction (e.g., 24-bit to 15-bit color).
- [This feature is not currently implemented.]

We also need overall control, marker parsing, and a data source module. The support code (memory management & error handling) can be shared with the compression half of the library.

There may be several implementations of each of these elements, particularly in the decompressor, where a wide range of speed/quality tradeoffs is very useful. It must be understood that some of the best speedups involve merging adjacent steps in the pipeline. For example, upsampling, color space conversion, and color quantization might all be done at once when using a low-quality ordered-dither technique. The system architecture is designed to allow such merging where appropriate.

Note: it is convenient to regard edge expansion (padding to block boundaries) as a preprocessing/postprocessing function, even though the JPEG spec includes it in compression/decompression. We do this because downsampling/upsampling can be simplified a little if they work on padded data: it's not necessary to have special cases at the right and bottom edges. Therefore the interface buffer is always an integral number of blocks wide and high, and we expect compression preprocessing to pad the source data properly. Padding will occur only to the next block (block_size-sample) boundary. In an interleaved-scan situation, additional dummy blocks may be used to fill out MCUs, but the MCU assembly and disassembly logic will create or discard these blocks internally. (This is advantageous for speed reasons, since we avoid DCTing the dummy blocks. It also permits a small reduction in file size, because the compressor can choose dummy block contents so as to minimize their size in compressed form. Finally, it makes the interface buffer specification independent of whether the file is actually interleaved or not.) Applications that wish to deal directly with the downsampled data must provide similar buffering and padding for odd-sized images.

*** Poor man's object-oriented programming ***

It should be clear by now that we have a lot of quasi-independent processing steps, many of which have several possible behaviors. To avoid cluttering the code with lots of switch statements, we use a simple form of object-style programming to separate out the different possibilities.

For example, two different color quantization algorithms could be implemented as two separate modules that present the same external interface; at runtime, the calling code will access the proper module indirectly through an "object".

We can get the limited features we need while staying within portable C. The basic tool is a function pointer. An "object" is just a struct containing one or more function pointer fields, each of which corresponds to a method name in real object-oriented languages. During initialization we fill in the function pointers with references to whichever module we have determined we need to use in this run. Then invocation of the module is done by indirecting through a function pointer; on most machines this is no more expensive than a switch statement, which would be the only other way of making the required run-time choice. The really significant benefit, of course, is keeping the source code clean and well structured.

We can also arrange to have private storage that varies between different implementations of the same kind of object. We do this by making all the module-specific object structs be separately allocated entities, which will be accessed via pointers in the master compression or decompression struct. The "public" fields or methods for a given kind of object are specified by a commonly known struct. But a module's initialization code can allocate a larger struct that contains the common struct as its first member, plus additional private fields. With appropriate pointer casting, the module's internal functions can access these private fields. (For a simple example, see `jdatadst.c`, which implements the external interface specified by struct `jpeg_destination_mgr`, but adds extra fields.)

(Of course this would all be a lot easier if we were using C++, but we are not yet prepared to assume that everyone has a C++ compiler.)

An important benefit of this scheme is that it is easy to provide multiple versions of any method, each tuned to a particular case. While a lot of precalculation might be done to select an optimal implementation of a method, the cost per invocation is constant. For example, the upsampling step might have a "generic" method, plus one or more "hardwired" methods for the most popular sampling factors; the hardwired methods would be faster because they'd use straight-line code instead of for-loops. The cost to determine which method to use is paid only once, at startup, and the selection criteria are hidden from the callers of the method.

This plan differs a little bit from usual object-oriented structures, in that only one instance of each object class will exist during execution. The reason for having the class structure is that on different runs we may create different instances (choose to execute different modules). You can think of the term "method" as denoting the common interface presented by a particular set of interchangeable functions, and "object" as denoting a group of related methods, or the total shared interface behavior of a group of modules.

*** Overall control structure ***

We previously mentioned the need for overall control logic in the compression and decompression libraries. In IJG implementations prior to v5, overall control was mostly provided by "pipeline control" modules, which proved to be large, unwieldy, and hard to understand. To improve the situation, the control logic has been subdivided into multiple modules. The control modules consist of:

1. Master control for module selection and initialization. This has two responsibilities:

1A. Startup initialization at the beginning of image processing.

The individual processing modules to be used in this run are selected and given initialization calls.

1B. Per-pass control. This determines how many passes will be performed and calls each active processing module to configure itself appropriately at the beginning of each pass. End-of-pass processing, where necessary, is also invoked from the master control module.

Method selection is partially distributed, in that a particular processing module may contain several possible implementations of a particular method, which it will select among when given its initialization call. The master control code need only be concerned with decisions that affect more than one module.

2. Data buffering control. A separate control module exists for each inter-processing-step data buffer. This module is responsible for invoking the processing steps that write or read that data buffer.

Each buffer controller sees the world as follows:

```
input data => processing step A => buffer => processing step B => output data
      |           |           |
      ----- controller -----
```

The controller knows the dataflow requirements of steps A and B: how much data they want to accept in one chunk and how much they output in one chunk. Its function is to manage its buffer and call A and B at the proper times.

A data buffer control module may itself be viewed as a processing step by a higher-level control module; thus the control modules form a binary tree with elementary processing steps at the leaves of the tree.

The control modules are objects. A considerable amount of flexibility can be had by replacing implementations of a control module. For example:

* Merging of adjacent steps in the pipeline is done by replacing a control module and its pair of processing-step modules with a single processing-step module. (Hence the possible merges are determined by the tree of

control modules.)

* In some processing modes, a given interstep buffer need only be a "strip" buffer large enough to accommodate the desired data chunk sizes. In other modes, a full-image buffer is needed and several passes are required. The control module determines which kind of buffer is used and manipulates virtual array buffers as needed. One or both processing steps may be unaware of the multi-pass behavior.

In theory, we might be able to make all of the data buffer controllers interchangeable and provide just one set of implementations for all. In practice, each one contains considerable special-case processing for its particular job. The buffer controller concept should be regarded as an overall system structuring principle, not as a complete description of the task performed by any one controller.

*** Compression object structure ***

Here is a sketch of the logical structure of the JPEG compression library:

```

                                |-- Colospace conversion
|-- Preprocessing controller --|
|                                |-- Downsampling
Main controller --|
|                                |-- Forward DCT, quantize
|-- Coefficient controller --|
|                                |-- Entropy encoding
```

This sketch also describes the flow of control (subroutine calls) during typical image data processing. Each of the components shown in the diagram is an "object" which may have several different implementations available. One or more source code files contain the actual implementation(s) of each object.

The objects shown above are:

* Main controller: buffer controller for the subsampled-data buffer, which holds the preprocessed input data. This controller invokes preprocessing to fill the subsampled-data buffer, and JPEG compression to empty it. There is usually no need for a full-image buffer here; a strip buffer is adequate.

* Preprocessing controller: buffer controller for the downsampling input data buffer, which lies between colospace conversion and downsampling. Note that a unified conversion/downsampling module would probably replace this controller entirely.

* Colospace conversion: converts application image data into the desired JPEG color space; also changes the data from pixel-interleaved layout to separate component planes. Processes one pixel row at a time.

* Downsampling: performs reduction of chroma components as required. Optionally may perform pixel-level smoothing as well. Processes a "row group" at a time, where a row group is defined as V_{max} pixel rows of each component before downsampling, and V_k sample rows afterwards (remember V_k differs across components). Some downsampling or smoothing algorithms may require context rows above and below the current row group; the preprocessing controller is responsible for supplying these rows via proper buffering. The downsampler is responsible for edge expansion at the right edge (i.e., extending each sample row to a multiple of `block_size` samples); but the preprocessing controller is responsible for vertical edge expansion (i.e., duplicating the bottom sample row as needed to make a multiple of `block_size` rows).

* Coefficient controller: buffer controller for the DCT-coefficient data. This controller handles MCU assembly, including insertion of dummy DCT blocks when needed at the right or bottom edge. When performing Huffman-code optimization or emitting a multiscan JPEG file, this controller is responsible for buffering the full image. The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the JPEG file is noninterleaved.

* Forward DCT and quantization: Perform DCT, quantize, and emit coefficients. Works on one or more DCT blocks at a time. (Note: the coefficients are now emitted in normal array order, which the entropy encoder is expected to convert to zigzag order as necessary. Prior versions of the IJG code did the conversion to zigzag order within the quantization step.)

* Entropy encoding: Perform Huffman or arithmetic entropy coding and emit the coded data to the data destination module. Works on one MCU per call. For progressive JPEG, the same DCT blocks are fed to the entropy coder during each pass, and the coder must emit the appropriate subset of coefficients.

In addition to the above objects, the compression library includes these objects:

* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules.

* Marker writing: generates JPEG markers (except for `RSTn`, which is emitted by the entropy encoder when needed).

* Data destination manager: writes the output JPEG datastream to its final destination (e.g., a file). The destination manager supplied with the library knows how to write to a stdio stream or to a memory buffer; for other behaviors, the surrounding application may provide its own destination manager.

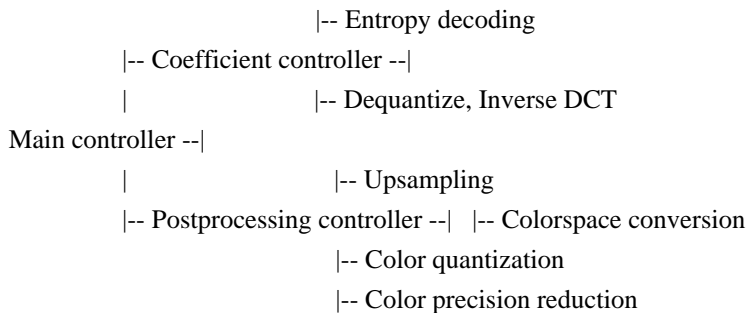
- * Memory manager: allocates and releases memory, controls virtual arrays (with backing store management, where required).
- * Error handler: performs formatting and output of error and trace messages; determines handling of nonfatal errors. The surrounding application may override some or all of this object's methods to change error handling.
- * Progress monitor: supports output of "percent-done" progress reports. This object represents an optional callback to the surrounding application: if wanted, it must be supplied by the application.

The error handler, destination manager, and progress monitor objects are defined as separate objects in order to simplify application-specific customization of the JPEG library. A surrounding application may override individual methods or supply its own all-new implementation of one of these objects. The object interfaces for these objects are therefore treated as part of the application interface of the library, whereas the other objects are internal to the library.

The error handler and memory manager are shared by JPEG compression and decompression; the progress monitor, if used, may be shared as well.

*** Decompression object structure ***

Here is a sketch of the logical structure of the JPEG decompression library:



As before, this diagram also represents typical control flow. The objects shown are:

- * Main controller: buffer controller for the subsampled-data buffer, which holds the output of JPEG decompression proper. This controller's primary task is to feed the postprocessing procedure. Some upsampling algorithms may require context rows above and below the current row group; when this is true, the main controller is responsible for managing its buffer so as to make context rows available. In the current design, the main buffer is always a strip buffer; a full-image buffer is never required.

- * Coefficient controller: buffer controller for the DCT-coefficient data. This controller handles MCU disassembly, including deletion of any dummy DCT blocks at the right or bottom edge. When reading a multiscan JPEG file, this controller is responsible for buffering the full image. (Buffering DCT coefficients, rather than samples, is necessary to support progressive JPEG.) The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the source JPEG file is noninterleaved.

- * Entropy decoding: Read coded data from the data source module and perform Huffman or arithmetic entropy decoding. Works on one MCU per call. For progressive JPEG decoding, the coefficient controller supplies the prior coefficients of each MCU (initially all zeroes), which the entropy decoder modifies in each scan.

- * Dequantization and inverse DCT: like it says. Note that the coefficients buffered by the coefficient controller have NOT been dequantized; we merge dequantization and inverse DCT into a single step for speed reasons. When scaled-down output is asked for, simplified DCT algorithms may be used that need fewer coefficients and emit fewer samples per DCT block, not the full 8x8. Works on one DCT block at a time.

- * Postprocessing controller: buffer controller for the color quantization input buffer, when quantization is in use. (Without quantization, this controller just calls the upsampler.) For two-pass quantization, this controller is responsible for buffering the full-image data.

- * Upsampling: restores chroma components to full size. (May support more general output rescaling, too. Note that if undersized DCT outputs have been emitted by the DCT module, this module must adjust so that properly sized outputs are created.) Works on one row group at a time. This module also calls the color conversion module, so its top level is effectively a buffer controller for the upsampling->color conversion buffer. However, in all but the highest-quality operating modes, upsampling and color conversion are likely to be merged into a single step.

- * Colorspace conversion: convert from JPEG color space to output color space, and change data layout from separate component planes to pixel-interleaved. Works on one pixel row at a time.

- * Color quantization: reduce the data to colormapped form, using either an externally specified colormap or an internally generated one. This module is not used for full-color output. Works on one pixel row at a time; may require two passes to generate a color map. Note that the output will always be a single component representing colormap indexes. In the current design, the output values are JSAMPLEs, so an 8-bit compilation cannot quantize to more than 256 colors. This is unlikely to be a problem in practice.

* Color reduction: this module handles color precision reduction, e.g., generating 15-bit color (5 bits/primary) from JPEG's 24-bit output. Not quite clear yet how this should be handled... should we merge it with colorspace conversion???

Note that some high-speed operating modes might condense the entire postprocessing sequence to a single module (upsample, color convert, and quantize in one step).

In addition to the above objects, the decompression library includes these objects:

* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules. This is subdivided into input and output control: `jdinput.c` controls only input-side processing, while `jdmaster.c` handles overall initialization and output-side control.

* Marker reading: decodes JPEG markers (except for RSTn).

* Data source manager: supplies the input JPEG datastream. The source manager supplied with the library knows how to read from a stdio stream or from a memory buffer; for other behaviors, the surrounding application may provide its own source manager.

* Memory manager: same as for compression library.

* Error handler: same as for compression library.

* Progress monitor: same as for compression library.

As with compression, the data source manager, error handler, and progress monitor are candidates for replacement by a surrounding application.

*** Decompression input and output separation ***

To support efficient incremental display of progressive JPEG files, the decompressor is divided into two sections that can run independently:

1. Data input includes marker parsing, entropy decoding, and input into the coefficient controller's DCT coefficient buffer. Note that this processing is relatively cheap and fast.
2. Data output reads from the DCT coefficient buffer and performs the IDCT and all postprocessing steps.

For a progressive JPEG file, the data input processing is allowed to get

arbitrarily far ahead of the data output processing. (This occurs only if the application calls `jpeg_consume_input()`; otherwise input and output run in lockstep, since the input section is called only when the output section needs more data.) In this way the application can avoid making extra display passes when data is arriving faster than the display pass can run. Furthermore, it is possible to abort an output pass without losing anything, since the coefficient buffer is read-only as far as the output section is concerned. See `libjpeg.txt` for more detail.

A full-image coefficient array is only created if the JPEG file has multiple scans (or if the application specifies buffered-image mode anyway). When reading a single-scan file, the coefficient controller normally creates only a one-MCU buffer, so input and output processing must run in lockstep in this case. `jpeg_consume_input()` is effectively a no-op in this situation.

The main impact of dividing the decompressor in this fashion is that we must be very careful with shared variables in the `cinfo` data structure. Each variable that can change during the course of decompression must be classified as belonging to data input or data output, and each section must look only at its own variables. For example, the data output section may not depend on any of the variables that describe the current scan in the JPEG file, because these may change as the data input section advances into a new scan.

The progress monitor is (somewhat arbitrarily) defined to treat input of the file as one pass when buffered-image mode is not used, and to ignore data input work completely when buffered-image mode is used. Note that the library has no reliable way to predict the number of passes when dealing with a progressive JPEG file, nor can it predict the number of output passes in buffered-image mode. So the work estimate is inherently bogus anyway.

No comparable division is currently made in the compression library, because there isn't any real need for it.

*** Data formats ***

Arrays of pixel sample values use the following data structure:

```
typedef something JSAMPLE; a pixel component value, 0..MAXJSAMPLE
typedef JSAMPLE *JSAMPROW; ptr to a row of samples
typedef JSAMPROW *JSAMPARRAY; ptr to a list of rows
typedef JSAMPARRAY *JSAMPIMAGE; ptr to a list of color-component arrays
```

The basic element type `JSAMPLE` will typically be one of unsigned char, (signed) char, or short. Short will be used if samples wider than 8 bits are to be supported (this is a compile-time option). Otherwise, unsigned char is used if possible. If the compiler only supports signed chars, then it is

necessary to mask off the value when reading. Thus, all reads of JSAMPLE values must be coded as "GETJSAMPLE(value)", where the macro will be defined as "((value) & 0xFF)" on signed-char machines and "(int) (value)" elsewhere.

With these conventions, JSAMPLE values can be assumed to be ≥ 0 . This helps simplify correct rounding during downsampling, etc. The JPEG standard's specification that sample values run from -128..127 is accommodated by subtracting 128 from the sample value in the DCT step. Similarly, during decompression the output of the IDCT step will be immediately shifted back to 0..255. (NB: different values are required when 12-bit samples are in use. The code is written in terms of MAXJSAMPLE and CENTERJSAMPLE, which will be defined as 255 and 128 respectively in an 8-bit implementation, and as 4095 and 2048 in a 12-bit implementation.)

We use a pointer per row, rather than a two-dimensional JSAMPLE array. This choice costs only a small amount of memory and has several benefits:

- * Code using the data structure doesn't need to know the allocated width of the rows. This simplifies edge expansion/compression, since we can work in an array that's wider than the logical picture width.
- * Indexing doesn't require multiplication; this is a performance win on many machines.
- * Arrays with more than 64K total elements can be supported even on machines where malloc() cannot allocate chunks larger than 64K.
- * The rows forming a component array may be allocated at different times without extra copying. This trick allows some speedups in smoothing steps that need access to the previous and next rows.

Note that each color component is stored in a separate array; we don't use the traditional layout in which the components of a pixel are stored together. This simplifies coding of modules that work on each component independently, because they don't need to know how many components there are. Furthermore, we can read or write each component to a temporary file independently, which is helpful when dealing with noninterleaved JPEG files.

In general, a specific sample value is accessed by code such as

```
GETJSAMPLE(image[colorcomponent][row][col])
```

where col is measured from the image left edge, but row is measured from the first sample row currently in memory. Either of the first two indexings can be precomputed by copying the relevant pointer.

Since most image-processing applications prefer to work on images in which the components of a pixel are stored together, the data passed to or from the surrounding application uses the traditional convention: a single pixel is represented by N consecutive JSAMPLE values, and an image row is an array of (# of color components)*(image width) JSAMPLEs. One or more rows of data can be represented by a pointer of type JSAMPARRAY in this scheme. This scheme is converted to component-wise storage inside the JPEG library. (Applications

that want to skip JPEG preprocessing or postprocessing will have to contend with component-wise storage.)

Arrays of DCT-coefficient values use the following data structure:

```
typedef short JCOEF; a 16-bit signed integer
typedef JCOEF JBLOCK[DCTSIZE2]; an 8x8 block of coefficients
typedef JBLOCK *JBLOCKROW; ptr to one horizontal row of 8x8 blocks
typedef JBLOCKROW *JBLOCKARRAY; ptr to a list of such rows
typedef JBLOCKARRAY *JBLOCKIMAGE; ptr to a list of color component arrays
```

The underlying type is at least a 16-bit signed integer; while "short" is big enough on all machines of interest, on some machines it is preferable to use "int" for speed reasons, despite the storage cost. Coefficients are grouped into 8x8 blocks (but we always use #defines DCTSIZE and DCTSIZE2 rather than "8" and "64").

The contents of a coefficient block may be in either "natural" or zigzagged order, and may be true values or divided by the quantization coefficients, depending on where the block is in the processing pipeline. In the current library, coefficient blocks are kept in natural order everywhere; the entropy codecs zigzag or dezigzag the data as it is written or read. The blocks contain quantized coefficients everywhere outside the DCT/IDCT subsystems. (This latter decision may need to be revisited to support variable quantization a la JPEG Part 3.)

Notice that the allocation unit is now a row of 8x8 coefficient blocks, corresponding to block_size rows of samples. Otherwise the structure is much the same as for samples, and for the same reasons.

On machines where malloc() can't handle a request bigger than 64Kb, this data structure limits us to rows of less than 512 JBLOCKS, or a picture width of 4000+ pixels. This seems an acceptable restriction.

On 80x86 machines, the bottom-level pointer types (JSAMPROW and JBLOCKROW) must be declared as "far" pointers, but the upper levels can be "near" (implying that the pointer lists are allocated in the DS segment).

We use a #define symbol FAR, which expands to the "far" keyword when compiling on 80x86 machines and to nothing elsewhere.

*** Suspendable processing ***

In some applications it is desirable to use the JPEG library as an incremental, memory-to-memory filter. In this situation the data source or destination may be a limited-size buffer, and we can't rely on being able to

empty or refill the buffer at arbitrary times. Instead the application would like to have control return from the library at buffer overflow/underrun, and then resume compression or decompression at a later time.

This scenario is supported for simple cases. (For anything more complex, we recommend that the application "bite the bullet" and develop real multitasking capability.) The libjpeg.txt file goes into more detail about the usage and limitations of this capability; here we address the implications for library structure.

The essence of the problem is that the entropy codec (coder or decoder) must be prepared to stop at arbitrary times. In turn, the controllers that call the entropy codec must be able to stop before having produced or consumed all the data that they normally would handle in one call. That part is reasonably straightforward: we make the controller call interfaces include "progress counters" which indicate the number of data chunks successfully processed, and we require callers to test the counter rather than just assume all of the data was processed.

Rather than trying to restart at an arbitrary point, the current Huffman codecs are designed to restart at the beginning of the current MCU after a suspension due to buffer overflow/underrun. At the start of each call, the codec's internal state is loaded from permanent storage (in the JPEG object structures) into local variables. On successful completion of the MCU, the permanent state is updated. (This copying is not very expensive, and may even lead to *improved* performance if the local variables can be registerized.) If a suspension occurs, the codec simply returns without updating the state, thus effectively reverting to the start of the MCU. Note that this implies leaving some data unprocessed in the source/destination buffer (ie, the compressed partial MCU). The data source/destination module interfaces are specified so as to make this possible. This also implies that the data buffer must be large enough to hold a worst-case compressed MCU; a couple thousand bytes should be enough.

In a successive-approximation AC refinement scan, the progressive Huffman decoder has to be able to undo assignments of newly nonzero coefficients if it suspends before the MCU is complete, since decoding requires distinguishing previously-zero and previously-nonzero coefficients. This is a bit tedious but probably won't have much effect on performance. Other variants of Huffman decoding need not worry about this, since they will just store the same values again if forced to repeat the MCU.

This approach would probably not work for an arithmetic codec, since its modifiable state is quite large and couldn't be copied cheaply. Instead it would have to suspend and resume exactly at the point of the buffer end.

The JPEG marker reader is designed to cope with suspension at an arbitrary point. It does so by backing up to the start of the marker parameter segment,

so the data buffer must be big enough to hold the largest marker of interest. Again, a couple KB should be adequate. (A special "skip" convention is used to bypass COM and APPn markers, so these can be larger than the buffer size without causing problems; otherwise a 64K buffer would be needed in the worst case.)

The JPEG marker writer currently does **not** cope with suspension. We feel that this is not necessary; it is much easier simply to require the application to ensure there is enough buffer space before starting. (An empty 2K buffer is more than sufficient for the header markers; and ensuring there are a dozen or two bytes available before calling `jpeg_finish_compress()` will suffice for the trailer.) This would not work for writing multi-scan JPEG files, but we simply do not intend to support that capability with suspension.

*** Memory manager services ***

The JPEG library's memory manager controls allocation and deallocation of memory, and it manages large "virtual" data arrays on machines where the operating system does not provide virtual memory. Note that the same memory manager serves both compression and decompression operations.

In all cases, allocated objects are tied to a particular compression or decompression master record, and they will be released when that master record is destroyed.

The memory manager does not provide explicit deallocation of objects. Instead, objects are created in "pools" of free storage, and a whole pool can be freed at once. This approach helps prevent storage-leak bugs, and it speeds up operations whenever `malloc/free` are slow (as they often are). The pools can be regarded as lifetime identifiers for objects. Two pools/lifetimes are defined:

- * `JPOOL_PERMANENT` lasts until master record is destroyed
- * `JPOOL_IMAGE` lasts until done with image (JPEG datastream)

Permanent lifetime is used for parameters and tables that should be carried across from one datastream to another; this includes all application-visible parameters. Image lifetime is used for everything else. (A third lifetime, `JPOOL_PASS` = one processing pass, was originally planned. However it was dropped as not being worthwhile. The actual usage patterns are such that the peak memory usage would be about the same anyway; and having per-pass storage substantially complicates the virtual memory allocation rules --- see below.)

The memory manager deals with three kinds of object:

1. "Small" objects. Typically these require no more than 10K-20K total.
2. "Large" objects. These may require tens to hundreds of K depending on image size. Semantically they behave the same as small objects, but we distinguish them for two reasons:

* On MS-DOS machines, large objects are referenced by FAR pointers, small objects by NEAR pointers.

* Pool allocation heuristics may differ for large and small objects.

Note that individual "large" objects cannot exceed the size allowed by type `size_t`, which may be 64K or less on some machines.

3. "Virtual" objects. These are large 2-D arrays of JSAMPLEs or JBLOCKs (typically large enough for the entire image being processed). The memory manager provides stripwise access to these arrays. On machines without virtual memory, the rest of the array may be swapped out to a temporary file.

(Note: JSAMPARRAY and JBLOCKARRAY data structures are a combination of large objects for the data proper and small objects for the row pointers. For convenience and speed, the memory manager provides single routines to create these structures. Similarly, virtual arrays include a small control block and a JSAMPARRAY or JBLOCKARRAY working buffer, all created with one call.)

In the present implementation, virtual arrays are only permitted to have image lifespan. (Permanent lifespan would not be reasonable, and pass lifespan is not very useful since a virtual array's raison d'etre is to store data for multiple passes through the image.) We also expect that only "small" objects will be given permanent lifespan, though this restriction is not required by the memory manager.

In a non-virtual-memory machine, some performance benefit can be gained by making the in-memory buffers for virtual arrays be as large as possible. (For small images, the buffers might fit entirely in memory, so blind swapping would be very wasteful.) The memory manager will adjust the height of the buffers to fit within a prespecified maximum memory usage. In order to do this in a reasonably optimal fashion, the manager needs to allocate all of the virtual arrays at once. Therefore, there isn't a one-step allocation routine for virtual arrays; instead, there is a "request" routine that simply allocates the control block, and a "realize" routine (called just once) that determines space allocation and creates all of the actual buffers. The realize routine must allow for space occupied by non-virtual large objects. (We don't bother to factor in the space needed for small objects, on the grounds that it isn't worth the trouble.)

To support all this, we establish the following protocol for doing business with the memory manager:

1. Modules must request virtual arrays (which may have only image lifespan) during the initial setup phase, i.e., in their `jinit_xxx` routines.
2. All "large" objects (including JSAMPARRAYs and JBLOCKARRAYs) must also be allocated during initial setup.
3. `realize_virt_arrays` will be called at the completion of initial setup.

The above conventions ensure that sufficient information is available for it to choose a good size for virtual array buffers.

Small objects of any lifespan may be allocated at any time. We expect that

the total space used for small objects will be small enough to be negligible in the `realize_virt_arrays` computation.

In a virtual-memory machine, we simply pretend that the available space is infinite, thus causing `realize_virt_arrays` to decide that it can allocate all the virtual arrays as full-size in-memory buffers. The overhead of the virtual-array access protocol is very small when no swapping occurs.

A virtual array can be specified to be "pre-zeroed"; when this flag is set, never-yet-written sections of the array are set to zero before being made available to the caller. If this flag is not set, never-written sections of the array contain garbage. (This feature exists primarily because the equivalent logic would otherwise be needed in `jdcoefct.c` for progressive JPEG mode; we may as well make it available for possible other uses.)

The first write pass on a virtual array is required to occur in top-to-bottom order; read passes, as well as any write passes after the first one, may access the array in any order. This restriction exists partly to simplify the virtual array control logic, and partly because some file systems may not support seeking beyond the current end-of-file in a temporary file. The main implication of this restriction is that rearrangement of rows (such as converting top-to-bottom data order to bottom-to-top) must be handled while reading data out of the virtual array, not while putting it in.

*** Memory manager internal structure ***

To isolate system dependencies as much as possible, we have broken the memory manager into two parts. There is a reasonably system-independent "front end" (`jmemmgr.c`) and a "back end" that contains only the code likely to change across systems. All of the memory management methods outlined above are implemented by the front end. The back end provides the following routines for use by the front end (none of these routines are known to the rest of the JPEG code):

`jpeg_mem_init`, `jpeg_mem_term` system-dependent initialization/shutdown

`jpeg_get_small`, `jpeg_free_small` interface to `malloc` and `free` library routines
(or their equivalents)

`jpeg_get_large`, `jpeg_free_large` interface to FAR `malloc/free` in MSDOS machines;
else usually the same as
`jpeg_get_small/jpeg_free_small`

`jpeg_mem_available` estimate available memory

`jpeg_open_backing_store` create a backing-store object

read_backing_store, manipulate a backing-store object
write_backing_store,
close_backing_store

On some systems there will be more than one type of backing-store object (specifically, in MS-DOS a backing store file might be an area of extended memory as well as a disk file). jpeg_open_backing_store is responsible for choosing how to implement a given object. The read/write/close routines are method pointers in the structure that describes a given object; this lets them be different for different object types.

It may be necessary to ensure that backing store objects are explicitly released upon abnormal program termination. For example, MS-DOS won't free extended memory by itself. To support this, we will expect the main program or surrounding application to arrange to call self_destruct (typically via jpeg_destroy) upon abnormal termination. This may require a SIGINT signal handler or equivalent. We don't want to have the back end module install its own signal handler, because that would pre-empt the surrounding application's ability to control signal handling.

The IJG distribution includes several memory manager back end implementations. Usually the same back end should be suitable for all applications on a given system, but it is possible for an application to supply its own back end at need.

*** Implications of DNL marker ***

Some JPEG files may use a DNL marker to postpone definition of the image height (this would be useful for a fax-like scanner's output, for instance). In these files the SOF marker claims the image height is 0, and you only find out the true image height at the end of the first scan.

We could read these files as follows:

1. Upon seeing zero image height, replace it by 65535 (the maximum allowed).
2. When the DNL is found, update the image height in the global image descriptor.

This implies that control modules must avoid making copies of the image height, and must re-test for termination after each MCU row. This would be easy enough to do.

In cases where image-size data structures are allocated, this approach will result in very inefficient use of virtual memory or much-larger-than-necessary temporary files. This seems acceptable for something that probably won't be a mainstream usage. People might have to forgo use of memory-hogging options (such as two-pass color quantization or noninterleaved JPEG files) if they want efficient conversion of such files. (One could improve efficiency by demanding a user-supplied upper bound for the height, less than 65536; in most

cases it could be much less.)

The standard also permits the SOF marker to overestimate the image height, with a DNL to give the true, smaller height at the end of the first scan. This would solve the space problems if the overestimate wasn't too great. However, it implies that you don't even know whether DNL will be used.

This leads to a couple of very serious objections:

1. Testing for a DNL marker must occur in the inner loop of the decompressor's Huffman decoder; this implies a speed penalty whether the feature is used or not.
2. There is no way to hide the last-minute change in image height from an application using the decoder. Thus *every* application using the IJG library would suffer a complexity penalty whether it cared about DNL or not.

We currently do not support DNL because of these problems.

A different approach is to insist that DNL-using files be preprocessed by a separate program that reads ahead to the DNL, then goes back and fixes the SOF marker. This is a much simpler solution and is probably far more efficient. Even if one wants piped input, buffering the first scan of the JPEG file needs a lot smaller temp file than is implied by the maximum-height method. For this approach we'd simply treat DNL as a no-op in the decompressor (at most, check that it matches the SOF image height).

We will not worry about making the compressor capable of outputting DNL. Something similar to the first scheme above could be applied if anyone ever wants to make that work.

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/structure.txt

No license file was found, but licenses were detected in source scan.

; For conditions of distribution and use, see the accompanying README file.

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemdosa.asm

No license file was found, but licenses were detected in source scan.

/*

* jdmainct.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* Modified 2002-2016 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains the main buffer controller for decompression.

```
* The main buffer lies between the JPEG decompressor proper and the
* post-processor; it holds downsampled data in the JPEG colorspace.
*
* Note that this code is bypassed in raw-data mode, since the application
* supplies the equivalent of the main buffer in that case.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmainct.c
No license file was found, but licenses were detected in source scan.
```

```
/*
* jaricom.c
*
* Developed 1997-2011 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains probability estimation tables for common use in
* arithmetic entropy encoding and decoding routines.
*
* This data represents Table D.3 in the JPEG spec (D.2 in the draft),
* ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81, and Table 24
* in the JBIG spec, ISO/IEC IS 11544 and CCITT Recommendation ITU-T T.82.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jaricom.c
No license file was found, but licenses were detected in source scan.
```

```
/*
* jerror.h
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 1997-2018 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file defines the error and message codes for the JPEG library.
* Edit this file to add new codes, or to translate the message strings to
* some other language.
* A set of error-reporting macros are defined too. Some applications using
* the JPEG library may wish to include this file to get the error codes
* and/or the macros.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jerror.h
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jdct.h
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2002-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This include file contains common declarations for the forward and
 * inverse DCT modules.  These declarations are private to the DCT managers
 * (jcdctmgr.c, jddctmgr.c) and the individual DCT algorithms.
 * The individual DCT algorithms are kept in separate files to ease
 * machine-dependent tuning (e.g., assembly coding).
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdct.h
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jccolor.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2011-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains input colorspace conversion routines.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jccolor.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jmemname.c
 *
 * Copyright (C) 1992-1997, Thomas G. Lane.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file provides a generic implementation of the system-dependent
 * portion of the JPEG memory manager.  This implementation assumes that
 * you must explicitly construct a name for each temp file.
 * Also, the problem of determining the amount of memory available
 * is shoved onto the user.
```

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemname.c
No license file was found, but licenses were detected in source scan.

/*

* cderror.h

*

* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2009-2017 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.

*

* This file defines the error and message codes for the cjpeg/djpeg
* applications. These strings are not needed as part of the JPEG library
* proper.
* Edit this file to add new codes, or to translate the message strings to
* some other language.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/cderror.h
No license file was found, but licenses were detected in source scan.

/*

* jcmaster.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2003-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.

*

* This file contains master control logic for the JPEG compressor.
* These routines are concerned with parameter validation, initial setup,
* and inter-pass control (determining the number of passes and the work
* to be done in each pass).

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcmaster.c
No license file was found, but licenses were detected in source scan.

/*

* jfdctint.c

*

* Copyright (C) 1991-1996, Thomas G. Lane.
* Modification developed 2003-2018 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains a slow-but-accurate integer implementation of the

* forward DCT (Discrete Cosine Transform).

*

* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT

* on each column. Direct algorithms are also available, but they are

* much more complex and seem not to be any faster when reduced to code.

*

* This implementation is based on an algorithm described in

* C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT

* Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,

* Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.

* The primary algorithm described there uses 11 multiplies and 29 adds.

* We use their alternate method with 12 multiplies and 32 adds.

* The advantage of this method is that no data path contains more than one

* multiplication; this allows a very simple and accurate implementation in

* scaled fixed-point arithmetic, with a minimal number of shifts.

*

* We also provide FDCT routines with various input sample block sizes for

* direct resolution reduction or enlargement and for direct resolving the

* common 2x1 and 1x2 subsampling cases without additional resampling: NxN

* (N=1...16), 2NxN, and Nx2N (N=1...8) pixels for one 8x8 output DCT block.

*

* For N<8 we fill the remaining block coefficients with zero.

* For N>8 we apply a partial N-point FDCT on the input samples, computing

* just the lower 8 frequency coefficients and discarding the rest.

*

* We must scale the output coefficients of the N-point FDCT appropriately

* to the standard 8-point FDCT level by 8/N per 1-D pass. This scaling

* is folded into the constant multipliers (pass 2) and/or final/initial

* shifting.

*

* CAUTION: We rely on the FIX() macro except for the N=1,2,4,8 cases

* since there would be too many additional constants to pre-calculate.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jfdctint.c

No license file was found, but licenses were detected in source scan.

/*

* wrtle.c

*

* Copyright (C) 1991-1996, Thomas G. Lane.

* Modified 2017-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to write output images in RLE format.
* The Utah Raster Toolkit library is required (version 3.1 or later).
*
* These routines may need modification for non-Unix environments or
* specialized applications. As they stand, they assume output to
* an ordinary stdio stream.
*
* Based on code contributed by Mike Lijewski,
* with updates from Robert Hutchinson.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrrle.c

No license file was found, but licenses were detected in source scan.

/*

* transupp.h

*

* Copyright (C) 1997-2019, Thomas G. Lane, Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains declarations for image transformation routines and
* other utility code used by the jpegtran sample application. These are
* NOT part of the core JPEG library. But we keep these routines separate
* from jpegtran.c to ease the task of maintaining jpegtran-like programs
* that have other user interfaces.

*

* NOTE: all the routines declared here have very specific requirements
* about when they are to be executed during the reading and writing of the
* source and destination files. See the comments in transupp.c, or see
* jpegtran.c for an example of correct usage.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/transupp.h

No license file was found, but licenses were detected in source scan.

/*

* transupp.c

*

* Copyright (C) 1997-2019, Thomas G. Lane, Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains image transformation routines and other utility code

* used by the jpegtran sample application. These are NOT part of the core
* JPEG library. But we keep these routines separate from jpegtran.c to
* ease the task of maintaining jpegtran-like programs that have other user
* interfaces.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/transupp.c

No license file was found, but licenses were detected in source scan.

USING THE IJG JPEG LIBRARY

Copyright (C) 1994-2019, Thomas G. Lane, Guido Vollbeding.

This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

This file describes how to use the IJG JPEG library within an application program. Read it if you want to write a program that uses the library.

The file example.c provides heavily commented skeleton code for calling the JPEG library. Also see jpeglib.h (the include file to be used by application programs) for full details about data structures and function parameter lists. The library source code, of course, is the ultimate reference.

Note that there have been *major* changes from the application interface presented by IJG version 4 and earlier versions. The old design had several inherent limitations, and it had accumulated a lot of cruft as we added features while trying to minimize application-interface changes. We have sacrificed backward compatibility in the version 5 rewrite, but we think the improvements justify this.

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You should read at least the overview and basic usage sections before trying to program with the library. The sections on advanced features can be read if and when you need them.

OVERVIEW

=====

Functions provided by the library

The IJG JPEG library provides C code to read and write JPEG-compressed image files. The surrounding application program receives or supplies image data a scanline at a time, using a straightforward uncompressed image format. All details of color conversion and other preprocessing/postprocessing can be handled by the library.

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. The application indirectly selects use of this code by specifying the format in which it wishes to supply or receive image data. For example, if colormapped output is requested, then the decompression library automatically invokes color quantization.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the

low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

A word about functions **not** provided by the library. We handle a subset of the ISO JPEG standard; most baseline, extended-sequential, and progressive JPEG processes are supported. (Our subset includes all features now in common use.) Unsupported ISO options include:

- * Hierarchical storage
- * Lossless JPEG
- * DNL marker
- * Nonintegral subsampling ratios

We support 8-bit to 12-bit data precision, but this is a compile-time choice rather than a run-time choice; hence it is difficult to use different precisions in a single application.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, this library is used by the free LIBTIFF library to support JPEG compression in TIFF.)

Outline of typical usage

The rough outline of a JPEG compression operation is:

```
Allocate and initialize a JPEG compression object
Specify the destination for the compressed data (eg, a file)
Set parameters for compression, including image size & colorspace
jpeg_start_compress(...);
while (scan lines remain to be written)
    jpeg_write_scanlines(...);
jpeg_finish_compress(...);
Release the JPEG compression object
```

A JPEG compression object holds parameters and working state for the JPEG library. We make creation/destruction of the object separate from starting or finishing compression of an image; the same object can be re-used for a series of image compression operations. This makes it easy to re-use the same parameter settings for a sequence of images. Re-use of a JPEG object also has important implications for processing abbreviated JPEG datastreams, as discussed later.

The image data to be compressed is supplied to `jpeg_write_scanlines()` from in-memory buffers. If the application is doing file-to-file compression, reading image data from the source file is the application's responsibility. The library emits compressed data by calling a "data destination manager",

which typically will write the data into a file; but the application can provide its own destination manager to do something else.

Similarly, the rough outline of a JPEG decompression operation is:

```
Allocate and initialize a JPEG decompression object
Specify the source of the compressed data (eg, a file)
Call jpeg_read_header() to obtain image info
Set parameters for decompression
jpeg_start_decompress(...);
while (scan lines remain to be read)
    jpeg_read_scanlines(...);
jpeg_finish_decompress(...);
Release the JPEG decompression object
```

This is comparable to the compression outline except that reading the datastream header is a separate step. This is helpful because information about the image's size, colorspace, etc is available when the application selects decompression parameters. For example, the application can choose an output scaling ratio that will fit the image into the available screen size.

The decompression library obtains compressed data by calling a data source manager, which typically will read the data from a file; but other behaviors can be obtained with a custom source manager. Decompressed data is delivered into in-memory buffers passed to `jpeg_read_scanlines()`.

It is possible to abort an incomplete compression or decompression operation by calling `jpeg_abort()`; or, if you do not need to retain the JPEG object, simply release it by calling `jpeg_destroy()`.

JPEG compression and decompression objects are two separate struct types. However, they share some common fields, and certain routines such as `jpeg_destroy()` can work on either type of object.

The JPEG library has no static variables: all state is in the compression or decompression object. Therefore it is possible to process multiple compression and decompression operations concurrently, using multiple JPEG objects.

Both compression and decompression can be done in an incremental memory-to-memory fashion, if suitable source/destination managers are used. See the section on "I/O suspension" for more details.

BASIC LIBRARY USAGE

=====

Data formats

Before diving into procedural details, it is helpful to understand the image data format that the JPEG library expects or returns.

The standard input image format is a rectangular array of pixels, with each pixel having the same number of "component" or "sample" values (color channels). You must specify how many components there are and the colorspace interpretation of the components. Most applications will use RGB data (three components per pixel) or grayscale data (one component per pixel). PLEASE NOTE THAT RGB DATA IS THREE SAMPLES PER PIXEL, GRAYSCALE ONLY ONE. A remarkable number of people manage to miss this, only to find that their programs don't work with grayscale JPEG files.

There is no provision for colormapped input. JPEG files are always full-color or full grayscale (or sometimes another colorspace such as CMYK). You can feed in a colormapped image by expanding it to full-color format. However JPEG often doesn't work very well with source data that has been colormapped, because of dithering noise. This is discussed in more detail in the JPEG FAQ and the other references mentioned in the README file.

Pixels are stored by scanlines, with each scanline running from left to right. The component values for each pixel are adjacent in the row; for example, R,G,B,R,G,B,R,G,B,... for 24-bit RGB color. Each scanline is an array of data type JSAMPLE --- which is typically "unsigned char", unless you've changed jmorecfg.h. (You can also change the RGB pixel layout, say to B,G,R order, by modifying jmorecfg.h. But see the restrictions listed in that file before doing so.)

A 2-D array of pixels is formed by making a list of pointers to the starts of scanlines; so the scanlines need not be physically adjacent in memory. Even if you process just one scanline at a time, you must make a one-element pointer array to conform to this structure. Pointers to JSAMPLE rows are of type JSAMPROW, and the pointer to the pointer array is of type JSAMPARRAY.

The library accepts or supplies one or more complete scanlines per call. It is not possible to process part of a row at a time. Scanlines are always processed top-to-bottom. You can process an entire image in one call if you have it all in memory, but usually it's simplest to process one scanline at a time.

For best results, source data values should have the precision specified by BITS_IN_JSAMPLE (normally 8 bits). For instance, if you choose to compress data that's only 6 bits/channel, you should left-justify each value in a byte before passing it to the compressor. If you need to compress data that has more than 8 bits/channel, compile with BITS_IN_JSAMPLE = 9 to 12. (See "Library compile-time options", later.)

The data format returned by the decompressor is the same in all details, except that colormapped output is supported. (Again, a JPEG file is never colormapped. But you can ask the decompressor to perform on-the-fly color quantization to deliver colormapped output.) If you request colormapped output then the returned data array contains a single JSAMPLE per pixel; its value is an index into a color map. The color map is represented as a 2-D JSAMPARRAY in which each row holds the values of one color component, that is, colormap[i][j] is the value of the i'th color component for pixel value (map index) j. Note that since the colormap indexes are stored in JSAMPLEs, the maximum number of colors is limited by the size of JSAMPLE (ie, at most 256 colors for an 8-bit JPEG library).

Compression details

Here we revisit the JPEG compression outline given in the overview.

1. Allocate and initialize a JPEG compression object.

A JPEG compression object is a "struct jpeg_compress_struct". (It also has a bunch of subsidiary structures which are allocated via malloc(), but the application doesn't control those directly.) This struct can be just a local variable in the calling routine, if a single routine is going to execute the whole JPEG compression sequence. Otherwise it can be static or allocated from malloc().

You will also need a structure representing a JPEG error handler. The part of this that the library cares about is a "struct jpeg_error_mgr". If you are providing your own error handler, you'll typically want to embed the jpeg_error_mgr struct in a larger structure; this is discussed later under "Error handling". For now we'll assume you are just using the default error handler. The default error handler will print JPEG error/warning messages on stderr, and it will call exit() if a fatal error occurs.

You must initialize the error handler structure, store a pointer to it into the JPEG object's "err" field, and then call jpeg_create_compress() to initialize the rest of the JPEG object.

Typical code for this step, if you are using the default error handler, is

```
struct jpeg_compress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_compress(&cinfo);
```

jpeg_create_compress allocates a small amount of memory, so it could fail if you are out of memory. In that case it will exit via the error handler; that's why the error handler must be initialized first.

2. Specify the destination for the compressed data (eg, a file).

As previously mentioned, the JPEG library delivers compressed data to a "data destination" module. The library includes one data destination module which knows how to write to a stdio stream. You can use your own destination module if you want to do something else, as discussed later.

If you use the standard destination module, you must open the target stdio stream beforehand. Typical code for this step looks like:

```
FILE * outfile;
...
if ((outfile = fopen(filename, "wb")) == NULL) {
    fprintf(stderr, "can't open %s\n", filename);
    exit(1);
}
jpeg_stdio_dest(&cinfo, outfile);
```

where the last line invokes the standard destination module.

WARNING: it is critical that the binary compressed data be delivered to the output file unchanged. On non-Unix systems the stdio library may perform newline translation or otherwise corrupt binary data. To suppress this behavior, you may need to use a "b" option to fopen (as shown above), or use setmode() or another routine to put the stdio stream in binary mode. See cjpeg.c and djpeg.c for code that has been found to work on many systems.

You can select the data destination after setting other parameters (step 3), if that's more convenient. You may not change the destination between calling jpeg_start_compress() and jpeg_finish_compress().

3. Set parameters for compression, including image size & colorspace.

You must supply information about the source image by setting the following fields in the JPEG object (cinfo structure):

```
image_width  Width of image, in pixels
image_height Height of image, in pixels
input_components  Number of color channels (samples per pixel)
in_color_space  Color space of source image
```

The image dimensions are, hopefully, obvious. JPEG supports image dimensions

of 1 to 64K pixels in either direction. The input color space is typically RGB or grayscale, and `input_components` is 3 or 1 accordingly. (See "Special color spaces", later, for more info.) The `in_color_space` field must be assigned one of the `J_COLOR_SPACE` enum constants, typically `JCS_RGB` or `JCS_GRAYSCALE`.

JPEG has a large number of compression parameters that determine how the image is encoded. Most applications don't need or want to know about all these parameters. You can set all the parameters to reasonable defaults by calling `jpeg_set_defaults()`; then, if there are particular values you want to change, you can do so after that. The "Compression parameter selection" section tells about all the parameters.

You must set `in_color_space` correctly before calling `jpeg_set_defaults()`, because the defaults depend on the source image colorspace. However the other three source image parameters need not be valid until you call `jpeg_start_compress()`. There's no harm in calling `jpeg_set_defaults()` more than once, if that happens to be convenient.

Typical code for a 24-bit RGB source image is

```
cinfo.image_width = Width; /* image width and height, in pixels */
cinfo.image_height = Height;
cinfo.input_components = 3; /* # of color components per pixel */
cinfo.in_color_space = JCS_RGB; /* colorspace of input image */

jpeg_set_defaults(&cinfo);
/* Make optional parameter settings here */
```

4. `jpeg_start_compress(...)`;

After you have established the data destination and set all the necessary source image info and other parameters, call `jpeg_start_compress()` to begin a compression cycle. This will initialize internal state, allocate working storage, and emit the first few bytes of the JPEG datastream header.

Typical code:

```
jpeg_start_compress(&cinfo, TRUE);
```

The "TRUE" parameter ensures that a complete JPEG interchange datastream will be written. This is appropriate in most cases. If you think you might want to use an abbreviated datastream, read the section on abbreviated datastreams, below.

Once you have called `jpeg_start_compress()`, you may not alter any JPEG parameters or other fields of the JPEG object until you have completed

the compression cycle.

```
5. while (scan lines remain to be written)
   jpeg_write_scanlines(...);
```

Now write all the required image data by calling `jpeg_write_scanlines()` one or more times. You can pass one or more scanlines in each call, up to the total image height. In most applications it is convenient to pass just one or a few scanlines at a time. The expected format for the passed data is discussed under "Data formats", above.

Image data should be written in top-to-bottom scanline order. The JPEG spec contains some weasel wording about how top and bottom are application-defined terms (a curious interpretation of the English language...) but if you want your files to be compatible with everyone else's, you WILL use top-to-bottom order. If the source data must be read in bottom-to-top order, you can use the JPEG library's virtual array mechanism to invert the data efficiently. Examples of this can be found in the sample application `cjpeg`.

The library maintains a count of the number of scanlines written so far in the `next_scanline` field of the JPEG object. Usually you can just use this variable as the loop counter, so that the loop test looks like "`while (cinfo.next_scanline < cinfo.image_height)`".

Code for this step depends heavily on the way that you store the source data. `example.c` shows the following code for the case of a full-size 2-D source array containing 3-byte RGB pixels:

```
JSAMPROW row_pointer[1]; /* pointer to a single row */
int row_stride; /* physical row width in buffer */

row_stride = image_width * 3; /* JSAMPLEs per row in image_buffer */

while (cinfo.next_scanline < cinfo.image_height) {
    row_pointer[0] = & image_buffer[cinfo.next_scanline * row_stride];
    jpeg_write_scanlines(&cinfo, row_pointer, 1);
}
```

`jpeg_write_scanlines()` returns the number of scanlines actually written. This will normally be equal to the number passed in, so you can usually ignore the return value. It is different in just two cases:

- * If you try to write more scanlines than the declared image height, the additional scanlines are ignored.
- * If you use a suspending data destination manager, output buffer overrun will cause the compressor to return before accepting all the passed lines. This feature is discussed under "I/O suspension", below. The normal `stdio` destination manager will NOT cause this to happen.

In any case, the return value is the same as the change in the value of `next_scanline`.

6. `jpeg_finish_compress(...)`;

After all the image data has been written, call `jpeg_finish_compress()` to complete the compression cycle. This step is **ESSENTIAL** to ensure that the last bufferload of data is written to the data destination.

`jpeg_finish_compress()` also releases working memory associated with the JPEG object.

Typical code:

```
jpeg_finish_compress(&cinfo);
```

If using the `stdio` destination manager, don't forget to close the output `stdio` stream (if necessary) afterwards.

If you have requested a multi-pass operating mode, such as Huffman code optimization, `jpeg_finish_compress()` will perform the additional passes using data buffered by the first pass. In this case `jpeg_finish_compress()` may take quite a while to complete. With the default compression parameters, this will not happen.

It is an error to call `jpeg_finish_compress()` before writing the necessary total number of scanlines. If you wish to abort compression, call `jpeg_abort()` as discussed below.

After completing a compression cycle, you may dispose of the JPEG object as discussed next, or you may use it to compress another image. In that case return to step 2, 3, or 4 as appropriate. If you do not change the destination manager, the new datastream will be written to the same target. If you do not change any JPEG parameters, the new datastream will be written with the same parameters as before. Note that you can change the input image dimensions freely between cycles, but if you change the input colorspace, you should call `jpeg_set_defaults()` to adjust for the new colorspace; and then you'll need to repeat all of step 3.

7. Release the JPEG compression object.

When you are done with a JPEG compression object, destroy it by calling `jpeg_destroy_compress()`. This will free all subsidiary memory (regardless of the previous state of the object). Or you can call `jpeg_destroy()`, which works for either compression or decompression objects --- this may be more convenient if you are sharing code between compression and decompression cases. (Actually, these routines are equivalent except for the declared type

of the passed pointer. To avoid gripes from ANSI C compilers, jpeg_destroy() should be passed a j_common_ptr.)

If you allocated the jpeg_compress_struct structure from malloc(), freeing it is your responsibility --- jpeg_destroy() won't. Ditto for the error handler structure.

Typical code:

```
jpeg_destroy_compress(&cinfo);
```

8. Aborting.

If you decide to abort a compression cycle before finishing, you can clean up in either of two ways:

* If you don't need the JPEG object any more, just call jpeg_destroy_compress() or jpeg_destroy() to release memory. This is legitimate at any point after calling jpeg_create_compress() --- in fact, it's safe even if jpeg_create_compress() fails.

* If you want to re-use the JPEG object, call jpeg_abort_compress(), or call jpeg_abort() which works on both compression and decompression objects. This will return the object to an idle state, releasing any working memory. jpeg_abort() is allowed at any time after successful object creation.

Note that cleaning up the data destination, if required, is your responsibility; neither of these routines will call term_destination(). (See "Compressed data handling", below, for more about that.)

jpeg_destroy() and jpeg_abort() are the only safe calls to make on a JPEG object that has reported an error by calling error_exit (see "Error handling" for more info). The internal state of such an object is likely to be out of whack. Either of these two routines will return the object to a known state.

Decompression details

Here we revisit the JPEG decompression outline given in the overview.

1. Allocate and initialize a JPEG decompression object.

This is just like initialization for compression, as discussed above, except that the object is a "struct jpeg_decompress_struct" and you call jpeg_create_decompress(). Error handling is exactly the same.

Typical code:

```
struct jpeg_decompress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_decompress(&cinfo);
```

(Both here and in the IJG code, we usually use variable name "cinfo" for both compression and decompression objects.)

2. Specify the source of the compressed data (eg, a file).

As previously mentioned, the JPEG library reads compressed data from a "data source" module. The library includes one data source module which knows how to read from a stdio stream. You can use your own source module if you want to do something else, as discussed later.

If you use the standard source module, you must open the source stdio stream beforehand. Typical code for this step looks like:

```
FILE * infile;
...
if ((infile = fopen(filename, "rb")) == NULL) {
    fprintf(stderr, "can't open %s\n", filename);
    exit(1);
}
jpeg_stdio_src(&cinfo, infile);
```

where the last line invokes the standard source module.

WARNING: it is critical that the binary compressed data be read unchanged. On non-Unix systems the stdio library may perform newline translation or otherwise corrupt binary data. To suppress this behavior, you may need to use a "b" option to fopen (as shown above), or use setmode() or another routine to put the stdio stream in binary mode. See cjpeg.c and djpeg.c for code that has been found to work on many systems.

You may not change the data source between calling jpeg_read_header() and jpeg_finish_decompress(). If you wish to read a series of JPEG images from a single source file, you should repeat the jpeg_read_header() to jpeg_finish_decompress() sequence without reinitializing either the JPEG object or the data source module; this prevents buffered input data from being discarded.

3. Call jpeg_read_header() to obtain image info.

Typical code for this step is just

```
jpeg_read_header(&cinfo, TRUE);
```

This will read the source datastream header markers, up to the beginning of the compressed data proper. On return, the image dimensions and other info have been stored in the JPEG object. The application may wish to consult this information before selecting decompression parameters.

More complex code is necessary if

- * A suspending data source is used --- in that case `jpeg_read_header()` may return before it has read all the header data. See "I/O suspension", below. The normal `stdio` source manager will NOT cause this to happen.
- * Abbreviated JPEG files are to be processed --- see the section on abbreviated datastreams. Standard applications that deal only in interchange JPEG files need not be concerned with this case either.

It is permissible to stop at this point if you just wanted to find out the image dimensions and other header info for a JPEG file. In that case, call `jpeg_destroy()` when you are done with the JPEG object, or call `jpeg_abort()` to return it to an idle state before selecting a new data source and reading another header.

4. Set parameters for decompression.

`jpeg_read_header()` sets appropriate default decompression parameters based on the properties of the image (in particular, its colorspace). However, you may well want to alter these defaults before beginning the decompression. For example, the default is to produce full color output from a color file. If you want colormapped output you must ask for it. Other options allow the returned image to be scaled and allow various speed/quality tradeoffs to be selected. "Decompression parameter selection", below, gives details.

If the defaults are appropriate, nothing need be done at this step.

Note that all default values are set by each call to `jpeg_read_header()`. If you reuse a decompression object, you cannot expect your parameter settings to be preserved across cycles, as you can for compression. You must set desired parameter values each time.

5. `jpeg_start_decompress(...)`;

Once the parameter values are satisfactory, call `jpeg_start_decompress()` to begin decompression. This will initialize internal state, allocate working memory, and prepare for returning data.

Typical code is just

```
jpeg_start_decompress(&cinfo);
```

If you have requested a multi-pass operating mode, such as 2-pass color quantization, `jpeg_start_decompress()` will do everything needed before data output can begin. In this case `jpeg_start_decompress()` may take quite a while to complete. With a single-scan (non progressive) JPEG file and default decompression parameters, this will not happen; `jpeg_start_decompress()` will return quickly.

After this call, the final output image dimensions, including any requested scaling, are available in the JPEG object; so is the selected colormap, if colormapped output has been requested. Useful fields include

```
output_width  image width and height, as scaled
output_height
out_color_components # of color components in out_color_space
output_components # of color components returned per pixel
colormap      the selected colormap, if any
actual_number_of_colors number of entries in colormap
```

`output_components` is 1 (a colormap index) when quantizing colors; otherwise it equals `out_color_components`. It is the number of JSAMPLE values that will be emitted per pixel in the output arrays.

Typically you will need to allocate data buffers to hold the incoming image. You will need `output_width * output_components` JSAMPLEs per scanline in your output buffer, and a total of `output_height` scanlines will be returned.

Note: if you are using the JPEG library's internal memory manager to allocate data buffers (as `djpeg` does), then the manager's protocol requires that you request large buffers *before* calling `jpeg_start_decompress()`. This is a little tricky since the `output_XXX` fields are not normally valid then. You can make them valid by calling `jpeg_calc_output_dimensions()` after setting the relevant parameters (scaling, output color space, and quantization flag).

6. while (scan lines remain to be read)

```
jpeg_read_scanlines(...);
```

Now you can read the decompressed image data by calling `jpeg_read_scanlines()` one or more times. At each call, you pass in the maximum number of scanlines to be read (ie, the height of your working buffer); `jpeg_read_scanlines()` will return up to that many lines. The return value is the number of lines actually read. The format of the returned data is discussed under "Data formats", above. Don't forget that grayscale and color JPEGs will return

different data formats!

Image data is returned in top-to-bottom scanline order. If you must write out the image in bottom-to-top order, you can use the JPEG library's virtual array mechanism to invert the data efficiently. Examples of this can be found in the sample application `djpeg`.

The library maintains a count of the number of scanlines returned so far in the `output_scanline` field of the JPEG object. Usually you can just use this variable as the loop counter, so that the loop test looks like `"while (cinfo.output_scanline < cinfo.output_height)"`. (Note that the test should NOT be against `image_height`, unless you never use scaling. The `image_height` field is the height of the original unscaled image.) The return value always equals the change in the value of `output_scanline`.

If you don't use a suspending data source, it is safe to assume that `jpeg_read_scanlines()` reads at least one scanline per call, until the bottom of the image has been reached.

If you use a buffer larger than one scanline, it is NOT safe to assume that `jpeg_read_scanlines()` fills it. (The current implementation returns only a few scanlines per call, no matter how large a buffer you pass.) So you must always provide a loop that calls `jpeg_read_scanlines()` repeatedly until the whole image has been read.

7. `jpeg_finish_decompress(...)`;

After all the image data has been read, call `jpeg_finish_decompress()` to complete the decompression cycle. This causes working memory associated with the JPEG object to be released.

Typical code:

```
jpeg_finish_decompress(&cinfo);
```

If using the `stdio` source manager, don't forget to close the source `stdio` stream if necessary.

It is an error to call `jpeg_finish_decompress()` before reading the correct total number of scanlines. If you wish to abort decompression, call `jpeg_abort()` as discussed below.

After completing a decompression cycle, you may dispose of the JPEG object as discussed next, or you may use it to decompress another image. In that case return to step 2 or 3 as appropriate. If you do not change the source manager, the next image will be read from the same source.

8. Release the JPEG decompression object.

When you are done with a JPEG decompression object, destroy it by calling `jpeg_destroy_decompress()` or `jpeg_destroy()`. The previous discussion of destroying compression objects applies here too.

Typical code:

```
jpeg_destroy_decompress(&cinfo);
```

9. Aborting.

You can abort a decompression cycle by calling `jpeg_destroy_decompress()` or `jpeg_destroy()` if you don't need the JPEG object any more, or `jpeg_abort_decompress()` or `jpeg_abort()` if you want to reuse the object. The previous discussion of aborting compression cycles applies here too.

Mechanics of usage: include files, linking, etc

Applications using the JPEG library should include the header file `jpeglib.h` to obtain declarations of data types and routines. Before including `jpeglib.h`, include system headers that define at least the typedefs `FILE` and `size_t`. On ANSI-conforming systems, including `<stdio.h>` is sufficient; on older Unix systems, you may need `<sys/types.h>` to define `size_t`.

If the application needs to refer to individual JPEG library error codes, also include `jerror.h` to define those symbols.

`jpeglib.h` indirectly includes the files `jconfig.h` and `jmorecfg.h`. If you are installing the JPEG header files in a system directory, you will want to install all four files: `jpeglib.h`, `jerror.h`, `jconfig.h`, `jmorecfg.h`.

The most convenient way to include the JPEG code into your executable program is to prepare a library file ("`libjpeg.a`", or a corresponding name on non-Unix machines) and reference it at your link step. If you use only half of the library (only compression or only decompression), only that much code will be included from the library, unless your linker is hopelessly brain-damaged. The supplied makefiles build `libjpeg.a` automatically (see `install.txt`).

While you can build the JPEG library as a shared library if the whim strikes you, we don't really recommend it. The trouble with shared libraries is that at some point you'll probably try to substitute a new version of the library without recompiling the calling applications. That generally doesn't work because the parameter struct declarations usually change with each new

version. In other words, the library's API is **not** guaranteed binary compatible across versions; we only try to ensure source-code compatibility. (In hindsight, it might have been smarter to hide the parameter structs from applications and introduce a ton of access functions instead. Too late now, however.)

On some systems your application may need to set up a signal handler to ensure that temporary files are deleted if the program is interrupted. This is most critical if you are on MS-DOS and use the `jmemdos.c` memory manager back end; it will try to grab extended memory for temp files, and that space will NOT be freed automatically. See `cjpeg.c` or `djpeg.c` for an example signal handler.

It may be worth pointing out that the core JPEG library does not actually require the stdio library: only the default source/destination managers and error handler need it. You can use the library in a stdio-less environment if you replace those modules and use `jmemnobs.c` (or another memory manager of your own devising). More info about the minimum system library requirements may be found in `jininclude.h`.

ADVANCED FEATURES

=====

Compression parameter selection

This section describes all the optional parameters you can set for JPEG compression, as well as the "helper" routines provided to assist in this task. Proper setting of some parameters requires detailed understanding of the JPEG standard; if you don't know what a parameter is for, it's best not to mess with it! See REFERENCES in the README file for pointers to more info about JPEG.

It's a good idea to call `jpeg_set_defaults()` first, even if you plan to set all the parameters; that way your code is more likely to work with future JPEG libraries that have additional parameters. For the same reason, we recommend you use a helper routine where one is provided, in preference to twiddling cinfo fields directly.

The helper routines are:

`jpeg_set_defaults (j_compress_ptr cinfo)`

This routine sets all JPEG parameters to reasonable defaults, using only the input image's color space (field `in_color_space`, which must already be set in `cinfo`). Many applications will only need to use this routine and perhaps `jpeg_set_quality()`.

`jpeg_set_colorspace (j_compress_ptr cinfo, J_COLOR_SPACE colorspace)`

Sets the JPEG file's colorspace (field `jpeg_color_space`) as specified, and sets other color-space-dependent parameters appropriately. See "Special color spaces", below, before using this. A large number of parameters, including all per-component parameters, are set by this routine; if you want to twiddle individual parameters you should call `jpeg_set_colorspace()` before rather than after.

`jpeg_default_colorspace (j_compress_ptr cinfo)`

Selects an appropriate JPEG colorspace based on `cinfo->in_color_space`, and calls `jpeg_set_colorspace()`. This is actually a subroutine of `jpeg_set_defaults()`. It's broken out in case you want to change just the colorspace-dependent JPEG parameters.

`jpeg_set_quality (j_compress_ptr cinfo, int quality, boolean force_baseline)`

Constructs JPEG quantization tables appropriate for the indicated quality setting. The quality value is expressed on the 0..100 scale recommended by IJG (cjpeg's "-quality" switch uses this routine). Note that the exact mapping from quality values to tables may change in future IJG releases as more is learned about DCT quantization. If the `force_baseline` parameter is TRUE, then the quantization table entries are constrained to the range 1..255 for full JPEG baseline compatibility. In the current implementation, this only makes a difference for quality settings below 25, and it effectively prevents very small/low quality files from being generated. The IJG decoder is capable of reading the non-baseline files generated at low quality settings when `force_baseline` is FALSE, but other decoders may not be.

`jpeg_set_linear_quality (j_compress_ptr cinfo, int scale_factor, boolean force_baseline)`

Same as `jpeg_set_quality()` except that the generated tables are the sample tables given in the JPEG spec section K.1, multiplied by the specified scale factor (which is expressed as a percentage; thus `scale_factor = 100` reproduces the spec's tables). Note that larger scale factors give lower quality. This entry point is useful for conforming to the Adobe PostScript DCT conventions, but we do not recommend linear scaling as a user-visible quality scale otherwise. `force_baseline` again constrains the computed table entries to 1..255.

`int jpeg_quality_scaling (int quality)`

Converts a value on the IJG-recommended quality scale to a linear scaling percentage. Note that this routine may change or go away in future releases --- IJG may choose to adopt a scaling method that can't be expressed as a simple scalar multiplier, in which case the premise of this routine collapses. Caveat user.

`jpeg_default_qtables (j_compress_ptr cinfo, boolean force_baseline)`

Set default quantization tables with linear `q_scale_factor[]` values (see below).

```
jpeg_add_quant_table (j_compress_ptr cinfo, int which_tbl,  
    const unsigned int *basic_table,  
    int scale_factor, boolean force_baseline)
```

Allows an arbitrary quantization table to be created. `which_tbl` indicates which table slot to fill. `basic_table` points to an array of 64 unsigned ints given in normal array order. These values are multiplied by `scale_factor/100` and then clamped to the range 1..65535 (or to 1..255 if `force_baseline` is TRUE).

CAUTION: prior to library version 6a, `jpeg_add_quant_table` expected the basic table to be given in JPEG zigzag order. If you need to write code that works with either older or newer versions of this routine, you must check the library version number. Something like `"#if JPEG_LIB_VERSION >= 61"` is the right test.

```
jpeg_simple_progression (j_compress_ptr cinfo)
```

Generates a default scan script for writing a progressive-JPEG file. This is the recommended method of creating a progressive file, unless you want to make a custom scan sequence. You must ensure that the JPEG color space is set correctly before calling this routine.

Compression parameters (cinfo fields) include:

`boolean arith_code`

If TRUE, use arithmetic coding.

If FALSE, use Huffman coding.

`int block_size`

Set DCT block size. All N from 1 to 16 are possible.

Default is 8 (baseline format).

Larger values produce higher compression,
smaller values produce higher quality.

An exact DCT stage is possible with 1 or 2.

With the default quality of 75 and default Luminance qtable
the DCT+Quantization stage is lossless for value 1.

Note that values other than 8 require a SmartScale capable decoder,
introduced with IJG JPEG 8. Setting the `block_size` parameter for
compression works with version 8c and later.

`J_DCT_METHOD dct_method`

Selects the algorithm used for the DCT step. Choices are:

JDCT_ISLOW: slow but accurate integer algorithm

JDCT_IFAST: faster, less accurate integer method

JDCT_FLOAT: floating-point method

JDCT_DEFAULT: default method (normally JDCT_ISLOW)

JDCT_FASTEST: fastest method (normally JDCT_IFAST)

The FLOAT method is very slightly more accurate than the ISLOW method,

but may give different results on different machines due to varying roundoff behavior. The integer methods should give the same results on all machines. On machines with sufficiently fast FP hardware, the floating-point method may also be the fastest. The IFAST method is considerably less accurate than the other two; its use is not recommended if high quality is a concern. JDCT_DEFAULT and JDCT_FASTEST are macros configurable by each installation.

unsigned int scale_num, scale_denom

Scale the image by the fraction scale_num/scale_denom. Default is 1/1, or no scaling. Currently, the supported scaling ratios are M/N with all N from 1 to 16, where M is the destination DCT size, which is 8 by default (see block_size parameter above).

(The library design allows for arbitrary scaling ratios but this is not likely to be implemented any time soon.)

J_COLOR_SPACE jpeg_color_space

int num_components

The JPEG color space and corresponding number of components; see "Special color spaces", below, for more info. We recommend using jpeg_set_colorspace() if you want to change these.

J_COLOR_TRANSFORM color_transform

Internal color transform identifier, writes LSE marker if nonzero (requires decoder with inverse color transform support, introduced with IJG JPEG 9).

Two values are currently possible: JCT_NONE and JCT_SUBTRACT_GREEN.

Set this value for lossless RGB application *before* calling jpeg_set_colorspace(), because entropy table assignment in jpeg_set_colorspace() depends on color_transform.

boolean optimize_coding

TRUE causes the compressor to compute optimal Huffman coding tables for the image. This requires an extra pass over the data and therefore costs a good deal of space and time. The default is FALSE, which tells the compressor to use the supplied or default Huffman tables. In most cases optimal tables save only a few percent of file size compared to the default tables. Note that when this is TRUE, you need not supply Huffman tables at all, and any you do supply will be overwritten.

unsigned int restart_interval

int restart_in_rows

To emit restart markers in the JPEG file, set one of these nonzero.

Set restart_interval to specify the exact interval in MCU blocks.

Set restart_in_rows to specify the interval in MCU rows. (If restart_in_rows is not 0, then restart_interval is set after the image width in MCUs is computed.) Defaults are zero (no restarts).

One restart marker per MCU row is often a good choice.

NOTE: the overhead of restart markers is higher in grayscale JPEG files than in color files, and MUCH higher in progressive JPEGs. If you use restarts, you may want to use larger intervals in those cases.

```
const jpeg_scan_info * scan_info
int num_scans
```

By default, scan_info is NULL; this causes the compressor to write a single-scan sequential JPEG file. If not NULL, scan_info points to an array of scan definition records of length num_scans. The compressor will then write a JPEG file having one scan for each scan definition record. This is used to generate noninterleaved or progressive JPEG files. The library checks that the scan array defines a valid JPEG scan sequence. (jpeg_simple_progression creates a suitable scan definition array for progressive JPEG.) This is discussed further under "Progressive JPEG support".

```
boolean do_fancy_downsampling
```

If TRUE, use direct DCT scaling with DCT size > 8 for downsampling of chroma components.

If FALSE, use only DCT size <= 8 and simple separate downsampling. Default is TRUE.

For better image stability in multiple generation compression cycles it is preferable that this value matches the corresponding do_fancy_upsampling value in decompression.

```
int smoothing_factor
```

If non-zero, the input image is smoothed; the value should be 1 for minimal smoothing to 100 for maximum smoothing. Consult jcsample.c for details of the smoothing algorithm. The default is zero.

```
boolean write_JFIF_header
```

If TRUE, a JFIF APP0 marker is emitted. jpeg_set_defaults() and jpeg_set_colorspace() set this TRUE if a JFIF-legal JPEG color space (ie, YCbCr or grayscale) is selected, otherwise FALSE.

```
UINT8 JFIF_major_version
```

```
UINT8 JFIF_minor_version
```

The version number to be written into the JFIF marker.

jpeg_set_defaults() initializes the version to 1.01 (major=minor=1).

You should set it to 1.02 (major=1, minor=2) if you plan to write any JFIF 1.02 extension markers.

```
UINT8 density_unit
```

```
UINT16 X_density
```

```
UINT16 Y_density
```

The resolution information to be written into the JFIF marker;

not used otherwise. `density_unit` may be 0 for unknown, 1 for dots/inch, or 2 for dots/cm. The default values are 0,1,1 indicating square pixels of unknown size.

boolean `write_Adobe_marker`

If TRUE, an Adobe APP14 marker is emitted. `jpeg_set_defaults()` and `jpeg_set_colorspace()` set this TRUE if JPEG color space RGB, CMYK, or YCCK is selected, otherwise FALSE. It is generally a bad idea to set both `write_JFIF_header` and `write_Adobe_marker`. In fact, you probably shouldn't change the default settings at all --- the default behavior ensures that the JPEG file's color space can be recognized by the decoder.

`JQUANT_TBL * quant_tbl_ptrs[NUM_QUANT_TBLS]`

Pointers to coefficient quantization tables, one per table slot, or NULL if no table is defined for a slot. Usually these should be set via one of the above helper routines; `jpeg_add_quant_table()` is general enough to define any quantization table. The other routines will set up table slot 0 for luminance quality and table slot 1 for chrominance.

`int q_scale_factor[NUM_QUANT_TBLS]`

Linear quantization scaling factors (percentage, initialized 100) for use with `jpeg_default_qtables()`.

See `rdswitch.c` and `cjpeg.c` for an example of usage.

Note that the `q_scale_factor[]` fields are the "linear" scales, so you have to convert from user-defined ratings via `jpeg_quality_scaling()`.

Here is an example code which corresponds to `cjpeg -quality 90,70`:

```
jpeg_set_defaults(cinfo);

/* Set luminance quality 90. */
cinfo->q_scale_factor[0] = jpeg_quality_scaling(90);
/* Set chrominance quality 70. */
cinfo->q_scale_factor[1] = jpeg_quality_scaling(70);
```

```
jpeg_default_qtables(cinfo, force_baseline);
```

CAUTION: You must also set 1x1 subsampling for efficient separate color quality selection, since the default value used by library is 2x2:

```
cinfo->comp_info[0].v_samp_factor = 1;
cinfo->comp_info[0].h_samp_factor = 1;
```

`JHUFF_TBL * dc_huff_tbl_ptrs[NUM_HUFF_TBLS]`

`JHUFF_TBL * ac_huff_tbl_ptrs[NUM_HUFF_TBLS]`

Pointers to Huffman coding tables, one per table slot, or NULL if

no table is defined for a slot. Slots 0 and 1 are filled with the JPEG sample tables by `jpeg_set_defaults()`. If you need to allocate more table structures, `jpeg_alloc_huff_table()` may be used. Note that optimal Huffman tables can be computed for an image by setting `optimize_coding`, as discussed above; there's seldom any need to mess with providing your own Huffman tables.

The actual dimensions of the JPEG image that will be written to the file are given by the following fields. These are computed from the input image dimensions and the compression parameters by `jpeg_start_compress()`. You can also call `jpeg_calc_jpeg_dimensions()` to obtain the values that will result from the current parameter settings. This can be useful if you are trying to pick a scaling ratio that will get close to a desired target size.

JDIMENSION `jpeg_width` Actual dimensions of output image.
JDIMENSION `jpeg_height`

Per-component parameters are stored in the struct `cinfo.comp_info[i]` for component number `i`. Note that components here refer to components of the JPEG color space, *not* the source image color space. A suitably large `comp_info[]` array is allocated by `jpeg_set_defaults()`; if you choose not to use that routine, it's up to you to allocate the array.

int `component_id`

The one-byte identifier code to be recorded in the JPEG file for this component. For the standard color spaces, we recommend you leave the default values alone.

int `h_samp_factor`

int `v_samp_factor`

Horizontal and vertical sampling factors for the component; must be 1..4 according to the JPEG standard. Note that larger sampling factors indicate a higher-resolution component; many people find this behavior quite unintuitive. The default values are 2,2 for luminance components and 1,1 for chrominance components, except for grayscale where 1,1 is used.

int `quant_tbl_no`

Quantization table number for component. The default value is 0 for luminance components and 1 for chrominance components.

int `dc_tbl_no`

int `ac_tbl_no`

DC and AC entropy coding table numbers. The default values are 0 for luminance components and 1 for chrominance components.

int component_index

Must equal the component's index in comp_info[]. (Beginning in release v6, the compressor library will fill this in automatically; you don't have to.)

Decompression parameter selection

Decompression parameter selection is somewhat simpler than compression parameter selection, since all of the JPEG internal parameters are recorded in the source file and need not be supplied by the application. (Unless you are working with abbreviated files, in which case see "Abbreviated datastreams", below.) Decompression parameters control the postprocessing done on the image to deliver it in a format suitable for the application's use. Many of the parameters control speed/quality tradeoffs, in which faster decompression may be obtained at the price of a poorer-quality image. The defaults select the highest quality (slowest) processing.

The following fields in the JPEG object are set by jpeg_read_header() and may be useful to the application in choosing decompression parameters:

JDIMENSION image_width Width and height of image
JDIMENSION image_height
int num_components Number of color components
J_COLOR_SPACE jpeg_color_space Colorspace of image
boolean saw_JFIF_marker TRUE if a JFIF APP0 marker was seen
UINT8 JFIF_major_version Version information from JFIF marker
UINT8 JFIF_minor_version
UINT8 density_unit Resolution data from JFIF marker
UINT16 X_density
UINT16 Y_density
boolean saw_Adobe_marker TRUE if an Adobe APP14 marker was seen
UINT8 Adobe_transform Color transform code from Adobe marker

The JPEG color space, unfortunately, is something of a guess since the JPEG standard proper does not provide a way to record it. In practice most files adhere to the JFIF or Adobe conventions, and the decoder will recognize these correctly. See "Special color spaces", below, for more info.

The decompression parameters that determine the basic properties of the returned image are:

J_COLOR_SPACE out_color_space
Output color space. jpeg_read_header() sets an appropriate default based on jpeg_color_space; typically it will be RGB or grayscale.

The application can change this field to request output in a different colorspace. For example, set it to JCS_GRAYSCALE to get grayscale output from a color file. (This is useful for previewing: grayscale output is faster than full color since the color components need not be processed.) Note that not all possible color space transforms are currently implemented; you may need to extend jdcolor.c if you want an unusual conversion.

unsigned int scale_num, scale_denom

Scale the image by the fraction scale_num/scale_denom. Currently, the supported scaling ratios are M/N with all M from 1 to 16, where N is the source DCT size, which is 8 for baseline JPEG. (The library design allows for arbitrary scaling ratios but this is not likely to be implemented any time soon.) The values are initialized by jpeg_read_header() with the source DCT size. For baseline JPEG this is 8/8. If you change only the scale_num value while leaving the other unchanged, then this specifies the DCT scaled size to be applied on the given input. For baseline JPEG this is equivalent to M/8 scaling, since the source DCT size for baseline JPEG is 8. Smaller scaling ratios permit significantly faster decoding since fewer pixels need be processed and a simpler IDCT method can be used.

boolean quantize_colors

If set TRUE, colormapped output will be delivered. Default is FALSE, meaning that full-color output will be delivered.

The next three parameters are relevant only if quantize_colors is TRUE.

int desired_number_of_colors

Maximum number of colors to use in generating a library-supplied color map (the actual number of colors is returned in a different field).
Default 256. Ignored when the application supplies its own color map.

boolean two_pass_quantize

If TRUE, an extra pass over the image is made to select a custom color map for the image. This usually looks a lot better than the one-size-fits-all colormap that is used otherwise. Default is TRUE. Ignored when the application supplies its own color map.

J_DITHER_MODE dither_mode

Selects color dithering method. Supported values are:

JDITHER_NONE no dithering: fast, very low quality

JDITHER_ORDERED ordered dither: moderate speed and quality

JDITHER_FS Floyd-Steinberg dither: slow, high quality

Default is JDITHER_FS. (At present, ordered dither is implemented only in the single-pass, standard-colormap case. If you ask for ordered dither when two_pass_quantize is TRUE or when you supply an external color map, you'll get F-S dithering.)

When `quantize_colors` is `TRUE`, the target color map is described by the next two fields. `colormap` is set to `NULL` by `jpeg_read_header()`. The application can supply a color map by setting `colormap` non-`NULL` and setting `actual_number_of_colors` to the map size. Otherwise, `jpeg_start_decompress()` selects a suitable color map and sets these two fields itself.

[Implementation restriction: at present, an externally supplied colormap is only accepted for 3-component output color spaces.]

JSAMPARRAY colormap

The color map, represented as a 2-D pixel array of `out_color_components` rows and `actual_number_of_colors` columns. Ignored if not quantizing.

CAUTION: if the JPEG library creates its own colormap, the storage pointed to by this field is released by `jpeg_finish_decompress()`.

Copy the colormap somewhere else first, if you want to save it.

`int actual_number_of_colors`

The number of colors in the color map.

Additional decompression parameters that the application may set include:

J_DCT_METHOD dct_method

Selects the algorithm used for the DCT step. Choices are the same as described above for compression.

`boolean do_fancy_upsampling`

If `TRUE`, use direct DCT scaling with DCT size > 8 for upsampling of chroma components.

If `FALSE`, use only DCT size <= 8 and simple separate upsampling.

Default is `TRUE`.

For better image stability in multiple generation compression cycles it is preferable that this value matches the corresponding `do_fancy_downsampling` value in compression.

`boolean do_block_smoothing`

If `TRUE`, interblock smoothing is applied in early stages of decoding progressive JPEG files; if `FALSE`, not. Default is `TRUE`. Early progression stages look "fuzzy" with smoothing, "blocky" without.

In any case, block smoothing ceases to be applied after the first few AC coefficients are known to full accuracy, so it is relevant only when using buffered-image mode for progressive images.

`boolean enable_1pass_quant`

`boolean enable_external_quant`

`boolean enable_2pass_quant`

These are significant only in buffered-image mode, which is described in its own section below.

The output image dimensions are given by the following fields. These are computed from the source image dimensions and the decompression parameters by `jpeg_start_decompress()`. You can also call `jpeg_calc_output_dimensions()` to obtain the values that will result from the current parameter settings. This can be useful if you are trying to pick a scaling ratio that will get close to a desired target size. It's also important if you are using the JPEG library's memory manager to allocate output buffer space, because you are supposed to request such buffers **before** `jpeg_start_decompress()`.

JDIMENSION output_width Actual dimensions of output image.

JDIMENSION output_height

int out_color_components Number of color components in out_color_space.

int output_components Number of color components returned.

int rec_outbuf_height Recommended height of scanline buffer.

When quantizing colors, `output_components` is 1, indicating a single color map index per pixel. Otherwise it equals `out_color_components`. The output arrays are required to be `output_width * output_components` JSAMPLEs wide.

`rec_outbuf_height` is the recommended minimum height (in scanlines) of the buffer passed to `jpeg_read_scanlines()`. If the buffer is smaller, the library will still work, but time will be wasted due to unnecessary data copying. In high-quality modes, `rec_outbuf_height` is always 1, but some faster, lower-quality modes set it to larger values (typically 2 to 4).

If you are going to ask for a high-speed processing mode, you may as well go to the trouble of honoring `rec_outbuf_height` so as to avoid data copying. (An output buffer larger than `rec_outbuf_height` lines is OK, but won't provide any material speed improvement over that height.)

Special color spaces

The JPEG standard itself is "color blind" and doesn't specify any particular color space. It is customary to convert color data to a luminance/chrominance color space before compressing, since this permits greater compression. The existing JPEG file interchange format standards specify YCbCr or GRAYSCALE data (JFIF version 1), GRAYSCALE, RGB, YCbCr, CMYK, or YCCK (Adobe), or BG_RGB or BG_YCC (big gamut color spaces, JFIF version 2). For special applications such as multispectral images, other color spaces can be used, but it must be understood that such files will be unportable.

The JPEG library can handle the most common colorspace conversions (namely RGB \Leftrightarrow YCbCr and CMYK \Leftrightarrow YCCK). It can also deal with data of an unknown color space, passing it through without conversion. If you deal extensively with an unusual color space, you can easily extend the library to understand additional color spaces and perform appropriate conversions.

For compression, the source data's color space is specified by field `in_color_space`. This is transformed to the JPEG file's color space given by `jpeg_color_space`. `jpeg_set_defaults()` chooses a reasonable JPEG color space depending on `in_color_space`, but you can override this by calling `jpeg_set_colorspace()`. Of course you must select a supported transformation. `jpegcolor.c` currently supports the following transformations:

RGB => YCbCr

RGB => GRAYSCALE

RGB => BG_YCC

YCbCr => GRAYSCALE

YCbCr => BG_YCC

CMYK => YCCK

plus the null transforms: GRAYSCALE => GRAYSCALE, RGB => RGB, BG_RGB => BG_RGB, YCbCr => YCbCr, BG_YCC => BG_YCC, CMYK => CMYK, YCCK => YCCK, and UNKNOWN => UNKNOWN.

The file interchange format standards (JFIF and Adobe) specify APPn markers that indicate the color space of the JPEG file. It is important to ensure that these are written correctly, or omitted if the JPEG file's color space is not one of the ones supported by the interchange standards.

`jpeg_set_colorspace()` will set the compression parameters to include or omit the APPn markers properly, so long as it is told the truth about the JPEG color space. For example, if you are writing some random 3-component color space without conversion, don't try to fake out the library by setting `in_color_space` and `jpeg_color_space` to `JCS_YCbCr`; use `JCS_UNKNOWN`. You may want to write an APPn marker of your own devising to identify the colorspace --- see "Special markers", below.

When told that the color space is UNKNOWN, the library will default to using luminance-quality compression parameters for all color components. You may well want to change these parameters. See the source code for `jpeg_set_colorspace()`, in `jcparam.c`, for details.

For decompression, the JPEG file's color space is given in `jpeg_color_space`, and this is transformed to the output color space `out_color_space`.

`jpeg_read_header's` setting of `jpeg_color_space` can be relied on if the file conforms to JFIF or Adobe conventions, but otherwise it is no better than a guess. If you know the JPEG file's color space for certain, you can override `jpeg_read_header's` guess by setting `jpeg_color_space`. `jpeg_read_header` also selects a default output color space based on (its guess of) `jpeg_color_space`; set `out_color_space` to override this. Again, you must select a supported transformation. `jpegcolor.c` currently supports

YCbCr => RGB

YCbCr => GRAYSCALE

BG_YCC => RGB

BG_YCC => GRAYSCALE

RGB => GRAYSCALE

GRAYSCALE => RGB

YCKK => CMYK

as well as the null transforms. (Since GRAYSCALE=>RGB is provided, an application can force grayscale JPEGs to look like color JPEGs if it only wants to handle one case.)

The two-pass color quantizer, `jquant2.c`, is specialized to handle RGB data (it weights distances appropriately for RGB colors). You'll need to modify the code if you want to use it for non-RGB output color spaces. Note that `jquant2.c` is used to map to an application-supplied colormap as well as for the normal two-pass colormap selection process.

CAUTION: it appears that Adobe Photoshop writes inverted data in CMYK JPEG files: 0 represents 100% ink coverage, rather than 0% ink as you'd expect. This is arguably a bug in Photoshop, but if you need to work with Photoshop CMYK files, you will have to deal with it in your application. We cannot "fix" this in the library by inverting the data during the CMYK<=>YCKK transform, because that would break other applications, notably Ghostscript. Photoshop versions prior to 3.0 write EPS files containing JPEG-encoded CMYK data in the same inverted-YCKK representation used in bare JPEG files, but the surrounding PostScript code performs an inversion using the PS image operator. I am told that Photoshop 3.0 will write uninverted YCKK in EPS/JPEG files, and will omit the PS-level inversion. (But the data polarity used in bare JPEG files will not change in 3.0.) In either case, the JPEG library must not invert the data itself, or else Ghostscript would read these EPS files incorrectly.

Error handling

When the default error handler is used, any error detected inside the JPEG routines will cause a message to be printed on `stderr`, followed by `exit()`. You can supply your own error handling routines to override this behavior and to control the treatment of nonfatal warnings and trace/debug messages. The file `example.c` illustrates the most common case, which is to have the application regain control after an error rather than exiting.

The JPEG library never writes any message directly; it always goes through the error handling routines. Three classes of messages are recognized:

- * Fatal errors: the library cannot continue.
- * Warnings: the library can continue, but the data is corrupt, and a damaged output image is likely to result.
- * Trace/informational messages. These come with a trace level indicating the importance of the message; you can control the verbosity of the program by adjusting the maximum trace level that will be displayed.

You may, if you wish, simply replace the entire JPEG error handling module

(jerror.c) with your own code. However, you can avoid code duplication by only replacing some of the routines depending on the behavior you need. This is accomplished by calling `jpeg_std_error()` as usual, but then overriding some of the method pointers in the `jpeg_error_mgr` struct, as illustrated by `example.c`.

All of the error handling routines will receive a pointer to the JPEG object (a `j_common_ptr` which points to either a `jpeg_compress_struct` or a `jpeg_decompress_struct`; if you need to tell which, test the `is_decompressor` field). This struct includes a pointer to the error manager struct in its "err" field. Frequently, custom error handler routines will need to access additional data which is not known to the JPEG library or the standard error handler. The most convenient way to do this is to embed either the JPEG object or the `jpeg_error_mgr` struct in a larger structure that contains additional fields; then casting the passed pointer provides access to the additional fields. Again, see `example.c` for one way to do it. (Beginning with IJG version 6b, there is also a void pointer "client_data" in each JPEG object, which the application can also use to find related data. The library does not touch `client_data` at all.)

The individual methods that you might wish to override are:

`error_exit (j_common_ptr cinfo)`

Receives control for a fatal error. Information sufficient to generate the error message has been stored in `cinfo->err`; call `output_message` to display it. Control must NOT return to the caller; generally this routine will `exit()` or `longjmp()` somewhere. Typically you would override this routine to get rid of the `exit()` default behavior. Note that if you continue processing, you should clean up the JPEG object with `jpeg_abort()` or `jpeg_destroy()`.

`output_message (j_common_ptr cinfo)`

Actual output of any JPEG message. Override this to send messages somewhere other than `stderr`. Note that this method does not know how to generate a message, only where to send it.

`format_message (j_common_ptr cinfo, char * buffer)`

Constructs a readable error message string based on the error info stored in `cinfo->err`. This method is called by `output_message`. Few applications should need to override this method. One possible reason for doing so is to implement dynamic switching of error message language.

`emit_message (j_common_ptr cinfo, int msg_level)`

Decide whether or not to emit a warning or trace message; if so, calls `output_message`. The main reason for overriding this method would be to abort on warnings. `msg_level` is -1 for warnings, 0 and up for trace messages.

Only `error_exit()` and `emit_message()` are called from the rest of the JPEG library; the other two are internal to the error handler.

The actual message texts are stored in an array of strings which is pointed to by the field `err->jpeg_message_table`. The messages are numbered from 0 to `err->last_jpeg_message`, and it is these code numbers that are used in the JPEG library code. You could replace the message texts (for instance, with messages in French or German) by changing the message table pointer. See `jerror.h` for the default texts. CAUTION: this table will almost certainly change or grow from one library version to the next.

It may be useful for an application to add its own message texts that are handled by the same mechanism. The error handler supports a second "add-on" message table for this purpose. To define an addon table, set the pointer `err->addon_message_table` and the message numbers `err->first_addon_message` and `err->last_addon_message`. If you number the addon messages beginning at 1000 or so, you won't have to worry about conflicts with the library's built-in messages. See the sample applications `cjpeg/djpeg` for an example of using addon messages (the addon messages are defined in `cderror.h`).

Actual invocation of the error handler is done via macros defined in `jerror.h`:

`ERREXITn(...)` for fatal errors

`WARNMSn(...)` for corrupt-data warnings

`TRACEMSn(...)` for trace and informational messages.

These macros store the message code and any additional parameters into the error handler struct, then invoke the `error_exit()` or `emit_message()` method. The variants of each macro are for varying numbers of additional parameters. The additional parameters are inserted into the generated message using standard `printf()` format codes.

See `jerror.h` and `jerror.c` for further details.

Compressed data handling (source and destination managers)

The JPEG compression library sends its compressed data to a "destination manager" module. The default destination manager just writes the data to a memory buffer or to a stdio stream, but you can provide your own manager to do something else. Similarly, the decompression library calls a "source manager" to obtain the compressed data; you can provide your own source manager if you want the data to come from somewhere other than a memory buffer or a stdio stream.

In both cases, compressed data is processed a bufferload at a time: the destination or source manager provides a work buffer, and the library invokes the manager only when the buffer is filled or emptied. (You could define a

one-character buffer to force the manager to be invoked for each byte, but that would be rather inefficient.) The buffer's size and location are controlled by the manager, not by the library. For example, the memory source manager just makes the buffer pointer and length point to the original data in memory. In this case the buffer-reload procedure will be invoked only if the decompressor ran off the end of the datastream, which would indicate an erroneous datastream.

The work buffer is defined as an array of datatype JOCTET, which is generally "char" or "unsigned char". On a machine where char is not exactly 8 bits wide, you must define JOCTET as a wider data type and then modify the data source and destination modules to transcribe the work arrays into 8-bit units on external storage.

A data destination manager struct contains a pointer and count defining the next byte to write in the work buffer and the remaining free space:

```
JOCTET * next_output_byte; /* => next byte to write in buffer */
size_t free_in_buffer;    /* # of byte spaces remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer is filled. The manager's empty_output_buffer method must reset the pointer and count. The manager is expected to remember the buffer's starting address and total size in private fields not visible to the library.

A data destination manager provides three methods:

init_destination (j_compress_ptr cinfo)

Initialize destination. This is called by jpeg_start_compress() before any data is actually written. It must initialize next_output_byte and free_in_buffer. free_in_buffer must be initialized to a positive value.

empty_output_buffer (j_compress_ptr cinfo)

This is called whenever the buffer has filled (free_in_buffer reaches zero). In typical applications, it should write out the *entire* buffer (use the saved start address and buffer length; ignore the current state of next_output_byte and free_in_buffer). Then reset the pointer & count to the start of the buffer, and return TRUE indicating that the buffer has been dumped. free_in_buffer must be set to a positive value when TRUE is returned. A FALSE return should only be used when I/O suspension is desired (this operating mode is discussed in the next section).

term_destination (j_compress_ptr cinfo)

Terminate destination --- called by jpeg_finish_compress() after all data has been written. In most applications, this must flush any data remaining in the buffer. Use either next_output_byte or

free_in_buffer to determine how much data is in the buffer.

term_destination() is NOT called by jpeg_abort() or jpeg_destroy(). If you want the destination manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a jpeg_destination_mgr struct, fill in its method pointers, and insert a pointer to the struct into the "dest" field of the JPEG compression object. This can be done in-line in your setup code if you like, but it's probably cleaner to provide a separate routine similar to the jpeg_stdio_dest() or jpeg_mem_dest() routines of the supplied destination managers.

Decompression source managers follow a parallel design, but with some additional frammishes. The source manager struct contains a pointer and count defining the next byte to read from the work buffer and the number of bytes remaining:

```
const JOCTET * next_input_byte; /* => next byte to read from buffer */
size_t bytes_in_buffer;      /* # of bytes remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer is emptied. The manager's fill_input_buffer method must reset the pointer and count. In most applications, the manager must remember the buffer's starting address and total size in private fields not visible to the library.

A data source manager provides five methods:

init_source (j_decompress_ptr cinfo)

Initialize source. This is called by jpeg_read_header() before any data is actually read. Unlike init_destination(), it may leave bytes_in_buffer set to 0 (in which case a fill_input_buffer() call will occur immediately).

fill_input_buffer (j_decompress_ptr cinfo)

This is called whenever bytes_in_buffer has reached zero and more data is wanted. In typical applications, it should read fresh data into the buffer (ignoring the current state of next_input_byte and bytes_in_buffer), reset the pointer & count to the start of the buffer, and return TRUE indicating that the buffer has been reloaded. It is not necessary to fill the buffer entirely, only to obtain at least one more byte. bytes_in_buffer MUST be set to a positive value if TRUE is returned. A FALSE return should only be used when I/O suspension is desired (this mode is discussed in the next section).

skip_input_data (j_decompress_ptr cinfo, long num_bytes)

Skip num_bytes worth of data. The buffer pointer and count should be advanced over num_bytes input bytes, refilling the buffer as

needed. This is used to skip over a potentially large amount of uninteresting data (such as an APPn marker). In some applications it may be possible to optimize away the reading of the skipped data, but it's not clear that being smart is worth much trouble; large skips are uncommon. `bytes_in_buffer` may be zero on return. A zero or negative skip count should be treated as a no-op.

`resync_to_restart` (`j_decompress_ptr` `cinfo`, `int` `desired`)

This routine is called only when the decompressor has failed to find a restart (RSTn) marker where one is expected. Its mission is to find a suitable point for resuming decompression. For most applications, we recommend that you just use the default resync procedure, `jpeg_resync_to_restart()`. However, if you are able to back up in the input data stream, or if you have a-priori knowledge about the likely location of restart markers, you may be able to do better. Read the `read_restart_marker()` and `jpeg_resync_to_restart()` routines in `jdmarker.c` if you think you'd like to implement your own resync procedure.

`term_source` (`j_decompress_ptr` `cinfo`)

Terminate source --- called by `jpeg_finish_decompress()` after all data has been read. Often a no-op.

For both `fill_input_buffer()` and `skip_input_data()`, there is no such thing as an EOF return. If the end of the file has been reached, the routine has a choice of exiting via `ERREXIT()` or inserting fake data into the buffer. In most cases, generating a warning message and inserting a fake EOI marker is the best course of action --- this will allow the decompressor to output however much of the image is there. In pathological cases, the decompressor may swallow the EOI and again demand data ... just keep feeding it fake EOIs. `jdatasrc.c` illustrates the recommended error recovery behavior.

`term_source()` is NOT called by `jpeg_abort()` or `jpeg_destroy()`. If you want the source manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a `jpeg_source_mgr` struct, fill in its method pointers, and insert a pointer to the struct into the "src" field of the JPEG decompression object. This can be done in-line in your setup code if you like, but it's probably cleaner to provide a separate routine similar to the `jpeg_stdio_src()` or `jpeg_mem_src()` routines of the supplied source managers.

For more information, consult the memory and stdio source and destination managers in `jdatasrc.c` and `jdatadst.c`.

I/O suspension

Some applications need to use the JPEG library as an incremental memory-to-memory filter: when the compressed data buffer is filled or emptied, they want control to return to the outer loop, rather than expecting that the buffer can be emptied or reloaded within the data source/destination manager subroutine. The library supports this need by providing an "I/O suspension" mode, which we describe in this section.

The I/O suspension mode is not a panacea: nothing is guaranteed about the maximum amount of time spent in any one call to the library, so it will not eliminate response-time problems in single-threaded applications. If you need guaranteed response time, we suggest you "bite the bullet" and implement a real multi-tasking capability.

To use I/O suspension, cooperation is needed between the calling application and the data source or destination manager; you will always need a custom source/destination manager. (Please read the previous section if you haven't already.) The basic idea is that the `empty_output_buffer()` or `fill_input_buffer()` routine is a no-op, merely returning `FALSE` to indicate that it has done nothing. Upon seeing this, the JPEG library suspends operation and returns to its caller. The surrounding application is responsible for emptying or refilling the work buffer before calling the JPEG library again.

Compression suspension:

For compression suspension, use an `empty_output_buffer()` routine that returns `FALSE`; typically it will not do anything else. This will cause the compressor to return to the caller of `jpeg_write_scanlines()`, with the return value indicating that not all the supplied scanlines have been accepted. The application must make more room in the output buffer, adjust the output buffer pointer/count appropriately, and then call `jpeg_write_scanlines()` again, pointing to the first unconsumed scanline.

When forced to suspend, the compressor will backtrack to a convenient stopping point (usually the start of the current MCU); it will regenerate some output data when restarted. Therefore, although `empty_output_buffer()` is only called when the buffer is filled, you should NOT write out the entire buffer after a suspension. Write only the data up to the current position of `next_output_byte/free_in_buffer`. The data beyond that point will be regenerated after resumption.

Because of the backtracking behavior, a good-size output buffer is essential for efficiency; you don't want the compressor to suspend often. (In fact, an overly small buffer could lead to infinite looping, if a single MCU required more data than would fit in the buffer.) We recommend a buffer of at least several Kbytes. You may want to insert explicit code to ensure that you don't call `jpeg_write_scanlines()` unless there is a reasonable amount of space in the output buffer; in other words, flush the buffer before trying to compress

more data.

The compressor does not allow suspension while it is trying to write JPEG markers at the beginning and end of the file. This means that:

- * At the beginning of a compression operation, there must be enough free space in the output buffer to hold the header markers (typically 600 or so bytes). The recommended buffer size is bigger than this anyway, so this is not a problem as long as you start with an empty buffer. However, this restriction might catch you if you insert large special markers, such as a JFIF thumbnail image, without flushing the buffer afterwards.
- * When you call `jpeg_finish_compress()`, there must be enough space in the output buffer to emit any buffered data and the final EOI marker. In the current implementation, half a dozen bytes should suffice for this, but for safety's sake we recommend ensuring that at least 100 bytes are free before calling `jpeg_finish_compress()`.

A more significant restriction is that `jpeg_finish_compress()` cannot suspend. This means you cannot use suspension with multi-pass operating modes, namely Huffman code optimization and multiple-scan output. Those modes write the whole file during `jpeg_finish_compress()`, which will certainly result in buffer overrun. (Note that this restriction applies only to compression, not decompression. The decompressor supports input suspension in all of its operating modes.)

Decompression suspension:

For decompression suspension, use a `fill_input_buffer()` routine that simply returns `FALSE` (except perhaps during error recovery, as discussed below). This will cause the decompressor to return to its caller with an indication that suspension has occurred. This can happen at four places:

- * `jpeg_read_header()`: will return `JPEG_SUSPENDED`.
- * `jpeg_start_decompress()`: will return `FALSE`, rather than its usual `TRUE`.
- * `jpeg_read_scanlines()`: will return the number of scanlines already completed (possibly 0).
- * `jpeg_finish_decompress()`: will return `FALSE`, rather than its usual `TRUE`.

The surrounding application must recognize these cases, load more data into the input buffer, and repeat the call. In the case of `jpeg_read_scanlines()`, increment the passed pointers past any scanlines successfully read.

Just as with compression, the decompressor will typically backtrack to a convenient restart point before suspending. When `fill_input_buffer()` is called, `next_input_byte/bytes_in_buffer` point to the current restart point, which is where the decompressor will backtrack to if `FALSE` is returned. The data beyond that position must NOT be discarded if you suspend; it needs to be re-read upon resumption. In most implementations, you'll need to shift this data down to the start of your work buffer and then load more data after it. Again, this behavior means that a several-Kbyte work buffer is essential for decent performance; furthermore, you should load a reasonable amount of

new data before resuming decompression. (If you loaded, say, only one new byte each time around, you could waste a LOT of cycles.)

The `skip_input_data()` source manager routine requires special care in a suspension scenario. This routine is NOT granted the ability to suspend the decompressor; it can decrement `bytes_in_buffer` to zero, but no more. If the requested skip distance exceeds the amount of data currently in the input buffer, then `skip_input_data()` must set `bytes_in_buffer` to zero and record the additional skip distance somewhere else. The decompressor will immediately call `fill_input_buffer()`, which should return `FALSE`, which will cause a suspension return. The surrounding application must then arrange to discard the recorded number of bytes before it resumes loading the input buffer. (Yes, this design is rather baroque, but it avoids complexity in the far more common case where a non-suspending source manager is used.)

If the input data has been exhausted, we recommend that you emit a warning and insert dummy EOI markers just as a non-suspending data source manager would do. This can be handled either in the surrounding application logic or within `fill_input_buffer()`; the latter is probably more efficient. If `fill_input_buffer()` knows that no more data is available, it can set the pointer/count to point to a dummy EOI marker and then return `TRUE` just as though it had read more data in a non-suspending situation.

The decompressor does not attempt to suspend within standard JPEG markers; instead it will backtrack to the start of the marker and reprocess the whole marker next time. Hence the input buffer must be large enough to hold the longest standard marker in the file. Standard JPEG markers should normally not exceed a few hundred bytes each (DHT tables are typically the longest). We recommend at least a 2K buffer for performance reasons, which is much larger than any correct marker is likely to be. For robustness against damaged marker length counts, you may wish to insert a test in your application for the case that the input buffer is completely full and yet the decoder has suspended without consuming any data --- otherwise, if this situation did occur, it would lead to an endless loop. (The library can't provide this test since it has no idea whether "the buffer is full", or even whether there is a fixed-size input buffer.)

The input buffer would need to be 64K to allow for arbitrary COM or APPn markers, but these are handled specially: they are either saved into allocated memory, or skipped over by calling `skip_input_data()`. In the former case, suspension is handled correctly, and in the latter case, the problem of buffer overrun is placed on `skip_input_data`'s shoulders, as explained above. Note that if you provide your own marker handling routine for large markers, you should consider how to deal with buffer overflow.

Multiple-buffer management:

In some applications it is desirable to store the compressed data in a linked

list of buffer areas, so as to avoid data copying. This can be handled by having `empty_output_buffer()` or `fill_input_buffer()` set the pointer and count to reference the next available buffer; `FALSE` is returned only if no more buffers are available. Although seemingly straightforward, there is a pitfall in this approach: the backtrack that occurs when `FALSE` is returned could back up into an earlier buffer. For example, when `fill_input_buffer()` is called, the current pointer & count indicate the backtrack restart point. Since `fill_input_buffer()` will set the pointer and count to refer to a new buffer, the restart position must be saved somewhere else. Suppose a second call to `fill_input_buffer()` occurs in the same library call, and no additional input data is available, so `fill_input_buffer` must return `FALSE`. If the JPEG library has not moved the pointer/count forward in the current buffer, then *the correct restart point is the saved position in the prior buffer*. Prior buffers may be discarded only after the library establishes a restart point within a later buffer. Similar remarks apply for output into a chain of buffers.

The library will never attempt to backtrack over a `skip_input_data()` call, so any skipped data can be permanently discarded. You still have to deal with the case of skipping not-yet-received data, however.

It's much simpler to use only a single buffer; when `fill_input_buffer()` is called, move any unconsumed data (beyond the current pointer/count) down to the beginning of this buffer and then load new data into the remaining buffer space. This approach requires a little more data copying but is far easier to get right.

Progressive JPEG support

Progressive JPEG rearranges the stored data into a series of scans of increasing quality. In situations where a JPEG file is transmitted across a slow communications link, a decoder can generate a low-quality image very quickly from the first scan, then gradually improve the displayed quality as more scans are received. The final image after all scans are complete is identical to that of a regular (sequential) JPEG file of the same quality setting. Progressive JPEG files are often slightly smaller than equivalent sequential JPEG files, but the possibility of incremental display is the main reason for using progressive JPEG.

The IJG encoder library generates progressive JPEG files when given a suitable "scan script" defining how to divide the data into scans. Creation of progressive JPEG files is otherwise transparent to the encoder. Progressive JPEG files can also be read transparently by the decoder library. If the decoding application simply uses the library as defined above, it will receive a final decoded image without any indication that the file was progressive. Of course, this approach does not allow incremental display.

To perform incremental display, an application needs to use the decoder library's "buffered-image" mode, in which it receives a decoded image multiple times.

Each displayed scan requires about as much work to decode as a full JPEG image of the same size, so the decoder must be fairly fast in relation to the data transmission rate in order to make incremental display useful. However, it is possible to skip displaying the image and simply add the incoming bits to the decoder's coefficient buffer. This is fast because only Huffman decoding need be done, not IDCT, upsampling, colorspace conversion, etc. The IJG decoder library allows the application to switch dynamically between displaying the image and simply absorbing the incoming bits. A properly coded application can automatically adapt the number of display passes to suit the time available as the image is received. Also, a final higher-quality display cycle can be performed from the buffered data after the end of the file is reached.

Progressive compression:

To create a progressive JPEG file (or a multiple-scan sequential JPEG file), set the scan_info cinfo field to point to an array of scan descriptors, and perform compression as usual. Instead of constructing your own scan list, you can call the jpeg_simple_progression() helper routine to create a recommended progression sequence; this method should be used by all applications that don't want to get involved in the nitty-gritty of progressive scan sequence design. (If you want to provide user control of scan sequences, you may wish to borrow the scan script reading code found in rdswitch.c, so that you can read scan script files just like cjpeg's.)

When scan_info is not NULL, the compression library will store DCT'd data into a buffer array as jpeg_write_scanlines() is called, and will emit all the requested scans during jpeg_finish_compress(). This implies that multiple-scan output cannot be created with a suspending data destination manager, since jpeg_finish_compress() does not support suspension. We should also note that the compressor currently forces Huffman optimization mode when creating a progressive JPEG file, because the default Huffman tables are unsuitable for progressive files.

Progressive decompression:

When buffered-image mode is not used, the decoder library will read all of a multi-scan file during jpeg_start_decompress(), so that it can provide a final decoded image. (Here "multi-scan" means either progressive or multi-scan sequential.) This makes multi-scan files transparent to the decoding application. However, existing applications that used suspending input with version 5 of the IJG library will need to be modified to check for a suspension return from jpeg_start_decompress().

To perform incremental display, an application must use the library's

buffered-image mode. This is described in the next section.

Buffered-image mode

In buffered-image mode, the library stores the partially decoded image in a coefficient buffer, from which it can be read out as many times as desired. This mode is typically used for incremental display of progressive JPEG files, but it can be used with any JPEG file. Each scan of a progressive JPEG file adds more data (more detail) to the buffered image. The application can display in lockstep with the source file (one display pass per input scan), or it can allow input processing to outrun display processing. By making input and display processing run independently, it is possible for the application to adapt progressive display to a wide range of data transmission rates.

The basic control flow for buffered-image decoding is

```
jpeg_create_decompress()
set data source
jpeg_read_header()
set overall decompression parameters
cinfo.buffered_image = TRUE; /* select buffered-image mode */
jpeg_start_decompress()
for (each output pass) {
    adjust output decompression parameters if required
    jpeg_start_output() /* start a new output pass */
    for (all scanlines in image) {
        jpeg_read_scanlines()
        display scanlines
    }
    jpeg_finish_output() /* terminate output pass */
}
jpeg_finish_decompress()
jpeg_destroy_decompress()
```

This differs from ordinary unbuffered decoding in that there is an additional level of looping. The application can choose how many output passes to make and how to display each pass.

The simplest approach to displaying progressive images is to do one display pass for each scan appearing in the input file. In this case the outer loop condition is typically

```
while (! jpeg_input_complete(&cinfo))
and the start-output call should read
jpeg_start_output(&cinfo, cinfo.input_scan_number);
```

The second parameter to `jpeg_start_output()` indicates which scan of the input

file is to be displayed; the scans are numbered starting at 1 for this purpose. (You can use a loop counter starting at 1 if you like, but using the library's input scan counter is easier.) The library automatically reads data as necessary to complete each requested scan, and `jpeg_finish_output()` advances to the next scan or end-of-image marker (hence `input_scan_number` will be incremented by the time control arrives back at `jpeg_start_output()`). With this technique, data is read from the input file only as needed, and input and output processing run in lockstep.

After reading the final scan and reaching the end of the input file, the buffered image remains available; it can be read additional times by repeating the `jpeg_start_output()/jpeg_read_scanlines()/jpeg_finish_output()` sequence. For example, a useful technique is to use fast one-pass color quantization for display passes made while the image is arriving, followed by a final display pass using two-pass quantization for highest quality. This is done by changing the library parameters before the final output pass. Changing parameters between passes is discussed in detail below.

In general the last scan of a progressive file cannot be recognized as such until after it is read, so a post-input display pass is the best approach if you want special processing in the final pass.

When done with the image, be sure to call `jpeg_finish_decompress()` to release the buffered image (or just use `jpeg_destroy_decompress()`).

If input data arrives faster than it can be displayed, the application can cause the library to decode input data in advance of what's needed to produce output. This is done by calling the routine `jpeg_consume_input()`.

The return value is one of the following:

`JPEG_REACHED_SOS`: reached an SOS marker (the start of a new scan)

`JPEG_REACHED_EOI`: reached the EOI marker (end of image)

`JPEG_ROW_COMPLETED`: completed reading one MCU row of compressed data

`JPEG_SCAN_COMPLETED`: completed reading last MCU row of current scan

`JPEG_SUSPENDED`: suspended before completing any of the above

(`JPEG_SUSPENDED` can occur only if a suspending data source is used.) This routine can be called at any time after initializing the JPEG object. It reads some additional data and returns when one of the indicated significant events occurs. (If called after the EOI marker is reached, it will immediately return `JPEG_REACHED_EOI` without attempting to read more data.)

The library's output processing will automatically call `jpeg_consume_input()` whenever the output processing overtakes the input; thus, simple lockstep display requires no direct calls to `jpeg_consume_input()`. But by adding calls to `jpeg_consume_input()`, you can absorb data in advance of what is being displayed. This has two benefits:

- * You can limit buildup of unprocessed data in your input buffer.
- * You can eliminate extra display passes by paying attention to the state of the library's input processing.

The first of these benefits only requires interspersing calls to `jpeg_consume_input()` with your display operations and any other processing you may be doing. To avoid wasting cycles due to backtracking, it's best to call `jpeg_consume_input()` only after a hundred or so new bytes have arrived. This is discussed further under "I/O suspension", above. (Note: the JPEG library currently is not thread-safe. You must not call `jpeg_consume_input()` from one thread of control if a different library routine is working on the same JPEG object in another thread.)

When input arrives fast enough that more than one new scan is available before you start a new output pass, you may as well skip the output pass corresponding to the completed scan. This occurs for free if you pass `cinfo.input_scan_number` as the target scan number to `jpeg_start_output()`. The `input_scan_number` field is simply the index of the scan currently being consumed by the input processor. You can ensure that this is up-to-date by emptying the input buffer just before calling `jpeg_start_output()`: call `jpeg_consume_input()` repeatedly until it returns `JPEG_SUSPENDED` or `JPEG_REACHED_EOI`.

The target scan number passed to `jpeg_start_output()` is saved in the `cinfo.output_scan_number` field. The library's output processing calls `jpeg_consume_input()` whenever the current input scan number and row within that scan is less than or equal to the current output scan number and row. Thus, input processing can "get ahead" of the output processing but is not allowed to "fall behind". You can achieve several different effects by manipulating this interlock rule. For example, if you pass a target scan number greater than the current input scan number, the output processor will wait until that scan starts to arrive before producing any output. (To avoid an infinite loop, the target scan number is automatically reset to the last scan number when the end of image is reached. Thus, if you specify a large target scan number, the library will just absorb the entire input file and then perform an output pass. This is effectively the same as what `jpeg_start_decompress()` does when you don't select buffered-image mode.) When you pass a target scan number equal to the current input scan number, the image is displayed no faster than the current input scan arrives. The final possibility is to pass a target scan number less than the current input scan number; this disables the input/output interlock and causes the output processor to simply display whatever it finds in the image buffer, without waiting for input. (However, the library will not accept a target scan number less than one, so you can't avoid waiting for the first scan.)

When data is arriving faster than the output display processing can advance through the image, `jpeg_consume_input()` will store data into the buffered image beyond the point at which the output processing is reading data out again. If the input arrives fast enough, it may "wrap around" the buffer to the point where the input is more than one whole scan ahead of the output. If the output processing simply proceeds through its display pass without

paying attention to the input, the effect seen on-screen is that the lower part of the image is one or more scans better in quality than the upper part. Then, when the next output scan is started, you have a choice of what target scan number to use. The recommended choice is to use the current input scan number at that time, which implies that you've skipped the output scans corresponding to the input scans that were completed while you processed the previous output scan. In this way, the decoder automatically adapts its speed to the arriving data, by skipping output scans as necessary to keep up with the arriving data.

When using this strategy, you'll want to be sure that you perform a final output pass after receiving all the data; otherwise your last display may not be full quality across the whole screen. So the right outer loop logic is something like this:

```
do {
    absorb any waiting input by calling jpeg_consume_input()
    final_pass = jpeg_input_complete(&cinfo);
    adjust output decompression parameters if required
    jpeg_start_output(&cinfo, cinfo.input_scan_number);
    ...
    jpeg_finish_output()
} while (! final_pass);
```

rather than quitting as soon as `jpeg_input_complete()` returns TRUE. This arrangement makes it simple to use higher-quality decoding parameters for the final pass. But if you don't want to use special parameters for the final pass, the right loop logic is like this:

```
for (;;) {
    absorb any waiting input by calling jpeg_consume_input()
    jpeg_start_output(&cinfo, cinfo.input_scan_number);
    ...
    jpeg_finish_output()
    if (jpeg_input_complete(&cinfo) &&
        cinfo.input_scan_number == cinfo.output_scan_number)
        break;
}
```

In this case you don't need to know in advance whether an output pass is to be the last one, so it's not necessary to have reached EOF before starting the final output pass; rather, what you want to test is whether the output pass was performed in sync with the final input scan. This form of the loop will avoid an extra output pass whenever the decoder is able (or nearly able) to keep up with the incoming data.

When the data transmission speed is high, you might begin a display pass, then find that much or all of the file has arrived before you can complete the pass. (You can detect this by noting the `JPEG_REACHED_EOI` return code from `jpeg_consume_input()`, or equivalently by testing `jpeg_input_complete()`.)

In this situation you may wish to abort the current display pass and start a new one using the newly arrived information. To do so, just call

jpeg_finish_output() and then start a new pass with jpeg_start_output().

A variant strategy is to abort and restart display if more than one complete scan arrives during an output pass; this can be detected by noting JPEG_REACHED_SOS returns and/or examining cinfo.input_scan_number. This idea should be employed with caution, however, since the display process might never get to the bottom of the image before being aborted, resulting in the lower part of the screen being several passes worse than the upper. In most cases it's probably best to abort an output pass only if the whole file has arrived and you want to begin the final output pass immediately.

When receiving data across a communication link, we recommend always using the current input scan number for the output target scan number; if a higher-quality final pass is to be done, it should be started (aborting any incomplete output pass) as soon as the end of file is received. However, many other strategies are possible. For example, the application can examine the parameters of the current input scan and decide whether to display it or not. If the scan contains only chroma data, one might choose not to use it as the target scan, expecting that the scan will be small and will arrive quickly. To skip to the next scan, call jpeg_consume_input() until it returns JPEG_REACHED_SOS or JPEG_REACHED_EOI. Or just use the next higher number as the target scan for jpeg_start_output(); but that method doesn't let you inspect the next scan's parameters before deciding to display it.

In buffered-image mode, jpeg_start_decompress() never performs input and thus never suspends. An application that uses input suspension with buffered-image mode must be prepared for suspension returns from these routines:

- * jpeg_start_output() performs input only if you request 2-pass quantization and the target scan isn't fully read yet. (This is discussed below.)
- * jpeg_read_scanlines(), as always, returns the number of scanlines that it was able to produce before suspending.
- * jpeg_finish_output() will read any markers following the target scan, up to the end of the file or the SOS marker that begins another scan. (But it reads no input if jpeg_consume_input() has already reached the end of the file or a SOS marker beyond the target output scan.)
- * jpeg_finish_decompress() will read until the end of file, and thus can suspend if the end hasn't already been reached (as can be tested by calling jpeg_input_complete()).

jpeg_start_output(), jpeg_finish_output(), and jpeg_finish_decompress() all return TRUE if they completed their tasks, FALSE if they had to suspend. In the event of a FALSE return, the application must load more input data and repeat the call. Applications that use non-suspending data sources need not check the return values of these three routines.

It is possible to change decoding parameters between output passes in the

buffered-image mode. The decoder library currently supports only very limited changes of parameters. ONLY THE FOLLOWING parameter changes are allowed after `jpeg_start_decompress()` is called:

* `dct_method` can be changed before each call to `jpeg_start_output()`.

For example, one could use a fast DCT method for early scans, changing to a higher quality method for the final scan.

* `dither_mode` can be changed before each call to `jpeg_start_output()`; of course this has no impact if not using color quantization. Typically one would use ordered dither for initial passes, then switch to Floyd-Steinberg dither for the final pass. Caution: changing dither mode can cause more memory to be allocated by the library. Although the amount of memory involved is not large (a scanline or so), it may cause the initial `max_memory_to_use` specification to be exceeded, which in the worst case would result in an out-of-memory failure.

* `do_block_smoothing` can be changed before each call to `jpeg_start_output()`. This setting is relevant only when decoding a progressive JPEG image. During the first DC-only scan, block smoothing provides a very "fuzzy" look instead of the very "blocky" look seen without it; which is better seems a matter of personal taste. But block smoothing is nearly always a win during later stages, especially when decoding a successive-approximation image: smoothing helps to hide the slight blockiness that otherwise shows up on smooth gradients until the lowest coefficient bits are sent.

* Color quantization mode can be changed under the rules described below. You *cannot* change between full-color and quantized output (because that would alter the required I/O buffer sizes), but you can change which quantization method is used.

When generating color-quantized output, changing quantization method is a very useful way of switching between high-speed and high-quality display. The library allows you to change among its three quantization methods:

1. Single-pass quantization to a fixed color cube.
Selected by `cinfo.two_pass_quantize = FALSE` and `cinfo.colormap = NULL`.
2. Single-pass quantization to an application-supplied colormap.
Selected by setting `cinfo.colormap` to point to the colormap (the value of `two_pass_quantize` is ignored); also set `cinfo.actual_number_of_colors`.
3. Two-pass quantization to a colormap chosen specifically for the image.
Selected by `cinfo.two_pass_quantize = TRUE` and `cinfo.colormap = NULL`. (This is the default setting selected by `jpeg_read_header`, but it is probably NOT what you want for the first pass of progressive display!)

These methods offer successively better quality and lesser speed. However, only the first method is available for quantizing in non-RGB color spaces.

IMPORTANT: because the different quantizer methods have very different working-storage requirements, the library requires you to indicate which one(s) you intend to use before you call `jpeg_start_decompress()`. (If we did not require this, the `max_memory_to_use` setting would be a complete fiction.)

You do this by setting one or more of these three `cinfo` fields to `TRUE`:

`enable_1pass_quant` Fixed color cube colormap

`enable_external_quant` Externally-supplied colormap
`enable_2pass_quant` Two-pass custom colormap
All three are initialized FALSE by `jpeg_read_header()`. But `jpeg_start_decompress()` automatically sets TRUE the one selected by the current `two_pass_quantize` and colormap settings, so you only need to set the enable flags for any other quantization methods you plan to change to later.

After setting the enable flags correctly at `jpeg_start_decompress()` time, you can change to any enabled quantization method by setting `two_pass_quantize` and colormap properly just before calling `jpeg_start_output()`. The following special rules apply:

1. You must explicitly set `cinfo.colormap` to NULL when switching to 1-pass or 2-pass mode from a different mode, or when you want the 2-pass quantizer to be re-run to generate a new colormap.
2. To switch to an external colormap, or to change to a different external colormap than was used on the prior pass, you must call `jpeg_new_colormap()` after setting `cinfo.colormap`.

NOTE: if you want to use the same colormap as was used in the prior pass, you should not do either of these things. This will save some nontrivial switchover costs.

(These requirements exist because `cinfo.colormap` will always be non-NULL after completing a prior output pass, since both the 1-pass and 2-pass quantizers set it to point to their output colormaps. Thus you have to do one of these two things to notify the library that something has changed. Yup, it's a bit klugy, but it's necessary to do it this way for backwards compatibility.)

Note that in buffered-image mode, the library generates any requested colormap during `jpeg_start_output()`, not during `jpeg_start_decompress()`.

When using two-pass quantization, `jpeg_start_output()` makes a pass over the buffered image to determine the optimum color map; it therefore may take a significant amount of time, whereas ordinarily it does little work. The progress monitor hook is called during this pass, if defined. It is also important to realize that if the specified target scan number is greater than or equal to the current input scan number, `jpeg_start_output()` will attempt to consume input as it makes this pass. If you use a suspending data source, you need to check for a FALSE return from `jpeg_start_output()` under these conditions. The combination of 2-pass quantization and a not-yet-fully-read target scan is the only case in which `jpeg_start_output()` will consume input.

Application authors who support buffered-image mode may be tempted to use it for all JPEG images, even single-scan ones. This will work, but it is inefficient: there is no need to create an image-sized coefficient buffer for single-scan images. Requesting buffered-image mode for such an image wastes memory. Worse, it can cost time on large images, since the buffered data has to be swapped out or written to a temporary file. If you are concerned about

maximum performance on baseline JPEG files, you should use buffered-image mode only when the incoming file actually has multiple scans. This can be tested by calling `jpeg_has_multiple_scans()`, which will return a correct result at any time after `jpeg_read_header()` completes.

It is also worth noting that when you use `jpeg_consume_input()` to let input processing get ahead of output processing, the resulting pattern of access to the coefficient buffer is quite nonsequential. It's best to use the memory manager `jmemnobs.c` if you can (ie, if you have enough real or virtual main memory). If not, at least make sure that `max_memory_to_use` is set as high as possible. If the JPEG memory manager has to use a temporary file, you will probably see a lot of disk traffic and poor performance. (This could be improved with additional work on the memory manager, but we haven't gotten around to it yet.)

In some applications it may be convenient to use `jpeg_consume_input()` for all input processing, including reading the initial markers; that is, you may wish to call `jpeg_consume_input()` instead of `jpeg_read_header()` during startup. This works, but note that you must check for `JPEG_REACHED_SOS` and `JPEG_REACHED_EOI` return codes as the equivalent of `jpeg_read_header()`'s codes. Once the first SOS marker has been reached, you must call `jpeg_start_decompress()` before `jpeg_consume_input()` will consume more input; it'll just keep returning `JPEG_REACHED_SOS` until you do. If you read a tables-only file this way, `jpeg_consume_input()` will return `JPEG_REACHED_EOI` without ever returning `JPEG_REACHED_SOS`; be sure to check for this case. If this happens, the decompressor will not read any more input until you call `jpeg_abort()` to reset it. It is OK to call `jpeg_consume_input()` even when not using buffered-image mode, but in that case it's basically a no-op after the initial markers have been read: it will just return `JPEG_SUSPENDED`.

Abbreviated datastreams and multiple images

A JPEG compression or decompression object can be reused to process multiple images. This saves a small amount of time per image by eliminating the "create" and "destroy" operations, but that isn't the real purpose of the feature. Rather, reuse of an object provides support for abbreviated JPEG datastreams. Object reuse can also simplify processing a series of images in a single input or output file. This section explains these features.

A JPEG file normally contains several hundred bytes worth of quantization and Huffman tables. In a situation where many images will be stored or transmitted with identical tables, this may represent an annoying overhead. The JPEG standard therefore permits tables to be omitted. The standard defines three classes of JPEG datastreams:

- * "Interchange" datastreams contain an image and all tables needed to decode the image. These are the usual kind of JPEG file.

* "Abbreviated image" datastreams contain an image, but are missing some or all of the tables needed to decode that image.

* "Abbreviated table specification" (henceforth "tables-only") datastreams contain only table specifications.

To decode an abbreviated image, it is necessary to load the missing table(s) into the decoder beforehand. This can be accomplished by reading a separate tables-only file. A variant scheme uses a series of images in which the first image is an interchange (complete) datastream, while subsequent ones are abbreviated and rely on the tables loaded by the first image. It is assumed that once the decoder has read a table, it will remember that table until a new definition for the same table number is encountered.

It is the application designer's responsibility to figure out how to associate the correct tables with an abbreviated image. While abbreviated datastreams can be useful in a closed environment, their use is strongly discouraged in any situation where data exchange with other applications might be needed. Caveat designer.

The JPEG library provides support for reading and writing any combination of tables-only datastreams and abbreviated images. In both compression and decompression objects, a quantization or Huffman table will be retained for the lifetime of the object, unless it is overwritten by a new table definition.

To create abbreviated image datastreams, it is only necessary to tell the compressor not to emit some or all of the tables it is using. Each quantization and Huffman table struct contains a boolean field "sent_table", which normally is initialized to FALSE. For each table used by the image, the header-writing process emits the table and sets sent_table = TRUE unless it is already TRUE. (In normal usage, this prevents outputting the same table definition multiple times, as would otherwise occur because the chroma components typically share tables.) Thus, setting this field to TRUE before calling jpeg_start_compress() will prevent the table from being written at all.

If you want to create a "pure" abbreviated image file containing no tables, just call "jpeg_suppress_tables(&cinfo, TRUE)" after constructing all the tables. If you want to emit some but not all tables, you'll need to set the individual sent_table fields directly.

To create an abbreviated image, you must also call jpeg_start_compress() with a second parameter of FALSE, not TRUE. Otherwise jpeg_start_compress() will force all the sent_table fields to FALSE. (This is a safety feature to prevent abbreviated images from being created accidentally.)

To create a tables-only file, perform the same parameter setup that you normally would, but instead of calling jpeg_start_compress() and so on, call jpeg_write_tables(&cinfo). This will write an abbreviated datastream

containing only SOI, DQT and/or DHT markers, and EOI. All the quantization and Huffman tables that are currently defined in the compression object will be emitted unless their `sent_tables` flag is already TRUE, and then all the `sent_tables` flags will be set TRUE.

A sure-fire way to create matching tables-only and abbreviated image files is to proceed as follows:

```
create JPEG compression object
set JPEG parameters
set destination to tables-only file
jpeg_write_tables(&cinfo);
set destination to image file
jpeg_start_compress(&cinfo, FALSE);
write data...
jpeg_finish_compress(&cinfo);
```

Since the JPEG parameters are not altered between writing the table file and the abbreviated image file, the same tables are sure to be used. Of course, you can repeat the `jpeg_start_compress()` ... `jpeg_finish_compress()` sequence many times to produce many abbreviated image files matching the table file.

You cannot suppress output of the computed Huffman tables when Huffman optimization is selected. (If you could, there'd be no way to decode the image...) Generally, you don't want to set `optimize_coding = TRUE` when you are trying to produce abbreviated files.

In some cases you might want to compress an image using tables which are not stored in the application, but are defined in an interchange or tables-only file readable by the application. This can be done by setting up a JPEG decompression object to read the specification file, then copying the tables into your compression object. See `jpeg_copy_critical_parameters()` for an example of copying quantization tables.

To read abbreviated image files, you simply need to load the proper tables into the decompression object before trying to read the abbreviated image. If the proper tables are stored in the application program, you can just allocate the table structs and fill in their contents directly. For example, to load a fixed quantization table into table slot "n":

```
if (cinfo.quant_tbl_ptrs[n] == NULL)
    cinfo.quant_tbl_ptrs[n] = jpeg_alloc_quant_table((j_common_ptr) &cinfo);
quant_ptr = cinfo.quant_tbl_ptrs[n]; /* quant_ptr is JQUANT_TBL* */
for (i = 0; i < 64; i++) {
    /* Qtable[] is desired quantization table, in natural array order */
    quant_ptr->quantval[i] = Qtable[i];
}
```

Code to load a fixed Huffman table is typically (for AC table "n"):

```
if (cinfo.ac_huff_tbl_ptrs[n] == NULL)
    cinfo.ac_huff_tbl_ptrs[n] = jpeg_alloc_huff_table((j_common_ptr) &cinfo);
huff_ptr = cinfo.ac_huff_tbl_ptrs[n]; /* huff_ptr is JHUFF_TBL* */
for (i = 1; i <= 16; i++) {
    /* counts[i] is number of Huffman codes of length i bits, i=1..16 */
    huff_ptr->bits[i] = counts[i];
}
for (i = 0; i < 256; i++) {
    /* symbols[] is the list of Huffman symbols, in code-length order */
    huff_ptr->huffval[i] = symbols[i];
}
```

(Note that trying to set `cinfo.quant_tbl_ptrs[n]` to point directly at a constant `JQUANT_TBL` object is not safe. If the incoming file happened to contain a quantization table definition, your master table would get overwritten! Instead allocate a working table copy and copy the master table into it, as illustrated above. Ditto for Huffman tables, of course.)

You might want to read the tables from a tables-only file, rather than hard-wiring them into your application. The `jpeg_read_header()` call is sufficient to read a tables-only file. You must pass a second parameter of `FALSE` to indicate that you do not require an image to be present. Thus, the typical scenario is

```
create JPEG decompression object
set source to tables-only file
jpeg_read_header(&cinfo, FALSE);
set source to abbreviated image file
jpeg_read_header(&cinfo, TRUE);
set decompression parameters
jpeg_start_decompress(&cinfo);
read data...
jpeg_finish_decompress(&cinfo);
```

In some cases, you may want to read a file without knowing whether it contains an image or just tables. In that case, pass `FALSE` and check the return value from `jpeg_read_header()`: it will be `JPEG_HEADER_OK` if an image was found, `JPEG_HEADER_TABLES_ONLY` if only tables were found. (A third return value, `JPEG_SUSPENDED`, is possible when using a suspending data source manager.) Note that `jpeg_read_header()` will not complain if you read an abbreviated image for which you haven't loaded the missing tables; the missing-table check occurs later, in `jpeg_start_decompress()`.

It is possible to read a series of images from a single source file by

repeating the `jpeg_read_header()` ... `jpeg_finish_decompress()` sequence, without releasing/recreating the JPEG object or the data source module. (If you did reinitialize, any partial bufferload left in the data source buffer at the end of one image would be discarded, causing you to lose the start of the next image.) When you use this method, stored tables are automatically carried forward, so some of the images can be abbreviated images that depend on tables from earlier images.

If you intend to write a series of images into a single destination file, you might want to make a specialized data destination module that doesn't flush the output buffer at `term_destination()` time. This would speed things up by some trifling amount. Of course, you'd need to remember to flush the buffer after the last image. You can make the later images be abbreviated ones by passing `FALSE` to `jpeg_start_compress()`.

Special markers

Some applications may need to insert or extract special data in the JPEG datastream. The JPEG standard provides marker types "COM" (comment) and "APP0" through "APP15" (application) to hold application-specific data. Unfortunately, the use of these markers is not specified by the standard. COM markers are fairly widely used to hold user-supplied text. The JFIF file format spec uses APP0 markers with specified initial strings to hold certain data. Adobe applications use APP14 markers beginning with the string "Adobe" for miscellaneous data. Other APPn markers are rarely seen, but might contain almost anything.

If you wish to store user-supplied text, we recommend you use COM markers and place readable 7-bit ASCII text in them. Newline conventions are not standardized --- expect to find LF (Unix style), CR/LF (DOS style), or CR (Mac style). A robust COM reader should be able to cope with random binary garbage, including nulls, since some applications generate COM markers containing non-ASCII junk. (But yours should not be one of them.)

For program-supplied data, use an APPn marker, and be sure to begin it with an identifying string so that you can tell whether the marker is actually yours. It's probably best to avoid using APP0 or APP14 for any private markers. (NOTE: the upcoming SPIFF standard will use APP8 markers; we recommend you not use APP8 markers for any private purposes, either.)

Keep in mind that at most 65533 bytes can be put into one marker, but you can have as many markers as you like.

By default, the IJG compression library will write a JFIF APP0 marker if the selected JPEG colorspace is grayscale or YCbCr, or an Adobe APP14 marker if the selected colorspace is RGB, CMYK, or YCCK. You can disable this, but

we don't recommend it. The decompression library will recognize JFIF and Adobe markers and will set the JPEG colorspace properly when one is found.

You can write special markers immediately following the datastream header by calling `jpeg_write_marker()` after `jpeg_start_compress()` and before the first call to `jpeg_write_scanlines()`. When you do this, the markers appear after the SOI and the JFIF APP0 and Adobe APP14 markers (if written), but before all else. Specify the marker type parameter as "JPEG_COM" for COM or "JPEG_APP0 + n" for APPn. (Actually, `jpeg_write_marker` will let you write any marker type, but we don't recommend writing any other kinds of marker.) For example, to write a user comment string pointed to by `comment_text`:

```
jpeg_write_marker(cinfo, JPEG_COM, comment_text, strlen(comment_text));
```

If it's not convenient to store all the marker data in memory at once, you can instead call `jpeg_write_m_header()` followed by multiple calls to `jpeg_write_m_byte()`. If you do it this way, it's your responsibility to call `jpeg_write_m_byte()` exactly the number of times given in the length parameter to `jpeg_write_m_header()`. (This method lets you empty the output buffer partway through a marker, which might be important when using a suspending data destination module. In any case, if you are using a suspending destination, you should flush its buffer after inserting any special markers. See "I/O suspension".)

Or, if you prefer to synthesize the marker byte sequence yourself, you can just cram it straight into the data destination module.

If you are writing JFIF 1.02 extension markers (thumbnail images), don't forget to set `cinfo.JFIF_minor_version = 2` so that the encoder will write the correct JFIF version number in the JFIF header marker. The library's default is to write version 1.01, but that's wrong if you insert any 1.02 extension markers. (We could probably get away with just defaulting to 1.02, but there used to be broken decoders that would complain about unknown minor version numbers. To reduce compatibility risks it's safest not to write 1.02 unless you are actually using 1.02 extensions.)

When reading, two methods of handling special markers are available:

1. You can ask the library to save the contents of COM and/or APPn markers into memory, and then examine them at your leisure afterwards.
2. You can supply your own routine to process COM and/or APPn markers on-the-fly as they are read.

The first method is simpler to use, especially if you are using a suspending data source; writing a marker processor that copes with input suspension is not easy (consider what happens if the marker is longer than your available input buffer). However, the second method conserves memory since the marker data need not be kept around after it's been processed.

For either method, you'd normally set up marker handling after creating a decompression object and before calling `jpeg_read_header()`, because the markers of interest will typically be near the head of the file and so will be scanned by `jpeg_read_header`. Once you've established a marker handling method, it will be used for the life of that decompression object (potentially many datastreams), unless you change it. Marker handling is determined separately for COM markers and for each APPn marker code.

To save the contents of special markers in memory, call `jpeg_save_markers(cinfo, marker_code, length_limit)` where `marker_code` is the marker type to save, `JPEG_COM` or `JPEG_APP0+n`. (To arrange to save all the special marker types, you need to call this routine 17 times, for COM and APP0-APP15.) If the incoming marker is longer than `length_limit` data bytes, only `length_limit` bytes will be saved; this parameter allows you to avoid chewing up memory when you only need to see the first few bytes of a potentially large marker. If you want to save all the data, set `length_limit` to `0xFFFF`; that is enough since marker lengths are only 16 bits. As a special case, setting `length_limit` to 0 prevents that marker type from being saved at all. (That is the default behavior, in fact.)

After `jpeg_read_header()` completes, you can examine the special markers by following the `cinfo->marker_list` pointer chain. All the special markers in the file appear in this list, in order of their occurrence in the file (but omitting any markers of types you didn't ask for). Both the original data length and the saved data length are recorded for each list entry; the latter will not exceed `length_limit` for the particular marker type. Note that these lengths exclude the marker length word, whereas the stored representation within the JPEG file includes it. (Hence the maximum data length is really only 65533.)

It is possible that additional special markers appear in the file beyond the SOS marker at which `jpeg_read_header` stops; if so, the marker list will be extended during reading of the rest of the file. This is not expected to be common, however. If you are short on memory you may want to reset the length limit to zero for all marker types after finishing `jpeg_read_header`, to ensure that the `max_memory_to_use` setting cannot be exceeded due to addition of later markers.

The marker list remains stored until you call `jpeg_finish_decompress` or `jpeg_abort`, at which point the memory is freed and the list is set to empty. (`jpeg_destroy` also releases the storage, of course.)

Note that the library is internally interested in APP0 and APP14 markers; if you try to set a small nonzero length limit on these types, the library will silently force the length up to the minimum it wants. (But you can set a zero length limit to prevent them from being saved at all.) Also, in a 16-bit environment, the maximum length limit may be constrained to less than

65533 by malloc() limitations. It is therefore best not to assume that the effective length limit is exactly what you set it to be.

If you want to supply your own marker-reading routine, you do it by calling `jpeg_set_marker_processor()`. A marker processor routine must have the signature

```
boolean jpeg_marker_parser_method (j_decompress_ptr cinfo)
```

Although the marker code is not explicitly passed, the routine can find it in `cinfo->unread_marker`. At the time of call, the marker proper has been read from the data source module. The processor routine is responsible for reading the marker length word and the remaining parameter bytes, if any. Return TRUE to indicate success. (FALSE should be returned only if you are using a suspending data source and it tells you to suspend. See the standard marker processors in `jdmarker.c` for appropriate coding methods if you need to use a suspending data source.)

If you override the default APP0 or APP14 processors, it is up to you to recognize JFIF and Adobe markers if you want colorspace recognition to occur properly. We recommend copying and extending the default processors if you want to do that. (A better idea is to save these marker types for later examination by calling `jpeg_save_markers()`; that method doesn't interfere with the library's own processing of these markers.)

`jpeg_set_marker_processor()` and `jpeg_save_markers()` are mutually exclusive --- if you call one it overrides any previous call to the other, for the particular marker type specified.

A simple example of an external COM processor can be found in `djpeg.c`. Also, see `jpegtran.c` for an example of using `jpeg_save_markers`.

Raw (downsampled) image data

Some applications need to supply already-downsampled image data to the JPEG compressor, or to receive raw downsampled data from the decompressor. The library supports this requirement by allowing the application to write or read raw data, bypassing the normal preprocessing or postprocessing steps. The interface is different from the standard one and is somewhat harder to use. If your interest is merely in bypassing color conversion, we recommend that you use the standard interface and simply set `jpeg_color_space = in_color_space` (or `jpeg_color_space = out_color_space` for decompression). The mechanism described in this section is necessary only to supply or receive downsampled image data, in which not all components have the same dimensions.

To compress raw data, you must supply the data in the colorspace to be used in the JPEG file (please read the earlier section on Special color spaces) and downsampled to the sampling factors specified in the JPEG parameters. You must supply the data in the format used internally by the JPEG library, namely a JSAMPIMAGE array. This is an array of pointers to two-dimensional arrays, each of type JSAMPARRAY. Each 2-D array holds the values for one color component. This structure is necessary since the components are of different sizes. If the image dimensions are not a multiple of the MCU size, you must also pad the data correctly (usually, this is done by replicating the last column and/or row). The data must be padded to a multiple of a DCT block in each component: that is, each downsampled row must contain a multiple of `DCT_h_scaled_size` valid samples, and there must be a multiple of `DCT_v_scaled_size` sample rows for each component. (For applications such as conversion of digital TV images, the standard image size is usually a multiple of the DCT block size, so that no padding need actually be done.)

The procedure for compression of raw data is basically the same as normal compression, except that you call `jpeg_write_raw_data()` in place of `jpeg_write_scanlines()`. Before calling `jpeg_start_compress()`, you must do the following:

- * Set `cinfo->raw_data_in` to TRUE. (It is set FALSE by `jpeg_set_defaults()`.) This notifies the library that you will be supplying raw data.
- * Ensure `jpeg_color_space` is correct --- an explicit `jpeg_set_colorspace()` call is a good idea. Note that since color conversion is bypassed, `in_color_space` is ignored, except that `jpeg_set_defaults()` uses it to choose the default `jpeg_color_space` setting.
- * Ensure the sampling factors, `cinfo->comp_info[i].h_samp_factor` and `cinfo->comp_info[i].v_samp_factor`, are correct. Since these indicate the dimensions of the data you are supplying, it's wise to set them explicitly, rather than assuming the library's defaults are what you want.

To pass raw data to the library, call `jpeg_write_raw_data()` in place of `jpeg_write_scanlines()`. The two routines work similarly except that `jpeg_write_raw_data` takes a JSAMPIMAGE data array rather than JSAMPARRAY. The scanlines count passed to and returned from `jpeg_write_raw_data` is measured in terms of the component with the largest `v_samp_factor`.

`jpeg_write_raw_data()` processes one MCU row per call, which is to say `v_samp_factor*min_DCT_v_scaled_size` sample rows of each component. The passed `num_lines` value must be at least `max_v_samp_factor*min_DCT_v_scaled_size`, and the return value will be exactly that amount (or possibly some multiple of that amount, in future library versions). This is true even on the last call at the bottom of the image; don't forget to pad your data as necessary.

The required dimensions of the supplied data can be computed for each component as

```
cinfo->comp_info[i].width_in_blocks *  
cinfo->comp_info[i].DCT_h_scaled_size  samples per row
```

```

cinfo->comp_info[i].height_in_blocks *
cinfo->comp_info[i].DCT_v_scaled_size rows in image

```

after `jpeg_start_compress()` has initialized those fields. If the valid data is smaller than this, it must be padded appropriately. For some sampling factors and image sizes, additional dummy DCT blocks are inserted to make the image a multiple of the MCU dimensions. The library creates such dummy blocks itself; it does not read them from your supplied data. Therefore you need never pad by more than `DCT_scaled_size` samples.

An example may help here. Assume 2h2v downsampling of YCbCr data, that is

```

cinfo->comp_info[0].h_samp_factor = 2 for Y
cinfo->comp_info[0].v_samp_factor = 2
cinfo->comp_info[1].h_samp_factor = 1 for Cb
cinfo->comp_info[1].v_samp_factor = 1
cinfo->comp_info[2].h_samp_factor = 1 for Cr
cinfo->comp_info[2].v_samp_factor = 1

```

and suppose that the nominal image dimensions (`cinfo->image_width` and `cinfo->image_height`) are 101x101 pixels. Then `jpeg_start_compress()` will compute `downsampled_width = 101` and `width_in_blocks = 13` for Y, `downsampled_width = 51` and `width_in_blocks = 7` for Cb and Cr (and the same for the height fields). You must pad the Y data to at least $13*8 = 104$ columns and rows, the Cb/Cr data to at least $7*8 = 56$ columns and rows. The MCU height is `max_v_samp_factor = 2` DCT rows so you must pass at least 16 scanlines on each call to `jpeg_write_raw_data()`, which is to say 16 actual sample rows of Y and 8 each of Cb and Cr. A total of 7 MCU rows are needed, so you must pass a total of $7*16 = 112$ "scanlines". The last DCT block row of Y data is dummy, so it doesn't matter what you pass for it in the data arrays, but the scanlines count must total up to 112 so that all of the Cb and Cr data gets passed.

Output suspension is supported with raw-data compression: if the data destination module suspends, `jpeg_write_raw_data()` will return 0. In this case the same data rows must be passed again on the next call.

Decompression with raw data output implies bypassing all postprocessing: you cannot ask for color quantization, for instance. More seriously, you must deal with the color space and sampling factors present in the incoming file. If your application only handles, say, 2h1v YCbCr data, you must check for and fail on other color spaces or other sampling factors. The library will not convert to a different color space for you.

To obtain raw data output, set `cinfo->raw_data_out = TRUE` before `jpeg_start_decompress()` (it is set `FALSE` by `jpeg_read_header()`). Be sure to verify that the color space and sampling factors are ones you can handle. Then call `jpeg_read_raw_data()` in place of `jpeg_read_scanlines()`. The decompression process is otherwise the same as usual.

`jpeg_read_raw_data()` returns one MCU row per call, and thus you must pass a

buffer of at least `max_v_samp_factor*min_DCT_v_scaled_size` scanlines (scanline counting is the same as for raw-data compression). The buffer you pass must be large enough to hold the actual data plus padding to DCT-block boundaries. As with compression, any entirely dummy DCT blocks are not processed so you need not allocate space for them, but the total scanline count includes them. The above example of computing buffer dimensions for raw-data compression is equally valid for decompression.

Input suspension is supported with raw-data decompression: if the data source module suspends, `jpeg_read_raw_data()` will return 0. You can also use buffered-image mode to read raw data in multiple passes.

Really raw data: DCT coefficients

It is possible to read or write the contents of a JPEG file as raw DCT coefficients. This facility is mainly intended for use in lossless transcoding between different JPEG file formats. Other possible applications include lossless cropping of a JPEG image, lossless reassembly of a multi-strip or multi-tile TIFF/JPEG file into a single JPEG datastream, etc.

To read the contents of a JPEG file as DCT coefficients, open the file and do `jpeg_read_header()` as usual. But instead of calling `jpeg_start_decompress()` and `jpeg_read_scanlines()`, call `jpeg_read_coefficients()`. This will read the entire image into a set of virtual coefficient-block arrays, one array per component. The return value is a pointer to an array of virtual-array descriptors. Each virtual array can be accessed directly using the JPEG memory manager's `access_virt_barray` method (see Memory management, below, and also `read.structure.txt`'s discussion of virtual array handling). Or, for simple transcoding to a different JPEG file format, the array list can just be handed directly to `jpeg_write_coefficients()`.

Each block in the block arrays contains quantized coefficient values in normal array order (not JPEG zigzag order). The block arrays contain only DCT blocks containing real data; any entirely-dummy blocks added to fill out interleaved MCUs at the right or bottom edges of the image are discarded during reading and are not stored in the block arrays. (The size of each block array can be determined from the `width_in_blocks` and `height_in_blocks` fields of the component's `comp_info` entry.) This is also the data format expected by `jpeg_write_coefficients()`.

When you are done using the virtual arrays, call `jpeg_finish_decompress()` to release the array storage and return the decompression object to an idle state; or just call `jpeg_destroy()` if you don't need to reuse the object.

If you use a suspending data source, `jpeg_read_coefficients()` will return NULL if it is forced to suspend; a non-NULL return value indicates successful

completion. You need not test for a NULL return value when using a non-suspending data source.

It is also possible to call `jpeg_read_coefficients()` to obtain access to the decoder's coefficient arrays during a normal decode cycle in buffered-image mode. This frammish might be useful for progressively displaying an incoming image and then re-encoding it without loss. To do this, decode in buffered-image mode as discussed previously, then call `jpeg_read_coefficients()` after the last `jpeg_finish_output()` call. The arrays will be available for your use until you call `jpeg_finish_decompress()`.

To write the contents of a JPEG file as DCT coefficients, you must provide the DCT coefficients stored in virtual block arrays. You can either pass block arrays read from an input JPEG file by `jpeg_read_coefficients()`, or allocate virtual arrays from the JPEG compression object and fill them yourself. In either case, `jpeg_write_coefficients()` is substituted for `jpeg_start_compress()` and `jpeg_write_scanlines()`. Thus the sequence is

- * Create compression object
- * Set all compression parameters as necessary
- * Request virtual arrays if needed
- * `jpeg_write_coefficients()`
- * `jpeg_finish_compress()`
- * Destroy or re-use compression object

`jpeg_write_coefficients()` is passed a pointer to an array of virtual block array descriptors; the number of arrays is equal to `cinfo.num_components`.

The virtual arrays need only have been requested, not realized, before `jpeg_write_coefficients()` is called. A side-effect of `jpeg_write_coefficients()` is to realize any virtual arrays that have been requested from the compression object's memory manager. Thus, when obtaining the virtual arrays from the compression object, you should fill the arrays after calling `jpeg_write_coefficients()`. The data is actually written out when you call `jpeg_finish_compress()`; `jpeg_write_coefficients()` only writes the file header.

When writing raw DCT coefficients, it is crucial that the JPEG quantization tables and sampling factors match the way the data was encoded, or the resulting file will be invalid. For transcoding from an existing JPEG file, we recommend using `jpeg_copy_critical_parameters()`. This routine initializes all the compression parameters to default values (like `jpeg_set_defaults()`), then copies the critical information from a source decompression object. The decompression object should have just been used to read the entire JPEG input file --- that is, it should be awaiting `jpeg_finish_decompress()`.

`jpeg_write_coefficients()` marks all tables stored in the compression object as needing to be written to the output file (thus, it acts like `jpeg_start_compress(cinfo, TRUE)`). This is for safety's sake, to avoid

emitting abbreviated JPEG files by accident. If you really want to emit an abbreviated JPEG file, call `jpeg_suppress_tables()`, or set the tables' individual `sent_table` flags, between calling `jpeg_write_coefficients()` and `jpeg_finish_compress()`.

Progress monitoring

Some applications may need to regain control from the JPEG library every so often. The typical use of this feature is to produce a percent-done bar or other progress display. (For a simple example, see `cjpeg.c` or `djpeg.c`.)

Although you do get control back frequently during the data-transferring pass (the `jpeg_read_scanlines` or `jpeg_write_scanlines` loop), any additional passes will occur inside `jpeg_finish_compress` or `jpeg_start_decompress`; those routines may take a long time to execute, and you don't get control back until they are done.

You can define a progress-monitor routine which will be called periodically by the library. No guarantees are made about how often this call will occur, so we don't recommend you use it for mouse tracking or anything like that. At present, a call will occur once per MCU row, scanline, or sample row group, whichever unit is convenient for the current processing mode; so the wider the image, the longer the time between calls. During the data transferring pass, only one call occurs per call of `jpeg_read_scanlines` or `jpeg_write_scanlines`, so don't pass a large number of scanlines at once if you want fine resolution in the progress count. (If you really need to use the callback mechanism for time-critical tasks like mouse tracking, you could insert additional calls inside some of the library's inner loops.)

To establish a progress-monitor callback, create a struct `jpeg_progress_mgr`, fill in its `progress_monitor` field with a pointer to your callback routine, and set `cinfo->progress` to point to the struct. The callback will be called whenever `cinfo->progress` is non-NULL. (This pointer is set to NULL by `jpeg_create_compress` or `jpeg_create_decompress`; the library will not change it thereafter. So if you allocate dynamic storage for the progress struct, make sure it will live as long as the JPEG object does. Allocating from the JPEG memory manager with lifetime `JPOOL_PERMANENT` will work nicely.) You can use the same callback routine for both compression and decompression.

The `jpeg_progress_mgr` struct contains four fields which are set by the library:

```
long pass_counter; /* work units completed in this pass */
long pass_limit; /* total number of work units in this pass */
int completed_passes; /* passes completed so far */
int total_passes; /* total number of passes expected */
```

During any one pass, `pass_counter` increases from 0 up to (not including) `pass_limit`; the step size is usually but not necessarily 1. The `pass_limit` value may change from one pass to another. The expected total number of

passes is in `total_passes`, and the number of passes already completed is in `completed_passes`. Thus the fraction of work completed may be estimated as

$$\frac{\text{completed_passes} + (\text{pass_counter}/\text{pass_limit})}{\text{total_passes}}$$

ignoring the fact that the passes may not be equal amounts of work.

When decompressing, `pass_limit` can even change within a pass, because it depends on the number of scans in the JPEG file, which isn't always known in advance. The computed fraction-of-work-done may jump suddenly (if the library discovers it has overestimated the number of scans) or even decrease (in the opposite case). It is not wise to put great faith in the work estimate.

When using the decompressor's buffered-image mode, the progress monitor work estimate is likely to be completely unhelpful, because the library has no way to know how many output passes will be demanded of it. Currently, the library sets `total_passes` based on the assumption that there will be one more output pass if the input file end hasn't yet been read (`jpeg_input_complete()` isn't TRUE), but no more output passes if the file end has been reached when the output pass is started. This means that `total_passes` will rise as additional output passes are requested. If you have a way of determining the input file size, estimating progress based on the fraction of the file that's been read will probably be more useful than using the library's value.

Memory management

This section covers some key facts about the JPEG library's built-in memory manager. For more info, please read `structure.txt`'s section about the memory manager, and consult the source code if necessary.

All memory and temporary file allocation within the library is done via the memory manager. If necessary, you can replace the "back end" of the memory manager to control allocation yourself (for example, if you don't want the library to use `malloc()` and `free()` for some reason).

Some data is allocated "permanently" and will not be freed until the JPEG object is destroyed. Most data is allocated "per image" and is freed by `jpeg_finish_compress`, `jpeg_finish_decompress`, or `jpeg_abort`. You can call the memory manager yourself to allocate structures that will automatically be freed at these times. Typical code for this is

```
ptr = (*cinfo->mem->alloc_small) ((j_common_ptr) cinfo, JPOOL_IMAGE, size);
```

Use `JPOOL_PERMANENT` to get storage that lasts as long as the JPEG object. Use `alloc_large` instead of `alloc_small` for anything bigger than a few Kbytes. There are also `alloc_sarray` and `alloc_barray` routines that automatically build 2-D sample or block arrays.

The library's minimum space requirements to process an image depend on the image's width, but not on its height, because the library ordinarily works with "strip" buffers that are as wide as the image but just a few rows high. Some operating modes (eg, two-pass color quantization) require full-image buffers. Such buffers are treated as "virtual arrays": only the current strip need be in memory, and the rest can be swapped out to a temporary file.

If you use the simplest memory manager back end (`jmemnobs.c`), then no temporary files are used; virtual arrays are simply `malloc()`'d. Images bigger than memory can be processed only if your system supports virtual memory. The other memory manager back ends support temporary files of various flavors and thus work in machines without virtual memory. They may also be useful on Unix machines if you need to process images that exceed available swap space.

When using temporary files, the library will make the in-memory buffers for its virtual arrays just big enough to stay within a "maximum memory" setting. Your application can set this limit by setting `cinfo->mem->max_memory_to_use` after creating the JPEG object. (Of course, there is still a minimum size for the buffers, so the max-memory setting is effective only if it is bigger than the minimum space needed.) If you allocate any large structures yourself, you must allocate them before `jpeg_start_compress()` or `jpeg_start_decompress()` in order to have them counted against the max memory limit. Also keep in mind that space allocated with `alloc_small()` is ignored, on the assumption that it's too small to be worth worrying about; so a reasonable safety margin should be left when setting `max_memory_to_use`.

If you use the `jmemname.c` or `jmemdos.c` memory manager back end, it is important to clean up the JPEG object properly to ensure that the temporary files get deleted. (This is especially crucial with `jmemdos.c`, where the "temporary files" may be extended-memory segments; if they are not freed, DOS will require a reboot to recover the memory.) Thus, with these memory managers, it's a good idea to provide a signal handler that will trap any early exit from your program. The handler should call either `jpeg_abort()` or `jpeg_destroy()` for any active JPEG objects. A handler is not needed with `jmemnobs.c`, and shouldn't be necessary with `jmemansi.c` or `jmemmac.c` either, since the C library is supposed to take care of deleting files made with `tmpfile()`.

Memory usage

Working memory requirements while performing compression or decompression depend on image dimensions, image characteristics (such as colorspace and JPEG process), and operating mode (application-selected options).

As of v6b, the decompressor requires:

1. About 24K in more-or-less-fixed-size data. This varies a bit depending

- on operating mode and image characteristics (particularly color vs. grayscale), but it doesn't depend on image dimensions.
2. Strip buffers (of size proportional to the image width) for IDCT and upsampling results. The worst case for commonly used sampling factors is about 34 bytes * width in pixels for a color image. A grayscale image only needs about 8 bytes per pixel column.
 3. A full-image DCT coefficient buffer is needed to decode a multi-scan JPEG file (including progressive JPEGs), or whenever you select buffered-image mode. This takes 2 bytes/coefficient. At typical 2x2 sampling, that's 3 bytes per pixel for a color image. Worst case (1x1 sampling) requires 6 bytes/pixel. For grayscale, figure 2 bytes/pixel.
 4. To perform 2-pass color quantization, the decompressor also needs a 128K color lookup table and a full-image pixel buffer (3 bytes/pixel). This does not count any memory allocated by the application, such as a buffer to hold the final output image.

The above figures are valid for 8-bit JPEG data precision and a machine with 32-bit ints. For 9-bit to 12-bit JPEG data, double the size of the strip buffers and quantization pixel buffer. The "fixed-size" data will be somewhat smaller with 16-bit ints, larger with 64-bit ints. Also, CMYK or other unusual color spaces will require different amounts of space.

The full-image coefficient and pixel buffers, if needed at all, do not have to be fully RAM resident; you can have the library use temporary files instead when the total memory usage would exceed a limit you set. (But if your OS supports virtual memory, it's probably better to just use `jmemnobs` and let the OS do the swapping.)

The compressor's memory requirements are similar, except that it has no need for color quantization. Also, it needs a full-image DCT coefficient buffer if Huffman-table optimization is asked for, even if progressive mode is not requested.

If you need more detailed information about memory usage in a particular situation, you can enable the `MEM_STATS` code in `jmemmgr.c`.

Library compile-time options

A number of compile-time options are available by modifying `jmorecfg.h`.

The IJG code currently supports 8-bit to 12-bit sample data precision by defining `BITS_IN_JSAMPLE` as 8, 9, 10, 11, or 12.

Note that a value larger than 8 causes `JSAMPLE` to be larger than a char, so it affects the surrounding application's image data.

The sample applications `cjpeg` and `djpeg` can support deeper than 8-bit data only for PPM and GIF file formats; you must disable the other file formats

to compile a 9-bit to 12-bit cjpeg or djpeg. (install.txt has more information about that.)

Run-time selection and conversion of data precision are currently not supported and may be added later.

Exception: The transcoding part (jpegtran) supports all settings in a single instance, since it operates on the level of DCT coefficients and not sample values.

(If you need to include an 8-bit library and a 9-bit to 12-bit library for compression or decompression in a single application, you could probably do it by defining NEED_SHORT_EXTERNAL_NAMES for just one of the copies. You'd have to access the 8-bit and the 9-bit to 12-bit copies from separate application source files. This is untested ... if you try it, we'd like to hear whether it works!)

Note that the standard Huffman tables are only valid for 8-bit data precision. If you selected more than 8-bit data precision, cjpeg uses arithmetic coding by default. The Huffman encoder normally uses entropy optimization to compute usable tables for higher precision. Otherwise, you'll have to supply different default Huffman tables. You may also want to supply your own DCT quantization tables; the existing quality-scaling code has been developed for 8-bit use, and probably doesn't generate especially good tables for 9-bit to 12-bit.

The maximum number of components (color channels) in the image is determined by MAX_COMPONENTS. The JPEG standard allows up to 255 components, but we expect that few applications will need more than four or so.

On machines with unusual data type sizes, you may be able to improve performance or reduce memory space by tweaking the various typedefs in jmorecfg.h. In particular, on some RISC CPUs, access to arrays of "short"s is quite slow; consider trading memory for speed by making JCOEF, INT16, and UINT16 be "int" or "unsigned int". UINT8 is also a candidate to become int. You probably don't want to make JSAMPLE be int unless you have lots of memory to burn.

You can reduce the size of the library by compiling out various optional functions. To do this, undefine xxx_SUPPORTED symbols as necessary.

You can also save a few K by not having text error messages in the library; the standard error message table occupies about 5Kb. This is particularly reasonable for embedded applications where there's no good way to display a message anyway. To do this, remove the creation of the message table (jpeg_std_message_table[]) from jerror.c, and alter format_message to do something reasonable without it. You could output the numeric value of the message code number, for example. If you do this, you can also save a couple more K by modifying the TRACEMSn() macros in jerror.h to expand to nothing; you don't need trace capability anyway, right?

Portability considerations

The JPEG library has been written to be extremely portable; the sample applications `cjpeg` and `djpeg` are slightly less so. This section summarizes the design goals in this area. (If you encounter any bugs that cause the library to be less portable than is claimed here, we'd appreciate hearing about them.)

The code works fine on ANSI C, C++, and pre-ANSI C compilers, using any of the popular system include file setups, and some not-so-popular ones too. See `install.txt` for configuration procedures.

The code is not dependent on the exact sizes of the C data types. As distributed, we make the assumptions that

- char is at least 8 bits wide
- short is at least 16 bits wide
- int is at least 16 bits wide
- long is at least 32 bits wide

(These are the minimum requirements of the ANSI C standard.) Wider types will work fine, although memory may be used inefficiently if char is much larger than 8 bits or short is much bigger than 16 bits. The code should work equally well with 16- or 32-bit ints.

In a system where these assumptions are not met, you may be able to make the code work by modifying the typedefs in `jmreconf.h`. However, you will probably have difficulty if int is less than 16 bits wide, since references to plain int abound in the code.

char can be either signed or unsigned, although the code runs faster if an unsigned char type is available. If char is wider than 8 bits, you will need to redefine `JOCTET` and/or provide custom data source/destination managers so that `JOCTET` represents exactly 8 bits of data on external storage.

The JPEG library proper does not assume ASCII representation of characters. But some of the image file I/O modules in `cjpeg/djpeg` do have ASCII dependencies in file-header manipulation; so does `cjpeg's select_file_type()` routine.

The JPEG library does not rely heavily on the C library. In particular, C `stdio` is used only by the data source/destination modules and the error handler, all of which are application-replaceable. (`cjpeg/djpeg` are more heavily dependent on `stdio`.) `malloc` and `free` are called only from the memory manager "back end" module, so you can use a different memory allocator by replacing that one file.

The code generally assumes that C names must be unique in the first 15

characters. However, global function names can be made unique in the first 6 characters by defining `NEED_SHORT_EXTERNAL_NAMES`.

More info about porting the code may be gleaned by reading `jconfig.txt`, `jmorecfg.h`, and `jinclue.h`.

Notes for MS-DOS implementors

The IJG code is designed to work efficiently in 80x86 "small" or "medium" memory models (i.e., data pointers are 16 bits unless explicitly declared "far"; code pointers can be either size). You may be able to use small model to compile `cjpeg` or `djpeg` by itself, but you will probably have to use medium model for any larger application. This won't make much difference in performance. You *will* take a noticeable performance hit if you use a large-data memory model (perhaps 10%-25%), and you should avoid "huge" model if at all possible.

The JPEG library typically needs 2Kb-3Kb of stack space. It will also malloc about 20K-30K of near heap space while executing (and lots of far heap, but that doesn't count in this calculation). This figure will vary depending on selected operating mode, and to a lesser extent on image size. There is also about 5Kb-6Kb of constant data which will be allocated in the near data segment (about 4Kb of this is the error message table). Thus you have perhaps 20K available for other modules' static data and near heap space before you need to go to a larger memory model. The C library's static data will account for several K of this, but that still leaves a good deal for your needs. (If you are tight on space, you could reduce the sizes of the I/O buffers allocated by `jdatasrc.c` and `jdatadst.c`, say from 4K to 1K. Another possibility is to move the error message table to far memory; this should be doable with only localized hacking on `jerror.c`.)

About 2K of the near heap space is "permanent" memory that will not be released until you destroy the JPEG object. This is only an issue if you save a JPEG object between compression or decompression operations.

Far data space may also be a tight resource when you are dealing with large images. The most memory-intensive case is decompression with two-pass color quantization, or single-pass quantization to an externally supplied color map. This requires a 128Kb color lookup table plus strip buffers amounting to about 40 bytes per column for typical sampling ratios (eg, about 25600 bytes for a 640-pixel-wide image). You may not be able to process wide images if you have large data structures of your own.

Of course, all of these concerns vanish if you use a 32-bit flat-memory-model compiler, such as DJGPP or Watcom C. We highly recommend flat model if you can use it; the JPEG library is significantly faster in flat model.

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/libjpeg.txt

No license file was found, but licenses were detected in source scan.

/*

* jchuff.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 2006-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains Huffman entropy encoding routines.

* Both sequential and progressive modes are supported in this single module.

*

* Much of the complexity here has to do with supporting output suspension.

* If the data destination module demands suspension, we want to be able to

* back up to the start of the current MCU. To do this, we copy state

* variables into local working storage, and update them back to the

* permanent JPEG objects only upon successful completion of an MCU.

*

* We do not support output suspension for the progressive JPEG mode, since

* the library currently does not allow multiple-scan files to be written

* with output suspension.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jchuff.c

No license file was found, but licenses were detected in source scan.

/*

* rdcolmap.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file implements djpeg's "-map file" switch. It reads a source image

* and constructs a colormap to be supplied to the JPEG decompressor.

*

* Currently, these file formats are supported for the map file:

* GIF: the contents of the GIF's global colormap are used.

* PPM (either text or raw flavor): the entire file is read and

* each unique pixel value is entered in the map.

* Note that reading a large PPM file will be horrendously slow.

* Typically, a PPM-format map file should contain just one pixel

* of each desired color. Such a file can be extracted from an

```
* ordinary image PPM file with ppmtomap(1).
*
* Rescaling a PPM that has a maxval unequal to MAXJSAMPLE is not
* currently implemented.
*/
/* Portions of this code are based on the PBMPLUS library, which is:
**
** Copyright (C) 1988 by Jef Poskanzer.
**
** Permission to use, copy, modify, and distribute this software and its
** documentation for any purpose and without fee is hereby granted, provided
** that the above copyright notice appear in all copies and that both that
** copyright notice and this permission notice appear in supporting
** documentation. This software is provided "as is" without express or
** implied warranty.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdcolmap.c
```

No license file was found, but licenses were detected in source scan.

```
/*
* jdatadst.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2009-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains compression data destination routines for the case of
* emitting JPEG data to memory or to a file (or any stdio stream).
* While these routines are sufficient for most applications,
* some will want to use a different destination manager.
* IMPORTANT: we assume that fwrite() will correctly transcribe an array of
* JOCTETs into 8-bit-wide elements on external storage. If char is wider
* than 8 bits on your machine, you may need to do some tweaking.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdatadst.c
```

No license file was found, but licenses were detected in source scan.

```
/*
* rdswitch.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modified 2003-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
```

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to process some of cjpeg's more complicated
* command-line switches. Switches processed here are:
* -qtables file Read quantization tables from text file
* -scans file Read scan script from text file
* -quality N[,N,...] Set quality ratings
* -qslots N[,N,...] Set component quantization table selectors
* -sample HxV[,HxV,...] Set component sampling factors
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdswitch.c
No license file was found, but licenses were detected in source scan.

/*
* wrjpgcom.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2015-2017 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a very simple stand-alone application that inserts
* user-supplied text as a COM (comment) marker in a JFIF file.
* This may be useful as an example of the minimum logic needed to parse
* JPEG markers.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrjpgcom.c
No license file was found, but licenses were detected in source scan.

/*
* jidctfst.c
*
* Copyright (C) 1994-1998, Thomas G. Lane.
* Modified 2015-2017 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a fast, not so accurate integer implementation of the
* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine
* must also perform dequantization of the input coefficients.
*
* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
* on each row (or vice versa, but it's more convenient to emit a row at
* a time). Direct algorithms are also available, but they are much more

* complex and seem not to be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
* JPEG textbook (see REFERENCES section in file README). The following code
* is based directly on figure 4-8 in P&M.
* While an 8-point DCT cannot be done in less than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs. These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries. The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with fixed-point math,
* accuracy is lost due to imprecise representation of the scaled
* quantization values. The smaller the quantization table entry, the less
* precise the scaled value, so this implementation does worse with high-
* quality-setting files than with low-quality ones.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jidctfst.c

No license file was found, but licenses were detected in source scan.

/*

* rdjpgcom.c

*

* Copyright (C) 1994-1997, Thomas G. Lane.

* Modified 2009 by Bill Allombert, Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains a very simple stand-alone application that displays

* the text in COM (comment) markers in a JFIF file.

* This may be useful as an example of the minimum logic needed to parse

* JPEG markers.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdjpgcom.c

No license file was found, but licenses were detected in source scan.

/*

* jcapistd.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* Modified 2013 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains application interface code for the compression half
* of the JPEG library. These are the "standard" API routines that are
* used in the normal full-compression case. They are not used by a
* transcoding-only application. Note that if an application links in
* jpeg_start_compress, it will end up linking in the entire compressor.
* We thus must separate this file from jcapimin.c to avoid linking the
* whole compression library into a transcoder.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcapistd.c
No license file was found, but licenses were detected in source scan.

/*
* jdcoefct.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2002-2011 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the coefficient buffer controller for decompression.
* This controller is the top level of the JPEG decompressor proper.
* The coefficient buffer lies between entropy decoding and inverse-DCT steps.
*
* In buffered-image mode, this controller is the interface between
* input-oriented processing and output-oriented processing.
* Also, the input side (only) is used when reading a file for transcoding.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdcoefct.c
No license file was found, but licenses were detected in source scan.

/*
* jmemnobs.c
*
* Copyright (C) 1992-1996, Thomas G. Lane.
* Modified 2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file provides a really simple implementation of the system-
* dependent portion of the JPEG memory manager. This implementation
* assumes that no backing-store files are needed: all required space
* can be obtained from malloc().

- * This is very portable in the sense that it'll compile on almost anything,
- * but you'd better have lots of main memory (or virtual memory) if you want
- * to process big images.
- * Note that the max_memory_to_use option is respected by this implementation.
- */

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemnobs.c

No license file was found, but licenses were detected in source scan.

/*

* jdhuft.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 2006-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains Huffman entropy decoding routines.

* Both sequential and progressive modes are supported in this single module.

*

* Much of the complexity here has to do with supporting input suspension.

* If the data source module demands suspension, we want to be able to back

* up to the start of the current MCU. To do this, we copy state variables

* into local working storage, and update them back to the permanent

* storage only upon successful completion of an MCU.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdhuft.c

No license file was found, but licenses were detected in source scan.

/*

* jmemmgr.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 2011-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains the JPEG system-independent memory management

* routines. This code is usable across a wide variety of machines; most

* of the system dependencies have been isolated in a separate file.

* The major functions provided here are:

* * pool-based allocation and freeing of memory;

* * policy decisions about how to divide available memory among the

* virtual arrays;

* * control logic for swapping virtual arrays between main memory and

* backing storage.
* The separate system-dependent file provides the actual backing-storage
* access code, and it contains the policy decision about how much total
* main memory to use.
* This file is system-dependent in the sense that some of its functions
* are unnecessary in some systems. For example, if there is enough virtual
* memory so that backing storage will never be used, much of the virtual
* array control logic could be removed. (Of course, if you have that much
* memory then you shouldn't care about a little bit of unused code...)
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemmgr.c
No license file was found, but licenses were detected in source scan.

/*
* jinput.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2002-2013 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains input control logic for the JPEG decompressor.
* These routines are concerned with controlling the decompressor's input
* processing (marker reading and coefficient decoding). The actual input
* reading is done in jdmarker.c, jdhuft.c, and jdarith.c.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jinput.c
No license file was found, but licenses were detected in source scan.

/*
* jdarith.c
*
* Developed 1997-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains portable arithmetic entropy decoding routines for JPEG
* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).
*
* Both sequential and progressive modes are supported in this single module.
*
* Suspension is not currently supported in this module.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdarith.c

No license file was found, but licenses were detected in source scan.

/*

* jmemansi.c

*

* Copyright (C) 1992-1996, Thomas G. Lane.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file provides a simple generic implementation of the system-

* dependent portion of the JPEG memory manager. This implementation

* assumes that you have the ANSI-standard library routine tmpfile().

* Also, the problem of determining the amount of memory available

* is shoved onto the user.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemansi.c

No license file was found, but licenses were detected in source scan.

/*

* jdtrans.c

*

* Copyright (C) 1995-1997, Thomas G. Lane.

* Modified 2000-2009 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains library routines for transcoding decompression,

* that is, reading raw DCT coefficient arrays from an input JPEG file.

* The routines in jdapimin.c will also be needed by a transcoder.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdtrans.c

No license file was found, but licenses were detected in source scan.

/*

* jmorecfg.h

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 1997-2013 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains additional configuration options that customize the

* JPEG software for special applications or support machine-dependent
* optimizations. Most users will not need to touch this file.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmorecfg.h

No license file was found, but licenses were detected in source scan.

/*

* jcmaint.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* Modified 2003-2012 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains the main buffer controller for compression.

* The main buffer lies between the pre-processor and the JPEG

* compressor proper; it holds downsampled data in the JPEG colorspace.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcmaint.c

No license file was found, but licenses were detected in source scan.

/*

* jpegint.h

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 1997-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file provides common declarations for the various JPEG modules.

* These declarations are considered internal to the JPEG library; most

* applications using the library shouldn't need to include this file.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jpegint.h

No license file was found, but licenses were detected in source scan.

/*

* jfdctflt.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* Modified 2003-2017 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a floating-point implementation of the
* forward DCT (Discrete Cosine Transform).
*
* This implementation should be more accurate than either of the integer
* DCT implementations. However, it may not give the same results on all
* machines because of differences in roundoff behavior. Speed will depend
* on the hardware's floating point capacity.
*
* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
* on each column. Direct algorithms are also available, but they are
* much more complex and seem not to be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
* JPEG textbook (see REFERENCES section in file README). The following code
* is based directly on figure 4-8 in P&M.
* While an 8-point DCT cannot be done in less than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs. These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries. The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with a fixed-point
* implementation, accuracy is lost due to imprecise representation of the
* scaled quantization values. However, that problem does not arise if
* we use floating point arithmetic.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jfdctflt.c

No license file was found, but licenses were detected in source scan.

/*

* wrppm.c

*

* Copyright (C) 1991-1996, Thomas G. Lane.

* Modified 2009-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains routines to write output images in PPM/PGM format.

* The extended 2-byte-per-sample raw PPM/PGM formats are supported.

* The PBMPLUS library is NOT required to compile this software

* (but it is highly useful as a set of PPM image manipulation programs).

*

- * These routines may need modification for non-Unix environments or
- * specialized applications. As they stand, they assume output to
- * an ordinary stdio stream.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrppm.c
No license file was found, but licenses were detected in source scan.

/*

* jtparam.c

*

- * Copyright (C) 1991-1998, Thomas G. Lane.
- * Modified 2003-2019 by Guido Vollbeding.
- * This file is part of the Independent JPEG Group's software.
- * For conditions of distribution and use, see the accompanying README file.

*

- * This file contains optional default-setting code for the JPEG compressor.
- * Applications do not have to use this file, but those that don't use it
- * must know a lot more about the innards of the JPEG code.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jtparam.c
No license file was found, but licenses were detected in source scan.

/*

* jmemmac.c

*

- * Copyright (C) 1992-1997, Thomas G. Lane.
- * This file is part of the Independent JPEG Group's software.
- * For conditions of distribution and use, see the accompanying README file.

*

- * jmemmac.c provides an Apple Macintosh implementation of the system-
- * dependent portion of the JPEG memory manager.

*

- * If you use jmemmac.c, then you must define USE_MAC_MEMMGR in the
- * JPEG_INTERNALS part of jconfig.h.

*

- * jmemmac.c uses the Macintosh toolbox routines NewPtr and DisposePtr
- * instead of malloc and free. It accurately determines the amount of
- * memory available by using CompactMem. Notice that if left to its
- * own devices, this code can chew up all available space in the
- * application's zone, with the exception of the rather small "slop"
- * factor computed in jpeg_mem_available(). The application can ensure
- * that more space is left over by reducing max_memory_to_use.

*

- * Large images are swapped to disk using temporary files and System 7.0+'s

* temporary folder functionality.
 *
 * Note that jmemmac.c depends on two features of MacOS that were first
 * introduced in System 7: FindFolder and the FSSpec-based calls.
 * If your application uses jmemmac.c and is run under System 6 or earlier,
 * and the jpeg library decides it needs a temporary file, it will abort,
 * printing error messages about requiring System 7. (If no temporary files
 * are created, it will run fine.)
 *
 * If you want to use jmemmac.c in an application that might be used with
 * System 6 or earlier, then you should remove dependencies on FindFolder
 * and the FSSpec calls. You will need to replace FindFolder with some
 * other mechanism for finding a place to put temporary files, and you
 * should replace the FSSpec calls with their HFS equivalents:
 *
 * FSpDelete -> HDelete
 * FSpGetFInfo -> HGetFInfo
 * FSpCreate -> HCreate
 * FSpOpenDF -> HOpen *** Note: not HOpenDF ***
 * FSMakeFSSpec -> (fill in spec by hand.)
 *
 * (Use HOpen instead of HOpenDF. HOpen is just a glue-interface to PBHOpen,
 * which is on all HFS macs. HOpenDF is a System 7 addition which avoids the
 * ages-old problem of names starting with a period.)
 *
 * Contributed by Sam Bushell (jsam@iagu.on.net) and
 * Dan Gildor (gyld@in-touch.com).
 */

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemmac.c

No license file was found, but licenses were detected in source scan.

/*

* jinclude.h

*

* Copyright (C) 1991-1994, Thomas G. Lane.

* Modified 2017 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file exists to provide a single place to fix any problems with

* including the wrong system include files. (Common problems are taken

* care of by the standard jconfig symbols, but on really weird systems

* you may have to edit this file.)

*

* NOTE: this file is NOT intended to be included by applications using the

* JPEG library. Most applications need only include jpeglib.h.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jinclude.h
No license file was found, but licenses were detected in source scan.

/*

* cdjpeg.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains common support routines used by the IJG application

* programs (cjpeg, djpeg, jpegtran).

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/cdjpeg.c
No license file was found, but licenses were detected in source scan.

/*

* rdbmp.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* Modified 2009-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains routines to read input images in Microsoft "BMP"

* format (MS Windows 3.x, OS/2 1.x, and OS/2 2.x flavors).

* Currently, only 8-, 24-, and 32-bit images are supported, not 1-bit or

* 4-bit (feeding such low-depth images into JPEG would be silly anyway).

* Also, we don't support RLE-compressed files.

*

* These routines may need modification for non-Unix environments or

* specialized applications. As they stand, they assume input from

* an ordinary stdio stream. They further assume that reading begins

* at the start of the file; start_input may need work if the

* user interface has already read some data (e.g., to determine that

* the file is indeed BMP format).

*

* This code contributed by James Arthur Boucher.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdbmp.c

No license file was found, but licenses were detected in source scan.

```
/*
 * jfdctfst.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2003-2017 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains a fast, not so accurate integer implementation of the
 * forward DCT (Discrete Cosine Transform).
 *
 * A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
 * on each column. Direct algorithms are also available, but they are
 * much more complex and seem not to be any faster when reduced to code.
 *
 * This implementation is based on Arai, Agui, and Nakajima's algorithm for
 * scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
 * Japanese, but the algorithm is described in the Pennebaker & Mitchell
 * JPEG textbook (see REFERENCES section in file README). The following code
 * is based directly on figure 4-8 in P&M.
 * While an 8-point DCT cannot be done in less than 11 multiplies, it is
 * possible to arrange the computation so that many of the multiplies are
 * simple scalings of the final outputs. These multiplies can then be
 * folded into the multiplications or divisions by the JPEG quantization
 * table entries. The AA&N method leaves only 5 multiplies and 29 adds
 * to be done in the DCT itself.
 * The primary disadvantage of this method is that with fixed-point math,
 * accuracy is lost due to imprecise representation of the scaled
 * quantization values. The smaller the quantization table entry, the less
 * precise the scaled value, so this implementation does worse with high-
 * quality-setting files than with low-quality ones.
 */
```

Found in path(s):

```
*/
 * /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jfdctfst.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jdsample.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2002-2015 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains upsampling routines.
```

*
* Upsampling input data is counted in "row groups". A row group
* is defined to be $(v_samp_factor * DCT_v_scaled_size / min_DCT_v_scaled_size)$
* sample rows of each component. Upsampling will normally produce
* $max_v_samp_factor$ pixel rows from each row group (but this could vary
* if the upsampler is applying a scale factor of its own).
*
* An excellent reference for image resampling is
* Digital Image Warping, George Wolberg, 1990.
* Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdsample.c
No license file was found, but licenses were detected in source scan.

/*
* jdmaster.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2002-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains master control logic for the JPEG decompressor.
* These routines are concerned with selecting the modules to be executed
* and with determining the number of passes and the work to be done in each
* pass.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmaster.c
No license file was found, but licenses were detected in source scan.

/*
* jdcolor.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2011-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains output colorspace conversion routines.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdcolor.c

No license file was found, but licenses were detected in source scan.

```
/*
 * jdapistd.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2002-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains application interface code for the decompression half
 * of the JPEG library. These are the "standard" API routines that are
 * used in the normal full-decompression case. They are not used by a
 * transcoding-only application. Note that if an application links in
 * jpeg_start_decompress, it will end up linking in the entire decompressor.
 * We thus must separate this file from jdapimin.c to avoid linking the
 * whole decompression library into a transcoder.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdapistd.c
No license file was found, but licenses were detected in source scan.
```

```
/*
 * wrbmp.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2017-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains routines to write output images in Microsoft "BMP"
 * format (MS Windows 3.x and OS/2 1.x flavors).
 * Either 8-bit colormapped or 24-bit full-color format can be written.
 * No compression is supported.
 *
 * These routines may need modification for non-Unix environments or
 * specialized applications. As they stand, they assume output to
 * an ordinary stdio stream.
 *
 * This code contributed by James Arthur Boucher.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrbmp.c
No license file was found, but licenses were detected in source scan.
```

```
/*
```

```
* rdtarga.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modified 2017-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in Targa format.
*
* These routines may need modification for non-Unix environments or
* specialized applications. As they stand, they assume input from
* an ordinary stdio stream. They further assume that reading begins
* at the start of the file; start_input may need work if the
* user interface has already read some data (e.g., to determine that
* the file is indeed Targa format).
*
* Based on code contributed by Lee Daniel Crocker.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdtarga.c
No license file was found, but licenses were detected in source scan.
```

IJG JPEG LIBRARY: FILE LIST

Copyright (C) 1994-2019, Thomas G. Lane, Guido Vollbeding.
This file is part of the Independent JPEG Group's software.
For conditions of distribution and use, see the accompanying README file.

Here is a road map to the files in the IJG JPEG distribution. The distribution includes the JPEG library proper, plus two application programs ("cjpeg" and "djpeg") which use the library to convert JPEG files to and from some other popular image formats. A third application "jpegtran" uses the library to do lossless conversion between different variants of JPEG. There are also two stand-alone applications, "rdjpgcom" and "wrjpgcom".

THE JPEG LIBRARY

=====

Include files:

jpeglib.h JPEG library's exported data and function declarations.
jconfig.h Configuration declarations. Note: this file is not present in the distribution; it is generated during installation.
jmorecfg.h Additional configuration declarations; need not be changed

for a standard installation.

jerror.h Declares JPEG library's error and trace message codes.

jinclude.h Central include file used by all IJG .c files to reference system include files.

jpegint.h JPEG library's internal data structures.

jdct.h Private declarations for forward & reverse DCT subsystems.

jmemsys.h Private declarations for memory management subsystem.

jversion.h Version information.

Applications using the library should include jpeglib.h (which in turn includes jconfig.h and jmorecfg.h). Optionally, jerror.h may be included if the application needs to reference individual JPEG error codes. The other include files are intended for internal use and would not normally be included by an application program. (cjpeg/djpeg/etc do use jinclude.h, since its function is to improve portability of the whole IJG distribution. Most other applications will directly include the system include files they want, and hence won't need jinclude.h.)

C source code files:

These files contain most of the functions intended to be called directly by an application program:

jpegim.c Application program interface: core routines for compression.

jpegstd.c Application program interface: standard compression.

jdapim.c Application program interface: core routines for decompression.

jdapstd.c Application program interface: standard decompression.

jpegapi.c Application program interface routines common to compression and decompression.

jpegparam.c Compression parameter setting helper routines.

jpegtrans.c API and library routines for transcoding compression.

jdtrans.c API and library routines for transcoding decompression.

Compression side of the library:

jpeginit.c Initialization: determines which other modules to use.

jpegmaster.c Master control: setup and inter-pass sequencing logic.

jpegmain.c Main buffer controller (preprocessor => JPEG compressor).

jpegprep.c Preprocessor buffer controller.

jpegcofct.c Buffer controller for DCT coefficient buffer.

jpegcolor.c Color space conversion.

jpegsample.c Downsampling.

jpegdctmgr.c DCT manager (DCT implementation selection & control).

jpegfdctint.c Forward DCT using slow-but-accurate integer method.

jpegfdctfst.c Forward DCT using faster, less accurate integer method.

jpegfdctflt.c Forward DCT using floating-point arithmetic.

jpegchuff.c Huffman entropy coding.

jcarith.c Arithmetic entropy coding.
jcmarker.c JPEG marker writing.
jdatadst.c Data destination managers for memory and stdio output.

Decompression side of the library:

jdmaster.c Master control: determines which other modules to use.
jdinput.c Input controller: controls input processing modules.
jdmainct.c Main buffer controller (JPEG decompressor => postprocessor).
jdcoeftc.c Buffer controller for DCT coefficient buffer.
jdpostct.c Postprocessor buffer controller.
jdmarker.c JPEG marker reading.
jdhuft.c Huffman entropy decoding.
jdarith.c Arithmetic entropy decoding.
jddctmgr.c IDCT manager (IDCT implementation selection & control).
jidctint.c Inverse DCT using slow-but-accurate integer method.
jidctfst.c Inverse DCT using faster, less accurate integer method.
jidctflt.c Inverse DCT using floating-point arithmetic.
jdsample.c Upsampling.
jdcolor.c Color space conversion.
jdmerge.c Merged upsampling/color conversion (faster, lower quality).
jquant1.c One-pass color quantization using a fixed-spacing colormap.
jquant2.c Two-pass color quantization using a custom-generated colormap.
Also handles one-pass quantization to an externally given map.
jdatasrc.c Data source managers for memory and stdio input.

Support files for both compression and decompression:

jaricom.c Tables for common use in arithmetic entropy encoding and decoding routines.
jerror.c Standard error handling routines (application replaceable).
jmemmgr.c System-independent (more or less) memory management code.
jutils.c Miscellaneous utility routines.

jmemmgr.c relies on a system-dependent memory management module. The IJG distribution includes the following implementations of the system-dependent module:

jmemnobs.c "No backing store": assumes adequate virtual memory exists.
jmemansi.c Makes temporary files with ANSI-standard routine tmpfile().
jmemname.c Makes temporary files with program-generated file names.
jmemdos.c Custom implementation for MS-DOS (16-bit environment only):
can use extended and expanded memory as well as temp files.
jmemmac.c Custom implementation for Apple Macintosh.

Exactly one of the system-dependent modules should be configured into an installed JPEG library (see install.txt for hints about which one to use).

On unusual systems you may find it worthwhile to make a special

system-dependent memory manager.

Non-C source code files:

jmemdosa.asm 80x86 assembly code support for jmemdos.c; used only in MS-DOS-specific configurations of the JPEG library.

CJPEG/DJPEG/JPEGTRAN

=====

Include files:

cdjpeg.h Declarations shared by cjpeg/djpeg/jpegtran modules.
cderror.h Additional error and trace message codes for cjpeg et al.
transupp.h Declarations for jpegtran support routines in transupp.c.

C source code files:

cjpeg.c Main program for cjpeg.
djpeg.c Main program for djpeg.
jpegtran.c Main program for jpegtran.
cdjpeg.c Utility routines used by all three programs.
rdcolmap.c Code to read a colormap file for djpeg's "-map" switch.
rdswitch.c Code to process some of cjpeg's more complex switches.
Also used by jpegtran.
transupp.c Support code for jpegtran: lossless image manipulations.

Image file reader modules for cjpeg:

rdbmp.c BMP file input.
rdgif.c GIF file input.
rdppm.c PPM/PGM file input.
rdrlc.c Utah RLE file input.
rdtarga.c Targa file input.

Image file writer modules for djpeg:

wrbmp.c BMP file output.
wrgif.c GIF file output.
wrppm.c PPM/PGM file output.
wrrlc.c Utah RLE file output.
wrtarga.c Targa file output.

RDJPGCOM/WRJPGCOM

=====

C source code files:

rdjpgcom.c Stand-alone rdjpgcom application.

wrjpgcom.c Stand-alone wrjpgcom application.

These programs do not depend on the IJG library. They do use jconfig.h and jinclude.h, only to improve portability.

ADDITIONAL FILES

=====

Documentation (see README for a guide to the documentation files):

README Master documentation file.

*.txt Other documentation files.

*.1 Documentation in Unix man page format.

change.log Version-to-version change highlights.

example.c Sample code for calling JPEG library.

Configuration/installation files and programs (see install.txt for more info):

configure Unix shell script to perform automatic configuration.

configure.ac Source file for use with Autoconf to generate configure.

ltmain.sh Support scripts for configure (from GNU libtool).

config.guess

config.sub

depcomp

missing

ar-lib

compile

install-sh Install shell script for those Unix systems lacking one.

Makefile.in Makefile input for configure.

Makefile.am Source file for use with Automake to generate Makefile.in.

ckconfig.c Program to generate jconfig.h on non-Unix systems.

jconfig.txt Template for making jconfig.h by hand.

mak*.* Sample makefiles for particular systems.

jconfig.* Sample jconfig.h for particular systems.

libjpeg.map Script to generate shared library with versioned symbols.

libjpeg.pc.in libjpeg.pc pkg-config file input for configure.

aclocal.m4 M4 macro definitions for use with Autoconf.

Test files (see install.txt for test procedure):

test*.* Source and comparison files for confidence test.

These are binary image files, NOT text files.

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/filelist.txt

No license file was found, but licenses were detected in source scan.

/*

* jdatasrc.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* Modified 2009-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains decompression data source routines for the case of

* reading JPEG data from memory or from a file (or any stdio stream).

* While these routines are sufficient for most applications,

* some will want to use a different source manager.

* IMPORTANT: we assume that fread() will correctly transcribe an array of

* JOCTETs from 8-bit-wide elements on external storage. If char is wider

* than 8 bits on your machine, you may need to do some tweaking.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdatasrc.c

No license file was found, but licenses were detected in source scan.

/*

* jccoefct.c

*

* Copyright (C) 1994-1997, Thomas G. Lane.

* Modified 2003-2011 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains the coefficient buffer controller for compression.

* This controller is the top level of the JPEG compressor proper.

* The coefficient buffer lies between forward-DCT and entropy encoding steps.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jccoefct.c

No license file was found, but licenses were detected in source scan.

/*

* jcmarker.c

*

* Copyright (C) 1991-1998, Thomas G. Lane.

* Modified 2003-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains routines to write JPEG datastream markers.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcmarker.c

No license file was found, but licenses were detected in source scan.

/*

* jidctint.c

*

* Copyright (C) 1991-1998, Thomas G. Lane.

* Modification developed 2002-2018 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains a slow-but-accurate integer implementation of the

* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine

* must also perform dequantization of the input coefficients.

*

* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT

* on each row (or vice versa, but it's more convenient to emit a row at

* a time). Direct algorithms are also available, but they are much more

* complex and seem not to be any faster when reduced to code.

*

* This implementation is based on an algorithm described in

* C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT

* Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,

* Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.

* The primary algorithm described there uses 11 multiplies and 29 adds.

* We use their alternate method with 12 multiplies and 32 adds.

* The advantage of this method is that no data path contains more than one

* multiplication; this allows a very simple and accurate implementation in

* scaled fixed-point arithmetic, with a minimal number of shifts.

*

* We also provide IDCT routines with various output sample block sizes for

* direct resolution reduction or enlargement and for direct resolving the

* common 2x1 and 1x2 subsampling cases without additional resampling: NxN

* (N=1...16), 2NxN, and Nx2N (N=1...8) pixels for one 8x8 input DCT block.

*

* For N<8 we simply take the corresponding low-frequency coefficients of

* the 8x8 input DCT block and apply an NxN point IDCT on the sub-block

* to yield the downsampled outputs.

* This can be seen as direct low-pass downsampling from the DCT domain

* point of view rather than the usual spatial domain point of view,

* yielding significant computational savings and results at least

* as good as common bilinear (averaging) spatial downsampling.

*
* For N>8 we apply a partial NxN IDCT on the 8 input coefficients as
* lower frequencies and higher frequencies assumed to be zero.
* It turns out that the computational effort is similar to the 8x8 IDCT
* regarding the output size.
* Furthermore, the scaling and descaling is the same for all IDCT sizes.
*
* CAUTION: We rely on the FIX() macro except for the N=1,2,4,8 cases
* since there would be too many additional constants to pre-calculate.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jidctint.c
No license file was found, but licenses were detected in source scan.

/*
* jquant2.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modified 2011 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains 2-pass color quantization (color mapping) routines.
* These routines provide selection of a custom color map for an image,
* followed by mapping of the image to that color map, with optional
* Floyd-Steinberg dithering.
* It is also possible to use just the second pass to map to an arbitrary
* externally-given color map.
*
* Note: ordered dithering is not supported, since there isn't any fast
* way to compute intercolor distances; it's unclear that ordered dither's
* fundamental assumptions even hold with an irregularly spaced color map.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jquant2.c
No license file was found, but licenses were detected in source scan.

/*
* jpegtran.c
*
* Copyright (C) 1995-2019, Thomas G. Lane, Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for JPEG transcoding.
* It is very similar to cjpeg.c, and partly to djpeg.c, but provides

- * lossless transcoding between different JPEG file formats. It also
- * provides some lossless and sort-of-lossless transformations of JPEG data.
- */

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jpegtran.c

No license file was found, but licenses were detected in source scan.

/*

* ckconfig.c

*

* Copyright (C) 1991-1994, Thomas G. Lane.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/ckconfig.c

No license file was found, but licenses were detected in source scan.

/*

* djpeg.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 2009-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains a command-line user interface for the JPEG decompressor.

* It should work on any system with Unix- or MS-DOS-style command lines.

*

* Two different command line styles are permitted, depending on the

* compile-time switch TWO_FILE_COMMANDLINE:

* djpeg [options] inputfile outputfile

* djpeg [options] [inputfile]

* In the second style, output is always to standard output, which you'd

* normally redirect to a file or pipe to some other program. Input is

* either from a named file or from standard input (typically redirected).

* The second style is convenient on Unix but is unhelpful on systems that

* don't support pipes. Also, you MUST use the first style if your system

* doesn't do binary I/O to stdin/stdout.

* To simplify script writing, the "-outfile" switch is provided. The syntax

* djpeg [options] -outfile outputfile inputfile

* works regardless of which command line style is used.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/djpeg.c

No license file was found, but licenses were detected in source scan.

```
/*
 * jcdctmgr.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2003-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains the forward-DCT management logic.
 * This code selects a particular DCT implementation to be used,
 * and it performs related housekeeping chores including coefficient
 * quantization.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcdctmgr.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * cjpeg.c
 *
 * Copyright (C) 1991-1998, Thomas G. Lane.
 * Modified 2003-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains a command-line user interface for the JPEG compressor.
 * It should work on any system with Unix- or MS-DOS-style command lines.
 *
 * Two different command line styles are permitted, depending on the
 * compile-time switch TWO_FILE_COMMANDLINE:
 * cjpeg [options] inputfile outputfile
 * cjpeg [options] [inputfile]
 * In the second style, output is always to standard output, which you'd
 * normally redirect to a file or pipe to some other program. Input is
 * either from a named file or from standard input (typically redirected).
 * The second style is convenient on Unix but is unhelpful on systems that
 * don't support pipes. Also, you MUST use the first style if your system
 * doesn't do binary I/O to stdin/stdout.
 * To simplify script writing, the "-outfile" switch is provided. The syntax
 * cjpeg [options] -outfile outputfile inputfile
 * works regardless of which command line style is used.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/cjpeg.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jcarith.c
 *
 * Developed 1997-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains portable arithmetic entropy encoding routines for JPEG
 * (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).
 *
 * Both sequential and progressive modes are supported in this single module.
 *
 * Suspension is not currently supported in this module.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcarith.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jmemdos.c
 *
 * Copyright (C) 1992-1997, Thomas G. Lane.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file provides an MS-DOS-compatible implementation of the system-
 * dependent portion of the JPEG memory manager. Temporary data can be
 * stored in extended or expanded memory as well as in regular DOS files.
 *
 * If you use this file, you must be sure that NEED_FAR_POINTERS is defined
 * if you compile in a small-data memory model; it should NOT be defined if
 * you use a large-data memory model. This file is not recommended if you
 * are using a flat-memory-space 386 environment such as DJGCC or Watcom C.
 * Also, this code will NOT work if struct fields are aligned on greater than
 * 2-byte boundaries.
 *
 * Based on code contributed by Ge' Weijers.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemdos.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jcapimin.c
```

*
* Copyright (C) 1994-1998, Thomas G. Lane.
* Modified 2003-2010 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains application interface code for the compression half
* of the JPEG library. These are the "minimum" API routines that may be
* needed in either the normal full-compression case or the transcoding-only
* case.
*
* Most of the routines intended to be called directly by an application
* are in this file or in jcapistd.c. But also see jcparam.c for
* parameter-setup helper routines, jcomapi.c for routines shared by
* compression and decompression, and jctrans.c for the transcoding case.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcapimin.c

No license file was found, but licenses were detected in source scan.

/*
* jidctflt.c
*
* Copyright (C) 1994-1998, Thomas G. Lane.
* Modified 2010-2017 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a floating-point implementation of the
* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine
* must also perform dequantization of the input coefficients.
*
* This implementation should be more accurate than either of the integer
* IDCT implementations. However, it may not give the same results on all
* machines because of differences in roundoff behavior. Speed will depend
* on the hardware's floating point capacity.
*
* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
* on each row (or vice versa, but it's more convenient to emit a row at
* a time). Direct algorithms are also available, but they are much more
* complex and seem not to be any faster when reduced to code.
*
* This implementation is based on Arai, Agui, and Nakajima's algorithm for
* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
* Japanese, but the algorithm is described in the Pennebaker & Mitchell
* JPEG textbook (see REFERENCES section in file README). The following code
* is based directly on figure 4-8 in P&M.

* While an 8-point DCT cannot be done in less than 11 multiplies, it is
* possible to arrange the computation so that many of the multiplies are
* simple scalings of the final outputs. These multiplies can then be
* folded into the multiplications or divisions by the JPEG quantization
* table entries. The AA&N method leaves only 5 multiplies and 29 adds
* to be done in the DCT itself.
* The primary disadvantage of this method is that with a fixed-point
* implementation, accuracy is lost due to imprecise representation of the
* scaled quantization values. However, that problem does not arise if
* we use floating point arithmetic.
*/

Found in path(s):

*/opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jidctflt.c

No license file was found, but licenses were detected in source scan.

/*

* rdppm.c

*

* Copyright (C) 1991-1997, Thomas G. Lane.

* Modified 2009-2019 by Bill Allombert, Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains routines to read input images in PPM/PGM format.

* The extended 2-byte-per-sample raw PPM/PGM formats are supported.

* The PBMPLUS library is NOT required to compile this software

* (but it is highly useful as a set of PPM image manipulation programs).

*

* These routines may need modification for non-Unix environments or

* specialized applications. As they stand, they assume input from

* an ordinary stdio stream. They further assume that reading begins

* at the start of the file; start_input may need work if the

* user interface has already read some data (e.g., to determine that

* the file is indeed PPM format).

*/

/* Portions of this code are based on the PBMPLUS library, which is:

**

** Copyright (C) 1988 by Jef Poskanzer.

**

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** documentation for any purpose and without fee is hereby granted, provided

** that the above copyright notice appear in all copies and that both that

** copyright notice and this permission notice appear in supporting

** documentation. This software is provided "as is" without express or

** implied warranty.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrc-v9d-tar-gz/jpeg-9d/rdppm.c

No license file was found, but licenses were detected in source scan.

/*

* jdpostct.c

*

* Copyright (C) 1994-1996, Thomas G. Lane.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains the decompression postprocessing controller.

* This controller manages the upsampling, color conversion, and color

* quantization/reduction steps; specifically, it controls the buffering

* between upsample/color conversion and color quantization/reduction.

*

* If no color quantization/reduction is required, then this module has no

* work to do, and it just hands off to the upsample/color conversion code.

* An integrated upsample/convert/quantize process would replace this module

* entirely.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrc-v9d-tar-gz/jpeg-9d/jdpostct.c

No license file was found, but licenses were detected in source scan.

/*

* jcsample.c

*

* Copyright (C) 1991-1996, Thomas G. Lane.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains downsampling routines.

*

* Downsampling input data is counted in "row groups". A row group

* is defined to be max_v_samp_factor pixel rows of each component,

* from which the downsampler produces v_samp_factor sample rows.

* A single row group is processed in each call to the downsampler module.

*

* The downsampler is responsible for edge-expansion of its output data

* to fill an integral number of DCT blocks horizontally. The source buffer

* may be modified if it is helpful for this purpose (the source buffer is

* allocated wide enough to correspond to the desired output width).

* The caller (the prep controller) is responsible for vertical padding.

*

* The downsampler may request "context rows" by setting need_context_rows

* during startup. In this case, the input arrays will contain at least

- * one row group's worth of pixels above and below the passed-in data;
- * the caller will create dummy rows at image top and bottom by replicating
- * the first or last real pixel row.
- *
- * An excellent reference for image resampling is
- * Digital Image Warping, George Wolberg, 1990.
- * Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.
- *
- * The downsampling algorithm used here is a simple average of the source
- * pixels covered by the output pixel. The hi-falutin sampling literature
- * refers to this as a "box filter". In general the characteristics of a box
- * filter are not very good, but for the specific cases we normally use (1:1
- * and 2:1 ratios) the box is equivalent to a "triangle filter" which is not
- * nearly so bad. If you intend to use other sampling ratios, you'd be well
- * advised to improve this code.
- *
- * A simple input-smoothing capability is provided. This is mainly intended
- * for cleaning up color-dithered GIF input files (if you find it inadequate,
- * we suggest using an external filtering program such as pnmconvol). When
- * enabled, each input pixel P is replaced by a weighted sum of itself and its
- * eight neighbors. P's weight is 1-8*SF and each neighbor's weight is SF,
- * where SF = (smoothing_factor / 1024).
- * Currently, smoothing is only supported for 2h2v sampling factors.
- */

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcsample.c
 No license file was found, but licenses were detected in source scan.

/*

* jquant1.c

*

* Copyright (C) 1991-1996, Thomas G. Lane.

* Modified 2011 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains 1-pass color quantization (color mapping) routines.

* These routines provide mapping to a fixed color map using equally spaced

* color values. Optional Floyd-Steinberg or ordered dithering is available.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jquant1.c
 No license file was found, but licenses were detected in source scan.

/*

* jutils.c

*
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modified 2009-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains tables and miscellaneous utility routines needed
* for both compression and decompression.
* Note we prefix all global names with "j" to minimize conflicts with
* a surrounding application.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jutils.c

No license file was found, but licenses were detected in source scan.

/*
* jdmarker.c
*
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modified 2009-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to decode JPEG datastream markers.
* Most of the complexity arises from our desire to support input
* suspension: if not all of the data for a marker is available,
* we must exit back to the application. On resumption, we reprocess
* the marker.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmarker.c

No license file was found, but licenses were detected in source scan.

/*
* cdjpeg.h
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains common declarations for the sample applications
* cjpeg and djpeg. It is NOT used by the core JPEG library.
*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrc-v9d-tar-gz/jpeg-9d/cdjpeg.h

No license file was found, but licenses were detected in source scan.

IJG JPEG LIBRARY: CODING RULES

Copyright (C) 1991-1996, Thomas G. Lane.

This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

Since numerous people will be contributing code and bug fixes, it's important to establish a common coding style. The goal of using similar coding styles is much more important than the details of just what that style is.

In general we follow the recommendations of "Recommended C Style and Coding Standards" revision 6.1 (Cannon et al. as modified by Spencer, Keppel and Brader). This document is available in the IJG FTP archive (see `jpeg/doc/cstyle.ms.tbl.Z`, or `cstyle.txt.Z` for those without `nroff/tbl`).

Block comments should be laid out thusly:

```
/*  
 * Block comments in this style.  
*/
```

We indent statements in K&R style, e.g.,

```
if (test) {  
    then-part;  
} else {  
    else-part;  
}
```

with two spaces per indentation level. (This indentation convention is handled automatically by GNU Emacs and many other text editors.)

Multi-word names should be written in lower case with underscores, e.g., `multi_word_name` (not `multiWordName`). Preprocessor symbols and enum constants are similar but upper case (`MULTI_WORD_NAME`). Names should be unique within the first fifteen characters. (On some older systems, global names must be unique within six characters. We accommodate this without cluttering the source code by using macros to substitute shorter names.)

We use function prototypes everywhere; we rely on automatic source code transformation to feed prototype-less C compilers. Transformation is done by the simple and portable tool 'ansi2knr.c' (courtesy of Ghostscript). `ansi2knr` is not very bright, so it imposes a format requirement on function declarations: the function name **MUST BEGIN IN COLUMN 1**. Thus all functions should be written in the following style:

```

LOCAL(int *)
function_name (int a, char *b)
{
    code...
}

```

Note that each function definition must begin with GLOBAL(type), LOCAL(type), or METHODDEF(type). These macros expand to "static type" or just "type" as appropriate. They provide a readable indication of the routine's usage and can readily be changed for special needs. (For instance, special linkage keywords can be inserted for use in Windows DLLs.)

ansi2knr does not transform method declarations (function pointers in structs). We handle these with a macro JMETHOD, defined as

```

#ifdef HAVE_PROTOTYPES
#define JMETHOD(type,methodname,arglist) type (*methodname) arglist
#else
#define JMETHOD(type,methodname,arglist) type (*methodname) ()
#endif

```

which is used like this:

```

struct function_pointers {
    JMETHOD(void, init_entropy_encoder, (int somearg, jparms *jp));
    JMETHOD(void, term_entropy_encoder, (void));
};

```

Note the set of parentheses surrounding the parameter list.

A similar solution is used for forward and external function declarations (see the EXTERN and JPP macros).

If the code is to work on non-ANSI compilers, we cannot rely on a prototype declaration to coerce actual parameters into the right types. Therefore, use explicit casts on actual parameters whenever the actual parameter type is not identical to the formal parameter. Beware of implicit conversions to "int".

It seems there are some non-ANSI compilers in which the sizeof() operator is defined to return int, yet size_t is defined as long. Needless to say, this is brain-damaged. Always use the SIZEOF() macro in place of sizeof(), so that the result is guaranteed to be of type size_t.

The JPEG library is intended to be used within larger programs. Furthermore, we want it to be reentrant so that it can be used by applications that process multiple images concurrently. The following rules support these requirements:

1. Avoid direct use of file I/O, "malloc", error report printouts, etc; pass these through the common routines provided.
2. Minimize global namespace pollution. Functions should be declared static

wherever possible. (Note that our method-based calling conventions help this a lot: in many modules only the initialization function will ever need to be called directly, so only that function need be externally visible.) All global function names should begin with "jpeg_", and should have an abbreviated name (unique in the first six characters) substituted by macro when NEED_SHORT_EXTERNAL_NAMES is set.

3. Don't use global variables; anything that must be used in another module should be in the common data structures.

4. Don't use static variables except for read-only constant tables. Variables that should be private to a module can be placed into private structures (see the system architecture document, structure.txt).

5. Source file names should begin with "j" for files that are part of the library proper; source files that are not part of the library, such as cjpeg.c and djpeg.c, do not begin with "j". Keep source file names to eight characters (plus ".c" or ".h", etc) to make life easy for MS-DOSers. Keep compression and decompression code in separate source files --- some applications may want only one half of the library.

Note: these rules (particularly #4) are not followed religiously in the modules that are used in cjpeg/djpeg but are not part of the JPEG library proper. Those modules are not really intended to be used in other applications.

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/coderules.txt

No license file was found, but licenses were detected in source scan.

/*

* rdgif.c

*

* Copyright (C) 1991-1996, Thomas G. Lane.

* Modified 2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains routines to read input images in GIF format.

*

* These routines may need modification for non-Unix environments or

* specialized applications. As they stand, they assume input from

* an ordinary stdio stream. They further assume that reading begins

* at the start of the file; start_input may need work if the

* user interface has already read some data (e.g., to determine that

* the file is indeed GIF format).

*/

/*

```

* This code is loosely based on giftppm from the PBMPLUS distribution
* of Feb. 1991. That file contains the following copyright notice:
* +-----+
* | Copyright 1990, David Koblas.          |
* | Permission to use, copy, modify, and distribute this software |
* | and its documentation for any purpose and without fee is hereby |
* | granted, provided that the above copyright notice appear in all |
* | copies and that both that copyright notice and this permission |
* | notice appear in supporting documentation. This software is    |
* | provided "as is" without express or implied warranty.          |
* +-----+
*/

```

Found in path(s):

```

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdgif.c

```

No license file was found, but licenses were detected in source scan.

```

/*
* jddctmgr.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2002-2013 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the inverse-DCT management logic.
* This code selects a particular IDCT implementation to be used,
* and it performs related housekeeping chores. No code in this file
* is executed per IDCT step, only during output pass setup.
*
* Note that the IDCT routines are responsible for performing coefficient
* dequantization as well as the IDCT proper. This module sets up the
* dequantization multiplier table needed by the IDCT routine.
*/

```

Found in path(s):

```

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jddctmgr.c

```

No license file was found, but licenses were detected in source scan.

```

/*
* wrgif.c
*
* Copyright (C) 1991-1996, Thomas G. Lane.
* Modified 2015-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to write output images in GIF format.

```

```
*
* These routines may need modification for non-Unix environments or
* specialized applications. As they stand, they assume output to
* an ordinary stdio stream.
*/
/*
* This code is loosely based on ppmtogif from the PBMPLUS distribution
* of Feb. 1991. That file contains the following copyright notice:
* Based on GIFENCODE by David Rowley <mgardi@watdscu.waterloo.edu>.
* Lempel-Ziv compression based on "compress" by Spencer W. Thomas et al.
* Copyright (C) 1989 by Jef Poskanzer.
* Permission to use, copy, modify, and distribute this software and its
* documentation for any purpose and without fee is hereby granted, provided
* that the above copyright notice appear in all copies and that both that
* copyright notice and this permission notice appear in supporting
* documentation. This software is provided "as is" without express or
* implied warranty.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrgif.c
No license file was found, but licenses were detected in source scan.
```

```
/*
* jerror.c
*
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modified 2012-2015 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains simple error-reporting and trace-message routines.
* These are suitable for Unix-like systems and others where writing to
* stderr is the right thing to do. Many applications will want to replace
* some or all of these routines.
*
* If you define USE_WINDOWS_MESSAGEBOX in jconfig.h or in the makefile,
* you get a Windows-specific hack to display error messages in a dialog box.
* It ain't much, but it beats dropping error messages into the bit bucket,
* which is what happens to output to stderr under most Windows C compilers.
*
* These routines are used by both the compression and decompression code.
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jerror.c
No license file was found, but licenses were detected in source scan.
```

INSTALLATION INSTRUCTIONS for the Independent JPEG Group's JPEG software

Copyright (C) 1991-2019, Thomas G. Lane, Guido Vollbeding.

This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

This file explains how to configure and install the IJG software. We have tried to make this software extremely portable and flexible, so that it can be adapted to almost any environment. The downside of this decision is that the installation process is complicated. We have provided shortcuts to simplify the task on common systems. But in any case, you will need at least a little familiarity with C programming and program build procedures for your system.

If you are only using this software as part of a larger program, the larger program's installation procedure may take care of configuring the IJG code. For example, Ghostscript's installation script will configure the IJG code. You don't need to read this file if you just want to compile Ghostscript.

If you are on a Unix machine, you may not need to read this file at all.

Try doing

```
./configure
```

```
make
```

```
make test
```

If that doesn't complain, do

```
make install
```

(better do "make -n install" first to see if the makefile will put the files where you want them). Read further if you run into snags or want to customize the code for your system.

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- by hand

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Hints for specific systems

BEFORE YOU START

=====
Before installing the software you must unpack the distributed source code. Since you are reading this file, you have probably already succeeded in this task. However, there is a potential for error if you needed to convert the files to the local standard text file format (for example, if you are on MS-DOS you may have converted LF end-of-line to CR/LF). You must apply such conversion to all the files EXCEPT those whose names begin with "test". The test files contain binary data; if you change them in any way then the self-test will give bad results.

Please check the last section of this file to see if there are hints for the specific machine or compiler you are using.

CONFIGURING THE SOFTWARE

=====

To configure the IJG code for your system, you need to create two files:

- * jconfig.h: contains values for system-dependent #define symbols.
- * Makefile: controls the compilation process.

(On a non-Unix machine, you may create "project files" or some other substitute for a Makefile. jconfig.h is needed in any environment.)

We provide three different ways to generate these files:

- * On a Unix system, you can just run the "configure" script.
- * We provide sample jconfig files and makefiles for popular machines; if your machine matches one of the samples, just copy the right sample files to jconfig.h and Makefile.
- * If all else fails, read the instructions below and make your own files.

Configuring the software using the automatic "configure" script

If you are on a Unix machine, you can just type

```
./configure
```

and let the configure script construct appropriate configuration files.

If you're using "csh" on an old version of System V, you might need to type

```
sh configure
```

instead to prevent csh from trying to execute configure itself.

Expect configure to run for a few minutes, particularly on slower machines; it works by compiling a series of test programs.

Configure was created with GNU Autoconf and it follows the usual conventions for GNU configure scripts. It makes a few assumptions that you may want to override. You can do this by providing optional switches to configure:

* Configure will build both static and shared libraries, if possible.

If you want to build libjpeg only as a static library, say

```
./configure --disable-shared
```

If you want to build libjpeg only as a shared library, say

```
./configure --disable-static
```

Configure uses GNU libtool to take care of system-dependent shared library building methods.

* Configure will use gcc (GNU C compiler) if it's available, otherwise cc.

To force a particular compiler to be selected, use the CC option, for example

```
./configure CC='cc'
```

The same method can be used to include any unusual compiler switches.

For example, on HP-UX you probably want to say

```
./configure CC='cc -Aa'
```

to get HP's compiler to run in ANSI mode.

* The default CFLAGS setting is "-g" for non-gcc compilers, "-g -O2" for gcc.

You can override this by saying, for example,

```
./configure CFLAGS='-O2'
```

if you want to compile without debugging support.

* Configure will set up the makefile so that "make install" will install files into /usr/local/bin, /usr/local/man, etc. You can specify an installation prefix other than "/usr/local" by giving configure the option "--prefix=PATH".

* If you don't have a lot of swap space, you may need to enable the IJG software's internal virtual memory mechanism. To do this, give the option "--enable-maxmem=N" where N is the default maxmemory limit in megabytes. This is discussed in more detail under "Selecting a memory manager", below. You probably don't need to worry about this on reasonably-sized Unix machines, unless you plan to process very large images.

Configure has some other features that are useful if you are cross-compiling or working in a network of multiple machine types; but if you need those features, you probably already know how to use them.

Configuring the software using one of the supplied jconfig and makefile files

If you have one of these systems, you can just use the provided configuration files:

Makefile jconfig file System and/or compiler

makefile.manx jconfig.manx Amiga, Manx Aztec C

makefile.sas jconfig.sas Amiga, SAS C

makeproj.mac jconfig.mac Apple Macintosh, Metrowerks CodeWarrior

mak*jpeg.st jconfig.st Atari ST/STE/TT, Pure C or Turbo C
makefile.bcc jconfig.bcc MS-DOS or OS/2, Borland C
makefile.dj jconfig.dj MS-DOS, DJGPP (Delorie's port of GNU C)
makefile.mc6 jconfig.mc6 MS-DOS, Microsoft C (16-bit only)
makefile.wat jconfig.wat MS-DOS, OS/2, or Windows NT, Watcom C
makefile.vc jconfig.vc Windows, MS Visual C++
makefile.vs jconfig.vc Windows, MS Visual C++ 6 Developer Studio
make*.vc6
makefile.vs jconfig.vc Windows, Visual Studio 2019 (v16)
make*.v16
makefile.b32 jconfig.vc Windows, Borland C++ 32-bit (bcc32)
makefile.mms jconfig.vms Digital VMS, with MMS software
makefile.vms jconfig.vms Digital VMS, without MMS software

Copy the proper jconfig file to jconfig.h and the makefile to Makefile (or whatever your system uses as the standard makefile name). For more info see the appropriate system-specific hints section near the end of this file.

Configuring the software by hand

First, generate a jconfig.h file. If you are moderately familiar with C, the comments in jconfig.txt should be enough information to do this; just copy jconfig.txt to jconfig.h and edit it appropriately. Otherwise, you may prefer to use the ckconfig.c program. You will need to compile and execute ckconfig.c by hand --- we hope you know at least enough to do that. ckconfig.c may not compile the first try (in fact, the whole idea is for it to fail if anything is going to). If you get compile errors, fix them by editing ckconfig.c according to the directions given in ckconfig.c. Once you get it to run, it will write a suitable jconfig.h file, and will also print out some advice about which makefile to use.

You may also want to look at the canned jconfig files, if there is one for a system similar to yours.

Second, select a makefile and copy it to Makefile (or whatever your system uses as the standard makefile name). The most generic makefiles we provide are

makefile.ansi: if your C compiler supports function prototypes
makefile.unix: if not.

(You have function prototypes if ckconfig.c put "#define HAVE_PROTOTYPES" in jconfig.h.) You may want to start from one of the other makefiles if there is one for a system similar to yours.

Look over the selected Makefile and adjust options as needed. In particular you may want to change the CC and CFLAGS definitions. For instance, if you are using GCC, set CC=gcc. If you had to use any compiler switches to get

ckconfig.c to work, make sure the same switches are in CFLAGS.

If you are on a system that doesn't use makefiles, you'll need to set up project files (or whatever you do use) to compile all the source files and link them into executable files cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom. See the file lists in any of the makefiles to find out which files go into each program. Note that the provided makefiles all make a "library" file libjpeg first, but you don't have to do that if you don't want to; the file lists identify which source files are actually needed for compression, decompression, or both. As a last resort, you can make a batch script that just compiles everything and links it all together; makefile.vms is an example of this (it's for VMS systems that have no make-like utility).

Here are comments about some specific configuration decisions you'll need to make:

Command line style

These programs can use a Unix-like command line style which supports redirection and piping, like this:

```
cjpeg inputfile >outputfile
```

```
cjpeg <inputfile >outputfile
```

```
source program | cjpeg >outputfile
```

The simpler "two file" command line style is just

```
cjpeg inputfile outputfile
```

You may prefer the two-file style, particularly if you don't have pipes.

You **MUST** use two-file style on any system that doesn't cope well with binary data fed through stdin/stdout; this is true for some MS-DOS compilers, for example. If you're not on a Unix system, it's safest to assume you need two-file style. (But if your compiler provides either the Posix-standard fdopen() library routine or a Microsoft-compatible setmode() routine, you can safely use the Unix command line style, by defining USE_FDOPEN or USE_SETMODE respectively.)

To use the two-file style, make jconfig.h say "#define TWO_FILE_COMMANDLINE".

Selecting a memory manager

The IJG code is capable of working on images that are too big to fit in main memory; data is swapped out to temporary files as necessary. However, the code to do this is rather system-dependent. We provide five different memory managers:

* jmemansi.c This version uses the ANSI-standard library routine tmpfile(), which not all non-ANSI systems have. On some systems

tmpfile() may put the temporary file in a non-optimal location; if you don't like what it does, use jmemname.c.

* jmemname.c This version creates named temporary files. For anything except a Unix machine, you'll need to configure the select_file_name() routine appropriately; see the comments near the head of jmemname.c. If you use this version, define NEED_SIGNAL_CATCHER in jconfig.h to make sure the temp files are removed if the program is aborted.

* jmemnobs.c (That stands for No Backing Store :-).) This will compile on almost any system, but it assumes you have enough main memory or virtual memory to hold the biggest images you work with.

* jmemdos.c This should be used with most 16-bit MS-DOS compilers. See the system-specific notes about MS-DOS for more info. IMPORTANT: if you use this, define USE_MSDOS_MEMMGR in jconfig.h, and include the assembly file jmemdosa.asm in the programs. The supplied makefiles and jconfig files for 16-bit MS-DOS compilers already do both.

* jmemmac.c Custom version for Apple Macintosh; see the system-specific notes for Macintosh for more info.

To use a particular memory manager, change the SYSDEPMEM variable in your makefile to equal the corresponding object file name (for example, jmemansi.o or jmemansi.obj for jmemansi.c).

If you have plenty of (real or virtual) main memory, just use jmemnobs.c.

"Plenty" means about ten bytes for every pixel in the largest images you plan to process, so a lot of systems don't meet this criterion.

If yours doesn't, try jmemansi.c first. If that doesn't compile, you'll have to use jmemname.c; be sure to adjust select_file_name() for local conditions. You may also need to change unlink() to remove() in close_backing_store().

Except with jmemnobs.c or jmemmac.c, you need to adjust the DEFAULT_MAX_MEM setting to a reasonable value for your system (either by adding a #define for DEFAULT_MAX_MEM to jconfig.h, or by adding a -D switch to the Makefile).

This value limits the amount of data space the program will attempt to allocate. Code and static data space isn't counted, so the actual memory needs for cjpeg or djpeg are typically 100 to 150Kb more than the max-memory setting. Larger max-memory settings reduce the amount of I/O needed to process a large image, but too large a value can result in "insufficient memory" failures. On most Unix machines (and other systems with virtual memory), just set DEFAULT_MAX_MEM to several million and forget it. At the other end of the spectrum, for MS-DOS machines you probably can't go much above 300K to 400K. (On MS-DOS the value refers to conventional memory only. Extended/expanded memory is handled separately by jmemdos.c.)

BUILDING THE SOFTWARE

=====

Now you should be able to compile the software. Just say "make" (or whatever's necessary to start the compilation). Have a cup of coffee.

Here are some things that could go wrong:

If your compiler complains about undefined structures, you should be able to shut it up by putting "#define INCOMPLETE_TYPES_BROKEN" in jconfig.h.

If you have trouble with missing system include files or inclusion of the wrong ones, read jininclude.h. This shouldn't happen if you used configure or ckconfig.c to set up jconfig.h.

There are a fair number of routines that do not use all of their parameters; some compilers will issue warnings about this, which you can ignore. There are also a few configuration checks that may give "unreachable code" warnings. Any other warning deserves investigation.

If you don't have a getenv() library routine, define NO_GETENV.

Also see the system-specific hints, below.

TESTING THE SOFTWARE

=====

As a quick test of functionality we've included a small sample image in several forms:

testorig.jpg Starting point for the djpeg tests.

testing.ppm The output of djpeg testorig.jpg

testing.bmp The output of djpeg -bmp -colors 256 testorig.jpg

testing.jpg The output of cjpeg testing.ppm

testprog.jpg Progressive-mode equivalent of testorig.jpg.

testingp.jpg The output of cjpeg -progressive -optimize testing.ppm

(The first- and second-generation .jpg files aren't identical since the default compression parameters are lossy.) If you can generate duplicates of the testing* files then you probably have working programs.

With most of the makefiles, "make test" will perform the necessary comparisons.

If you're using a makefile that doesn't provide the test option, run djpeg and cjpeg by hand and compare the output files to testing* with whatever binary file comparison tool you have. The files should be bit-for-bit

identical.

If the programs complain "MAX_ALLOC_CHUNK is wrong, please fix", then you need to reduce MAX_ALLOC_CHUNK to a value that fits in type size_t. Try adding "#define MAX_ALLOC_CHUNK 65520L" to jconfig.h. A less likely configuration error is "ALIGN_TYPE is wrong, please fix": defining ALIGN_TYPE as long should take care of that one.

If the cjpeg test run fails with "Missing Huffman code table entry", it's a good bet that you needed to define RIGHT_SHIFT_IS_UNSIGNED. Go back to the configuration step and run ckconfig.c. (This is a good plan for any other test failure, too.)

If you are using Unix (one-file) command line style on a non-Unix system, it's a good idea to check that binary I/O through stdin/stdout actually works. You should get the same results from "djpeg <testorig.jpg >out.ppm" as from "djpeg -outfile out.ppm testorig.jpg". Note that the makefiles all use the latter style and therefore do not exercise stdin/stdout! If this check fails, try recompiling with USE_SETMODE or USE_FDOPEN defined. If it still doesn't work, better use two-file style.

If you chose a memory manager other than jmemnobs.c, you should test that temporary-file usage works. Try "djpeg -bmp -colors 256 -max 0 testorig.jpg" and make sure its output matches testimg.bmp. If you have any really large images handy, try compressing them with -optimize and/or decompressing with -colors 256 to make sure your DEFAULT_MAX_MEM setting is not too large.

NOTE: this is far from an exhaustive test of the JPEG software; some modules, such as 1-pass color quantization, are not exercised at all. It's just a quick test to give you some confidence that you haven't missed something major.

INSTALLING THE SOFTWARE

=====

Once you're done with the above steps, you can install the software by copying the executable files (cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom) to wherever you normally install programs. On Unix systems, you'll also want to put the man pages (cjpeg.1, djpeg.1, jpegtran.1, rdjpgcom.1, wrjpgcom.1) in the man-page directory. The pre-fab makefiles don't support this step since there's such a wide variety of installation procedures on different systems.

If you generated a Makefile with the "configure" script, you can just say
make install
to install the programs and their man pages into the standard places.
(You'll probably need to be root to do this.) We recommend first saying

make -n install

to see where configure thought the files should go. You may need to edit the Makefile, particularly if your system's conventions for man page filenames don't match what configure expects.

If you want to install the IJG library itself, for use in compiling other programs besides ours, then you need to put the four include files

jpeglib.h jerror.h jconfig.h jmorecfg.h

into your include-file directory, and put the library file libjpeg.a

(extension may vary depending on system) wherever library files go.

If you generated a Makefile with "configure", it will do what it thinks is the right thing if you say

make install-lib

OPTIONAL STUFF

=====

Progress monitor:

If you like, you can #define PROGRESS_REPORT (in jconfig.h) to enable display of percent-done progress reports. The routine provided in cdjpeg.c merely prints percentages to stderr, but you can customize it to do something fancier.

Utah RLE file format support:

We distribute the software with support for RLE image files (Utah Raster Toolkit format) disabled, because the RLE support won't compile without the Utah library. If you have URT version 3.1 or later, you can enable RLE support as follows:

1. #define RLE_SUPPORTED in jconfig.h.
2. Add a -I option to CFLAGS in the Makefile for the directory containing the URT .h files (typically the "include" subdirectory of the URT distribution).
3. Add -L... -lrle to LDLIBS in the Makefile, where ... specifies the directory containing the URT "librle.a" file (typically the "lib" subdirectory of the URT distribution).

Support for 9-bit to 12-bit deep pixel data:

The IJG code currently allows 8, 9, 10, 11, or 12 bits sample data precision. (For color, this means 8 to 12 bits per channel, of course.) If you need to work with deeper than 8-bit data, you can compile the IJG code for 9-bit to 12-bit operation.

To do so:

1. In jmorecfg.h, define BITS_IN_JSAMPLE as 9, 10, 11, or 12 rather than 8.
2. In jconfig.h, undefine BMP_SUPPORTED, RLE_SUPPORTED, and TARGA_SUPPORTED,

because the code for those formats doesn't handle deeper than 8-bit data and won't even compile. (The PPM code does work, as explained below. The GIF code works too; it scales 8-bit GIF data to and from 12-bit depth automatically.)

3. Compile. Don't expect "make test" to pass, since the supplied test files are for 8-bit data.

Currently, 9-bit to 12-bit support does not work on 16-bit-int machines.

Run-time selection and conversion of data precision are currently not supported and may be added later.

Exception: The transcoding part (jpegtran) supports all settings in a single instance, since it operates on the level of DCT coefficients and not sample values.

The PPM reader (rdppm.c) can read deeper than 8-bit data from either text-format or binary-format PPM and PGM files. Binary-format PPM/PGM files which have a maxval greater than 255 are assumed to use 2 bytes per sample, MSB first (big-endian order). As of early 1995, 2-byte binary format is not officially supported by the PBMPLUS library, but it is expected that a future release of PBMPLUS will support it. Note that the PPM reader will read files of any maxval regardless of the BITS_IN_JSAMPLE setting; incoming data is automatically rescaled to maxval=MAXJSAMPLE as appropriate for the cjpeg bit depth.

The PPM writer (wrppm.c) will normally write 2-byte binary PPM or PGM format, maxval=MAXJSAMPLE, when compiled with BITS_IN_JSAMPLE>8. Since this format is not yet widely supported, you can disable it by compiling wrppm.c with PPM_NORAWWORD defined; then the data is scaled down to 8 bits to make a standard 1-byte/sample PPM or PGM file. (Yes, this means still another copy of djpeg to keep around. But hopefully you won't need it for very long. Poskanzer's supposed to get that new PBMPLUS release out Real Soon Now.)

Of course, if you are working with 9-bit to 12-bit data, you probably have it stored in some other, nonstandard format. In that case you'll probably want to write your own I/O modules to read and write your format.

Note:

The standard Huffman tables are only valid for 8-bit data precision. If you selected more than 8-bit data precision, cjpeg uses arithmetic coding by default. The Huffman encoder normally uses entropy optimization to compute usable tables for higher precision. Otherwise, you'll have to supply different default Huffman tables.

Removing code:

If you need to make a smaller version of the JPEG software, some optional functions can be removed at compile time. See the xxx_SUPPORTED #defines in

jconfig.h and jmorecfg.h. If at all possible, we recommend that you leave in decoder support for all valid JPEG files, to ensure that you can read anyone's output. Taking out support for image file formats that you don't use is the most painless way to make the programs smaller. Another possibility is to remove some of the DCT methods: in particular, the "IFAST" method may not be enough faster than the others to be worth keeping on your machine. (If you do remove ISLOW or IFAST, be sure to redefine JDCT_DEFAULT or JDCT_FASTEST to a supported method, by adding a #define in jconfig.h.)

OPTIMIZATION

=====

Unless you own a Cray, you'll probably be interested in making the JPEG software go as fast as possible. This section covers some machine-dependent optimizations you may want to try. We suggest that before trying any of this, you first get the basic installation to pass the self-test step. Repeat the self-test after any optimization to make sure that you haven't broken anything.

The integer DCT routines perform a lot of multiplications. These multiplications must yield 32-bit results, but none of their input values are more than 16 bits wide. On many machines, notably the 680x0 and 80x86 CPUs, a 16x16=>32 bit multiply instruction is faster than a full 32x32=>32 bit multiply. Unfortunately there is no portable way to specify such a multiplication in C, but some compilers can generate one when you use the right combination of casts. See the MULTIPLYxxx macro definitions in jdct.h. If your compiler makes "int" be 32 bits and "short" be 16 bits, defining SHORTxSHORT_32 is fairly likely to work. When experimenting with alternate definitions, be sure to test not only whether the code still works (use the self-test), but also whether it is actually faster --- on some compilers, alternate definitions may compute the right answer, yet be slower than the default. Timing cjpeg on a large PGM (grayscale) input file is the best way to check this, as the DCT will be the largest fraction of the runtime in that mode. (Note: some of the distributed compiler-specific jconfig files already contain #define switches to select appropriate MULTIPLYxxx definitions.)

If your machine has sufficiently fast floating point hardware, you may find that the float DCT method is faster than the integer DCT methods, even after tweaking the integer multiply macros. In that case you may want to make the float DCT be the default method. (The only objection to this is that float DCT results may vary slightly across machines.) To do that, add "#define JDCT_DEFAULT JDCT_FLOAT" to jconfig.h. Even if you don't change the default, you should redefine JDCT_FASTEST, which is the method selected by djpeg's -fast switch. Don't forget to update the documentation files (usage.txt and/or cjpeg.1, djpeg.1) to agree with what you've done.

If access to "short" arrays is slow on your machine, it may be a win to define type JCOEF as int rather than short. This will cost a good deal of memory though, particularly in some multi-pass modes, so don't do it unless you have memory to burn and short is REALLY slow.

If your compiler can compile function calls in-line, make sure the INLINE macro in jmorecfg.h is defined as the keyword that marks a function inline-able. Some compilers have a switch that tells the compiler to inline any function it thinks is profitable (e.g., -finline-functions for gcc). Enabling such a switch is likely to make the compiled code bigger but faster.

In general, it's worth trying the maximum optimization level of your compiler, and experimenting with any optional optimizations such as loop unrolling. (Unfortunately, far too many compilers have optimizer bugs ... be prepared to back off if the code fails self-test.) If you do any experimentation along these lines, please report the optimal settings to jpeg-info@jpegclub.org so we can mention them in future releases. Be sure to specify your machine and compiler version.

HINTS FOR SPECIFIC SYSTEMS

=====

We welcome reports on changes needed for systems not mentioned here. Submit 'em to jpeg-info@jpegclub.org. Also, if configure or ckconfig.c is wrong about how to configure the JPEG software for your system, please let us know.

Acorn RISC OS:

(Thanks to Simon Middleton for these hints on compiling with Desktop C.) After renaming the files according to Acorn conventions, take a copy of makefile.ansi, change all occurrences of 'libjpeg.a' to 'libjpeg.o' and change these definitions as indicated:

```
CFLAGS= -throwback -IC: -Wn
LDLIBS=C:o.Stubs
SYSDEPMEM=jmemansi.o
LN=Link
AR=LibFile -c -o
```

Also add a new line 'c.o.; \$(cc) \$< \$(cflags) -c -o \$@'. Remove the lines '\$(RM) libjpeg.o' and '\$(AR2) libjpeg.o' and the 'jconfig.h' dependency section.

Copy jconfig.txt to jconfig.h. Edit jconfig.h to define TWO_FILE_COMMANDLINE and CHAR_IS_UNSIGNED.

Run the makefile using !AMU not !Make. If you want to use the 'clean' and 'test' makefile entries then you will have to fiddle with the syntax a bit and rename the test files.

Amiga:

SAS C 6.50 reportedly is too buggy to compile the IJG code properly. A patch to update to 6.51 is available from SAS or AmiNet FTP sites.

The supplied config files are set up to use jmemname.c as the memory manager, with temporary files being created on the device named by "JPEGTMP:".

Atari ST/STE/TT:

Copy the project files makcjpeg.st, makdjpeg.st, maktjpeg.st, and makljpeg.st to cjpeg.prj, djpeg.prj, jpegtran.prj, and libjpeg.prj respectively. The project files should work as-is with Pure C. For Turbo C, change library filenames "pc..." to "tc..." in each project file. Note that libjpeg.prj selects jmemansi.c as the recommended memory manager. You'll probably want to adjust the DEFAULT_MAX_MEM setting --- you want it to be a couple hundred K less than your normal free memory. Put "#define DEFAULT_MAX_MEM nnnn" into jconfig.h to do this.

To use the 68881/68882 coprocessor for the floating point DCT, add the compiler option "-8" to the project files and replace pcftlib.lib with pc881lib.lib in cjpeg.prj and djpeg.prj. Or if you don't have a coprocessor, you may prefer to remove the float DCT code by undefining DCT_FLOAT_SUPPORTED in jmorecfg.h (since without a coprocessor, the float code will be too slow to be useful). In that case, you can delete pcftlib.lib from the project files.

Note that you must make libjpeg.lib before making cjpeg.ttp, djpeg.ttp, or jpegtran.ttp. You'll have to perform the self-test by hand.

We haven't bothered to include project files for rdjpgcom and wrjpgcom. Those source files should just be compiled by themselves; they don't depend on the JPEG library. You can use the default.prj project file of the Pure C distribution to make the programs.

There is a bug in some older versions of the Turbo C library which causes the space used by temporary files created with "tmpfile()" not to be freed after an abnormal program exit. If you check your disk afterwards, you will find cluster chains that are allocated but not used by a file. This should not happen in cjpeg/djpeg/jpegtran, since we enable a signal catcher to explicitly close temp files before exiting. But if you use the JPEG library with your

own code, be sure to supply a signal catcher, or else use a different system-dependent memory manager.

Cray:

Should you be so fortunate as to be running JPEG on a Cray YMP, there is a compiler bug in old versions of Cray's Standard C (prior to 3.1). If you still have an old compiler, you'll need to insert a line reading "#pragma novector" just before the loop

```
for (i = 1; i <= (int) htbl->bits[l]; i++)
    huffsize[p++] = (char) l;
```

in `fix_huff_tbl` (in V5beta1, line 204 of `jchuff.c` and line 176 of `jdchuff.c`). [This bug may or may not still occur with the current IJG code, but it's probably a dead issue anyway...]

HP-UX:

If you have HP-UX 7.05 or later with the "software development" C compiler, you should run the compiler in ANSI mode. If using the configure script, say

```
./configure CC='cc -Aa'
```

(or `-Ae` if you prefer). If configuring by hand, use `makefile.ansi` and add `"-Aa"` to the `CFLAGS` line in the makefile.

If you have a pre-7.05 system, or if you are using the non-ANSI C compiler delivered with a minimum HP-UX system, then you must use `makefile.unix` (and do NOT add `-Aa`); or just run `configure` without the `CC` option.

On HP 9000 series 800 machines, the HP C compiler is buggy in revisions prior to A.08.07. If you get complaints about "not a typedef name", you'll have to use `makefile.unix`, or run `configure` without the `CC` option.

Macintosh, generic comments:

The supplied user-interface files (`cjpeg.c`, `djpeg.c`, etc) are set up to provide a Unix-style command line interface. You can use this interface on the Mac by means of the `ccommand()` library routine provided by Metrowerks CodeWarrior or Think C. This is only appropriate for testing the library, however; to make a user-friendly equivalent of `cjpeg/djpeg` you'd really want to develop a Mac-style user interface. There isn't a complete example available at the moment, but there are some helpful starting points:

1. Sam Bushell's free "To JPEG" applet provides drag-and-drop conversion to JPEG under System 7 and later. This only illustrates how to use the compression half of the library, but it does a very nice job of that part.

The CodeWarrior source code is available from <http://www.pobox.com/~jsam>.

2. Jim Brunner prepared a Mac-style user interface for both compression and decompression. Unfortunately, it hasn't been updated since IJG v4, and the library's API has changed considerably since then. Still it may be of some help, particularly as a guide to compiling the IJG code under Think C. Jim's code is available from the Info-Mac archives, at sumex-aim.stanford.edu or mirrors thereof; see file `/info-mac/dev/src/jpeg-convert-c.hqx`.

`jmemmac.c` is the recommended memory manager back end for Macintosh. It uses `NewPtr/DisposePtr` instead of `malloc/free`, and has a Mac-specific implementation of `jpeg_mem_available()`. It also creates temporary files that follow Mac conventions. (That part of the code relies on System-7-or-later OS functions. See the comments in `jmemmac.c` if you need to run it on System 6.) NOTE that `USE_MAC_MEMMGR` must be defined in `jconfig.h` to use `jmemmac.c`.

You can also use `jmemnobs.c`, if you don't care about handling images larger than available memory. If you use any memory manager back end other than `jmemmac.c`, we recommend replacing "malloc" and "free" by "NewPtr" and "DisposePtr", because Mac C libraries often have peculiar implementations of `malloc/free`. (For instance, `free()` may not return the freed space to the Mac Memory Manager. This is undesirable for the IJG code because `jmemmgr.c` already clumps space requests.)

Macintosh, Metrowerks CodeWarrior:

The Unix-command-line-style interface can be used by defining `USE_CCOMMAND`. You'll also need to define `TWO_FILE_COMMANDLINE` to avoid `stdin/stdout`. This means that when using the `cjpeg/djpeg` programs, you'll have to type the input and output file names in the "Arguments" text-edit box, rather than using the file radio buttons. (Perhaps `USE_FDOPEN` or `USE_SETMODE` would eliminate the problem, but I haven't heard from anyone who's tried it.)

On 680x0 Macs, Metrowerks defines type "double" as a 10-byte IEEE extended float. `jmemmgr.c` won't like this: it wants `sizeof(ALIGN_TYPE)` to be a power of 2. Add `"#define ALIGN_TYPE long"` to `jconfig.h` to eliminate the complaint.

The supplied configuration file `jconfig.mac` can be used for your `jconfig.h`; it includes all the recommended symbol definitions. If you have AppleScript installed, you can run the supplied script `makeproj.mac` to create CodeWarrior project files for the library and the testbed applications, then build the library and applications. (Thanks to Dan Sears and Don Agro for this nifty hack, which saves us from trying to maintain CodeWarrior project files as part of the IJG distribution...)

Macintosh, Think C:

The documentation in Jim Brunner's "JPEG Convert" source code (see above)

includes detailed build instructions for Think C; it's probably somewhat out of date for the current release, but may be helpful.

If you want to build the minimal command line version, proceed as follows. You'll have to prepare project files for the programs; we don't include any in the distribution since they are not text files. Use the file lists in any of the supplied makefiles as a guide. Also add the ANSI and Unix C libraries in a separate segment. You may need to divide the JPEG files into more than one segment; we recommend dividing compression and decompression modules. Define `USE_CCOMMAND` in `jconfig.h` so that the `ccommand()` routine is called. You must also define `TWO_FILE_COMMANDLINE` because `stdin/stdout` don't handle binary data correctly.

On 680x0 Macs, Think C defines type "double" as a 12-byte IEEE extended float. `jmemmgr.c` won't like this: it wants `sizeof(ALIGN_TYPE)` to be a power of 2. Add `#define ALIGN_TYPE long` to `jconfig.h` to eliminate the complaint.

`jconfig.mac` should work as a `jconfig.h` configuration file for Think C, but the `makeproj.mac` AppleScript script is specific to CodeWarrior. Sorry.

MIPS R3000:

MIPS's `cc` version 1.31 has a rather nasty optimization bug. Don't use `-O` if you have that compiler version. (Use `cc -V` to check the version.) Note that the R3000 chip is found in workstations from DEC and others.

MS-DOS, generic comments for 16-bit compilers:

The IJG code is designed to work well in 80x86 "small" or "medium" memory models (i.e., data pointers are 16 bits unless explicitly declared "far"; code pointers can be either size). You may be able to use small model to compile `cjpeg` or `djpeg` by itself, but you will probably have to use medium model for any larger application. This won't make much difference in performance. You *will* take a noticeable performance hit if you use a large-data memory model, and you should avoid "huge" model if at all possible. Be sure that `NEED_FAR_POINTERS` is defined in `jconfig.h` if you use a small-data memory model; be sure it is NOT defined if you use a large-data model. (The supplied makefiles and `jconfig` files for Borland and Microsoft C compile in medium model and define `NEED_FAR_POINTERS`.)

The DOS-specific memory manager, `jmemdos.c`, should be used if possible. It needs some assembly-code routines which are in `jmemdosa.asm`; make sure your makefile assembles that file and includes it in the library. If you don't have a suitable assembler, you can get pre-assembled object files for `jmemdosa` by FTP from `ftp.uu.net:/graphics/jpeg/jdosaobj.zip`. (DOS-oriented distributions of the IJG source code often include these object files.)

When using `jmemdos.c`, `jconfig.h` must define `USE_MSDOS_MEMMGR` and must set `MAX_ALLOC_CHUNK` to less than 64K (65520L is a typical value). If your C library's far-heap `malloc()` can't allocate blocks that large, reduce `MAX_ALLOC_CHUNK` to whatever it can handle.

If you can't use `jmemdos.c` for some reason --- for example, because you don't have an assembler to assemble `jmemdosa.asm` --- you'll have to fall back to `jmemansi.c` or `jmemname.c`. You'll probably still need to set `MAX_ALLOC_CHUNK` in `jconfig.h`, because most DOS C libraries won't `malloc()` more than 64K at a time. **IMPORTANT:** if you use `jmemansi.c` or `jmemname.c`, you will have to compile in a large-data memory model in order to get the right `stdio` library. Too bad.

`wrjpgcom` needs to be compiled in large model, because it `malloc()`s a 64KB work area to hold the comment text. If your C library's `malloc` can't handle that, reduce `MAX_COM_LENGTH` as necessary in `wrjpgcom.c`.

Most MS-DOS compilers treat `stdin/stdout` as text files, so you must use two-file command line style. But if your compiler has either `fdopen()` or `setmode()`, you can use one-file style if you like. To do this, define `USE_SETMODE` or `USE_FDOPEN` so that `stdin/stdout` will be set to binary mode. (`USE_SETMODE` seems to work with more DOS compilers than `USE_FDOPEN`.) You should test that I/O through `stdin/stdout` produces the same results as I/O to explicitly named files... the "make test" procedures in the supplied makefiles do NOT use `stdin/stdout`.

MS-DOS, generic comments for 32-bit compilers:

None of the above comments about memory models apply if you are using a 32-bit flat-memory-space environment, such as DJGPP or Watcom C. (And you should use one if you have it, as performance will be much better than 8086-compatible code!) For flat-memory-space compilers, do NOT define `NEED_FAR_POINTERS`, and do NOT use `jmemdos.c`. Use `jmemnobs.c` if the environment supplies adequate virtual memory, otherwise use `jmemansi.c` or `jmemname.c`.

You'll still need to be careful about binary I/O through `stdin/stdout`. See the last paragraph of the previous section.

MS-DOS, Borland C:

Be sure to convert all the source files to DOS text format (CR/LF newlines). Although Borland C will often work OK with unmodified Unix (LF newlines) source files, sometimes it will give bogus compile errors.

"Illegal character '#'" is the most common such error. (This is true with

Borland C 3.1, but perhaps is fixed in newer releases.)

If you want one-file command line style, just undefine TWO_FILE_COMMANDLINE.
jconfig.bcc already includes #define USE_SETMODE to make this work.
(fdopen does not work correctly.)

MS-DOS, Microsoft C:

makefile.mc6 works with Microsoft C, DOS Visual C++, etc. It should only
be used if you want to build a 16-bit (small or medium memory model) program.

If you want one-file command line style, just undefine TWO_FILE_COMMANDLINE.
jconfig.mc6 already includes #define USE_SETMODE to make this work.
(fdopen does not work correctly.)

Note that this makefile assumes that the working copy of itself is called
"makefile". If you want to call it something else, say "makefile.mak",
be sure to adjust the dependency line that reads "\$(RFILE) : makefile".
Otherwise the make will fail because it doesn't know how to create "makefile".
Worse, some releases of Microsoft's make utilities give an incorrect error
message in this situation.

Old versions of MS C fail with an "out of macro expansion space" error
because they can't cope with the macro TRACEMS8 (defined in jerror.h).
If this happens to you, the easiest solution is to change TRACEMS8 to
expand to nothing. You'll lose the ability to dump out JPEG coefficient
tables with djpeg -debug -debug, but at least you can compile.

Original MS C 6.0 is very buggy; it compiles incorrect code unless you turn
off optimization entirely (remove -O from CFLAGS). 6.00A is better, but it
still generates bad code if you enable loop optimizations (-Ol or -Ox).

MS C 8.0 crashes when compiling jquant1.c with optimization switch /Oo ...
which is on by default. To work around this bug, compile that one file
with /Oo-.

Microsoft Windows (all versions), generic comments:

Some Windows system include files define typedef boolean as "unsigned char".
The IJG code also defines typedef boolean, but we make it an "enum" by default.
This doesn't affect the IJG programs because we don't import those Windows
include files. But if you use the JPEG library in your own program, and some
of your program's files import one definition of boolean while some import the
other, you can get all sorts of mysterious problems. A good preventive step
is to make the IJG library use "unsigned char" for boolean. To do that,
add something like this to your jconfig.h file:


```

/* Define "boolean" as unsigned char, not enum, per Windows custom */
#ifndef __RPCNDR_H__ /* don't conflict if rpcndr.h already read */
typedef unsigned char boolean;
#endif
#ifndef FALSE /* in case these macros already exist */
#define FALSE 0 /* values of boolean */
#endif
#ifndef TRUE
#define TRUE 1
#endif
#define HAVE_BOOLEAN /* prevent jmorecfg.h from redefining it */
(This is already in jconfig.vc, by the way.)

```

windef.h contains the declarations

```

#define far
#define FAR far

```

Since jmorecfg.h tries to define FAR as empty, you may get a compiler warning if you include both jpeglib.h and windef.h (which windows.h includes). To suppress the warning, you can put "#ifndef FAR" around the line "#define FAR" in jmorecfg.h.

(Something like this is already in jmorecfg.h, by the way.)

When using the library in a Windows application, you will almost certainly want to modify or replace the error handler module jerror.c, since our default error handler does a couple of inappropriate things:

1. it tries to write error and warning messages on stderr;
2. in event of a fatal error, it exits by calling exit().

A simple stopgap solution for problem 1 is to replace the line

```
fprintf(stderr, "%s\n", buffer);
```

(in output_message in jerror.c) with

```
MessageBox(GetActiveWindow(),buffer,"JPEG Error",MB_OK|MB_ICONERROR);
```

It's highly recommended that you at least do that much, since otherwise error messages will disappear into nowhere. (Beginning with IJG v6b, this code is already present in jerror.c; just define USE_WINDOWS_MESSAGEBOX in jconfig.h to enable it.)

The proper solution for problem 2 is to return control to your calling application after a library error. This can be done with the setjmp/longjmp technique discussed in libjpeg.txt and illustrated in example.c. (NOTE: some older Windows C compilers provide versions of setjmp/longjmp that don't actually work under Windows. You may need to use the Windows system functions Catch and Throw instead.)

The recommended memory manager under Windows is jmemnobs.c; in other words, let Windows do any virtual memory management needed. You should NOT use jmemdos.c nor jmemdosa.asm under Windows.

For Windows 3.1, we recommend compiling in medium or large memory model; for newer Windows versions, use a 32-bit flat memory model. (See the MS-DOS sections above for more info about memory models.) In the 16-bit memory models only, you'll need to put

```
#define MAX_ALLOC_CHUNK 65520L /* Maximum request to malloc() */
```

into `jconfig.h` to limit allocation chunks to 64Kb. (Without that, you'd have to use huge memory model, which slows things down unnecessarily.) `jmemnobs.c` works without modification in large or flat memory models, but to use medium model, you need to modify its `jpeg_get_large` and `jpeg_free_large` routines to allocate far memory. In any case, you might like to replace its calls to `malloc` and `free` with direct calls on Windows memory allocation functions.

You may also want to modify `jdatasrc.c` and `jdatadst.c` to use Windows file operations rather than `fread/fwrite`. This is only necessary if your C compiler doesn't provide a competent implementation of C `stdio` functions.

You might want to tweak the `RGB_xxx` macros in `jmorecfg.h` so that the library will accept or deliver color pixels in BGR sample order, not RGB; BGR order is usually more convenient under Windows. Note that this change will break the sample applications `cjpeg/djpeg`, but the library itself works fine.

Many people want to convert the IJG library into a DLL. This is reasonably straightforward, but watch out for the following:

1. Don't try to compile as a DLL in small or medium memory model; use large model, or even better, 32-bit flat model. Many places in the IJG code assume the address of a local variable is an ordinary (not FAR) pointer; that isn't true in a medium-model DLL.

2. Microsoft C cannot pass file pointers between applications and DLLs. (See Microsoft Knowledge Base, PSS ID Number Q50336.) So `jdatasrc.c` and `jdatadst.c` don't work if you open a file in your application and then pass the pointer to the DLL. One workaround is to make `jdatasrc.c/jdatadst.c` part of your main application rather than part of the DLL.

3. You'll probably need to modify the macros `GLOBAL()` and `EXTERN()` to attach suitable linkage keywords to the exported routine names. Similarly, you'll want to modify `METHODDEF()` and `JMETHOD()` to ensure function pointers are declared in a way that lets application routines be called back through the function pointers. These macros are in `jmorecfg.h`. Typical definitions for a 16-bit DLL are:

```
#define GLOBAL(type) type _far _pascal _loadds _export
#define EXTERN(type) extern type _far _pascal _loadds
#define METHODDEF(type) static type _far _pascal
#define JMETHOD(type,methodname,arglist) \
    type (_far _pascal *methodname) arglist
```

For a 32-bit DLL you may want something like

```
#define GLOBAL(type) __declspec(dllexport) type
#define EXTERN(type) extern __declspec(dllexport) type
```

Although not all the GLOBAL routines are actually intended to be called by the application, the performance cost of making them all DLL entry points is negligible.

The unmodified IJG library presents a very C-specific application interface, so the resulting DLL is only usable from C or C++ applications. There has been some talk of writing wrapper code that would present a simpler interface usable from other languages, such as Visual Basic. This is on our to-do list but hasn't been very high priority --- any volunteers out there?

Microsoft Windows, Borland C:

The provided jconfig.bcc should work OK in a 32-bit Windows environment, but you'll need to tweak it in a 16-bit environment (you'd need to define NEED_FAR_POINTERS and MAX_ALLOC_CHUNK). Beware that makefile.bcc will need alteration if you want to use it for Windows --- in particular, you should use jmemnobs.c not jmemdos.c under Windows.

Borland C++ 4.5 fails with an internal compiler error when trying to compile jdmerge.c in 32-bit mode. If enough people complain, perhaps Borland will fix it. In the meantime, the simplest known workaround is to add a redundant definition of the variable range_limit in h2v1_merged_upsample(), at the head of the block that handles odd image width (about line 268 in v6 jdmerge.c):

```
/* If image width is odd, do the last output column separately */
if (cinfo->output_width & 1) {
    register JSAMPLE * range_limit = cinfo->sample_range_limit; /* ADD THIS */
    cb = GETJSAMPLE(*inptr1);
```

Pretty bizarre, especially since the very similar routine h2v2_merged_upsample doesn't trigger the bug.

Recent reports suggest that this bug does not occur with "bcc32a" (the Pentium-optimized version of the compiler).

Another report from a user of Borland C 4.5 was that incorrect code (leading to a color shift in processed images) was produced if any of the following optimization switch combinations were used:

```
-Ot -Og
-Ot -Op
-Ot -Om
```

So try backing off on optimization if you see such a problem. (Are there several different releases all numbered "4.5"??)

Microsoft Windows, Microsoft Visual C++:

jconfig.vc should work OK with any Microsoft compiler for a 32-bit memory model. makefile.vc is intended for command-line use. (If you are using the Developer Studio environment, you may prefer the DevStudio project files; see below.)

IJG JPEG 7 adds extern "C" to jpeglib.h. This avoids the need to put extern "C" { ... } around #include "jpeglib.h" in your C++ application. You can also force VC++ to treat the library as C++ code by renaming all the *.c files to *.cpp (and adjusting the makefile to match). In this case you also need to define the symbol DONT_USE_EXTERN_C in the configuration to prevent jpeglib.h from using extern "C".

Microsoft Windows, Microsoft Visual C++ 6 Developer Studio:

We include makefiles that should work as project files in Developer Studio 6.0 or later. There is a library makefile that builds the IJG library as a static Win32 library, and application makefiles that build the sample applications as Win32 console applications. (Even if you only want the library, we recommend building the applications so that you can run the self-test.)

To use:

1. Open the command prompt, change to the source directory and execute the command line

```
NMAKE /f makefile.vs setup-vc6
```

If you get an error message saying that the "NMAKE" command could not be found, execute the command

```
"%ProgramFiles%\Microsoft Visual Studio\VC98\Bin\VCVARS32"
```

to set the environment for using Microsoft Visual C++ tools, and repeat the NMAKE call.

This will move jconfig.vc to jconfig.h and makefiles to project files.

(Note that the renaming is critical!)

Alternatively you can use

```
NMAKE /f makefile.vs setupcopy-vc6
```

This will create renamed copies of the files, which allows to repeat the setup later.

2. Open the workspace file jpeg.dsw, build the library project.
(If you are using Developer Studio more recent than 6.0, you'll probably get a message saying that the project files are being updated.)
3. Open the workspace file apps.dsw, build the application projects.
4. To perform the self-test, execute the command line

```
NMAKE /f makefile.vs test-build
```
5. Move the application .exe files from the Release folder to an appropriate location on your path.

Microsoft Windows, Visual Studio 2019 (v16):

We include makefiles that should work as project files in Visual Studio 2019 (v16) or later. There is a library makefile that builds the IJG library as a static Win32/x64 library, and application makefiles that build the sample applications as Win32/x64 console applications. (Even if you only want the library, we recommend building the applications so that you can run the self-test.)

To use:

1. Open the Developer Command Prompt for VS 2019, change to the source directory and execute the command line

```
NMAKE /f makefile.vs setup-v16
```

This will move `jconfig.vc` to `jconfig.h` and makefiles to project files.

(Note that the renaming is critical!)

Alternatively you can use

```
NMAKE /f makefile.vs setupcopy-v16
```

This will create renamed copies of the files, which allows to repeat the setup later.

2. Open the solution file `jpeg.sln`, build the library project.

- a) If you are using Visual Studio more recent than 2019 (v16), you'll probably get a message saying that the project files are being updated.

- b) If necessary, open the project properties and adapt the Windows Target Platform Version in the Configuration Properties, General section; we support the latest version at the time of release.

- c) If you want to build x64 code, change the platform setting from Win32 to x64. You can build Win32 and x64 versions side by side.

3. Open the solution file `apps.sln`, build the application projects.

4. To perform the self-test, execute the command line

```
NMAKE /f makefile.vs test-32
```

for the Win32 build, or on a 64-bit system

```
NMAKE /f makefile.vs test-64
```

for the x64 build.

5. Move the application `.exe` files from the Release folder to an appropriate location on your path.

OS/2, Borland C++:

Watch out for optimization bugs in older Borland compilers; you may need to back off the optimization switch settings. See the comments in `makefile.bcc`.

SGI:

On some SGI systems, you may need to set `"AR2= ar -ts"` in the Makefile.

If you are using configure, you can do this by saying

```
./configure RANLIB='ar -ts'
```

This change is not needed on all SGIs. Use it only if the make fails at the stage of linking the completed programs.

On the MIPS R4000 architecture (Indy, etc.), the compiler option "-mips2" reportedly speeds up the float DCT method substantially, enough to make it faster than the default int method (but still slower than the fast int method). If you use -mips2, you may want to alter the default DCT method to be float. To do this, put "#define JDCT_DEFAULT JDCT_FLOAT" in jconfig.h.

VMS:

On an Alpha/VMS system with MMS, be sure to use the "/Marco=Alpha=1" qualifier with MMS when building the JPEG package.

VAX/VMS v5.5-1 may have problems with the test step of the build procedure reporting differences when it compares the original and test images. If the error points to the last block of the files, it is most likely bogus and may be safely ignored. It seems to be because the files are Stream_LF and Backup/Compare has difficulty with the (presumably) null padded files. This problem was not observed on VAX/VMS v6.1 or AXP/VMS v6.1.

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/install.txt
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* jversion.h
```

```
*
```

```
* Copyright (C) 1991-2020, Thomas G. Lane, Guido Vollbeding.
```

```
* This file is part of the Independent JPEG Group's software.
```

```
* For conditions of distribution and use, see the accompanying README file.
```

```
*
```

```
* This file contains software version identification.
```

```
*/
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jversion.h
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* jconfig.txt
```

```
*
```

```
* Copyright (C) 1991-1994, Thomas G. Lane.
```

```
* Modified 2009-2013 by Guido Vollbeding.
```

```
* This file is part of the Independent JPEG Group's software.
```

```

* For conditions of distribution and use, see the accompanying README file.
*
* This file documents the configuration options that are required to
* customize the JPEG software for a particular system.
*
* The actual configuration options for a particular installation are stored
* in jconfig.h. On many machines, jconfig.h can be generated automatically
* or copied from one of the "canned" jconfig files that we supply. But if
* you need to generate a jconfig.h file by hand, this file tells you how.
*
* DO NOT EDIT THIS FILE --- IT WON'T ACCOMPLISH ANYTHING.
* EDIT A COPY NAMED JCONFIG.H.
*/

/*
* These symbols indicate the properties of your machine or compiler.
* #define the symbol if yes, #undef it if no.
*/

/* Does your compiler support function prototypes?
* (If not, you also need to use ansi2knr, see install.txt)
*/
#define HAVE_PROTOTYPES

/* Does your compiler support the declaration "unsigned char" ?
* How about "unsigned short" ?
*/
#define HAVE_UNSIGNED_CHAR
#define HAVE_UNSIGNED_SHORT

/* Define "void" as "char" if your compiler doesn't know about type void.
* NOTE: be sure to define void such that "void *" represents the most general
* pointer type, e.g., that returned by malloc().
*/
/* #define void char */

/* Define "const" as empty if your compiler doesn't know the "const" keyword.
*/
/* #define const */

/* Define this if an ordinary "char" type is unsigned.
* If you're not sure, leaving it undefined will work at some cost in speed.
* If you defined HAVE_UNSIGNED_CHAR then the speed difference is minimal.
*/
#undef CHAR_IS_UNSIGNED

/* Define this if your system has an ANSI-conforming <stddef.h> file.

```

```

*/
#define HAVE_STDDEF_H

/* Define this if your system has an ANSI-conforming <stdlib.h> file.
*/
#define HAVE_STDLIB_H

/* Define this if your system does not have an ANSI/SysV <string.h>,
* but does have a BSD-style <strings.h>.
*/
#undef NEED_BSD_STRINGS

/* Define this if your system does not provide typedef size_t in any of the
* ANSI-standard places (stddef.h, stdlib.h, or stdio.h), but places it in
* <sys/types.h> instead.
*/
#undef NEED_SYS_TYPES_H

/* For 80x86 machines, you need to define NEED_FAR_POINTERS,
* unless you are using a large-data memory model or 80386 flat-memory mode.
* On less brain-damaged CPUs this symbol must not be defined.
* (Defining this symbol causes large data structures to be referenced through
* "far" pointers and to be allocated with a special version of malloc.)
*/
#undef NEED_FAR_POINTERS

/* Define this if your linker needs global names to be unique in less
* than the first 15 characters.
*/
#undef NEED_SHORT_EXTERNAL_NAMES

/* Although a real ANSI C compiler can deal perfectly well with pointers to
* unspecified structures (see "incomplete types" in the spec), a few pre-ANSI
* and pseudo-ANSI compilers get confused. To keep one of these bozos happy,
* define INCOMPLETE_TYPES_BROKEN. This is not recommended unless you
* actually get "missing structure definition" warnings or errors while
* compiling the JPEG code.
*/
#undef INCOMPLETE_TYPES_BROKEN

/* Define "boolean" as unsigned char, not enum, on Windows systems.
*/
#ifdef _WIN32
#ifndef __RPCNDR_H__ /* don't conflict if rpcnldr.h already read */
typedef unsigned char boolean;
#endif
#endif
#ifndef FALSE /* in case these macros already exist */
#define FALSE 0 /* values of boolean */

```



```

#endif
#ifndef TRUE
#define TRUE 1
#endif
#define HAVE_BOOLEAN /* prevent jmorecfg.h from redefining it */
#endif

/*
 * The following options affect code selection within the JPEG library,
 * but they don't need to be visible to applications using the library.
 * To minimize application namespace pollution, the symbols won't be
 * defined unless JPEG_INTERNALS has been defined.
 */

#ifdef JPEG_INTERNALS

/* Define this if your compiler implements ">>" on signed values as a logical
 * (unsigned) shift; leave it undefined if ">>" is a signed (arithmetic) shift,
 * which is the normal and rational definition.
 */
#undef RIGHT_SHIFT_IS_UNSIGNED

#endif /* JPEG_INTERNALS */

/*
 * The remaining options do not affect the JPEG library proper,
 * but only the sample applications cjpeg/djpeg (see cjpeg.c, djpeg.c).
 * Other applications can ignore these.
 */

#ifdef JPEG_CJPEG_DJPEG

/* These defines indicate which image (non-JPEG) file formats are allowed. */

#define BMP_SUPPORTED /* BMP image file format */
#define GIF_SUPPORTED /* GIF image file format */
#define PPM_SUPPORTED /* PBMPLUS PPM/PGM image file format */
#undef RLE_SUPPORTED /* Utah RLE image file format */
#define TARGA_SUPPORTED /* Targa image file format */

/* Define this if you want to name both input and output files on the command
 * line, rather than using stdout and optionally stdin. You MUST do this if
 * your system can't cope with binary I/O to stdin/stdout. See comments at
 * head of cjpeg.c or djpeg.c.
 */

```

```
#undef TWO_FILE_COMMANDLINE
```

```
/* Define this if your system needs explicit cleanup of temporary files.  
* This is crucial under MS-DOS, where the temporary "files" may be areas  
* of extended memory; on most other systems it's not as important.  
*/
```

```
#undef NEED_SIGNAL_CATCHER
```

```
/* By default, we open image files with fopen(...,"rb") or fopen(...,"wb").  
* This is necessary on systems that distinguish text files from binary files,  
* and is harmless on most systems that don't. If you have one of the rare  
* systems that complains about the "b" spec, define this symbol.  
*/
```

```
#undef DONT_USE_B_MODE
```

```
/* Define this if you want percent-done progress reports from cjpeg/djpeg.  
*/
```

```
#undef PROGRESS_REPORT
```

```
#endif /* JPEG_CJPEG_DJPEG */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jconfig.txt
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* jdmerge.c
```

```
*
```

```
* Copyright (C) 1994-1996, Thomas G. Lane.
```

```
* Modified 2013-2019 by Guido Vollbeding.
```

```
* This file is part of the Independent JPEG Group's software.
```

```
* For conditions of distribution and use, see the accompanying README file.
```

```
*
```

```
* This file contains code for merged upsampling/color conversion.
```

```
*
```

```
* This file combines functions from jdsample.c and jdcolor.c;
```

```
* read those files first to understand what's going on.
```

```
*
```

```
* When the chroma components are to be upsampled by simple replication
```

```
* (ie, box filtering), we can save some work in color conversion by
```

```
* calculating all the output pixels corresponding to a pair of chroma
```

```
* samples at one time. In the conversion equations
```

```
*  $R = Y + K1 * Cr$ 
```

```
*  $G = Y + K2 * Cb + K3 * Cr$ 
```

```
*  $B = Y + K4 * Cb$ 
```

```
* only the Y term varies among the group of pixels corresponding to a pair
```

```
* of chroma samples, so the rest of the terms can be calculated just once.
```

- * At typical sampling ratios, this eliminates half or three-quarters of the
- * multiplications needed for color conversion.
- *
- * This file currently provides implementations for the following cases:
- * YCC => RGB color conversion only (YCbCr or BG_YCC).
- * Sampling ratios of 2h1v or 2h2v.
- * No scaling needed at upsample time.
- * Corner-aligned (non-CCIR601) sampling alignment.
- * Other special cases could be added, but in most applications these are
- * the only common cases. (For uncommon cases we fall back on the more
- * general code in jdsample.c and jdcolor.c.)
- */

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmerge.c

No license file was found, but licenses were detected in source scan.

/*

* jdapimin.c

*

* Copyright (C) 1994-1998, Thomas G. Lane.

* Modified 2009-2013 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

* This file contains application interface code for the decompression half

* of the JPEG library. These are the "minimum" API routines that may be

* needed in either the normal full-decompression case or the

* transcoding-only case.

*

* Most of the routines intended to be called directly by an application

* are in this file or in jdpastd.c. But also see jcomapi.c for routines

* shared by compression and decompression, and jdtrans.c for the transcoding

* case.

*/

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdapimin.c

No license file was found, but licenses were detected in source scan.

/*

* jpeglib.h

*

* Copyright (C) 1991-1998, Thomas G. Lane.

* Modified 2002-2019 by Guido Vollbeding.

* This file is part of the Independent JPEG Group's software.

* For conditions of distribution and use, see the accompanying README file.

*

- * This file defines the application interface for the JPEG library.
- * Most applications using the library need only include this file,
- * and perhaps jerror.h if they want to know the exact error codes.
- */

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jpeglib.h

No license file was found, but licenses were detected in source scan.

The Independent JPEG Group's JPEG software

=====

README for release 9d of 12-Jan-2020

=====

This distribution contains the ninth public release of the Independent JPEG Group's free JPEG software. You are welcome to redistribute this software and to use it for any purpose, subject to the conditions under LEGAL ISSUES, below.

This software is the work of Tom Lane, Guido Vollbeding, Philip Gladstone, Bill Allombert, Jim Boucher, Lee Crocker, Bob Friesenhahn, Ben Jackson, John Korejwa, Julian Minguillon, Luis Ortiz, George Phillips, Davide Rossi, Ge' Weijers, and other members of the Independent JPEG Group.

IJG is not affiliated with the ISO/IEC JTC1/SC29/WG1 standards committee (previously known as JPEG, together with ITU-T SG16).

DOCUMENTATION ROADMAP

=====

This file contains the following sections:

- OVERVIEW General description of JPEG and the IJG software.
- LEGAL ISSUES Copyright, lack of warranty, terms of distribution.
- REFERENCES Where to learn more about JPEG.
- ARCHIVE LOCATIONS Where to find newer versions of this software.
- ACKNOWLEDGMENTS Special thanks.
- FILE FORMAT WARS Software *not* to get.
- TO DO Plans for future IJG releases.

Other documentation files in the distribution are:

User documentation:

- install.txt How to configure and install the IJG software.
- usage.txt Usage instructions for cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom.
- *.1 Unix-style man pages for programs (same info as usage.txt).

wizard.txt Advanced usage instructions for JPEG wizards only.
change.log Version-to-version change highlights.
Programmer and internal documentation:
libjpeg.txt How to use the JPEG library in your own programs.
example.c Sample code for calling the JPEG library.
structure.txt Overview of the JPEG library's internal structure.
filelist.txt Road map of IJG files.
coderrules.txt Coding style rules --- please read if you contribute code.

Please read at least the files install.txt and usage.txt. Some information can also be found in the JPEG FAQ (Frequently Asked Questions) article. See ARCHIVE LOCATIONS below to find out where to obtain the FAQ article.

If you want to understand how the JPEG code works, we suggest reading one or more of the REFERENCES, then looking at the documentation files (in roughly the order listed) before diving into the code.

OVERVIEW

=====

This package contains C software to implement JPEG image encoding, decoding, and transcoding. JPEG (pronounced "jay-peg") is a standardized compression method for full-color and grayscale images.

This software implements JPEG baseline, extended-sequential, and progressive compression processes. Provision is made for supporting all variants of these processes, although some uncommon parameter settings aren't implemented yet. We have made no provision for supporting the hierarchical or lossless processes defined in the standard.

We provide a set of library routines for reading and writing JPEG image files, plus two sample applications "cjpeg" and "djpeg", which use the library to perform conversion between JPEG and some other popular image file formats. The library is intended to be reused in other applications.

In order to support file conversion and viewing software, we have included considerable functionality beyond the bare JPEG coding/decoding capability; for example, the color quantization modules are not strictly part of JPEG decoding, but they are essential for output to colormapped file formats or colormapped displays. These extra functions can be compiled out of the library if not required for a particular application.

We have also included "jpegtran", a utility for lossless transcoding between different JPEG processes, and "rdjpgcom" and "wrjpgcom", two simple applications for inserting and extracting textual comments in JFIF files.

The emphasis in designing this software has been on achieving portability and

flexibility, while also making it fast enough to be useful. In particular, the software is not intended to be read as a tutorial on JPEG. (See the REFERENCES section for introductory material.) Rather, it is intended to be reliable, portable, industrial-strength code. We do not claim to have achieved that goal in every aspect of the software, but we strive for it.

We welcome the use of this software as a component of commercial products. No royalty is required, but we do ask for an acknowledgement in product documentation, as described under LEGAL ISSUES.

LEGAL ISSUES

=====

In plain English:

1. We don't promise that this software works. (But if you find any bugs, please let us know!)
2. You can use this software for whatever you want. You don't have to pay us.
3. You may not pretend that you wrote this software. If you use it in a program, you must acknowledge somewhere in your documentation that you've used the IJG code.

In legalese:

The authors make NO WARRANTY or representation, either express or implied, with respect to this software, its quality, accuracy, merchantability, or fitness for a particular purpose. This software is provided "AS IS", and you, its user, assume the entire risk as to its quality and accuracy.

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- (2) If only executable code is distributed, then the accompanying documentation must state that "this software is based in part on the work of the Independent JPEG Group".
- (3) Permission for use of this software is granted only if the user accepts full responsibility for any undesirable consequences; the authors accept NO LIABILITY for damages of any kind.

These conditions apply to any software derived from or based on the IJG code,

not just to the unmodified library. If you use our work, you ought to acknowledge us.

Permission is NOT granted for the use of any IJG author's name or company name in advertising or publicity relating to this software or products derived from it. This software may be referred to only as "the Independent JPEG Group's software".

We specifically permit and encourage the use of this software as the basis of commercial products, provided that all warranty or liability claims are assumed by the product vendor.

The Unix configuration script "configure" was produced with GNU Autoconf. It is copyright by the Free Software Foundation but is freely distributable. The same holds for its supporting scripts (config.guess, config.sub, ltmain.sh). Another support script, install-sh, is copyright by X Consortium but is also freely distributable.

REFERENCES

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We recommend reading one or more of these references before trying to understand the innards of the JPEG software.

The best short technical introduction to the JPEG compression algorithm is Wallace, Gregory K. "The JPEG Still Picture Compression Standard", Communications of the ACM, April 1991 (vol. 34 no. 4), pp. 30-44. (Adjacent articles in that issue discuss MPEG motion picture compression, applications of JPEG, and related topics.) If you don't have the CACM issue handy, a PDF file containing a revised version of Wallace's article is available at <http://www.ijg.org/files/Wallace.JPEG.pdf>. The file (actually a preprint for an article that appeared in IEEE Trans. Consumer Electronics) omits the sample images that appeared in CACM, but it includes corrections and some added material. Note: the Wallace article is copyright ACM and IEEE, and it may not be used for commercial purposes.

A somewhat less technical, more leisurely introduction to JPEG can be found in "The Data Compression Book" by Mark Nelson and Jean-loup Gailly, published by M&T Books (New York), 2nd ed. 1996, ISBN 1-55851-434-1. This book provides good explanations and example C code for a multitude of compression methods including JPEG. It is an excellent source if you are comfortable reading C code but don't know much about data compression in general. The book's JPEG sample code is far from industrial-strength, but when you are ready to look at a full implementation, you've got one here...

The best currently available description of JPEG is the textbook "JPEG Still

Image Data Compression Standard" by William B. Pennebaker and Joan L. Mitchell, published by Van Nostrand Reinhold, 1993, ISBN 0-442-01272-1. Price US\$59.95, 638 pp. The book includes the complete text of the ISO JPEG standards (DIS 10918-1 and draft DIS 10918-2).

Although this is by far the most detailed and comprehensive exposition of JPEG publicly available, we point out that it is still missing an explanation of the most essential properties and algorithms of the underlying DCT technology.

If you think that you know about DCT-based JPEG after reading this book, then you are in delusion. The real fundamentals and corresponding potential of DCT-based JPEG are not publicly known so far, and that is the reason for all the mistaken developments taking place in the image coding domain.

The original JPEG standard is divided into two parts, Part 1 being the actual specification, while Part 2 covers compliance testing methods. Part 1 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 1: Requirements and guidelines" and has document numbers ISO/IEC IS 10918-1, ITU-T T.81. Part 2 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 2: Compliance testing" and has document numbers ISO/IEC IS 10918-2, ITU-T T.83.

IJG JPEG 8 introduced an implementation of the JPEG SmartScale extension which is specified in two documents: A contributed document at ITU and ISO with title "ITU-T JPEG-Plus Proposal for Extending ITU-T T.81 for Advanced Image Coding", April 2006, Geneva, Switzerland. The latest version of this document is Revision 3. And a contributed document ISO/IEC JTC1/SC29/WG1 N 5799 with title "Evolution of JPEG", June/July 2011, Berlin, Germany.

IJG JPEG 9 introduces a reversible color transform for improved lossless compression which is described in a contributed document ISO/IEC JTC1/SC29/WG1 N 6080 with title "JPEG 9 Lossless Coding", June/July 2012, Paris, France.

The JPEG standard does not specify all details of an interchangeable file format. For the omitted details we follow the "JFIF" conventions, version 2. JFIF version 1 has been adopted as Recommendation ITU-T T.871 (05/2011) : Information technology - Digital compression and coding of continuous-tone still images: JPEG File Interchange Format (JFIF). It is available as a free download in PDF file format from <http://www.itu.int/rec/T-REC-T.871>. A PDF file of the older JFIF document is available at <http://www.w3.org/Graphics/JPEG/jfif3.pdf>.

The TIFF 6.0 file format specification can be obtained by FTP from <ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps.gz>. The JPEG incorporation scheme found in the TIFF 6.0 spec of 3-June-92 has a number of serious problems. IJG does not recommend use of the TIFF 6.0 design (TIFF Compression tag 6). Instead, we recommend the JPEG design proposed by TIFF Technical Note #2 (Compression tag 7). Copies of this Note can be obtained from <http://www.ijg.org/files/>. It is expected that the next revision of the TIFF spec will replace the 6.0 JPEG design with the Note's design.

Although IJG's own code does not support TIFF/JPEG, the free libtiff library uses our library to implement TIFF/JPEG per the Note.

ARCHIVE LOCATIONS

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The "official" archive site for this software is www.ijg.org.

The most recent released version can always be found there in directory "files". This particular version will be archived as <http://www.ijg.org/files/jpegsrc.v9d.tar.gz>, and in Windows-compatible "zip" archive format as <http://www.ijg.org/files/jpegsr9d.zip>.

The JPEG FAQ (Frequently Asked Questions) article is a source of some general information about JPEG.

It is available on the World Wide Web at <http://www.faqs.org/faqs/jpeg-faq/> and other news.answers archive sites, including the official news.answers archive at [rtfm.mit.edu: ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/](ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/). If you don't have Web or FTP access, send e-mail to mail-server@rtfm.mit.edu with body
send usenet/news.answers/jpeg-faq/part1
send usenet/news.answers/jpeg-faq/part2

ACKNOWLEDGMENTS

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Thank to Juergen Bruder for providing me with a copy of the common DCT algorithm article, only to find out that I had come to the same result in a more direct and comprehensible way with a more generative approach.

Thank to Istvan Sebestyen and Joan L. Mitchell for inviting me to the ITU JPEG (Study Group 16) meeting in Geneva, Switzerland.

Thank to Thomas Wiegand and Gary Sullivan for inviting me to the Joint Video Team (MPEG & ITU) meeting in Geneva, Switzerland.

Thank to Thomas Richter and Daniel Lee for inviting me to the ISO/IEC JTC1/SC29/WG1 (previously known as JPEG, together with ITU-T SG16) meeting in Berlin, Germany.

Thank to John Korejwa and Massimo Ballerini for inviting me to fruitful consultations in Boston, MA and Milan, Italy.

Thank to Hendrik Elstner, Roland Fassauer, Simone Zuck, Guenther Maier-Gerber, Walter Stoeber, Fred Schmitz, and Norbert Braunagel for corresponding business development.

Thank to Nico Zschach and Dirk Stelling of the technical support team at the Digital Images company in Halle for providing me with extra equipment for configuration tests.

Thank to Richard F. Lyon (then of Foveon Inc.) for fruitful communication about JPEG configuration in Sigma Photo Pro software.

Thank to Andrew Finkenstadt for hosting the ijg.org site.

Thank to Thomas G. Lane for the original design and development of this singular software package.

Thank to Lars Goehler, Andreas Heinecke, Sebastian Fuss, Yvonne Roebert, Andrej Werner, and Ulf-Dietrich Braumann for support and public relations.

FILE FORMAT WARS

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The ISO/IEC JTC1/SC29/WG1 standards committee (previously known as JPEG, together with ITU-T SG16) currently promotes different formats containing the name "JPEG" which is misleading because these formats are incompatible with original DCT-based JPEG and are based on faulty technologies.

IJG therefore does not and will not support such momentary mistakes (see REFERENCES).

There exist also distributions under the name "OpenJPEG" promoting such kind of formats which is misleading because they don't support original JPEG images.

We have no sympathy for the promotion of inferior formats. Indeed, one of the original reasons for developing this free software was to help force convergence on common, interoperable format standards for JPEG files.

Don't use an incompatible file format!

(In any case, our decoder will remain capable of reading existing JPEG image files indefinitely.)

The ISO committee pretends to be "responsible for the popular JPEG" in their public reports which is not true because they don't respond to actual requirements for the maintenance of the original JPEG specification.

Furthermore, the ISO committee pretends to "ensure interoperability" with their standards which is not true because their "standards" support only application-specific and proprietary use cases and contain mathematically incorrect code.

There are currently different distributions in circulation containing the name "libjpeg" which is misleading because they don't have the features and are incompatible with formats supported by actual IJG libjpeg distributions. One of those fakes is released by members of the ISO committee and just uses the name of libjpeg for misdirection of people, similar to the abuse of the

name JPEG as described above, while having nothing in common with actual IJG libjpeg distributions and containing mathematically incorrect code.

The other one claims to be a "derivative" or "fork" of the original libjpeg, but violates the license conditions as described under LEGAL ISSUES above and violates basic C programming properties.

We have no sympathy for the release of misleading, incorrect and illegal distributions derived from obsolete code bases.

Don't use an obsolete code base!

According to the UCC (Uniform Commercial Code) law, IJG has the lawful and legal right to foreclose on certain standardization bodies and other institutions or corporations that knowingly perform substantial and systematic deceptive acts and practices, fraud, theft, and damaging of the value of the people of this planet without their knowing, willing and intentional consent.

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IJG asserts what is: that each man, woman, and child has unalienable value and rights granted and deposited in them by the Creator and not any one of the people is subordinate to any artificial principality, corporate fiction or the special interest of another without their appropriate knowing, willing and intentional consent made by contract or accommodation agreement. IJG expresses that which already was.

The people have already determined and demanded that public administration entities, national governments, and their supporting judicial systems must be fully transparent, accountable, and liable.

IJG has secured the value for all concerned free people of the planet.

A partial list of foreclosed institutions and corporations ("Hall of Shame") is currently prepared and will be published later.

TO DO

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Version 9 is the second release of a new generation JPEG standard to overcome the limitations of the original JPEG specification, and is the first true source reference JPEG codec.

More features are being prepared for coming releases...

Please send bug reports, offers of help, etc. to jpeg-info@jpegclub.org.

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* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/README

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```
/*
 * jcrepct.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains the compression preprocessing controller.
 * This controller manages the color conversion, downsampling,
 * and edge expansion steps.
 *
 * Most of the complexity here is associated with buffering input rows
 * as required by the downsampler. See the comments at the head of
 * jcsample.c for the downsampler's needs.
 */
```

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```
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```

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```
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 * wrtarga.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2015-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains routines to write output images in Targa format.
 *
 * These routines may need modification for non-Unix environments or
 * specialized applications. As they stand, they assume output to
 * an ordinary stdio stream.
 *
 * Based on code contributed by Lee Daniel Crocker.
 */
```

Found in path(s):

```
* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrtarga.c
```

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```
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 * jcinit.c
 *
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 * Modified 2003-2017 by Guido Vollbeding.
```

* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains initialization logic for the JPEG compressor.
* This routine is in charge of selecting the modules to be executed and
* making an initialization call to each one.
*
* Logically, this code belongs in jcmaster.c. It's split out because
* linking this routine implies linking the entire compression library.
* For a transcoding-only application, we want to be able to use jcmaster.c
* without linking in the whole library.
*/

Found in path(s):

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/*

* jcomapi.c

*

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*

* This file contains application interface routines that are used for both

* compression and decompression.

*/

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* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcomapi.c

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/*

* jmehsys.h

*

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*

* This include file defines the interface between the system-independent

* and system-dependent portions of the JPEG memory manager. No other

* modules need include it. (The system-independent portion is jmehmgr.c;

* there are several different versions of the system-dependent portion.)

*

* This file works as-is for the system-dependent memory managers supplied

* in the IJG distribution. You may need to modify it if you write a

* custom memory manager. If system-dependent changes are needed in

```
* this file, the best method is to #ifdef them based on a configuration
* symbol supplied in jconfig.h, as we have done with USE_MSDOS_MEMMGR
* and USE_MAC_MEMMGR.
*/
```

Found in path(s):

```
*/opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemsys.h
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```

```
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* rdrle.c
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* Modified 2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains routines to read input images in Utah RLE format.
* The Utah Raster Toolkit library is required (version 3.1 or later).
*
* These routines may need modification for non-Unix environments or
* specialized applications. As they stand, they assume input from
* an ordinary stdio stream. They further assume that reading begins
* at the start of the file; start_input may need work if the
* user interface has already read some data (e.g., to determine that
* the file is indeed RLE format).
*
* Based on code contributed by Mike Lijewski,
* with updates from Robert Hutchinson.
*/
```

Found in path(s):

```
*/opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdrle.c
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```

```
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* jctrans.c
*
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* Modified 2000-2017 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains library routines for transcoding compression,
* that is, writing raw DCT coefficient arrays to an output JPEG file.
* The routines in jcapimin.c will also be needed by a transcoder.
*/
```

Found in path(s):

* /opt/cola/permits/1095780917_1601546048.33/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jctrans.c

1.36 alsa-plugins 1.2.6

1.36.1 Available under license :

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Version 2, June 1991

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```
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```

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1.38 qt 6.2.3

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/*

* SpanDSP - a series of DSP components for telephony

*

* g722_decode.c - The ITU G.722 codec, decode part.

*

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*

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NAME: WebDriver

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debug

```
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```

```

```

A tiny JavaScript debugging utility modelled after Node.js core's debugging technique. Works in Node.js and web browsers.

Installation

```
```bash
$ npm install debug
```
```

Usage

`debug`` exposes a function; simply pass this function the name of your module, and it will return a decorated version of `console.error`` for you to pass debug statements to. This will allow you to toggle the debug output for different parts of your module as well as the module as a whole.

Example [_app.js_](./examples/node/app.js):

```
```js
var debug = require('debug')('http')
, http = require('http')
, name = 'My App';

// fake app

debug('booting %o', name);

http.createServer(function(req, res){
 debug(req.method + ' ' + req.url);
 res.end('hello\n');
}).listen(3000, function(){
 debug('listening');
});

// fake worker of some kind

require('./worker');
```
```

Example [_worker.js_](./examples/node/worker.js):

```
```js
var a = require('debug')('worker:a')
, b = require('debug')('worker:b');

function work() {
 a('doing lots of uninteresting work');
 setTimeout(work, Math.random() * 1000);
}

work();

function workb() {
```

```
b('doing some work');
setTimeout(workb, Math.random() * 2000);
}

workb();
...

```

The `DEBUG` environment variable is then used to enable these based on space or comma-delimited names.

Here are some examples:

```



```

#### Windows command prompt notes

##### CMD

On Windows the environment variable is set using the `set` command.

```
```cmd
set DEBUG=*,-not_this
```

```

Example:

```
```cmd
set DEBUG=* & node app.js
```

```

##### PowerShell (VS Code default)

PowerShell uses different syntax to set environment variables.

```
```cmd
$env:DEBUG = "*,-not_this"
```

```

Example:

```
```cmd
$env:DEBUG='app';node app.js
```

```

Then, run the program to be debugged as usual.

npm script example:

```
```.js
"windowsDebug": "@powershell -Command $env:DEBUG='*';node app.js",
```.
```

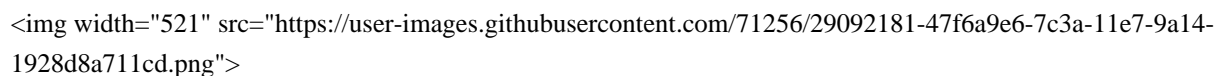
## ## Namespace Colors

Every debug instance has a color generated for it based on its namespace name.

This helps when visually parsing the debug output to identify which debug instance a debug line belongs to.

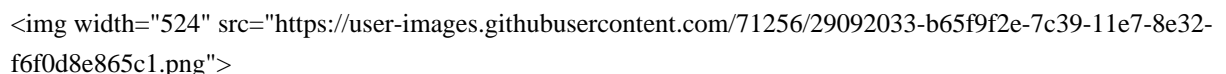
## #### Node.js

In Node.js, colors are enabled when stderr is a TTY. You also should install the `[ supports-color ]`(<https://npmjs.org/supports-color>) module alongside debug, otherwise debug will only use a small handful of basic colors.



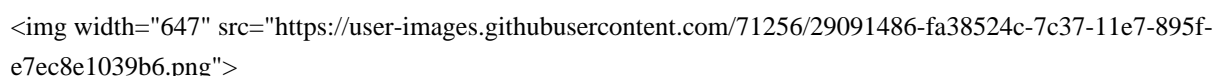
## #### Web Browser

Colors are also enabled on "Web Inspectors" that understand the ``%c`` formatting option. These are WebKit web inspectors, Firefox ([since version 31](<https://hacks.mozilla.org/2014/05/editable-box-model-multiple-selection-sublime-text-keys-much-more-firefox-developer-tools-episode-31/>)) and the Firebug plugin for Firefox (any version).



## ## Millisecond diff

When actively developing an application it can be useful to see when the time spent between one ``debug()`` call and the next. Suppose for example you invoke ``debug()`` before requesting a resource, and after as well, the `"+NNNms"` will show you how much time was spent between calls.



When stdout is not a TTY, ``Date#toISOString()`` is used, making it more useful for logging the debug information as shown below:



c948396d6edd.png">

## ## Conventions

If you're using this in one or more of your libraries, you should use the name of your library so that developers may toggle debugging as desired without guessing names. If you have more than one debuggers you should prefix them with your library name and use ":" to separate features. For example "bodyParser" from Connect would then be "connect:bodyParser". If you append a "\*" to the end of your name, it will always be enabled regardless of the setting of the DEBUG environment variable. You can then use it for normal output as well as debug output.

## ## Wildcards

The "\*" character may be used as a wildcard. Suppose for example your library has debuggers named "connect:bodyParser", "connect:compress", "connect:session", instead of listing all three with

```
`DEBUG=connect:bodyParser,connect:compress,connect:session`, you may simply do
`DEBUG=connect:*`, or to run everything using this module simply use `DEBUG=*`.
```

You can also exclude specific debuggers by prefixing them with a "-" character. For example, `DEBUG=\*,-connect:\*` would include all debuggers except those starting with "connect:".

## ## Environment Variables

When running through Node.js, you can set a few environment variables that will change the behavior of the debug logging:

Name	Purpose
`DEBUG`	Enables/disables specific debugging namespaces.
`DEBUG_HIDE_DATE`	Hide date from debug output (non-TTY).
`DEBUG_COLORS`	Whether or not to use colors in the debug output.
`DEBUG_DEPTH`	Object inspection depth.
`DEBUG_SHOW_HIDDEN`	Shows hidden properties on inspected objects.

Note: The environment variables beginning with `DEBUG\_` end up being converted into an Options object that gets used with `%o`/`%O` formatters.

See the Node.js documentation for

[util.inspect()](https://nodejs.org/api/util.html#util\_util\_inspect\_object\_options) for the complete list.

## ## Formatters

Debug uses [printf-style](https://wikipedia.org/wiki/Printf\_format\_string) formatting.

Below are the officially supported formatters:

Formatter	Representation
<code>`%O`</code>	Pretty-print an Object on multiple lines.
<code>`%o`</code>	Pretty-print an Object all on a single line.
<code>`%s`</code>	String.
<code>`%d`</code>	Number (both integer and float).
<code>`%j`</code>	JSON. Replaced with the string '[Circular]' if the argument contains circular references.
<code>`%%`</code>	Single percent sign ('%'). This does not consume an argument.

### ### Custom formatters

You can add custom formatters by extending the ``debug.formatters`` object. For example, if you wanted to add support for rendering a Buffer as hex with ``%h``, you could do something like:

```

```js
const createDebug = require('debug')
createDebug.formatters.h = (v) => {
  return v.toString('hex')
}

// elsewhere
const debug = createDebug('foo')
debug('this is hex: %h', new Buffer('hello world'))
// foo this is hex: 68656c6c6f20776f726c6421 +0ms
```

```

### ## Browser Support

You can build a browser-ready script using [\[browserify\]](https://github.com/substack/node-browserify)(https://github.com/substack/node-browserify), or just use the [\[browserify-as-a-service\]](https://wzrd.in/)(https://wzrd.in/) [\[build\]](https://wzrd.in/standalone/debug@latest)(https://wzrd.in/standalone/debug@latest), if you don't want to build it yourself.

Debug's enable state is currently persisted by ``localStorage``. Consider the situation shown below where you have ``worker:a`` and ``worker:b``, and wish to debug both. You can enable this using ``localStorage.debug``:

```

```js
localStorage.debug = 'worker:*'
```

```

And then refresh the page.

```

```js
a = debug('worker:a');
b = debug('worker:b');
```

```



```
setInterval(function(){
 a('doing some work');
}, 1000);
```

```
setInterval(function(){
 b('doing some work');
}, 1200);
...

```

## ## Output streams

By default `debug` will log to stderr, however this can be configured per-namespace by overriding the `log` method:

Example [`_stdout.js_`](./examples/node/stdout.js):

```
```js
var debug = require('debug');
var error = debug('app:error');

// by default stderr is used
error('goes to stderr!');

var log = debug('app:log');
// set this namespace to log via console.log
log.log = console.log.bind(console); // don't forget to bind to console!
log('goes to stdout');
error('still goes to stderr!');

// set all output to go via console.info
// overrides all per-namespace log settings
debug.log = console.info.bind(console);
error('now goes to stdout via console.info');
log('still goes to stdout, but via console.info now');
```

```

## ## Extend

You can simply extend debugger

```
```js
const log = require('debug')('auth');

//creates new debug instance with extended namespace
const logSign = log.extend('sign');
const logLogin = log.extend('login');

log('hello'); // auth hello

```

```
logSign('hello'); //auth:sign hello
logLogin('hello'); //auth:login hello
...

```

```
## Set dynamically

```

You can also enable debug dynamically by calling the ``enable()`` method :

```
```js
let debug = require('debug');

console.log(1, debug.enabled('test'));

debug.enable('test');
console.log(2, debug.enabled('test'));

debug.disable();
console.log(3, debug.enabled('test'));

...

```

```
print :

```

```
...

```

```
1 false

```

```
2 true

```

```
3 false

```

```
...

```

Usage :

```
`enable(namespaces)`
```

``namespaces`` can include modes separated by a colon and wildcards.

Note that calling ``enable()`` completely overrides previously set `DEBUG` variable :

```
...

```

```
$ DEBUG=foo node -e 'var dbg = require("debug"); dbg.enable("bar"); console.log(dbg.enabled("foo"))'
```

```
=> false

```

```
...

```

```
Checking whether a debug target is enabled

```

After you've created a debug instance, you can determine whether or not it is enabled by checking the ``enabled`` property:

```
```javascript
const debug = require('debug')('http');

if (debug.enabled) {

```

```
// do stuff...
}
...
```

You can also manually toggle this property to force the debug instance to be enabled or disabled.

Authors

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\*

\* g711.h - In line A-law and u-law conversion routines

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```
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```

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```
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```

```
<signature of Ty Coon>, 1 April 1989
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```

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curl

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dynamic\_annotations

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eigen3

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```
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```

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-----  
Following applies to:

- ./test/mapstaticmethods.cpp
- ./test/schur\_real.cpp
- ./test/prec\_inverse\_4x4.cpp
- ./test/smallvectors.cpp
- ./test/redux.cpp
- ./test/special\_numbers.cpp
- ./test/adjoint.cpp
- ./test/resize.cpp
- ./test/mixingtypes.cpp
- ./test/product\_trmv.cpp
- ./test/sparse\_solvers.cpp
- ./test/cholesky.cpp
- ./test/geo\_quaternion.cpp
- ./test/miscmatrices.cpp
- ./test/stddeque.cpp
- ./test/integer\_types.cpp
- ./test/product\_large.cpp
- ./test/eigensolver\_generic.cpp
- ./test/householder.cpp
- ./test/geo\_orthomethods.cpp
- ./test/array\_for\_matrix.cpp
- ./test/sparseLM.cpp
- ./test/upperbidiagonalization.cpp
- ./test/nomalloc.cpp
- ./test/packetmath.cpp
- ./test/jacobisvd.cpp
- ./test/geo\_transformations.cpp
- ./test/swap.cpp
- ./test/eigensolver\_selfadjoint.cpp
- ./test/inverse.cpp
- ./test/product\_selfadjoint.cpp
- ./test/product\_trsolve.cpp
- ./test/product\_extra.cpp
- ./test/sparse\_solver.h

./test/mapstride.cpp  
./test/mapped\_matrix.cpp  
./test/geo\_eulerangles.cpp  
./test/eigen2support.cpp  
./test/denseLM.cpp  
./test/stdvector.cpp  
./test/nesting\_ops.cpp  
./test/sparse\_permutations.cpp  
./test/zerosized.cpp  
./test/exceptions.cpp  
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./test/linearstructure.cpp  
./test/sparse\_product.cpp  
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./test/sparse\_basic.cpp  
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./test/meta.cpp  
./test/real\_qz.cpp  
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./test/lu.cpp  
./test/qr.cpp  
./test/hessenberg.cpp  
./test/sizeof.cpp  
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./test/determinant.cpp  
./test/array\_reverse.cpp

./test/unalignedassert.cpp  
./test/stdlist.cpp  
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./test/dontalign.cpp  
./test/visitor.cpp  
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./demos/mix\_eigen\_and\_c/example.c

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- ./Eigen/src/QR/ColPivHouseholderQR\_MKL.h
- ./Eigen/src/QR/ColPivHouseholderQR\_MKL.h
- ./Eigen/src/SVD/JacobiSVD\_MKL.h
- ./Eigen/src/SVD/JacobiSVD\_MKL.h
- ./Eigen/src/PardisoSupport/PardisoSupport.h
- ./Eigen/src/PardisoSupport/PardisoSupport.h
- ./Eigen/src/Core/Assign\_MKL.h
- ./Eigen/src/Core/Assign\_MKL.h
- ./Eigen/src/Core/products/SelfadjointMatrixVector\_MKL.h
- ./Eigen/src/Core/products/SelfadjointMatrixVector\_MKL.h
- ./Eigen/src/Core/products/GeneralMatrixVector\_MKL.h
- ./Eigen/src/Core/products/GeneralMatrixVector\_MKL.h
- ./Eigen/src/Core/products/SelfadjointMatrixMatrix\_MKL.h
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- ./Eigen/src/Core/products/TriangularMatrixMatrix\_MKL.h
- ./Eigen/src/Core/products/TriangularMatrixMatrix\_MKL.h

./Eigen/src/Core/products/GeneralMatrixMatrix\_MKL.h  
./Eigen/src/Core/products/GeneralMatrixMatrix\_MKL.h  
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./Eigen/src/Core/products/TriangularMatrixVector\_MKL.h  
./Eigen/src/Core/products/GeneralMatrixMatrixTriangular\_MKL.h  
./Eigen/src/Core/products/GeneralMatrixMatrixTriangular\_MKL.h  
./Eigen/src/Core/products/TriangularSolverMatrix\_MKL.h  
./Eigen/src/Core/products/TriangularSolverMatrix\_MKL.h  
./Eigen/src/Core/util/MKL\_support.h  
./Eigen/src/Core/util/MKL\_support.h  
./Eigen/src/Cholesky/LLT\_MKL.h  
./Eigen/src/Cholesky/LLT\_MKL.h

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Following applies to:

`./test/metis_support.cpp`  
`./test/sparselu.cpp`  
`./unsupported/test/mpreal/mpreal.h`  
`./unsupported/Eigen/src/IterativeSolvers/IterationController.h`  
`./unsupported/Eigen/src/IterativeSolvers/ConstrainedConjGrad.h`  
`./unsupported/Eigen/src/Eigenvalues/ArpackSelfAdjointEigenSolver.h`  
`./Eigen/src/OrderingMethods/Amd.h`  
`./Eigen/src/SparseCholesky/SimplicialCholesky_impl.h`

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Version 3, 29 June 2007

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./unsupported/Eigen/src/LevenbergMarquardt/LevenbergMarquardt.h  
./unsupported/Eigen/src/LevenbergMarquardt/LMcovar.h  
./unsupported/Eigen/src/LevenbergMarquardt/LMonestep.h  
./unsupported/Eigen/src/LevenbergMarquardt/LMpar.h  
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freetype2

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2006-Jan-27

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- o [freetype-devel@nongnu.org](mailto:freetype-devel@nongnu.org)

Discusses bugs, as well as engine internals, design issues, specific licenses, porting, etc.

Our home page can be found at

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Mesa Component Licenses

| Component        | Location                                      | Primary Author | License          |
|------------------|-----------------------------------------------|----------------|------------------|
| Main Mesa code   | src/ mesa/                                    | Brian Paul     | Mesa (MIT)       |
| Device drivers   | src/ mesa/ drivers/ *                         | See drivers    | See drivers      |
| Ext headers      | include/ GL/ glext.h<br>include/ GL/ glxext.h | SGI            | SGI Free B       |
| GLUT             | src/ glut/                                    | Mark Kilgard   | Mark's copyright |
| GLEW             | src/ glew-1.13.0                              | Nigel Stewart  | Modified BSD     |
| Mesa GLU library | src/ glu/ mesa/                               | Brian Paul     | GNU-LGPL         |
| SGI GLU library  | src/ glu/ sgi/                                | SGI            | SGI Free B       |
| demo programs    | progs/ demos/                                 | various        | see source files |
| X demos          | progs/ xdemos/                                | Brian Paul     | see source files |
| SGI demos        | progs/ samples/                               | SGI            | SGI copyright    |
| RedBook demos    | progs/ redbook/                               | SGI            | SGI copyright    |

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Version 2, June 1991

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java/android\_libs/exoplayer

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java/android\_libs/protobuf\_nano

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javascript/jquery\_ui

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javascript/jquery/v2\_0\_1

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javascript/tracing\_framework

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java_src/android_libs/exoplayer

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java\_src/android\_libs/protobuf\_nano/v2

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jpeg

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(extracted from src/README)

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libogg

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libunwind

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libvorbis

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libxcb

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libxml

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Libxml2, an XML C Parser

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lodepng

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LodePNG

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minizip

zlib
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mongoose

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objective\_c/gtm\_session\_fetcher

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openctm

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zlib

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jsoncpp

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libwebp

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became

Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
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NPM License Checker

=====



[![Build Status](https://www.travis-ci.org/davglass/license-checker.svg?branch=master)](https://www.travis-ci.org/davglass/license-checker)

\*As of v17.0.0 the `failOn`` and `onlyAllow`` arguments take semicolons as delimiters instead of commas. Some license names contain commas and it messed with the parsing\*

Ever needed to see all the license info for a module and its dependencies?

It's this easy:

```
```shell
npm install -g license-checker

mkdir foo
cd foo
npm install yui-lint
license-checker
```
```

You should see something like this:

```
```
cli@0.4.3
  repository: http://github.com/chriso/cli
  licenses: MIT
glob@3.1.14
  repository: https://github.com/isaacs/node-glob
  licenses: UNKNOWN
graceful-fs@1.1.14
  repository: https://github.com/isaacs/node-graceful-fs
  licenses: UNKNOWN
inherits@1.0.0
  repository: https://github.com/isaacs/inherits
  licenses: UNKNOWN
jshint@0.9.1
  licenses: MIT
lru-cache@1.0.6
  repository: https://github.com/isaacs/node-lru-cache
  licenses: MIT
lru-cache@2.0.4
  repository: https://github.com/isaacs/node-lru-cache
  licenses: MIT
minimatch@0.0.5
  repository: https://github.com/isaacs/minimatch
  licenses: MIT
minimatch@0.2.9
```
```

```
repository: https://github.com/isaacs/minimatch
licenses: MIT
sigmund@1.0.0
 repository: https://github.com/isaacs/sigmund
 licenses: UNKNOWN
yui-lint@0.1.1
 licenses: BSD
 repository: http://github.com/yui/yui-lint
...

```

An asterisk next to a license name means that it was deduced from an other file than package.json (README, LICENSE, COPYING, ...)  
You could see something like this:

```
...
debug@2.0.0
 repository: https://github.com/visionmedia/debug
 licenses: MIT*
...

```

## Options

-----

- \* `--production` only show production dependencies.
- \* `--development` only show development dependencies.
- \* `--start [path of the initial json to look for]`
- \* `--unknown` report guessed licenses as unknown licenses.
- \* `--onlyunknown` only list packages with unknown or guessed licenses.
- \* `--json` output in json format.
- \* `--csv` output in csv format.
- \* `--csvComponentPrefix` prefix column for component in csv format.
- \* `--out [filepath]` write the data to a specific file.
- \* `--customPath` to add a custom Format file in JSON
- \* `--exclude [list]` exclude modules which licenses are in the comma-separated list from the output
- \* `--relativeLicensePath` output the location of the license files as relative paths
- \* `--summary` output a summary of the license usage',
- \* `--failOn [list]` fail (exit with code 1) on the first occurrence of the licenses of the semicolon-separated list
- \* `--onlyAllow [list]` fail (exit with code 1) on the first occurrence of the licenses not in the semicolon-separated list
- \* `--packages [list]` restrict output to the packages (package@version) in the semicolon-separated list
- \* `--excludePackages [list]` restrict output to the packages (package@version) not in the semicolon-separated list
- \* `--excludePrivatePackages` restrict output to not include any package marked as private
- \* `--direct` look for direct dependencies only`

## Exclusions

-----

A list of licenses is the simplest way to describe what you want to exclude.

You can use valid [SPDX identifiers](<https://spdx.org/licenses/>).

You can use valid SPDX expressions like `MIT OR X11`.

You can use non-valid SPDX identifiers, like `Public Domain`, since `npm` does support some license strings that are not SPDX identifiers.

## Examples

-----

---

```
license-checker --json > /path/to/licenses.json
license-checker --csv --out /path/to/licenses.csv
license-checker --unknown
license-checker --customPath customFormatExample.json
license-checker --exclude 'MIT, MIT OR X11, BSD, ISC'
license-checker --packages 'react@16.3.0;react-dom@16.3.0;lodash@4.3.1'
license-checker --excludePackages 'internal-1;internal-2'
license-checker --onlyunknown

```

## Custom format

-----

The `--customPath` option can be used with CSV to specify the columns. Note that the first column, `module\_name`, will always be used.

When used with JSON format, it will add the specified items to the usual ones.

The available items are the following:

- name
- version
- description
- repository
- publisher
- email
- url
- licenses
- licenseFile
- licenseText
- licenseModified

You can also give default values for each item.

See an example in [customFormatExample.json](customFormatExample.json).

## Requiring

-----

```
```js
var checker = require('license-checker');
```

```

checker.init({
  start: '/path/to/start/looking'
}, function(err, packages) {
  if (err) {
    //Handle error
  } else {
    //The sorted package data
    //as an Object
  }
});
...

```

Debugging

license-checker uses [debug](https://www.npmjs.com/package/debug) for internal logging. There's two internal markers:

- * `license-checker:error` for errors
- * `license-checker:log` for non-errors

Set the `DEBUG` environment variable to one of these to see debug output:

```

```shell
$ export DEBUG=license-checker*; license-checker
scanning ./yui-lint
cli@0.4.3
 repository: http://github.com/chriso/cli
 licenses: MIT
...
...

```

## How Licenses are Found

-----

We walk through the `node\_modules` directory with the [read-installed](https://www.npmjs.org/package/read-installed) module. Once we gathered a list of modules we walk through them and look at all of their `package.json`'s, We try to identify the license with the [spdx](https://www.npmjs.com/package/spdx) module to see if it has a valid SPDX license attached. If that fails, we then look into the module for the following files: `LICENSE`, `LICENCE`, `COPYING`, & `README`.

If one of the those files are found (in that order) we will attempt to parse the license data from it with a list of known license texts. This will be shown with the `\*` next to the name of the license to show that we "guessed" at it. The Mesa header files use the following licenses.

=====

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/\*\*

\* workerpool.js

\* <https://github.com/josdejong/workerpool>

\*

\* Offload tasks to a pool of workers on node.js and in the browser.

\*

\* @version 6.1.0

\* @date 2021-01-31

\*

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2000-05-05

^ expected errors | v input

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/\*---

esid: sec-assignment-operators-static-semantics-early-errors

description: Minimal test

---\*/

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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path: "tensorflow.errors.PermissionDeniedError"

```
tf_class {
 is_instance: "<class \'tensorflow.python.framework.errors_impl.PermissionDeniedError\'>"
 is_instance: "<class \'tensorflow.python.framework.errors_impl.OpError\'>"
 is_instance: "<type \'exceptions.Exception\'>"
 member {
 name: "args"
 mtype: "<type \'getset_descriptor\'>"
 }
 member {
 name: "error_code"
 mtype: "<type \'property\'>"
 }
 member {
 name: "message"
 mtype: "<type \'property\'>"
 }
 member {
 name: "node_def"
 mtype: "<type \'property\'>"
 }
 member {
 name: "op"
 mtype: "<type \'property\'>"
 }
 member_method {
 name: "__init__"
 argspec: "args=[\'self\', \'node_def\', \'op\', \'message\'], varargs=None, keywords=None, defaults=None"
 }
}
```

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/\* zlib.h -- interface of the 'zlib' general purpose compression library  
version 1.2.11, January 15th, 2017

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/\*

\* Written by Wilco Dijkstra, 1996. The following email exchange establishes the  
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\*

\* From: Wilco Dijkstra <[Wilco.Dijkstra@ntlworld.com](mailto:Wilco.Dijkstra@ntlworld.com)>

\* Date: Fri, Jun 24, 2011 at 3:20 AM

\* Subject: Re: sqrt routine

\* To: Kevin Ma <[kma@google.com](mailto:kma@google.com)>

\* Hi Kevin,

\* Thanks for asking. Those routines are public domain (originally posted to

\* [comp.sys.arm](mailto:comp.sys.arm) a long time ago), so you can use them freely for any purpose.

\* Cheers,

\* Wilco

\*

\* ----- Original Message -----

\* From: "Kevin Ma" <[kma@google.com](mailto:kma@google.com)>

\* To: <Wilco.Dijkstra@ntlworld.com>  
\* Sent: Thursday, June 23, 2011 11:44 PM  
\* Subject: Fwd: sqrt routine  
\* Hi Wilco,  
\* I saw your sqrt routine from several web sites, including  
\* <http://www.finesse.demon.co.uk/steven/sqrt.html>.  
\* Just wonder if there's any copyright information with your Successive  
\* approximation routines, or if I can freely use it for any purpose.  
\* Thanks.  
\* Kevin  
\*/

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- topographic model from Elevation model 2 m (U4421B, U4421D, U4422A and U4422C) 08/2014

- map image extracted from Topographic map raster 1:50 000 (U442) 08/2014

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reporting:

reports:

- lcov
- text
- text-summary

check:

global:

- statements: 95
- lines: 95
- branches: 90



functions: 100

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## Commands to generate dependency files

GEN\_DEPS.c= \$(CC) -E -MM \$(DEFS) \$(CPPFLAGS)

GEN\_DEPS.cc= \$(CXX) -E -MM \$(DEFS) \$(CPPFLAGS)

## Flags for position independent code

SHAREDLIBCFLAGS = -fPIC

SHAREDLIBCXXFLAGS = -fPIC

SHAREDLIBCPPFLAGS = -DPIC

## Additional flags when building libraries and with threads

```

THREADSCPPFLAGS = -D_REENTRANT
LIBCPPFLAGS =

Compiler switch to embed a runtime search path
LD_RPATH=
LD_RPATH_PRE= -Wl,-rpath,

Compiler switch to embed a library name
LD_SONAME = -Wl,-soname -Wl,$(notdir $(MIDDLE_SO_TARGET))

Shared library options
LD_SOOPTIONS= -Wl,-Bsymbolic

Shared object suffix
SO = so
Non-shared intermediate object suffix
STATIC_O = ao

Compilation rules
%.${STATIC_O}: $(srcdir)/%.c
$(COMPILE.c) $(STATICCPPFLAGS) $(STATICCFLAGS) -o $@ $<
%.o: $(srcdir)/%.c
$(COMPILE.c) $(DYNAMICCPPFLAGS) $(DYNAMICCFLAGS) -o $@ $<

%.${STATIC_O}: $(srcdir)/%.cpp
$(COMPILE.cc) $(STATICCPPFLAGS) $(STATICCXXFLAGS) -o $@ $<
%.o: $(srcdir)/%.cpp
$(COMPILE.cc) $(DYNAMICCPPFLAGS) $(DYNAMICCXXFLAGS) -o $@ $<

Dependency rules
%.d: $(srcdir)/%.c
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.c) $< \
| sed "s^\($*\)\.o[:]*^1.o $@ : /g\" > $@; \
[-s $@] || rm -f $@'

%.d: $(srcdir)/%.cpp
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.cc) $< \
| sed "s^\($*\)\.o[:]*^1.o $@ : /g\" > $@; \
[-s $@] || rm -f $@'

Versioned libraries rules

%.${SO}.${SO_TARGET_VERSION_MAJOR}: %.${SO}.${SO_TARGET_VERSION}
$(RM) $@ && ln -s ${<F} $@
%.${SO}: %.${SO}.${SO_TARGET_VERSION_MAJOR}

```

\$(RM) \$@ && ln -s \${\*F}.\$(SO).\$(SO\_TARGET\_VERSION) \$@

## Bind internal references

# LDflags that pkgdata will use

BIR\_LDFLAGS= -Wl,-Bsymbolic

# Dependencies [i.e. map files] for the final library

BIR\_DEPS=

## Remove shared library 's'

STATIC\_PREFIX\_WHEN\_USED =

STATIC\_PREFIX =

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C++ Big Integer Library  
(see ChangeLog for version)

<http://mattmccutchen.net/bigint/>

Written and maintained by Matt McCutchen <[matt@mattmccutchen.net](mailto:matt@mattmccutchen.net)>

You can use this library in a C++ program to do arithmetic on integers of size limited only by your computer's memory. The library provides `BigUnsigned` and `BigInteger` classes that represent nonnegative integers and signed integers, respectively. Most of the C++ arithmetic operators are overloaded for these classes, so big-integer calculations are as easy as:

```
#include "BigIntegerLibrary.hh"

BigInteger a = 65536;
cout << (a * a * a * a * a * a * a * a * a * a);

(print 340282366920938463463374607431768211456)
```

The code in `sample.cc` demonstrates the most important features of the library. To get started quickly, read the code and explanations in that file and run it. If you want more detail or a feature not shown in `sample.cc`, consult the consult the actual header and source files, which are thoroughly commented.

This library emphasizes ease of use and clarity of implementation over speed; some users will prefer GMP (<http://swox.com/gmp/>), which is faster. The code is intended to be reasonably portable across computers and modern C++ compilers; in particular, it uses whatever word size the computer provides (32-bit, 64-bit, or otherwise).

#### Compiling programs that use the library

-----  
The library consists of a folder full of C++ header files (`.hh`) and source files (`.cc`). Your own programs should `#include` the necessary header files and link with the source files. A makefile that builds the sample program (`.sample.cc`) is included; you can adapt it to replace the sample with your own program.

Alternatively, you can use your own build system or IDE. In that case, you must put the library header files where the compiler will find them and arrange to have your program linked with the library source files; otherwise, you will get errors about missing header files or "undefined references". To learn how to do this, consult the documentation for the build system or IDE; don't bother asking me. Adding all the library files to your project will work in many IDEs but may not be the most desirable approach.

#### Resources

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The library's Web site (above) provides links to released versions, the current development version, and a mailing list for release announcements, questions, bug reports, and other discussion of the library. I would be delighted to hear from you if you like this library and/or find a good use for it.

#### Bugs and enhancements

-----  
The library has been tested by me and others but is by no means bug-free. If you find a bug, please report it, whether it comes in the form of compiling trouble, a mathematically inaccurate result, or a memory-management blooper (since I use Java, these are altogether too common in my C++). I generally fix all reported bugs. You are also welcome to request enhancements, but I am unlikely to do substantial amounts of work on enhancements at this point.

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#

.gitignore

#

builds/unix/pkg.m4

#

docs/FTL.TXT

docs/GPLv2.TXT

#

include/freetype/internal/fthash.h

#

src/base/fthash.c

src/base/md5.c

src/base/md5.h

#

src/bdf/bdf.c

```
src/bdf/bdf.h
src/bdf/bdfdrivr.c
src/bdf/bdfdrivr.h
src/bdf/bdferror.h
src/bdf/bdflib.c
src/bdf/module.mk
src/bdf/README
src/bdf/rules.mk
#
src/pcf/module.mk
src/pcf/pcf.c
src/pcf/pcf.h
src/pcf/pcfdrivr.c
src/pcf/pcfdrivr.h
src/pcf/pcferror.h
src/pcf/pcfread.c
src/pcf/pcfread.h
src/pcf/pcfutil.c
src/pcf/pcfutil.h
src/pcf/README
src/pcf/rules.mk
#
src/gzip/adler32.c
src/gzip/infblock.c
src/gzip/infblock.h
src/gzip/infcodes.c
src/gzip/infcodes.h
src/gzip/inffixed.h
src/gzip/inflate.c
src/gzip/inftrees.c
src/gzip/inftrees.h
src/gzip/infutil.c
src/gzip/infutil.h
src/gzip/zconf.h
src/gzip/zlib.h
src/gzip/zutil.c
src/gzip/zutil.h
#
src/tools/apinames.c
src/tools/ftrandom/ftrandom.c
#
EOF
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By: Marijn Haverbeke, Ingvar Stepanyan, Adrian Heine

Repository: <https://github.com/acornjs/acorn.git>

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Repository: jonschlinkert/fill-range

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Repository: gulpjs/glob-parent

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## normalize-path

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By: Jon Schlinkert, Blaine Bublitz

Repository: [jonschlinkert/normalize-path](https://github.com/jonschlinkert/normalize-path)

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By: Ben Coe

Repository: <https://github.com/tapjs/signal-exit.git>

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By: Rich Harris

Repository: <https://github.com/Rich-Harris/sourcemap-codec>

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By: Ben Coe  
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Version 3, 29 June 2007

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```

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```
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```

```
<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
```

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validate-npm-package-license

=====

Give me a string and I'll tell you if it's a valid npm package license string.

```
```javascript  
var valid = require('validate-npm-package-license');  
```
```

SPDX license identifiers are valid license strings:

```
```javascript  
  
var assert = require('assert');  
var validSPDXExpression = {  
  validForNewPackages: true,  
  validForOldPackages: true,  
  spdx: true  
};  
  
assert.deepEqual(valid('MIT'), validSPDXExpression);  
assert.deepEqual(valid('BSD-2-Clause'), validSPDXExpression);
```

```
assert.deepEqual(valid('Apache-2.0'), validSPDXExpression);
assert.deepEqual(valid('ISC'), validSPDXExpression);
...

```

The function will return a warning and suggestion for nearly-correct license identifiers:

```
```javascript
assert.deepEqual(
 valid('Apache 2.0'),
 {
 validForOldPackages: false,
 validForNewPackages: false,
 warnings: [
 'license should be ' +
 'a valid SPDX license expression (without "LicenseRef"), ' +
 "'UNLICENSED', or ' +
 "'SEE LICENSE IN <filename>",
 'license is similar to the valid expression "Apache-2.0"'
]
 }
);
...

```

SPDX expressions are valid, too ...

```
```javascript
// Simple SPDX license expression for dual licensing
assert.deepEqual(
  valid('(GPL-3.0-only OR BSD-2-Clause)'),
  validSPDXExpression
);
...

```

... except if they contain `LicenseRef`:

```
```javascript
var warningAboutLicenseRef = {
 validForOldPackages: false,
 validForNewPackages: false,
 spdx: true,
 warnings: [
 'license should be ' +
 'a valid SPDX license expression (without "LicenseRef"), ' +
 "'UNLICENSED', or ' +
 "'SEE LICENSE IN <filename>",
]
};

assert.deepEqual(

```

```

valid('LicenseRef-Made-Up'),
warningAboutLicenseRef
);

assert.deepEqual(
valid('(MIT OR LicenseRef-Made-Up)'),
warningAboutLicenseRef
);
...

```

If you can't describe your licensing terms with standardized SPDX identifiers, put the terms in a file in the package and point users there:

```

```javascript
assert.deepEqual(
valid('SEE LICENSE IN LICENSE.txt'),
{
  validForNewPackages: true,
  validForOldPackages: true,
  inFile: 'LICENSE.txt'
}
);

assert.deepEqual(
valid('SEE LICENSE IN license.md'),
{
  validForNewPackages: true,
  validForOldPackages: true,
  inFile: 'license.md'
}
);
...

```

If there aren't any licensing terms, use `UNLICENSED`:

```

```javascript
var unlicensed = {
 validForNewPackages: true,
 validForOldPackages: true,
 unlicensed: true
};
assert.deepEqual(valid('UNLICENSED'), unlicensed);
assert.deepEqual(valid('UNLICENSED'), unlicensed);
...

```

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Version 2.0 - August 6, 2003

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- (iii) Applications may not pass on functionality which in any way makes it possible for others to create software with the Licensed Software; provided however that Licensee may use the Licensed Software's scripting and QML ("Qt Quick") functionality solely in order to enable scripting, themes and styles that augment the functionality and appearance of the Application(s) without adding primary and substantial functionality to the Application(s);
- (iv) Licensee shall not use Licensed Software in any manner or for any purpose that infringes, misappropriates or otherwise violates any Intellectual property or right of any third party, or that violates any applicable law;
- (v) Licensee shall not use The Qt Company's or any of its suppliers' names, logos, or trademarks to market Applications, except that Licensee may use "Built with Qt" logo to indicate that Application(s) was developed using the Licensed Software;
- (vi) Licensee shall not distribute, sublicense or disclose source code of Licensed Software to any third party (provided however that Licensee may appoint employee(s) of Contractors as Designated Users to use Licensed Software pursuant to this Agreement). Such right may be available for the Licensee subject to a separate software development kit ("SDK") license agreement to be concluded with The Qt Company;

- (vii) Licensee shall not grant the Customers a right to (i) make copies of the Redistributables except when and to the extent required to use the Applications and/or Devices for their intended purpose, (ii) modify the Redistributables or create derivative works thereof, (iii) decompile, disassemble or otherwise reverse engineer Redistributables, or (iv) redistribute any copy or portion of the Redistributables to any third party, except as part of the onward sale of the Device on which the Redistributables are installed;
- (viii) Licensee shall not and shall cause that its Affiliates or Contractors shall not use Licensed Software in any Prohibited Combination, unless Licensee has received an advance written permission from The Qt Company to do so. Absent such written permission, any and all distribution by the Licensee during the Term of a hardware device or product a) which incorporate or integrate any part of Licensed Software or Open Source Qt; or b) where the main user interface or substantial functionality is provided by software built with Licensed Software or Open Source Qt or otherwise depends on the Licensed Software or Open Source Qt, shall be considered to be Device distribution under this Agreement and shall be dependent on Licensee's compliance thereof (including but not limited to obligation to pay applicable License Fees for such distribution). Notwithstanding what is provided above in this sub-section (viii), Licensee is entitled to use and combine Licensed Software with any Permitted Software;
- (ix) Licensee shall cause all of its Affiliates and Contractors entitled to make use of the licenses granted under this Agreement, to be contractually bound to comply with the relevant terms of this Agreement and not to use the Licensed Software beyond the terms hereof and for any purposes other than operating within the scope of their services for Licensee. Licensee shall be responsible for any and all actions and omissions of its Affiliates and Contractors relating to the Licensed Software and use thereof (including but not limited to payment of all applicable License Fees);
- (x) Except when and to the extent explicitly provided in this Section 3, Licensee shall not transfer, publish, disclose, display or otherwise make available the Licensed Software; and
- (xi) Licensee shall not attempt or enlist a third party to conduct or attempt to conduct any of the above.

Above terms shall not be applicable if and to the extent they conflict with any mandatory provisions of any applicable laws.

Any use of Licensed Software beyond the provisions of this Agreement is strictly prohibited and requires an additional license from The Qt Company.

#### 4. THIRD-PARTY SOFTWARE

The Licensed Software may provide links to third party libraries or code (collectively "Third-Party Software") to implement various functions.

Third-Party Software does not comprise part of the Licensed Software. In some cases, access to Third-Party Software may be included with the Licensed Software. Such Third-Party Software will be listed in the ".../src/3rdparty" source tree delivered with the Licensed Software or documented in the Licensed Software, as such may be amended from time to time. Licensee acknowledges that use or distribution of Third-Party Software is in all respects subject to applicable license terms of applicable third-party right holders.

## 5. PRE-RELEASE CODE

The Licensed Software may contain pre-release code and functionality, or sample code marked or otherwise stated with appropriate designation such as "Technology Preview", "Alpha", "Beta", "Sample" etc. ("Pre-Release Code").

Such Pre-Release Code may be present complimentary for the Licensee, in order to provide experimental support or information for new platforms or preliminary versions of one or more new functionalities or for other similar reasons. The Pre-Release Code may not be at the level of performance and compatibility of a final, generally available, product offering. The Pre-Release Code may not operate correctly, may contain errors and may be substantially modified by The Qt Company prior to the first commercial product release, if any. The Qt Company is under no obligation to make Pre-Release Code commercially available, or provide any Support or Updates relating thereto. The Qt Company assumes no liability whatsoever regarding any Pre-Release Code, but any use thereof is exclusively at Licensee's own risk and expense.

For clarity, unless Licensed Software specifies different license terms for the respective Pre-Release Code, the Licensee is entitled to use such pre-release code pursuant to Section 3, just like other Licensed Software, provided however that in the event Add-on Products are included and available as such Pre-Release Code, Licensee's right to use such Add-on Products is nevertheless subject to and conditional upon conclusion of separate agreement with The Qt Company.

## 6. LIMITED WARRANTY AND WARRANTY DISCLAIMER

The Qt Company hereby represents and warrants that it has the power and authority to grant the rights and licenses granted to Licensee under this Agreement.

Except as set forth above, the Licensed Software is licensed to Licensee "as is" and Licensee's exclusive remedy and The Qt Company's entire liability for errors in the Licensed Software shall be limited, at The Qt Company's option, to correction of the error, replacement of the Licensed Software or return of the applicable fees paid for the defective Licensed Software for the time period during which the License is not able to utilize the Licensed Software under the terms of this Agreement.



TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, THE QT COMPANY ON BEHALF OF ITSELF AND ITS LICENSORS, SUPPLIERS AND AFFILIATES, DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE AND NON-INFRINGEMENT WITH REGARD TO THE LICENSED SOFTWARE. THE QT COMPANY DOES NOT WARRANT THAT THE LICENSED SOFTWARE WILL SATISFY LICENSEE'S REQUIREMENTS OR THAT IT WILL OPERATE WITHOUT DEFECT OR ERROR OR THAT THE OPERATION THEREOF WILL BE UNINTERRUPTED.

## 7. INDEMNIFICATION AND LIMITATION OF LIABILITY

### 7.1. Limitation of Liability

EXCEPT FOR (I) CASES OF GROSS NEGLIGENCE OR INTENTIONAL MISCONDUCT, AND (II) BREACH OF CONFIDENTIALITY, AND TO THE EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL EITHER PARTY BE LIABLE TO THE OTHER PARTY FOR ANY LOSS OF PROFIT, LOSS OF DATA, LOSS OF BUSINESS OR GOODWILL OR ANY OTHER INDIRECT, SPECIAL, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE COST, DAMAGES OR EXPENSE OF ANY KIND, HOWSOEVER ARISING UNDER OR IN CONNECTION WITH THIS AGREEMENT.

EXCEPT FOR (I) CASES OF GROSS NEGLIGENCE OR INTENTIONAL MISCONDUCT, AND (II) BREACH OF CONFIDENTIALITY, AND TO THE EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL EITHER PARTY'S TOTAL AGGREGATE LIABILITY UNDER THIS AGREEMENT EXCEED THE AGGREGATE LICENSE FEES PAID OR PAYABLE TO THE QT COMPANY FROM LICENSEE DURING THE PERIOD OF TWELVE (12) MONTHS IMMEDIATELY PRECEDING THE EVENT RESULTING IN SUCH LIABILITY.

THE PROVISIONS OF THIS SECTION 7 ALLOCATE THE RISKS UNDER THIS AGREEMENT BETWEEN THE QT COMPANY AND LICENSEE AND THE PARTIES HAVE RELIED UPON THE LIMITATIONS SET FORTH HEREIN IN DETERMINING WHETHER TO ENTER INTO THIS AGREEMENT.

NOTWITHSTANDING ANYTHING TO THE CONTRARY IN THIS AGREEMENT, LICENSEE SHALL ALWAYS BE LIABLE TO PAY THE APPLICABLE LICENSE FEES CORRESPONDING TO ITS ACTUAL USE OF LICENSED SOFTWARE.

## 8. SUPPORT, UPDATES AND ONLINE SERVICES

Upon due payment of the agreed License Fees the Licensee will be eligible to receive Support and Updates and to use the Online Services during the License Term, provided, however, that in the event the License Term is longer than 36 months, the initial payment includes Support for only the first 12 months, unless the Parties specifically otherwise agree.

Unless otherwise decided by The Company at its free and absolute discretion, Upgrades will not be included in the Support but may be available subject to additional fees.

From time to time The Qt Company may change the Support terms, provided that

during the respective ongoing License Term the level of Support provided by The Qt Company may not be reduced without the consent of the Licensee.

Unless otherwise agreed, The Qt Company shall not be responsible for providing any service or support to Customers.

## 9. CONFIDENTIALITY

Each Party acknowledges that during the Term of this Agreement each Party may receive information about the other Party's business, business methods, business plans, customers, business relations, technology, and other information, including the terms of this Agreement, that is confidential and of great value to the other Party, and the value of which would be significantly reduced if disclosed to third parties ("Confidential Information"). Accordingly, when a Party (the "Receiving Party") receives Confidential Information from the other Party (the "Disclosing Party"), the Receiving Party shall only disclose such information to employees and Contractors on a need to know basis, and shall cause its employees and employees of its Affiliates to: (i) maintain any and all Confidential Information in confidence; (ii) not disclose the Confidential Information to a third party without the Disclosing Party's prior written approval; and (iii) not, directly or indirectly, use the Confidential Information for any purpose other than for exercising its rights and fulfilling its responsibilities pursuant to this Agreement. Each Party shall take reasonable measures to protect the Confidential Information of the other Party, which measures shall not be less than the measures taken by such Party to protect its own confidential and proprietary information.

Obligation of confidentiality shall not apply to information that (i) is or becomes generally known to the public through no act or omission of the Receiving Party; (ii) was in the Receiving Party's lawful possession prior to the disclosure hereunder and was not subject to limitations on disclosure or use; (iii) is developed independently by employees or Contractors of the Receiving Party or other persons working for the Receiving Party who have not had access to the Confidential Information of the Disclosing Party, as proven by the written records of the Receiving Party; (iv) is lawfully disclosed to the Receiving Party without restrictions, by a third party not under an obligation of confidentiality; or (v) the Receiving Party is legally compelled to disclose, in which case the Receiving Party shall notify the Disclosing Party of such compelled disclosure and assert the privileged and confidential nature of the information and cooperate fully with the Disclosing Party to limit the scope of disclosure and the dissemination of disclosed Confidential Information to the minimum extent necessary.

The obligations under this Section 9 shall continue to remain in force for a period of five (5) years after the last disclosure, and, with respect to trade secrets, for so long as such trade secrets are protected under applicable trade secret laws.

## 10. FEES, DELIVERY AND PAYMENT

### 10.1. License Fees

License Fees are described in The Qt Company's standard price list, quote or Purchase Order confirmation or in an appendix hereto, as the case may be.

The License Fees shall not be refunded or claimed as a credit in any event or for any reason whatsoever.

### 10.2. Ordering Licenses

Licensee may purchase Development Licenses and Distribution Licenses pursuant to agreed pricing terms or, if no specific pricing terms have been agreed upon, at The Qt Company's standard pricing terms applicable at the time of purchase. Unless specifically otherwise provided, any pricing terms referenced in this Agreement shall be valid for twelve (12) months from the date of this Agreement.

Licensee shall submit all purchase orders for Development Licenses and Distribution Licenses to The Qt Company by email or any other method acceptable to The Qt Company (each such order is referred to herein as a "Purchase Order") for confirmation, whereupon the Purchase Order shall become binding between the Parties.

### 10.3. Distribution License Packs

Unless otherwise agreed, Distribution Licenses shall be purchased by way of Distribution License Packs.

Upon due payment of the ordered Distribution License Pack(s), the Licensee will have an account of Distribution Licenses available for distributing the Redistributables in accordance with this Agreement.

Each time Licensee distributes a copy of Redistributables, then one Distribution License is used, and Licensee's account of available Distribution Licenses is decreased accordingly.

Licensee may distribute copies of the Redistributables so long as Licensee has Distribution Licenses remaining on its account.

### 10.4. Payment Terms

License Fees and any other charges under this Agreement shall be paid by Licensee no later than thirty (30) days from the date of the applicable invoice from The Qt Company.

The Qt Company will submit an invoice to Licensee after the date of this Agreement and/or after The Qt Company receives a Purchase Order from Licensee.

A late payment charge of the lower of (a) one percent per month; or (b) the

interest rate stipulated by applicable law, shall be charged on any unpaid balances that remain past due.

#### 10.5. Taxes

All License Fees and other charges payable hereunder are gross amounts but exclusive of any value added tax, use tax, sales tax, withholding tax and other taxes, duties or tariffs ("Taxes") levied directly for the sale, delivery or use of Licensed Software hereunder pursuant to any applicable law. Such applicable Taxes shall be paid by Licensee to The Qt Company, or, where applicable, in lieu of payment of such Taxes to The Qt Company, Licensee shall provide an exemption certificate to The Qt Company and any applicable authority.

### 11. RECORD-KEEPING AND REPORTING OBLIGATIONS; AUDIT RIGHTS

#### 11.1. Licensee's Record-keeping

Licensee shall at all times during the Term of this Agreement and for a period of seven (7) years thereafter maintain Licensee's Records in an accurate and up-to-date form. Licensee's Records shall be adequate to reasonably enable The Qt Company to determine Licensee's compliance with the provisions of this Agreement. The records shall conform to general good accounting practices.

Licensee shall, within thirty (30) days from receiving The Qt Company's request to that effect, deliver to The Qt Company a report based on Licensee's Records, such report to contain information, in sufficient detail, on (i) number and identity of users working with Licensed Software or Open Source Qt, (ii) copies of Redistributables distributed by Licensee during the most recent calendar quarter and/or any other term specified by The Qt Company, (iii) number of undistributed copies of Redistributables and corresponding number of unused Distribution Licenses remaining on Licensee's account, and (iv) any other information as The Qt Company may reasonably require from time to time.

#### 11.2. The Qt Company's Audit Rights

The Qt Company or an independent auditor acting on behalf of The Qt Company's, may, upon at least five (5) business days' prior written notice and at its expense, audit Licensee with respect to the Licensee's use of the Licensed Software, but not more frequently than once during each 6-month period. Such audit may be conducted by mail, electronic means or through an in-person visit to Licensee's place of business. Any such in-person audit shall be conducted during regular business hours at Licensee's facilities and shall not unreasonably interfere with Licensee's business activities. The Qt Company or the independent auditor acting on behalf of The Qt Company shall be entitled to inspect Licensee's Records and conduct necessary interviews of Licensee's relevant employees and Contractors. All such Licensee's Records and use thereof shall be subject to an obligation of confidentiality under this Agreement.

If an audit reveals that Licensee is using the Licensed Software beyond scope of the licenses Licensee has paid for, Licensee agrees to pay The Qt Company any amounts owed for such unauthorized use within 30 days from receipt of the corresponding invoice from The Qt Company.

In addition, in the event the audit reveals a material violation of the terms of this Agreement (without limitation, either (i) underpayment of more than 10 % of License Fees or 10,000 euros (whichever is more) or (ii) distribution of products, which include or result from Prohibited Combination, shall be deemed a material violation for purposes of this section), then the Licensee shall pay The Qt Company's reasonable cost of conducting such audit.

## 12. TERM AND TERMINATION

### 12.1. Agreement Term

This Agreement shall enter into force upon due acceptance by both Parties and remain in force for as long as there is any Development License(s) purchased under this Agreement in force ("Term"), unless and until terminated pursuant to the terms of this Section 12.

### 12.2. Termination and suspension of rights

Either Party shall have the right to terminate this Agreement upon thirty (30) days prior written notice if the other Party commits a material breach of any obligation of this Agreement and fails to remedy such breach within such notice period.

Instead of termination, The Qt Company shall have the right to suspend or withhold grants of all rights to the Licensed Software hereunder, including but not limited to the Development Licenses, Distribution License, and Support, should Licensee fail to make payment in timely fashion or otherwise violates or is reasonably suspected to violate its obligations or terms of this Agreement, and where such violation or breach is not cured within five (5) business days following The Qt Company's written notice thereof.

### 12.3. Mutual Right to Terminate

Either Party shall have the right to terminate this Agreement immediately upon written notice in the event that the other Party becomes insolvent, files for any form of bankruptcy, makes any assignment for the benefit of creditors, has a receiver, administrative receiver or officer appointed over the whole or a substantial part of its assets, ceases to conduct business, or an act equivalent to any of the above occurs under the laws of the jurisdiction of the other Party.

### 12.4. Parties' Rights and Duties upon Termination

Upon expiry or termination of the Agreement, Licensee shall cease and shall cause all Designated Users (including those of its Affiliates' and

Contractors') to cease using the Licensed Software and distribution of the Redistributables under this Agreement.

Notwithstanding the above, in the event the Agreement expires or is terminated:

- (i) as a result of The Qt Company choosing not to renew the Development License(s) as set forth in Section 3.1, and where such decision of non-renewal is not due to any ongoing breach or alleged breach (as reasonably determined by The Qt Company) by Licensee of the terms of this Agreement or any applicable license terms of Open Source Qt, then all valid licenses possessed by the Licensee at such date shall be extended to be valid in perpetuity under the terms of this Agreement and Licensee is entitled to purchase additional licenses as set forth in Section 10.2; or
- (ii) for reason other than by The Qt Company pursuant to item (i) above or pursuant to Section 12.2, then the Licensee is entitled, for a period of six (6) months after the effective date of termination, to continue distribution of Devices under the Distribution Licenses paid but unused at such effective date of termination.

Upon any such termination the Licensee shall destroy or return to The Qt Company all copies of the Licensed Software and all related materials and will certify the same to The Qt Company upon its request, provided however that Licensee may retain and exploit such copies of the Licensed Software as it may reasonably require in providing continued support to Customers.

Expiry or termination of this Agreement for any reason whatsoever shall not relieve Licensee of its obligation to pay any License Fees accrued or payable to The Qt Company prior to the effective date of termination, and Licensee shall immediately pay to The Qt Company all such fees upon the effective date of termination. Termination of this Agreement shall not affect any rights of Customers to continue use of Applications and Devices (and therein incorporated Redistributables).

#### 12.5. Extension in case of bankruptcy

In the event The Qt Company is declared bankrupt under a final, non-cancellable decision by relevant court of law, and this Agreement is not, at the date of expiry of the Development License(s) pursuant to Section 3.1, assigned to party, who has assumed The Qt Company's position as a legitimate licensor of Licensed Software under this Agreement, then all valid licenses possessed by the Licensee at such date of expiry, and which the Licensee has not notified for expiry, shall be extended to be valid in perpetuity under the terms of this Agreement.

### 13. GOVERNING LAW AND LEGAL VENUE

In the event this Agreement is in the name of The Qt Company Inc., a Delaware Corporation, then:

- (i) this Agreement shall be construed and interpreted in accordance with the laws of the State of California, USA, excluding its choice of

- law provisions;
- (ii) the United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement; and
  - (iii) any dispute, claim or controversy arising out of or relating to this Agreement or the breach, termination, enforcement, interpretation or validity thereof, including the determination of the scope or applicability of this Agreement to arbitrate, shall be determined by arbitration in San Francisco, USA, before one arbitrator. The arbitration shall be administered by JAMS pursuant to JAMS' Streamlined Arbitration Rules and Procedures. Judgment on the Award may be entered in any court having jurisdiction. This Section shall not preclude parties from seeking provisional remedies in aid of arbitration from a court of appropriate jurisdiction.

In the event this Agreement is in the name of The Qt Company Ltd., a Finnish Company, then:

- (i) this Agreement shall be construed and interpreted in accordance with the laws of Finland, excluding its choice of law provisions;
- (ii) the United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement; and
- (iii) any disputes, controversy or claim arising out of or relating to this Agreement, or the breach, termination or validity thereof shall be finally settled by arbitration in accordance with the Arbitration Rules of Finland Chamber of Commerce. The arbitration tribunal shall consist of one (1), or if either Party so requires, of three (3), arbitrators. The award shall be final and binding and enforceable in any court of competent jurisdiction. The arbitration shall be held in Helsinki, Finland and the process shall be conducted in the English language. This Section shall not preclude parties from seeking provisional remedies in aid of arbitration from a court of appropriate jurisdiction.

## 14. GENERAL PROVISIONS

### 14.1. No Assignment

Except in the case of a merger or sale of substantially all of its corporate assets, Licensee shall not be entitled to assign or transfer all or any of its rights, benefits and obligations under this Agreement without the prior written consent of The Qt Company, which shall not be unreasonably withheld or delayed. The Qt Company shall be entitled to freely assign or transfer any of its rights, benefits or obligations under this Agreement.

### 14.2. No Third-Party Representations

Licensee shall make no representations or warranties concerning the Licensed Software on behalf of The Qt Company. Any representation or warranty Licensee makes or purports to make on The Qt Company's behalf shall be void as to The Qt Company.

#### 14.3. Surviving Sections

Any terms and conditions that by their nature or otherwise reasonably should survive termination of this Agreement shall so be deemed to survive. Such sections include especially the following: 1, 2, 6, 7, 9, 11, 12.4, 13 and 14.

#### 14.4. Entire Agreement

This Agreement, the exhibits hereto, the License Certificate and any applicable Purchase Order accepted by The Qt Company constitute the complete agreement between the Parties and supersedes all prior or contemporaneous discussions, representations, and proposals, written or oral, with respect to the subject matters discussed herein.

In the event of any conflict or inconsistency between this Agreement and any Purchase Order, the terms of this Agreement will prevail over the terms of the Purchase Order with respect to such conflict or inconsistency.

Parties specifically acknowledge and agree that this Agreement prevails over any click-to-accept or similar agreements the Designated Users may need to accept online upon download of the Licensed Software, as may be required by The Qt Company's applicable processes relating to Licensed Software.

#### 14.5. Modifications

No modification of this Agreement shall be effective unless contained in a writing executed by an authorized representative of each Party. No term or condition contained in Licensee's Purchase Order ("Deviating Terms") shall apply unless The Qt Company has expressly agreed such Deviating Terms in writing. Unless and to the extent expressly agreed by The Qt Company, any such Deviating Terms shall be deemed void and with no legal effect. For clarity, delivery of the Licensed Software following the receipt of the Purchase Order including Deviating Terms shall not constitute acceptance of such Deviating Terms."

#### 14.6. Force Majeure

Except for the payment obligations hereunder, neither Party shall be liable to the other for any delay or non-performance of its obligations hereunder in the event and to the extent that such delay or non-performance is due to an event of act of God, terrorist attack or other similar unforeseeable catastrophic event that prevents either Party for fulfilling its obligations under this Agreement and which such Party cannot avoid or circumvent ("Force Majeure Event"). If the Force Majeure Event results in a delay or non-performance of a Party for a period of three (3) months or longer, then either Party shall have the right to terminate this Agreement with immediate effect without any liability (except for the obligations of payment arising prior to the event of Force Majeure) towards the other Party.

#### 14.7. Notices



Any notice given by one Party to the other shall be deemed properly given and deemed received if specifically acknowledged by the receiving Party in writing or when successfully delivered to the recipient by hand, fax, or special courier during normal business hours on a business day to the addresses specified for each Party on the signature page. Each communication and document made or delivered by one Party to the other Party pursuant to this Agreement shall be in the English language.

#### 14.8. Export Control

Licensee acknowledges that the Redistributables, as incorporated in Applications or Devices, may be subject to export control restrictions under the applicable laws of respective countries. Licensee shall fully comply with all applicable export license restrictions and requirements as well as with all laws and regulations relating to the Redistributables and exercise of licenses hereunder and shall procure all necessary governmental authorizations, including without limitation, all necessary licenses, approvals, permissions or consents, where necessary for the re-exportation of the Redistributables, Applications and/or Devices.

#### 14.9. No Implied License

There are no implied licenses or other implied rights granted under this Agreement, and all rights, save for those expressly granted hereunder, shall remain with The Qt Company and its licensors. In addition, no licenses or immunities are granted to the combination of the Licensed Software with any other software or hardware not delivered by The Qt Company under this Agreement.

#### 14.10. Attorney Fees

The prevailing Party in any action to enforce this Agreement shall be entitled to recover its attorney's fees and costs in connection with such action.

#### 14.11. Privacy

Licensee acknowledges and agrees that for the purpose of this Agreement, The Qt Company may collect, use, transfer and disclose personal data pertaining to Designated Users as well as any other employees and directors of the Licensee and its Contractors relevant for carrying out the intent of this Agreement. Such personal data may be collected from the Licensee or directly from the relevant individuals. The Parties acknowledge that with regard to such personal data processed hereunder, The Qt Company shall be regarded as the Data Controller under the applicable Data Protection Legislation. The Qt Company shall process any such personal data in accordance with its privacy policies and practices, which will comply with all applicable requirements of the Data Protection Legislation.

#### 14.12. Severability

If any provision of this Agreement shall be adjudged by any court of competent jurisdiction to be unenforceable or invalid, that provision shall

be limited or eliminated to the minimum extent necessary so that this Agreement shall otherwise remain in full force and effect and enforceable.

## APPENDICES

The Agreement includes Appendix 1, and possibly one or more of the appendices 3-5, depending on the product(s) purchased by the Licensee, what is stated in the quote or invoice, and/or what is stated in the Licensee's License Certificate.

## APPENDIX 1

The modules and/or tools that are included in the respective product - Qt for Application Development (QtAD), Qt for Device Creation (QtDC), Qt for MCUs (QtMCU), Qt 3D Studio (Qt3DS) and Qt Design Studio (QtDS) - are marked with 'X' in the below table. The modules and tools are ported to Qt 6 in stages and are subject to availability.

Parts of the product that are permitted for distribution in object-code form only ("Redistributables") are marked with 'R' in the below table.

| Modules / Tools       | QtAD | QtDC | QtMCU | Qt3DS | QtDS |
|-----------------------|------|------|-------|-------|------|
| Qt Core               | X, R | X, R |       |       |      |
| Qt GUI                | X, R | X, R |       |       |      |
| Qt Multimedia         | X, R | X, R |       |       |      |
| Qt Multimedia Widgets | X, R | X, R |       |       |      |
| Qt Network            | X, R | X, R |       |       |      |
| Qt PDF                | X, R | X, R |       |       |      |
| Qt QML                | X, R | X, R |       |       |      |
| Qt Quick              | X, R | X, R |       |       |      |
| Qt Quick Controls 2   | X, R | X, R |       |       |      |
| Qt Quick Dialogs      | X, R | X, R |       |       |      |
| Qt Quick Layouts      | X, R | X, R |       |       |      |
| Qt Quick Test         | X, R | X, R |       |       |      |

|                          |             |  |  |  |
|--------------------------|-------------|--|--|--|
| Qt SQL                   | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Test                  | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Widgets               | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Active Qt                | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt 3D                    | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Android Extras        | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Bluetooth             | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Canvas 3D             | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Concurrent            | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt D-Bus                 | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Gamepad               | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Graphical Effects     | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Help                  | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Image Formats         | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Location              | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Mac Extras            | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Network Authorization | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt NFC                   | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Platform Headers      | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Positioning           | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Print Support         | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Purchasing            | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt for Python            | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |
| Qt Quick Controls        | X, R   X, R |  |  |  |
| +-----+                  |             |  |  |  |

|                       |             |  |  |  |
|-----------------------|-------------|--|--|--|
| Qt Quick Extras       | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Quick Widgets      | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt SCXML              | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Sensors            | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Serial Bus         | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Serial Port        | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Speech             | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt SVG                | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt UI Tools           | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt WebChannel         | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt WebEngine          | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt WebSockets         | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt WebView            | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Windows Extras     | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt X11 Extras         | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt XML                | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt XML Patterns       | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Wayland Compositor | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Charts             | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Data Visualization | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Qt Virtual Keyboard   | X, R   X, R |  |  |  |
| +-----+               |             |  |  |  |
| Boot 2 Qt stack       | X, R        |  |  |  |
| +-----+               |             |  |  |  |
| Qt OTA                | X, R        |  |  |  |
| +-----+               |             |  |  |  |
| Device Utilities      | X, R        |  |  |  |
| +-----+               |             |  |  |  |

|                                       |  |      |      |      |  |  |
|---------------------------------------|--|------|------|------|--|--|
| Qt Debugging Bridge (QDB) Daemon      |  | X, R |      |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Quick Ultralite Controls           |  |      | X, R |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Quick Ultralite                    |  |      | X, R |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Creator                            |  | X    | X    | X    |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Designer (Qt Widget Designer)      |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Quick Designer (Qt Creator plugin) |  | X, R | X, R | X, R |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Linguist                           |  | X, R | X, R | X, R |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Assistant                          |  | X, R | X, R | X, R |  |  |
| +-----+                               |  |      |      |      |  |  |
| Lupdate                               |  | X, R | X, R | X, R |  |  |
| +-----+                               |  |      |      |      |  |  |
| Lrelease                              |  | X, R | X, R | X, R |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qmake                                 |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Uic                                   |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Rcc                                   |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qlalr                                 |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qdoc                                  |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qmlscene                              |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qmlviewer                             |  | X    | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Target toolchains                     |  |      | X    | X    |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Debugging Bridge (QDB) Host Tools  |  |      | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| qtconfig-gui                          |  |      | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qt Emulator                           |  |      | X    |      |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qmlinterfacegenerator                 |  |      |      | X    |  |  |
| +-----+                               |  |      |      |      |  |  |
| Qmltocpp                              |  |      |      | X    |  |  |
| +-----+                               |  |      |      |      |  |  |

|                     |  |  |   |      |  |  |
|---------------------|--|--|---|------|--|--|
| qulfontcompiler     |  |  | X |      |  |  |
| Qt53DStudioRuntime2 |  |  |   | X, R |  |  |
| Qt 3D Studio        |  |  |   | X    |  |  |
| Qt Design Studio    |  |  |   | X    |  |  |

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|                                      | Add-On Product(s) |          |               |         |                        |             |                        |
|--------------------------------------|-------------------|----------|---------------|---------|------------------------|-------------|------------------------|
| Modules / Tools of Licensed Software | Qt for Automation | Qt Suite | Qt Automotive | Qt Safe | Qt Application Manager | Qt GammaRay | Qt Deployment Platform |
| Qt MQTT                              | X, R              |          |               |         |                        |             |                        |
| Qt KNX                               | X, R              |          |               |         |                        |             |                        |
| Qt OPC UA                            | X, R              |          |               |         |                        |             |                        |
| Qt CoAP                              | X, R              |          |               |         |                        |             |                        |
| Qt Safe Renderer                     |                   | X, R     | X, R          |         |                        |             |                        |
| Qt Application Manager               |                   | X, R     |               | X, R    |                        |             |                        |
| Qt IVI                               |                   | X, R     |               |         |                        |             |                        |

|                            |  |      |  |   |   |   |  |  |
|----------------------------|--|------|--|---|---|---|--|--|
| Reference UI               |  | X, R |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt GENIVI Extras           |  | X, R |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| QML Live                   |  | X    |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt Creator                 |  | X    |  |   |   |   |  |  |
| Deployment                 |  |      |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt Creator Plugin          |  | X    |  | X |   |   |  |  |
| for Qt Application Manager |  |      |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt Automotive Suite        |  | X    |  |   |   |   |  |  |
| Deployment Server          |  |      |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt Design Studio           |  | X    |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt 3D Studio               |  | X    |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| GammaRay                   |  | X    |  |   | X |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Platform adaptations       |  |      |  |   |   | X |  |  |
| for specified              |  |      |  |   |   |   |  |  |
| Deployment Platforms       |  |      |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |
| Qt for Device              |  | X    |  |   |   |   |  |  |
| Creation                   |  |      |  |   |   |   |  |  |
| +-----+                    |  |      |  |   |   |   |  |  |

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\*\*\* Portions of the driver (that is, bdf.c and bdf.h):

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For example, with most compilers, you could add this to your project

```
CXXFLAGS: -DEIGEN_MPL2_ONLY
```

This will cause a compilation error to be generated if you #include any code that is LGPL licensed.

-----  
Following applies to:

- ./test/mapstaticmethods.cpp
- ./test/schur\_real.cpp
- ./test/prec\_inverse\_4x4.cpp
- ./test/smallvectors.cpp
- ./test/redux.cpp
- ./test/special\_numbers.cpp
- ./test/adjoint.cpp
- ./test/resize.cpp
- ./test/mixingtypes.cpp
- ./test/product\_trmv.cpp
- ./test/sparse\_solvers.cpp
- ./test/cholesky.cpp
- ./test/geo\_quaternion.cpp
- ./test/miscmatrices.cpp
- ./test/stddeque.cpp
- ./test/integer\_types.cpp
- ./test/product\_large.cpp
- ./test/eigensolver\_generic.cpp
- ./test/householder.cpp
- ./test/geo\_orthomethods.cpp
- ./test/array\_for\_matrix.cpp
- ./test/sparseLM.cpp
- ./test/upperbidiagonalization.cpp

./test/nomalloc.cpp  
./test/packetmath.cpp  
./test/jacobisvd.cpp  
./test/geo\_transformations.cpp  
./test/swap.cpp  
./test/eigensolver\_selfadjoint.cpp  
./test/inverse.cpp  
./test/product\_selfadjoint.cpp  
./test/product\_trsolve.cpp  
./test/product\_extra.cpp  
./test/sparse\_solver.h  
./test/mapstride.cpp  
./test/mapped\_matrix.cpp  
./test/geo\_eulerangles.cpp  
./test/eigen2support.cpp  
./test/denseLM.cpp  
./test/stdvector.cpp  
./test/nesting\_ops.cpp  
./test/sparse\_permutations.cpp  
./test/zerosized.cpp  
./test/exceptions.cpp  
./test/vectorwiseop.cpp  
./test/cwiseop.cpp  
./test/basicstuff.cpp  
./test/product\_trmm.cpp  
./test/linearstructure.cpp  
./test/sparse\_product.cpp  
./test/stdvector\_overload.cpp  
./test/stable\_norm.cpp  
./test/umeyama.cpp  
./test/unalignedcount.cpp  
./test/triangular.cpp  
./test/product\_mmtr.cpp  
./test/sparse\_basic.cpp  
./test/sparse\_vector.cpp  
./test/meta.cpp  
./test/real\_qz.cpp  
./test/ref.cpp  
./test/eigensolver\_complex.cpp  
./test/cholmod\_support.cpp  
./test/conjugate\_gradient.cpp  
./test/sparse.h  
./test/simplicial\_cholesky.cpp  
./test/bicgstab.cpp  
./test/dynalloc.cpp  
./test/product\_notemporary.cpp  
./test/geo\_hyperplane.cpp  
./test/lu.cpp

./test/qr.cpp  
./test/hessenberg.cpp  
./test/sizeof.cpp  
./test/main.h  
./test/selfadjoint.cpp  
./test/permutationmatrices.cpp  
./test/superlu\_support.cpp  
./test/qtvector.cpp  
./test/geo\_homogeneous.cpp  
./test/determinant.cpp  
./test/array\_reverse.cpp  
./test/unalignedassert.cpp  
./test/stdlist.cpp  
./test/product\_symm.cpp  
./test/corners.cpp  
./test/dontalign.cpp  
./test/visitor.cpp  
./test/geo\_alignedbox.cpp  
./test/diagonalmatrices.cpp  
./test/product\_small.cpp  
./test/eigensolver\_generalized\_real.cpp  
./test/umfpack\_support.cpp  
./test/first\_aligned.cpp  
./test/qr\_fullpivoting.cpp  
./test/array\_replicate.cpp  
./test/geo\_parametrizedline.cpp  
./test/eigen2/eigen2\_unalignedassert.cpp  
./test/eigen2/eigen2\_prec\_inverse\_4x4.cpp  
./test/eigen2/eigen2\_alignedbox.cpp  
./test/eigen2/eigen2\_sparse\_product.cpp  
./test/eigen2/eigen2\_meta.cpp  
./test/eigen2/eigen2\_nomalloc.cpp  
./test/eigen2/eigen2\_visitor.cpp  
./test/eigen2/eigen2\_packetmath.cpp  
./test/eigen2/eigen2\_svd.cpp  
./test/eigen2/eigen2\_mixingtypes.cpp  
./test/eigen2/eigen2\_qr.cpp  
./test/eigen2/eigen2\_cwiseop.cpp  
./test/eigen2/eigen2\_geometry\_with\_eigen2\_prefix.cpp  
./test/eigen2/eigen2\_smallvectors.cpp  
./test/eigen2/eigen2\_commainitializer.cpp  
./test/eigen2/eigen2\_sparse\_solvers.cpp  
./test/eigen2/eigen2\_hyperplane.cpp  
./test/eigen2/eigen2\_eigensolver.cpp  
./test/eigen2/eigen2\_linearstructure.cpp  
./test/eigen2/eigen2\_sizeof.cpp  
./test/eigen2/eigen2\_parametrizedline.cpp  
./test/eigen2/eigen2\_lu.cpp

./test/eigen2/eigen2\_adjoint.cpp  
./test/eigen2/eigen2\_geometry.cpp  
./test/eigen2/eigen2\_stdvector.cpp  
./test/eigen2/eigen2\_newstdvector.cpp  
./test/eigen2/eigen2\_submatrices.cpp  
./test/eigen2/sparse.h  
./test/eigen2/eigen2\_swap.cpp  
./test/eigen2/eigen2\_triangular.cpp  
./test/eigen2/eigen2\_basicstuff.cpp  
./test/eigen2/gsl\_helper.h  
./test/eigen2/eigen2\_dynalloc.cpp  
./test/eigen2/eigen2\_array.cpp  
./test/eigen2/eigen2\_map.cpp  
./test/eigen2/main.h  
./test/eigen2/eigen2\_miscmatrices.cpp  
./test/eigen2/eigen2\_product\_large.cpp  
./test/eigen2/eigen2\_first\_aligned.cpp  
./test/eigen2/eigen2\_cholesky.cpp  
./test/eigen2/eigen2\_determinant.cpp  
./test/eigen2/eigen2\_sum.cpp  
./test/eigen2/eigen2\_inverse.cpp  
./test/eigen2/eigen2\_regression.cpp  
./test/eigen2/eigen2\_product\_small.cpp  
./test/eigen2/eigen2\_qtvector.cpp  
./test/eigen2/eigen2\_sparse\_vector.cpp  
./test/eigen2/product.h  
./test/eigen2/eigen2\_sparse\_basic.cpp  
./test/eigen2/eigen2\_bug\_132.cpp  
./test/array.cpp  
./test/product\_syrk.cpp  
./test/commainitializer.cpp  
./test/conservative\_resize.cpp  
./test/qr\_colpivoting.cpp  
./test/nullary.cpp  
./test/bandmatrix.cpp  
./test/pastix\_support.cpp  
./test/product.h  
./test/block.cpp  
./test/vectorization\_logic.cpp  
./test/jacobi.cpp  
./test/diagonal.cpp  
./test/schur\_complex.cpp  
./test/sizeoverflow.cpp  
./bench/BenchTimer.h  
./bench/benchFFT.cpp  
./bench/eig33.cpp  
./bench/spbench/spbenchsolver.h  
./bench/spbench/spbenchstyle.h

./lapack/complex\_double.cpp  
./lapack/cholesky.cpp  
./lapack/lapack\_common.h  
./lapack/eigenvalues.cpp  
./lapack/single.cpp  
./lapack/lu.cpp  
./lapack/complex\_single.cpp  
./lapack/double.cpp  
./demos/mix\_eigen\_and\_c/binary\_library.cpp  
./demos/mix\_eigen\_and\_c/binary\_library.h  
./demos/mix\_eigen\_and\_c/example.c  
./demos/mandelbrot/mandelbrot.cpp  
./demos/mandelbrot/mandelbrot.h  
./demos/opengl/icosphere.cpp  
./demos/opengl/icosphere.h  
./demos/opengl/camera.cpp  
./demos/opengl/quaternion\_demo.h  
./demos/opengl/camera.h  
./demos/opengl/trackball.h  
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./unsupported/Eigen/src/Eigenvalues/ArpackSelfAdjointEigenSolver.h
./Eigen/src/OrderingMethods/Amd.h
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./unsupported/Eigen/src/LevenbergMarquardt/LMcovar.h  
./unsupported/Eigen/src/LevenbergMarquardt/LMonestep.h  
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3.1.0 / 2017-09-26

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- \* Add `DEBUG\_HIDE\_DATE` env var (#486)
- \* Remove ReDoS regexp in %o formatter (#504)
- \* Remove "component" from package.json
- \* Remove `component.json`
- \* Ignore package-lock.json
- \* Examples: fix colors printout
- \* Fix: browser detection
- \* Fix: spelling mistake (#496, @EdwardBetts)

3.0.1 / 2017-08-24

=====

- \* Fix: Disable colors in Edge and Internet Explorer (#489)

3.0.0 / 2017-08-08

=====

- \* Breaking: Remove DEBUG\_FD (#406)
- \* Breaking: Use `Date#toISOString()` instead to `Date#toUTCString()` when output is not a TTY (#418)
- \* Breaking: Make millisecond timer namespace specific and allow 'always enabled' output (#408)
- \* Addition: document `enabled` flag (#465)
- \* Addition: add 256 colors mode (#481)
- \* Addition: `enabled()` updates existing debug instances, add `destroy()` function (#440)
- \* Update: component: update "ms" to v2.0.0
- \* Update: separate the Node and Browser tests in Travis-CI
- \* Update: refactor Readme, fixed documentation, added "Namespace Colors" section, redid screenshots
- \* Update: separate Node.js and web browser examples for organization
- \* Update: update "browserify" to v14.4.0
- \* Fix: fix Readme typo (#473)



2.6.9 / 2017-09-22

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- \* remove ReDoS regexp in %o formatter (#504)

2.6.8 / 2017-05-18

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- \* Fix: Check for undefined on browser globals (#462, @marbemac)

2.6.7 / 2017-05-16

=====

- \* Fix: Update ms to 2.0.0 to fix regular expression denial of service vulnerability (#458, @hubdotcom)
- \* Fix: Inline extend function in node implementation (#452, @dougwilson)
- \* Docs: Fix typo (#455, @msasad)

2.6.5 / 2017-04-27

=====

- \* Fix: null reference check on window.documentElement.style.WebkitAppearance (#447, @thebigredgeek)
- \* Misc: clean up browser reference checks (#447, @thebigredgeek)
- \* Misc: add npm-debug.log to .gitignore (@thebigredgeek)

2.6.4 / 2017-04-20

=====

- \* Fix: bug that would occur if process.env.DEBUG is a non-string value. (#444, @LucianBuzzo)
- \* Chore: ignore bower.json in npm installations. (#437, @joaovieira)
- \* Misc: update "ms" to v0.7.3 (@tootallnate)

2.6.3 / 2017-03-13

=====

- \* Fix: Electron reference to `process.env.DEBUG` (#431, @paulcbetts)
- \* Docs: Changelog fix (@thebigredgeek)

2.6.2 / 2017-03-10

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- \* Fix: DEBUG\_MAX\_ARRAY\_LENGTH (#420, @slavaGanzin)
- \* Docs: Add backers and sponsors from Open Collective (#422, @piamancini)
- \* Docs: Add Slackin invite badge (@tootallnate)

2.6.1 / 2017-02-10

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- \* Fix: Module's `export default` syntax fix for IE8 `Expected identifier` error
- \* Fix: Whitelist DEBUG\_FD for values 1 and 2 only (#415, @pi0)
- \* Fix: IE8 "Expected identifier" error (#414, @vgoma)
- \* Fix: Namespaces would not disable once enabled (#409, @musikov)

2.6.0 / 2016-12-28

=====

- \* Fix: added better null pointer checks for browser useColors (@thebigredgeek)
- \* Improvement: removed explicit `window.debug` export (#404, @tootallnate)
- \* Improvement: deprecated `DEBUG\_FD` environment variable (#405, @tootallnate)

2.5.2 / 2016-12-25

=====

- \* Fix: reference error on window within webworkers (#393, @KlausTrainer)
- \* Docs: fixed README typo (#391, @lurch)
- \* Docs: added notice about v3 api discussion (@thebigredgeek)

2.5.1 / 2016-12-20

=====

- \* Fix: babel-core compatibility

2.5.0 / 2016-12-20

=====

- \* Fix: wrong reference in bower file (@thebigredgeek)
- \* Fix: webworker compatibility (@thebigredgeek)
- \* Fix: output formatting issue (#388, @kribblo)
- \* Fix: babel-loader compatibility (#383, @escwald)
- \* Misc: removed built asset from repo and publications (@thebigredgeek)
- \* Misc: moved source files to /src (#378, @yamikuronue)
- \* Test: added karma integration and replaced babel with browserify for browser tests (#378, @yamikuronue)
- \* Test: coveralls integration (#378, @yamikuronue)
- \* Docs: simplified language in the opening paragraph (#373, @yamikuronue)

2.4.5 / 2016-12-17

=====

- \* Fix: `navigator` undefined in Rhino (#376, @jochenberger)
- \* Fix: custom log function (#379, @hsiliev)
- \* Improvement: bit of cleanup + linting fixes (@thebigredgeek)
- \* Improvement: rm non-maintained `dist` dir (#375, @freewil)
- \* Docs: simplified language in the opening paragraph. (#373, @yamikuronue)

2.4.4 / 2016-12-14

=====

\* Fix: work around debug being loaded in preload scripts for electron (#368, @paulcbetts)

2.4.3 / 2016-12-14

=====

\* Fix: navigation.userAgent error for react native (#364, @escwald)

2.4.2 / 2016-12-14

=====

\* Fix: browser colors (#367, @tootallnate)

\* Misc: travis ci integration (@thebigredgeek)

\* Misc: added linting and testing boilerplate with sanity check (@thebigredgeek)

2.4.1 / 2016-12-13

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\* Fix: typo that broke the package (#356)

2.4.0 / 2016-12-13

=====

\* Fix: bower.json references unbuilt src entry point (#342, @justmatt)

\* Fix: revert "handle regex special characters" (@tootallnate)

\* Feature: configurable util.inspect() options for NodeJS (#327, @tootallnate)

\* Feature: %O (big O) pretty-prints objects (#322, @tootallnate)

\* Improvement: allow colors in workers (#335, @botverse)

\* Improvement: use same color for same namespace. (#338, @lchenay)

2.3.3 / 2016-11-09

=====

\* Fix: Catch `JSON.stringify()` errors (#195, Jovan Alleyne)

\* Fix: Returning `localStorage` saved values (#331, Levi Thomason)

\* Improvement: Don't create an empty object when no `process` (Nathan Rajlich)

2.3.2 / 2016-11-09

=====

\* Fix: be super-safe in index.js as well (@TooTallNate)

\* Fix: should check whether process exists (Tom Newby)

2.3.1 / 2016-11-09

=====

\* Fix: Added electron compatibility (#324, @paulcbetts)

- \* Improvement: Added performance optimizations (@tootallnate)
- \* Readme: Corrected PowerShell environment variable example (#252, @gimre)
- \* Misc: Removed yarn lock file from source control (#321, @fengmk2)

### 2.3.0 / 2016-11-07

=====

- \* Fix: Consistent placement of ms diff at end of output (#215, @gorangajic)
- \* Fix: Escaping of regex special characters in namespace strings (#250, @zacronos)
- \* Fix: Fixed bug causing crash on react-native (#282, @vkarпов15)
- \* Feature: Enabled ES6+ compatible import via default export (#212 @bucaran)
- \* Feature: Added %O formatter to reflect Chrome's console.log capability (#279, @oncleTom)
- \* Package: Update "ms" to 0.7.2 (#315, @DevSide)
- \* Package: removed superfluous version property from bower.json (#207 @kkirsche)
- \* Readme: fix USE\_COLORS to DEBUG\_COLORS
- \* Readme: Doc fixes for format string sugar (#269, @mlucol)
- \* Readme: Updated docs for DEBUG\_FD and DEBUG\_COLORS environment variables (#232, @mattlyons0)
- \* Readme: doc fixes for PowerShell (#271 #243, @exoticknight @unreadable)
- \* Readme: better docs for browser support (#224, @matthewmueller)
- \* Tooling: Added yarn integration for development (#317, @thebigredgeek)
- \* Misc: Renamed History.md to CHANGELOG.md (@thebigredgeek)
- \* Misc: Added license file (#226 #274, @CantemoInternal @sdaitzman)
- \* Misc: Updated contributors (@thebigredgeek)

### 2.2.0 / 2015-05-09

=====

- \* package: update "ms" to v0.7.1 (#202, @dougwilson)
- \* README: add logging to file example (#193, @DanielOchoa)
- \* README: fixed a typo (#191, @amir-s)
- \* browser: expose `storage` (#190, @stephenmathieson)
- \* Makefile: add a `distclean` target (#189, @stephenmathieson)

### 2.1.3 / 2015-03-13

=====

- \* Updated stdout/stderr example (#186)
- \* Updated example/stdout.js to match debug current behaviour
- \* Renamed example/stderr.js to stdout.js
- \* Update Readme.md (#184)
- \* replace high intensity foreground color for bold (#182, #183)

### 2.1.2 / 2015-03-01

=====

- \* dist: recompile
- \* update "ms" to v0.7.0
- \* package: update "browserify" to v9.0.3

- \* component: fix "ms.js" repo location
- \* changed bower package name
- \* updated documentation about using debug in a browser
- \* fix: security error on safari (#167, #168, @yields)

2.1.1 / 2014-12-29

=====

- \* browser: use `typeof` to check for `console` existence
- \* browser: check for `console.log` truthiness (fix IE 8/9)
- \* browser: add support for Chrome apps
- \* Readme: added Windows usage remarks
- \* Add `bower.json` to properly support bower install

2.1.0 / 2014-10-15

=====

- \* node: implement `DEBUG\_FD` env variable support
- \* package: update "browserify" to v6.1.0
- \* package: add "license" field to package.json (#135, @panuhorsmalhti)

2.0.0 / 2014-09-01

=====

- \* package: update "browserify" to v5.11.0
- \* node: use stderr rather than stdout for logging (#29, @stephenmathieson)

1.0.4 / 2014-07-15

=====

- \* dist: recompile
- \* example: remove `console.info()` log usage
- \* example: add "Content-Type" UTF-8 header to browser example
- \* browser: place %c marker after the space character
- \* browser: reset the "content" color via `color: inherit`
- \* browser: add colors support for Firefox >= v31
- \* debug: prefer an instance `log()` function over the global one (#119)
- \* Readme: update documentation about styled console logs for FF v31 (#116, @wryk)

1.0.3 / 2014-07-09

=====

- \* Add support for multiple wildcards in namespaces (#122, @seegno)
- \* browser: fix lint

1.0.2 / 2014-06-10

=====

- \* browser: update color palette (#113, @gscottolson)
- \* common: make console logging function configurable (#108, @timoxley)
- \* node: fix %o colors on old node <= 0.8.x
- \* Makefile: find node path using shell/which (#109, @timoxley)

1.0.1 / 2014-06-06

=====

- \* browser: use `removeItem()` to clear localStorage
- \* browser, node: don't set DEBUG if namespaces is undefined (#107, @leedm777)
- \* package: add "contributors" section
- \* node: fix comment typo
- \* README: list authors

1.0.0 / 2014-06-04

=====

- \* make ms diff be global, not be scope
- \* debug: ignore empty strings in enable()
- \* node: make DEBUG\_COLORS able to disable coloring
- \* \*: export the `colors` array
- \* npmnignore: don't publish the `dist` dir
- \* Makefile: refactor to use browserify
- \* package: add "browserify" as a dev dependency
- \* Readme: add Web Inspector Colors section
- \* node: reset terminal color for the debug content
- \* node: map "%o" to `util.inspect()`
- \* browser: map "%j" to `JSON.stringify()`
- \* debug: add custom "formatters"
- \* debug: use "ms" module for humanizing the diff
- \* Readme: add "bash" syntax highlighting
- \* browser: add Firebug color support
- \* browser: add colors for WebKit browsers
- \* node: apply log to `console`
- \* rewrite: abstract common logic for Node & browsers
- \* add .jshintrc file

0.8.1 / 2014-04-14

=====

- \* package: re-add the "component" section

0.8.0 / 2014-03-30

=====

- \* add `enable()` method for nodejs. Closes #27
- \* change from stderr to stdout
- \* remove unnecessary index.js file

0.7.4 / 2013-11-13

=====

- \* remove "browserify" key from package.json (fixes something in browserify)

0.7.3 / 2013-10-30

=====

- \* fix: catch localStorage security error when cookies are blocked (Chrome)
- \* add debug(err) support. Closes #46
- \* add .browser prop to package.json. Closes #42

0.7.2 / 2013-02-06

=====

- \* fix package.json
- \* fix: Mobile Safari (private mode) is broken with debug
- \* fix: Use unicode to send escape character to shell instead of octal to work with strict mode javascript

0.7.1 / 2013-02-05

=====

- \* add repository URL to package.json
- \* add DEBUG\_COLORED to force colored output
- \* add browserify support
- \* fix component. Closes #24

0.7.0 / 2012-05-04

=====

- \* Added .component to package.json
- \* Added debug.component.js build

0.6.0 / 2012-03-16

=====

- \* Added support for "-" prefix in DEBUG [Vinay Pulim]
- \* Added ` .enabled ` flag to the node version [TooTallNate]

0.5.0 / 2012-02-02

=====

- \* Added: humanize diffs. Closes #8
- \* Added `debug.disable()` to the CS variant
- \* Removed padding. Closes #10
- \* Fixed: persist client-side variant again. Closes #9

0.4.0 / 2012-02-01

=====

- \* Added browser variant support for older browsers [TooTallNate]
- \* Added ``debug.enable('project:*')`` to browser variant [TooTallNate]
- \* Added padding to diff (moved it to the right)

0.3.0 / 2012-01-26

=====

- \* Added millisecond diff when isatty, otherwise UTC string

0.2.0 / 2012-01-22

=====

- \* Added wildcard support

0.1.0 / 2011-12-02

=====

- \* Added: remove colors unless stderr isatty [TooTallNate]

0.0.1 / 2010-01-03

=====

- \* Initial release

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[This is the first released version of the library GPL. It is  
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### Preamble

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Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that companies distributing free software will individually obtain patent licenses, thus in effect transforming the program into proprietary software. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License, which was designed for utility programs. This license, the GNU Library General Public License, applies to certain designated libraries. This license is quite different from the ordinary one; be sure to read it in full, and don't assume that anything in it is the same as in the ordinary license.

The reason we have a separate public license for some libraries is that they blur the distinction we usually make between modifying or adding to a program and simply using it. Linking a program with a library, without changing the library, is in some sense simply using the library, and is analogous to running a utility program or application program. However, in a textual and legal sense, the linked executable is a combined work, a derivative of the original library, and the ordinary General Public License treats it as such.

Because of this blurred distinction, using the ordinary General Public License for libraries did not effectively promote software sharing, because most developers did not use the libraries. We concluded that weaker conditions might promote sharing better.

However, unrestricted linking of non-free programs would deprive the users of those programs of all benefit from the free status of the libraries themselves. This Library General Public License is intended to permit developers of non-free programs to use free libraries, while preserving your freedom as a user of such programs to change the free libraries that are incorporated in them. (We have not seen how to achieve this as regards changes in header files, but we have achieved it as regards changes in the actual functions of the Library.) The hope is that this will lead to faster development of free libraries.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, while the latter only works together with the library.

Note that it is possible for a library to be covered by the ordinary

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A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

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- b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.
- c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.
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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under

the scope of this License.

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The



threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also compile or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

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It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

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For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this

case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)



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When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

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```
/**
```

```
 * Base64 - a simple base64 encoder and decoder.
```

```
 */
```

```
 * Copyright (c) 1999, Bob Withers - bwit@pobox.com
```

```
 */
```

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 * intact.
```

```
 */
```

```
 * Enhancements by Stanley Yamane:
```

```
 * o reverse lookup table for the decode function
```

```
 * o reserve string buffer space in advance
```

/\*\*

/\*\*

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language: node\_js

node\_js:

- "6"

- "8"

cache:

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\* Ring Buffer utility.  
\*  
\* Author: Phil Burk, <http://www.softsynth.com>  
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\* also, allowed for const where possible  
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\*  
\* Note that this is safe only for a single-thread reader and a  
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- libpostproc
- optional x86 optimization in the files
  - `libavcodec/x86/flac\_dsp\_gpl.asm`
  - `libavcodec/x86/idct\_mmx.c`
  - `libavfilter/x86/vf\_removegrain.asm`
- the following building and testing tools
  - `compat/solaris/make\_sunver.pl`
  - `doc/t2h.pm`
  - `doc/txi2pod.pl`
  - `libswresample/tests/swresample.c`
  - `tests/checkasm/\*`
  - `tests/tiny\_ssim.c`
- the following filters in libavfilter:
  - `signature\_lookup.c`
  - `vf\_blackframe.c`
  - `vf\_boxblur.c`
  - `vf\_colormatrix.c`
  - `vf\_cover\_rect.c`
  - `vf\_croptdetect.c`
  - `vf\_delogo.c`
  - `vf\_eq.c`
  - `vf\_find\_rect.c`
  - `vf\_fspp.c`
  - `vf\_histeq.c`
  - `vf\_hqdn3d.c`
  - `vf\_kerndeint.c`
  - `vf\_lensfun.c` (GPL version 3 or later)
  - `vf\_mcdeint.c`
  - `vf\_mpdecimate.c`
  - `vf\_nnedi.c`
  - `vf\_owdenoise.c`
  - `vf\_perspective.c`
  - `vf\_phase.c`
  - `vf\_pp.c`
  - `vf\_pp7.c`
  - `vf\_pullup.c`
  - `vf\_repeatfields.c`
  - `vf\_sab.c`
  - `vf\_signature.c`
  - `vf\_smartblur.c`
  - `vf\_spp.c`
  - `vf\_stereo3d.c`
  - `vf\_super2xsai.c`
  - `vf\_tinterlace.c`
  - `vf\_uspp.c`
  - `vf\_vaguedenoiser.c`
  - `vsrc\_mptestsrc.c`

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- \* `tests/reference.pnm` is under the expat license.

## ## External libraries

FFmpeg can be combined with a number of external libraries, which sometimes affect the licensing of binaries resulting from the combination.

## ### Compatible libraries

The following libraries are under GPL version 2:

- avisynth
- frei0r
- libcdio
- libdavs2
- librubberband
- libvidstab
- libx264
- libx265
- libxavs
- libxavs2
- libxvid

When combining them with FFmpeg, FFmpeg needs to be licensed as GPL as well by passing `--enable-gpl` to configure.

The following libraries are under LGPL version 3:

- gmp
- libaribb24
- liblensfun

When combining them with FFmpeg, use the configure option `--enable-version3` to upgrade FFmpeg to the LGPL v3.

The VMAF, mbedTLS, RK MPI, OpenCORE and VisualOn libraries are under the Apache License

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The smbclient library is under the GPL v3, to combine it with FFmpeg, the options `--enable-gpl` and `--enable-version3` have to be passed to configure to upgrade FFmpeg to the GPL v3.

### ### Incompatible libraries

There are certain libraries you can combine with FFmpeg whose licenses are not compatible with the GPL and/or the LGPL. If you wish to enable these libraries, even in circumstances that their license may be incompatible, pass `--enable-nonfree` to configure. This will cause the resulting binary to be unredistributable.

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```
#!/usr/bin/env node
```

```
/*
```

```
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```

```
Code licensed under the BSD License:
```

```
http://yuilibrary.com/license/
```

```
*/
```

```
var checker = require('./lib/index');
```

```
var args = require('./lib/args').parse();
```

```
var mkdirp = require('mkdirp');
```

```
var path = require('path');
```

```
var chalk = require('chalk');
```

```
var fs = require('fs');
```

```
if (args.help) {
```

```
 console.error('license-checker@' + require('./package.json').version);
```

```
 var usage = [
```

```
 ",
```

```
 ' --production only show production dependencies.',
```

```
 ' --development only show development dependencies.',
```

```
 ' --unknown report guessed licenses as unknown licenses.',
```

```
 ' --start [path of the initial json to look for]',
```

```
 ' --onlyunknown only list packages with unknown or guessed licenses.',
```

```
 ' --json output in json format.',
```

```
 ' --csv output in csv format.',
```

```
 ' --csvComponentPrefix column prefix for components in csv file',
```

```
 ' --out [filepath] write the data to a specific file.',
```

```
 ' --customPath to add a custom Format file in JSON',
```

```
 ' --exclude [list] exclude modules which licenses are in the comma-separated list from the output',
```

```
 ' --relativeLicensePath output the location of the license files as relative paths',
```

```
 ' --summary output a summary of the license usage',
```

```
 ' --failOn [list] fail (exit with code 1) on the first occurrence of the licenses of the semicolon-separated list',
```

```
 ' --onlyAllow [list] fail (exit with code 1) on the first occurrence of the licenses not in the semicolon-separated
```

```
list',
```

```
 ' --direct look for direct dependencies only',
```

```
 ' --packages [list] restrict output to the packages (package@version) in the semicolon-separated list',
```

```
 ' --excludePackages [list] restrict output to the packages (package@version) not in the semicolon-separated
```

```
list',
```

```
 ' --excludePrivatePackages restrict output to not include any package marked as private',
```

```

 ",
 ' --version The current version',
 ' --help The text you are reading right now :)',
 "
];
console.error(usage.join('\n'), '\n');
process.exit(0);
}

if (args.version) {
 console.error(require('../package.json').version);
 process.exit(1);
}

if (args.failOn && args.onlyAllow) {
 console.error('--failOn and --onlyAllow can not be used at the same time. Choose one or the other. ');
 process.exit(1);
} else {
 var argValue = args.failOn || args.onlyAllow;
 if (argValue && argValue.indexOf(',') >= 0) {
 var argName = args.failOn ? 'failOn' : 'onlyAllow';
 console.warn("Warning: As of v17 the --' + argName + ' argument takes semicolons as delimiters instead of
commas (some license names can contain commas)");
 }
}

checker.init(args, function(err, json) {

 var formattedOutput = "";

 if (!err) {
 console.error('Found error');
 console.error(err);
 }

 if (shouldColorizeOutput(args)) {
 var keys = Object.keys(json);
 keys.forEach(function(key) {
 var keyParts = key.split('@');
 var coloredKey = chalk.blue(keyParts[0]) + chalk.dim('@') + chalk.green(keyParts[1]);
 json[coloredKey] = json[key];
 delete json[key];
 });
 }

 if (args.json) {
 formattedOutput = JSON.stringify(json, null, 2) + '\n';
 } else if (args.csv) {

```

```

 formattedOutput = checker.asCSV(json, args.customFormat, args.csvComponentPrefix);
 } else if (args.markdown){
 formattedOutput = checker.asMarkDown(json, args.customFormat) + '\n';
 } else if (args.summary) {
 formattedOutput = checker.asSummary(json);
 } else {
 formattedOutput = checker.asTree(json);
 }

 if (args.files) {
 checker.asFiles(json, args.files);
 } else if (args.out) {
 var dir = path.dirname(args.out);
 mkdirp.sync(dir);
 fs.writeFileSync(args.out, formattedOutput, 'utf8');
 } else {
 console.log(formattedOutput);
 }
});

function shouldColorizeOutput(args) {
 return args.color && !args.out && !(args.csv || args.json || args.markdown);
}

```

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If

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When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

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- a) Accompany the work with the complete corresponding

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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# Please keep the list sorted.

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Chris Palmer <chris@noncombatant.org>

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#### ## Change Log

### v25.0.1 (2019/01/10 19:29 +00:00)

- [f1c835b](https://github.com/davglass/license-checker/commit/f1c835b991b65dc928eafe64c29b73df9e703169) Updated readme with new args (@davglass)
- [ada667f](https://github.com/davglass/license-checker/commit/ada667f28e8ef4e96b5b6059fe05541d05ca936c) changelog (@davglass)
- [7813f0d](https://github.com/davglass/license-checker/commit/7813f0db3b51f7cc4cd37d8e7b4670f9005fed06) contrib (@davglass)

### v25.0.0 (2019/01/10 15:09 +00:00)

- [cdb77d9](https://github.com/davglass/license-checker/commit/cdb77d9a2b36cd87503f32265a0ee388b25c24ae) 25.0.0 (@davglass)
- [b897345](https://github.com/davglass/license-checker/commit/b89734549bc05fb5e143083fdf6d3959d87eb2b8) [Fixes #136] Document --start option and add the depth option for looking into root dependencies or infinitely (@davglass)
- [#185](https://github.com/davglass/license-checker/pull/185) Merge pull request #185 from theboolean/fix/exclude-packages-and-private (@theboolean)
- [#184](https://github.com/davglass/license-checker/pull/184) Merge pull request #184 from theboolean/docs/fix-typo (@theboolean)
- [987a60f](https://github.com/davglass/license-checker/commit/987a60fbb58052cf36d5a80e6252e81136bb1dd8) changes 24.1.0 (@davglass)

### v24.1.0 (2018/12/14 20:54 +00:00)

- [18ab8a1](https://github.com/davglass/license-checker/commit/18ab8a1eb478d1354429ca4318c1df3de3e4cbb1) 24.1.0 (@davglass)
- [1dca0f6](https://github.com/davglass/license-checker/commit/1dca0f616aebdef2d398c130a2a4f86c2b4e88c8) Changelog (@davglass)

- [#188](https://github.com/davglass/license-checker/pull/188) Fix for #153: remove deprecated package 'spdx' (#188) (@rogierschouten)
- [d1d34b1](https://github.com/davglass/license-checker/commit/d1d34b1a8894987807419c093c3ec10b4f06db3d) Fix typo in package.json description (@theboolean)
- [f5c9008](https://github.com/davglass/license-checker/commit/f5c9008a6d20b503e21c0d8130e52be526a5bfe8) Fix: Allow excluding packages and private packages together (@theboolean)
- [98c4dc6](https://github.com/davglass/license-checker/commit/98c4dc670fdebb6e58b62b38ebcb12302e5b1db5) changes (@davglass)

### v24.0.1 (2018/10/11 16:40 +00:00)

- [d72eae8](https://github.com/davglass/license-checker/commit/d72eae8bcb80d8582e6d12c5e2664e9c19135709) 24.0.1 (@davglass)
- [9433e64](https://github.com/davglass/license-checker/commit/9433e640ea9f629aad5f00c224a9f61026b8116d) [Fixes #181] - Removed extra line break with --cvs (@davglass)
- [65baa28](https://github.com/davglass/license-checker/commit/65baa28f532f87ebb75a32578c7ac5837806d12f) contrib and changes (@davglass)

### v24.0.0 (2018/10/09 21:12 +00:00)

- [84d64a2](https://github.com/davglass/license-checker/commit/84d64a28fa971c3bfb20b9e9de27cafbe6e8481b) 24.0.0 (@davglass)
- [#180](https://github.com/davglass/license-checker/pull/180) Feature: Exclude Private Packages (#180) (Jonny Reeves)
- [#179](https://github.com/davglass/license-checker/pull/179) Merge pull request #179 from jonny-improbable/fix/fix-strict-checks (@jonny-improbable)
- [179077d](https://github.com/davglass/license-checker/commit/179077d079acbcd0183aa6691cfe5c2ec0f93f07) Fixes 176, Packages are not ignored when using --onlyAllow and --excludePackages. (@jonny-improbable)
- [890ca17](https://github.com/davglass/license-checker/commit/890ca17d179bc43a6cb7cff962d69d1521dc9ac2) changelog (@davglass)

### v23.0.0 (2018/10/09 14:37 +00:00)

- [f243287](https://github.com/davglass/license-checker/commit/f243287fbce6da33838a226ddfe8c412535390d4) 23.0.0 (@davglass)
- [#178](https://github.com/davglass/license-checker/pull/178) Merge pull request #178 from jonny-improbable/fix/filtering (@jonny-improbable)
- [#175](https://github.com/davglass/license-checker/pull/175) Merge pull request #175 from jonny-improbable/patch-1 (@jonny-improbable)
- [f2c6611](https://github.com/davglass/license-checker/commit/f2c6611d6c68e50b2b6f56260026837e7167f44a) Fixes #177, --packages and --excludePackages filtering (@jonny-improbable)
- [0a598df](https://github.com/davglass/license-checker/commit/0a598df55c3ec33803ef33be07cc47a910eee961) Improve --onlyAllow violation Error
- [ee723af](https://github.com/davglass/license-checker/commit/ee723af79889a4d98ed067494a58f6aa41a44ac7) changes (@davglass)

### v22.0.0 (2018/10/08 19:00 +00:00)

- [bd398c3](https://github.com/davglass/license-checker/commit/bd398c3bce0279699c9aad1dc4b592f398a75766) 22.0.0 (@davglass)
- [#172](https://github.com/davglass/license-checker/pull/172) Merge pull request #172 from fzaninotto/exclude-packages (@fzaninotto)

- [014fd96](https://github.com/davglass/license-checker/commit/014fd9613fe5460e0b7a0fc118a659a337e25e2c) added changes (@davglass)

### v21.0.0 (2018/10/06 13:24 +00:00)

- [d75fe43](https://github.com/davglass/license-checker/commit/d75fe43d61a9d5b6696d71a663e25a53fd3d44f7) 21.0.0 (@davglass)

- [05cb221](https://github.com/davglass/license-checker/commit/05cb221359de4ffe1039f586cd9e8fb7cb9d6398) [Fixes #174] - Moved private and unknown detection above filtering (@davglass)

- [b1d5700](https://github.com/davglass/license-checker/commit/b1d570088236dfb90253bdac27763523b2e74ffb) Add an excludePackages option (@fzaninotto)

- [231bd3f](https://github.com/davglass/license-checker/commit/231bd3f2412507be1d702ad100b23c1b1fe93602) updated readme (@davglass)

- [6c61a7b](https://github.com/davglass/license-checker/commit/6c61a7bd102466c702065d42706392c11717cc1d) changelog (@davglass)

### v20.2.0 (2018/07/30 13:49 +00:00)

- [28dc521](https://github.com/davglass/license-checker/commit/28dc5218dec3340778bd801593275ad1b222e53f) 20.2.0 (@davglass)

- [#169](https://github.com/davglass/license-checker/pull/169) Merge pull request #169 from codepunkt/restrict\_packages (@codepunkt)

- [5e4b274](https://github.com/davglass/license-checker/commit/5e4b274e955485fb2aba37e65fec913b8042f38d) refactor: restore previous code style (@codepunkt)

- [ed25d68](https://github.com/davglass/license-checker/commit/ed25d6829602793e13233d3da2d97b92ee2044c6) test: add test for --packages flag (@codepunkt)

- [0f53922](https://github.com/davglass/license-checker/commit/0f53922088be0b0dfd4f8db7ea884b53d0137e45) feat: allow restricting output to specified packages (@codepunkt)

- [5f63f87](https://github.com/davglass/license-checker/commit/5f63f8766a17e589b57db99bda4eb54d91b85b77) changes and contrib (@davglass)

### v20.1.0 (2018/06/07 14:33 +00:00)

- [970882a](https://github.com/davglass/license-checker/commit/970882a09b345c7f32496431e5ca4c069ad7e320) 20.1.0 (@davglass)

- [#165](https://github.com/davglass/license-checker/pull/165) Merge pull request #165 from santiagocanti/fix-exclude-not-adding-custom-licenses (@santiagocanti)

- [89e48a9](https://github.com/davglass/license-checker/commit/89e48a9d3d0c9f2e48bfcee0dc3563ce4b652e22) Fix exclude not including custom licenses (@santiagocanti)

### v20.0.0 (2018/05/17 14:14 +00:00)

- [0e89310](https://github.com/davglass/license-checker/commit/0e8931021df777cb401d9a332fa2a8c9a2c49eb2) 20.0.0 (@davglass)

- [c36a5c9](https://github.com/davglass/license-checker/commit/c36a5c99bb4f68816e4e19cad5090ba3c7ba67a4) changes (@davglass)

- [ccb66f3](https://github.com/davglass/license-checker/commit/ccb66f3410a4589e6f2b7cf1c3aefb1446bab460) contributors (@davglass)

- [#156](https://github.com/davglass/license-checker/pull/156) Merge pull request #156 from zodiac403/z4/copyright (@zodiac403)

- [56414b4](https://github.com/davglass/license-checker/commit/56414b4a67cbb25bcc8eb8cc05b0ac712b677dc2) Add unit test for Copyright statement. (@zodiac403)

- [3eafe24](https://github.com/davglass/license-checker/commit/3eafe249ad662af727a9b7472f7ad6c1b9a73ade) fixing test coverage with switch to nyc from istanbul (@davglass)

### v19.0.0 (2018/04/30 14:51 +00:00)

- [7e83a06](https://github.com/davglass/license-checker/commit/7e83a069d23c104c3cd8257eb6466670ecca465) 19.0.0 (@davglass)

- [e5eb49b](https://github.com/davglass/license-checker/commit/e5eb49bcb5546dbc681f736f159d63908cd39ce9) upgrading packages (@davglass)

- [442aee6](https://github.com/davglass/license-checker/commit/442aee69b5d44e47bfd2e441c4e1f86d387e49c6) Changlog (@davglass)

### v18.1.0 (2018/04/30 14:16 +00:00)

- [82ec91b](https://github.com/davglass/license-checker/commit/82ec91bb02e6bf998164b62b4aa827198156ad4c) 18.1.0 (@davglass)

- [4b546d3](https://github.com/davglass/license-checker/commit/4b546d38ce91bcbe8d21e7bc53e44635b0447fc2) contrib (@davglass)

- [#155](https://github.com/davglass/license-checker/pull/155) Merge pull request #155 from ktmouk/supress-path-property (@ktmouk)

- [#160](https://github.com/davglass/license-checker/pull/160) Merge pull request #160 from helio-frota/pr (@helio-frota)

- [8b068f2](https://github.com/davglass/license-checker/commit/8b068f25fe910d087c06e29312bc250b49aba4c7) fix: Updating debug dependency to fix a security warning (@helio-frota)

- [040dd94](https://github.com/davglass/license-checker/commit/040dd9468261966c5c40e4a418aa9ba8f716c3a2) Copyright statement: Handle multi-line stagements (@zodiac403)

- [0480750](https://github.com/davglass/license-checker/commit/04807506d61aa1d704e8b51da3a289baa025b510) Fix layout issue. (@zodiac403)

- [9cb45f2](https://github.com/davglass/license-checker/commit/9cb45f2b9ce2c1142c0d1f556f01f7d754737a4c) Link with customFormat (@zodiac403)

- [f83aaae](https://github.com/davglass/license-checker/commit/f83aaae85ad4cc2e9880802951dfacbc86dc2d7f) Merge branch 'z4/copyright' of https://github.com/zodiac403/license-checker into z4/copyright (@zodiac403)

- [7536af9](https://github.com/davglass/license-checker/commit/7536af935d91078657f0e169ed82383f099607f6) Trim output. (@zodiac403)

- [8716845](https://github.com/davglass/license-checker/commit/87168456cae35263882bd2b6d6d0081f228b6b66) Suppress path property (@ktmouk)

- [be57ee8](https://github.com/davglass/license-checker/commit/be57ee8f76c8aada0d227913b7d0e12aca0dc640) Add example for (c) statement. (@zodiac403)

- [fe17f7c](https://github.com/davglass/license-checker/commit/fe17f7c76dbdae0cbf689a0cd260a746698f3281) Parse (c) statements from LICENSE file. (@zodiac403)

- [#149](https://github.com/davglass/license-checker/pull/149) Merge pull request #149 from honzajavorek/patch-1 (@honzajavorek)

- [955bbf6](https://github.com/davglass/license-checker/commit/955bbf6070ffcd9f0d01ef37bb84ffbac65e007b) remove the old status badge (@honzajavorek)

### v18.0.0 (2018/03/20 12:30 +00:00)

- [315de0b](https://github.com/davglass/license-checker/commit/315de0b1a881cf8737c3c0131c217c4820df13a8) 18.0.0 (@davglass)

- [76655d5](https://github.com/davglass/license-checker/commit/76655d59bad95c2e52724aaa3a0cf036f0e60bd6) changelog (@davglass)



- [c8aa823](https://github.com/davglass/license-checker/commit/c8aa823342b7a250d510582c8a03dd76af50bd9c) added contributors (@davglass)
- [#147](https://github.com/davglass/license-checker/pull/147) Merge pull request #147 from honzajavorek/honzajavorek/license-files (@honzajavorek)
- [#148](https://github.com/davglass/license-checker/pull/148) Merge pull request #148 from honzajavorek/honzajavorek/use-stderr (@honzajavorek)
- [#146](https://github.com/davglass/license-checker/pull/146) Merge pull request #146 from honzajavorek/honzajavorek/fix-e2e-test (@honzajavorek)
- [#145](https://github.com/davglass/license-checker/pull/145) Merge pull request #145 from honzajavorek/honzajavorek/drop-4-add-8 (@honzajavorek)
- [0105f7d](https://github.com/davglass/license-checker/commit/0105f7dcf01a67b8f7c34371d95a1d76b191d5ed) use stderr where applicable (@honzajavorek)
- [0ff8d91](https://github.com/davglass/license-checker/commit/0ff8d917c659446256074c0940ae43dd84930233) add support for LICENSE-MIT and similar (@honzajavorek)
- [f02589e](https://github.com/davglass/license-checker/commit/f02589e62c0ba8221081b8b1799d561c3ff20500) isolate and test the license file detection (@honzajavorek)
- [f0da0fe](https://github.com/davglass/license-checker/commit/f0da0fe2ab28f1658e4ed504bb034fb1536b9ff8) add warning about commas and test it (@honzajavorek)
- [3db0b6f](https://github.com/davglass/license-checker/commit/3db0b6f05a68ccfff4181503ca87edce4ef10cd7) fix e2e test (transition from comma delimiter to semicolon) (@honzajavorek)
- [cec3b73](https://github.com/davglass/license-checker/commit/cec3b73505ac40a2dca211e78427624d009585dc) let Travis CI to cache node\_modules (@honzajavorek)
- [8cea3dc](https://github.com/davglass/license-checker/commit/8cea3dccf1d185dc3ae3f37f44a82d7e123a1988) add Travis CI badge to the README (@honzajavorek)
- [8f59c3b](https://github.com/davglass/license-checker/commit/8f59c3b494f69b1d51535bcff80c0e006d0ef6bb) drop support for node 4, add support for node 8 (@honzajavorek)

### v17.0.0 (2018/03/19 13:26 +00:00)

- [cd5fdd8](https://github.com/davglass/license-checker/commit/cd5fdd8e94267d7d8f29e86dd9cbf8b694c037f1) 17.0.0 (@davglass)
- [13c11ee](https://github.com/davglass/license-checker/commit/13c11eeea1b1a3e012de62536100fce91c355c8b) updated readme and help text (@davglass)
- [#144](https://github.com/davglass/license-checker/pull/144) Merge pull request #144 from creising/parser-fixes (@creising)
- [d2ab8df](https://github.com/davglass/license-checker/commit/d2ab8df30bc3e6b38b321a1e12a70cf477a69eb0) added support for lic with commas and spaces (@creising)
- [2075208](https://github.com/davglass/license-checker/commit/20752083c6029823fb389a30a1ed4d7d90fa9297) contrib and changelog (@davglass)
- [6c5274c](https://github.com/davglass/license-checker/commit/6c5274c6064d318844cf36185dea395e0893ff08) [fixes #132] - Fixed issue with asFiles and path issues (@davglass)
- [a46c448](https://github.com/davglass/license-checker/commit/a46c4483f872c3db9498a65b7ae3dc6d8164de0a) 16.0.0 (@davglass)
- [38d63e2](https://github.com/davglass/license-checker/commit/38d63e2c2c3fd6c11012fb69b1470b2ba06d5554) [fixes #128] - Added --onlyAllow option (@davglass)

### v16.0.0 (2018/01/18 15:02 +00:00)

- [#131](https://github.com/davglass/license-checker/pull/131) Merge pull request #131 from mischah/patch-1 (@mischah)

- [e341d17](https://github.com/davglass/license-checker/commit/e341d1701092be87309ec4b51fa6eb23f7e9a589) Fix typo in Readme (@mischah)  
- [cc38a20](https://github.com/davglass/license-checker/commit/cc38a2047bf41b6fe25266114a13a9bf54133e04) updated license text (@davglass)

### v15.0.0 (2017/10/19 14:24 +00:00)

- [a9bd001](https://github.com/davglass/license-checker/commit/a9bd001b649bfa186bae5598bb8c67ff56383599) 15.0.0 (@davglass)  
- [db621fa](https://github.com/davglass/license-checker/commit/db621fa6beeff870699c33be484bf49816ab7866) changelog (@davglass)  
- [#124](https://github.com/davglass/license-checker/pull/124) Merge pull request #124 from neverendingqs/app/stricterguesses (@neverendingqs)  
- [#126](https://github.com/davglass/license-checker/pull/126) app - output now includes path to dependency. (#126) (@neverendingqs)  
- [9f68b29](https://github.com/davglass/license-checker/commit/9f68b29bbfa73278cdab92e221be6ccbab191932) app - strengthening license guessing; resolves #123. (@neverendingqs)  
- [3061c87](https://github.com/davglass/license-checker/commit/3061c87363f3416d86ca6c2ba7b2bfa77def0e73) changes (@davglass)

### v14.0.0 (2017/08/28 13:22 +00:00)

- [b2a4403](https://github.com/davglass/license-checker/commit/b2a440309c1537c52e5c5a2106f11e72d5b784ec) 14.0.0 (@davglass)  
- [#122](https://github.com/davglass/license-checker/pull/122) Added --failOn [list] mode (#122) (@tobilg)

### v13.1.0 (2017/08/25 15:00 +00:00)

- [ee25265](https://github.com/davglass/license-checker/commit/ee25265f92fe0d3b603da6b8c88d175e0d1f2fa5) 13.1.0 (@davglass)  
- [5bb9a17](https://github.com/davglass/license-checker/commit/5bb9a17f89d7e180b3a9d929ebc073135262bd2f) changes (@davglass)  
- [b1e0392](https://github.com/davglass/license-checker/commit/b1e0392afa4b511b7c532125cd3165a828d3d4e3) added contrib (@davglass)  
- [#121](https://github.com/davglass/license-checker/pull/121) Add `--summary` mode to show a summary with counts of the used licenses (#121) (@tobilg)  
- [#119](https://github.com/davglass/license-checker/pull/119) Fix minor spelling mistakes (#119) (@tobiasbueschel)  
- [#118](https://github.com/davglass/license-checker/pull/118) Minor readme text improvements (#118) (@peteruithoven)  
- [d2bc5ea](https://github.com/davglass/license-checker/commit/d2bc5ea91ab50becea91d5f0f050955fe9a6ac59) added license parsing info to README (@davglass)  
- [3e9d320](https://github.com/davglass/license-checker/commit/3e9d320acb2e9f14297d6a4355680f34a9b0609d) changes (@davglass)

### v13.0.3 (2017/08/04 17:15 +00:00)

- [2caf76b](https://github.com/davglass/license-checker/commit/2caf76be7f2849e153ee28410f3b7a41df3283b5) 13.0.3 (@davglass)  
- [faddc8](https://github.com/davglass/license-checker/commit/faddc895ef9c6f182e2283c5605a8c1d8fa8a25) [fixes #117] fixed minor URL parsing (@davglass)  
- [e58a868](https://github.com/davglass/license-checker/commit/e58a868268aefd97d735b364bd87d03140d76482)

changes (@davglass)

### v13.0.2 (2017/07/18 16:24 +00:00)

- [2c712b7](https://github.com/davglass/license-checker/commit/2c712b7c7e6efe916d60f3ef3125f7f019c46d59) 13.0.2 (@davglass)
- [ef812c1](https://github.com/davglass/license-checker/commit/ef812c1168901d08b97dbd450a64ca03bb7062ad) [fixes #114] - Custom URL/File parsing skipped if file found on disk (@davglass)

### v13.0.1 (2017/07/17 12:48 +00:00)

- [a1bf8f1](https://github.com/davglass/license-checker/commit/a1bf8f152b100d81b44757b3b7e141df6a971c44) 13.0.1 (@davglass)
- [e6d0c89](https://github.com/davglass/license-checker/commit/e6d0c893b8a86e12493f7a5c22fd74ef26267994) contrib & changes (@davglass)
- [#113](https://github.com/davglass/license-checker/pull/113) Use LICENSE file in preference to README (#113) (@ibeucaly)
- [6b7f79f](https://github.com/davglass/license-checker/commit/6b7f79f654e21903ea37e4391fba3601ece32e90) changes (@davglass)

### v13.0.0 (2017/07/14 12:49 +00:00)

- [dd9e880](https://github.com/davglass/license-checker/commit/dd9e880abd234d683d8c1e57e7a5f889c9156de4) 13.0.0 (@davglass)
- [051b20b](https://github.com/davglass/license-checker/commit/051b20b0c4b35f223f724705a0025dafc809373f) cleaned up some tests (@davglass)
- [#110](https://github.com/davglass/license-checker/pull/110) FEATURE: Recognise some custom licenses by file or url (#110) (@dancrumb)
- [#111](https://github.com/davglass/license-checker/pull/111) Resolves #60 (#111) Adding support for GPL and LGPL (@dancrumb)
- [#109](https://github.com/davglass/license-checker/pull/109) FEATURE: Improve license exclusion (#109) (@dancrumb)
- [#108](https://github.com/davglass/license-checker/pull/108) FEATURE: Detect private modules and report them as UNLICENSED (#108) (@dancrumb)

### v12.1.0 (2017/07/12 16:48 +00:00)

- [dc944e5](https://github.com/davglass/license-checker/commit/dc944e54d55d77b0ef6b6321d9abee847662ccb8) 12.1.0 (@davglass)
- [d415c58](https://github.com/davglass/license-checker/commit/d415c580b04bc5eefa592dc9f9a0a31b244c1bd3) updated contrib and changes (@davglass)
- [#107](https://github.com/davglass/license-checker/pull/107) Merge pull request #107 from dancrumb/feature/support-for-public-domain-licenses (@dancrumb)
- [0c55770](https://github.com/davglass/license-checker/commit/0c55770294167161c48b79cc82a15a6545154a87) FEATURE: Add support for Public Domain licenses (@dancrumb)

### v12.0.0 (2017/07/05 13:33 +00:00)

- [8b74fa1](https://github.com/davglass/license-checker/commit/8b74fa1fe3b5edb0d217aa3ce86f4662eb024621) 12.0.0 (@davglass)
- [4f3367c](https://github.com/davglass/license-checker/commit/4f3367c2bf2e9713a6cccd11341f7f4fa70ed400) changes & contrib (@davglass)
- [#106](https://github.com/davglass/license-checker/pull/106) Merge pull request #106 from helio-frota/licensefile-

readme (@helio-frota)

- [a229507](https://github.com/davglass/license-checker/commit/a2295073d0178dca1b88e85ea8f52c21d35e52fc) src: the README is added as licenseFile (@helio-frota)
- [b59d90d](https://github.com/davglass/license-checker/commit/b59d90d8705f6f728c817b89936f95097d26857b) changes & contrib (@davglass)

### v11.0.0 (2017/05/30 13:33 +00:00)

- [258df10](https://github.com/davglass/license-checker/commit/258df102da484943088da8e0b6160b80c0e703cd) 11.0.0 (@davglass)
- [#102](https://github.com/davglass/license-checker/pull/102) Merge pull request #102 from xswordsx/multiple-licenses (@xswordsx)
- [c5c8b0f](https://github.com/davglass/license-checker/commit/c5c8b0f408f2a26259a7b1109f7cc135ed5bf9c4) Check for SPDX-compatible licenses (@xswordsx)

### v10.1.0 (2017/05/25 16:16 +00:00)

- [b52a16d](https://github.com/davglass/license-checker/commit/b52a16d0ba414e7287f82325dd65619cd76afdd1) 10.1.0 (@davglass)
- [f911a99](https://github.com/davglass/license-checker/commit/f911a9919033254945ecbbf69362cb171436688e) contrib & changes (@davglass)
- [#100](https://github.com/davglass/license-checker/pull/100) Suppress JSON properties with custom format (#100) (@tbbstny)
- [ed5b3ab](https://github.com/davglass/license-checker/commit/ed5b3ab50825f0be032958f8233dd3000ee98e85) changelog (@davglass)

### v10.0.0 (2017/05/17 13:51 +00:00)

- [b2c2283](https://github.com/davglass/license-checker/commit/b2c2283cf5a937e64a07ab200ec2379e481903b6) 10.0.0 (@davglass)
- [a0406ac](https://github.com/davglass/license-checker/commit/a0406ac2c7a0b1037ca31b47e36d316b9c088938) [fixes #96] - do not replace newline, etc in licenses for exporting to json/markdown (@davglass)
- [98a03fa](https://github.com/davglass/license-checker/commit/98a03fa700ef6d038cc2f9104ea5cf17c82a10ad) [fixes #97] - Added a newline to the output file (@davglass)
- [#98](https://github.com/davglass/license-checker/pull/98) Merge pull request #98 from davglass/eslint (@davglass)
- [10fe441](https://github.com/davglass/license-checker/commit/10fe441a2e70e549e57f7da99d2287fc55355500) moved to eslint (@davglass)
- [f82b535](https://github.com/davglass/license-checker/commit/f82b535d3b7f152fa00bb4680e94af18d1c1421d) changelog (@davglass)

### v9.0.3 (2017/04/10 13:42 +00:00)

- [a0fd60f](https://github.com/davglass/license-checker/commit/a0fd60f972b7c84a32117b3dfc1f95bfa2282f27) 9.0.3 (@davglass)
- [#95](https://github.com/davglass/license-checker/pull/95) Merge pull request #95 from abtris/prefix-component (@abtris)
- [3b80272](https://github.com/davglass/license-checker/commit/3b80272a217687c2f0cd7a0c1e98775064d820ff) test: add test for csvComponentPrefix (@abtris)
- [d593554](https://github.com/davglass/license-checker/commit/d593554c1a6b4f7e004e4a23fca88cb7294f8351) feat: add support for csvComponentPrefix (@abtris)
- [5b2eea1](https://github.com/davglass/license-checker/commit/5b2eea12d8c54068a01a2cf1fd9bdeca8c1f0fa2)

added contrib (@davglass)

### v9.0.2 (2017/04/05 14:55 +00:00)

- [f24833b](https://github.com/davglass/license-checker/commit/f24833bce846f608ec3d8c327d335da56c42b895) 9.0.2 (@davglass)
- [#94](https://github.com/davglass/license-checker/pull/94) Merge pull request #94 from timbru31/fix-comma-exclude (@timbru31)
- [2d08a77](https://github.com/davglass/license-checker/commit/2d08a77030362c7ab03ac12358dd524c0be47eee) contrib & changelog (@davglass)

### v9.0.1 (2017/04/05 13:09 +00:00)

- [9f1a1f3](https://github.com/davglass/license-checker/commit/9f1a1f32194a9bb312858f624e303af1ad4f61ca) 9.0.1 (@davglass)
- [c99f612](https://github.com/davglass/license-checker/commit/c99f612fee22d9eb03db0ad41e7918fbaf6e8ed9) added test for licenseText (@davglass)
- [#93](https://github.com/davglass/license-checker/pull/93) Merge pull request #93 from abtris/licenseText-just-in-customFormat (@abtris)
- [8d7fb2f](https://github.com/davglass/license-checker/commit/8d7fb2f85fc585d8e75ab1459e0b0cef43993ba4) fix: allow escaped commas in exclude string (@timbru31)
- [da4d73c](https://github.com/davglass/license-checker/commit/da4d73c0feb22f50ddbce54364eef5b7bcc7f1a4) test: fix test, remove check from non custom format (@abtris)
- [dcd3b59](https://github.com/davglass/license-checker/commit/dcd3b59bb9457df354fa3095189235b6e030df1a) feat: add licenseText only for customFormat
- [4e02eca](https://github.com/davglass/license-checker/commit/4e02eca6e8bd332ff6d90e5039cacb50f0df1bf3) updated contribs and changelog (@davglass)

### v9.0.0 (2017/04/04 12:26 +00:00)

- [267c80e](https://github.com/davglass/license-checker/commit/267c80efac89eef70c71a12b8f12b3dc8e6d58dd) 9.0.0 (@davglass)
- [057af47](https://github.com/davglass/license-checker/commit/057af47bc52ac526f646ba21496f338689801809) added licenseFile assertion to tests (@davglass)
- [#92](https://github.com/davglass/license-checker/pull/92) Merge pull request #92 from abtris/includeFileContent (@abtris)
- [1cda118](https://github.com/davglass/license-checker/commit/1cda118e1aa18cc391ba2765dcaae89172943a0f) fix: replace problematic chars for easy import to Excel (@abtris)
- [dd6ecab](https://github.com/davglass/license-checker/commit/dd6ecab1a7b1354c4d1d001491f58dbe0f5e3e63) feat: add licenseText (@abtris)
- [6395498](https://github.com/davglass/license-checker/commit/639549890c54a12043244579ad0c0d5972309fb2) changes and contrib (@davglass)

### v8.0.4 (2017/02/15 16:21 +00:00)

- [28d379a](https://github.com/davglass/license-checker/commit/28d379aca51da7a47af324bc6feb63736ea02295) 8.0.4 (@davglass)
- [#89](https://github.com/davglass/license-checker/pull/89) Merge pull request #89 from Pawamoy/master (@Pawamoy)
- [#90](https://github.com/davglass/license-checker/pull/90) Merge pull request #90 from drewfish/bsd-source-code (@drewfish)
- [b704bc1](https://github.com/davglass/license-checker/commit/b704bc18a43de246302b8ff6933f8fe5f96ee3a6)

guess BSD-Source-Code license (@drewfish)

- [8d31eab](https://github.com/davglass/license-checker/commit/8d31eabfb671d32e6f3e63215d6530d7fb4acc59)

Add docs about customFormat option (@pawamoy)

- [2529d31](https://github.com/davglass/license-checker/commit/2529d3118dfae53f1e01056ec99f5c542cb8d63e)  
changes (@davglass)

### v8.0.3 (2016/11/10 17:04 +00:00)

- [66fd7b5](https://github.com/davglass/license-checker/commit/66fd7b5ad5577cc2c85668a7c6607365c86a2c85)

8.0.3 (@davglass)

- [#87](https://github.com/davglass/license-checker/pull/87) Merge pull request #87 from drewfish/guess-cc0  
(@drewfish)

- [668bbd3](https://github.com/davglass/license-checker/commit/668bbd38fd5148f99c5263f4e0506e04d5e3f8a0)  
guess CC0-1.0, upgraded jshint (@drewfish)

### v8.0.2 (2016/11/09 21:57 +00:00)

- [0bdedd8](https://github.com/davglass/license-checker/commit/0bdedd8cb990e1f5ffacde1c12cc708185a5b866)

8.0.2 (@davglass)

- [ef67bb4](https://github.com/davglass/license-checker/commit/ef67bb454373352343faa49d4dc978a295bd1544)  
updated semver (@davglass)

- [14b5c85](https://github.com/davglass/license-checker/commit/14b5c8551cbb5c5ce8aa76fb5367857c891d013)  
Changelog (@davglass)

### v8.0.1 (2016/11/09 21:51 +00:00)

- [594871d](https://github.com/davglass/license-checker/commit/594871d6197a030121f940500495e6ca7d82f02c)

8.0.1 (@davglass)

- [c243663](https://github.com/davglass/license-checker/commit/c243663b0ab8a0126251292a57b2c47369a51ebf)  
added contrib (@davglass)

- [#86](https://github.com/davglass/license-checker/pull/86) Merge pull request #86 from drewfish/copying  
(@drewfish)

- [380aa26](https://github.com/davglass/license-checker/commit/380aa26799cb527739907484e69c6dae26d5f17a)  
also support COPYING file (@drewfish)

- [329c367](https://github.com/davglass/license-checker/commit/329c3676d0cd5c5947a53fd205ff23b767b7f882)  
handling undefined@undefined error better (@davglass)

- [1f93a07](https://github.com/davglass/license-checker/commit/1f93a072632aad0660b63f61c56c3bd2fe109474)  
changelog (@davglass)

### v8.0.0 (2016/09/09 13:23 +00:00)

- [44c2c48](https://github.com/davglass/license-checker/commit/44c2c48ae177915523fdf89a74474fe0953408bf)

8.0.0 (@davglass)

- [b5f5c6a](https://github.com/davglass/license-checker/commit/b5f5c6ae03a8c60c52fdd308f1721744a4baaa99)  
[fixes #78] - include notice file if found (@davglass)

- [dfcbdd6f](https://github.com/davglass/license-checker/commit/dfcbdd6f4966adc74e065f71e45cbd08ba8fe62ab)  
changelog (@davglass)

- [99976d0](https://github.com/davglass/license-checker/commit/99976d07980e241384be10341d0305d08de9cea5)  
7.1.1 (@davglass)

- [ef857b7](https://github.com/davglass/license-checker/commit/ef857b7e9bab706299a1cc565ec5d144893af424)  
[fixes #77] fixed readme file name parsing, made it more strict (@davglass)

### v7.1.1 (2016/09/07 19:16 +00:00)

- [28be6d4](https://github.com/davglass/license-checker/commit/28be6d4128a3625cf8ed37ba149e79ed3a41b4fa)  
changelog (@davglass)

### v7.1.0 (2016/09/07 15:12 +00:00)

- [9f8b7f1](https://github.com/davglass/license-checker/commit/9f8b7f1c367dfe86342ee5f5cc97171bf97281aa)

7.1.0 (@davglass)

- [60fce1a](https://github.com/davglass/license-checker/commit/60fce1a24a4ef5add98a08dd8c8a85870db3f4a6)

Fixed order of operations for parsing (@davglass)

- [9d4db11](https://github.com/davglass/license-checker/commit/9d4db112794b8110a1bfe0abfe2d3e63bc812299)

Updated changelog (@davglass)

### v7.0.0 (2016/09/06 14:50 +00:00)

- [a3a08da](https://github.com/davglass/license-checker/commit/a3a08da70b680d724045f655e107f36b16b45fea)

7.0.0 (@davglass)

- [b993399](https://github.com/davglass/license-checker/commit/b9933994472162cc9c4292cb42f2900e17a5167f)

added contrib (@davglass)

- [d783029](https://github.com/davglass/license-checker/commit/d7830297b053496e45b7145b3cfa5809ac8ab1d1)

Fixes #76 - If readme data not found, look for it on disk (@davglass)

- [#75](https://github.com/davglass/license-checker/pull/75) Merge pull request #75 from revov/master (@revov)

- [6204a24](https://github.com/davglass/license-checker/commit/6204a244ee71ae0329b4f2c1ca6cf37713741f32)

Fix incorrect example in README (@revov)

- [90e24ac](https://github.com/davglass/license-checker/commit/90e24ac9ad20591d5ac166cc2974034fb997b30a)

Added changelog (@davglass)

- [dd768c6](https://github.com/davglass/license-checker/commit/dd768c6c8cbc39b596881a2eca582ad4bb816879)

Added contributors (@davglass)

### v6.0.0 (2016/08/26 19:46 +00:00)

- [4bca140](https://github.com/davglass/license-checker/commit/4bca140db752b7b98ad1e261e5ee965d84995741)

6.0.0 (@davglass)

- [889ff17](https://github.com/davglass/license-checker/commit/889ff171aeb01a2180f4c9100ca9ea528a264d81)

updating tests (@davglass)

- [ed18801](https://github.com/davglass/license-checker/commit/ed188010351c4afb44db0d32dfa1025de53bf10f)

Merge branch 'nodeback' of git://github.com/bengl/license-checker into bengl-nodeback (@davglass)

- [34bb266](https://github.com/davglass/license-checker/commit/34bb26677cd0e25500fa545d4f1e8aef216b8cc7)

dropping node 0.10 and adding node 6.0 to travis (@davglass)

- [1d30667](https://github.com/davglass/license-checker/commit/1d306674a7fface2cad31f2bd76d7584c7922bbc)

updating tests (@davglass)

- [65d7c73](https://github.com/davglass/license-checker/commit/65d7c73f967111003fcc71ae24a4a5391bd48046)

Cleaned up some code (@davglass)

- [f753998](https://github.com/davglass/license-checker/commit/f753998a06cbb5fd9fff6430b3588a3b3cf81339)

Merge branch 'master' of git://github.com/amittkSharma/license-checker into amittkSharma-master (@davglass)

- [28e4462](https://github.com/davglass/license-checker/commit/28e4462543724685080c1623dc2dbd57cabb1c30)

Added tests and cleaned up linting (@davglass)

- [153857a](https://github.com/davglass/license-checker/commit/153857a251a97d14c883f6479579844b2980b5aa)

Publisher Information incorporated.

- [1265cb3](https://github.com/davglass/license-checker/commit/1265cb38d186ab1609dbdfa4124f237f8aa15846)

Added ability to output individual license files (@aweber1)

- [49e11d0](https://github.com/davglass/license-checker/commit/49e11d049645d565b7ef6d3c778af54eb13af888) fix tests (@bengl)  
- [26ffc6f](https://github.com/davglass/license-checker/commit/26ffc6f63d43c372c9a18f9c0c137608b3d5e4fa) use nodeback/errback (@bengl)

### v5.1.2 (2016/05/04 18:32 +00:00)

- [7101c77](https://github.com/davglass/license-checker/commit/7101c77667ad134fe01f02c298e7df2a4080e311) 5.1.2 (@davglass)  
- [#67](https://github.com/davglass/license-checker/pull/67) Merge pull request #67 from graingert/patch-2 (@graingert)  
- [a6ee290](https://github.com/davglass/license-checker/commit/a6ee2904eb7fced220dcfe8548f80ec74fde3a2) Upgrade read-installed (@graingert)  
- [42e29c6](https://github.com/davglass/license-checker/commit/42e29c637940959121842762d74921bece5e8d93) migrating tests from vows to mocha (@davglass)

### v5.1.1 (2016/04/14 13:20 +00:00)

- [6ae0334](https://github.com/davglass/license-checker/commit/6ae03348ca8e5835ac732028afdab664a381cfc4) 5.1.1 (@davglass)  
- [0720a46](https://github.com/davglass/license-checker/commit/0720a46569f3e12eb398165526944f307e08aad6) Fixes #64 - Turn off color for --json/markdown/csv options (@davglass)

### v5.1.0 (2016/03/09 15:50 +00:00)

- [86772d2](https://github.com/davglass/license-checker/commit/86772d202b63d4a4c6729b9a774193ca6ef5cb3f) 5.1.0 (@davglass)  
- [#61](https://github.com/davglass/license-checker/pull/61) Merge pull request #61 from sgtcdck/master (@sgtcdck)  
- [6547ac1](https://github.com/davglass/license-checker/commit/6547ac1ded58560c7c4abdfc68fa69d17b81fe1e) Removed obsolete d[key].name assignment from tests (@sgtcdck)  
- [00b18a6](https://github.com/davglass/license-checker/commit/00b18a6012387e1a4a8284c07bf2d08740e03ddd) Added a --relativeLicensePath option to display the license file relatively to the current path. (@sgtcdck)  
- [629da20](https://github.com/davglass/license-checker/commit/629da201e0d1170057fd9efe05efcb293d2f1bda) Added latest contributors (@davglass)

### v5.0.1 (2016/02/08 15:57 +00:00)

- [33731fc](https://github.com/davglass/license-checker/commit/33731fca482936a7a18fffe3fca2f3cd41e3a625) 5.0.1 (@davglass)  
- [fe06eae](https://github.com/davglass/license-checker/commit/fe06eaeef8844d050ad0f80d576a221dd605131de) Fixed replace (@davglass)  
- [997914f](https://github.com/davglass/license-checker/commit/997914fd6f94030452d4d9bf549eb156ae8ef7c0) fix git+https URLs (@graingert)  
- [#57](https://github.com/davglass/license-checker/pull/57) Merge pull request #57 from Damien-Larmine/doc-license-asterisk (@Damien-Larmine)  
- [2adff2d](https://github.com/davglass/license-checker/commit/2adff2da98a5af79479a162e4998eb5892ab31c3) Explicit the asterisk in license report (@Damien-Larmine)  
- [b2fc9cf](https://github.com/davglass/license-checker/commit/b2fc9cf2a8eaa008c7593037d046f245a7ce7f25) 5.0.0 (@davglass)  
- [7f71c53](https://github.com/davglass/license-checker/commit/7f71c53833cf1318ffe84215fcb1291f9ce4fbd5) updated contributors (@davglass)



### v5.0.0 (2016/01/22 15:31 +00:00)

- [#55](https://github.com/davglass/license-checker/pull/55) Merge pull request #55 from davglass/devflag (@davglass)
- [ff1d8f2](https://github.com/davglass/license-checker/commit/ff1d8f20d5d7248a4f61e2fc9279fdfea91a6ec6) supporting --production and --development flags (@davglass)
- [#53](https://github.com/davglass/license-checker/pull/53) Merge pull request #53 from swashcap/enhancement/#46-verbose-output (@swashcap)
- [#54](https://github.com/davglass/license-checker/pull/54) Merge pull request #54 from davglass/travis-updates (@davglass)
- [2c80d9d](https://github.com/davglass/license-checker/commit/2c80d9d2dcc59340698630144256096a91e23f22) fixing tests in other node versions (@davglass)
- [78820ac](https://github.com/davglass/license-checker/commit/78820ac33ab8aed74809c8a5f8847705c8b2848e) travis config updates (@davglass)
- [f94263b](https://github.com/davglass/license-checker/commit/f94263b203046e2f53d64997b0261498010eb38d) Update documentation for debug use. (@swashcap)
- [429e44d](https://github.com/davglass/license-checker/commit/429e44d697527221ef22bb03af9d67820015446f) Change `console.error` call to use debug module. (@swashcap)
- [7312daf](https://github.com/davglass/license-checker/commit/7312daf7af195a1b9d1b1f290fae15963fbb2ab4) Add debug to project. (@swashcap)

### v4.2.0 (2015/10/20 13:44 +00:00)

- [3583d92](https://github.com/davglass/license-checker/commit/3583d925e96fc9f63b3bbf0110b11c8448aed0e7) 4.2.0 (@davglass)
- [981eeda](https://github.com/davglass/license-checker/commit/981eeda898084dea88d54ea29c5bda93c5313fb6) Fixes #49: Default to unknown if licenses null and added ISC support (@davglass)

### v4.1.2 (2015/09/29 13:46 +00:00)

- [ba946dd](https://github.com/davglass/license-checker/commit/ba946dd1065e762c36b27dcecd9bb7389ad18d4) 4.1.2 (@davglass)
- [#48](https://github.com/davglass/license-checker/pull/48) Merge pull request #48 from CantemoInternal/master (@CantemoInternal)
- [e314a6d](https://github.com/davglass/license-checker/commit/e314a6d1f505d19478c33871640a763fabff6abd) Fix json, csv and markdown output for license-checker (@mattiasa)

### v4.1.1 (2015/09/12 14:39 +00:00)

- [c918314](https://github.com/davglass/license-checker/commit/c918314bfc687b647d1d288bb5857dd1caac1393) 4.1.1 (@davglass)
- [#47](https://github.com/davglass/license-checker/pull/47) Merge pull request #47 from tmpvar/ensure-bin-runs (@tmpvar)
- [a842eca](https://github.com/davglass/license-checker/commit/a842ecae4f008c07df3039dcaacd4641d7273625) add missing } (@tmpvar)
- [1d513bb](https://github.com/davglass/license-checker/commit/1d513bb673d726f34286061446f965e46d96170e) ensure bin/license-checker works at a high-level (@tmpvar)

### v4.1.0 (2015/09/09 14:52 +00:00)

- [a4bb437](https://github.com/davglass/license-checker/commit/a4bb437ffa806c0832f877da2de7a107863d0a1f) 4.1.0 (@davglass)
- [ddd317a](https://github.com/davglass/license-checker/commit/ddd317a5a09344f0021812b8dee2f39bbbf07a0)

fixed all of the windows line endings (@davglass)

- [11e6487](https://github.com/davglass/license-checker/commit/11e64870484435e1e6f8efb9b0f13e6b2f737a6b)

Fix issues caused by merge (@ptusch)

- [313a7ed](https://github.com/davglass/license-checker/commit/313a7edc3dbdf8d50e43ba8da89306d3c89326bc)

Merge remote-tracking branch 'remotes/upstream/master' into ft\_custom\_format (@ptusch)

- [1f5e326](https://github.com/davglass/license-checker/commit/1f5e326dbca91fc8a396b9e02efe3eac9fd82a82)

added contributors to package.json (@davglass)

- [#45](https://github.com/davglass/license-checker/pull/45) Merge pull request #45 from hufsm/ft\_error\_handling (@hufsm)

- [c806034](https://github.com/davglass/license-checker/commit/c806034ab6feaacf297d0c23afb536b290ba8c81)

Remove unused var statement (@ptusch)

- [778b1fa](https://github.com/davglass/license-checker/commit/778b1fa1a9c1be0c816545165020522d2dbf17ef)

More tests to fulfill the required % (@ptusch)

- [22257d9](https://github.com/davglass/license-checker/commit/22257d95490765db816578cc48c2b5b62699f1aa)

Add tests for licenses (WTFPL) (@ptusch)

- [0fe7561](https://github.com/davglass/license-checker/commit/0fe75611a73970fe9e9e0aab2d4bdee5250435b2)

Remove unused filter option (never used) (@ptusch)

- [83caa10](https://github.com/davglass/license-checker/commit/83caa10493a5a05ffba6c0e80b5c03f9cd4f65d6)

Change license shortcut for WTFPL (@ptusch)

- [3e348db](https://github.com/davglass/license-checker/commit/3e348dbe5feeb7bd356ebef3cd34e69329dbc8c1)

More tests for the custom formatter (@ptusch)

- [96c2d6f](https://github.com/davglass/license-checker/commit/96c2d6f24c509df2bf3f6bd8b83a613fea8d9ecc)

Add tests for customFormatter (@ptusch)

- [c9948c4](https://github.com/davglass/license-checker/commit/c9948c4b7b2cccdd053ba63f4fd2a6a6d0a46493)

Add test configs (@ptusch)

- [4b2dea0](https://github.com/davglass/license-checker/commit/4b2dea0c124f6aba63abd2129625825c3b5a6570)

Fix merge issues - semicolon slipped through (@ptusch)

- [cc7662a](https://github.com/davglass/license-checker/commit/cc7662a46719c97745410e3ac2b782f937dc54ef)

Merge branch 'master' into ft\_error\_handling (@ptusch)

- [04a2294](https://github.com/davglass/license-checker/commit/04a2294b82a8227ccc83d76f73cbd7cf62af533)

Add additional test (@ptusch)

- [52fa91c](https://github.com/davglass/license-checker/commit/52fa91c5cbc345736ebe6e97f400a27a773502d2)

Add parseJson test (@ptusch)

- [d846c5e](https://github.com/davglass/license-checker/commit/d846c5e6970737dd3085688e7b601e9ea4546417)

Fix tests after merge conflict (@ptusch)

- [7eac458](https://github.com/davglass/license-checker/commit/7eac4583f8003b5bda4ef966768bbb457fe8dc44)

Merge branch 'master' into ft\_custom\_format (@ptusch)

- [4aa7065](https://github.com/davglass/license-checker/commit/4aa7065c5eef88d49c3684369b2edd9802c3f374)

Add tests for customFormat (@ptusch)

### v4.0.0 (2015/09/04 13:40 +00:00)

- [3fbba5b](https://github.com/davglass/license-checker/commit/3fbba5bd5a489ea8c17328eabf71c4d5e9beb17e)

4.0.0 (@davglass)

- [ce8d661](https://github.com/davglass/license-checker/commit/ce8d66108a49af7855c16231ce675c567a2ffe7f)

tests: added 100% coverage for license file (@davglass)

- [#42](https://github.com/davglass/license-checker/pull/42) Merge pull request #42 from ptusch/ft\_onlyunknown (@ptusch)

- [8929e90](https://github.com/davglass/license-checker/commit/8929e90413be0362f19e755048e9218c372abf68)

Add tests for the error generation (@ptusch)  
- [1a93a41](https://github.com/davglass/license-checker/commit/1a93a41569a53a1580c94c2c903a5bc127ad2692)  
Add error handling (@ptusch)  
- [6b79145](https://github.com/davglass/license-checker/commit/6b791457463dca71b22b09eecff16bbf982db682)  
Add additional check to negate the test (@ptusch)  
- [559e72c](https://github.com/davglass/license-checker/commit/559e72ccab2420bc42bf28b498702dad13ef967a)  
Add test for the first function call. (@ptusch)  
- [faf8ffd](https://github.com/davglass/license-checker/commit/faf8ffd69fd8ae475484a9b47b57a7b6ea738856)  
Remove trivial UNKNOWN check (@ptusch)  
- [6fa44ef](https://github.com/davglass/license-checker/commit/6fa44ef8c045ab2b0a1291b45990edf52adfc0e2)  
Merge branch 'master' into ft\_custom\_format (@ptusch)  
- [efe23d9](https://github.com/davglass/license-checker/commit/efe23d991cfc40dc6980fbf13461408da822b1f)  
Merge branch 'master' into ft\_onlyunknown (@ptusch)  
- [c287959](https://github.com/davglass/license-checker/commit/c2879592858805d7ecd0304a39c5cf079efe6a7c)  
Add option to only show unknown licenses (@ptusch)  
- [#43](https://github.com/davglass/license-checker/pull/43) Merge pull request #43 from senotrusov/master (@senotrusov)  
- [d7a663f](https://github.com/davglass/license-checker/commit/d7a663f9deeb4d7a648a6d2cb9db84d5667ee540)  
Add test for exclude option. (@senotrusov)  
- [45a27de](https://github.com/davglass/license-checker/commit/45a27de02a3c1d57a86e3f8e14b6e335788c23ba)  
Add option to exclude from the output modules which licenses are in the comma-separated list (@senotrusov)  
- [#41](https://github.com/davglass/license-checker/pull/41) Merge pull request #41 from ptusch/ft\_path\_to\_unknown\_dependency (@ptusch)  
- [1ff5f22](https://github.com/davglass/license-checker/commit/1ff5f225fd2ba97edfd3ef3f6462981832740c19) Add option to see the path of a dependency if unknown (@ptusch)  
- [ea4d629](https://github.com/davglass/license-checker/commit/ea4d6297de32d94201bb4786da7ba824d928c8f2)  
Add additional 'undefined' checks (@ptusch)  
- [af043a2](https://github.com/davglass/license-checker/commit/af043a2c11af45d28bfe71914cd10672855b3297)  
Merge branch 'master' into ft\_custom\_format (@ptusch)  
- [2d94a19](https://github.com/davglass/license-checker/commit/2d94a19ece177836345a4227893a82d956141b2e)  
updating the docs for --unknown to make it clear (@davglass)  
- [38a2bd2](https://github.com/davglass/license-checker/commit/38a2bd28a9597fdb06d844258f1070054b38bbcf)  
Fix codestyle and whitespaces (@ptusch)  
- [dd173ba](https://github.com/davglass/license-checker/commit/dd173badc65368dc6140476ffe5ae3768fbf9618)  
Add --customPath in README.md (@ptusch)  
- [911fc1c](https://github.com/davglass/license-checker/commit/911fc1c6b5cc27a32aac60bb409c08be138bc707)  
Finalize the customFormat (markdown) (@ptusch)  
- [8102091](https://github.com/davglass/license-checker/commit/8102091f7949fa8b73cfc803e4aead3624b81148)  
Add functionality to add a custom format (@ptusch)

### v3.1.0 (2015/06/29 14:25 +00:00)  
- [59e1e58](https://github.com/davglass/license-checker/commit/59e1e58ca0bea1cd38e3da1712fe7ca624d860b0)  
3.1.0 (@davglass)  
- [0e33f7a](https://github.com/davglass/license-checker/commit/0e33f7a2cb9fa69d13d1e2b5c69f70f885e09e08)  
reformatted code, fixed lint issues and added tests (@davglass)  
- [83a7f09](https://github.com/davglass/license-checker/commit/83a7f0933d1cc1f331279e53fcce13e4efface91)  
Merge branch 'asMarkdown' of git://github.com/ptusch/license-checker into ptusch-asMarkdown (@davglass)  
- [703ad47](https://github.com/davglass/license-checker/commit/703ad4714173559e05267e8fd24c74e5b9d3aee0)

fixing tests (@davglass)

- [2d9fffd](https://github.com/davglass/license-checker/commit/2d9fffd75192e9812692c9099481d23e265bb493)

Added Markdown Option (@ptusch)

- [67dca36](https://github.com/davglass/license-checker/commit/67dca365b941a7265e4a98d2de533b22c761b169)

Remove color tags (@ptusch)

### v3.0.3 (2015/06/03 13:35 +00:00)

- [7475c12](https://github.com/davglass/license-checker/commit/7475c129bf291289e4616d9692a962ae537401e8)

3.0.3 (@davglass)

- [c7dae0f](https://github.com/davglass/license-checker/commit/c7dae0fe5317a17b3aef61e8c118fafc6bb43a56)

spdx license (@davglass)

### v3.0.2 (2015/05/12 20:29 +00:00)

- [01f3b53](https://github.com/davglass/license-checker/commit/01f3b5384998be6243d38e0d95a4478e5fe3cfa5)

3.0.2 (@davglass)

- [fc0c083](https://github.com/davglass/license-checker/commit/fc0c0832ee291c55e53efe6b37a7b9d89f191bc7)

defensive code, fixes #34 (@davglass)

### v3.0.1 (2015/05/04 12:28 +00:00)

- [0479570](https://github.com/davglass/license-checker/commit/0479570faf87eccc9b37fbb25afae7faaec6636)

3.0.1 (@davglass)

- [d85e355](https://github.com/davglass/license-checker/commit/d85e355b55998952facf202eabf8d374fec69a7e)

Checking for valid path first (@davglass)

### v3.0.0 (2015/04/24 14:38 +00:00)

- [e22b61d](https://github.com/davglass/license-checker/commit/e22b61d5d32fef7ffb18627f55a97e1863a78096)

3.0.0 (@davglass)

- [fde9635](https://github.com/davglass/license-checker/commit/fde963583dd207eca4badffb3e0d033a038f17b5)

always try to find and log the license file (@davglass)

### v2.0.2 (2015/01/26 18:18 +00:00)

- [490f31d](https://github.com/davglass/license-checker/commit/490f31d6820f068814cfe27adf3af1ac6d58f733)

2.0.2 (@davglass)

- [a3fefdb](https://github.com/davglass/license-checker/commit/a3fefdb8fafd7ec64714defb793d757a9e8ad065)

fixes #30 (@davglass)

### v2.0.1 (2015/01/12 18:34 +00:00)

- [898fbd5](https://github.com/davglass/license-checker/commit/898fbd53fa289338cf8a9a1735eea440c2a6c525)

2.0.1 (@davglass)

- [2da23db](https://github.com/davglass/license-checker/commit/2da23db2f240e7e73efdf93cc554e4d7783af225)

cleaned up spacing and moved vars around (@davglass)

- [d47dbe4](https://github.com/davglass/license-checker/commit/d47dbe45c992dbbdb15bfb45e8af7f18ee0ca737)

fixes #29 (@davglass)

### v2.0.0 (2014/12/04 16:34 +00:00)

- [f94edfe](https://github.com/davglass/license-checker/commit/f94edfec7a9914b4a36f455e8bffc6230d6f7a5e)

2.0.0 (@davglass)

- [f4c7b1a](https://github.com/davglass/license-checker/commit/f4c7b1a3d4e9c0e4753a9b267e51714fe7f7051e)

syntax cleanup (@davglass)  
- [d189623](https://github.com/davglass/license-checker/commit/d1896234a5649621ee57ff9a901877d769217194)  
Document CLI options in Readme. (@timoxley)  
- [11e204c](https://github.com/davglass/license-checker/commit/11e204c5c078eae1f165fa010da229d2a9fb4b5)  
Default to --no-colour for json, csv & file output. (@timoxley)  
- [7e80d50](https://github.com/davglass/license-checker/commit/7e80d50c733f8ee42c7b4a79dc3344b3dd330cff)  
Add --out flag for writing an output file. (@timoxley)  
- [47bffc9](https://github.com/davglass/license-checker/commit/47bffc9e0e249b2847c8ed4f3eaadb0dcdd731b9)  
Always print to stdout, don't write files. (@timoxley)  
- [b725080](https://github.com/davglass/license-checker/commit/b725080d2dbdfddbf0994867577d4c5e3dc0ee2a)  
Don't print info messages to stdout. (@timoxley)

### v1.0.1 (2014/11/27 15:23 +00:00)

- [e60f792](https://github.com/davglass/license-checker/commit/e60f792159351aa7ccff1f7af73e289afee261a5)  
1.0.1 (@davglass)  
- [3f74178](https://github.com/davglass/license-checker/commit/3f7417822dc8804978d1bae4ed84190d327df15c)  
Merge branch 'fixinfiniterecursion' of github.com:yzapuchlak/license-checker into yapuchlak-fixinfiniterecursion (@davglass)  
- [dc78ea0](https://github.com/davglass/license-checker/commit/dc78ea0dca546283440c89fec2dc6818dc4cc1c1)  
sticking vows 0.8.0 for testing (@davglass)  
- [bd549b3](https://github.com/davglass/license-checker/commit/bd549b3b68e74fddd0e08dac10d5f88a8bb51ca6)  
Fixed issue where circular dependencies in dependency tree would cause the flatten function to infinitely recurse. If the current key is found to be already in the data object (which means it was already processed), we stop processing that key and return the data object. (@yzapuchlak)

### v1.0.0 (2014/11/21 13:56 +00:00)

- [917193d](https://github.com/davglass/license-checker/commit/917193dab27147534976b71307a77f48198ca322)  
1.0.0 (@davglass)  
- [63e5f9c](https://github.com/davglass/license-checker/commit/63e5f9c77e348720b3867171bcc67541e846d088)  
added options.filter to checker.init (@davglass)

### v0.1.2 (2014/11/20 15:48 +00:00)

- [8e5f5f0](https://github.com/davglass/license-checker/commit/8e5f5f0e7f83252e4039f6c7d16cc266acc1a33a)  
0.1.2 (@davglass)  
- [3d7a74e](https://github.com/davglass/license-checker/commit/3d7a74e90122f908057b2008ab29d8bd49011291)  
fixed lint issue (@davglass)

### v0.1.1 (2014/11/20 15:47 +00:00)

- [750d507](https://github.com/davglass/license-checker/commit/750d5079d32b44ecc984ff7ed672498d1b197235)  
0.1.1 (@davglass)  
- [94522e0](https://github.com/davglass/license-checker/commit/94522e099434dfdf163c3f2c5cacb3e6aa196cf8)  
fixed merge issues (@davglass)

### v0.1.0 (2014/11/20 15:41 +00:00)

- [8127f5e](https://github.com/davglass/license-checker/commit/8127f5e79eeceb7dfd86cd5f694080e4183dcb11)  
0.1.0 (@davglass)  
- [76c71ac](https://github.com/davglass/license-checker/commit/76c71ac46baeca8c349fe5892dcb659e859b9608)  
Updated to newer read-installed (@davglass)

### v0.0.10 (2014/08/12 12:48 +00:00)

- [807507d](https://github.com/davglass/license-checker/commit/807507df1a293bc0360adffd725a9f911331ff2b)

0.0.10 (@davglass)

- [e39ad9b](https://github.com/davglass/license-checker/commit/e39ad9bce6bcd545772c241e2e7aba8f40d5bbbb)

Added checking that the license file is a normal file, because otherwise an appropriately named directory crashes the license-checker through EISDIR, illegal operation on a directory.

- [40ca4da](https://github.com/davglass/license-checker/commit/40ca4dadbc163ca774c87b1de249bd295952faa9)

colorize (@couchand)

### v0.0.9 (2014/07/29 01:48 +00:00)

- [c14ef79](https://github.com/davglass/license-checker/commit/c14ef79f10f950ff0985e7e0b3138147b98ab1ec)

0.0.9 (@davglass)

- [ba1b66b](https://github.com/davglass/license-checker/commit/ba1b66b6172a2f9f8dbcdc56f40206820bc0916b)

Fixes #12 - Using some nicer regexes (@davglass)

- [bce94d5](https://github.com/davglass/license-checker/commit/bce94d5a8ab2f146356851776b2543df65fbf750)

case insensitive check (@davglass)

- [87c3406](https://github.com/davglass/license-checker/commit/87c3406aee2507eaf1d00d592f6dcb59a16e7c48)

Allow for LICENCE (@gdw2)

### v0.0.8 (2014/07/07 20:10 +00:00)

- [6ad6ee2](https://github.com/davglass/license-checker/commit/6ad6ee21813e698e7f995e98dcadafbd961f6a33)

0.0.8 (@davglass)

- [b8c5815](https://github.com/davglass/license-checker/commit/b8c58151135f57d91fb0d1cfb194d034c012073f)

added tests and refactored the code a little (@davglass)

- [275f276](https://github.com/davglass/license-checker/commit/275f276dc6e6d5635f9cb5b7e9a978e286f2d174)

Added --csv option to readme file

- [d91eb72](https://github.com/davglass/license-checker/commit/d91eb7289466853ae6e88448b953b4d3d98ebab5)

Apparently abbrev is now at version 1.0.5 which caused the unit test to fail.

- [40b4a42](https://github.com/davglass/license-checker/commit/40b4a420e520c2008b9395d1a8fdf38b56f846f5)

Modified changes based on lshint output during Travis build

- [54e2390](https://github.com/davglass/license-checker/commit/54e2390cefd1dc664a15cd3a84347227f889f48b)

Added csv output option similar to the existing JSON output option. Requires an output filename.

### v0.0.7 (2014/02/26 04:52 +00:00)

- [1ce6d42](https://github.com/davglass/license-checker/commit/1ce6d42147b2d0237870818e8059003b331816cf)

0.0.7 (@davglass)

- [7d04195](https://github.com/davglass/license-checker/commit/7d041959450c68b3c5f427007c43cd6c73c6adfb)

Added not check and a proper test (@davglass)

- [40d6e25](https://github.com/davglass/license-checker/commit/40d6e2580946c3cee1d408ebe28ff523852e8eb2)

Undefined handling (@garrows)

- [90217d0](https://github.com/davglass/license-checker/commit/90217d070fd62cf76eb4e7b1610ed5eef6ae840d)

travis Stuff (@davglass)

- [2bd76c8](https://github.com/davglass/license-checker/commit/2bd76c894f740cd83f6246e0e7341832c6432d8b)

0.0.6 (@davglass)

- [6f390ff](https://github.com/davglass/license-checker/commit/6f390fff60b31a07939e6d325796bdcfbefb5907)

Added some better tests (@davglass)

- [2dbcac3](https://github.com/davglass/license-checker/commit/2dbcac37b5795ceb6db53452d0e41d1c4bc3153f)

Looking for WTFPL as well as the string (@davglass)  
- [5d91a07](https://github.com/davglass/license-checker/commit/5d91a073a8b76ec9a497c1e3b83198ce97e144fd)  
Flattened array of one (@davglass)  
- [e95da82](https://github.com/davglass/license-checker/commit/e95da820c63e0d56c4567f1cfad07142d3110eca)  
Fixed extra var (@davglass)  
- [fe8f2f7](https://github.com/davglass/license-checker/commit/fe8f2f7d39d520c0c4d87d34c9d4f55d59f4222d)  
Removing unnecessary log statement (@paulmand31)  
- [72a6f24](https://github.com/davglass/license-checker/commit/72a6f2403de43ecf5ec07bb504cb931c0e53f6a3)  
Adding license checks in the LICENSE file (and variations) (@paulmand31)  
- [#7](https://github.com/davglass/license-checker/pull/7) Merge pull request #7 from jamesbloomer/master (@jamesbloomer)  
- [a81eee0](https://github.com/davglass/license-checker/commit/a81eee0a27f580688e371cc15015e848f591bb92)  
Fixed missing "install" in npm -g (@jamesbloomer)  
- [416b012](https://github.com/davglass/license-checker/commit/416b01219e07a8274e05cd883ec050376902adeb)  
Updated Version (@davglass)  
- [6d9bd1e](https://github.com/davglass/license-checker/commit/6d9bd1e195202c871693d4b1e9bac8c055683e8b)  
Fixed lint issue and added a test placeholder. Will add more tests soon (@davglass)  
- [655a316](https://github.com/davglass/license-checker/commit/655a316f6448daf3c449f8b88e8878a95a8b153e)  
Added Travis test file (@davglass)  
- [99895df](https://github.com/davglass/license-checker/commit/99895df6d3ac0f9ae4e8c935311fb1b3f88a688e)  
Version Bump (@davglass)  
- [#4](https://github.com/davglass/license-checker/pull/4) Merge pull request #4 from badunk/refactor (@badunk)  
- [1123a1b](https://github.com/davglass/license-checker/commit/1123a1baefc1975f8c36cb59952254cd66c31017)  
Merge branch 'master' of https://github.com/davglass/license-checker (@badunk)  
- [191612e](https://github.com/davglass/license-checker/commit/191612e5c21a01bd453368299a14cc5ff1c6fb13)  
Version Bump (@davglass)  
- [#2](https://github.com/davglass/license-checker/pull/2) Merge pull request #2 from badunk/circular (@badunk)  
- [9b5a117](https://github.com/davglass/license-checker/commit/9b5a1175892254e96d72f3d8dc793dcc4e2bde37)  
fixed special case when an empty array is passed to license/licenses (@badunk)  
- [025668b](https://github.com/davglass/license-checker/commit/025668b0a62b0d5b58662ce6aeed91de909a6fef)  
fixed bug with multiple licenses objects not showing (@badunk)  
- [e6bdf52](https://github.com/davglass/license-checker/commit/e6bdf52a8e5f9ebed29982014fa4d4586f63d06a)  
cleaned up the code (@badunk)  
- [efb62f2](https://github.com/davglass/license-checker/commit/efb62f2f52a29e9a37a7f387b280fc17ab0a5f19)  
added check for circular dependencies (@badunk)  
- [825b40c](https://github.com/davglass/license-checker/commit/825b40cb61fee36dd60751daa9d44e28853587ac)  
Version Bump (@davglass)  
- [#1](https://github.com/davglass/license-checker/pull/1) Merge pull request #1 from mwilliamson/master (@mwilliamson)  
- [2f24319](https://github.com/davglass/license-checker/commit/2f24319dd8dd212a1f78ad91af7fee21d50ab762)  
Don't ignore license field if it's a string (@mwilliamson)  
- [7b8c34f](https://github.com/davglass/license-checker/commit/7b8c34f75b04a7541bf23d596bbae5447492c53)  
Initial Commit (@davglass)  
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version 1.2.11, January 15th, 2017

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Julian Seward, jseward@bzip.org  
bzip2/libbzip2 version 1.0.6 of 6 September 2010

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# spdx-license-ids

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## Installation

[Download JSON directly](<https://raw.githubusercontent.com/shininn/spdx-license-ids/master/index.json>), or  
[use](<https://docs.npmjs.com/cli/install>) [npm](<https://docs.npmjs.com/about-npm/>):

...

```
npm install spdx-license-ids
```

...

```
[Node.js](https://nodejs.org/) API
```

```
require('spdx-license-ids')
```

```
Type: `string[]`
```

All license IDs except for the currently deprecated ones.

```
```javascript
```

```
const ids = require('spdx-license-ids');
```

```
//=> ['0BSD', 'AAL', 'ADSL', 'AFL-1.1', 'AFL-1.2', 'AFL-2.0', 'AFL-2.1', 'AFL-3.0', 'AGPL-1.0-only', ...]
```

```
ids.includes('BSD-3-Clause'); //=> true
```

```
ids.includes('CC-BY-1.0'); //=> true
```

```
ids.includes('GPL-3.0'); //=> false
```

```
...
```

```
### require('spdx-license-ids/deprecated')
```

```
Type: `string[]`
```

Deprecated license IDs.

```
```javascript
```

```
const deprecatedIds = require('spdx-license-ids/deprecated');
```

```
//=> ['AGPL-1.0', 'AGPL-3.0', 'GFDL-1.1', 'GFDL-1.2', 'GFDL-1.3', 'GPL-1.0', 'GPL-2.0', ...]
```

```
deprecatedIds.includes('BSD-3-Clause'); //=> false
```

```
deprecatedIds.includes('CC-BY-1.0'); //=> false
```

```
deprecatedIds.includes('GPL-3.0'); //=> true
```

```
...
```

```
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```

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reimplemented pthread\_once with the same form  
as described by A.Terekhov (later version 2);  
implementation of MCS (Mellor-Crummey/Scott) locks.

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node-http-proxy

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\* gzip/zlib I/O support.

Michael Poole <mdpoole@troilus.org>  
\* Fixed warnings about generated constructors not explicitly initializing all fields (only present with certain compiler settings).  
\* Added generation of field number constants.

Wink Saville <wink@google.com>  
\* Fixed initialization ordering problem in logging code.

Will Pierce <willp@nuclei.com>  
\* Small patch improving performance of in Python serialization.

Alexandre Vassalotti <alexandre@peadrop.com>  
\* Emacs mode for Protocol Buffers (editors/protobuf-mode.el).

Scott Stafford <scott.stafford@gmail.com>  
\* Added Swap(), SwapElements(), and RemoveLast() to Reflection interface.

Alexander Melnikov <alm@sibmail.ru>  
\* HPUX support.

Oliver Jowett <oliver.jowett@gmail.com>  
\* Detect whether zlib is new enough in configure script.  
\* Fixes for Solaris 10 32/64-bit confusion.

Evan Jones <evanj@mit.edu>  
\* Optimize Java serialization code when writing a small message to a stream.  
\* Optimize Java serialization of strings so that UTF-8 encoding happens only once per string per serialization call.  
\* Clean up some Java warnings.  
\* Fix bug with permanent callbacks that delete themselves when run.

Michael Kucharski <m.kucharski@gmail.com>  
\* Added CodedInputStream.getTotalBytesRead().

Kacper Kowalik <xarthisius.kk@gmail.com>  
\* Fixed m4/acx\_pthread.m4 problem for some Linux distributions.

William Orr <will@worrbase.com>  
\* Fixed detection of sched\_yield on Solaris.  
\* Added atomicops for Solaris

Andrew Paprocki <andrew@ishiboo.com>  
\* Fixed minor IBM xLC compiler build issues  
\* Added atomicops for AIX (POWER)

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in src/main/native/src/org/apache/hadoop/util:

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#####

BezierEasing - use bezier curve for transition easing function  
by Gatan Renaudeau 2014 - 2015 MIT License

Credits: is based on Firefox's nsSMILKeySpline.cpp

Usage:

```
var spline = BezierEasing([0.25, 0.1, 0.25, 1.0])
```

spline.get(x) => returns the easing value | x must be in [0, 1] range

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#

# Don't put empty lines into this file!

#

builds/unix/pkg.m4

#

docs/FTL.TXT

docs/GPLv2.TXT

#

include/freetype/internal/fthash.h

#

src/base/fthash.c

src/base/md5.c

src/base/md5.h

#

src/bdf/bdf.c

src/bdf/bdf.h

src/bdf/bdfdrivr.c

src/bdf/bdfdrivr.h

src/bdf/bdferror.h

src/bdf/bdfplib.c

src/bdf/module.mk

src/bdf/README

src/bdf/rules.mk

#

src/pcf/module.mk

src/pcf/pcf.c

src/pcf/pcf.h

src/pcf/pcfdrivr.c

src/pcf/pcfdrivr.h

src/pcf/pcferror.h

src/pcf/pcfread.c

src/pcf/pcfread.h

```
src/pcf/pcfutil.c
src/pcf/pcfutil.h
src/pcf/README
src/pcf/rules.mk
#
src/gzip/adler32.c
src/gzip/infblock.c
src/gzip/infblock.h
src/gzip/infcodes.c
src/gzip/infcodes.h
src/gzip/inffixed.h
src/gzip/inflate.c
src/gzip/inftrees.c
src/gzip/inftrees.h
src/gzip/infutil.c
src/gzip/infutil.h
src/gzip/zconf.h
src/gzip/zlib.h
src/gzip/zutil.c
src/gzip/zutil.h
#
src/tools/apinames.c
src/tools/ftandom/ftandom.c
#
subprojects/dlg
#
EOF
```

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```
// sigslot.h: Signal/Slot classes
```

```
//
```

```
// Written by Sarah Thompson (sarah@telergy.com) 2002.
```

```
//
```

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The code in this library is an extension of Bala Vatti's clipping algorithm:

"A generic solution to polygon clipping"

Communications of the ACM, Vol 35, Issue 7 (July 1992) pp 56-63.

<http://portal.acm.org/citation.cfm?id=129906>

Computer graphics and geometric modeling: implementation and algorithms

By Max K. Agoston

Springer; 1 edition (January 4, 2005)

<http://books.google.com/books?q=vatti+clipping+agoston>

### See also:

"Polygon Offsetting by Computing Winding Numbers"

Paper no. DETC2005-85513 pp. 565-575

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```
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```

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## 1.43 curl 7.86.0

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

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| Release        | Derived from | Year      | Owner      | GPL-compatible? (1) |
|----------------|--------------|-----------|------------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI        | yes                 |
| 1.3 thru 1.5.2 | 1.2          | 1995-1999 | CNRI       | yes                 |
| 1.6            | 1.5.2        | 2000      | CNRI       | no                  |
| 2.0            | 1.6          | 2000      | BeOpen.com | no                  |
| 1.6.1          | 1.6          | 2001      | CNRI       | yes (2)             |
| 2.1            | 2.0+1.6.1    | 2001      | PSF        | no                  |
| 2.0.1          | 2.0+1.6.1    | 2001      | PSF        | yes                 |
| 2.1.1          | 2.1+2.0.1    | 2001      | PSF        | yes                 |
| 2.1.2          | 2.1.1        | 2002      | PSF        | yes                 |
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2.2 and above 2.1.1 2001-now PSF yes

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 *
 * version 1.0 - 1999.10.15 - First version.
 *
```

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glennrp at users.sourceforge.net  
January 5, 2017

/\*-----

wpng - simple PNG-writing program                      writepng.c

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## 1.49 fairplay 10.0.10

### 1.49.1 Available under license :

No license file was found, but licenses were detected in source scan.

```
/*
 * hal_reference.c
 * Copyright (C) 2018 Apple Inc. All Rights Reserved.
 * Confidential and privileged
 */
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/hal_reference.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * @file TAHAL_test.h
 * @brief Test functions header
 *
 * Copyright (C) 2018 Apple Inc. All Rights Reserved.
 * Confidential and privileged
 */
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/TAHAL_test.h
```

No license file was found, but licenses were detected in source scan.

```
/*
TAHAL.h
Copyright (C) 2018 Apple Inc. All Rights Reserved.
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/fairplay_tee/inc/TAHAL.h
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/TAHAL.h
```

No license file was found, but licenses were detected in source scan.

```
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Confidential and privileged
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/generate_test_vectors.bash
```

No license file was found, but licenses were detected in source scan.

```
/*
 * TAHAL_test.c
 * Copyright (C) 2018 Apple Inc. All Rights Reserved.
 * Confidential and privileged
 * Author: Jean-Baptiste Lescher
 */
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/TAHAL_test.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * libfps Basic Test
 *
 * Verifies basic functionality of libFPS.so, including decryption.
 * Requires communication with libTACore.a and key server.
 *
 * Dependencies on openssl, curl, and json-c.
 *
 * Sections with "#error TODO" require some modification.
 *
 * Copyright (C) 2011-2019 Apple Inc. All Rights Reserved.
 * Confidential and privileged
 */
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/libfps_basic_test.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * libTACore Basic Test
 *
 * Verifies some functionality of libTACore.a as a standalone library.
 * Most of the functionality, including decryption, is not included
 * here, because it cannot be verified without communication to
 * libFPS.so in the REE.
 *
 * Sections with "#error TODO" require some modification.
 *
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 * Confidential and privileged
 */
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/libtcore_basic_test.c
```

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```
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```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/fairplay_ree/inc/FPSLibraryInterface.h
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* @file main.c
```

```
* @brief Entry point
```

```
*
```

```
* Copyright (C) 2018 Apple Inc. All Rights Reserved.
```

```
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/main.c
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* hal_openssl.c
```

```
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```

```
* Confidential and privileged
```

```
* Author: Jean-Baptiste Lescher
```

```
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/tests/TAHAL_test/hal_openssl.c
```

No license file was found, but licenses were detected in source scan.

```
// Copyright (C) 2018 Apple Inc. All Rights Reserved.
```

Found in path(s):

```
* /opt/cola/permits/1702297921_1687560904.0752783/0/fairplay-10-0-10-tar-gz/fairplay_tee/inc/TACoreInterface.h
```

## 1.50 libqrencode 3.4.1

### 1.50.1 Available under license :

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Version 2.1, February 1999

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```
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```

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version 2.1 of the License, or (at your option) any later version.
```

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```

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id KAA22876; Wed, 10 May 1995 10:21:10 -0400 (from spcedt@armory.com for <chet@odin.INS.CWRU.Edu>)

Received: from deepthought.armory.com (mmdf@deepthought.armory.com [192.122.209.42]) by po.cwru.edu with SMTP (8.6.10+cwru/CWRU-2.3)

id BAA16354; Wed, 10 May 1995 01:33:22 -0400 (from spcedt@armory.com for <chet@po.cwru.edu>)

From: John DuBois <spcedt@armory.com>

Date: Tue, 9 May 1995 22:33:12 -0700

In-Reply-To: Chet Ramey <chet@odin.ins.cwru.edu>

"ksh scripts" (May 9, 1:36pm)

X-Www: <http://www.armory.com/~spcedt/>

X-Mailer: Mail User's Shell (7.2.5 10/14/92)

To: chet@po.cwru.edu

Subject: Re: ksh scripts

Message-ID: <9505092233.aa13001@deepthought.armory.com>

Sure. The canonical versions are available on ftp.armory.com; you might want to pick up the latest versions before modifying them.

John

On May 9, 1:36pm, Chet Ramey wrote:

} Subject: ksh scripts

} From odin.ins.cwru.edu!chet Tue May 9 10:39:51 1995

} Received: from odin.INS.CWRU.Edu by deepthought.armory.com id aa22336;

} 9 May 95 10:39 PDT

} Received: (chet@localhost) by odin.INS.CWRU.Edu (8.6.10+cwru/CWRU-2.1-ins)

} id NAA20487; Tue, 9 May 1995 13:39:24 -0400 (from chet)  
} Date: Tue, 9 May 1995 13:36:54 -0400  
} From: Chet Ramey <chet@odin.ins.cwru.edu>  
} To: john@armory.com  
} Subject: ksh scripts  
} Cc: chet@odin.ins.cwru.edu  
} Reply-To: chet@po.cwru.edu  
} Message-ID: <9505091736.AA20411.SM@odin.INS.CWRU.Edu>  
} Read-Receipt-To: chet@po.CWRU.Edu  
} MIME-Version: 1.0  
} Content-Type: text/plain; charset=us-ascii  
} Status: OR  
}  
} Hi. I'm the maintainer of bash (the GNU `Bourne Again shell') for  
} the FSF.  
}  
} I picked up a tar file of ksh scripts you wrote from an anon FTP site  
} a while back. I'd like your permission to include modified versions  
} of some of them in the next major bash distribution (with proper credit  
} given, of course). Is it OK if I do that?  
}  
} Chet Ramey  
}  
} --  
} ``The lyf so short, the craft so long to lerne." - Chaucer  
}  
} Chet Ramey, Case Western Reserve University Internet: chet@po.CWRU.Edu  
}-- End of excerpt from Chet Ramey

From friedman@cli.com Thu May 25 12:19:06 1995

Flags: 10

Return-Path: friedman@cli.com

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(8.6.10+cwru/CWRU-2.1-ins)

id MAA08685; Thu, 25 May 1995 12:19:05 -0400 (from friedman@cli.com for <chet@odin.INS.CWRU.Edu>)

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id MAA11299; Thu, 25 May 1995 12:19:00 -0400 (from friedman@cli.com for <chet@po.cwru.edu>)

Received: from tepui.cli.com by cli.com (4.1/SMI-4.1)

id AA27213; Thu, 25 May 95 11:18:25 CDT

Received: by tepui.cli.com (4.1) id AA16031; Thu, 25 May 95 11:18:23 CDT

Message-Id: <9505251618.AA16031@tepui.cli.com>

From: friedman@gnu.ai.mit.edu (Noah Friedman)

To: chet@po.cwru.edu

Subject: Bash scripts

Reply-To: friedman@gnu.ai.mit.edu

In-Reply-To: <chet@odin.ins.cwru.edu> Thu, 25 May 1995 11:19:59 -0400

References: <9505251519.AA06424.SM@odin.INS.CWRU.Edu>

Date: Thu, 25 May 95 11:18:21 CST

>Hi. I snagged some of your bash functions from your home directory on  
>the FSF machines (naughty, I know), and I was wondering if you'd let  
>me distribute them with bash-2.0. Thanks.

Sure. I think there's a later copy in  
~ftp/friedman/shell-inits/init-4.89.tar.gz. There are also some elisp and  
es frobs in that file.

It should serve as a pretty good example of how to get carried away. :-)

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Subject: Re: Ksh debugger from Rosenblatt's book [for bash]

To: Chet Ramey <chet@odin.INS.CWRU.Edu>

Cc: cmarie@ora.com, cam@iinet.com.au, brosenblatt@tm.com

In-Reply-To: Chet Ramey <chet@odin.INS.CWRU.Edu>, Mon, 31 Jul 1995 16:22:48 -0400

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```

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```
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```

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```
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```

```
<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
```

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## 1.57 zlib 1.2.8

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```
/* zlib.h -- interface of the 'zlib' general purpose compression library
version 1.2.11, January 15th, 2017
```

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\*/

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NR START END SECTORS SIZE NAME UUID

```
1 32 7679 7648 3.7M 8f8378c0-01
2 7680 16383 8704 4.3M 8f8378c0-02
5 7936 12799 4864 2.4M
6 12544 16127 3584 1.8M
```

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```
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```



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A0mImImI...

lost+found...

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WEV[B "1

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## 1.61 react-table 7.8.0

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## 1.63 unbound 1.17.0

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## 1.80 linux-kernel 4.9.337

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/\* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)

\* nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)

\*

\* Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.

\* <http://www.hypermall.com/>

\* 10/1/97 - commented out CFG\_PHYIE bit - we don't care when the PHY

\* interrupts us (except possibly for removal/insertion of the cable?)

\* 10/4/97 - began heavy inline documentation of the code. Corrected typos

\* and spelling mistakes.

\* 10/5/97 - added code to handle PHY interrupts, disable PHY on

\* loss of link, and correctly re-enable PHY when link is

\* re-established. (put back CFG\_PHYIE)

\*

\* Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.

\*

\* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997

\*

\* Linux driver for the IDT77201 NICStAR PCI ATM controller.

\* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;

\* see `init_nicstar()` for PHY initialization to change this. This driver

\* expects the Linux ATM stack to support scatter-gather lists

\* (`skb->atm.iovcnt != 0`) for Rx skb's passed to `vcc->push`.

\*

\* Implementing minimal-copy of received data:

\* IDT always receives data into a small buffer, then large buffers

\* as needed. This means that data must always be copied to create

\* the linear buffer needed by most non-ATM protocol stacks (e.g. IP)

\* Fix is simple: make large buffers large enough to hold entire

\* SDU, and leave `<small_buffer_data>` bytes empty at the start. Then

\* copy small buffer contents to head of large buffer.

\* Trick is to avoid fragmenting Linux, due to need for a lot of large

\* buffers. This is done by 2 things:

\* 1) `skb->destructor / skb->atm.recycle_buffer`

\* combined, allow nicstar\_free\_rx\_skb to be called to  
\* recycle large data buffers  
\* 2) skb\_clone of received buffers  
\* See nicstar\_free\_rx\_skb and linearize\_buffer for implementation  
\* details.  
\*  
\*  
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\*  
\* M. Welsh, 6 July 1996  
\*  
\*  
\*/

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## 1.82 soupsieve 2.0.1

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```

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To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

```
<one line to give the program's name and a brief idea of what it does.>
Copyright (C) <year> <name of author>
```

```
This program is free software; you can redistribute it and/or modify
it under the terms of the GNU General Public License as published by
the Free Software Foundation; either version 2 of the License, or
(at your option) any later version.
```

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This program is distributed in the hope that it will be useful,
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You should have received a copy of the GNU General Public License along
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51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA.
```

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

```
Gnomovision version 69, Copyright (C) year name of author
Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.
```

The hypothetical commands `show w` and `show c` should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than `show w` and `show c`; they could even be mouse-clicks or menu items--whatever suits your program.

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Yoyodyne, Inc., hereby disclaims all copyright interest in the program  
`Gnomovision' (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989  
Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License.

## 1.90 sharp-libtpcapi 20170403

## 1.91 tftp-hpa 5.2

### 1.91.1 Available under license :

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* LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
* OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF
* SUCH DAMAGE.
*/

```

Found in path(s):

```

* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftp/tftp.c
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/common/tftpsubs.c
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftp/main.c

```

No license file was found, but licenses were detected in source scan.

```

/* *_- c *_- ----- */
*
* Copyright 2001-2006 H. Peter Anvin - All Rights Reserved
*
* This program is free software available under the same license
* as the "OpenBSD" operating system, distributed at
* http://www.openbsd.org/.
*
* ----- */

```

Found in path(s):

```

* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/config.h

```

No license file was found, but licenses were detected in source scan.

```

/* ----- */
*
* Copyright 2001-2007 H. Peter Anvin - All Rights Reserved
*
* This program is free software available under the same license
* as the "OpenBSD" operating system, distributed at
* http://www.openbsd.org/.
*
* ----- */

```

Found in path(s):

```
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/remap.h
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/misc.c
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/remap.c
No license file was found, but licenses were detected in source scan.
```

Summary: The client for the Trivial File Transfer Protocol (TFTP).

Name: tftp

Version: @@VERSION@@

Release: 1

License: BSD

Group: Applications/Internet

Source0: <http://www.kernel.org/pub/software/network/tftp/tftp-hpa-%{version}.tar.gz>

BuildRequires: tcp\_wrappers-devel

BuildRoot: %{\_tmppath}/%{name}-root

%description

The Trivial File Transfer Protocol (TFTP) is normally used only for booting diskless workstations. The tftp package provides the user interface for TFTP, which allows users to transfer files to and from a remote machine. This program and TFTP provide very little security, and should not be enabled unless it is expressly needed.

%package server

Group: System Environment/Daemons

Summary: The server for the Trivial File Transfer Protocol (TFTP).

Requires: xinetd

%description server

The Trivial File Transfer Protocol (TFTP) is normally used only for booting diskless workstations. The tftp-server package provides the server for TFTP, which allows users to transfer files to and from a remote machine. TFTP provides very little security, and should not be enabled unless it is expressly needed. The TFTP server is run from /etc/xinetd.d/tftp, and is disabled by default on Red Hat Linux systems.

%prep

%setup -q -n tftp-hpa-%{version}

%build

%configure

make %{?\_smp\_mflags}

%install

rm -rf \${RPM\_BUILD\_ROOT}

mkdir -p \${RPM\_BUILD\_ROOT}%{\_bindir}

mkdir -p \${RPM\_BUILD\_ROOT}%{\_mandir}/man{1,8}

mkdir -p \${RPM\_BUILD\_ROOT}%{\_sbindir}

```

make INSTALLROOT=${RPM_BUILD_ROOT} \
 SBINDIR=% {_sbindir} MANDIR=% {_mandir} \
 install
install -m755 -d ${RPM_BUILD_ROOT}% {_sysconfdir}/xinetd.d/ ${RPM_BUILD_ROOT}/tftpboot
install -m644 tftp-xinetd ${RPM_BUILD_ROOT}% {_sysconfdir}/xinetd.d/tftp

%post server
/sbin/service xinetd reload > /dev/null 2>&1 || :

%postun server
if [$1 = 0]; then
 /sbin/service xinetd reload > /dev/null 2>&1 || :
fi

%clean
rm -rf ${RPM_BUILD_ROOT}

%files
%defattr(-,root,root)
% {_bindir}/tftp
% {_mandir}/man1/*

%files server
%defattr(-,root,root)
%config(noreplace) % {_sysconfdir}/xinetd.d/tftp
%dir /tftpboot
% {_sbindir}/in.tftpd
% {_mandir}/man8/*

%changelog
* Tue Sep 14 2004 H. Peter Anvin <hpa@zytor.com>
- removed completely broken "Malta" patch.
- integrated into build machinery so rpm -ta works.

* Fri Feb 13 2004 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Wed Jun 04 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Fri Apr 11 2003 Elliot Lee <sopwith@redhat.com>
- 0.33
- Add /tftpboot directory (#88204)

* Mon Feb 24 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

```

- \* Sun Feb 23 2003 Tim Powers <timp@redhat.com>  
- add BuildPreReq on tcp\_wrappers
- \* Wed Jan 22 2003 Tim Powers <timp@redhat.com>  
- rebuilt
- \* Mon Nov 11 2002 Elliot Lee <sopwith@redhat.com> 0.32-1  
- Update to 0.32
- \* Wed Oct 23 2002 Elliot Lee <sopwith@redhat.com> 0.30-1  
- Fix #55789  
- Update to 0.30
- \* Thu Jun 27 2002 Elliot Lee <sopwith@redhat.com>  
- Try applying HJ's patch from #65476
- \* Fri Jun 21 2002 Tim Powers <timp@redhat.com>  
- automated rebuild
- \* Mon Jun 17 2002 Elliot Lee <sopwith@redhat.com>  
- Update to 0.29
- \* Thu May 23 2002 Tim Powers <timp@redhat.com>  
- automated rebuild
- \* Wed Jan 09 2002 Tim Powers <timp@redhat.com>  
- automated rebuild
- \* Tue Dec 18 2001 Elliot Lee <sopwith@redhat.com> 0.17-15  
- Add patch4: netkit-tftp-0.17-defaultport.patch for bug #57562  
- Update to tftp-hpa-0.28 (bug #56131)  
- Remove include/arpa/tftp.h to fix #57259  
- Add resource limits in tftp-xinetd (#56722)
- \* Sun Jun 24 2001 Elliot Lee <sopwith@redhat.com>  
- Bump release + rebuild.
- \* Tue Jun 12 2001 Helge Deller <hdeller@redhat.de> (0.17-13)  
- updated tftp-hpa source to tftp-hpa-0.17  
- tweaked specfile with different defines for tftp-netkit and tftp-hpa version  
- use hpa's tftpd.8 man page instead of the netkits one
- \* Mon May 07 2001 Helge Deller <hdeller@redhat.de>  
- rebuilt in 7.1.x
- \* Wed Apr 18 2001 Helge Deller <hdeller@redhat.de>  
- fix tftp client's put problems (#29529)  
- update to tftp-hpa-0.16

- \* Wed Apr 4 2001 Jakub Jelinek <jakub@redhat.com>
  - don't let configure to guess compiler, it can pick up egcs
  
- \* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
  - changed "wait" in xinetd file to "yes" (hpa-tftpd forks and exits) (#26467)
  - fixed hpa-tftpd to handle files greater than 32MB (#23725)
  - added "-l" flag to hpa-tftpd for file-logging (#26467)
  - added description for "-l" to the man-page
  
- \* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
  - updated tftp client to 0.17 stable (#19640),
  - drop dependency on xinetd for tftp client (#25051),
  
- \* Wed Jan 17 2001 Jeff Johnson <jbj@redhat.com>
  - xinetd shouldn't wait on tftp (which forks) (#23923).
  
- \* Sat Jan 6 2001 Jeff Johnson <jbj@redhat.com>
  - fix to permit tftp put's (#18128).
  - startup as root with chroot to /tftpboot with early reversion to nobody is preferable to starting as nobody w/o ability to chroot.
  - %%post is needed by server, not client. Add %%postun for erasure as well.
  
- \* Wed Aug 23 2000 Nalin Dahyabhai <nalin@redhat.com>
  - default to being disabled
  
- \* Thu Aug 17 2000 Jeff Johnson <jbj@redhat.com>
  - correct group.
  
- \* Tue Jul 25 2000 Nalin Dahyabhai <nalin@redhat.com>
  - change user from root to nobody
  
- \* Sat Jul 22 2000 Jeff Johnson <jbj@redhat.com>
  - update to tftp-hpa-0.14 (#14003).
  - add server\_args (#14003).
  - remove -D\_BSD\_SOURCE (#14003).
  
- \* Fri Jul 21 2000 Nalin Dahyabhai <nalin@redhat.com>
  - cook up an xinetd config file for tftpd
  
- \* Wed Jul 12 2000 Prospector <bugzilla@redhat.com>
  - automatic rebuild
  
- \* Sun Jun 18 2000 Jeff Johnson <jbj@redhat.com>
  - FHS packaging.
  - update to 0.17.
  
- \* Fri May 5 2000 Matt Wilson <maw@redhat.com>

- use `_BSD_SOURCE` for hpa's tftpd so we get BSD signal semantics.

\* Fri Feb 11 2000 Bill Nottingham <notting@redhat.com>

- fix description

\* Wed Feb 9 2000 Jeff Johnson <jbj@redhat.com>

- compress man pages (again).

\* Wed Feb 02 2000 Cristian Gafton <gafton@redhat.com>

- man pages are compressed

- fix description and summary

\* Tue Jan 4 2000 Bill Nottingham <notting@redhat.com>

- split client and server

\* Tue Dec 21 1999 Jeff Johnson <jbj@redhat.com>

- update to 0.16.

\* Sat Aug 28 1999 Jeff Johnson <jbj@redhat.com>

- update to 0.15.

\* Wed Apr 7 1999 Jeff Johnson <jbj@redhat.com>

- tftpd should truncate file when overwriting (#412)

\* Sun Mar 21 1999 Cristian Gafton <gafton@redhat.com>

- auto rebuild in the new build environment (release 22)

\* Mon Mar 15 1999 Jeff Johnson <jbj@redhat.com>

- compile for 6.0.

\* Fri Aug 7 1998 Jeff Johnson <jbj@redhat.com>

- build root

\* Mon Apr 27 1998 Prospector System <bugs@redhat.com>

- translations modified for de, fr, tr

\* Mon Sep 22 1997 Erik Troan <ewt@redhat.com>

- added check for `getpwnam()` failure

\* Tue Jul 15 1997 Erik Troan <ewt@redhat.com>

- initial build

Found in path(s):

\* `/opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftp.spec.in`

No license file was found, but licenses were detected in source scan.

Summary: The client for the Trivial File Transfer Protocol (TFTP).

Name: tftp

Version: 5.2  
Release: 1  
License: BSD  
Group: Applications/Internet  
Source0: <http://www.kernel.org/pub/software/network/tftp/tftp-hpa-%{version}.tar.gz>  
BuildRequires: tcp\_wrappers-devel  
BuildRoot: %{\_tmppath}/%{name}-root

%description

The Trivial File Transfer Protocol (TFTP) is normally used only for booting diskless workstations. The tftp package provides the user interface for TFTP, which allows users to transfer files to and from a remote machine. This program and TFTP provide very little security, and should not be enabled unless it is expressly needed.

%package server

Group: System Environment/Daemons  
Summary: The server for the Trivial File Transfer Protocol (TFTP).  
Requires: xinetd

%description server

The Trivial File Transfer Protocol (TFTP) is normally used only for booting diskless workstations. The tftp-server package provides the server for TFTP, which allows users to transfer files to and from a remote machine. TFTP provides very little security, and should not be enabled unless it is expressly needed. The TFTP server is run from /etc/xinetd.d/tftp, and is disabled by default on Red Hat Linux systems.

%prep

%setup -q -n tftp-hpa-%{version}

%build

%configure

make %{?\_smp\_mflags}

%install

rm -rf \${RPM\_BUILD\_ROOT}  
mkdir -p \${RPM\_BUILD\_ROOT}%{\_bindir}  
mkdir -p \${RPM\_BUILD\_ROOT}%{\_mandir}/man{1,8}  
mkdir -p \${RPM\_BUILD\_ROOT}%{\_sbindir}

make INSTALLROOT=\${RPM\_BUILD\_ROOT} \

SBINDIR=%{\_sbindir} MANDIR=%{\_mandir} \

install

install -m755 -d \${RPM\_BUILD\_ROOT}%{\_sysconfdir}/xinetd.d/ \${RPM\_BUILD\_ROOT}/tftpboot

install -m644 tftp-xinetd \${RPM\_BUILD\_ROOT}%{\_sysconfdir}/xinetd.d/tftp

```

%post server
/sbin/service xinetd reload > /dev/null 2>&1 || :

%postun server
if [$1 = 0]; then
 /sbin/service xinetd reload > /dev/null 2>&1 || :
fi

%clean
rm -rf ${RPM_BUILD_ROOT}

%files
%defattr(-,root,root)
%{_bindir}/tftp
%{_mandir}/man1/*

%files server
%defattr(-,root,root)
%config(noreplace) %{_sysconfdir}/xinetd.d/tftp
%dir /tftpboot
%{_sbindir}/in.tftpd
%{_mandir}/man8/*

%changelog
* Tue Sep 14 2004 H. Peter Anvin <hpa@zytor.com>
- removed completely broken "Malta" patch.
- integrated into build machinery so rpm -ta works.

* Fri Feb 13 2004 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Wed Jun 04 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Fri Apr 11 2003 Elliot Lee <sopwith@redhat.com>
- 0.33
- Add /tftpboot directory (#88204)

* Mon Feb 24 2003 Elliot Lee <sopwith@redhat.com>
- rebuilt

* Sun Feb 23 2003 Tim Powers <timp@redhat.com>
- add BuildPreReq on tcp_wrappers

* Wed Jan 22 2003 Tim Powers <timp@redhat.com>
- rebuilt

* Mon Nov 11 2002 Elliot Lee <sopwith@redhat.com> 0.32-1

```



- Update to 0.32
  
- \* Wed Oct 23 2002 Elliot Lee <sopwith@redhat.com> 0.30-1
- Fix #55789
- Update to 0.30
  
- \* Thu Jun 27 2002 Elliot Lee <sopwith@redhat.com>
- Try applying HJ's patch from #65476
  
- \* Fri Jun 21 2002 Tim Powers <timp@redhat.com>
- automated rebuild
  
- \* Mon Jun 17 2002 Elliot Lee <sopwith@redhat.com>
- Update to 0.29
  
- \* Thu May 23 2002 Tim Powers <timp@redhat.com>
- automated rebuild
  
- \* Wed Jan 09 2002 Tim Powers <timp@redhat.com>
- automated rebuild
  
- \* Tue Dec 18 2001 Elliot Lee <sopwith@redhat.com> 0.17-15
- Add patch4: netkit-tftp-0.17-defaultport.patch for bug #57562
- Update to tftp-hpa-0.28 (bug #56131)
- Remove include/arpa/tftp.h to fix #57259
- Add resource limits in tftp-xinetd (#56722)
  
- \* Sun Jun 24 2001 Elliot Lee <sopwith@redhat.com>
- Bump release + rebuild.
  
- \* Tue Jun 12 2001 Helge Deller <hdeller@redhat.de> (0.17-13)
- updated tftp-hpa source to tftp-hpa-0.17
- tweaked specfile with different defines for tftp-netkit and tftp-hpa version
- use hpa's tftpd.8 man page instead of the netkits one
  
- \* Mon May 07 2001 Helge Deller <hdeller@redhat.de>
- rebuilt in 7.1.x
  
- \* Wed Apr 18 2001 Helge Deller <hdeller@redhat.de>
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- update to tftp-hpa-0.16
  
- \* Wed Apr 4 2001 Jakub Jelinek <jakub@redhat.com>
- don't let configure to guess compiler, it can pick up egcs
  
- \* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
- changed "wait" in xinetd file to "yes" (hpa-tftpd forks and exits) (#26467)
- fixed hpa-tftpd to handle files greater than 32MB (#23725)

- added "-l" flag to hpa-tftpd for file-logging (#26467)
- added description for "-l" to the man-page
  
- \* Thu Feb 08 2001 Helge Deller <hdeller@redhat.de>
- updated tftp client to 0.17 stable (#19640),
- drop dependency on xinetd for tftp client (#25051),
  
- \* Wed Jan 17 2001 Jeff Johnson <jbj@redhat.com>
- xinetd shouldn't wait on tftp (which forks) (#23923).
  
- \* Sat Jan 6 2001 Jeff Johnson <jbj@redhat.com>
- fix to permit tftp put's (#18128).
- startup as root with chroot to /tftpboot with early reversion to nobody is preferable to starting as nobody w/o ability to chroot.
- %%post is needed by server, not client. Add %%postun for erasure as well.
  
- \* Wed Aug 23 2000 Nalin Dahyabhai <nalin@redhat.com>
- default to being disabled
  
- \* Thu Aug 17 2000 Jeff Johnson <jbj@redhat.com>
- correct group.
  
- \* Tue Jul 25 2000 Nalin Dahyabhai <nalin@redhat.com>
- change user from root to nobody
  
- \* Sat Jul 22 2000 Jeff Johnson <jbj@redhat.com>
- update to tftp-hpa-0.14 (#14003).
- add server\_args (#14003).
- remove -D\_BSD\_SOURCE (#14003).
  
- \* Fri Jul 21 2000 Nalin Dahyabhai <nalin@redhat.com>
- cook up an xinetd config file for tftpd
  
- \* Wed Jul 12 2000 Prospector <bugzilla@redhat.com>
- automatic rebuild
  
- \* Sun Jun 18 2000 Jeff Johnson <jbj@redhat.com>
- FHS packaging.
- update to 0.17.
  
- \* Fri May 5 2000 Matt Wilson <msw@redhat.com>
- use \_BSD\_SOURCE for hpa's tftpd so we get BSD signal semantics.
  
- \* Fri Feb 11 2000 Bill Nottingham <notting@redhat.com>
- fix description
  
- \* Wed Feb 9 2000 Jeff Johnson <jbj@redhat.com>
- compress man pages (again).

\* Wed Feb 02 2000 Cristian Gafton <gafton@redhat.com>

- man pages are compressed
- fix description and summary

\* Tue Jan 4 2000 Bill Nottingham <notting@redhat.com>

- split client and server

\* Tue Dec 21 1999 Jeff Johnson <jbj@redhat.com>

- update to 0.16.

\* Sat Aug 28 1999 Jeff Johnson <jbj@redhat.com>

- update to 0.15.

\* Wed Apr 7 1999 Jeff Johnson <jbj@redhat.com>

- tftpd should truncate file when overwriting (#412)

\* Sun Mar 21 1999 Cristian Gafton <gafton@redhat.com>

- auto rebuild in the new build environment (release 22)

\* Mon Mar 15 1999 Jeff Johnson <jbj@redhat.com>

- compile for 6.0.

\* Fri Aug 7 1998 Jeff Johnson <jbj@redhat.com>

- build root

\* Mon Apr 27 1998 Prospector System <bugs@redhat.com>

- translations modified for de, fr, tr

\* Mon Sep 22 1997 Erik Troan <ewt@redhat.com>

- added check for getpwnam() failure

\* Tue Jul 15 1997 Erik Troan <ewt@redhat.com>

- initial build

Found in path(s):

\* /opt/cola/permits/1108298343\_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftp.spec

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Found in path(s):

\* /opt/cola/permits/1108298343\_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/MCONFIG.in

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.\ " \*- nroff \*- ----- \*

.\ "

```

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.\" LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
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.\" SUCH DAMAGE.
.\"
.\"----- */

```

Found in path(s):

```
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/tftpd.8.in
```

No license file was found, but licenses were detected in source scan.

```

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*
*----- */

```

Found in path(s):

```
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/recvfrom.c
```

```
* /opt/cola/permits/1108298343_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/recvfrom.h
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```

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\* /opt/cola/permits/1108298343\_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftp/tftp.1.in

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\* /opt/cola/permits/1108298343\_1611281305.28/0/tftp-hpa-5-2-tar-bz2/tftp-hpa-5.2/tftpd/tftpd.h

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# 1.98 icu4c 71.1

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Commands to generate dependency files
GEN_DEPS.c= $(CC) -E -MM $(DEFS) $(CPPFLAGS)
GEN_DEPS.cc= $(CXX) -E -MM $(DEFS) $(CPPFLAGS)

Flags for position independent code
SHAREDLIBCFLAGS = -fPIC
SHAREDLIBCXXFLAGS = -fPIC
SHAREDLIBCPPFLAGS = -DPIC

Additional flags when building libraries and with threads
THREADSCPPFLAGS = -D_REENTRANT
LIBCPPFLAGS =

Compiler switch to embed a runtime search path
LD_RPATH=
LD_RPATH_PRE= -Wl,-rpath,

Compiler switch to embed a library name
LD_SONAME = -Wl,-soname -Wl,$(notdir $(MIDDLE_SO_TARGET))

Shared library options
LD_SOOPTIONS= -Wl,-Bsymbolic

Shared object suffix
SO = so

Non-shared intermediate object suffix
STATIC_O = ao

Compilation rules
%.${STATIC_O}: $(srcdir)/%.c
$(COMPILE.c) $(STATICCPPFLAGS) $(STATICCFLAGS) -o $@ $<
%.o: $(srcdir)/%.c
$(COMPILE.c) $(DYNAMICCPPFLAGS) $(DYNAMICCFLAGS) -o $@ $<
```

```
%. $(STATIC_O): $(srcdir)/%.cpp
$(COMPILE.cc) $(STATICCPPFLAGS) $(STATICCXXFLAGS) -o $@ $<
%.o: $(srcdir)/%.cpp
$(COMPILE.cc) $(DYNAMICCPPFLAGS) $(DYNAMICCXXFLAGS) -o $@ $<
```

### ## Dependency rules

```
%.d: $(srcdir)/%.c
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.c) $< \
| sed "s^\($*\)\.o[:]*/1.o $@ : /g\" > $@; \
[-s $@] || rm -f $@'
```

```
%.d: $(srcdir)/%.cpp
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.cc) $< \
| sed "s^\($*\)\.o[:]*/1.o $@ : /g\" > $@; \
[-s $@] || rm -f $@'
```

### ## Versioned libraries rules

```
%. $(SO).$(SO_TARGET_VERSION_MAJOR): %. $(SO).$(SO_TARGET_VERSION)
$(RM) $@ && ln -s ${<F} $@
%. $(SO): %. $(SO).$(SO_TARGET_VERSION_MAJOR)
$(RM) $@ && ln -s ${*F}. $(SO).$(SO_TARGET_VERSION) $@
```

### ## Bind internal references

```
LDflags that pkgdata will use
BIR_LDFLAGS= -Wl,-Bsymbolic
```

```
Dependencies [i.e. map files] for the final library
BIR_DEPS=
```

```
Remove shared library 's'
STATIC_PREFIX_WHEN_USED =
STATIC_PREFIX =
```

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## 1.106 webob 1.8.6

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## 1.107 strace 5.17

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```
Mathieu Desnoyers
May 13th, 2009
```

IBM Corporation allowed LGPLv2.1+ licensing of their contribution to the userspace RCU library in a patch submitted on May 8, 2009 from Paul E. McKenney and reviewed by Steven L. Bennett:

<https://lists.lttng.org/pipermail/lttng-dev/2009-May/012835.html>

I (Mathieu Desnoyers) re-implemented ACCESS\_ONCE(), likely(), unlikely() and barrier() from scratch without reference to the original code.

```
commit id : 2dc5fa0f7cfbfb0a64a7a67b39626650e863f16a
```

Bert Wesarg <bert.wesarg@googlemail.com> approved LGPL relicensing of his patch in an email dated May 13, 2009 :

<http://lkml.org/lkml/2009/5/13/16>

xchg() primitives has been rewritten from a MIT-licensed cmpxchg for Intel and powerpc. They are MIT-licensed and therefore usable in LGPL code. This cmpxchg code was obtained from the atomic\_ops project:

[http://www.hpl.hp.com/research/linux/atomic\\_ops/](http://www.hpl.hp.com/research/linux/atomic_ops/)

I (Mathieu Desnoyers) wrote the remainder of the code.

The license for the library files in this project was therefore changed to LGPLv2.1 on May 13, 2009, as detailed in LICENSE.

## 1.110 glib 2.74.0

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For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

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A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the



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If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

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- a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under

Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

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```

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## 1.117 sqlite 3.42.0

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\* The following source files are in the public domain:

libarchive/archive\_getdate.c

\* The following source files are triple-licensed with the ability to choose from CC0 1.0 Universal, OpenSSL or Apache 2.0 licenses:

libarchive/archive\_blake2.h  
libarchive/archive\_blake2\_impl.h  
libarchive/archive\_blake2s\_ref.c  
libarchive/archive\_blake2sp\_ref.c

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I intend for all new source code to use the license below and hope over time to replace code with other licenses with new implementations that do use the license below. The varying licensing of the build scripts seems to be an unavoidable mess.

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# 1.120 glibc 2.35

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@center Version 2.1, February 1999

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@subheading END OF TERMS AND CONDITIONS

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## \*-makefile-\*-

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```

Commands to generate dependency files
GEN_DEPS.c= $(CC) -E -MM $(DEFS) $(CPPFLAGS)
GEN_DEPS.cc= $(CXX) -E -MM $(DEFS) $(CPPFLAGS)

Flags for position independent code
SHAREDLIBCFLAGS = -fPIC
SHAREDLIBCXXFLAGS = -fPIC
SHAREDLIBCPPFLAGS = -DPIC

Additional flags when building libraries and with threads
THREADSCPPFLAGS = -D_REENTRANT
LIBCPPFLAGS =

Compiler switch to embed a runtime search path
LD_RPATH=
LD_RPATH_PRE= -Wl,-rpath,

Compiler switch to embed a library name
LD_SONAME = -Wl,-soname -Wl,$(notdir $(MIDDLE_SO_TARGET))

Shared library options
LD_SOOPTIONS= -Wl,-Bsymbolic

Shared object suffix
SO = so
Non-shared intermediate object suffix
STATIC_O = ao

Compilation rules
%. $(STATIC_O): $(srcdir)/%.c
$(COMPILE.c) $(STATICCPPFLAGS) $(STATICCFLAGS) -o $@ $<
%.o: $(srcdir)/%.c
$(COMPILE.c) $(DYNAMICCPPFLAGS) $(DYNAMICCFLAGS) -o $@ $<

%. $(STATIC_O): $(srcdir)/%.cpp
$(COMPILE.cc) $(STATICCPPFLAGS) $(STATICCXXFLAGS) -o $@ $<
%.o: $(srcdir)/%.cpp
$(COMPILE.cc) $(DYNAMICCPPFLAGS) $(DYNAMICCXXFLAGS) -o $@ $<

Dependency rules
%.d: $(srcdir)/%.c
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.c) $< \
| sed "s/^(.*)\.o[:]*^1.o $@ :/g\" > $@; \
[-s $@] || rm -f $@'

```

```
%d: $(srcdir)/%.cpp
@echo "generating dependency information for $<"
@$(SHELL) -ec '$(GEN_DEPS.cc) $< \
| sed \"s^\($*\)\.o[:]*^/1.o $@ : /g\" > $@; \
[-s $@] || rm -f $@'
```

```
Versioned libraries rules
```

```
%.${SO}.${SO_TARGET_VERSION_MAJOR}: %.${SO}.${SO_TARGET_VERSION}
$(RM) $@ && ln -s ${<F} $@
%.${SO}: %.${SO}.${SO_TARGET_VERSION_MAJOR}
$(RM) $@ && ln -s ${*F}.${SO}.${SO_TARGET_VERSION} $@
```

```
Bind internal references
```

```
LDflags that pkgdata will use
BIR_LDFLAGS= -Wl,-Bsymbolic
```

```
Dependencies [i.e. map files] for the final library
BIR_DEPS=
```

```
Remove shared library 's'
STATIC_PREFIX_WHEN_USED =
STATIC_PREFIX =
```

```
End BSD-specific setup
```

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## 1.130 glibc 2.17

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## 1.139 inotify-tools 3.22.6.0

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## 1.140 libseccomp 2.5.3

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## 1.142 pcre 8.45

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## THE BASIC LIBRARY FUNCTIONS

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Written by: Philip Hazel  
Email local part: Philip.Hazel  
Email domain: gmail.com

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snprintf/snprintf.c  
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snprintf/vfprintf.c  
snprintf/wcio.h:5  
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```

```
#
```

```
Example makefile for build outside of the LTTng-UST tree.
```

```
hello:
```

```
 ${CC} -O2 -I. -o hello -lc -llttng-ust hello.c tp.c
```

```
.PHONY: clean
```

```
clean:
```

```
 rm -f hello
```

```
Example makefile for build outside of the LTTng-UST tree.
```

```
hello:
```

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 ${CC} -O2 -I. -o hello -lc -llttng-ust hello.c tp.c
```

.PHONY: clean

clean:

rm -f hello

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## THANKS

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Special thanks to Michel Dagenais and the

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## 1.147 tcpdump 4.99.4

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```
-*- perl -*-
```

```
$testlist = [
```

```
 # This specific test fails on OpenBSD because the .pcap file uses DLT_RAW,
```

```
 # which OpenBSD treats as DLT_LOOP.
```

```
{
 config_unset => 'IS_OPENBSD',
 name => 'heap-overflow-1',
 input => 'heap-overflow-1.pcap',
 output => 'heap-overflow-1.out',
 args => '-v'
},
];

1;
```

## 1.148 libusb 1.0.22

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## 1.149 repoze-profile 2.3

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## 1.152 protobuf 3.7.1-2

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text format.

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Oleg Smolsky <oleg.smolsky@gmail.com>  
\* MS Visual Studio error format option.  
\* Detect unordered\_map in stl\_hash.m4.

Brian Olson <brianolson@google.com>  
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\* Fixed warnings about generated constructors not explicitly initializing all fields (only present with certain compiler settings).  
\* Added generation of field number constants.

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\* Fixed initialization ordering problem in logging code.

Will Pierce <willp@nuclei.com>  
\* Small patch improving performance of in Python serialization.

Alexandre Vassalotti <alexandre@peadrop.com>  
\* Emacs mode for Protocol Buffers (editors/protobuf-mode.el).

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\* Added Swap(), SwapElements(), and RemoveLast() to Reflection interface.

Alexander Melnikov <alm@sibmail.ru>  
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Oliver Jowett <oliver.jowett@gmail.com>  
\* Detect whether zlib is new enough in configure script.  
\* Fixes for Solaris 10 32/64-bit confusion.

Evan Jones <evanj@mit.edu>  
\* Optimize Java serialization code when writing a small message to a stream.  
\* Optimize Java serialization of strings so that UTF-8 encoding happens only once per string per serialization call.  
\* Clean up some Java warnings.  
\* Fix bug with permanent callbacks that delete themselves when run.

Michael Kucharski <m.kucharski@gmail.com>  
\* Added CodedInputStream.getTotalBytesRead().

Kacper Kowalik <xarthisius.kk@gmail.com>  
\* Fixed m4/acx\_pthread.m4 problem for some Linux distributions.

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\* Fixed detection of sched\_yield on Solaris.  
\* Added atomicops for Solaris

Andrew Paprocki <andrew@ishiboo.com>  
\* Fixed minor IBM xLC compiler build issues  
\* Added atomicops for AIX (POWER)

# 1.153 wpa-supPLICant 2.10

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wpa\_supPLICant and hostapd  
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## 1.155 nettle 3.8.1

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## 1.156 io-ts 2.2.20

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## 5

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8efd98903fca507e58144865d26c47c91565bb55-tar-gz/quickjspp-  
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\* /opt/cola/permits/1397821141\_1661521927.6057177/0/quickjspp-  
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8efd98903fca507e58144865d26c47c91565bb55/quickjs/cutils.c  
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8efd98903fca507e58144865d26c47c91565bb55/quickjs/quickjs.c  
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\* Unicode utilities

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8efd98903fca507e58144865d26c47c91565bb55-tar-gz/quickjspp-  
8efd98903fca507e58144865d26c47c91565bb55/quickjs/libunicode.h  
\* /opt/cola/permits/1397821141\_1661521927.6057177/0/quickjspp-  
8efd98903fca507e58144865d26c47c91565bb55-tar-gz/quickjspp-  
8efd98903fca507e58144865d26c47c91565bb55/quickjs/libunicode.c  
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\* QuickJS C library

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8efd98903fca507e58144865d26c47c91565bb55-tar-gz/quickjspp-  
8efd98903fca507e58144865d26c47c91565bb55/quickjs/quickjs-libc.h

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\* Linux klist like system

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\* Regular Expression Engine

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\* Tiny arbitrary precision floating point library

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\* QuickJS Javascript Engine

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8efd98903fca507e58144865d26c47c91565bb55/quickjs/quickjs.h

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\* QuickJS opcode definitions

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8efd98903fca507e58144865d26c47c91565bb55/quickjs/quickjs-opcode.h

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* QuickJS atom definitions
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8efd98903fca507e58144865d26c47c91565bb55/quickjs/quickjs-atom.h
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8efd98903fca507e58144865d26c47c91565bb55/quickjs/quickjs-libc.c

## 1.159 react 18.2.0

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Ajay Tirumala  
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2006-Jan-27

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#
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docs/GPLv2.TXT
#
include/freetype/internal/fthash.h
#
src/base/fthash.c
src/base/md5.c
src/base/md5.h
#
src/bdf/bdf.c
src/bdf/bdf.h
src/bdf/bdfdrivr.c
src/bdf/bdfdrivr.h
src/bdf/bdferror.h
src/bdf/bdfplib.c
src/bdf/module.mk
src/bdf/README
src/bdf/rules.mk
#
src/pcf/module.mk
src/pcf/pcf.c
src/pcf/pcf.h
src/pcf/pcfdrivr.c
src/pcf/pcfdrivr.h
src/pcf/pcferror.h
src/pcf/pcfread.c
src/pcf/pcfread.h
src/pcf/pcfutil.c
src/pcf/pcfutil.h
src/pcf/README
src/pcf/rules.mk
#
src/gzip/adler32.c
src/gzip/ftzconf.c
src/gzip/infblock.c
src/gzip/infblock.h
src/gzip/infcodes.c
src/gzip/infcodes.h
src/gzip/inffixed.h
src/gzip/inflate.c
src/gzip/inftrees.c
```

```
src/gzip/inftrees.h
src/gzip/infutil.c
src/gzip/infutil.h
src/gzip/zconf.h
src/gzip/zlib.h
src/gzip/zutil.c
src/gzip/zutil.h
#
src/tools/apinames.c
src/tools/ftrandom/ftrandom.c
#
subprojects/dlg
#
EOF
```

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However, unrestricted linking of non-free programs would deprive the users of those programs of all benefit from the free status of the libraries themselves. This Library General Public License is intended to permit developers of non-free programs to use free libraries, while preserving your freedom as a user of such programs to change the free libraries that are incorporated in them. (We have not seen how to achieve this as regards changes in header files, but we have achieved it as regards changes in the actual functions of the Library.) The hope is that this will lead to faster development of free libraries.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, while the latter only works together with the library.

Note that it is possible for a library to be covered by the ordinary General Public License rather than by this special one.

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"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

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If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

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c) If distribution of the work is made by offering access to copy

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```

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```
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```

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```

```
<signature of Ty Coon>, 1 April 1989
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/\* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)

\* nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)

\*

\* Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.

\* <http://www.hypermall.com/>

\* 10/1/97 - commented out CFG\_PHYIE bit - we don't care when the PHY  
 \* interrupts us (except possibly for removal/insertion of the cable?)  
 \* 10/4/97 - began heavy inline documentation of the code. Corrected typos  
 \* and spelling mistakes.  
 \* 10/5/97 - added code to handle PHY interrupts, disable PHY on  
 \* loss of link, and correctly re-enable PHY when link is  
 \* re-established. (put back CFG\_PHYIE)  
 \*  
 \* Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.  
 \*  
 \* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997  
 \*  
 \* Linux driver for the IDT77201 NICStAR PCI ATM controller.  
 \* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;  
 \* see init\_nicstar() for PHY initialization to change this. This driver  
 \* expects the Linux ATM stack to support scatter-gather lists  
 \* (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.  
 \*  
 \* Implementing minimal-copy of received data:  
 \* IDT always receives data into a small buffer, then large buffers  
 \* as needed. This means that data must always be copied to create  
 \* the linear buffer needed by most non-ATM protocol stacks (e.g. IP)  
 \* Fix is simple: make large buffers large enough to hold entire  
 \* SDU, and leave <small\_buffer\_data> bytes empty at the start. Then  
 \* copy small buffer contents to head of large buffer.  
 \* Trick is to avoid fragmenting Linux, due to need for a lot of large  
 \* buffers. This is done by 2 things:  
 \* 1) skb->destructor / skb->atm.recycle\_buffer  
 \* combined, allow nicstar\_free\_rx\_skb to be called to  
 \* recycle large data buffers  
 \* 2) skb\_clone of received buffers  
 \* See nicstar\_free\_rx\_skb and linearize\_buffer for implementation  
 \* details.  
 \*  
 \*  
 \*  
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- \* Foundation, Inc., 675 Mass Ave, Cambridge, MA 02139, USA.
- \*
- \* M. Welsh, 6 July 1996
- \*
- \*
- \*/

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Michael Hunold <m.hunold@gmx.de>  
for the initial saa7146 driver and its recent overhaul

Christian Theiss  
for his work on the initial Linux DVB driver

Marcus Metzler <mocm@metzlerbros.de>  
Ralph Metzler <rjkm@metzlerbros.de>  
for their continuing work on the DVB driver

Michael Holzt <kju@debian.org>  
for his contributions to the dvb-net driver



Diego Picciani <d.picciani@novacomp.it>  
for CyberLogin for Linux which allows logging onto EON  
(in case you are wondering where CyberLogin is, EON changed its login  
procedure and CyberLogin is no longer used.)

Martin Schaller <martin@smurf.franken.de>  
for patching the cable card decoder driver

Klaus Schmidinger <Klaus.Schmidinger@cadsoft.de>  
for various fixes regarding tuning, OSD and CI stuff and his work on VDR

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for his AFC kernel thread

Christoph Martin <martin@uni-mainz.de>  
for his LIRC infrared handler

Andreas Oberritter <obi@linuxtv.org>  
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Felix Domke <tmbinc@elitedvb.net>  
Florian Schirmer <jolt@tuxbox.org>  
Ronny Strutz <3des@elitedvb.de>  
Wolfram Joost <dbox2@frokaschwei.de>  
...and all the other dbox2 people  
for many bugfixes in the generic DVB Core, frontend drivers and  
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for many bugfixes

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for the tda1004x frontend driver, and various bugfixes

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for tuning/DiSEqC support for the DEC 3000-s

Peter Beutner <p.beutner@gmx.net>  
for the IR code for the ttusb-dec driver

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Michael Krufky <mkrufky@m1k.net>  
for maintaining v4l/dvb inter-tree dependencies

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for the nxt2002 frontend driver

Jean-Francois Thibert <jeanfrancois@sagetv.com>  
for the nxt2004 frontend driver

Kirk Lapray <kirk.lapray@gmail.com>  
for the or51211 and or51132 frontend drivers, and  
for merging the nxt2002 and nxt2004 modules into a  
single nxt200x frontend driver.

(If you think you should be in this list, but you are not, drop a  
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## 1.168 python-beautifulsoup4 4.9.3

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# 1.170 ncurses 6.4-20230408

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## 1.173 linux-kernel 4.5.4

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```
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#define __LICENSE_H
```

```
static inline int license_is_gpl_compatible(const char *license)
{
 return (strcmp(license, "GPL") == 0
 || strcmp(license, "GPL v2") == 0
 || strcmp(license, "GPL and additional rights") == 0
 || strcmp(license, "Dual BSD/GPL") == 0
 || strcmp(license, "Dual MIT/GPL") == 0
 || strcmp(license, "Dual MPL/GPL") == 0);
}
```

```
#endif
```

```
/* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)
 * nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)
 *
 * Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.
 * http://www.hypermall.com/
 * 10/1/97 - commented out CFG_PHYIE bit - we don't care when the PHY
 * interrupts us (except possibly for removal/insertion of the cable?)
 * 10/4/97 - began heavy inline documentation of the code. Corrected typos
 * and spelling mistakes.
 * 10/5/97 - added code to handle PHY interrupts, disable PHY on
 * loss of link, and correctly re-enable PHY when link is
 * re-established. (put back CFG_PHYIE)
 *
 * Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.
 *
 * R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997
 *
 * Linux driver for the IDT77201 NICStAR PCI ATM controller.
 * PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;
 * see init_nicstar() for PHY initialization to change this. This driver
 * expects the Linux ATM stack to support scatter-gather lists
 * (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.
 *
 * Implementing minimal-copy of received data:
 * IDT always receives data into a small buffer, then large buffers
 * as needed. This means that data must always be copied to create
 * the linear buffer needed by most non-ATM protocol stacks (e.g. IP)
 * Fix is simple: make large buffers large enough to hold entire
```



\* SDU, and leave <small\_buffer\_data> bytes empty at the start. Then  
\* copy small buffer contents to head of large buffer.  
\* Trick is to avoid fragmenting Linux, due to need for a lot of large  
\* buffers. This is done by 2 things:  
\* 1) skb->destructor / skb->atm.recycle\_buffer  
\* combined, allow nicstar\_free\_rx\_skb to be called to  
\* recycle large data buffers  
\* 2) skb\_clone of received buffers  
\* See nicstar\_free\_rx\_skb and linearize\_buffer for implementation  
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\*  
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\* along with this program; if not, write to the Free Software  
\* Foundation, Inc., 675 Mass Ave, Cambridge, MA 02139, USA.  
\*  
\* M. Welsh, 6 July 1996  
\*  
\*  
\*/

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Version 1.1, March 2000

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for the initial saa7146 driver and its recent overhaul

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for his work on the initial Linux DVB driver

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for his contributions to the dvb-net driver

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for CyberLogin for Linux which allows logging onto EON  
(in case you are wondering where CyberLogin is, EON changed its login procedure and CyberLogin is no longer used.)

Martin Schaller <martin@smurf.franken.de>  
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for the nxt2004 frontend driver

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for the or51211 and or51132 frontend drivers, and  
for merging the nxt2002 and nxt2004 modules into a  
single nxt200x frontend driver.

(If you think you should be in this list, but you are not, drop a  
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## 1.174 tamlib 5.4.2

### 1.174.1 Available under license :

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_openssl_authentication.c --
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_openssl_authentication.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_user_sessions.c --
*
* February 2013, Bo Berry
*
* Copyright (c) 2012 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_user_sessions.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_reg_access.c -- Aikido specific register access APIs
*
* December 2015, Jimmy Chou
*
* Copyright (c) 2015 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_reg_access.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_hash.c -- hash (SHA) APIs
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_hash.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_private_tomhash.c
*
* May 2014, Tzu-Min Chou (Jimmy)
*
* Copyright (c) 2014 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_private_tomhash.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_device.h --
*
*-----
```

\* February 2013, Bo Berry

\*

\* Copyright (c) 2013 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_device.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_tommath.h

\*

\* May 2014, Tzu-Min Chou (Jimmy)

\*

\* Copyright (c) 2014 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_tommath.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_cert.h

\*

\* May 2014, Tzu-Min Chou (Jimmy)

\*

\* Copyright (c) 2014 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_cert.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_mapped\_objects.c

\*

\* April 2017, Andrew K. Thanos, III

\*

\* Copyright (c) 2017 by Cisco Systems, Inc.



\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_mapped\_objects.c

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_tommath.c

\*

\* May 2014, Tzu-Min Chou (Jimmy)

\*

\* Copyright (c) 2014 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_tommath.c

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_safec.c

\*

\* July 2014, Chandana Prakash

\*

\* Copyright (c) 2013 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_safec.c

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_hmac.c -- Hash-based Message Authentication Code

\*

\* February 2013, Bo Berry

\*

\* Copyright (c) 2013 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_hmac.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_private_sha2.c -- SHA 2 bundled routines
*
* January 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_sha2.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_image_signing.c -- Image Signing APIs
*
* January 2017, TAM team
*
* Copyright (c) 2017 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_image\_signing.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_openssl_aik_validate.c --
*
* February 2017, Chandana Prakash
*
* Copyright (c) 2017 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-

5.4.2/tam\_library/tam\_lib\_openssl\_aik\_validate.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_uefi.c -- APIs for certificate and key retrieval
*
* July 2017, Burhan Wani
*
* Copyright (c) 2019 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

`/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_uefi.c`

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_types.h -- optional type file for primitive systems
*
* March 2013, Bo Berry
*
* Copyright (c) 2012 by Cisco Systems, Inc
* All rights reserved.
*-----
*/
```

Found in path(s):

`/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_types.h`

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_scc.c --
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

`/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_scc.c`

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_private_endian.h -- internal macros to deal with byte order
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_private_endian.h
No license file was found, but licenses were detected in source scan.
```

```
/*-----
* tam_lib_device.c --
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_device.c
No license file was found, but licenses were detected in source scan.
```

```
/*-----
* tam_lib_private_libTom_sha2.c --
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_private_libTom_sha2.c
No license file was found, but licenses were detected in source scan.
```

```
/*-----
* tam_lib_private_device.h -- internal device management data
*
*-----
*/
```

\* February 2013, Bo Berry

\*

\* Copyright (c) 2013 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_device.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_mailbox.c

\*

\* May 2016, Jimmy Chou

\*

\* Copyright (c) 2016 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_mailbox.c

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_debug.h -- Debug supporting macros

\*

\* February 2013, Bo Berry

\*

\* Copyright (c) 2013 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_debug.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_sha2.h -- abstracts the platform SHA APIs

\*

\* January 2013, Bo Berry

\*

\* Copyright (c) 2013 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_sha2.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_secure\_msg.h -- secure transport APIs

\*

\* March 2014, Srinivas Vundru

\*

\* Copyright (c) 2014 by Cisco Systems, Inc

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_secure\_msg.h

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_cert\_parse.c

\*

\* May 2014, Tzu-Min Chou (Jimmy)

\*

\* Copyright (c) 2014 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_cert\_parse.c

No license file was found, but licenses were detected in source scan.

/\*-----

\* tam\_lib\_private\_msg\_openssl.c -- utility functionality for openssl based crypto operations.

\*

\* Jun 2014, Srinivas Vundru

\*

\* Copyright (c) 2014 by Cisco Systems, Inc.

\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_msg\_openssl.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_trand.c -- true random APIs
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_trand.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_aik_validate.c
*
* January 2017, Chandana Prakash
*
* Copyright (c) 2017 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_aik\_validate.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_chipguard.c Chip guard feature APIs
*
* March 2017 - Burhan Wani
*
* Copyright (c) 2017 by Cisco Systems, Inc.
* All rights reserved.

*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-

5.4.2/tam\_library/tam\_lib\_chipguard.c

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_private_lib.h -- internal definitions
*
* February 2013, Bo Berry
*
* Copyright (c) 2019 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

`/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_private_lib.h`

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_private_tomcrypt.h
*
* May 2014, Tzu-Min Chou (Jimmy)
*
* Copyright (c) 2014 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

`/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_private_tomcrypt.h`

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_compute_read_time.c --
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

`/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_compute_read_time.c`

No license file was found, but licenses were detected in source scan.



```
/*-----
* tam_library.h --
*
* TAM Library v5.4.2-Release
* Commit Date: Thu Apr 13 09:08:30 2023 -0700
* by huyt2 huyt2@cisco.com
*
* DO NOT EDIT - THIS FILE IS GENERATED
*
* Copyright (c) 2023 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_library.h
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_version.c -- TAM library version string APIs
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_version.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* act2_rsa_crypto.h --
*
* February 2012, Bo Berry
*
* Copyright (c) 2012 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_rsa_crypto.h
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_private_message.c -- library messaging layer
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
*/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_private_message.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
* tam_lib_ecc_crypto.c --
*
* March 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
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*-----
*/
```

Found in path(s):

```
*/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_ecc_crypto.c
```

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```
/*-----
* tam_lib_drand.c -- deterministic random APIs
*
* February 2013, Bo Berry
*
* Copyright (c) 2013 by Cisco Systems, Inc.
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*-----
*/
```

Found in path(s):

```
*/opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_drand.c
```

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```
/*-----
```

\* tam\_lib\_object\_manager.h --

\*

\* February 2013, Bo Berry

\*

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\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_objname\_library/tam\_lib\_object\_manager.h

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/\*-----

\* tam\_lib\_pcr.c -- Digital Attestation APIs

\*

\* March 2020, tam\_dev

\*

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\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_pcr.c

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/\*-----

\* tam\_lib\_private\_message.h -- internal message formatting routines

\*

\* February 2013, Bo Berry

\*

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/\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_message.h

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```
/*-----
* tam_lib_authentication.c
*
* May 2014, Jimmy Chou
*
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*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_authentication.c

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```
/*-----
* tam_lib_cert_verify.c
*
* May 2014, Tzu-Min Chou (Jimmy)
*
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*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_cert\_verify.c

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```
/*-----
* tam_lib_private_tomcrypt.c
*
* January 2016, Chandana Prakash
*
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*-----
*/
```

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_tomcrypt.c

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```
/*-----
* tam_lib_utils.c --
*
* February 2013, Bo Berry
*
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_utils.c
```

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```
/*-----
* tam_lib_espi.c -- Aikido eSPI related APIs
*
* December 2015, Jimmy Chou
*
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_espi.c
```

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```
/*-----
* tam_lib_uefi.h --
*
* July 2017, Burhan Wani
*
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_library/tam_lib_uefi.h
```

No license file was found, but licenses were detected in source scan.

```
/*-----
```

\* tam\_symmetric\_crypto.c -- AES

\*

\* February 2013, Bo Berry

\*

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\*-----

\*/

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\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_symmetric\_crypto.c

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/\*-----

\* tam\_lib\_chip.c -- chip specific APIs

\*

\* February 2012, Bo Berry

\*

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/\*-----

\* tam\_lib\_private\_msg\_util.c -- utility functionality for message encryption.

\*

\* Jun 2014, Srinivas Vundru

\*

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\*-----

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/\*-----

\* tam\_authen\_admin.c -- Admin Authentication, "a"

\*

\* February 2013, Bo Berry

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/\*-----  
\* tam\_lib\_private\_safec.h -- Wrapper for CRT calls  
\*  
\* January 2015, Chandana Prakash  
\*  
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\*-----  
\*/

Found in path(s):

\* /opt/cola/permits/1702297969\_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam\_library-release-5.4.2/tam\_library/tam\_lib\_private\_safec.h

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/\*-----  
\* tam\_lib\_rsa\_crypto.c -- RSA Crypto  
\*  
\* February 2013, Bo Berry  
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/\*-----



\* tam\_lib\_compute\_read\_time.h --

\*

\* February 2013, Bo Berry

\*

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/\*-----

\* tam\_lib\_notice.c --

\*

\* Description

\* This file is generated prior to building

\* from the Git context.

\*

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/\*-----

\* tam\_secure\_objects.c -- Secure Object APIs

\*

\* February 2013, Bo Berry

\*

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\*-----

\*/

Found in path(s):

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```
/*-----
* tam_lib_object_manager.c --
*
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*
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297969_1687534786.897944/0/tam-library-release-5-4-2-tar-gz/tam_library-release-5.4.2/tam_objname_library/tam_lib_object_manager.c
```

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By: angular

Repository: <<https://github.com/angular/angular.git>>

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By: Rebecca Turner

Repository: <git+https://github.com/iarna/iarna-toml.git>

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By: Paul Vorbach

Repository: <git://github.com/pvorb/node-clone.git>

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### collapse-white-space@v1.0.6

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By: Titus Wormer

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### color-convert@v1.9.3

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### color-name@v1.1.3

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By: DY

Repository: <git@github.com:dfcreative/color-name.git>

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### comondir@v1.0.1

License: MIT

By: James Halliday

Repository: <http://github.com/substack/node-comondir.git>

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### concat-map@v0.0.1

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By: James Halliday

Repository: <[git://github.com/substack/node-concat-map.git](https://github.com/substack/node-concat-map)>

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### cosmiconfig@v7.0.1

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By: David Clark

Repository: <git+https://github.com/davidtheclark/cosmiconfig.git>

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By: Andr Cruz

Repository: <git@github.com:moxystudio/node-cross-spawn.git>

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### defaults@v1.0.4

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By: Elijah Insua

Repository: <git://github.com/sindresorhus/node-defaults.git>

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### dir-glob@v3.0.1

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### editorconfig-to-prettier@v1.0.0

License: ISC

By: Joseph Frazier

Repository: <[git+https://github.com/josephfrazier/editorconfig-to-prettier.git](https://github.com/josephfrazier/editorconfig-to-prettier.git)>

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### emoji-regex@v9.2.2

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By: Mathias Bynens

Repository: <<https://github.com/mathiasbynens/emoji-regex.git>>

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By: Stefan Thomas

Repository: <<https://github.com/justmoon/node-extend.git>>

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By: James Halliday

Repository: <git://github.com/epoberezkin/fast-json-stable-stringify.git>

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By: Matteo Collina

Repository: <git+https://github.com/mcollina/fastq.git>

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By: Thorsten Lorenz

Repository: <[git://github.com/thlorenz/find-parent-dir.git](https://github.com/thlorenz/find-parent-dir.git)>

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By: Joshua Holbrook

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License: ISC

By: Isaac Z. Schlueter

Repository: <[git://github.com/isaacs/node-glob.git](https://github.com/isaacs/node-glob)>

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Repository: <git://github.com/tarruda/has.git>

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By: kael

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### is-buffer@v2.0.5

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By: Jordan Harband

Repository: <git+https://github.com/inspect-js/is-core-module.git>

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By: Kenny F.

Repository: <<https://github.com/meriyah/meriyah>>

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Repository: <http://github.com/nacholibre/node-readlines.git>

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Repository: <[git+https://github.com/albell/parse-srcset.git](https://github.com/albell/parse-srcset.git)>

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Repository: <<https://github.com/jbgutierrez/path-parse.git>>

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By: typicode

Repository: <git+https://github.com/typicode/please-upgrade-node.git>

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By: dryoma

Repository: <git+https://github.com/dryoma/postcss-media-query-parser.git>

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Repository: <git://github.com/feross/run-parallel.git>

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By: James Halliday

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Repository: <git://github.com/mikolalysenko/uniq.git>

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By: Tim Oxley

Repository: <git+<https://github.com/timoxley/wewidth.git>>

> wewidth.js: JavaScript Portng of Markus Kuhn's wewidth() Implementation

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## 1.178 ujson 5.7.0

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Portions of code from MODP\_ASCII - Ascii transformations (upper/lower, etc)

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# 1.179 net-tools 1.60

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```

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```
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```

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## 1.180 util-linux 2.26.2

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Initialize empty image

f1c9645dbc14efddc7d8a322685f26eb bsd.img

Create new DOS partition table

57e721e38d1266c2df055067c18f2cf9 bsd.img

---layout-----

Disk <removed>: 10 MiB, 10485760 bytes, 20480 sectors

Units: sectors of 1 \* 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes

Disklabel type: dos

Disk identifier: <removed>

-----

Create 1st primary partition

ada64ace122978d00d1d1c0e5ee45d26 bsd.img

---layout-----

Disk <removed>: 10 MiB, 10485760 bytes, 20480 sectors

Units: sectors of 1 \* 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes

Disklabel type: dos

Disk identifier: <removed>

Device Boot Start End Sectors Size Id Type

<removed>1 2048 4095 2048 1M 83 Linux

-----

Create 2st primary partition

1bebf87248e05d6e4e62b749da65d023 bsd.img

Set 2nd partition type

2d8e8dff51a88a045db233418dd73fbe bsd.img

---layout-----



Disk <removed>: 10 MiB, 10485760 bytes, 20480 sectors  
Units: sectors of 1 \* 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disklabel type: dos  
Disk identifier: <removed>

| Device     | Boot | Start | End   | Sectors | Size | Id | Type    |
|------------|------|-------|-------|---------|------|----|---------|
| <removed>1 |      | 2048  | 4095  | 2048    | 1M   | 83 | Linux   |
| <removed>2 |      | 4096  | 20479 | 16384   | 8M   | a5 | FreeBSD |

-----  
Create default BSD  
2e1cee529cb59c9341afef0443f196a1 bsd.img

---layout-----

Welcome to fdisk <removed>.  
Changes will remain in memory only, until you decide to write them.  
Be careful before using the write command.

Command (m for help): Entering nested BSD disklabel.

Command (m for help): Disk <removed>2: 10 MiB, 10485760 bytes, 20480 sectors  
Geometry: 255 heads, 63 sectors/track, 1 cylinders  
Units: sectors of 1 \* 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disklabel type: bsd  
partitions: 4

| Slice | Start | End   | Sectors | Size | Type   | Fsize | Bsize | Cpg |
|-------|-------|-------|---------|------|--------|-------|-------|-----|
| c     | 4096  | 20479 | 16384   | 8M   | unused | 0     | 0     | 0   |
| d     | 0     | 16064 | 16065   | 7.9M | unused | 0     | 0     | 0   |

Partition table entries are not in disk order.

Command (m for help): Leaving nested disklabel.

Command (m for help):  
-----

b5c121c2091b2ff26b880551feac7112 bsd.img

---layout-----

Welcome to fdisk <removed>.

Changes will remain in memory only, until you decide to write them.  
Be careful before using the write command.

Command (m for help): Entering nested BSD disklabel.

Command (m for help): Disk <removed>2: 10 MiB, 10485760 bytes, 20480 sectors  
Geometry: 255 heads, 63 sectors/track, 1 cylinders  
Units: sectors of 1 \* 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disklabel type: BSD  
partitions: 4

| Slice | Start | End   | Sectors | Size | Type   | Fsize | Bsize | Cpg |
|-------|-------|-------|---------|------|--------|-------|-------|-----|
| a     | 4096  | 6144  | 2049    | 1M   | 4.2BSD | 0     | 0     | 0   |
| c     | 4096  | 20479 | 16384   | 8M   | unused | 0     | 0     | 0   |
| d     | 0     | 16064 | 16065   | 7.9M | unused | 0     | 0     | 0   |

Partition table entries are not in disk order.

Command (m for help): Leaving nested disklabel.

Command (m for help):  
-----

Changes will remain in memory only, until you decide to write them.  
Be careful before using the write command.

Command (m for help): Entering nested BSD disklabel.

Command (m for help):

|   |           |   |                |   |          |    |       |
|---|-----------|---|----------------|---|----------|----|-------|
| 0 | unused    | 5 | 4.1BSD         | 9 | 4.4LFS   | d  | boot  |
| 1 | swap      | 6 | Eighth Edition | a | unknown  | e  | ADOS  |
| 2 | Version 6 | 7 | 4.2BSD         | b | HPFS     | f  | HFS   |
| 3 | Version 7 | 8 | MS-DOS         | c | ISO-9660 | 10 | AdvFS |
| 4 | System V  |   |                |   |          |    |       |

Command (m for help):

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```
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This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.
```

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```
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`Gnomovision' (which makes passes at compilers) written by James Hacker.
```

```
<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
```

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# 1.182 wayland-eglstream-protocols 1.1.4

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## 1.183 e2fsprogs 1.46.5

### 1.183.1 Available under license :

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#

# This is a Makefile stub which handles the creation of BSD shared  
# libraries.

#

# In order to use this stub, the following makefile variables must be defined.

#

# BSDLIB\_VERSION = 1.0

# BSDLIB\_IMAGE = libce

# BSDLIB\_MYDIR = et

# BSDLIB\_INSTALL\_DIR = \$(SHLIBDIR)

#

all:: image

real-subdirs:: Makefile

@echo " MKDIR pic"

@mkdir -p pic

BSD\_LIB = \$(BSDLIB\_IMAGE).so.\$(BSDLIB\_VERSION)

BSDLIB\_PIC\_FLAG = -fpic

image: \$(BSD\_LIB)

\$(BSD\_LIB): \$(OBJS)

(cd pic; ld -Bshareable -o \$(BSD\_LIB) \$(LDFLAGS\_SHLIB) \$(OBJS))

\$(MV) pic/\$(BSD\_LIB) .

\$(RM) -f ../\$(BSD\_LIB)

(cd ..; \$(LN) \$(LINK\_BUILD\_FLAGS) \

`echo \$(my\_dir) | sed -e 's;lib/;;' /\$(BSD\_LIB) \$(BSD\_LIB))

install-shlibs install:: \$(BSD\_LIB)

@echo " INSTALL\_PROGRAM \$(BSDLIB\_INSTALL\_DIR)/\$(BSD\_LIB)"

@\$(INSTALL\_PROGRAM) \$(BSD\_LIB) \

\$(DESTDIR)\$\$(BSDLIB\_INSTALL\_DIR)/\$(BSD\_LIB)

@-\$(LDCONFIG)

install-strip: install

install-shlibs-strip:: install-shlibs

uninstall-shlibs uninstall::

\$(RM) -f \$(DESTDIR)\$\$(BSDLIB\_INSTALL\_DIR)/\$(BSD\_LIB)

clean::

\$(RM) -rf pic

\$(RM) -f \$(BSD\_LIB)

\$(RM) -f ../\$(BSD\_LIB)

This package was added to the e2fsprogs debian source package by  
Theodore Ts'o <tytso@mit.edu> on Sat Mar 15 15:33:37 EST 2003

It is part of the main e2fsprogs distribution, which can be found at:

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Index: `tdbsa/tdb.c`

```
=====
--- tdbsa.orig/tdb.c
+++ tdbsa/tdb.c
@@ -4,11 +4,11 @@ Rev: 23371
Last Changed Date: 2007-06-06 20:14:06 -0400 (Wed, 06 Jun 2007)
*/
/*
- Unix SMB/CIFS implementation.
+ trivial database library - standalone version

- trivial database library - private includes
-
- Copyright (C) Andrew Tridgell 2005
+ Copyright (C) Andrew Tridgell 1999-2005
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Theodore Ts'o  
23-June-2007

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This package was added to the e2fsprogs debian source package by Theodore Ts'o <tytso@mit.edu> on Sat Mar 15 15:33:37 EST 2003

It is part of the main e2fsprogs distribution, which can be found at:

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This package was put together by Yann Dirson <dirson@debian.org>, from sources obtained from a mirror of:  
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```

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```

```
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```

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## 1.190 hwmon-audiobridge 14

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```
/**

* @file stm32f4xx_hal_conf_template.h
* @author MCD Application Team
* @brief HAL configuration template file.
* This file should be copied to the application folder and renamed
* to stm32f4xx_hal_conf.h.

* @attention
*
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*/
```

Found in path(s):

```
* /opt/cola/permits/1702297785_1687537937.5486555/0/hwmon-audiobridge-14-tar-
gz/audiobridge/stm32f4xx_hal_conf.h
```

## 1.191 evmctl 1.2

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# 1.193 util-linux 2.26.2

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## 1.196 python-pillow 9.5.0

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Name: custompalette

Columns: 4

#

0 0 0 Index 3

65 38 30 Index 4

103 62 49 Index 6

79 73 72 Index 7

114 101 97 Index 8

208 127 100 Index 9

151 144 142 Index 10

221 207 199 Index 11

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Name: badpaletteentry  
Columns: 4  
#  
0 0 0 Index 3  
65 38  
103 62 49 Index 6  
79 73 72 Index 7  
114 101 97 Index 8  
208 127 100 Index 9  
151 144 142 Index 10  
221 207 199 Index 11

## 1.197 wpa-supPLICANT 2.10

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<one line to give the program's name and a brief idea of what it does.>
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```

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## 1.199 tensorrt l4t-8.2.1.9

### 1.199.1 Available under license :

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## 1.200 libjpeg 8b

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/\*

\* jidctflt.c

\*

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\*  
\* This file contains a floating-point implementation of the  
\* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine  
\* must also perform dequantization of the input coefficients.  
\*  
\* This implementation should be more accurate than either of the integer  
\* IDCT implementations. However, it may not give the same results on all  
\* machines because of differences in roundoff behavior. Speed will depend  
\* on the hardware's floating point capacity.  
\*  
\* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT  
\* on each row (or vice versa, but it's more convenient to emit a row at  
\* a time). Direct algorithms are also available, but they are much more  
\* complex and seem not to be any faster when reduced to code.  
\*  
\* This implementation is based on Arai, Agui, and Nakajima's algorithm for  
\* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in  
\* Japanese, but the algorithm is described in the Pennebaker & Mitchell  
\* JPEG textbook (see REFERENCES section in file README). The following code  
\* is based directly on figure 4-8 in P&M.  
\* While an 8-point DCT cannot be done in less than 11 multiplies, it is  
\* possible to arrange the computation so that many of the multiplies are  
\* simple scalings of the final outputs. These multiplies can then be  
\* folded into the multiplications or divisions by the JPEG quantization  
\* table entries. The AA&N method leaves only 5 multiplies and 29 adds  
\* to be done in the DCT itself.  
\* The primary disadvantage of this method is that with a fixed-point  
\* implementation, accuracy is lost due to imprecise representation of the  
\* scaled quantization values. However, that problem does not arise if  
\* we use floating point arithmetic.  
\*/

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\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jidctflt.c

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\* jerror.h

\*

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\*

\* This file defines the error and message codes for the JPEG library.

\* Edit this file to add new codes, or to translate the message strings to  
\* some other language.  
\* A set of error-reporting macros are defined too. Some applications using  
\* the JPEG library may wish to include this file to get the error codes  
\* and/or the macros.  
\*/

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\* jdatadst.c

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\*

\* This file contains compression data destination routines for the case of  
\* emitting JPEG data to memory or to a file (or any stdio stream).

\* While these routines are sufficient for most applications,

\* some will want to use a different destination manager.

\* IMPORTANT: we assume that fwrite() will correctly transcribe an array of

\* JOCTETs into 8-bit-wide elements on external storage. If char is wider

\* than 8 bits on your machine, you may need to do some tweaking.

\*/

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\* jaricom.c

\*

\* Developed 1997-2011 by Guido Vollbeding.

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\*

\* This file contains probability estimation tables for common use in

\* arithmetic entropy encoding and decoding routines.

\*

\* This data represents Table D.3 in the JPEG spec (D.2 in the draft),

\* ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81, and Table 24

\* in the JBIG spec, ISO/IEC IS 11544 and CCITT Recommendation ITU-T T.82.

\*/

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\* wrtarga.c

\*

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\*

\* This file contains routines to write output images in Targa format.

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to

\* an ordinary stdio stream.

\*

\* Based on code contributed by Lee Daniel Crocker.

\*/

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\*

\* This file contains output colorspace conversion routines.

\*/

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## IJG JPEG LIBRARY: CODING RULES

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Since numerous people will be contributing code and bug fixes, it's important to establish a common coding style. The goal of using similar coding styles

is much more important than the details of just what that style is.

In general we follow the recommendations of "Recommended C Style and Coding Standards" revision 6.1 (Cannon et al. as modified by Spencer, Keppel and Brader). This document is available in the IJG FTP archive (see `jpeg/doc/cstyle.ms.tbl.Z`, or `cstyle.txt.Z` for those without `nroff/tbl`).

Block comments should be laid out thusly:

```
/*
* Block comments in this style.
*/
```

We indent statements in K&R style, e.g.,

```
if (test) {
 then-part;
} else {
 else-part;
}
```

with two spaces per indentation level. (This indentation convention is handled automatically by GNU Emacs and many other text editors.)

Multi-word names should be written in lower case with underscores, e.g., `multi_word_name` (not `multiWordName`). Preprocessor symbols and enum constants are similar but upper case (`MULTI_WORD_NAME`). Names should be unique within the first fifteen characters. (On some older systems, global names must be unique within six characters. We accommodate this without cluttering the source code by using macros to substitute shorter names.)

We use function prototypes everywhere; we rely on automatic source code transformation to feed prototype-less C compilers. Transformation is done by the simple and portable tool `'ansi2knr.c'` (courtesy of Ghostscript). `ansi2knr` is not very bright, so it imposes a format requirement on function declarations: the function name **MUST BEGIN IN COLUMN 1**. Thus all functions should be written in the following style:

```
LOCAL(int *)
function_name (int a, char *b)
{
 code...
}
```

Note that each function definition must begin with `GLOBAL(type)`, `LOCAL(type)`, or `METHODDEF(type)`. These macros expand to "static type" or just "type" as appropriate. They provide a readable indication of the routine's usage and can readily be changed for special needs. (For instance, special linkage keywords can be inserted for use in Windows DLLs.)



```
ansi2knr does not transform method declarations (function pointers in
structs). We handle these with a macro JMETHOD, defined as
#ifdef HAVE_PROTOTYPES
#define JMETHOD(type,methodname,arglist) type (*methodname) arglist
#else
#define JMETHOD(type,methodname,arglist) type (*methodname) ()
#endif
```

which is used like this:

```
struct function_pointers {
 JMETHOD(void, init_entropy_encoder, (int somearg, jparms *jp));
 JMETHOD(void, term_entropy_encoder, (void));
};
```

Note the set of parentheses surrounding the parameter list.

A similar solution is used for forward and external function declarations (see the EXTERN and JPP macros).

If the code is to work on non-ANSI compilers, we cannot rely on a prototype declaration to coerce actual parameters into the right types. Therefore, use explicit casts on actual parameters whenever the actual parameter type is not identical to the formal parameter. Beware of implicit conversions to "int".

It seems there are some non-ANSI compilers in which the sizeof() operator is defined to return int, yet size\_t is defined as long. Needless to say, this is brain-damaged. Always use the SIZEOF() macro in place of sizeof(), so that the result is guaranteed to be of type size\_t.

The JPEG library is intended to be used within larger programs. Furthermore, we want it to be reentrant so that it can be used by applications that process multiple images concurrently. The following rules support these requirements:

1. Avoid direct use of file I/O, "malloc", error report printouts, etc; pass these through the common routines provided.
2. Minimize global namespace pollution. Functions should be declared static wherever possible. (Note that our method-based calling conventions help this a lot: in many modules only the initialization function will ever need to be called directly, so only that function need be externally visible.) All global function names should begin with "jpeg\_", and should have an abbreviated name (unique in the first six characters) substituted by macro when NEED\_SHORT\_EXTERNAL\_NAMES is set.
3. Don't use global variables; anything that must be used in another module should be in the common data structures.
4. Don't use static variables except for read-only constant tables. Variables that should be private to a module can be placed into private structures (see

the system architecture document, structure.txt).

5. Source file names should begin with "j" for files that are part of the library proper; source files that are not part of the library, such as cjpeg.c and djpeg.c, do not begin with "j". Keep source file names to eight characters (plus ".c" or ".h", etc) to make life easy for MS-DOSers. Keep compression and decompression code in separate source files --- some applications may want only one half of the library.

Note: these rules (particularly #4) are not followed religiously in the modules that are used in cjpeg/djpeg but are not part of the JPEG library proper. Those modules are not really intended to be used in other applications.

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/\*

\* jmemmac.c

\*

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\*

\* jmemmac.c provides an Apple Macintosh implementation of the system-

\* dependent portion of the JPEG memory manager.

\*

\* If you use jmemmac.c, then you must define USE\_MAC\_MEMMGR in the

\* JPEG\_INTERNALS part of jconfig.h.

\*

\* jmemmac.c uses the Macintosh toolbox routines NewPtr and DisposePtr

\* instead of malloc and free. It accurately determines the amount of

\* memory available by using CompactMem. Notice that if left to its

\* own devices, this code can chew up all available space in the

\* application's zone, with the exception of the rather small "slop"

\* factor computed in jpeg\_mem\_available(). The application can ensure

\* that more space is left over by reducing max\_memory\_to\_use.

\*

\* Large images are swapped to disk using temporary files and System 7.0+'s

\* temporary folder functionality.

\*

\* Note that jmemmac.c depends on two features of MacOS that were first

\* introduced in System 7: FindFolder and the FSSpec-based calls.

\* If your application uses jmemmac.c and is run under System 6 or earlier,

\* and the jpeg library decides it needs a temporary file, it will abort,

\* printing error messages about requiring System 7. (If no temporary files

\* are created, it will run fine.)

```

*
* If you want to use jmemmac.c in an application that might be used with
* System 6 or earlier, then you should remove dependencies on FindFolder
* and the FSSpec calls. You will need to replace FindFolder with some
* other mechanism for finding a place to put temporary files, and you
* should replace the FSSpec calls with their HFS equivalents:
*
* FSpDelete -> HDelete
* FSpGetFInfo -> HGetFInfo
* FSpCreate -> HCreate
* FSpOpenDF -> HOpen *** Note: not HOpenDF ***
* FSMakeFSSpec -> (fill in spec by hand.)
*
* (Use HOpen instead of HOpenDF. HOpen is just a glue-interface to PBHOpen,
* which is on all HFS macs. HOpenDF is a System 7 addition which avoids the
* ages-old problem of names starting with a period.)
*
* Contributed by Sam Bushell (jsam@iagu.on.net) and
* Dan Gildor (gyld@in-touch.com).
*/

```

Found in path(s):

```

* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemmac.c

```

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```

/*
* jarith.c
*
* Developed 1997-2013 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
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*
* This file contains portable arithmetic entropy encoding routines for JPEG
* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).
*
* Both sequential and progressive modes are supported in this single module.
*
* Suspension is not currently supported in this module.
*/

```

Found in path(s):

```

* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jarith.c

```

No license file was found, but licenses were detected in source scan.

```

/*
* ckconfig.c
*
* Copyright (C) 1991-1994, Thomas G. Lane.

```

\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/ckconfig.c

No license file was found, but licenses were detected in source scan.

/\*

\* jcapistd.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains application interface code for the compression half

\* of the JPEG library. These are the "standard" API routines that are

\* used in the normal full-compression case. They are not used by a

\* transcoding-only application. Note that if an application links in

\* jpeg\_start\_compress, it will end up linking in the entire compressor.

\* We thus must separate this file from jcapimin.c to avoid linking the

\* whole compression library into a transcoder.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcapistd.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdct.h

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2002-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This include file contains common declarations for the forward and

\* inverse DCT modules. These declarations are private to the DCT managers

\* (jcdctmgr.c, jddctmgr.c) and the individual DCT algorithms.

\* The individual DCT algorithms are kept in separate files to ease

\* machine-dependent tuning (e.g., assembly coding).

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdct.h

No license file was found, but licenses were detected in source scan.

```
/*
 * jquant2.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2011 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains 2-pass color quantization (color mapping) routines.
 * These routines provide selection of a custom color map for an image,
 * followed by mapping of the image to that color map, with optional
 * Floyd-Steinberg dithering.
 * It is also possible to use just the second pass to map to an arbitrary
 * externally-given color map.
 *
 * Note: ordered dithering is not supported, since there isn't any fast
 * way to compute intercolor distances; it's unclear that ordered dither's
 * fundamental assumptions even hold with an irregularly spaced color map.
 */
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jquant2.c
No license file was found, but licenses were detected in source scan.
```

```
/*
 * jcomapi.c
 *
 * Copyright (C) 1994-1997, Thomas G. Lane.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains application interface routines that are used for both
 * compression and decompression.
 */
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcomapi.c
No license file was found, but licenses were detected in source scan.
```

```
/*
 * cderror.h
 *
 * Copyright (C) 1994-1997, Thomas G. Lane.
 * Modified 2009-2017 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file defines the error and message codes for the cjpeg/djpeg
```

\* applications. These strings are not needed as part of the JPEG library  
\* proper.  
\* Edit this file to add new codes, or to translate the message strings to  
\* some other language.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/cderror.h  
No license file was found, but licenses were detected in source scan.

/\*

\* rdrle.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to read input images in Utah RLE format.

\* The Utah Raster Toolkit library is required (version 3.1 or later).

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume input from

\* an ordinary stdio stream. They further assume that reading begins

\* at the start of the file; start\_input may need work if the

\* user interface has already read some data (e.g., to determine that

\* the file is indeed RLE format).

\*

\* Based on code contributed by Mike Lijewski,

\* with updates from Robert Hutchinson.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdrle.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdtrans.c

\*

\* Copyright (C) 1995-1997, Thomas G. Lane.

\* Modified 2000-2009 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains library routines for transcoding decompression,

\* that is, reading raw DCT coefficient arrays from an input JPEG file.

\* The routines in jdapimin.c will also be needed by a transcoder.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdtrans.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdjpgcom.c

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

\* Modified 2009 by Bill Allombert, Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a very simple stand-alone application that displays

\* the text in COM (comment) markers in a JFIF file.

\* This may be useful as an example of the minimum logic needed to parse

\* JPEG markers.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdjpgcom.c

No license file was found, but licenses were detected in source scan.

/\*

\* jcmarker.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2003-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to write JPEG datastream markers.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcmarker.c

No license file was found, but licenses were detected in source scan.

/\*

\* jfdctint.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modification developed 2003-2015 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a slow-but-accurate integer implementation of the

\* forward DCT (Discrete Cosine Transform).

\*

- \* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
- \* on each column. Direct algorithms are also available, but they are
- \* much more complex and seem not to be any faster when reduced to code.
- \*
- \* This implementation is based on an algorithm described in
- \* C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT
- \* Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,
- \* Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.
- \* The primary algorithm described there uses 11 multiplies and 29 adds.
- \* We use their alternate method with 12 multiplies and 32 adds.
- \* The advantage of this method is that no data path contains more than one
- \* multiplication; this allows a very simple and accurate implementation in
- \* scaled fixed-point arithmetic, with a minimal number of shifts.
- \*
- \* We also provide FDCT routines with various input sample block sizes for
- \* direct resolution reduction or enlargement and for direct resolving the
- \* common 2x1 and 1x2 subsampling cases without additional resampling: NxN
- \* (N=1...16), 2NxN, and Nx2N (N=1...8) pixels for one 8x8 output DCT block.
- \*
- \* For N<8 we fill the remaining block coefficients with zero.
- \* For N>8 we apply a partial N-point FDCT on the input samples, computing
- \* just the lower 8 frequency coefficients and discarding the rest.
- \*
- \* We must scale the output coefficients of the N-point FDCT appropriately
- \* to the standard 8-point FDCT level by 8/N per 1-D pass. This scaling
- \* is folded into the constant multipliers (pass 2) and/or final/initial
- \* shifting.
- \*
- \* CAUTION: We rely on the FIX() macro except for the N=1,2,4,8 cases
- \* since there would be too many additional constants to pre-calculate.
- \*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jfdctint.c

No license file was found, but licenses were detected in source scan.

/\*

\* cjpeg.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2003-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a command-line user interface for the JPEG compressor.

\* It should work on any system with Unix- or MS-DOS-style command lines.

\*

\* Two different command line styles are permitted, depending on the



```
* compile-time switch TWO_FILE_COMMANDLINE:
* cjpeg [options] inputfile outputfile
* cjpeg [options] [inputfile]
* In the second style, output is always to standard output, which you'd
* normally redirect to a file or pipe to some other program. Input is
* either from a named file or from standard input (typically redirected).
* The second style is convenient on Unix but is unhelpful on systems that
* don't support pipes. Also, you MUST use the first style if your system
* doesn't do binary I/O to stdin/stdout.
* To simplify script writing, the "-outfile" switch is provided. The syntax
* cjpeg [options] -outfile outputfile inputfile
* works regardless of which command line style is used.
*/
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/cjpeg.c
No license file was found, but licenses were detected in source scan.
```

```
/*
```

```
* jpegtran.c
```

```
*
```

```
* Copyright (C) 1995-2013, Thomas G. Lane, Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for JPEG transcoding.
* It is very similar to cjpeg.c, and partly to djpeg.c, but provides
* lossless transcoding between different JPEG file formats. It also
* provides some lossless and sort-of-lossless transformations of JPEG data.
*/
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jpegtran.c
No license file was found, but licenses were detected in source scan.
```

```
/*
```

```
* jddctmgr.c
```

```
*
```

```
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2002-2013 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the inverse-DCT management logic.
* This code selects a particular IDCT implementation to be used,
* and it performs related housekeeping chores. No code in this file
* is executed per IDCT step, only during output pass setup.
*
```

\* Note that the IDCT routines are responsible for performing coefficient  
\* dequantization as well as the IDCT proper. This module sets up the  
\* dequantization multiplier table needed by the IDCT routine.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jddctmgr.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jcsample.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains downsampling routines.

\*

\* Downsampling input data is counted in "row groups". A row group

\* is defined to be max\_v\_samp\_factor pixel rows of each component,

\* from which the downsampler produces v\_samp\_factor sample rows.

\* A single row group is processed in each call to the downsampler module.

\*

\* The downsampler is responsible for edge-expansion of its output data

\* to fill an integral number of DCT blocks horizontally. The source buffer

\* may be modified if it is helpful for this purpose (the source buffer is

\* allocated wide enough to correspond to the desired output width).

\* The caller (the prep controller) is responsible for vertical padding.

\*

\* The downsampler may request "context rows" by setting need\_context\_rows

\* during startup. In this case, the input arrays will contain at least

\* one row group's worth of pixels above and below the passed-in data;

\* the caller will create dummy rows at image top and bottom by replicating

\* the first or last real pixel row.

\*

\* An excellent reference for image resampling is

\* Digital Image Warping, George Wolberg, 1990.

\* Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.

\*

\* The downsampling algorithm used here is a simple average of the source

\* pixels covered by the output pixel. The hi-falutin sampling literature

\* refers to this as a "box filter". In general the characteristics of a box

\* filter are not very good, but for the specific cases we normally use (1:1

\* and 2:1 ratios) the box is equivalent to a "triangle filter" which is not

\* nearly so bad. If you intend to use other sampling ratios, you'd be well

\* advised to improve this code.

\*

\* A simple input-smoothing capability is provided. This is mainly intended

- \* for cleaning up color-dithered GIF input files (if you find it inadequate,
- \* we suggest using an external filtering program such as pnmconvol). When
- \* enabled, each input pixel P is replaced by a weighted sum of itself and its
- \* eight neighbors. P's weight is  $1-8*SF$  and each neighbor's weight is SF,
- \* where  $SF = (\text{smoothing\_factor} / 1024)$ .
- \* Currently, smoothing is only supported for 2h2v sampling factors.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcsample.c  
No license file was found, but licenses were detected in source scan.

/\*

\* cdjpeg.h

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains common declarations for the sample applications

\* cjpeg and djpeg. It is NOT used by the core JPEG library.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/cdjpeg.h  
No license file was found, but licenses were detected in source scan.

/\*

\* djpeg.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 2009-2015 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a command-line user interface for the JPEG decompressor.

\* It should work on any system with Unix- or MS-DOS-style command lines.

\*

\* Two different command line styles are permitted, depending on the

\* compile-time switch `TWO_FILE_COMMANDLINE`:

\* `djpeg [options] inputfile outputfile`

\* `djpeg [options] [inputfile]`

\* In the second style, output is always to standard output, which you'd

\* normally redirect to a file or pipe to some other program. Input is

\* either from a named file or from standard input (typically redirected).

\* The second style is convenient on Unix but is unhelpful on systems that

\* don't support pipes. Also, you MUST use the first style if your system

\* doesn't do binary I/O to stdin/stdout.

- \* To simplify script writing, the "-outfile" switch is provided. The syntax
- \* djpeg [options] -outfile outputfile inputfile
- \* works regardless of which command line style is used.

\*/

Found in path(s):

- \* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/djpeg.c

No license file was found, but licenses were detected in source scan.

/\*

- \* jquant1.c

\*

- \* Copyright (C) 1991-1996, Thomas G. Lane.

- \* Modified 2011 by Guido Vollbeding.

- \* This file is part of the Independent JPEG Group's software.

- \* For conditions of distribution and use, see the accompanying README file.

\*

- \* This file contains 1-pass color quantization (color mapping) routines.

- \* These routines provide mapping to a fixed color map using equally spaced

- \* color values. Optional Floyd-Steinberg or ordered dithering is available.

\*/

Found in path(s):

- \* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jquant1.c

No license file was found, but licenses were detected in source scan.

/\*

- \* jmorecfg.h

\*

- \* Copyright (C) 1991-1997, Thomas G. Lane.

- \* Modified 1997-2013 by Guido Vollbeding.

- \* This file is part of the Independent JPEG Group's software.

- \* For conditions of distribution and use, see the accompanying README file.

\*

- \* This file contains additional configuration options that customize the

- \* JPEG software for special applications or support machine-dependent

- \* optimizations. Most users will not need to touch this file.

\*/

Found in path(s):

- \* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmorecfg.h

No license file was found, but licenses were detected in source scan.

/\*

- \* jdinput.c

\*

- \* Copyright (C) 1991-1997, Thomas G. Lane.

- \* Modified 2002-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains input control logic for the JPEG decompressor.  
\* These routines are concerned with controlling the decompressor's input  
\* processing (marker reading and coefficient decoding). The actual input  
\* reading is done in jdmarker.c, jdhuft.c, and jdarith.c.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdinput.c

No license file was found, but licenses were detected in source scan.

/\*

\* jccolor.c

\*/

\* Copyright (C) 1991-1996, Thomas G. Lane.  
\* Modified 2011-2013 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains input colorspace conversion routines.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jccolor.c

No license file was found, but licenses were detected in source scan.

## USING THE IJG JPEG LIBRARY

Copyright (C) 1994-2013, Thomas G. Lane, Guido Vollbeding.  
This file is part of the Independent JPEG Group's software.  
For conditions of distribution and use, see the accompanying README file.

This file describes how to use the IJG JPEG library within an application program. Read it if you want to write a program that uses the library.

The file example.c provides heavily commented skeleton code for calling the JPEG library. Also see jpeglib.h (the include file to be used by application programs) for full details about data structures and function parameter lists. The library source code, of course, is the ultimate reference.

Note that there have been *major* changes from the application interface presented by IJG version 4 and earlier versions. The old design had several inherent limitations, and it had accumulated a lot of cruft as we added features while trying to minimize application-interface changes. We have sacrificed backward compatibility in the version 5 rewrite, but we think the

improvements justify this.

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You should read at least the overview and basic usage sections before trying to program with the library. The sections on advanced features can be read if and when you need them.

## OVERVIEW

=====

### Functions provided by the library

-----

The IJG JPEG library provides C code to read and write JPEG-compressed image files. The surrounding application program receives or supplies image data a scanline at a time, using a straightforward uncompressed image format. All

details of color conversion and other preprocessing/postprocessing can be handled by the library.

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. The application indirectly selects use of this code by specifying the format in which it wishes to supply or receive image data. For example, if colormapped output is requested, then the decompression library automatically invokes color quantization.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

A word about functions *\*not\** provided by the library. We handle a subset of the ISO JPEG standard; most baseline, extended-sequential, and progressive JPEG processes are supported. (Our subset includes all features now in common use.) Unsupported ISO options include:

- \* Hierarchical storage
- \* Lossless JPEG
- \* DNL marker
- \* Nonintegral subsampling ratios

We support 8-bit to 12-bit data precision, but this is a compile-time choice rather than a run-time choice; hence it is difficult to use different precisions in a single application.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, this library is used by the free LIBTIFF library to support JPEG compression in TIFF.)

Outline of typical usage

-----

The rough outline of a JPEG compression operation is:

- Allocate and initialize a JPEG compression object
- Specify the destination for the compressed data (eg, a file)
- Set parameters for compression, including image size & colorspace

```
jpeg_start_compress(...);
while (scan lines remain to be written)
 jpeg_write_scanlines(...);
jpeg_finish_compress(...);
Release the JPEG compression object
```

A JPEG compression object holds parameters and working state for the JPEG library. We make creation/destruction of the object separate from starting or finishing compression of an image; the same object can be re-used for a series of image compression operations. This makes it easy to re-use the same parameter settings for a sequence of images. Re-use of a JPEG object also has important implications for processing abbreviated JPEG datastreams, as discussed later.

The image data to be compressed is supplied to `jpeg_write_scanlines()` from in-memory buffers. If the application is doing file-to-file compression, reading image data from the source file is the application's responsibility. The library emits compressed data by calling a "data destination manager", which typically will write the data into a file; but the application can provide its own destination manager to do something else.

Similarly, the rough outline of a JPEG decompression operation is:

```
Allocate and initialize a JPEG decompression object
Specify the source of the compressed data (eg, a file)
Call jpeg_read_header() to obtain image info
Set parameters for decompression
jpeg_start_decompress(...);
while (scan lines remain to be read)
 jpeg_read_scanlines(...);
jpeg_finish_decompress(...);
Release the JPEG decompression object
```

This is comparable to the compression outline except that reading the datastream header is a separate step. This is helpful because information about the image's size, colorspace, etc is available when the application selects decompression parameters. For example, the application can choose an output scaling ratio that will fit the image into the available screen size.

The decompression library obtains compressed data by calling a data source manager, which typically will read the data from a file; but other behaviors can be obtained with a custom source manager. Decompressed data is delivered into in-memory buffers passed to `jpeg_read_scanlines()`.

It is possible to abort an incomplete compression or decompression operation by calling `jpeg_abort()`; or, if you do not need to retain the JPEG object, simply release it by calling `jpeg_destroy()`.



JPEG compression and decompression objects are two separate struct types. However, they share some common fields, and certain routines such as `jpeg_destroy()` can work on either type of object.

The JPEG library has no static variables: all state is in the compression or decompression object. Therefore it is possible to process multiple compression and decompression operations concurrently, using multiple JPEG objects.

Both compression and decompression can be done in an incremental memory-to-memory fashion, if suitable source/destination managers are used. See the section on "I/O suspension" for more details.

## BASIC LIBRARY USAGE

=====

### Data formats

-----

Before diving into procedural details, it is helpful to understand the image data format that the JPEG library expects or returns.

The standard input image format is a rectangular array of pixels, with each pixel having the same number of "component" or "sample" values (color channels). You must specify how many components there are and the colorspace interpretation of the components. Most applications will use RGB data (three components per pixel) or grayscale data (one component per pixel). PLEASE NOTE THAT RGB DATA IS THREE SAMPLES PER PIXEL, GRAYSCALE ONLY ONE. A remarkable number of people manage to miss this, only to find that their programs don't work with grayscale JPEG files.

There is no provision for colormapped input. JPEG files are always full-color or full grayscale (or sometimes another colorspace such as CMYK). You can feed in a colormapped image by expanding it to full-color format. However JPEG often doesn't work very well with source data that has been colormapped, because of dithering noise. This is discussed in more detail in the JPEG FAQ and the other references mentioned in the README file.

Pixels are stored by scanlines, with each scanline running from left to right. The component values for each pixel are adjacent in the row; for example, R,G,B,R,G,B,R,G,B,... for 24-bit RGB color. Each scanline is an array of data type `JSAMPLE` --- which is typically "unsigned char", unless you've changed `jpegconf.h`. (You can also change the RGB pixel layout, say to B,G,R order, by modifying `jpegconf.h`. But see the restrictions listed in that file before doing so.)

A 2-D array of pixels is formed by making a list of pointers to the starts of

scanlines; so the scanlines need not be physically adjacent in memory. Even if you process just one scanline at a time, you must make a one-element pointer array to conform to this structure. Pointers to JSAMPLE rows are of type JSAMPROW, and the pointer to the pointer array is of type JSAMPARRAY.

The library accepts or supplies one or more complete scanlines per call. It is not possible to process part of a row at a time. Scanlines are always processed top-to-bottom. You can process an entire image in one call if you have it all in memory, but usually it's simplest to process one scanline at a time.

For best results, source data values should have the precision specified by BITS\_IN\_JSAMPLE (normally 8 bits). For instance, if you choose to compress data that's only 6 bits/channel, you should left-justify each value in a byte before passing it to the compressor. If you need to compress data that has more than 8 bits/channel, compile with BITS\_IN\_JSAMPLE = 9 to 12. (See "Library compile-time options", later.)

The data format returned by the decompressor is the same in all details, except that colormapped output is supported. (Again, a JPEG file is never colormapped. But you can ask the decompressor to perform on-the-fly color quantization to deliver colormapped output.) If you request colormapped output then the returned data array contains a single JSAMPLE per pixel; its value is an index into a color map. The color map is represented as a 2-D JSAMPARRAY in which each row holds the values of one color component, that is, colormap[i][j] is the value of the i'th color component for pixel value (map index) j. Note that since the colormap indexes are stored in JSAMPLEs, the maximum number of colors is limited by the size of JSAMPLE (ie, at most 256 colors for an 8-bit JPEG library).

#### Compression details

-----

Here we revisit the JPEG compression outline given in the overview.

##### 1. Allocate and initialize a JPEG compression object.

A JPEG compression object is a "struct jpeg\_compress\_struct". (It also has a bunch of subsidiary structures which are allocated via malloc(), but the application doesn't control those directly.) This struct can be just a local variable in the calling routine, if a single routine is going to execute the whole JPEG compression sequence. Otherwise it can be static or allocated from malloc().

You will also need a structure representing a JPEG error handler. The part of this that the library cares about is a "struct jpeg\_error\_mgr". If you

are providing your own error handler, you'll typically want to embed the `jpeg_error_mgr` struct in a larger structure; this is discussed later under "Error handling". For now we'll assume you are just using the default error handler. The default error handler will print JPEG error/warning messages on `stderr`, and it will call `exit()` if a fatal error occurs.

You must initialize the error handler structure, store a pointer to it into the JPEG object's "err" field, and then call `jpeg_create_compress()` to initialize the rest of the JPEG object.

Typical code for this step, if you are using the default error handler, is

```
struct jpeg_compress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_compress(&cinfo);
```

`jpeg_create_compress` allocates a small amount of memory, so it could fail if you are out of memory. In that case it will exit via the error handler; that's why the error handler must be initialized first.

## 2. Specify the destination for the compressed data (eg, a file).

As previously mentioned, the JPEG library delivers compressed data to a "data destination" module. The library includes one data destination module which knows how to write to a `stdio` stream. You can use your own destination module if you want to do something else, as discussed later.

If you use the standard destination module, you must open the target `stdio` stream beforehand. Typical code for this step looks like:

```
FILE * outfile;
...
if ((outfile = fopen(filename, "wb")) == NULL) {
 fprintf(stderr, "can't open %s\n", filename);
 exit(1);
}
jpeg_stdio_dest(&cinfo, outfile);
```

where the last line invokes the standard destination module.

**WARNING:** it is critical that the binary compressed data be delivered to the output file unchanged. On non-Unix systems the `stdio` library may perform newline translation or otherwise corrupt binary data. To suppress this behavior, you may need to use a "b" option to `fopen` (as shown above), or use `setmode()` or another routine to put the `stdio` stream in binary mode. See

cjpeg.c and djpeg.c for code that has been found to work on many systems.

You can select the data destination after setting other parameters (step 3), if that's more convenient. You may not change the destination between calling jpeg\_start\_compress() and jpeg\_finish\_compress().

3. Set parameters for compression, including image size & colorspace.

You must supply information about the source image by setting the following fields in the JPEG object (cinfo structure):

image\_width Width of image, in pixels  
image\_height Height of image, in pixels  
input\_components Number of color channels (samples per pixel)  
in\_color\_space Color space of source image

The image dimensions are, hopefully, obvious. JPEG supports image dimensions of 1 to 64K pixels in either direction. The input color space is typically RGB or grayscale, and input\_components is 3 or 1 accordingly. (See "Special color spaces", later, for more info.) The in\_color\_space field must be assigned one of the J\_COLOR\_SPACE enum constants, typically JCS\_RGB or JCS\_GRAYSCALE.

JPEG has a large number of compression parameters that determine how the image is encoded. Most applications don't need or want to know about all these parameters. You can set all the parameters to reasonable defaults by calling jpeg\_set\_defaults(); then, if there are particular values you want to change, you can do so after that. The "Compression parameter selection" section tells about all the parameters.

You must set in\_color\_space correctly before calling jpeg\_set\_defaults(), because the defaults depend on the source image colorspace. However the other three source image parameters need not be valid until you call jpeg\_start\_compress(). There's no harm in calling jpeg\_set\_defaults() more than once, if that happens to be convenient.

Typical code for a 24-bit RGB source image is

```
cinfo.image_width = Width; /* image width and height, in pixels */
cinfo.image_height = Height;
cinfo.input_components = 3; /* # of color components per pixel */
cinfo.in_color_space = JCS_RGB; /* colorspace of input image */

jpeg_set_defaults(&cinfo);
/* Make optional parameter settings here */
```

#### 4. jpeg\_start\_compress(...);

After you have established the data destination and set all the necessary source image info and other parameters, call `jpeg_start_compress()` to begin a compression cycle. This will initialize internal state, allocate working storage, and emit the first few bytes of the JPEG datastream header.

Typical code:

```
jpeg_start_compress(&cinfo, TRUE);
```

The "TRUE" parameter ensures that a complete JPEG interchange datastream will be written. This is appropriate in most cases. If you think you might want to use an abbreviated datastream, read the section on abbreviated datastreams, below.

Once you have called `jpeg_start_compress()`, you may not alter any JPEG parameters or other fields of the JPEG object until you have completed the compression cycle.

#### 5. while (scan lines remain to be written)

```
jpeg_write_scanlines(...);
```

Now write all the required image data by calling `jpeg_write_scanlines()` one or more times. You can pass one or more scanlines in each call, up to the total image height. In most applications it is convenient to pass just one or a few scanlines at a time. The expected format for the passed data is discussed under "Data formats", above.

Image data should be written in top-to-bottom scanline order. The JPEG spec contains some weasel wording about how top and bottom are application-defined terms (a curious interpretation of the English language...) but if you want your files to be compatible with everyone else's, you **WILL** use top-to-bottom order. If the source data must be read in bottom-to-top order, you can use the JPEG library's virtual array mechanism to invert the data efficiently. Examples of this can be found in the sample application `cjpeg`.

The library maintains a count of the number of scanlines written so far in the `next_scanline` field of the JPEG object. Usually you can just use this variable as the loop counter, so that the loop test looks like `"while (cinfo.next_scanline < cinfo.image_height)"`.

Code for this step depends heavily on the way that you store the source data. `example.c` shows the following code for the case of a full-size 2-D source array containing 3-byte RGB pixels:

```
JSAMPROW row_pointer[1]; /* pointer to a single row */
```

```

int row_stride; /* physical row width in buffer */

row_stride = image_width * 3; /* JSAMPLEs per row in image_buffer */

while (cinfo.next_scanline < cinfo.image_height) {
 row_pointer[0] = &image_buffer[cinfo.next_scanline * row_stride];
 jpeg_write_scanlines(&cinfo, row_pointer, 1);
}

```

jpeg\_write\_scanlines() returns the number of scanlines actually written. This will normally be equal to the number passed in, so you can usually ignore the return value. It is different in just two cases:

- \* If you try to write more scanlines than the declared image height, the additional scanlines are ignored.
- \* If you use a suspending data destination manager, output buffer overrun will cause the compressor to return before accepting all the passed lines. This feature is discussed under "I/O suspension", below. The normal stdio destination manager will NOT cause this to happen.

In any case, the return value is the same as the change in the value of next\_scanline.

## 6. jpeg\_finish\_compress(...);

After all the image data has been written, call jpeg\_finish\_compress() to complete the compression cycle. This step is ESSENTIAL to ensure that the last bufferload of data is written to the data destination.

jpeg\_finish\_compress() also releases working memory associated with the JPEG object.

Typical code:

```
jpeg_finish_compress(&cinfo);
```

If using the stdio destination manager, don't forget to close the output stdio stream (if necessary) afterwards.

If you have requested a multi-pass operating mode, such as Huffman code optimization, jpeg\_finish\_compress() will perform the additional passes using data buffered by the first pass. In this case jpeg\_finish\_compress() may take quite a while to complete. With the default compression parameters, this will not happen.

It is an error to call jpeg\_finish\_compress() before writing the necessary total number of scanlines. If you wish to abort compression, call jpeg\_abort() as discussed below.

After completing a compression cycle, you may dispose of the JPEG object

as discussed next, or you may use it to compress another image. In that case return to step 2, 3, or 4 as appropriate. If you do not change the destination manager, the new datastream will be written to the same target. If you do not change any JPEG parameters, the new datastream will be written with the same parameters as before. Note that you can change the input image dimensions freely between cycles, but if you change the input colorspace, you should call `jpeg_set_defaults()` to adjust for the new colorspace; and then you'll need to repeat all of step 3.

#### 7. Release the JPEG compression object.

When you are done with a JPEG compression object, destroy it by calling `jpeg_destroy_compress()`. This will free all subsidiary memory (regardless of the previous state of the object). Or you can call `jpeg_destroy()`, which works for either compression or decompression objects --- this may be more convenient if you are sharing code between compression and decompression cases. (Actually, these routines are equivalent except for the declared type of the passed pointer. To avoid gripes from ANSI C compilers, `jpeg_destroy()` should be passed a `j_common_ptr`.)

If you allocated the `jpeg_compress_struct` structure from `malloc()`, freeing it is your responsibility --- `jpeg_destroy()` won't. Ditto for the error handler structure.

Typical code:

```
jpeg_destroy_compress(&cinfo);
```

#### 8. Aborting.

If you decide to abort a compression cycle before finishing, you can clean up in either of two ways:

\* If you don't need the JPEG object any more, just call `jpeg_destroy_compress()` or `jpeg_destroy()` to release memory. This is legitimate at any point after calling `jpeg_create_compress()` --- in fact, it's safe even if `jpeg_create_compress()` fails.

\* If you want to re-use the JPEG object, call `jpeg_abort_compress()`, or call `jpeg_abort()` which works on both compression and decompression objects. This will return the object to an idle state, releasing any working memory. `jpeg_abort()` is allowed at any time after successful object creation.

Note that cleaning up the data destination, if required, is your responsibility; neither of these routines will call `term_destination()`. (See "Compressed data handling", below, for more about that.)

jpeg\_destroy() and jpeg\_abort() are the only safe calls to make on a JPEG object that has reported an error by calling error\_exit (see "Error handling" for more info). The internal state of such an object is likely to be out of whack. Either of these two routines will return the object to a known state.

## Decompression details

-----

Here we revisit the JPEG decompression outline given in the overview.

### 1. Allocate and initialize a JPEG decompression object.

This is just like initialization for compression, as discussed above, except that the object is a "struct jpeg\_decompress\_struct" and you call jpeg\_create\_decompress(). Error handling is exactly the same.

Typical code:

```
struct jpeg_decompress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_decompress(&cinfo);
```

(Both here and in the IJG code, we usually use variable name "cinfo" for both compression and decompression objects.)

### 2. Specify the source of the compressed data (eg, a file).

As previously mentioned, the JPEG library reads compressed data from a "data source" module. The library includes one data source module which knows how to read from a stdio stream. You can use your own source module if you want to do something else, as discussed later.

If you use the standard source module, you must open the source stdio stream beforehand. Typical code for this step looks like:

```
FILE * infile;
...
if ((infile = fopen(filename, "rb")) == NULL) {
 fprintf(stderr, "can't open %s\n", filename);
 exit(1);
}
jpeg_stdio_src(&cinfo, infile);
```



where the last line invokes the standard source module.

WARNING: it is critical that the binary compressed data be read unchanged. On non-Unix systems the stdio library may perform newline translation or otherwise corrupt binary data. To suppress this behavior, you may need to use a "b" option to fopen (as shown above), or use setmode() or another routine to put the stdio stream in binary mode. See cjpeg.c and djpeg.c for code that has been found to work on many systems.

You may not change the data source between calling jpeg\_read\_header() and jpeg\_finish\_decompress(). If you wish to read a series of JPEG images from a single source file, you should repeat the jpeg\_read\_header() to jpeg\_finish\_decompress() sequence without reinitializing either the JPEG object or the data source module; this prevents buffered input data from being discarded.

3. Call jpeg\_read\_header() to obtain image info.

Typical code for this step is just

```
jpeg_read_header(&cinfo, TRUE);
```

This will read the source datastream header markers, up to the beginning of the compressed data proper. On return, the image dimensions and other info have been stored in the JPEG object. The application may wish to consult this information before selecting decompression parameters.

More complex code is necessary if

- \* A suspending data source is used --- in that case jpeg\_read\_header() may return before it has read all the header data. See "I/O suspension", below. The normal stdio source manager will NOT cause this to happen.
- \* Abbreviated JPEG files are to be processed --- see the section on abbreviated datastreams. Standard applications that deal only in interchange JPEG files need not be concerned with this case either.

It is permissible to stop at this point if you just wanted to find out the image dimensions and other header info for a JPEG file. In that case, call jpeg\_destroy() when you are done with the JPEG object, or call jpeg\_abort() to return it to an idle state before selecting a new data source and reading another header.

4. Set parameters for decompression.

jpeg\_read\_header() sets appropriate default decompression parameters based on the properties of the image (in particular, its colorspace). However, you may well want to alter these defaults before beginning the decompression.

For example, the default is to produce full color output from a color file. If you want colormapped output you must ask for it. Other options allow the returned image to be scaled and allow various speed/quality tradeoffs to be selected. "Decompression parameter selection", below, gives details.

If the defaults are appropriate, nothing need be done at this step.

Note that all default values are set by each call to `jpeg_read_header()`. If you reuse a decompression object, you cannot expect your parameter settings to be preserved across cycles, as you can for compression. You must set desired parameter values each time.

5. `jpeg_start_decompress(...)`;

Once the parameter values are satisfactory, call `jpeg_start_decompress()` to begin decompression. This will initialize internal state, allocate working memory, and prepare for returning data.

Typical code is just

```
jpeg_start_decompress(&cinfo);
```

If you have requested a multi-pass operating mode, such as 2-pass color quantization, `jpeg_start_decompress()` will do everything needed before data output can begin. In this case `jpeg_start_decompress()` may take quite a while to complete. With a single-scan (non progressive) JPEG file and default decompression parameters, this will not happen; `jpeg_start_decompress()` will return quickly.

After this call, the final output image dimensions, including any requested scaling, are available in the JPEG object; so is the selected colormap, if colormapped output has been requested. Useful fields include

```
output_width image width and height, as scaled
output_height
out_color_components # of color components in out_color_space
output_components # of color components returned per pixel
colormap the selected colormap, if any
actual_number_of_colors number of entries in colormap
```

`output_components` is 1 (a colormap index) when quantizing colors; otherwise it equals `out_color_components`. It is the number of JSAMPLE values that will be emitted per pixel in the output arrays.

Typically you will need to allocate data buffers to hold the incoming image. You will need `output_width * output_components` JSAMPLEs per scanline in your output buffer, and a total of `output_height` scanlines will be returned.

Note: if you are using the JPEG library's internal memory manager to allocate data buffers (as djpeg does), then the manager's protocol requires that you request large buffers \*before\* calling `jpeg_start_decompress()`. This is a little tricky since the `output_XXX` fields are not normally valid then. You can make them valid by calling `jpeg_calc_output_dimensions()` after setting the relevant parameters (scaling, output color space, and quantization flag).

```
6. while (scan lines remain to be read)
 jpeg_read_scanlines(...);
```

Now you can read the decompressed image data by calling `jpeg_read_scanlines()` one or more times. At each call, you pass in the maximum number of scanlines to be read (ie, the height of your working buffer); `jpeg_read_scanlines()` will return up to that many lines. The return value is the number of lines actually read. The format of the returned data is discussed under "Data formats", above. Don't forget that grayscale and color JPEGs will return different data formats!

Image data is returned in top-to-bottom scanline order. If you must write out the image in bottom-to-top order, you can use the JPEG library's virtual array mechanism to invert the data efficiently. Examples of this can be found in the sample application `djpeg`.

The library maintains a count of the number of scanlines returned so far in the `output_scanline` field of the JPEG object. Usually you can just use this variable as the loop counter, so that the loop test looks like "`while (cinfo.output_scanline < cinfo.output_height)`". (Note that the test should NOT be against `image_height`, unless you never use scaling. The `image_height` field is the height of the original unscaled image.) The return value always equals the change in the value of `output_scanline`.

If you don't use a suspending data source, it is safe to assume that `jpeg_read_scanlines()` reads at least one scanline per call, until the bottom of the image has been reached.

If you use a buffer larger than one scanline, it is NOT safe to assume that `jpeg_read_scanlines()` fills it. (The current implementation returns only a few scanlines per call, no matter how large a buffer you pass.) So you must always provide a loop that calls `jpeg_read_scanlines()` repeatedly until the whole image has been read.

```
7. jpeg_finish_decompress(...);
```

After all the image data has been read, call `jpeg_finish_decompress()` to complete the decompression cycle. This causes working memory associated

with the JPEG object to be released.

Typical code:

```
jpeg_finish_decompress(&cinfo);
```

If using the stdio source manager, don't forget to close the source stdio stream if necessary.

It is an error to call `jpeg_finish_decompress()` before reading the correct total number of scanlines. If you wish to abort decompression, call `jpeg_abort()` as discussed below.

After completing a decompression cycle, you may dispose of the JPEG object as discussed next, or you may use it to decompress another image. In that case return to step 2 or 3 as appropriate. If you do not change the source manager, the next image will be read from the same source.

#### 8. Release the JPEG decompression object.

When you are done with a JPEG decompression object, destroy it by calling `jpeg_destroy_decompress()` or `jpeg_destroy()`. The previous discussion of destroying compression objects applies here too.

Typical code:

```
jpeg_destroy_decompress(&cinfo);
```

#### 9. Aborting.

You can abort a decompression cycle by calling `jpeg_destroy_decompress()` or `jpeg_destroy()` if you don't need the JPEG object any more, or `jpeg_abort_decompress()` or `jpeg_abort()` if you want to reuse the object. The previous discussion of aborting compression cycles applies here too.

Mechanics of usage: include files, linking, etc

-----

Applications using the JPEG library should include the header file `jpeglib.h` to obtain declarations of data types and routines. Before including `jpeglib.h`, include system headers that define at least the typedefs `FILE` and `size_t`. On ANSI-conforming systems, including `<stdio.h>` is sufficient; on older Unix systems, you may need `<sys/types.h>` to define `size_t`.

If the application needs to refer to individual JPEG library error codes, also

include jerror.h to define those symbols.

jpeglib.h indirectly includes the files jconfig.h and jmorecfg.h. If you are installing the JPEG header files in a system directory, you will want to install all four files: jpeglib.h, jerror.h, jconfig.h, jmorecfg.h.

The most convenient way to include the JPEG code into your executable program is to prepare a library file ("libjpeg.a", or a corresponding name on non-Unix machines) and reference it at your link step. If you use only half of the library (only compression or only decompression), only that much code will be included from the library, unless your linker is hopelessly brain-damaged. The supplied makefiles build libjpeg.a automatically (see install.txt).

While you can build the JPEG library as a shared library if the whim strikes you, we don't really recommend it. The trouble with shared libraries is that at some point you'll probably try to substitute a new version of the library without recompiling the calling applications. That generally doesn't work because the parameter struct declarations usually change with each new version. In other words, the library's API is *\*not\** guaranteed binary compatible across versions; we only try to ensure source-code compatibility. (In hindsight, it might have been smarter to hide the parameter structs from applications and introduce a ton of access functions instead. Too late now, however.)

On some systems your application may need to set up a signal handler to ensure that temporary files are deleted if the program is interrupted. This is most critical if you are on MS-DOS and use the jmemdos.c memory manager back end; it will try to grab extended memory for temp files, and that space will NOT be freed automatically. See cjpeg.c or djpeg.c for an example signal handler.

It may be worth pointing out that the core JPEG library does not actually require the stdio library: only the default source/destination managers and error handler need it. You can use the library in a stdio-less environment if you replace those modules and use jmemnobs.c (or another memory manager of your own devising). More info about the minimum system library requirements may be found in jinclude.h.

## ADVANCED FEATURES

=====

### Compression parameter selection

-----

This section describes all the optional parameters you can set for JPEG compression, as well as the "helper" routines provided to assist in this task. Proper setting of some parameters requires detailed understanding of the JPEG standard; if you don't know what a parameter is for, it's best

not to mess with it! See REFERENCES in the README file for pointers to more info about JPEG.

It's a good idea to call `jpeg_set_defaults()` first, even if you plan to set all the parameters; that way your code is more likely to work with future JPEG libraries that have additional parameters. For the same reason, we recommend you use a helper routine where one is provided, in preference to twiddling `cinfo` fields directly.

The helper routines are:

`jpeg_set_defaults (j_compress_ptr cinfo)`

This routine sets all JPEG parameters to reasonable defaults, using only the input image's color space (field `in_color_space`, which must already be set in `cinfo`). Many applications will only need to use this routine and perhaps `jpeg_set_quality()`.

`jpeg_set_colorspace (j_compress_ptr cinfo, J_COLOR_SPACE colorspace)`

Sets the JPEG file's colorspace (field `jpeg_color_space`) as specified, and sets other color-space-dependent parameters appropriately. See "Special color spaces", below, before using this. A large number of parameters, including all per-component parameters, are set by this routine; if you want to twiddle individual parameters you should call `jpeg_set_colorspace()` before rather than after.

`jpeg_default_colorspace (j_compress_ptr cinfo)`

Selects an appropriate JPEG colorspace based on `cinfo->in_color_space`, and calls `jpeg_set_colorspace()`. This is actually a subroutine of `jpeg_set_defaults()`. It's broken out in case you want to change just the colorspace-dependent JPEG parameters.

`jpeg_set_quality (j_compress_ptr cinfo, int quality, boolean force_baseline)`

Constructs JPEG quantization tables appropriate for the indicated quality setting. The quality value is expressed on the 0..100 scale recommended by IJG (cjpeg's "-quality" switch uses this routine). Note that the exact mapping from quality values to tables may change in future IJG releases as more is learned about DCT quantization. If the `force_baseline` parameter is TRUE, then the quantization table entries are constrained to the range 1..255 for full JPEG baseline compatibility. In the current implementation, this only makes a difference for quality settings below 25, and it effectively prevents very small/low quality files from being generated. The IJG decoder is capable of reading the non-baseline files generated at low quality settings when `force_baseline` is FALSE, but other decoders may not be.

`jpeg_set_linear_quality (j_compress_ptr cinfo, int scale_factor, boolean force_baseline)`

Same as `jpeg_set_quality()` except that the generated tables are the

sample tables given in the JPEG spec section K.1, multiplied by the specified scale factor (which is expressed as a percentage; thus `scale_factor = 100` reproduces the spec's tables). Note that larger scale factors give lower quality. This entry point is useful for conforming to the Adobe PostScript DCT conventions, but we do not recommend linear scaling as a user-visible quality scale otherwise. `force_baseline` again constrains the computed table entries to 1..255.

`int jpeg_quality_scaling (int quality)`

Converts a value on the IJG-recommended quality scale to a linear scaling percentage. Note that this routine may change or go away in future releases --- IJG may choose to adopt a scaling method that can't be expressed as a simple scalar multiplier, in which case the premise of this routine collapses. Caveat user.

`jpeg_default_qtables (j_compress_ptr cinfo, boolean force_baseline)`  
Set default quantization tables with linear `q_scale_factor[]` values (see below).

`jpeg_add_quant_table (j_compress_ptr cinfo, int which_tbl,  
const unsigned int *basic_table,  
int scale_factor, boolean force_baseline)`

Allows an arbitrary quantization table to be created. `which_tbl` indicates which table slot to fill. `basic_table` points to an array of 64 unsigned ints given in normal array order. These values are multiplied by `scale_factor/100` and then clamped to the range 1..65535 (or to 1..255 if `force_baseline` is TRUE).

CAUTION: prior to library version 6a, `jpeg_add_quant_table` expected the basic table to be given in JPEG zigzag order. If you need to write code that works with either older or newer versions of this routine, you must check the library version number. Something like `"#if JPEG_LIB_VERSION >= 61"` is the right test.

`jpeg_simple_progression (j_compress_ptr cinfo)`

Generates a default scan script for writing a progressive-JPEG file. This is the recommended method of creating a progressive file, unless you want to make a custom scan sequence. You must ensure that the JPEG color space is set correctly before calling this routine.

Compression parameters (cinfo fields) include:

`boolean arith_code`

If TRUE, use arithmetic coding.

If FALSE, use Huffman coding.

`int block_size`

Set DCT block size. All N from 1 to 16 are possible.

Default is 8 (baseline format).

Larger values produce higher compression,

smaller values produce higher quality.

An exact DCT stage is possible with 1 or 2.

With the default quality of 75 and default Luminance qtable

the DCT+Quantization stage is lossless for value 1.

Note that values other than 8 require a SmartScale capable decoder,

introduced with IJG JPEG 8. Setting the `block_size` parameter for

compression works with version 8c and later.

`J_DCT_METHOD` `dct_method`

Selects the algorithm used for the DCT step. Choices are:

`JDCT_ISLOW`: slow but accurate integer algorithm

`JDCT_IFAST`: faster, less accurate integer method

`JDCT_FLOAT`: floating-point method

`JDCT_DEFAULT`: default method (normally `JDCT_ISLOW`)

`JDCT_FASTEST`: fastest method (normally `JDCT_IFAST`)

The `FLOAT` method is very slightly more accurate than the `ISLOW` method,

but may give different results on different machines due to varying

roundoff behavior. The integer methods should give the same results

on all machines. On machines with sufficiently fast FP hardware, the

floating-point method may also be the fastest. The `IFAST` method is

considerably less accurate than the other two; its use is not

recommended if high quality is a concern. `JDCT_DEFAULT` and

`JDCT_FASTEST` are macros configurable by each installation.

`unsigned int` `scale_num`, `scale_denom`

Scale the image by the fraction `scale_num/scale_denom`. Default is

1/1, or no scaling. Currently, the supported scaling ratios are

`M/N` with all `N` from 1 to 16, where `M` is the destination DCT size,

which is 8 by default (see `block_size` parameter above).

(The library design allows for arbitrary scaling ratios but this

is not likely to be implemented any time soon.)

`J_COLOR_SPACE` `jpeg_color_space`

`int` `num_components`

The JPEG color space and corresponding number of components; see

"Special color spaces", below, for more info. We recommend using

`jpeg_set_colorspace()` if you want to change these.

`J_COLOR_TRANSFORM` `color_transform`

Internal color transform identifier, writes LSE marker if nonzero

(requires decoder with inverse color transform support, introduced

with IJG JPEG 9).

Two values are currently possible: `JCT_NONE` and `JCT_SUBTRACT_GREEN`.

Set this value for lossless RGB application *before* calling

`jpeg_set_colorspace()`, because entropy table assignment in

`jpeg_set_colorspace()` depends on `color_transform`.



boolean optimize\_coding

TRUE causes the compressor to compute optimal Huffman coding tables for the image. This requires an extra pass over the data and therefore costs a good deal of space and time. The default is FALSE, which tells the compressor to use the supplied or default Huffman tables. In most cases optimal tables save only a few percent of file size compared to the default tables. Note that when this is TRUE, you need not supply Huffman tables at all, and any you do supply will be overwritten.

unsigned int restart\_interval

int restart\_in\_rows

To emit restart markers in the JPEG file, set one of these nonzero. Set restart\_interval to specify the exact interval in MCU blocks. Set restart\_in\_rows to specify the interval in MCU rows. (If restart\_in\_rows is not 0, then restart\_interval is set after the image width in MCUs is computed.) Defaults are zero (no restarts). One restart marker per MCU row is often a good choice. NOTE: the overhead of restart markers is higher in grayscale JPEG files than in color files, and MUCH higher in progressive JPEGs. If you use restarts, you may want to use larger intervals in those cases.

const jpeg\_scan\_info \* scan\_info

int num\_scans

By default, scan\_info is NULL; this causes the compressor to write a single-scan sequential JPEG file. If not NULL, scan\_info points to an array of scan definition records of length num\_scans. The compressor will then write a JPEG file having one scan for each scan definition record. This is used to generate noninterleaved or progressive JPEG files. The library checks that the scan array defines a valid JPEG scan sequence. (jpeg\_simple\_progression creates a suitable scan definition array for progressive JPEG.) This is discussed further under "Progressive JPEG support".

boolean do\_fancy\_downsampling

If TRUE, use direct DCT scaling with DCT size > 8 for downsampling of chroma components.

If FALSE, use only DCT size <= 8 and simple separate downsampling. Default is TRUE.

For better image stability in multiple generation compression cycles it is preferable that this value matches the corresponding do\_fancy\_upsampling value in decompression.

int smoothing\_factor

If non-zero, the input image is smoothed; the value should be 1 for minimal smoothing to 100 for maximum smoothing. Consult jcsample.c

for details of the smoothing algorithm. The default is zero.

boolean write\_JFIF\_header

If TRUE, a JFIF APP0 marker is emitted. `jpeg_set_defaults()` and `jpeg_set_colorspace()` set this TRUE if a JFIF-legal JPEG color space (ie, YCbCr or grayscale) is selected, otherwise FALSE.

UINT8 JFIF\_major\_version

UINT8 JFIF\_minor\_version

The version number to be written into the JFIF marker.

`jpeg_set_defaults()` initializes the version to 1.01 (major=minor=1).

You should set it to 1.02 (major=1, minor=2) if you plan to write any JFIF 1.02 extension markers.

UINT8 density\_unit

UINT16 X\_density

UINT16 Y\_density

The resolution information to be written into the JFIF marker;

not used otherwise. `density_unit` may be 0 for unknown,

1 for dots/inch, or 2 for dots/cm. The default values are 0,1,1

indicating square pixels of unknown size.

boolean write\_Adobe\_marker

If TRUE, an Adobe APP14 marker is emitted. `jpeg_set_defaults()` and `jpeg_set_colorspace()` set this TRUE if JPEG color space RGB, CMYK, or YCCK is selected, otherwise FALSE. It is generally a bad idea to set both `write_JFIF_header` and `write_Adobe_marker`. In fact, you probably shouldn't change the default settings at all --- the default behavior ensures that the JPEG file's color space can be recognized by the decoder.

JQUANT\_TBL \* quant\_tbl\_ptrs[NUM\_QUANT\_TBLS]

Pointers to coefficient quantization tables, one per table slot,

or NULL if no table is defined for a slot. Usually these should

be set via one of the above helper routines; `jpeg_add_quant_table()`

is general enough to define any quantization table. The other

routines will set up table slot 0 for luminance quality and table

slot 1 for chrominance.

int q\_scale\_factor[NUM\_QUANT\_TBLS]

Linear quantization scaling factors (percentage, initialized 100)

for use with `jpeg_default_qtables()`.

See `rdswitch.c` and `cjpeg.c` for an example of usage.

Note that the `q_scale_factor[]` fields are the "linear" scales, so you

have to convert from user-defined ratings via `jpeg_quality_scaling()`.

Here is an example code which corresponds to `cjpeg -quality 90,70`:

```
jpeg_set_defaults(cinfo);
```

```

/* Set luminance quality 90. */
cinfo->q_scale_factor[0] = jpeg_quality_scaling(90);
/* Set chrominance quality 70. */
cinfo->q_scale_factor[1] = jpeg_quality_scaling(70);

jpeg_default_qtables(cinfo, force_baseline);

```

CAUTION: You must also set 1x1 subsampling for efficient separate color quality selection, since the default value used by library is 2x2:

```

cinfo->comp_info[0].v_samp_factor = 1;
cinfo->comp_info[0].h_samp_factor = 1;

```

JHUFF\_TBL \* dc\_huff\_tbl\_ptrs[NUM\_HUFF\_TBLS]  
JHUFF\_TBL \* ac\_huff\_tbl\_ptrs[NUM\_HUFF\_TBLS]  
Pointers to Huffman coding tables, one per table slot, or NULL if no table is defined for a slot. Slots 0 and 1 are filled with the JPEG sample tables by jpeg\_set\_defaults(). If you need to allocate more table structures, jpeg\_alloc\_huff\_table() may be used. Note that optimal Huffman tables can be computed for an image by setting optimize\_coding, as discussed above; there's seldom any need to mess with providing your own Huffman tables.

The actual dimensions of the JPEG image that will be written to the file are given by the following fields. These are computed from the input image dimensions and the compression parameters by jpeg\_start\_compress(). You can also call jpeg\_calc\_jpeg\_dimensions() to obtain the values that will result from the current parameter settings. This can be useful if you are trying to pick a scaling ratio that will get close to a desired target size.

JDIMENSION jpeg\_width Actual dimensions of output image.  
JDIMENSION jpeg\_height

Per-component parameters are stored in the struct cinfo.comp\_info[i] for component number i. Note that components here refer to components of the JPEG color space, \*not\* the source image color space. A suitably large comp\_info[] array is allocated by jpeg\_set\_defaults(); if you choose not to use that routine, it's up to you to allocate the array.

int component\_id

The one-byte identifier code to be recorded in the JPEG file for this component. For the standard color spaces, we recommend you leave the default values alone.

int h\_samp\_factor

int v\_samp\_factor

Horizontal and vertical sampling factors for the component; must be 1..4 according to the JPEG standard. Note that larger sampling factors indicate a higher-resolution component; many people find this behavior quite unintuitive. The default values are 2,2 for luminance components and 1,1 for chrominance components, except for grayscale where 1,1 is used.

int quant\_tbl\_no

Quantization table number for component. The default value is 0 for luminance components and 1 for chrominance components.

int dc\_tbl\_no

int ac\_tbl\_no

DC and AC entropy coding table numbers. The default values are 0 for luminance components and 1 for chrominance components.

int component\_index

Must equal the component's index in comp\_info[]. (Beginning in release v6, the compressor library will fill this in automatically; you don't have to.)

#### Decompression parameter selection

-----

Decompression parameter selection is somewhat simpler than compression parameter selection, since all of the JPEG internal parameters are recorded in the source file and need not be supplied by the application. (Unless you are working with abbreviated files, in which case see "Abbreviated datastreams", below.) Decompression parameters control the postprocessing done on the image to deliver it in a format suitable for the application's use. Many of the parameters control speed/quality tradeoffs, in which faster decompression may be obtained at the price of a poorer-quality image. The defaults select the highest quality (slowest) processing.

The following fields in the JPEG object are set by jpeg\_read\_header() and may be useful to the application in choosing decompression parameters:

JDIMENSION image\_width Width and height of image

JDIMENSION image\_height

int num\_components Number of color components

J\_COLOR\_SPACE jpeg\_color\_space Colorspace of image

boolean saw\_JFIF\_marker TRUE if a JFIF APP0 marker was seen

UINT8 JFIF\_major\_version Version information from JFIF marker

UINT8 JFIF\_minor\_version

UINT8 density\_unit Resolution data from JFIF marker  
UINT16 X\_density  
UINT16 Y\_density  
boolean saw\_Adobe\_marker TRUE if an Adobe APP14 marker was seen  
UINT8 Adobe\_transform Color transform code from Adobe marker

The JPEG color space, unfortunately, is something of a guess since the JPEG standard proper does not provide a way to record it. In practice most files adhere to the JFIF or Adobe conventions, and the decoder will recognize these correctly. See "Special color spaces", below, for more info.

The decompression parameters that determine the basic properties of the returned image are:

J\_COLOR\_SPACE out\_color\_space  
Output color space. jpeg\_read\_header() sets an appropriate default based on jpeg\_color\_space; typically it will be RGB or grayscale. The application can change this field to request output in a different colorspace. For example, set it to JCS\_GRAYSCALE to get grayscale output from a color file. (This is useful for previewing: grayscale output is faster than full color since the color components need not be processed.) Note that not all possible color space transforms are currently implemented; you may need to extend jdcolor.c if you want an unusual conversion.

unsigned int scale\_num, scale\_denom  
Scale the image by the fraction scale\_num/scale\_denom. Currently, the supported scaling ratios are M/N with all M from 1 to 16, where N is the source DCT size, which is 8 for baseline JPEG. (The library design allows for arbitrary scaling ratios but this is not likely to be implemented any time soon.) The values are initialized by jpeg\_read\_header() with the source DCT size. For baseline JPEG this is 8/8. If you change only the scale\_num value while leaving the other unchanged, then this specifies the DCT scaled size to be applied on the given input. For baseline JPEG this is equivalent to M/8 scaling, since the source DCT size for baseline JPEG is 8. Smaller scaling ratios permit significantly faster decoding since fewer pixels need be processed and a simpler IDCT method can be used.

boolean quantize\_colors  
If set TRUE, colormapped output will be delivered. Default is FALSE, meaning that full-color output will be delivered.

The next three parameters are relevant only if quantize\_colors is TRUE.

int desired\_number\_of\_colors  
Maximum number of colors to use in generating a library-supplied color

map (the actual number of colors is returned in a different field).  
Default 256. Ignored when the application supplies its own color map.

boolean two\_pass\_quantize

If TRUE, an extra pass over the image is made to select a custom color map for the image. This usually looks a lot better than the one-size-fits-all colormap that is used otherwise. Default is TRUE. Ignored when the application supplies its own color map.

J\_DITHER\_MODE dither\_mode

Selects color dithering method. Supported values are:

JDITHER\_NONE no dithering: fast, very low quality

JDITHER\_ORDERED ordered dither: moderate speed and quality

JDITHER\_FS Floyd-Steinberg dither: slow, high quality

Default is JDITHER\_FS. (At present, ordered dither is implemented only in the single-pass, standard-colormap case. If you ask for ordered dither when two\_pass\_quantize is TRUE or when you supply an external color map, you'll get F-S dithering.)

When quantize\_colors is TRUE, the target color map is described by the next two fields. colormap is set to NULL by jpeg\_read\_header(). The application can supply a color map by setting colormap non-NULL and setting actual\_number\_of\_colors to the map size. Otherwise, jpeg\_start\_decompress() selects a suitable color map and sets these two fields itself.

[Implementation restriction: at present, an externally supplied colormap is only accepted for 3-component output color spaces.]

JSAMPARRAY colormap

The color map, represented as a 2-D pixel array of out\_color\_components rows and actual\_number\_of\_colors columns. Ignored if not quantizing.

CAUTION: if the JPEG library creates its own colormap, the storage pointed to by this field is released by jpeg\_finish\_decompress().

Copy the colormap somewhere else first, if you want to save it.

int actual\_number\_of\_colors

The number of colors in the color map.

Additional decompression parameters that the application may set include:

J\_DCT\_METHOD dct\_method

Selects the algorithm used for the DCT step. Choices are the same as described above for compression.

boolean do\_fancy\_upsampling

If TRUE, use direct DCT scaling with DCT size > 8 for upsampling of chroma components.

If FALSE, use only DCT size <= 8 and simple separate upsampling.

Default is TRUE.

For better image stability in multiple generation compression cycles it is preferable that this value matches the corresponding `do_fancy_downsampling` value in compression.

boolean `do_block_smoothing`

If TRUE, interblock smoothing is applied in early stages of decoding progressive JPEG files; if FALSE, not. Default is TRUE. Early progression stages look "fuzzy" with smoothing, "blocky" without. In any case, block smoothing ceases to be applied after the first few AC coefficients are known to full accuracy, so it is relevant only when using buffered-image mode for progressive images.

boolean `enable_1pass_quant`

boolean `enable_external_quant`

boolean `enable_2pass_quant`

These are significant only in buffered-image mode, which is described in its own section below.

The output image dimensions are given by the following fields. These are computed from the source image dimensions and the decompression parameters by `jpeg_start_decompress()`. You can also call `jpeg_calc_output_dimensions()` to obtain the values that will result from the current parameter settings. This can be useful if you are trying to pick a scaling ratio that will get close to a desired target size. It's also important if you are using the JPEG library's memory manager to allocate output buffer space, because you are supposed to request such buffers *\*before\** `jpeg_start_decompress()`.

JDIMENSION `output_width` Actual dimensions of output image.

JDIMENSION `output_height`

int `out_color_components` Number of color components in `out_color_space`.

int `output_components` Number of color components returned.

int `rec_outbuf_height` Recommended height of scanline buffer.

When quantizing colors, `output_components` is 1, indicating a single color map index per pixel. Otherwise it equals `out_color_components`. The output arrays are required to be `output_width * output_components` JSAMPLEs wide.

`rec_outbuf_height` is the recommended minimum height (in scanlines) of the buffer passed to `jpeg_read_scanlines()`. If the buffer is smaller, the library will still work, but time will be wasted due to unnecessary data copying. In high-quality modes, `rec_outbuf_height` is always 1, but some faster, lower-quality modes set it to larger values (typically 2 to 4). If you are going to ask for a high-speed processing mode, you may as well go to the trouble of honoring `rec_outbuf_height` so as to avoid data copying. (An output buffer larger than `rec_outbuf_height` lines is OK, but won't provide any material speed improvement over that height.)

## Special color spaces

-----

The JPEG standard itself is "color blind" and doesn't specify any particular color space. It is customary to convert color data to a luminance/chrominance color space before compressing, since this permits greater compression. The existing JPEG file interchange format standards specify YCbCr or GRAYSCALE data (JFIF version 1), GRAYSCALE, RGB, YCbCr, CMYK, or YCCK (Adobe), or BG\_RGB or BG\_YCC (big gamut color spaces, JFIF version 2). For special applications such as multispectral images, other color spaces can be used, but it must be understood that such files will be unportable.

The JPEG library can handle the most common colorspace conversions (namely RGB  $\Leftrightarrow$  YCbCr and CMYK  $\Leftrightarrow$  YCCK). It can also deal with data of an unknown color space, passing it through without conversion. If you deal extensively with an unusual color space, you can easily extend the library to understand additional color spaces and perform appropriate conversions.

For compression, the source data's color space is specified by field `in_color_space`. This is transformed to the JPEG file's color space given by `jpeg_color_space`. `jpeg_set_defaults()` chooses a reasonable JPEG color space depending on `in_color_space`, but you can override this by calling `jpeg_set_colorspace()`. Of course you must select a supported transformation. `jccolor.c` currently supports the following transformations:

RGB  $\Rightarrow$  YCbCr

RGB  $\Rightarrow$  GRAYSCALE

RGB  $\Rightarrow$  BG\_YCC

YCbCr  $\Rightarrow$  GRAYSCALE

YCbCr  $\Rightarrow$  BG\_YCC

CMYK  $\Rightarrow$  YCCK

plus the null transforms: GRAYSCALE  $\Rightarrow$  GRAYSCALE, RGB  $\Rightarrow$  RGB, BG\_RGB  $\Rightarrow$  BG\_RGB, YCbCr  $\Rightarrow$  YCbCr, BG\_YCC  $\Rightarrow$  BG\_YCC, CMYK  $\Rightarrow$  CMYK, YCCK  $\Rightarrow$  YCCK, and UNKNOWN  $\Rightarrow$  UNKNOWN.

The file interchange format standards (JFIF and Adobe) specify APPn markers that indicate the color space of the JPEG file. It is important to ensure that these are written correctly, or omitted if the JPEG file's color space is not one of the ones supported by the interchange standards.

`jpeg_set_colorspace()` will set the compression parameters to include or omit the APPn markers properly, so long as it is told the truth about the JPEG color space. For example, if you are writing some random 3-component color space without conversion, don't try to fake out the library by setting `in_color_space` and `jpeg_color_space` to `JCS_YCbCr`; use `JCS_UNKNOWN`. You may want to write an APPn marker of your own devising to identify the colorspace --- see "Special markers", below.

When told that the color space is UNKNOWN, the library will default to using



luminance-quality compression parameters for all color components. You may well want to change these parameters. See the source code for `jpeg_set_colorspace()`, in `jcparam.c`, for details.

For decompression, the JPEG file's color space is given in `jpeg_color_space`, and this is transformed to the output color space `out_color_space`. `jpeg_read_header`'s setting of `jpeg_color_space` can be relied on if the file conforms to JFIF or Adobe conventions, but otherwise it is no better than a guess. If you know the JPEG file's color space for certain, you can override `jpeg_read_header`'s guess by setting `jpeg_color_space`. `jpeg_read_header` also selects a default output color space based on (its guess of) `jpeg_color_space`; set `out_color_space` to override this. Again, you must select a supported transformation. `jdcolor.c` currently supports

YCbCr => RGB

YCbCr => GRAYSCALE

BG\_YCC => RGB

BG\_YCC => GRAYSCALE

RGB => GRAYSCALE

GRAYSCALE => RGB

YCK => CMYK

as well as the null transforms. (Since GRAYSCALE=>RGB is provided, an application can force grayscale JPEGs to look like color JPEGs if it only wants to handle one case.)

The two-pass color quantizer, `jquant2.c`, is specialized to handle RGB data (it weights distances appropriately for RGB colors). You'll need to modify the code if you want to use it for non-RGB output color spaces. Note that `jquant2.c` is used to map to an application-supplied colormap as well as for the normal two-pass colormap selection process.

CAUTION: it appears that Adobe Photoshop writes inverted data in CMYK JPEG files: 0 represents 100% ink coverage, rather than 0% ink as you'd expect. This is arguably a bug in Photoshop, but if you need to work with Photoshop CMYK files, you will have to deal with it in your application. We cannot "fix" this in the library by inverting the data during the CMYK<=>YCK transform, because that would break other applications, notably Ghostscript. Photoshop versions prior to 3.0 write EPS files containing JPEG-encoded CMYK data in the same inverted-YCK representation used in bare JPEG files, but the surrounding PostScript code performs an inversion using the PS image operator. I am told that Photoshop 3.0 will write uninverted YCK in EPS/JPEG files, and will omit the PS-level inversion. (But the data polarity used in bare JPEG files will not change in 3.0.) In either case, the JPEG library must not invert the data itself, or else Ghostscript would read these EPS files incorrectly.

Error handling

-----

When the default error handler is used, any error detected inside the JPEG routines will cause a message to be printed on `stderr`, followed by `exit()`. You can supply your own error handling routines to override this behavior and to control the treatment of nonfatal warnings and trace/debug messages. The file `example.c` illustrates the most common case, which is to have the application regain control after an error rather than exiting.

The JPEG library never writes any message directly; it always goes through the error handling routines. Three classes of messages are recognized:

- \* Fatal errors: the library cannot continue.
- \* Warnings: the library can continue, but the data is corrupt, and a damaged output image is likely to result.
- \* Trace/informational messages. These come with a trace level indicating the importance of the message; you can control the verbosity of the program by adjusting the maximum trace level that will be displayed.

You may, if you wish, simply replace the entire JPEG error handling module (`jerror.c`) with your own code. However, you can avoid code duplication by only replacing some of the routines depending on the behavior you need. This is accomplished by calling `jpeg_std_error()` as usual, but then overriding some of the method pointers in the `jpeg_error_mgr` struct, as illustrated by `example.c`.

All of the error handling routines will receive a pointer to the JPEG object (a `j_common_ptr` which points to either a `jpeg_compress_struct` or a `jpeg_decompress_struct`; if you need to tell which, test the `is_decompressor` field). This struct includes a pointer to the error manager struct in its "err" field. Frequently, custom error handler routines will need to access additional data which is not known to the JPEG library or the standard error handler. The most convenient way to do this is to embed either the JPEG object or the `jpeg_error_mgr` struct in a larger structure that contains additional fields; then casting the passed pointer provides access to the additional fields. Again, see `example.c` for one way to do it. (Beginning with IJG version 6b, there is also a void pointer "client\_data" in each JPEG object, which the application can also use to find related data. The library does not touch `client_data` at all.)

The individual methods that you might wish to override are:

`error_exit(j_common_ptr cinfo)`

Receives control for a fatal error. Information sufficient to generate the error message has been stored in `cinfo->err`; call `output_message` to display it. Control must NOT return to the caller; generally this routine will `exit()` or `longjmp()` somewhere.

Typically you would override this routine to get rid of the `exit()` default behavior. Note that if you continue processing, you should clean up the JPEG object with `jpeg_abort()` or `jpeg_destroy()`.

`output_message(j_common_ptr cinfo)`

Actual output of any JPEG message. Override this to send messages somewhere other than `stderr`. Note that this method does not know how to generate a message, only where to send it.

`format_message(j_common_ptr cinfo, char * buffer)`

Constructs a readable error message string based on the error info stored in `cinfo->err`. This method is called by `output_message`. Few applications should need to override this method. One possible reason for doing so is to implement dynamic switching of error message language.

`emit_message(j_common_ptr cinfo, int msg_level)`

Decide whether or not to emit a warning or trace message; if so, calls `output_message`. The main reason for overriding this method would be to abort on warnings. `msg_level` is -1 for warnings, 0 and up for trace messages.

Only `error_exit()` and `emit_message()` are called from the rest of the JPEG library; the other two are internal to the error handler.

The actual message texts are stored in an array of strings which is pointed to by the field `err->jpeg_message_table`. The messages are numbered from 0 to `err->last_jpeg_message`, and it is these code numbers that are used in the JPEG library code. You could replace the message texts (for instance, with messages in French or German) by changing the message table pointer. See `jerror.h` for the default texts. CAUTION: this table will almost certainly change or grow from one library version to the next.

It may be useful for an application to add its own message texts that are handled by the same mechanism. The error handler supports a second "add-on" message table for this purpose. To define an addon table, set the pointer `err->addon_message_table` and the message numbers `err->first_addon_message` and `err->last_addon_message`. If you number the addon messages beginning at 1000 or so, you won't have to worry about conflicts with the library's built-in messages. See the sample applications `cjpeg/djpeg` for an example of using addon messages (the addon messages are defined in `cderror.h`).

Actual invocation of the error handler is done via macros defined in `jerror.h`:

`ERREXITn(...)` for fatal errors

`WARNMSn(...)` for corrupt-data warnings

`TRACEMSn(...)` for trace and informational messages.

These macros store the message code and any additional parameters into the error handler struct, then invoke the `error_exit()` or `emit_message()` method. The variants of each macro are for varying numbers of additional parameters. The additional parameters are inserted into the generated message using standard `printf()` format codes.

See `jerror.h` and `jerror.c` for further details.

#### Compressed data handling (source and destination managers)

-----

The JPEG compression library sends its compressed data to a "destination manager" module. The default destination manager just writes the data to a memory buffer or to a stdio stream, but you can provide your own manager to do something else. Similarly, the decompression library calls a "source manager" to obtain the compressed data; you can provide your own source manager if you want the data to come from somewhere other than a memory buffer or a stdio stream.

In both cases, compressed data is processed a bufferload at a time: the destination or source manager provides a work buffer, and the library invokes the manager only when the buffer is filled or emptied. (You could define a one-character buffer to force the manager to be invoked for each byte, but that would be rather inefficient.) The buffer's size and location are controlled by the manager, not by the library. For example, the memory source manager just makes the buffer pointer and length point to the original data in memory. In this case the buffer-reload procedure will be invoked only if the decompressor ran off the end of the datastream, which would indicate an erroneous datastream.

The work buffer is defined as an array of datatype `JOCTET`, which is generally "char" or "unsigned char". On a machine where char is not exactly 8 bits wide, you must define `JOCTET` as a wider data type and then modify the data source and destination modules to transcribe the work arrays into 8-bit units on external storage.

A data destination manager struct contains a pointer and count defining the next byte to write in the work buffer and the remaining free space:

```
JOCTET * next_output_byte; /* => next byte to write in buffer */
size_t free_in_buffer; /* # of byte spaces remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer is filled. The manager's `empty_output_buffer` method must reset the pointer and count. The manager is expected to remember the buffer's starting address and total size in private fields not visible to the library.

A data destination manager provides three methods:

```
init_destination (j_compress_ptr cinfo)
Initialize destination. This is called by jpeg_start_compress()
before any data is actually written. It must initialize
```

next\_output\_byte and free\_in\_buffer. free\_in\_buffer must be initialized to a positive value.

empty\_output\_buffer (j\_compress\_ptr cinfo)

This is called whenever the buffer has filled (free\_in\_buffer reaches zero). In typical applications, it should write out the \*entire\* buffer (use the saved start address and buffer length; ignore the current state of next\_output\_byte and free\_in\_buffer). Then reset the pointer & count to the start of the buffer, and return TRUE indicating that the buffer has been dumped. free\_in\_buffer must be set to a positive value when TRUE is returned. A FALSE return should only be used when I/O suspension is desired (this operating mode is discussed in the next section).

term\_destination (j\_compress\_ptr cinfo)

Terminate destination --- called by jpeg\_finish\_compress() after all data has been written. In most applications, this must flush any data remaining in the buffer. Use either next\_output\_byte or free\_in\_buffer to determine how much data is in the buffer.

term\_destination() is NOT called by jpeg\_abort() or jpeg\_destroy(). If you want the destination manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a jpeg\_destination\_mgr struct, fill in its method pointers, and insert a pointer to the struct into the "dest" field of the JPEG compression object. This can be done in-line in your setup code if you like, but it's probably cleaner to provide a separate routine similar to the jpeg\_stdio\_dest() or jpeg\_mem\_dest() routines of the supplied destination managers.

Decompression source managers follow a parallel design, but with some additional frammishes. The source manager struct contains a pointer and count defining the next byte to read from the work buffer and the number of bytes remaining:

```
const JOCTET * next_input_byte; /* => next byte to read from buffer */
size_t bytes_in_buffer; /* # of bytes remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer is emptied. The manager's fill\_input\_buffer method must reset the pointer and count. In most applications, the manager must remember the buffer's starting address and total size in private fields not visible to the library.

A data source manager provides five methods:

init\_source (j\_decompress\_ptr cinfo)

Initialize source. This is called by jpeg\_read\_header() before any

data is actually read. Unlike `init_destination()`, it may leave `bytes_in_buffer` set to 0 (in which case a `fill_input_buffer()` call will occur immediately).

`fill_input_buffer (j_decompress_ptr cinfo)`

This is called whenever `bytes_in_buffer` has reached zero and more data is wanted. In typical applications, it should read fresh data into the buffer (ignoring the current state of `next_input_byte` and `bytes_in_buffer`), reset the pointer & count to the start of the buffer, and return `TRUE` indicating that the buffer has been reloaded. It is not necessary to fill the buffer entirely, only to obtain at least one more byte. `bytes_in_buffer` **MUST** be set to a positive value if `TRUE` is returned. A `FALSE` return should only be used when I/O suspension is desired (this mode is discussed in the next section).

`skip_input_data (j_decompress_ptr cinfo, long num_bytes)`

Skip `num_bytes` worth of data. The buffer pointer and count should be advanced over `num_bytes` input bytes, refilling the buffer as needed. This is used to skip over a potentially large amount of uninteresting data (such as an APPn marker). In some applications it may be possible to optimize away the reading of the skipped data, but it's not clear that being smart is worth much trouble; large skips are uncommon. `bytes_in_buffer` may be zero on return. A zero or negative skip count should be treated as a no-op.

`resync_to_restart (j_decompress_ptr cinfo, int desired)`

This routine is called only when the decompressor has failed to find a restart (RSTn) marker where one is expected. Its mission is to find a suitable point for resuming decompression. For most applications, we recommend that you just use the default resync procedure, `jpeg_resync_to_restart()`. However, if you are able to back up in the input data stream, or if you have a-priori knowledge about the likely location of restart markers, you may be able to do better. Read the `read_restart_marker()` and `jpeg_resync_to_restart()` routines in `jdmarker.c` if you think you'd like to implement your own resync procedure.

`term_source (j_decompress_ptr cinfo)`

Terminate source --- called by `jpeg_finish_decompress()` after all data has been read. Often a no-op.

For both `fill_input_buffer()` and `skip_input_data()`, there is no such thing as an EOF return. If the end of the file has been reached, the routine has a choice of exiting via `ERREXIT()` or inserting fake data into the buffer. In most cases, generating a warning message and inserting a fake EOI marker is the best course of action --- this will allow the decompressor to output however much of the image is there. In pathological cases, the decompressor may swallow the EOI and again demand data ... just keep feeding it fake EOIs.

jdatasrc.c illustrates the recommended error recovery behavior.

term\_source() is NOT called by jpeg\_abort() or jpeg\_destroy(). If you want the source manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a jpeg\_source\_mgr struct, fill in its method pointers, and insert a pointer to the struct into the "src" field of the JPEG decompression object. This can be done in-line in your setup code if you like, but it's probably cleaner to provide a separate routine similar to the jpeg\_stdio\_src() or jpeg\_mem\_src() routines of the supplied source managers.

For more information, consult the memory and stdio source and destination managers in jdatasrc.c and jdatadst.c.

#### I/O suspension

-----

Some applications need to use the JPEG library as an incremental memory-to-memory filter: when the compressed data buffer is filled or emptied, they want control to return to the outer loop, rather than expecting that the buffer can be emptied or reloaded within the data source/destination manager subroutine. The library supports this need by providing an "I/O suspension" mode, which we describe in this section.

The I/O suspension mode is not a panacea: nothing is guaranteed about the maximum amount of time spent in any one call to the library, so it will not eliminate response-time problems in single-threaded applications. If you need guaranteed response time, we suggest you "bite the bullet" and implement a real multi-tasking capability.

To use I/O suspension, cooperation is needed between the calling application and the data source or destination manager; you will always need a custom source/destination manager. (Please read the previous section if you haven't already.) The basic idea is that the empty\_output\_buffer() or fill\_input\_buffer() routine is a no-op, merely returning FALSE to indicate that it has done nothing. Upon seeing this, the JPEG library suspends operation and returns to its caller. The surrounding application is responsible for emptying or refilling the work buffer before calling the JPEG library again.

#### Compression suspension:

For compression suspension, use an empty\_output\_buffer() routine that returns FALSE; typically it will not do anything else. This will cause the compressor to return to the caller of jpeg\_write\_scanlines(), with the return value indicating that not all the supplied scanlines have been accepted.

The application must make more room in the output buffer, adjust the output

buffer pointer/count appropriately, and then call `jpeg_write_scanlines()` again, pointing to the first unconsumed scanline.

When forced to suspend, the compressor will backtrack to a convenient stopping point (usually the start of the current MCU); it will regenerate some output data when restarted. Therefore, although `empty_output_buffer()` is only called when the buffer is filled, you should NOT write out the entire buffer after a suspension. Write only the data up to the current position of `next_output_byte/free_in_buffer`. The data beyond that point will be regenerated after resumption.

Because of the backtracking behavior, a good-size output buffer is essential for efficiency; you don't want the compressor to suspend often. (In fact, an overly small buffer could lead to infinite looping, if a single MCU required more data than would fit in the buffer.) We recommend a buffer of at least several Kbytes. You may want to insert explicit code to ensure that you don't call `jpeg_write_scanlines()` unless there is a reasonable amount of space in the output buffer; in other words, flush the buffer before trying to compress more data.

The compressor does not allow suspension while it is trying to write JPEG markers at the beginning and end of the file. This means that:

- \* At the beginning of a compression operation, there must be enough free space in the output buffer to hold the header markers (typically 600 or so bytes). The recommended buffer size is bigger than this anyway, so this is not a problem as long as you start with an empty buffer. However, this restriction might catch you if you insert large special markers, such as a JFIF thumbnail image, without flushing the buffer afterwards.
- \* When you call `jpeg_finish_compress()`, there must be enough space in the output buffer to emit any buffered data and the final EOI marker. In the current implementation, half a dozen bytes should suffice for this, but for safety's sake we recommend ensuring that at least 100 bytes are free before calling `jpeg_finish_compress()`.

A more significant restriction is that `jpeg_finish_compress()` cannot suspend. This means you cannot use suspension with multi-pass operating modes, namely Huffman code optimization and multiple-scan output. Those modes write the whole file during `jpeg_finish_compress()`, which will certainly result in buffer overrun. (Note that this restriction applies only to compression, not decompression. The decompressor supports input suspension in all of its operating modes.)

Decompression suspension:

For decompression suspension, use a `fill_input_buffer()` routine that simply returns FALSE (except perhaps during error recovery, as discussed below). This will cause the decompressor to return to its caller with an indication that suspension has occurred. This can happen at four places:



\* `jpeg_read_header()`: will return `JPEG_SUSPENDED`.  
\* `jpeg_start_decompress()`: will return `FALSE`, rather than its usual `TRUE`.  
\* `jpeg_read_scanlines()`: will return the number of scanlines already completed (possibly 0).  
\* `jpeg_finish_decompress()`: will return `FALSE`, rather than its usual `TRUE`.  
The surrounding application must recognize these cases, load more data into the input buffer, and repeat the call. In the case of `jpeg_read_scanlines()`, increment the passed pointers past any scanlines successfully read.

Just as with compression, the decompressor will typically backtrack to a convenient restart point before suspending. When `fill_input_buffer()` is called, `next_input_byte/bytes_in_buffer` point to the current restart point, which is where the decompressor will backtrack to if `FALSE` is returned. The data beyond that position must NOT be discarded if you suspend; it needs to be re-read upon resumption. In most implementations, you'll need to shift this data down to the start of your work buffer and then load more data after it. Again, this behavior means that a several-Kbyte work buffer is essential for decent performance; furthermore, you should load a reasonable amount of new data before resuming decompression. (If you loaded, say, only one new byte each time around, you could waste a LOT of cycles.)

The `skip_input_data()` source manager routine requires special care in a suspension scenario. This routine is NOT granted the ability to suspend the decompressor; it can decrement `bytes_in_buffer` to zero, but no more. If the requested skip distance exceeds the amount of data currently in the input buffer, then `skip_input_data()` must set `bytes_in_buffer` to zero and record the additional skip distance somewhere else. The decompressor will immediately call `fill_input_buffer()`, which should return `FALSE`, which will cause a suspension return. The surrounding application must then arrange to discard the recorded number of bytes before it resumes loading the input buffer. (Yes, this design is rather baroque, but it avoids complexity in the far more common case where a non-suspending source manager is used.)

If the input data has been exhausted, we recommend that you emit a warning and insert dummy EOI markers just as a non-suspending data source manager would do. This can be handled either in the surrounding application logic or within `fill_input_buffer()`; the latter is probably more efficient. If `fill_input_buffer()` knows that no more data is available, it can set the pointer/count to point to a dummy EOI marker and then return `TRUE` just as though it had read more data in a non-suspending situation.

The decompressor does not attempt to suspend within standard JPEG markers; instead it will backtrack to the start of the marker and reprocess the whole marker next time. Hence the input buffer must be large enough to hold the longest standard marker in the file. Standard JPEG markers should normally not exceed a few hundred bytes each (DHT tables are typically the longest). We recommend at least a 2K buffer for performance reasons, which is much larger than any correct marker is likely to be. For robustness against

damaged marker length counts, you may wish to insert a test in your application for the case that the input buffer is completely full and yet the decoder has suspended without consuming any data --- otherwise, if this situation did occur, it would lead to an endless loop. (The library can't provide this test since it has no idea whether "the buffer is full", or even whether there is a fixed-size input buffer.)

The input buffer would need to be 64K to allow for arbitrary COM or APPn markers, but these are handled specially: they are either saved into allocated memory, or skipped over by calling `skip_input_data()`. In the former case, suspension is handled correctly, and in the latter case, the problem of buffer overrun is placed on `skip_input_data`'s shoulders, as explained above. Note that if you provide your own marker handling routine for large markers, you should consider how to deal with buffer overflow.

Multiple-buffer management:

In some applications it is desirable to store the compressed data in a linked list of buffer areas, so as to avoid data copying. This can be handled by having `empty_output_buffer()` or `fill_input_buffer()` set the pointer and count to reference the next available buffer; `FALSE` is returned only if no more buffers are available. Although seemingly straightforward, there is a pitfall in this approach: the backtrack that occurs when `FALSE` is returned could back up into an earlier buffer. For example, when `fill_input_buffer()` is called, the current pointer & count indicate the backtrack restart point. Since `fill_input_buffer()` will set the pointer and count to refer to a new buffer, the restart position must be saved somewhere else. Suppose a second call to `fill_input_buffer()` occurs in the same library call, and no additional input data is available, so `fill_input_buffer` must return `FALSE`. If the JPEG library has not moved the pointer/count forward in the current buffer, then \*the correct restart point is the saved position in the prior buffer\*. Prior buffers may be discarded only after the library establishes a restart point within a later buffer. Similar remarks apply for output into a chain of buffers.

The library will never attempt to backtrack over a `skip_input_data()` call, so any skipped data can be permanently discarded. You still have to deal with the case of skipping not-yet-received data, however.

It's much simpler to use only a single buffer; when `fill_input_buffer()` is called, move any unconsumed data (beyond the current pointer/count) down to the beginning of this buffer and then load new data into the remaining buffer space. This approach requires a little more data copying but is far easier to get right.

Progressive JPEG support

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Progressive JPEG rearranges the stored data into a series of scans of increasing quality. In situations where a JPEG file is transmitted across a slow communications link, a decoder can generate a low-quality image very quickly from the first scan, then gradually improve the displayed quality as more scans are received. The final image after all scans are complete is identical to that of a regular (sequential) JPEG file of the same quality setting. Progressive JPEG files are often slightly smaller than equivalent sequential JPEG files, but the possibility of incremental display is the main reason for using progressive JPEG.

The IJG encoder library generates progressive JPEG files when given a suitable "scan script" defining how to divide the data into scans. Creation of progressive JPEG files is otherwise transparent to the encoder. Progressive JPEG files can also be read transparently by the decoder library. If the decoding application simply uses the library as defined above, it will receive a final decoded image without any indication that the file was progressive. Of course, this approach does not allow incremental display. To perform incremental display, an application needs to use the decoder library's "buffered-image" mode, in which it receives a decoded image multiple times.

Each displayed scan requires about as much work to decode as a full JPEG image of the same size, so the decoder must be fairly fast in relation to the data transmission rate in order to make incremental display useful. However, it is possible to skip displaying the image and simply add the incoming bits to the decoder's coefficient buffer. This is fast because only Huffman decoding need be done, not IDCT, upsampling, colorspace conversion, etc. The IJG decoder library allows the application to switch dynamically between displaying the image and simply absorbing the incoming bits. A properly coded application can automatically adapt the number of display passes to suit the time available as the image is received. Also, a final higher-quality display cycle can be performed from the buffered data after the end of the file is reached.

Progressive compression:

To create a progressive JPEG file (or a multiple-scan sequential JPEG file), set the scan\_info cinfo field to point to an array of scan descriptors, and perform compression as usual. Instead of constructing your own scan list, you can call the jpeg\_simple\_progression() helper routine to create a recommended progression sequence; this method should be used by all applications that don't want to get involved in the nitty-gritty of progressive scan sequence design. (If you want to provide user control of scan sequences, you may wish to borrow the scan script reading code found in rdswitch.c, so that you can read scan script files just like cjpeg's.) When scan\_info is not NULL, the compression library will store DCT'd data into a buffer array as jpeg\_write\_scanlines() is called, and will emit all

the requested scans during `jpeg_finish_compress()`. This implies that multiple-scan output cannot be created with a suspending data destination manager, since `jpeg_finish_compress()` does not support suspension. We should also note that the compressor currently forces Huffman optimization mode when creating a progressive JPEG file, because the default Huffman tables are unsuitable for progressive files.

#### Progressive decompression:

When buffered-image mode is not used, the decoder library will read all of a multi-scan file during `jpeg_start_decompress()`, so that it can provide a final decoded image. (Here "multi-scan" means either progressive or multi-scan sequential.) This makes multi-scan files transparent to the decoding application. However, existing applications that used suspending input with version 5 of the IJG library will need to be modified to check for a suspension return from `jpeg_start_decompress()`.

To perform incremental display, an application must use the library's buffered-image mode. This is described in the next section.

#### Buffered-image mode

-----

In buffered-image mode, the library stores the partially decoded image in a coefficient buffer, from which it can be read out as many times as desired. This mode is typically used for incremental display of progressive JPEG files, but it can be used with any JPEG file. Each scan of a progressive JPEG file adds more data (more detail) to the buffered image. The application can display in lockstep with the source file (one display pass per input scan), or it can allow input processing to outrun display processing. By making input and display processing run independently, it is possible for the application to adapt progressive display to a wide range of data transmission rates.

The basic control flow for buffered-image decoding is

```
jpeg_create_decompress()
set data source
jpeg_read_header()
set overall decompression parameters
cinfo.buffered_image = TRUE; /* select buffered-image mode */
jpeg_start_decompress()
for (each output pass) {
 adjust output decompression parameters if required
 jpeg_start_output() /* start a new output pass */
 for (all scanlines in image) {
 jpeg_read_scanlines()
```

```

 display_scanlines
 }
 jpeg_finish_output() /* terminate output pass */
}
jpeg_finish_decompress()
jpeg_destroy_decompress()

```

This differs from ordinary unbuffered decoding in that there is an additional level of looping. The application can choose how many output passes to make and how to display each pass.

The simplest approach to displaying progressive images is to do one display pass for each scan appearing in the input file. In this case the outer loop condition is typically

```
while (! jpeg_input_complete(&cinfo))
```

and the start-output call should read

```
jpeg_start_output(&cinfo, cinfo.input_scan_number);
```

The second parameter to `jpeg_start_output()` indicates which scan of the input file is to be displayed; the scans are numbered starting at 1 for this purpose. (You can use a loop counter starting at 1 if you like, but using the library's input scan counter is easier.) The library automatically reads data as necessary to complete each requested scan, and `jpeg_finish_output()` advances to the next scan or end-of-image marker (hence `input_scan_number` will be incremented by the time control arrives back at `jpeg_start_output()`).

With this technique, data is read from the input file only as needed, and input and output processing run in lockstep.

After reading the final scan and reaching the end of the input file, the buffered image remains available; it can be read additional times by repeating the `jpeg_start_output()/jpeg_read_scanlines()/jpeg_finish_output()` sequence. For example, a useful technique is to use fast one-pass color quantization for display passes made while the image is arriving, followed by a final display pass using two-pass quantization for highest quality. This is done by changing the library parameters before the final output pass. Changing parameters between passes is discussed in detail below.

In general the last scan of a progressive file cannot be recognized as such until after it is read, so a post-input display pass is the best approach if you want special processing in the final pass.

When done with the image, be sure to call `jpeg_finish_decompress()` to release the buffered image (or just use `jpeg_destroy_decompress()`).

If input data arrives faster than it can be displayed, the application can cause the library to decode input data in advance of what's needed to produce output. This is done by calling the routine `jpeg_consume_input()`.

The return value is one of the following:

`JPEG_REACHED_SOS`: reached an SOS marker (the start of a new scan)

JPEG\_REACHED\_EOI: reached the EOI marker (end of image)  
JPEG\_ROW\_COMPLETED: completed reading one MCU row of compressed data  
JPEG\_SCAN\_COMPLETED: completed reading last MCU row of current scan  
JPEG\_SUSPENDED: suspended before completing any of the above  
(JPEG\_SUSPENDED can occur only if a suspending data source is used.) This routine can be called at any time after initializing the JPEG object. It reads some additional data and returns when one of the indicated significant events occurs. (If called after the EOI marker is reached, it will immediately return JPEG\_REACHED\_EOI without attempting to read more data.)

The library's output processing will automatically call `jpeg_consume_input()` whenever the output processing overtakes the input; thus, simple lockstep display requires no direct calls to `jpeg_consume_input()`. But by adding calls to `jpeg_consume_input()`, you can absorb data in advance of what is being displayed. This has two benefits:

- \* You can limit buildup of unprocessed data in your input buffer.
- \* You can eliminate extra display passes by paying attention to the state of the library's input processing.

The first of these benefits only requires interspersing calls to `jpeg_consume_input()` with your display operations and any other processing you may be doing. To avoid wasting cycles due to backtracking, it's best to call `jpeg_consume_input()` only after a hundred or so new bytes have arrived. This is discussed further under "I/O suspension", above. (Note: the JPEG library currently is not thread-safe. You must not call `jpeg_consume_input()` from one thread of control if a different library routine is working on the same JPEG object in another thread.)

When input arrives fast enough that more than one new scan is available before you start a new output pass, you may as well skip the output pass corresponding to the completed scan. This occurs for free if you pass `cinfo.input_scan_number` as the target scan number to `jpeg_start_output()`. The `input_scan_number` field is simply the index of the scan currently being consumed by the input processor. You can ensure that this is up-to-date by emptying the input buffer just before calling `jpeg_start_output()`: call `jpeg_consume_input()` repeatedly until it returns `JPEG_SUSPENDED` or `JPEG_REACHED_EOI`.

The target scan number passed to `jpeg_start_output()` is saved in the `cinfo.output_scan_number` field. The library's output processing calls `jpeg_consume_input()` whenever the current input scan number and row within that scan is less than or equal to the current output scan number and row. Thus, input processing can "get ahead" of the output processing but is not allowed to "fall behind". You can achieve several different effects by manipulating this interlock rule. For example, if you pass a target scan number greater than the current input scan number, the output processor will wait until that scan starts to arrive before producing any output. (To avoid an infinite loop, the target scan number is automatically reset to the last

scan number when the end of image is reached. Thus, if you specify a large target scan number, the library will just absorb the entire input file and then perform an output pass. This is effectively the same as what `jpeg_start_decompress()` does when you don't select buffered-image mode.) When you pass a target scan number equal to the current input scan number, the image is displayed no faster than the current input scan arrives. The final possibility is to pass a target scan number less than the current input scan number; this disables the input/output interlock and causes the output processor to simply display whatever it finds in the image buffer, without waiting for input. (However, the library will not accept a target scan number less than one, so you can't avoid waiting for the first scan.)

When data is arriving faster than the output display processing can advance through the image, `jpeg_consume_input()` will store data into the buffered image beyond the point at which the output processing is reading data out again. If the input arrives fast enough, it may "wrap around" the buffer to the point where the input is more than one whole scan ahead of the output. If the output processing simply proceeds through its display pass without paying attention to the input, the effect seen on-screen is that the lower part of the image is one or more scans better in quality than the upper part. Then, when the next output scan is started, you have a choice of what target scan number to use. The recommended choice is to use the current input scan number at that time, which implies that you've skipped the output scans corresponding to the input scans that were completed while you processed the previous output scan. In this way, the decoder automatically adapts its speed to the arriving data, by skipping output scans as necessary to keep up with the arriving data.

When using this strategy, you'll want to be sure that you perform a final output pass after receiving all the data; otherwise your last display may not be full quality across the whole screen. So the right outer loop logic is something like this:

```
do {
 absorb any waiting input by calling jpeg_consume_input()
 final_pass = jpeg_input_complete(&cinfo);
 adjust output decompression parameters if required
 jpeg_start_output(&cinfo, cinfo.input_scan_number);
 ...
 jpeg_finish_output()
} while (! final_pass);
```

rather than quitting as soon as `jpeg_input_complete()` returns TRUE. This arrangement makes it simple to use higher-quality decoding parameters for the final pass. But if you don't want to use special parameters for the final pass, the right loop logic is like this:

```
for (;;) {
 absorb any waiting input by calling jpeg_consume_input()
 jpeg_start_output(&cinfo, cinfo.input_scan_number);
 ...
```

```

jpeg_finish_output()
if (jpeg_input_complete(&cinfo) &&
 cinfo.input_scan_number == cinfo.output_scan_number)
 break;
}

```

In this case you don't need to know in advance whether an output pass is to be the last one, so it's not necessary to have reached EOF before starting the final output pass; rather, what you want to test is whether the output pass was performed in sync with the final input scan. This form of the loop will avoid an extra output pass whenever the decoder is able (or nearly able) to keep up with the incoming data.

When the data transmission speed is high, you might begin a display pass, then find that much or all of the file has arrived before you can complete the pass. (You can detect this by noting the JPEG\_REACHED\_EOI return code from `jpeg_consume_input()`, or equivalently by testing `jpeg_input_complete()`.) In this situation you may wish to abort the current display pass and start a new one using the newly arrived information. To do so, just call `jpeg_finish_output()` and then start a new pass with `jpeg_start_output()`.

A variant strategy is to abort and restart display if more than one complete scan arrives during an output pass; this can be detected by noting JPEG\_REACHED\_SOS returns and/or examining `cinfo.input_scan_number`. This idea should be employed with caution, however, since the display process might never get to the bottom of the image before being aborted, resulting in the lower part of the screen being several passes worse than the upper. In most cases it's probably best to abort an output pass only if the whole file has arrived and you want to begin the final output pass immediately.

When receiving data across a communication link, we recommend always using the current input scan number for the output target scan number; if a higher-quality final pass is to be done, it should be started (aborting any incomplete output pass) as soon as the end of file is received. However, many other strategies are possible. For example, the application can examine the parameters of the current input scan and decide whether to display it or not. If the scan contains only chroma data, one might choose not to use it as the target scan, expecting that the scan will be small and will arrive quickly. To skip to the next scan, call `jpeg_consume_input()` until it returns JPEG\_REACHED\_SOS or JPEG\_REACHED\_EOI. Or just use the next higher number as the target scan for `jpeg_start_output()`; but that method doesn't let you inspect the next scan's parameters before deciding to display it.

In buffered-image mode, `jpeg_start_decompress()` never performs input and thus never suspends. An application that uses input suspension with buffered-image mode must be prepared for suspension returns from these routines:

- \* `jpeg_start_output()` performs input only if you request 2-pass quantization



and the target scan isn't fully read yet. (This is discussed below.)

\* `jpeg_read_scanlines()`, as always, returns the number of scanlines that it was able to produce before suspending.

\* `jpeg_finish_output()` will read any markers following the target scan, up to the end of the file or the SOS marker that begins another scan. (But it reads no input if `jpeg_consume_input()` has already reached the end of the file or a SOS marker beyond the target output scan.)

\* `jpeg_finish_decompress()` will read until the end of file, and thus can suspend if the end hasn't already been reached (as can be tested by calling `jpeg_input_complete()`).

`jpeg_start_output()`, `jpeg_finish_output()`, and `jpeg_finish_decompress()` all return TRUE if they completed their tasks, FALSE if they had to suspend.

In the event of a FALSE return, the application must load more input data and repeat the call. Applications that use non-suspending data sources need not check the return values of these three routines.

It is possible to change decoding parameters between output passes in the buffered-image mode. The decoder library currently supports only very limited changes of parameters. ONLY THE FOLLOWING parameter changes are allowed after `jpeg_start_decompress()` is called:

\* `dct_method` can be changed before each call to `jpeg_start_output()`.

For example, one could use a fast DCT method for early scans, changing to a higher quality method for the final scan.

\* `dither_mode` can be changed before each call to `jpeg_start_output()`; of course this has no impact if not using color quantization. Typically one would use ordered dither for initial passes, then switch to Floyd-Steinberg dither for the final pass. Caution: changing dither mode can cause more memory to be allocated by the library. Although the amount of memory involved is not large (a scanline or so), it may cause the initial `max_memory_to_use` specification to be exceeded, which in the worst case would result in an out-of-memory failure.

\* `do_block_smoothing` can be changed before each call to `jpeg_start_output()`.

This setting is relevant only when decoding a progressive JPEG image.

During the first DC-only scan, block smoothing provides a very "fuzzy" look instead of the very "blocky" look seen without it; which is better seems a matter of personal taste. But block smoothing is nearly always a win during later stages, especially when decoding a successive-approximation image: smoothing helps to hide the slight blockiness that otherwise shows up on smooth gradients until the lowest coefficient bits are sent.

\* Color quantization mode can be changed under the rules described below. You *cannot* change between full-color and quantized output (because that would alter the required I/O buffer sizes), but you can change which quantization method is used.

When generating color-quantized output, changing quantization method is a very useful way of switching between high-speed and high-quality display.

The library allows you to change among its three quantization methods:

1. Single-pass quantization to a fixed color cube.  
Selected by `cinfo.two_pass_quantize = FALSE` and `cinfo.colormap = NULL`.
  2. Single-pass quantization to an application-supplied colormap.  
Selected by setting `cinfo.colormap` to point to the colormap (the value of `two_pass_quantize` is ignored); also set `cinfo.actual_number_of_colors`.
  3. Two-pass quantization to a colormap chosen specifically for the image.  
Selected by `cinfo.two_pass_quantize = TRUE` and `cinfo.colormap = NULL`.  
(This is the default setting selected by `jpeg_read_header`, but it is probably NOT what you want for the first pass of progressive display!)
- These methods offer successively better quality and lesser speed. However, only the first method is available for quantizing in non-RGB color spaces.

IMPORTANT: because the different quantizer methods have very different working-storage requirements, the library requires you to indicate which one(s) you intend to use before you call `jpeg_start_decompress()`. (If we did not require this, the `max_memory_to_use` setting would be a complete fiction.)

You do this by setting one or more of these three `cinfo` fields to TRUE:

```
enable_1pass_quant Fixed color cube colormap
enable_external_quant Externally-supplied colormap
enable_2pass_quant Two-pass custom colormap
```

All three are initialized FALSE by `jpeg_read_header()`. But `jpeg_start_decompress()` automatically sets TRUE the one selected by the current `two_pass_quantize` and `colormap` settings, so you only need to set the enable flags for any other quantization methods you plan to change to later.

After setting the enable flags correctly at `jpeg_start_decompress()` time, you can change to any enabled quantization method by setting `two_pass_quantize` and `colormap` properly just before calling `jpeg_start_output()`. The following special rules apply:

1. You must explicitly set `cinfo.colormap` to NULL when switching to 1-pass or 2-pass mode from a different mode, or when you want the 2-pass quantizer to be re-run to generate a new colormap.
2. To switch to an external colormap, or to change to a different external colormap than was used on the prior pass, you must call `jpeg_new_colormap()` after setting `cinfo.colormap`.

NOTE: if you want to use the same colormap as was used in the prior pass, you should not do either of these things. This will save some nontrivial switchover costs.

(These requirements exist because `cinfo.colormap` will always be non-NULL after completing a prior output pass, since both the 1-pass and 2-pass quantizers set it to point to their output colormaps. Thus you have to do one of these two things to notify the library that something has changed. Yup, it's a bit klugy, but it's necessary to do it this way for backwards compatibility.)

Note that in buffered-image mode, the library generates any requested colormap during `jpeg_start_output()`, not during `jpeg_start_decompress()`.

When using two-pass quantization, `jpeg_start_output()` makes a pass over the buffered image to determine the optimum color map; it therefore may take a significant amount of time, whereas ordinarily it does little work. The progress monitor hook is called during this pass, if defined. It is also important to realize that if the specified target scan number is greater than or equal to the current input scan number, `jpeg_start_output()` will attempt to consume input as it makes this pass. If you use a suspending data source, you need to check for a `FALSE` return from `jpeg_start_output()` under these conditions. The combination of 2-pass quantization and a not-yet-fully-read target scan is the only case in which `jpeg_start_output()` will consume input.

Application authors who support buffered-image mode may be tempted to use it for all JPEG images, even single-scan ones. This will work, but it is inefficient: there is no need to create an image-sized coefficient buffer for single-scan images. Requesting buffered-image mode for such an image wastes memory. Worse, it can cost time on large images, since the buffered data has to be swapped out or written to a temporary file. If you are concerned about maximum performance on baseline JPEG files, you should use buffered-image mode only when the incoming file actually has multiple scans. This can be tested by calling `jpeg_has_multiple_scans()`, which will return a correct result at any time after `jpeg_read_header()` completes.

It is also worth noting that when you use `jpeg_consume_input()` to let input processing get ahead of output processing, the resulting pattern of access to the coefficient buffer is quite nonsequential. It's best to use the memory manager `jmemnobs.c` if you can (ie, if you have enough real or virtual main memory). If not, at least make sure that `max_memory_to_use` is set as high as possible. If the JPEG memory manager has to use a temporary file, you will probably see a lot of disk traffic and poor performance. (This could be improved with additional work on the memory manager, but we haven't gotten around to it yet.)

In some applications it may be convenient to use `jpeg_consume_input()` for all input processing, including reading the initial markers; that is, you may wish to call `jpeg_consume_input()` instead of `jpeg_read_header()` during startup. This works, but note that you must check for `JPEG_REACHED_SOS` and `JPEG_REACHED_EOI` return codes as the equivalent of `jpeg_read_header's` codes. Once the first SOS marker has been reached, you must call `jpeg_start_decompress()` before `jpeg_consume_input()` will consume more input; it'll just keep returning `JPEG_REACHED_SOS` until you do. If you read a tables-only file this way, `jpeg_consume_input()` will return `JPEG_REACHED_EOI` without ever returning `JPEG_REACHED_SOS`; be sure to check for this case. If this happens, the decompressor will not read any more input until you call `jpeg_abort()` to reset it. It is OK to call `jpeg_consume_input()` even when not using buffered-image mode, but in that case it's basically a no-op after the initial markers have been read: it will just return `JPEG_SUSPENDED`.

A JPEG compression or decompression object can be reused to process multiple images. This saves a small amount of time per image by eliminating the "create" and "destroy" operations, but that isn't the real purpose of the feature. Rather, reuse of an object provides support for abbreviated JPEG datastreams. Object reuse can also simplify processing a series of images in a single input or output file. This section explains these features.

A JPEG file normally contains several hundred bytes worth of quantization and Huffman tables. In a situation where many images will be stored or transmitted with identical tables, this may represent an annoying overhead. The JPEG standard therefore permits tables to be omitted. The standard defines three classes of JPEG datastreams:

- \* "Interchange" datastreams contain an image and all tables needed to decode the image. These are the usual kind of JPEG file.
- \* "Abbreviated image" datastreams contain an image, but are missing some or all of the tables needed to decode that image.
- \* "Abbreviated table specification" (henceforth "tables-only") datastreams contain only table specifications.

To decode an abbreviated image, it is necessary to load the missing table(s) into the decoder beforehand. This can be accomplished by reading a separate tables-only file. A variant scheme uses a series of images in which the first image is an interchange (complete) datastream, while subsequent ones are abbreviated and rely on the tables loaded by the first image. It is assumed that once the decoder has read a table, it will remember that table until a new definition for the same table number is encountered.

It is the application designer's responsibility to figure out how to associate the correct tables with an abbreviated image. While abbreviated datastreams can be useful in a closed environment, their use is strongly discouraged in any situation where data exchange with other applications might be needed. Caveat designer.

The JPEG library provides support for reading and writing any combination of tables-only datastreams and abbreviated images. In both compression and decompression objects, a quantization or Huffman table will be retained for the lifetime of the object, unless it is overwritten by a new table definition.

To create abbreviated image datastreams, it is only necessary to tell the compressor not to emit some or all of the tables it is using. Each quantization and Huffman table struct contains a boolean field "sent\_table", which normally is initialized to FALSE. For each table used by the image, the header-writing process emits the table and sets sent\_table = TRUE unless it is already TRUE. (In normal usage, this prevents outputting the same table

definition multiple times, as would otherwise occur because the chroma components typically share tables.) Thus, setting this field to TRUE before calling `jpeg_start_compress()` will prevent the table from being written at all.

If you want to create a "pure" abbreviated image file containing no tables, just call `"jpeg_suppress_tables(&cinfo, TRUE)"` after constructing all the tables. If you want to emit some but not all tables, you'll need to set the individual `sent_table` fields directly.

To create an abbreviated image, you must also call `jpeg_start_compress()` with a second parameter of FALSE, not TRUE. Otherwise `jpeg_start_compress()` will force all the `sent_table` fields to FALSE. (This is a safety feature to prevent abbreviated images from being created accidentally.)

To create a tables-only file, perform the same parameter setup that you normally would, but instead of calling `jpeg_start_compress()` and so on, call `jpeg_write_tables(&cinfo)`. This will write an abbreviated datastream containing only SOI, DQT and/or DHT markers, and EOI. All the quantization and Huffman tables that are currently defined in the compression object will be emitted unless their `sent_tables` flag is already TRUE, and then all the `sent_tables` flags will be set TRUE.

A sure-fire way to create matching tables-only and abbreviated image files is to proceed as follows:

```
create JPEG compression object
set JPEG parameters
set destination to tables-only file
jpeg_write_tables(&cinfo);
set destination to image file
jpeg_start_compress(&cinfo, FALSE);
write data...
jpeg_finish_compress(&cinfo);
```

Since the JPEG parameters are not altered between writing the table file and the abbreviated image file, the same tables are sure to be used. Of course, you can repeat the `jpeg_start_compress() ... jpeg_finish_compress()` sequence many times to produce many abbreviated image files matching the table file.

You cannot suppress output of the computed Huffman tables when Huffman optimization is selected. (If you could, there'd be no way to decode the image...) Generally, you don't want to set `optimize_coding = TRUE` when you are trying to produce abbreviated files.

In some cases you might want to compress an image using tables which are not stored in the application, but are defined in an interchange or tables-only file readable by the application. This can be done by setting up

a JPEG decompression object to read the specification file, then copying the tables into your compression object. See `jpeg_copy_critical_parameters()` for an example of copying quantization tables.

To read abbreviated image files, you simply need to load the proper tables into the decompression object before trying to read the abbreviated image. If the proper tables are stored in the application program, you can just allocate the table structs and fill in their contents directly. For example, to load a fixed quantization table into table slot "n":

```
if (cinfo.quant_tbl_ptrs[n] == NULL)
 cinfo.quant_tbl_ptrs[n] = jpeg_alloc_quant_table((j_common_ptr) &cinfo);
quant_ptr = cinfo.quant_tbl_ptrs[n]; /* quant_ptr is JQUANT_TBL* */
for (i = 0; i < 64; i++) {
 /* Qtable[] is desired quantization table, in natural array order */
 quant_ptr->quantval[i] = Qtable[i];
}
```

Code to load a fixed Huffman table is typically (for AC table "n"):

```
if (cinfo.ac_huff_tbl_ptrs[n] == NULL)
 cinfo.ac_huff_tbl_ptrs[n] = jpeg_alloc_huff_table((j_common_ptr) &cinfo);
huff_ptr = cinfo.ac_huff_tbl_ptrs[n]; /* huff_ptr is JHUFF_TBL* */
for (i = 1; i <= 16; i++) {
 /* counts[i] is number of Huffman codes of length i bits, i=1..16 */
 huff_ptr->bits[i] = counts[i];
}
for (i = 0; i < 256; i++) {
 /* symbols[] is the list of Huffman symbols, in code-length order */
 huff_ptr->huffval[i] = symbols[i];
}
```

(Note that trying to set `cinfo.quant_tbl_ptrs[n]` to point directly at a constant `JQUANT_TBL` object is not safe. If the incoming file happened to contain a quantization table definition, your master table would get overwritten! Instead allocate a working table copy and copy the master table into it, as illustrated above. Ditto for Huffman tables, of course.)

You might want to read the tables from a tables-only file, rather than hard-wiring them into your application. The `jpeg_read_header()` call is sufficient to read a tables-only file. You must pass a second parameter of `FALSE` to indicate that you do not require an image to be present. Thus, the typical scenario is

```
create JPEG decompression object
set source to tables-only file
jpeg_read_header(&cinfo, FALSE);
```

```
set source to abbreviated image file
jpeg_read_header(&cinfo, TRUE);
set decompression parameters
jpeg_start_decompress(&cinfo);
read data...
jpeg_finish_decompress(&cinfo);
```

In some cases, you may want to read a file without knowing whether it contains an image or just tables. In that case, pass `FALSE` and check the return value from `jpeg_read_header()`: it will be `JPEG_HEADER_OK` if an image was found, `JPEG_HEADER_TABLES_ONLY` if only tables were found. (A third return value, `JPEG_SUSPENDED`, is possible when using a suspending data source manager.) Note that `jpeg_read_header()` will not complain if you read an abbreviated image for which you haven't loaded the missing tables; the missing-table check occurs later, in `jpeg_start_decompress()`.

It is possible to read a series of images from a single source file by repeating the `jpeg_read_header() ... jpeg_finish_decompress()` sequence, without releasing/recreating the JPEG object or the data source module. (If you did reinitialize, any partial bufferload left in the data source buffer at the end of one image would be discarded, causing you to lose the start of the next image.) When you use this method, stored tables are automatically carried forward, so some of the images can be abbreviated images that depend on tables from earlier images.

If you intend to write a series of images into a single destination file, you might want to make a specialized data destination module that doesn't flush the output buffer at `term_destination()` time. This would speed things up by some trifling amount. Of course, you'd need to remember to flush the buffer after the last image. You can make the later images be abbreviated ones by passing `FALSE` to `jpeg_start_compress()`.

### Special markers

-----

Some applications may need to insert or extract special data in the JPEG datastream. The JPEG standard provides marker types "COM" (comment) and "APP0" through "APP15" (application) to hold application-specific data. Unfortunately, the use of these markers is not specified by the standard. COM markers are fairly widely used to hold user-supplied text. The JFIF file format spec uses APP0 markers with specified initial strings to hold certain data. Adobe applications use APP14 markers beginning with the string "Adobe" for miscellaneous data. Other APPn markers are rarely seen, but might contain almost anything.

If you wish to store user-supplied text, we recommend you use COM markers

and place readable 7-bit ASCII text in them. Newline conventions are not standardized --- expect to find LF (Unix style), CR/LF (DOS style), or CR (Mac style). A robust COM reader should be able to cope with random binary garbage, including nulls, since some applications generate COM markers containing non-ASCII junk. (But yours should not be one of them.)

For program-supplied data, use an APPn marker, and be sure to begin it with an identifying string so that you can tell whether the marker is actually yours. It's probably best to avoid using APP0 or APP14 for any private markers. (NOTE: the upcoming SPIFF standard will use APP8 markers; we recommend you not use APP8 markers for any private purposes, either.)

Keep in mind that at most 65533 bytes can be put into one marker, but you can have as many markers as you like.

By default, the IJG compression library will write a JFIF APP0 marker if the selected JPEG colorspace is grayscale or YCbCr, or an Adobe APP14 marker if the selected colorspace is RGB, CMYK, or YCCK. You can disable this, but we don't recommend it. The decompression library will recognize JFIF and Adobe markers and will set the JPEG colorspace properly when one is found.

You can write special markers immediately following the datastream header by calling `jpeg_write_marker()` after `jpeg_start_compress()` and before the first call to `jpeg_write_scanlines()`. When you do this, the markers appear after the SOI and the JFIF APP0 and Adobe APP14 markers (if written), but before all else. Specify the marker type parameter as "JPEG\_COM" for COM or "JPEG\_APP0 + n" for APPn. (Actually, `jpeg_write_marker` will let you write any marker type, but we don't recommend writing any other kinds of marker.) For example, to write a user comment string pointed to by `comment_text`:

```
jpeg_write_marker(cinfo, JPEG_COM, comment_text, strlen(comment_text));
```

If it's not convenient to store all the marker data in memory at once, you can instead call `jpeg_write_m_header()` followed by multiple calls to `jpeg_write_m_byte()`. If you do it this way, it's your responsibility to call `jpeg_write_m_byte()` exactly the number of times given in the length parameter to `jpeg_write_m_header()`. (This method lets you empty the output buffer partway through a marker, which might be important when using a suspending data destination module. In any case, if you are using a suspending destination, you should flush its buffer after inserting any special markers. See "I/O suspension".)

Or, if you prefer to synthesize the marker byte sequence yourself, you can just cram it straight into the data destination module.

If you are writing JFIF 1.02 extension markers (thumbnail images), don't forget to set `cinfo.JFIF_minor_version = 2` so that the encoder will write the correct JFIF version number in the JFIF header marker. The library's default



is to write version 1.01, but that's wrong if you insert any 1.02 extension markers. (We could probably get away with just defaulting to 1.02, but there used to be broken decoders that would complain about unknown minor version numbers. To reduce compatibility risks it's safest not to write 1.02 unless you are actually using 1.02 extensions.)

When reading, two methods of handling special markers are available:

1. You can ask the library to save the contents of COM and/or APPn markers into memory, and then examine them at your leisure afterwards.
2. You can supply your own routine to process COM and/or APPn markers on-the-fly as they are read.

The first method is simpler to use, especially if you are using a suspending data source; writing a marker processor that copes with input suspension is not easy (consider what happens if the marker is longer than your available input buffer). However, the second method conserves memory since the marker data need not be kept around after it's been processed.

For either method, you'd normally set up marker handling after creating a decompression object and before calling `jpeg_read_header()`, because the markers of interest will typically be near the head of the file and so will be scanned by `jpeg_read_header`. Once you've established a marker handling method, it will be used for the life of that decompression object (potentially many datastreams), unless you change it. Marker handling is determined separately for COM markers and for each APPn marker code.

To save the contents of special markers in memory, call `jpeg_save_markers(cinfo, marker_code, length_limit)` where `marker_code` is the marker type to save, `JPEG_COM` or `JPEG_APP0+n`. (To arrange to save all the special marker types, you need to call this routine 17 times, for COM and APP0-APP15.) If the incoming marker is longer than `length_limit` data bytes, only `length_limit` bytes will be saved; this parameter allows you to avoid chewing up memory when you only need to see the first few bytes of a potentially large marker. If you want to save all the data, set `length_limit` to `0xFFFF`; that is enough since marker lengths are only 16 bits. As a special case, setting `length_limit` to 0 prevents that marker type from being saved at all. (That is the default behavior, in fact.)

After `jpeg_read_header()` completes, you can examine the special markers by following the `cinfo->marker_list` pointer chain. All the special markers in the file appear in this list, in order of their occurrence in the file (but omitting any markers of types you didn't ask for). Both the original data length and the saved data length are recorded for each list entry; the latter will not exceed `length_limit` for the particular marker type. Note that these lengths exclude the marker length word, whereas the stored representation within the JPEG file includes it. (Hence the maximum data length is really only 65533.)

It is possible that additional special markers appear in the file beyond the SOS marker at which `jpeg_read_header` stops; if so, the marker list will be extended during reading of the rest of the file. This is not expected to be common, however. If you are short on memory you may want to reset the length limit to zero for all marker types after finishing `jpeg_read_header`, to ensure that the `max_memory_to_use` setting cannot be exceeded due to addition of later markers.

The marker list remains stored until you call `jpeg_finish_decompress` or `jpeg_abort`, at which point the memory is freed and the list is set to empty. (`jpeg_destroy` also releases the storage, of course.)

Note that the library is internally interested in APP0 and APP14 markers; if you try to set a small nonzero length limit on these types, the library will silently force the length up to the minimum it wants. (But you can set a zero length limit to prevent them from being saved at all.) Also, in a 16-bit environment, the maximum length limit may be constrained to less than 65533 by `malloc()` limitations. It is therefore best not to assume that the effective length limit is exactly what you set it to be.

If you want to supply your own marker-reading routine, you do it by calling `jpeg_set_marker_processor()`. A marker processor routine must have the signature

```
boolean jpeg_marker_parser_method (j_decompress_ptr cinfo)
```

Although the marker code is not explicitly passed, the routine can find it in `cinfo->unread_marker`. At the time of call, the marker proper has been read from the data source module. The processor routine is responsible for reading the marker length word and the remaining parameter bytes, if any. Return TRUE to indicate success. (FALSE should be returned only if you are using a suspending data source and it tells you to suspend. See the standard marker processors in `jdmarker.c` for appropriate coding methods if you need to use a suspending data source.)

If you override the default APP0 or APP14 processors, it is up to you to recognize JFIF and Adobe markers if you want colorspace recognition to occur properly. We recommend copying and extending the default processors if you want to do that. (A better idea is to save these marker types for later examination by calling `jpeg_save_markers()`; that method doesn't interfere with the library's own processing of these markers.)

`jpeg_set_marker_processor()` and `jpeg_save_markers()` are mutually exclusive --- if you call one it overrides any previous call to the other, for the particular marker type specified.

A simple example of an external COM processor can be found in `djpeg.c`. Also, see `jpegtran.c` for an example of using `jpeg_save_markers`.

## Raw (downsampled) image data

-----

Some applications need to supply already-downsampled image data to the JPEG compressor, or to receive raw downsampled data from the decompressor. The library supports this requirement by allowing the application to write or read raw data, bypassing the normal preprocessing or postprocessing steps. The interface is different from the standard one and is somewhat harder to use. If your interest is merely in bypassing color conversion, we recommend that you use the standard interface and simply set `jpeg_color_space = in_color_space` (or `jpeg_color_space = out_color_space` for decompression). The mechanism described in this section is necessary only to supply or receive downsampled image data, in which not all components have the same dimensions.

To compress raw data, you must supply the data in the colorspace to be used in the JPEG file (please read the earlier section on Special color spaces) and downsampled to the sampling factors specified in the JPEG parameters. You must supply the data in the format used internally by the JPEG library, namely a JSAMPIMAGE array. This is an array of pointers to two-dimensional arrays, each of type JSAMPARRAY. Each 2-D array holds the values for one color component. This structure is necessary since the components are of different sizes. If the image dimensions are not a multiple of the MCU size, you must also pad the data correctly (usually, this is done by replicating the last column and/or row). The data must be padded to a multiple of a DCT block in each component: that is, each downsampled row must contain a multiple of `block_size` valid samples, and there must be a multiple of `block_size` sample rows for each component. (For applications such as conversion of digital TV images, the standard image size is usually a multiple of the DCT block size, so that no padding need actually be done.)

The procedure for compression of raw data is basically the same as normal compression, except that you call `jpeg_write_raw_data()` in place of `jpeg_write_scanlines()`. Before calling `jpeg_start_compress()`, you must do the following:

- \* Set `cinfo->raw_data_in` to TRUE. (It is set FALSE by `jpeg_set_defaults()`.) This notifies the library that you will be supplying raw data. Furthermore, set `cinfo->do_fancy_downsampling` to FALSE if you want to use real downsampled data. (It is set TRUE by `jpeg_set_defaults()`.)
- \* Ensure `jpeg_color_space` is correct --- an explicit `jpeg_set_colorspace()` call is a good idea. Note that since color conversion is bypassed, `in_color_space` is ignored, except that `jpeg_set_defaults()` uses it to choose the default `jpeg_color_space` setting.
- \* Ensure the sampling factors, `cinfo->comp_info[i].h_samp_factor` and `cinfo->comp_info[i].v_samp_factor`, are correct. Since these indicate the

dimensions of the data you are supplying, it's wise to set them explicitly, rather than assuming the library's defaults are what you want.

To pass raw data to the library, call `jpeg_write_raw_data()` in place of `jpeg_write_scanlines()`. The two routines work similarly except that `jpeg_write_raw_data` takes a JSAMPIMAGE data array rather than JSAMPARRAY. The scanlines count passed to and returned from `jpeg_write_raw_data` is measured in terms of the component with the largest `v_samp_factor`.

`jpeg_write_raw_data()` processes one MCU row per call, which is to say `v_samp_factor*block_size` sample rows of each component. The passed `num_lines` value must be at least `max_v_samp_factor*block_size`, and the return value will be exactly that amount (or possibly some multiple of that amount, in future library versions). This is true even on the last call at the bottom of the image; don't forget to pad your data as necessary.

The required dimensions of the supplied data can be computed for each component as

`cinfo->comp_info[i].width_in_blocks*block_size` samples per row

`cinfo->comp_info[i].height_in_blocks*block_size` rows in image

after `jpeg_start_compress()` has initialized those fields. If the valid data is smaller than this, it must be padded appropriately. For some sampling factors and image sizes, additional dummy DCT blocks are inserted to make the image a multiple of the MCU dimensions. The library creates such dummy blocks itself; it does not read them from your supplied data. Therefore you need never pad by more than `block_size` samples. An example may help here.

Assume 2h2v downsampling of YCbCr data, that is

`cinfo->comp_info[0].h_samp_factor = 2` for Y

`cinfo->comp_info[0].v_samp_factor = 2`

`cinfo->comp_info[1].h_samp_factor = 1` for Cb

`cinfo->comp_info[1].v_samp_factor = 1`

`cinfo->comp_info[2].h_samp_factor = 1` for Cr

`cinfo->comp_info[2].v_samp_factor = 1`

and suppose that the nominal image dimensions (`cinfo->image_width` and `cinfo->image_height`) are 101x101 pixels. Then `jpeg_start_compress()` will compute `downsampled_width = 101` and `width_in_blocks = 13` for Y, `downsampled_width = 51` and `width_in_blocks = 7` for Cb and Cr (and the same for the height fields). You must pad the Y data to at least  $13*8 = 104$  columns and rows, the Cb/Cr data to at least  $7*8 = 56$  columns and rows. The MCU height is `max_v_samp_factor = 2` DCT rows so you must pass at least 16 scanlines on each call to `jpeg_write_raw_data()`, which is to say 16 actual sample rows of Y and 8 each of Cb and Cr. A total of 7 MCU rows are needed, so you must pass a total of  $7*16 = 112$  "scanlines". The last DCT block row of Y data is dummy, so it doesn't matter what you pass for it in the data arrays, but the scanlines count must total up to 112 so that all of the Cb and Cr data gets passed.

Output suspension is supported with raw-data compression: if the data

destination module suspends, `jpeg_write_raw_data()` will return 0.  
In this case the same data rows must be passed again on the next call.

Decompression with raw data output implies bypassing all postprocessing. You must deal with the color space and sampling factors present in the incoming file. If your application only handles, say, 2h1v YCbCr data, you must check for and fail on other color spaces or other sampling factors. The library will not convert to a different color space for you.

To obtain raw data output, set `cinfo->raw_data_out = TRUE` before `jpeg_start_decompress()` (it is set `FALSE` by `jpeg_read_header()`). Be sure to verify that the color space and sampling factors are ones you can handle. Furthermore, set `cinfo->do_fancy_upsampling = FALSE` if you want to get real downsampled data (it is set `TRUE` by `jpeg_read_header()`). Then call `jpeg_read_raw_data()` in place of `jpeg_read_scanlines()`. The decompression process is otherwise the same as usual.

`jpeg_read_raw_data()` returns one MCU row per call, and thus you must pass a buffer of at least `max_v_samp_factor*block_size` scanlines (scanline counting is the same as for raw-data compression). The buffer you pass must be large enough to hold the actual data plus padding to DCT-block boundaries. As with compression, any entirely dummy DCT blocks are not processed so you need not allocate space for them, but the total scanline count includes them. The above example of computing buffer dimensions for raw-data compression is equally valid for decompression.

Input suspension is supported with raw-data decompression: if the data source module suspends, `jpeg_read_raw_data()` will return 0. You can also use buffered-image mode to read raw data in multiple passes.

Really raw data: DCT coefficients

-----

It is possible to read or write the contents of a JPEG file as raw DCT coefficients. This facility is mainly intended for use in lossless transcoding between different JPEG file formats. Other possible applications include lossless cropping of a JPEG image, lossless reassembly of a multi-strip or multi-tile TIFF/JPEG file into a single JPEG datastream, etc.

To read the contents of a JPEG file as DCT coefficients, open the file and do `jpeg_read_header()` as usual. But instead of calling `jpeg_start_decompress()` and `jpeg_read_scanlines()`, call `jpeg_read_coefficients()`. This will read the entire image into a set of virtual coefficient-block arrays, one array per component. The return value is a pointer to an array of virtual-array descriptors. Each virtual array can be accessed directly using the JPEG memory manager's `access_virt_barray` method (see Memory management, below,

and also read structure.txt's discussion of virtual array handling). Or, for simple transcoding to a different JPEG file format, the array list can just be handed directly to `jpeg_write_coefficients()`.

Each block in the block arrays contains quantized coefficient values in normal array order (not JPEG zigzag order). The block arrays contain only DCT blocks containing real data; any entirely-dummy blocks added to fill out interleaved MCUs at the right or bottom edges of the image are discarded during reading and are not stored in the block arrays. (The size of each block array can be determined from the `width_in_blocks` and `height_in_blocks` fields of the component's `comp_info` entry.) This is also the data format expected by `jpeg_write_coefficients()`.

When you are done using the virtual arrays, call `jpeg_finish_decompress()` to release the array storage and return the decompression object to an idle state; or just call `jpeg_destroy()` if you don't need to reuse the object.

If you use a suspending data source, `jpeg_read_coefficients()` will return NULL if it is forced to suspend; a non-NULL return value indicates successful completion. You need not test for a NULL return value when using a non-suspending data source.

It is also possible to call `jpeg_read_coefficients()` to obtain access to the decoder's coefficient arrays during a normal decode cycle in buffered-image mode. This frammish might be useful for progressively displaying an incoming image and then re-encoding it without loss. To do this, decode in buffered-image mode as discussed previously, then call `jpeg_read_coefficients()` after the last `jpeg_finish_output()` call. The arrays will be available for your use until you call `jpeg_finish_decompress()`.

To write the contents of a JPEG file as DCT coefficients, you must provide the DCT coefficients stored in virtual block arrays. You can either pass block arrays read from an input JPEG file by `jpeg_read_coefficients()`, or allocate virtual arrays from the JPEG compression object and fill them yourself. In either case, `jpeg_write_coefficients()` is substituted for `jpeg_start_compress()` and `jpeg_write_scanlines()`. Thus the sequence is

- \* Create compression object
- \* Set all compression parameters as necessary
- \* Request virtual arrays if needed
- \* `jpeg_write_coefficients()`
- \* `jpeg_finish_compress()`
- \* Destroy or re-use compression object

`jpeg_write_coefficients()` is passed a pointer to an array of virtual block array descriptors; the number of arrays is equal to `cinfo.num_components`.

The virtual arrays need only have been requested, not realized, before `jpeg_write_coefficients()` is called. A side-effect of

`jpeg_write_coefficients()` is to realize any virtual arrays that have been requested from the compression object's memory manager. Thus, when obtaining the virtual arrays from the compression object, you should fill the arrays after calling `jpeg_write_coefficients()`. The data is actually written out when you call `jpeg_finish_compress()`; `jpeg_write_coefficients()` only writes the file header.

When writing raw DCT coefficients, it is crucial that the JPEG quantization tables and sampling factors match the way the data was encoded, or the resulting file will be invalid. For transcoding from an existing JPEG file, we recommend using `jpeg_copy_critical_parameters()`. This routine initializes all the compression parameters to default values (like `jpeg_set_defaults()`), then copies the critical information from a source decompression object. The decompression object should have just been used to read the entire JPEG input file --- that is, it should be awaiting `jpeg_finish_decompress()`.

`jpeg_write_coefficients()` marks all tables stored in the compression object as needing to be written to the output file (thus, it acts like `jpeg_start_compress(cinfo, TRUE)`). This is for safety's sake, to avoid emitting abbreviated JPEG files by accident. If you really want to emit an abbreviated JPEG file, call `jpeg_suppress_tables()`, or set the tables' individual `sent_table` flags, between calling `jpeg_write_coefficients()` and `jpeg_finish_compress()`.

#### Progress monitoring

-----

Some applications may need to regain control from the JPEG library every so often. The typical use of this feature is to produce a percent-done bar or other progress display. (For a simple example, see `cjpeg.c` or `djpeg.c`.) Although you do get control back frequently during the data-transferring pass (the `jpeg_read_scanlines` or `jpeg_write_scanlines` loop), any additional passes will occur inside `jpeg_finish_compress` or `jpeg_start_decompress`; those routines may take a long time to execute, and you don't get control back until they are done.

You can define a progress-monitor routine which will be called periodically by the library. No guarantees are made about how often this call will occur, so we don't recommend you use it for mouse tracking or anything like that. At present, a call will occur once per MCU row, scanline, or sample row group, whichever unit is convenient for the current processing mode; so the wider the image, the longer the time between calls. During the data transferring pass, only one call occurs per call of `jpeg_read_scanlines` or `jpeg_write_scanlines`, so don't pass a large number of scanlines at once if you want fine resolution in the progress count. (If you really need to use the callback mechanism for time-critical tasks like mouse tracking, you could insert additional calls inside some of the library's inner loops.)

To establish a progress-monitor callback, create a struct `jpeg_progress_mgr`, fill in its `progress_monitor` field with a pointer to your callback routine, and set `cinfo->progress` to point to the struct. The callback will be called whenever `cinfo->progress` is non-NULL. (This pointer is set to NULL by `jpeg_create_compress` or `jpeg_create_decompress`; the library will not change it thereafter. So if you allocate dynamic storage for the progress struct, make sure it will live as long as the JPEG object does. Allocating from the JPEG memory manager with lifetime `JPOOL_PERMANENT` will work nicely.) You can use the same callback routine for both compression and decompression.

The `jpeg_progress_mgr` struct contains four fields which are set by the library:

```
long pass_counter; /* work units completed in this pass */
long pass_limit; /* total number of work units in this pass */
int completed_passes; /* passes completed so far */
int total_passes; /* total number of passes expected */
```

During any one pass, `pass_counter` increases from 0 up to (not including) `pass_limit`; the step size is usually but not necessarily 1. The `pass_limit` value may change from one pass to another. The expected total number of passes is in `total_passes`, and the number of passes already completed is in `completed_passes`. Thus the fraction of work completed may be estimated as

```

total_passes
```

ignoring the fact that the passes may not be equal amounts of work.

When decompressing, `pass_limit` can even change within a pass, because it depends on the number of scans in the JPEG file, which isn't always known in advance. The computed fraction-of-work-done may jump suddenly (if the library discovers it has overestimated the number of scans) or even decrease (in the opposite case). It is not wise to put great faith in the work estimate.

When using the decompressor's buffered-image mode, the progress monitor work estimate is likely to be completely unhelpful, because the library has no way to know how many output passes will be demanded of it. Currently, the library sets `total_passes` based on the assumption that there will be one more output pass if the input file end hasn't yet been read (`jpeg_input_complete()` isn't TRUE), but no more output passes if the file end has been reached when the output pass is started. This means that `total_passes` will rise as additional output passes are requested. If you have a way of determining the input file size, estimating progress based on the fraction of the file that's been read will probably be more useful than using the library's value.

## Memory management

```

```

This section covers some key facts about the JPEG library's built-in memory



manager. For more info, please read structure.txt's section about the memory manager, and consult the source code if necessary.

All memory and temporary file allocation within the library is done via the memory manager. If necessary, you can replace the "back end" of the memory manager to control allocation yourself (for example, if you don't want the library to use malloc() and free() for some reason).

Some data is allocated "permanently" and will not be freed until the JPEG object is destroyed. Most data is allocated "per image" and is freed by jpeg\_finish\_compress, jpeg\_finish\_decompress, or jpeg\_abort. You can call the memory manager yourself to allocate structures that will automatically be freed at these times. Typical code for this is

```
ptr = (*cinfo->mem->alloc_small) ((j_common_ptr) cinfo, JPOOL_IMAGE, size);
```

Use JPOOL\_PERMANENT to get storage that lasts as long as the JPEG object.

Use alloc\_large instead of alloc\_small for anything bigger than a few Kbytes.

There are also alloc\_sarray and alloc\_barray routines that automatically build 2-D sample or block arrays.

The library's minimum space requirements to process an image depend on the image's width, but not on its height, because the library ordinarily works with "strip" buffers that are as wide as the image but just a few rows high. Some operating modes (eg, two-pass color quantization) require full-image buffers. Such buffers are treated as "virtual arrays": only the current strip need be in memory, and the rest can be swapped out to a temporary file.

If you use the simplest memory manager back end (jmemnobs.c), then no temporary files are used; virtual arrays are simply malloc()'d. Images bigger than memory can be processed only if your system supports virtual memory. The other memory manager back ends support temporary files of various flavors and thus work in machines without virtual memory. They may also be useful on Unix machines if you need to process images that exceed available swap space.

When using temporary files, the library will make the in-memory buffers for its virtual arrays just big enough to stay within a "maximum memory" setting. Your application can set this limit by setting cinfo->mem->max\_memory\_to\_use after creating the JPEG object. (Of course, there is still a minimum size for the buffers, so the max-memory setting is effective only if it is bigger than the minimum space needed.) If you allocate any large structures yourself, you must allocate them before jpeg\_start\_compress() or jpeg\_start\_decompress() in order to have them counted against the max memory limit. Also keep in mind that space allocated with alloc\_small() is ignored, on the assumption that it's too small to be worth worrying about; so a reasonable safety margin should be left when setting max\_memory\_to\_use.

If you use the jmemname.c or jmemdos.c memory manager back end, it is important to clean up the JPEG object properly to ensure that the temporary files get deleted. (This is especially crucial with jmemdos.c, where the

"temporary files" may be extended-memory segments; if they are not freed, DOS will require a reboot to recover the memory.) Thus, with these memory managers, it's a good idea to provide a signal handler that will trap any early exit from your program. The handler should call either jpeg\_abort() or jpeg\_destroy() for any active JPEG objects. A handler is not needed with jmemnobs.c, and shouldn't be necessary with jmemansi.c or jmemmac.c either, since the C library is supposed to take care of deleting files made with tmpfile().

## Memory usage

-----

Working memory requirements while performing compression or decompression depend on image dimensions, image characteristics (such as colorspace and JPEG process), and operating mode (application-selected options).

As of v6b, the decompressor requires:

1. About 24K in more-or-less-fixed-size data. This varies a bit depending on operating mode and image characteristics (particularly color vs. grayscale), but it doesn't depend on image dimensions.
2. Strip buffers (of size proportional to the image width) for IDCT and upsampling results. The worst case for commonly used sampling factors is about 34 bytes \* width in pixels for a color image. A grayscale image only needs about 8 bytes per pixel column.
3. A full-image DCT coefficient buffer is needed to decode a multi-scan JPEG file (including progressive JPEGs), or whenever you select buffered-image mode. This takes 2 bytes/coefficient. At typical 2x2 sampling, that's 3 bytes per pixel for a color image. Worst case (1x1 sampling) requires 6 bytes/pixel. For grayscale, figure 2 bytes/pixel.
4. To perform 2-pass color quantization, the decompressor also needs a 128K color lookup table and a full-image pixel buffer (3 bytes/pixel). This does not count any memory allocated by the application, such as a buffer to hold the final output image.

The above figures are valid for 8-bit JPEG data precision and a machine with 32-bit ints. For 9-bit to 12-bit JPEG data, double the size of the strip buffers and quantization pixel buffer. The "fixed-size" data will be somewhat smaller with 16-bit ints, larger with 64-bit ints. Also, CMYK or other unusual color spaces will require different amounts of space.

The full-image coefficient and pixel buffers, if needed at all, do not have to be fully RAM resident; you can have the library use temporary files instead when the total memory usage would exceed a limit you set. (But if your OS supports virtual memory, it's probably better to just use jmemnobs and let the OS do the swapping.)

The compressor's memory requirements are similar, except that it has no need

for color quantization. Also, it needs a full-image DCT coefficient buffer if Huffman-table optimization is asked for, even if progressive mode is not requested.

If you need more detailed information about memory usage in a particular situation, you can enable the MEM\_STATS code in jmemmgr.c.

#### Library compile-time options

-----

A number of compile-time options are available by modifying jmorecfg.h.

The IJG code currently supports 8-bit to 12-bit sample data precision by defining BITS\_IN\_JSAMPLE as 8, 9, 10, 11, or 12.

Note that a value larger than 8 causes JSAMPLE to be larger than a char, so it affects the surrounding application's image data.

The sample applications cjpeg and djpeg can support deeper than 8-bit data only for PPM and GIF file formats; you must disable the other file formats to compile a 9-bit to 12-bit cjpeg or djpeg. (install.txt has more information about that.)

Run-time selection and conversion of data precision are currently not supported and may be added later.

Exception: The transcoding part (jpegtran) supports all settings in a single instance, since it operates on the level of DCT coefficients and not sample values.

(If you need to include an 8-bit library and a 9-bit to 12-bit library for compression or decompression in a single application, you could probably do it by defining NEED\_SHORT\_EXTERNAL\_NAMES for just one of the copies. You'd have to access the 8-bit and the 9-bit to 12-bit copies from separate application source files. This is untested ... if you try it, we'd like to hear whether it works!)

Note that the standard Huffman tables are only valid for 8-bit data precision. If you selected more than 8-bit data precision, cjpeg uses arithmetic coding by default. The Huffman encoder normally uses entropy optimization to compute usable tables for higher precision. Otherwise, you'll have to supply different default Huffman tables. You may also want to supply your own DCT quantization tables; the existing quality-scaling code has been developed for 8-bit use, and probably doesn't generate especially good tables for 9-bit to 12-bit.

The maximum number of components (color channels) in the image is determined by MAX\_COMPONENTS. The JPEG standard allows up to 255 components, but we expect that few applications will need more than four or so.

On machines with unusual data type sizes, you may be able to improve performance or reduce memory space by tweaking the various typedefs in

jmorcfg.h. In particular, on some RISC CPUs, access to arrays of "short"s is quite slow; consider trading memory for speed by making JCOEF, INT16, and UINT16 be "int" or "unsigned int". UINT8 is also a candidate to become int. You probably don't want to make JSAMPLE be int unless you have lots of memory to burn.

You can reduce the size of the library by compiling out various optional functions. To do this, undefine xxx\_SUPPORTED symbols as necessary.

You can also save a few K by not having text error messages in the library; the standard error message table occupies about 5Kb. This is particularly reasonable for embedded applications where there's no good way to display a message anyway. To do this, remove the creation of the message table (jpeg\_std\_message\_table[]) from jerror.c, and alter format\_message to do something reasonable without it. You could output the numeric value of the message code number, for example. If you do this, you can also save a couple more K by modifying the TRACEMSn() macros in jerror.h to expand to nothing; you don't need trace capability anyway, right?

#### Portability considerations

-----

The JPEG library has been written to be extremely portable; the sample applications cjpeg and djpeg are slightly less so. This section summarizes the design goals in this area. (If you encounter any bugs that cause the library to be less portable than is claimed here, we'd appreciate hearing about them.)

The code works fine on ANSI C, C++, and pre-ANSI C compilers, using any of the popular system include file setups, and some not-so-popular ones too. See install.txt for configuration procedures.

The code is not dependent on the exact sizes of the C data types. As distributed, we make the assumptions that

- char is at least 8 bits wide
- short is at least 16 bits wide
- int is at least 16 bits wide
- long is at least 32 bits wide

(These are the minimum requirements of the ANSI C standard.) Wider types will work fine, although memory may be used inefficiently if char is much larger than 8 bits or short is much bigger than 16 bits. The code should work equally well with 16- or 32-bit ints.

In a system where these assumptions are not met, you may be able to make the code work by modifying the typedefs in jmorcfg.h. However, you will probably have difficulty if int is less than 16 bits wide, since references to plain int abound in the code.

char can be either signed or unsigned, although the code runs faster if an unsigned char type is available. If char is wider than 8 bits, you will need to redefine JOCTET and/or provide custom data source/destination managers so that JOCTET represents exactly 8 bits of data on external storage.

The JPEG library proper does not assume ASCII representation of characters. But some of the image file I/O modules in cjpeg/djpeg do have ASCII dependencies in file-header manipulation; so does cjpeg's select\_file\_type() routine.

The JPEG library does not rely heavily on the C library. In particular, C stdio is used only by the data source/destination modules and the error handler, all of which are application-replaceable. (cjpeg/djpeg are more heavily dependent on stdio.) malloc and free are called only from the memory manager "back end" module, so you can use a different memory allocator by replacing that one file.

The code generally assumes that C names must be unique in the first 15 characters. However, global function names can be made unique in the first 6 characters by defining NEED\_SHORT\_EXTERNAL\_NAMES.

More info about porting the code may be gleaned by reading jconfig.txt, jmorecfg.h, and jinclude.h.

Notes for MS-DOS implementors

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The IJG code is designed to work efficiently in 80x86 "small" or "medium" memory models (i.e., data pointers are 16 bits unless explicitly declared "far"; code pointers can be either size). You may be able to use small model to compile cjpeg or djpeg by itself, but you will probably have to use medium model for any larger application. This won't make much difference in performance. You *will* take a noticeable performance hit if you use a large-data memory model (perhaps 10%-25%), and you should avoid "huge" model if at all possible.

The JPEG library typically needs 2Kb-3Kb of stack space. It will also malloc about 20K-30K of near heap space while executing (and lots of far heap, but that doesn't count in this calculation). This figure will vary depending on selected operating mode, and to a lesser extent on image size. There is also about 5Kb-6Kb of constant data which will be allocated in the near data segment (about 4Kb of this is the error message table). Thus you have perhaps 20K available for other modules' static data and near heap space before you need to go to a larger memory model. The C library's static data will account for several K of this, but that still leaves a good deal for your needs. (If you are tight on space, you could reduce the sizes

of the I/O buffers allocated by `jdatasrc.c` and `jdatadst.c`, say from 4K to 1K. Another possibility is to move the error message table to far memory; this should be doable with only localized hacking on `jerror.c`.)

About 2K of the near heap space is "permanent" memory that will not be released until you destroy the JPEG object. This is only an issue if you save a JPEG object between compression or decompression operations.

Far data space may also be a tight resource when you are dealing with large images. The most memory-intensive case is decompression with two-pass color quantization, or single-pass quantization to an externally supplied color map. This requires a 128Kb color lookup table plus strip buffers amounting to about 40 bytes per column for typical sampling ratios (eg, about 25600 bytes for a 640-pixel-wide image). You may not be able to process wide images if you have large data structures of your own.

Of course, all of these concerns vanish if you use a 32-bit flat-memory-model compiler, such as DJGPP or Watcom C. We highly recommend flat model if you can use it; the JPEG library is significantly faster in flat model.

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/libjpeg.txt
```

No license file was found, but licenses were detected in source scan.

## IJG JPEG LIBRARY: SYSTEM ARCHITECTURE

Copyright (C) 1991-2013, Thomas G. Lane, Guido Vollbeding.

This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

This file provides an overview of the architecture of the IJG JPEG software; that is, the functions of the various modules in the system and the interfaces between modules. For more precise details about any data structure or calling convention, see the include files and comments in the source code.

We assume that the reader is already somewhat familiar with the JPEG standard.

The README file includes references for learning about JPEG. The file `libjpeg.txt` describes the library from the viewpoint of an application programmer using the library; it's best to read that file before this one.

Also, the file `coderrules.txt` describes the coding style conventions we use.

In this document, JPEG-specific terminology follows the JPEG standard:

A "component" means a color channel, e.g., Red or Luminance.

A "sample" is a single component value (i.e., one number in the image data).

A "coefficient" is a frequency coefficient (a DCT transform output number).

A "block" is an array of samples or coefficients.

An "MCU" (minimum coded unit) is an interleaved set of blocks of size

determined by the sampling factors, or a single block in a noninterleaved scan.

We do not use the terms "pixel" and "sample" interchangeably. When we say pixel, we mean an element of the full-size image, while a sample is an element of the downsampled image. Thus the number of samples may vary across components while the number of pixels does not. (This terminology is not used rigorously throughout the code, but it is used in places where confusion would otherwise result.)

\*\*\* System features \*\*\*

The IJG distribution contains two parts:

- \* A subroutine library for JPEG compression and decompression.
- \* cjpeg/djpeg, two sample applications that use the library to transform JFIF JPEG files to and from several other image formats.

cjpeg/djpeg are of no great intellectual complexity: they merely add a simple command-line user interface and I/O routines for several uncompressed image formats. This document concentrates on the library itself.

We desire the library to be capable of supporting all JPEG baseline, extended sequential, and progressive DCT processes. The library does not support the hierarchical or lossless processes defined in the standard.

Within these limits, any set of compression parameters allowed by the JPEG spec should be readable for decompression. (We can be more restrictive about what formats we can generate.) Although the system design allows for all parameter values, some uncommon settings are not yet implemented and may never be; nonintegral sampling ratios are the prime example. Furthermore, we treat 8-bit vs. 12-bit data precision as a compile-time switch, not a run-time option, because most machines can store 8-bit pixels much more compactly than 12-bit.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, libtiff uses this library to implement JPEG compression within the TIFF file format.)

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. This code can be omitted if not needed.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs,

ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

### \*\*\* Portability issues \*\*\*

Portability is an essential requirement for the library. The key portability issues that show up at the level of system architecture are:

1. Memory usage. We want the code to be able to run on PC-class machines with limited memory. Images should therefore be processed sequentially (in strips), to avoid holding the whole image in memory at once. Where a full-image buffer is necessary, we should be able to use either virtual memory or temporary files.
2. Near/far pointer distinction. To run efficiently on 80x86 machines, the code should distinguish "small" objects (kept in near data space) from "large" ones (kept in far data space). This is an annoying restriction, but fortunately it does not impact code quality for less brain-damaged machines, and the source code clutter turns out to be minimal with sufficient use of pointer typedefs.
3. Data precision. We assume that "char" is at least 8 bits, "short" and "int" at least 16, "long" at least 32. The code will work fine with larger data sizes, although memory may be used inefficiently in some cases. However, the JPEG compressed datastream must ultimately appear on external storage as a sequence of 8-bit bytes if it is to conform to the standard. This may pose a problem on machines where char is wider than 8 bits. The library represents compressed data as an array of values of typedef JOCTET. If no data type exactly 8 bits wide is available, custom data source and data destination modules must be written to unpack and pack the chosen JOCTET datatype into 8-bit external representation.

### \*\*\* System overview \*\*\*

The compressor and decompressor are each divided into two main sections: the JPEG compressor or decompressor proper, and the preprocessing or postprocessing functions. The interface between these two sections is the image data that the official JPEG spec regards as its input or output: this data is in the colorspace to be used for compression, and it is downsampled to the sampling factors to be used. The preprocessing and postprocessing steps are responsible for converting a normal image representation to or from this form. (Those few applications that want to deal with YCbCr downsampled data can skip the preprocessing or postprocessing step.)



Looking more closely, the compressor library contains the following main elements:

Preprocessing:

- \* Color space conversion (e.g., RGB to YCbCr).
- \* Edge expansion and downsampling. Optionally, this step can do simple smoothing --- this is often helpful for low-quality source data.

JPEG proper:

- \* MCU assembly, DCT, quantization.
- \* Entropy coding (sequential or progressive, Huffman or arithmetic).

In addition to these modules we need overall control, marker generation, and support code (memory management & error handling). There is also a module responsible for physically writing the output data --- typically this is just an interface to `fwrite()`, but some applications may need to do something else with the data.

The decompressor library contains the following main elements:

JPEG proper:

- \* Entropy decoding (sequential or progressive, Huffman or arithmetic).
- \* Dequantization, inverse DCT, MCU disassembly.

Postprocessing:

- \* Upsampling. Optionally, this step may be able to do more general rescaling of the image.
- \* Color space conversion (e.g., YCbCr to RGB). This step may also provide gamma adjustment [ currently it does not ].
- \* Optional color quantization (e.g., reduction to 256 colors).
- \* Optional color precision reduction (e.g., 24-bit to 15-bit color).  
[This feature is not currently implemented.]

We also need overall control, marker parsing, and a data source module. The support code (memory management & error handling) can be shared with the compression half of the library.

There may be several implementations of each of these elements, particularly in the decompressor, where a wide range of speed/quality tradeoffs is very useful. It must be understood that some of the best speedups involve merging adjacent steps in the pipeline. For example, upsampling, color space conversion, and color quantization might all be done at once when using a low-quality ordered-dither technique. The system architecture is designed to allow such merging where appropriate.

Note: it is convenient to regard edge expansion (padding to block boundaries) as a preprocessing/postprocessing function, even though the JPEG spec includes it in compression/decompression. We do this because downsampling/upsampling

can be simplified a little if they work on padded data: it's not necessary to have special cases at the right and bottom edges. Therefore the interface buffer is always an integral number of blocks wide and high, and we expect compression preprocessing to pad the source data properly. Padding will occur only to the next block (block\_size-sample) boundary. In an interleaved-scan situation, additional dummy blocks may be used to fill out MCUs, but the MCU assembly and disassembly logic will create or discard these blocks internally. (This is advantageous for speed reasons, since we avoid DCTing the dummy blocks. It also permits a small reduction in file size, because the compressor can choose dummy block contents so as to minimize their size in compressed form. Finally, it makes the interface buffer specification independent of whether the file is actually interleaved or not.) Applications that wish to deal directly with the downsampled data must provide similar buffering and padding for odd-sized images.

\*\*\* Poor man's object-oriented programming \*\*\*

It should be clear by now that we have a lot of quasi-independent processing steps, many of which have several possible behaviors. To avoid cluttering the code with lots of switch statements, we use a simple form of object-style programming to separate out the different possibilities.

For example, two different color quantization algorithms could be implemented as two separate modules that present the same external interface; at runtime, the calling code will access the proper module indirectly through an "object".

We can get the limited features we need while staying within portable C. The basic tool is a function pointer. An "object" is just a struct containing one or more function pointer fields, each of which corresponds to a method name in real object-oriented languages. During initialization we fill in the function pointers with references to whichever module we have determined we need to use in this run. Then invocation of the module is done by indirecting through a function pointer; on most machines this is no more expensive than a switch statement, which would be the only other way of making the required run-time choice. The really significant benefit, of course, is keeping the source code clean and well structured.

We can also arrange to have private storage that varies between different implementations of the same kind of object. We do this by making all the module-specific object structs be separately allocated entities, which will be accessed via pointers in the master compression or decompression struct. The "public" fields or methods for a given kind of object are specified by a commonly known struct. But a module's initialization code can allocate a larger struct that contains the common struct as its first member, plus additional private fields. With appropriate pointer casting, the module's internal functions can access these private fields. (For a simple example, see jdatadst.c, which implements the external interface specified by struct

jpeg\_destination\_mgr, but adds extra fields.)

(Of course this would all be a lot easier if we were using C++, but we are not yet prepared to assume that everyone has a C++ compiler.)

An important benefit of this scheme is that it is easy to provide multiple versions of any method, each tuned to a particular case. While a lot of precalculation might be done to select an optimal implementation of a method, the cost per invocation is constant. For example, the upsampling step might have a "generic" method, plus one or more "hardwired" methods for the most popular sampling factors; the hardwired methods would be faster because they'd use straight-line code instead of for-loops. The cost to determine which method to use is paid only once, at startup, and the selection criteria are hidden from the callers of the method.

This plan differs a little bit from usual object-oriented structures, in that only one instance of each object class will exist during execution. The reason for having the class structure is that on different runs we may create different instances (choose to execute different modules). You can think of the term "method" as denoting the common interface presented by a particular set of interchangeable functions, and "object" as denoting a group of related methods, or the total shared interface behavior of a group of modules.

\*\*\* Overall control structure \*\*\*

We previously mentioned the need for overall control logic in the compression and decompression libraries. In IJG implementations prior to v5, overall control was mostly provided by "pipeline control" modules, which proved to be large, unwieldy, and hard to understand. To improve the situation, the control logic has been subdivided into multiple modules. The control modules consist of:

1. Master control for module selection and initialization. This has two responsibilities:

1A. Startup initialization at the beginning of image processing.

The individual processing modules to be used in this run are selected and given initialization calls.

1B. Per-pass control. This determines how many passes will be performed and calls each active processing module to configure itself appropriately at the beginning of each pass. End-of-pass processing, where necessary, is also invoked from the master control module.

Method selection is partially distributed, in that a particular processing module may contain several possible implementations of a particular method, which it will select among when given its initialization call. The master

control code need only be concerned with decisions that affect more than one module.

2. Data buffering control. A separate control module exists for each inter-processing-step data buffer. This module is responsible for invoking the processing steps that write or read that data buffer.

Each buffer controller sees the world as follows:

```
input data => processing step A => buffer => processing step B => output data
 | | |
 ----- controller -----
```

The controller knows the dataflow requirements of steps A and B: how much data they want to accept in one chunk and how much they output in one chunk. Its function is to manage its buffer and call A and B at the proper times.

A data buffer control module may itself be viewed as a processing step by a higher-level control module; thus the control modules form a binary tree with elementary processing steps at the leaves of the tree.

The control modules are objects. A considerable amount of flexibility can be had by replacing implementations of a control module. For example:

\* Merging of adjacent steps in the pipeline is done by replacing a control module and its pair of processing-step modules with a single processing-step module. (Hence the possible merges are determined by the tree of control modules.)

\* In some processing modes, a given interstep buffer need only be a "strip" buffer large enough to accommodate the desired data chunk sizes. In other modes, a full-image buffer is needed and several passes are required.

The control module determines which kind of buffer is used and manipulates virtual array buffers as needed. One or both processing steps may be unaware of the multi-pass behavior.

In theory, we might be able to make all of the data buffer controllers interchangeable and provide just one set of implementations for all. In practice, each one contains considerable special-case processing for its particular job. The buffer controller concept should be regarded as an overall system structuring principle, not as a complete description of the task performed by any one controller.

\*\*\* Compression object structure \*\*\*

Here is a sketch of the logical structure of the JPEG compression library:

```
 |-- Colorspace conversion
|-- Preprocessing controller --|
```

```

| |-- Downsampling
Main controller --|
| |-- Forward DCT, quantize
|-- Coefficient controller --|
| |-- Entropy encoding

```

This sketch also describes the flow of control (subroutine calls) during typical image data processing. Each of the components shown in the diagram is an "object" which may have several different implementations available. One or more source code files contain the actual implementation(s) of each object.

The objects shown above are:

- \* Main controller: buffer controller for the subsampled-data buffer, which holds the preprocessed input data. This controller invokes preprocessing to fill the subsampled-data buffer, and JPEG compression to empty it. There is usually no need for a full-image buffer here; a strip buffer is adequate.
- \* Preprocessing controller: buffer controller for the downsampling input data buffer, which lies between colorspace conversion and downsampling. Note that a unified conversion/downsampling module would probably replace this controller entirely.
- \* Colorspace conversion: converts application image data into the desired JPEG color space; also changes the data from pixel-interleaved layout to separate component planes. Processes one pixel row at a time.
- \* Downsampling: performs reduction of chroma components as required. Optionally may perform pixel-level smoothing as well. Processes a "row group" at a time, where a row group is defined as  $V_{max}$  pixel rows of each component before downsampling, and  $V_k$  sample rows afterwards (remember  $V_k$  differs across components). Some downsampling or smoothing algorithms may require context rows above and below the current row group; the preprocessing controller is responsible for supplying these rows via proper buffering. The downsampler is responsible for edge expansion at the right edge (i.e., extending each sample row to a multiple of `block_size` samples); but the preprocessing controller is responsible for vertical edge expansion (i.e., duplicating the bottom sample row as needed to make a multiple of `block_size` rows).
- \* Coefficient controller: buffer controller for the DCT-coefficient data. This controller handles MCU assembly, including insertion of dummy DCT blocks when needed at the right or bottom edge. When performing Huffman-code optimization or emitting a multiscan JPEG file, this controller is responsible for buffering the full image. The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the JPEG file is noninterleaved.

\* Forward DCT and quantization: Perform DCT, quantize, and emit coefficients. Works on one or more DCT blocks at a time. (Note: the coefficients are now emitted in normal array order, which the entropy encoder is expected to convert to zigzag order as necessary. Prior versions of the IJG code did the conversion to zigzag order within the quantization step.)

\* Entropy encoding: Perform Huffman or arithmetic entropy coding and emit the coded data to the data destination module. Works on one MCU per call. For progressive JPEG, the same DCT blocks are fed to the entropy coder during each pass, and the coder must emit the appropriate subset of coefficients.

In addition to the above objects, the compression library includes these objects:

\* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules.

\* Marker writing: generates JPEG markers (except for RSTn, which is emitted by the entropy encoder when needed).

\* Data destination manager: writes the output JPEG datastream to its final destination (e.g., a file). The destination manager supplied with the library knows how to write to a stdio stream or to a memory buffer; for other behaviors, the surrounding application may provide its own destination manager.

\* Memory manager: allocates and releases memory, controls virtual arrays (with backing store management, where required).

\* Error handler: performs formatting and output of error and trace messages; determines handling of nonfatal errors. The surrounding application may override some or all of this object's methods to change error handling.

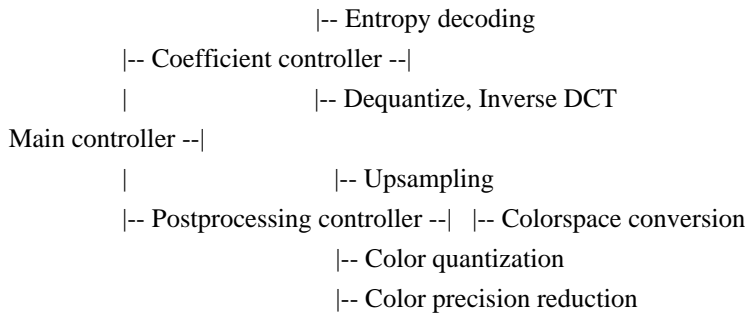
\* Progress monitor: supports output of "percent-done" progress reports. This object represents an optional callback to the surrounding application: if wanted, it must be supplied by the application.

The error handler, destination manager, and progress monitor objects are defined as separate objects in order to simplify application-specific customization of the JPEG library. A surrounding application may override individual methods or supply its own all-new implementation of one of these objects. The object interfaces for these objects are therefore treated as part of the application interface of the library, whereas the other objects are internal to the library.

The error handler and memory manager are shared by JPEG compression and decompression; the progress monitor, if used, may be shared as well.

\*\*\* Decompression object structure \*\*\*

Here is a sketch of the logical structure of the JPEG decompression library:



As before, this diagram also represents typical control flow. The objects shown are:

\* Main controller: buffer controller for the subsampled-data buffer, which holds the output of JPEG decompression proper. This controller's primary task is to feed the postprocessing procedure. Some upsampling algorithms may require context rows above and below the current row group; when this is true, the main controller is responsible for managing its buffer so as to make context rows available. In the current design, the main buffer is always a strip buffer; a full-image buffer is never required.

\* Coefficient controller: buffer controller for the DCT-coefficient data. This controller handles MCU disassembly, including deletion of any dummy DCT blocks at the right or bottom edge. When reading a multiscan JPEG file, this controller is responsible for buffering the full image. (Buffering DCT coefficients, rather than samples, is necessary to support progressive JPEG.) The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the source JPEG file is noninterleaved.

\* Entropy decoding: Read coded data from the data source module and perform Huffman or arithmetic entropy decoding. Works on one MCU per call. For progressive JPEG decoding, the coefficient controller supplies the prior coefficients of each MCU (initially all zeroes), which the entropy decoder modifies in each scan.

\* Dequantization and inverse DCT: like it says. Note that the coefficients buffered by the coefficient controller have NOT been dequantized; we merge dequantization and inverse DCT into a single step for speed reasons. When scaled-down output is asked for, simplified DCT algorithms may be used that need fewer coefficients and emit fewer samples per DCT block, not the full 8x8. Works on one DCT block at a time.

- \* Postprocessing controller: buffer controller for the color quantization input buffer, when quantization is in use. (Without quantization, this controller just calls the upsampler.) For two-pass quantization, this controller is responsible for buffering the full-image data.
- \* Upsampling: restores chroma components to full size. (May support more general output rescaling, too. Note that if undersized DCT outputs have been emitted by the DCT module, this module must adjust so that properly sized outputs are created.) Works on one row group at a time. This module also calls the color conversion module, so its top level is effectively a buffer controller for the upsampling->color conversion buffer. However, in all but the highest-quality operating modes, upsampling and color conversion are likely to be merged into a single step.
- \* Colorspace conversion: convert from JPEG color space to output color space, and change data layout from separate component planes to pixel-interleaved. Works on one pixel row at a time.
- \* Color quantization: reduce the data to colormapped form, using either an externally specified colormap or an internally generated one. This module is not used for full-color output. Works on one pixel row at a time; may require two passes to generate a color map. Note that the output will always be a single component representing colormap indexes. In the current design, the output values are JSAMPLEs, so an 8-bit compilation cannot quantize to more than 256 colors. This is unlikely to be a problem in practice.
- \* Color reduction: this module handles color precision reduction, e.g., generating 15-bit color (5 bits/primary) from JPEG's 24-bit output. Not quite clear yet how this should be handled... should we merge it with colorspace conversion???

Note that some high-speed operating modes might condense the entire postprocessing sequence to a single module (upsample, color convert, and quantize in one step).

In addition to the above objects, the decompression library includes these objects:

- \* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules. This is subdivided into input and output control: `jdinput.c` controls only input-side processing, while `jdmaster.c` handles overall initialization and output-side control.
- \* Marker reading: decodes JPEG markers (except for RSTn).
- \* Data source manager: supplies the input JPEG datastream. The source manager supplied with the library knows how to read from a stdio stream



or from a memory buffer; for other behaviors, the surrounding application may provide its own source manager.

\* Memory manager: same as for compression library.

\* Error handler: same as for compression library.

\* Progress monitor: same as for compression library.

As with compression, the data source manager, error handler, and progress monitor are candidates for replacement by a surrounding application.

\*\*\* Decompression input and output separation \*\*\*

To support efficient incremental display of progressive JPEG files, the decompressor is divided into two sections that can run independently:

1. Data input includes marker parsing, entropy decoding, and input into the coefficient controller's DCT coefficient buffer. Note that this processing is relatively cheap and fast.
2. Data output reads from the DCT coefficient buffer and performs the IDCT and all postprocessing steps.

For a progressive JPEG file, the data input processing is allowed to get arbitrarily far ahead of the data output processing. (This occurs only if the application calls `jpeg_consume_input()`; otherwise input and output run in lockstep, since the input section is called only when the output section needs more data.) In this way the application can avoid making extra display passes when data is arriving faster than the display pass can run. Furthermore, it is possible to abort an output pass without losing anything, since the coefficient buffer is read-only as far as the output section is concerned. See `libjpeg.txt` for more detail.

A full-image coefficient array is only created if the JPEG file has multiple scans (or if the application specifies buffered-image mode anyway). When reading a single-scan file, the coefficient controller normally creates only a one-MCU buffer, so input and output processing must run in lockstep in this case. `jpeg_consume_input()` is effectively a no-op in this situation.

The main impact of dividing the decompressor in this fashion is that we must be very careful with shared variables in the `cinfo` data structure. Each variable that can change during the course of decompression must be classified as belonging to data input or data output, and each section must look only at its own variables. For example, the data output section may not depend on any of the variables that describe the current scan in the JPEG file, because these may change as the data input section advances into a new

scan.

The progress monitor is (somewhat arbitrarily) defined to treat input of the file as one pass when buffered-image mode is not used, and to ignore data input work completely when buffered-image mode is used. Note that the library has no reliable way to predict the number of passes when dealing with a progressive JPEG file, nor can it predict the number of output passes in buffered-image mode. So the work estimate is inherently bogus anyway.

No comparable division is currently made in the compression library, because there isn't any real need for it.

\*\*\* Data formats \*\*\*

Arrays of pixel sample values use the following data structure:

```
typedef something JSAMPLE; a pixel component value, 0..MAXJSAMPLE
typedef JSAMPLE *JSAMPROW; ptr to a row of samples
typedef JSAMPROW *JSAMPARRAY; ptr to a list of rows
typedef JSAMPARRAY *JSAMPIMAGE; ptr to a list of color-component arrays
```

The basic element type JSAMPLE will typically be one of unsigned char, (signed) char, or short. Short will be used if samples wider than 8 bits are to be supported (this is a compile-time option). Otherwise, unsigned char is used if possible. If the compiler only supports signed chars, then it is necessary to mask off the value when reading. Thus, all reads of JSAMPLE values must be coded as "GETJSAMPLE(value)", where the macro will be defined as "((value) & 0xFF)" on signed-char machines and "((int) (value))" elsewhere.

With these conventions, JSAMPLE values can be assumed to be  $\geq 0$ . This helps simplify correct rounding during downsampling, etc. The JPEG standard's specification that sample values run from -128..127 is accommodated by subtracting 128 from the sample value in the DCT step. Similarly, during decompression the output of the IDCT step will be immediately shifted back to 0..255. (NB: different values are required when 12-bit samples are in use. The code is written in terms of MAXJSAMPLE and CENTERJSAMPLE, which will be defined as 255 and 128 respectively in an 8-bit implementation, and as 4095 and 2048 in a 12-bit implementation.)

We use a pointer per row, rather than a two-dimensional JSAMPLE array. This choice costs only a small amount of memory and has several benefits:

- \* Code using the data structure doesn't need to know the allocated width of the rows. This simplifies edge expansion/compression, since we can work in an array that's wider than the logical picture width.
- \* Indexing doesn't require multiplication; this is a performance win on many machines.
- \* Arrays with more than 64K total elements can be supported even on machines

where malloc() cannot allocate chunks larger than 64K.

\* The rows forming a component array may be allocated at different times without extra copying. This trick allows some speedups in smoothing steps that need access to the previous and next rows.

Note that each color component is stored in a separate array; we don't use the traditional layout in which the components of a pixel are stored together. This simplifies coding of modules that work on each component independently, because they don't need to know how many components there are. Furthermore, we can read or write each component to a temporary file independently, which is helpful when dealing with noninterleaved JPEG files.

In general, a specific sample value is accessed by code such as

```
GETJSAMPLE(image[colorcomponent][row][col])
```

where col is measured from the image left edge, but row is measured from the first sample row currently in memory. Either of the first two indexings can be precomputed by copying the relevant pointer.

Since most image-processing applications prefer to work on images in which the components of a pixel are stored together, the data passed to or from the surrounding application uses the traditional convention: a single pixel is represented by N consecutive JSAMPLE values, and an image row is an array of (# of color components)\*(image width) JSAMPLEs. One or more rows of data can be represented by a pointer of type JSAMPARRAY in this scheme. This scheme is converted to component-wise storage inside the JPEG library. (Applications that want to skip JPEG preprocessing or postprocessing will have to contend with component-wise storage.)

Arrays of DCT-coefficient values use the following data structure:

```
typedef short JCOEF; a 16-bit signed integer
typedef JCOEF JBLOCK[DCTSIZE2]; an 8x8 block of coefficients
typedef JBLOCK *JBLOCKROW; ptr to one horizontal row of 8x8 blocks
typedef JBLOCKROW *JBLOCKARRAY; ptr to a list of such rows
typedef JBLOCKARRAY *JBLOCKIMAGE; ptr to a list of color component arrays
```

The underlying type is at least a 16-bit signed integer; while "short" is big enough on all machines of interest, on some machines it is preferable to use "int" for speed reasons, despite the storage cost. Coefficients are grouped into 8x8 blocks (but we always use #defines DCTSIZE and DCTSIZE2 rather than "8" and "64").

The contents of a coefficient block may be in either "natural" or zigzagged order, and may be true values or divided by the quantization coefficients, depending on where the block is in the processing pipeline. In the current library, coefficient blocks are kept in natural order everywhere; the entropy

codecs zigzag or dezigzag the data as it is written or read. The blocks contain quantized coefficients everywhere outside the DCT/IDCT subsystems. (This latter decision may need to be revisited to support variable quantization a la JPEG Part 3.)

Notice that the allocation unit is now a row of 8x8 coefficient blocks, corresponding to block\_size rows of samples. Otherwise the structure is much the same as for samples, and for the same reasons.

On machines where malloc() can't handle a request bigger than 64Kb, this data structure limits us to rows of less than 512 JBLOCKS, or a picture width of 4000+ pixels. This seems an acceptable restriction.

On 80x86 machines, the bottom-level pointer types (JSAMPROW and JBLOCKROW) must be declared as "far" pointers, but the upper levels can be "near" (implying that the pointer lists are allocated in the DS segment). We use a #define symbol FAR, which expands to the "far" keyword when compiling on 80x86 machines and to nothing elsewhere.

\*\*\* Suspendable processing \*\*\*

In some applications it is desirable to use the JPEG library as an incremental, memory-to-memory filter. In this situation the data source or destination may be a limited-size buffer, and we can't rely on being able to empty or refill the buffer at arbitrary times. Instead the application would like to have control return from the library at buffer overflow/underrun, and then resume compression or decompression at a later time.

This scenario is supported for simple cases. (For anything more complex, we recommend that the application "bite the bullet" and develop real multitasking capability.) The libjpeg.txt file goes into more detail about the usage and limitations of this capability; here we address the implications for library structure.

The essence of the problem is that the entropy codec (coder or decoder) must be prepared to stop at arbitrary times. In turn, the controllers that call the entropy codec must be able to stop before having produced or consumed all the data that they normally would handle in one call. That part is reasonably straightforward: we make the controller call interfaces include "progress counters" which indicate the number of data chunks successfully processed, and we require callers to test the counter rather than just assume all of the data was processed.

Rather than trying to restart at an arbitrary point, the current Huffman codecs are designed to restart at the beginning of the current MCU after a suspension due to buffer overflow/underrun. At the start of each call, the

codec's internal state is loaded from permanent storage (in the JPEG object structures) into local variables. On successful completion of the MCU, the permanent state is updated. (This copying is not very expensive, and may even lead to *\*improved\** performance if the local variables can be registerized.) If a suspension occurs, the codec simply returns without updating the state, thus effectively reverting to the start of the MCU. Note that this implies leaving some data unprocessed in the source/destination buffer (ie, the compressed partial MCU). The data source/destination module interfaces are specified so as to make this possible. This also implies that the data buffer must be large enough to hold a worst-case compressed MCU; a couple thousand bytes should be enough.

In a successive-approximation AC refinement scan, the progressive Huffman decoder has to be able to undo assignments of newly nonzero coefficients if it suspends before the MCU is complete, since decoding requires distinguishing previously-zero and previously-nonzero coefficients. This is a bit tedious but probably won't have much effect on performance. Other variants of Huffman decoding need not worry about this, since they will just store the same values again if forced to repeat the MCU.

This approach would probably not work for an arithmetic codec, since its modifiable state is quite large and couldn't be copied cheaply. Instead it would have to suspend and resume exactly at the point of the buffer end.

The JPEG marker reader is designed to cope with suspension at an arbitrary point. It does so by backing up to the start of the marker parameter segment, so the data buffer must be big enough to hold the largest marker of interest. Again, a couple KB should be adequate. (A special "skip" convention is used to bypass COM and APPn markers, so these can be larger than the buffer size without causing problems; otherwise a 64K buffer would be needed in the worst case.)

The JPEG marker writer currently does *\*not\** cope with suspension. We feel that this is not necessary; it is much easier simply to require the application to ensure there is enough buffer space before starting. (An empty 2K buffer is more than sufficient for the header markers; and ensuring there are a dozen or two bytes available before calling `jpeg_finish_compress()` will suffice for the trailer.) This would not work for writing multi-scan JPEG files, but we simply do not intend to support that capability with suspension.

\*\*\* Memory manager services \*\*\*

The JPEG library's memory manager controls allocation and deallocation of memory, and it manages large "virtual" data arrays on machines where the operating system does not provide virtual memory. Note that the same memory manager serves both compression and decompression operations.

In all cases, allocated objects are tied to a particular compression or decompression master record, and they will be released when that master record is destroyed.

The memory manager does not provide explicit deallocation of objects. Instead, objects are created in "pools" of free storage, and a whole pool can be freed at once. This approach helps prevent storage-leak bugs, and it speeds up operations whenever malloc/free are slow (as they often are). The pools can be regarded as lifetime identifiers for objects. Two pools/lifetimes are defined:

- \* JPOOL\_PERMANENT lasts until master record is destroyed
- \* JPOOL\_IMAGE lasts until done with image (JPEG datastream)

Permanent lifetime is used for parameters and tables that should be carried across from one datastream to another; this includes all application-visible parameters. Image lifetime is used for everything else. (A third lifetime, JPOOL\_PASS = one processing pass, was originally planned. However it was dropped as not being worthwhile. The actual usage patterns are such that the peak memory usage would be about the same anyway; and having per-pass storage substantially complicates the virtual memory allocation rules --- see below.)

The memory manager deals with three kinds of object:

1. "Small" objects. Typically these require no more than 10K-20K total.
2. "Large" objects. These may require tens to hundreds of K depending on image size. Semantically they behave the same as small objects, but we distinguish them for two reasons:
  - \* On MS-DOS machines, large objects are referenced by FAR pointers, small objects by NEAR pointers.
  - \* Pool allocation heuristics may differ for large and small objects.Note that individual "large" objects cannot exceed the size allowed by type size\_t, which may be 64K or less on some machines.
3. "Virtual" objects. These are large 2-D arrays of JSAMPLEs or JBLOCKS (typically large enough for the entire image being processed). The memory manager provides stripwise access to these arrays. On machines without virtual memory, the rest of the array may be swapped out to a temporary file.

(Note: JSAMPARRAY and JBLOCKARRAY data structures are a combination of large objects for the data proper and small objects for the row pointers. For convenience and speed, the memory manager provides single routines to create these structures. Similarly, virtual arrays include a small control block and a JSAMPARRAY or JBLOCKARRAY working buffer, all created with one call.)

In the present implementation, virtual arrays are only permitted to have image lifespan. (Permanent lifespan would not be reasonable, and pass lifespan is not very useful since a virtual array's raison d'etre is to store data for multiple passes through the image.) We also expect that only "small" objects will be given permanent lifespan, though this restriction is not required by

the memory manager.

In a non-virtual-memory machine, some performance benefit can be gained by making the in-memory buffers for virtual arrays be as large as possible. (For small images, the buffers might fit entirely in memory, so blind swapping would be very wasteful.) The memory manager will adjust the height of the buffers to fit within a prespecified maximum memory usage. In order to do this in a reasonably optimal fashion, the manager needs to allocate all of the virtual arrays at once. Therefore, there isn't a one-step allocation routine for virtual arrays; instead, there is a "request" routine that simply allocates the control block, and a "realize" routine (called just once) that determines space allocation and creates all of the actual buffers. The realize routine must allow for space occupied by non-virtual large objects. (We don't bother to factor in the space needed for small objects, on the grounds that it isn't worth the trouble.)

To support all this, we establish the following protocol for doing business with the memory manager:

1. Modules must request virtual arrays (which may have only image lifespan) during the initial setup phase, i.e., in their `jinit_xxx` routines.
2. All "large" objects (including JSAMPARRAYs and JBLOCKARRAYs) must also be allocated during initial setup.
3. `realize_virt_arrays` will be called at the completion of initial setup.

The above conventions ensure that sufficient information is available for it to choose a good size for virtual array buffers.

Small objects of any lifespan may be allocated at any time. We expect that the total space used for small objects will be small enough to be negligible in the `realize_virt_arrays` computation.

In a virtual-memory machine, we simply pretend that the available space is infinite, thus causing `realize_virt_arrays` to decide that it can allocate all the virtual arrays as full-size in-memory buffers. The overhead of the virtual-array access protocol is very small when no swapping occurs.

A virtual array can be specified to be "pre-zeroed"; when this flag is set, never-yet-written sections of the array are set to zero before being made available to the caller. If this flag is not set, never-written sections of the array contain garbage. (This feature exists primarily because the equivalent logic would otherwise be needed in `jdcoefct.c` for progressive JPEG mode; we may as well make it available for possible other uses.)

The first write pass on a virtual array is required to occur in top-to-bottom order; read passes, as well as any write passes after the first one, may access the array in any order. This restriction exists partly to simplify the virtual array control logic, and partly because some file systems may not support seeking beyond the current end-of-file in a temporary file. The main implication of this restriction is that rearrangement of rows (such as converting top-to-bottom data order to bottom-to-top) must be handled while

reading data out of the virtual array, not while putting it in.

\*\*\* Memory manager internal structure \*\*\*

To isolate system dependencies as much as possible, we have broken the memory manager into two parts. There is a reasonably system-independent "front end" (jmemmgr.c) and a "back end" that contains only the code likely to change across systems. All of the memory management methods outlined above are implemented by the front end. The back end provides the following routines for use by the front end (none of these routines are known to the rest of the JPEG code):

jpeg\_mem\_init, jpeg\_mem\_term system-dependent initialization/shutdown

jpeg\_get\_small, jpeg\_free\_small interface to malloc and free library routines  
(or their equivalents)

jpeg\_get\_large, jpeg\_free\_large interface to FAR malloc/free in MSDOS machines;  
else usually the same as  
jpeg\_get\_small/jpeg\_free\_small

jpeg\_mem\_available estimate available memory

jpeg\_open\_backing\_store create a backing-store object

read\_backing\_store, manipulate a backing-store object  
write\_backing\_store,  
close\_backing\_store

On some systems there will be more than one type of backing-store object (specifically, in MS-DOS a backing store file might be an area of extended memory as well as a disk file). jpeg\_open\_backing\_store is responsible for choosing how to implement a given object. The read/write/close routines are method pointers in the structure that describes a given object; this lets them be different for different object types.

It may be necessary to ensure that backing store objects are explicitly released upon abnormal program termination. For example, MS-DOS won't free extended memory by itself. To support this, we will expect the main program or surrounding application to arrange to call self\_destruct (typically via jpeg\_destroy) upon abnormal termination. This may require a SIGINT signal handler or equivalent. We don't want to have the back end module install its own signal handler, because that would pre-empt the surrounding application's ability to control signal handling.

The IJG distribution includes several memory manager back end implementations. Usually the same back end should be suitable for all applications on a given



system, but it is possible for an application to supply its own back end at need.

\*\*\* Implications of DNL marker \*\*\*

Some JPEG files may use a DNL marker to postpone definition of the image height (this would be useful for a fax-like scanner's output, for instance). In these files the SOF marker claims the image height is 0, and you only find out the true image height at the end of the first scan.

We could read these files as follows:

1. Upon seeing zero image height, replace it by 65535 (the maximum allowed).
2. When the DNL is found, update the image height in the global image descriptor.

This implies that control modules must avoid making copies of the image height, and must re-test for termination after each MCU row. This would be easy enough to do.

In cases where image-size data structures are allocated, this approach will result in very inefficient use of virtual memory or much-larger-than-necessary temporary files. This seems acceptable for something that probably won't be a mainstream usage. People might have to forgo use of memory-hogging options (such as two-pass color quantization or noninterleaved JPEG files) if they want efficient conversion of such files. (One could improve efficiency by demanding a user-supplied upper bound for the height, less than 65536; in most cases it could be much less.)

The standard also permits the SOF marker to overestimate the image height, with a DNL to give the true, smaller height at the end of the first scan.

This would solve the space problems if the overestimate wasn't too great. However, it implies that you don't even know whether DNL will be used.

This leads to a couple of very serious objections:

1. Testing for a DNL marker must occur in the inner loop of the decompressor's Huffman decoder; this implies a speed penalty whether the feature is used or not.
2. There is no way to hide the last-minute change in image height from an application using the decoder. Thus *every* application using the IJG library would suffer a complexity penalty whether it cared about DNL or not.

We currently do not support DNL because of these problems.

A different approach is to insist that DNL-using files be preprocessed by a separate program that reads ahead to the DNL, then goes back and fixes the SOF marker. This is a much simpler solution and is probably far more efficient. Even if one wants piped input, buffering the first scan of the JPEG file needs a lot smaller temp file than is implied by the maximum-height method. For

this approach we'd simply treat DNL as a no-op in the decompressor (at most, check that it matches the SOF image height).

We will not worry about making the compressor capable of outputting DNL. Something similar to the first scheme above could be applied if anyone ever wants to make that work.

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/structure.txt

No license file was found, but licenses were detected in source scan.

/\*

\* jdarith.c

\*

\* Developed 1997-2015 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains portable arithmetic entropy decoding routines for JPEG

\* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).

\*

\* Both sequential and progressive modes are supported in this single module.

\*

\* Suspension is not currently supported in this module.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdarith.c

No license file was found, but licenses were detected in source scan.

/\*

\* transupp.c

\*

\* Copyright (C) 1997-2017, Thomas G. Lane, Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains image transformation routines and other utility code

\* used by the jpegtran sample application. These are NOT part of the core

\* JPEG library. But we keep these routines separate from jpegtran.c to

\* ease the task of maintaining jpegtran-like programs that have other user

\* interfaces.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/transupp.c

No license file was found, but licenses were detected in source scan.

```
/*
 * rdswitch.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2003-2015 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains routines to process some of cjpeg's more complicated
 * command-line switches. Switches processed here are:
 * -qtables file Read quantization tables from text file
 * -scans file Read scan script from text file
 * -quality N[,N,...] Set quality ratings
 * -qslots N[,N,...] Set component quantization table selectors
 * -sample HxV[,HxV,...] Set component sampling factors
 */
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdswitch.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jchuff.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2006-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains Huffman entropy encoding routines.
 * Both sequential and progressive modes are supported in this single module.
 *
 * Much of the complexity here has to do with supporting output suspension.
 * If the data destination module demands suspension, we want to be able to
 * back up to the start of the current MCU. To do this, we copy state
 * variables into local working storage, and update them back to the
 * permanent JPEG objects only upon successful completion of an MCU.
 *
 * We do not support output suspension for the progressive JPEG mode, since
 * the library currently does not allow multiple-scan files to be written
 * with output suspension.
 */
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jchuff.c
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* jccoefct.c
*
* Copyright (C) 1994-1997, Thomas G. Lane.
* Modified 2003-2011 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the coefficient buffer controller for compression.
* This controller is the top level of the JPEG compressor proper.
* The coefficient buffer lies between forward-DCT and entropy encoding steps.
*/
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jccoefct.c
```

No license file was found, but licenses were detected in source scan.

```
/*
* jdmainct.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* Modified 2002-2016 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the main buffer controller for decompression.
* The main buffer lies between the JPEG decompressor proper and the
* post-processor; it holds downsampled data in the JPEG colorspace.
*
* Note that this code is bypassed in raw-data mode, since the application
* supplies the equivalent of the main buffer in that case.
*/
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdmainct.c
```

No license file was found, but licenses were detected in source scan.

```
/*
* jmemname.c
*
* Copyright (C) 1992-1997, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file provides a generic implementation of the system-dependent
* portion of the JPEG memory manager. This implementation assumes that
* you must explicitly construct a name for each temp file.
* Also, the problem of determining the amount of memory available
* is shoved onto the user.
```

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemname.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdsample.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2002-2015 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains upsampling routines.

\*

\* Upsampling input data is counted in "row groups". A row group

\* is defined to be  $(v\_samp\_factor * DCT\_v\_scaled\_size / min\_DCT\_v\_scaled\_size)$

\* sample rows of each component. Upsampling will normally produce

\*  $max\_v\_samp\_factor$  pixel rows from each row group (but this could vary

\* if the upsampler is applying a scale factor of its own).

\*

\* An excellent reference for image resampling is

\* Digital Image Warping, George Wolberg, 1990.

\* Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdsample.c

No license file was found, but licenses were detected in source scan.

/\*

\* jctrans.c

\*

\* Copyright (C) 1995-1998, Thomas G. Lane.

\* Modified 2000-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains library routines for transcoding compression,

\* that is, writing raw DCT coefficient arrays to an output JPEG file.

\* The routines in jcapimin.c will also be needed by a transcoder.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jctrans.c

No license file was found, but licenses were detected in source scan.

```

/*
 * jidctint.c
 *
 * Copyright (C) 1991-1998, Thomas G. Lane.
 * Modification developed 2002-2016 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains a slow-but-accurate integer implementation of the
 * inverse DCT (Discrete Cosine Transform). In the IJG code, this routine
 * must also perform dequantization of the input coefficients.
 *
 * A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
 * on each row (or vice versa, but it's more convenient to emit a row at
 * a time). Direct algorithms are also available, but they are much more
 * complex and seem not to be any faster when reduced to code.
 *
 * This implementation is based on an algorithm described in
 * C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT
 * Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,
 * Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.
 * The primary algorithm described there uses 11 multiplies and 29 adds.
 * We use their alternate method with 12 multiplies and 32 adds.
 * The advantage of this method is that no data path contains more than one
 * multiplication; this allows a very simple and accurate implementation in
 * scaled fixed-point arithmetic, with a minimal number of shifts.
 *
 * We also provide IDCT routines with various output sample block sizes for
 * direct resolution reduction or enlargement and for direct resolving the
 * common 2x1 and 1x2 subsampling cases without additional resampling: NxN
 * (N=1...16), 2NxN, and Nx2N (N=1...8) pixels for one 8x8 input DCT block.
 *
 * For N<8 we simply take the corresponding low-frequency coefficients of
 * the 8x8 input DCT block and apply an NxN point IDCT on the sub-block
 * to yield the downsampled outputs.
 * This can be seen as direct low-pass downsampling from the DCT domain
 * point of view rather than the usual spatial domain point of view,
 * yielding significant computational savings and results at least
 * as good as common bilinear (averaging) spatial downsampling.
 *
 * For N>8 we apply a partial NxN IDCT on the 8 input coefficients as
 * lower frequencies and higher frequencies assumed to be zero.
 * It turns out that the computational effort is similar to the 8x8 IDCT
 * regarding the output size.
 * Furthermore, the scaling and descaling is the same for all IDCT sizes.
 *
 * CAUTION: We rely on the FIX() macro except for the N=1,2,4,8 cases
 * since there would be too many additional constants to pre-calculate.

```

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jidctint.c

No license file was found, but licenses were detected in source scan.

## INSTALLATION INSTRUCTIONS for the Independent JPEG Group's JPEG software

Copyright (C) 1991-2017, Thomas G. Lane, Guido Vollbeding.

This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

This file explains how to configure and install the IJG software. We have tried to make this software extremely portable and flexible, so that it can be adapted to almost any environment. The downside of this decision is that the installation process is complicated. We have provided shortcuts to simplify the task on common systems. But in any case, you will need at least a little familiarity with C programming and program build procedures for your system.

If you are only using this software as part of a larger program, the larger program's installation procedure may take care of configuring the IJG code. For example, Ghostscript's installation script will configure the IJG code. You don't need to read this file if you just want to compile Ghostscript.

If you are on a Unix machine, you may not need to read this file at all.

Try doing

```
./configure
```

```
make
```

```
make test
```

If that doesn't complain, do

```
make install
```

(better do "make -n install" first to see if the makefile will put the files where you want them). Read further if you run into snags or want to customize the code for your system.

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-----

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Optimization  
Hints for specific systems

## BEFORE YOU START

=====

Before installing the software you must unpack the distributed source code. Since you are reading this file, you have probably already succeeded in this task. However, there is a potential for error if you needed to convert the files to the local standard text file format (for example, if you are on MS-DOS you may have converted LF end-of-line to CR/LF). You must apply such conversion to all the files EXCEPT those whose names begin with "test". The test files contain binary data; if you change them in any way then the self-test will give bad results.

Please check the last section of this file to see if there are hints for the specific machine or compiler you are using.

## CONFIGURING THE SOFTWARE

=====

To configure the IJG code for your system, you need to create two files:

- \* jconfig.h: contains values for system-dependent #define symbols.
- \* Makefile: controls the compilation process.

(On a non-Unix machine, you may create "project files" or some other substitute for a Makefile. jconfig.h is needed in any environment.)

We provide three different ways to generate these files:

- \* On a Unix system, you can just run the "configure" script.
- \* We provide sample jconfig files and makefiles for popular machines; if your machine matches one of the samples, just copy the right sample files to jconfig.h and Makefile.
- \* If all else fails, read the instructions below and make your own files.

Configuring the software using the automatic "configure" script

-----

If you are on a Unix machine, you can just type

```
./configure
```

and let the configure script construct appropriate configuration files.

If you're using "csh" on an old version of System V, you might need to type

```
sh configure
```

instead to prevent csh from trying to execute configure itself.

Expect configure to run for a few minutes, particularly on slower machines;



it works by compiling a series of test programs.

Configure was created with GNU Autoconf and it follows the usual conventions for GNU configure scripts. It makes a few assumptions that you may want to override. You can do this by providing optional switches to configure:

\* Configure will build both static and shared libraries, if possible.

If you want to build libjpeg only as a static library, say

```
./configure --disable-shared
```

If you want to build libjpeg only as a shared library, say

```
./configure --disable-static
```

Configure uses GNU libtool to take care of system-dependent shared library building methods.

\* Configure will use gcc (GNU C compiler) if it's available, otherwise cc.

To force a particular compiler to be selected, use the CC option, for example

```
./configure CC='cc'
```

The same method can be used to include any unusual compiler switches.

For example, on HP-UX you probably want to say

```
./configure CC='cc -Aa'
```

to get HP's compiler to run in ANSI mode.

\* The default CFLAGS setting is "-g" for non-gcc compilers, "-g -O2" for gcc.

You can override this by saying, for example,

```
./configure CFLAGS='-O2'
```

if you want to compile without debugging support.

\* Configure will set up the makefile so that "make install" will install files into /usr/local/bin, /usr/local/man, etc. You can specify an installation prefix other than "/usr/local" by giving configure the option "--prefix=PATH".

\* If you don't have a lot of swap space, you may need to enable the IJG software's internal virtual memory mechanism. To do this, give the option "--enable-maxmem=N" where N is the default maxmemory limit in megabytes. This is discussed in more detail under "Selecting a memory manager", below. You probably don't need to worry about this on reasonably-sized Unix machines, unless you plan to process very large images.

Configure has some other features that are useful if you are cross-compiling or working in a network of multiple machine types; but if you need those features, you probably already know how to use them.

Configuring the software using one of the supplied jconfig and makefile files

-----

If you have one of these systems, you can just use the provided configuration files:

Makefile jconfig file System and/or compiler

makefile.manx jconfig.manx Amiga, Manx Aztec C  
makefile.sas jconfig.sas Amiga, SAS C  
makeproj.mac jconfig.mac Apple Macintosh, Metrowerks CodeWarrior  
mak\*jpeg.st jconfig.st Atari ST/STE/TT, Pure C or Turbo C  
makefile.bcc jconfig.bcc MS-DOS or OS/2, Borland C  
makefile.dj jconfig.dj MS-DOS, DJGPP (Delorie's port of GNU C)  
makefile.mc6 jconfig.mc6 MS-DOS, Microsoft C (16-bit only)  
makefile.wat jconfig.wat MS-DOS, OS/2, or Windows NT, Watcom C  
makefile.vc jconfig.vc Windows, MS Visual C++  
makefile.vs jconfig.vc Windows, MS Visual C++ 6 Developer Studio  
make\*.vc6  
makefile.vs jconfig.vc Windows, Visual Studio 2017 (v15)  
make\*.v15  
makefile.b32 jconfig.vc Windows, Borland C++ 32-bit (bcc32)  
makefile.mms jconfig.vms Digital VMS, with MMS software  
makefile.vms jconfig.vms Digital VMS, without MMS software

Copy the proper jconfig file to jconfig.h and the makefile to Makefile (or whatever your system uses as the standard makefile name). For more info see the appropriate system-specific hints section near the end of this file.

Configuring the software by hand

-----

First, generate a jconfig.h file. If you are moderately familiar with C, the comments in jconfig.txt should be enough information to do this; just copy jconfig.txt to jconfig.h and edit it appropriately. Otherwise, you may prefer to use the ckconfig.c program. You will need to compile and execute ckconfig.c by hand --- we hope you know at least enough to do that. ckconfig.c may not compile the first try (in fact, the whole idea is for it to fail if anything is going to). If you get compile errors, fix them by editing ckconfig.c according to the directions given in ckconfig.c. Once you get it to run, it will write a suitable jconfig.h file, and will also print out some advice about which makefile to use.

You may also want to look at the canned jconfig files, if there is one for a system similar to yours.

Second, select a makefile and copy it to Makefile (or whatever your system uses as the standard makefile name). The most generic makefiles we provide are

makefile.ansi: if your C compiler supports function prototypes  
makefile.unix: if not.

(You have function prototypes if ckconfig.c put "#define HAVE\_PROTOTYPES"

in jconfig.h.) You may want to start from one of the other makefiles if there is one for a system similar to yours.

Look over the selected Makefile and adjust options as needed. In particular you may want to change the CC and CFLAGS definitions. For instance, if you are using GCC, set CC=gcc. If you had to use any compiler switches to get ckconfig.c to work, make sure the same switches are in CFLAGS.

If you are on a system that doesn't use makefiles, you'll need to set up project files (or whatever you do use) to compile all the source files and link them into executable files cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom. See the file lists in any of the makefiles to find out which files go into each program. Note that the provided makefiles all make a "library" file libjpeg first, but you don't have to do that if you don't want to; the file lists identify which source files are actually needed for compression, decompression, or both. As a last resort, you can make a batch script that just compiles everything and links it all together; makefile.vms is an example of this (it's for VMS systems that have no make-like utility).

Here are comments about some specific configuration decisions you'll need to make:

#### Command line style

-----

These programs can use a Unix-like command line style which supports redirection and piping, like this:

```
cjpeg inputfile >outputfile
```

```
cjpeg <inputfile >outputfile
```

```
source program | cjpeg >outputfile
```

The simpler "two file" command line style is just

```
cjpeg inputfile outputfile
```

You may prefer the two-file style, particularly if you don't have pipes.

You **MUST** use two-file style on any system that doesn't cope well with binary data fed through stdin/stdout; this is true for some MS-DOS compilers, for example. If you're not on a Unix system, it's safest to assume you need two-file style. (But if your compiler provides either the Posix-standard fdopen() library routine or a Microsoft-compatible setmode() routine, you can safely use the Unix command line style, by defining USE\_FDOPEN or USE\_SETMODE respectively.)

To use the two-file style, make jconfig.h say "#define TWO\_FILE\_COMMANDLINE".

#### Selecting a memory manager

-----

The IJG code is capable of working on images that are too big to fit in main

memory; data is swapped out to temporary files as necessary. However, the code to do this is rather system-dependent. We provide five different memory managers:

- \* `jmemansi.c` This version uses the ANSI-standard library routine `tmpfile()`, which not all non-ANSI systems have. On some systems `tmpfile()` may put the temporary file in a non-optimal location; if you don't like what it does, use `jmemname.c`.
- \* `jmemname.c` This version creates named temporary files. For anything except a Unix machine, you'll need to configure the `select_file_name()` routine appropriately; see the comments near the head of `jmemname.c`. If you use this version, define `NEED_SIGNAL_CATCHER` in `jconfig.h` to make sure the temp files are removed if the program is aborted.
- \* `jmemnobs.c` (That stands for No Backing Store :-).) This will compile on almost any system, but it assumes you have enough main memory or virtual memory to hold the biggest images you work with.
- \* `jmemdos.c` This should be used with most 16-bit MS-DOS compilers. See the system-specific notes about MS-DOS for more info. **IMPORTANT:** if you use this, define `USE_MSDDOS_MEMMGR` in `jconfig.h`, and include the assembly file `jmemdosa.asm` in the programs. The supplied makefiles and `jconfig` files for 16-bit MS-DOS compilers already do both.
- \* `jmemmac.c` Custom version for Apple Macintosh; see the system-specific notes for Macintosh for more info.

To use a particular memory manager, change the `SYSDEPMEM` variable in your makefile to equal the corresponding object file name (for example, `jmemansi.o` or `jmemansi.obj` for `jmemansi.c`).

If you have plenty of (real or virtual) main memory, just use `jmemnobs.c`.

"Plenty" means about ten bytes for every pixel in the largest images you plan to process, so a lot of systems don't meet this criterion.

If yours doesn't, try `jmemansi.c` first. If that doesn't compile, you'll have to use `jmemname.c`; be sure to adjust `select_file_name()` for local conditions. You may also need to change `unlink()` to `remove()` in `close_backing_store()`.

Except with `jmemnobs.c` or `jmemmac.c`, you need to adjust the `DEFAULT_MAX_MEM` setting to a reasonable value for your system (either by adding a `#define` for `DEFAULT_MAX_MEM` to `jconfig.h`, or by adding a `-D` switch to the Makefile). This value limits the amount of data space the program will attempt to allocate. Code and static data space isn't counted, so the actual memory needs for `cjpeg` or `djpeg` are typically 100 to 150Kb more than the max-memory setting. Larger max-memory settings reduce the amount of I/O needed to

process a large image, but too large a value can result in "insufficient memory" failures. On most Unix machines (and other systems with virtual memory), just set `DEFAULT_MAX_MEM` to several million and forget it. At the other end of the spectrum, for MS-DOS machines you probably can't go much above 300K to 400K. (On MS-DOS the value refers to conventional memory only. Extended/expanded memory is handled separately by `jmemdos.c`.)

## BUILDING THE SOFTWARE

=====

Now you should be able to compile the software. Just say "make" (or whatever's necessary to start the compilation). Have a cup of coffee.

Here are some things that could go wrong:

If your compiler complains about undefined structures, you should be able to shut it up by putting `#define INCOMPLETE_TYPES_BROKEN` in `jconfig.h`.

If you have trouble with missing system include files or inclusion of the wrong ones, read `jinclude.h`. This shouldn't happen if you used `configure` or `ckconfig.c` to set up `jconfig.h`.

There are a fair number of routines that do not use all of their parameters; some compilers will issue warnings about this, which you can ignore. There are also a few configuration checks that may give "unreachable code" warnings. Any other warning deserves investigation.

If you don't have a `getenv()` library routine, define `NO_GETENV`.

Also see the system-specific hints, below.

## TESTING THE SOFTWARE

=====

As a quick test of functionality we've included a small sample image in several forms:

`testorig.jpg` Starting point for the djpeg tests.

`testimg.ppm` The output of djpeg `testorig.jpg`

`testimg.bmp` The output of djpeg `-bmp -colors 256 testorig.jpg`

`testimg.jpg` The output of cjpeg `testimg.ppm`

`testprog.jpg` Progressive-mode equivalent of `testorig.jpg`.

`testimgp.jpg` The output of cjpeg `-progressive -optimize testimg.ppm`

(The first- and second-generation `.jpg` files aren't identical since the default compression parameters are lossy.) If you can generate duplicates of the `testimg*` files then you probably have working programs.

With most of the makefiles, "make test" will perform the necessary comparisons.

If you're using a makefile that doesn't provide the test option, run djpeg and cjpeg by hand and compare the output files to testing\* with whatever binary file comparison tool you have. The files should be bit-for-bit identical.

If the programs complain "MAX\_ALLOC\_CHUNK is wrong, please fix", then you need to reduce MAX\_ALLOC\_CHUNK to a value that fits in type size\_t. Try adding "#define MAX\_ALLOC\_CHUNK 65520L" to jconfig.h. A less likely configuration error is "ALIGN\_TYPE is wrong, please fix": defining ALIGN\_TYPE as long should take care of that one.

If the cjpeg test run fails with "Missing Huffman code table entry", it's a good bet that you needed to define RIGHT\_SHIFT\_IS\_UNSIGNED. Go back to the configuration step and run ckconfig.c. (This is a good plan for any other test failure, too.)

If you are using Unix (one-file) command line style on a non-Unix system, it's a good idea to check that binary I/O through stdin/stdout actually works. You should get the same results from "djpeg <testorig.jpg >out.ppm" as from "djpeg -outfile out.ppm testorig.jpg". Note that the makefiles all use the latter style and therefore do not exercise stdin/stdout! If this check fails, try recompiling with USE\_SETMODE or USE\_FDOPEN defined. If it still doesn't work, better use two-file style.

If you chose a memory manager other than jmemnobs.c, you should test that temporary-file usage works. Try "djpeg -bmp -colors 256 -max 0 testorig.jpg" and make sure its output matches testing.bmp. If you have any really large images handy, try compressing them with -optimize and/or decompressing with -colors 256 to make sure your DEFAULT\_MAX\_MEM setting is not too large.

NOTE: this is far from an exhaustive test of the JPEG software; some modules, such as 1-pass color quantization, are not exercised at all. It's just a quick test to give you some confidence that you haven't missed something major.

## INSTALLING THE SOFTWARE

=====

Once you're done with the above steps, you can install the software by copying the executable files (cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom) to wherever you normally install programs. On Unix systems, you'll also want to put the man pages (cjpeg.1, djpeg.1, jpegtran.1, rdjpgcom.1, wrjpgcom.1) in the man-page directory. The pre-fab makefiles don't support this step since there's such a wide variety of installation procedures on different

systems.

If you generated a Makefile with the "configure" script, you can just say  
make install  
to install the programs and their man pages into the standard places.  
(You'll probably need to be root to do this.) We recommend first saying  
make -n install  
to see where configure thought the files should go. You may need to edit  
the Makefile, particularly if your system's conventions for man page  
filenames don't match what configure expects.

If you want to install the IJG library itself, for use in compiling other  
programs besides ours, then you need to put the four include files  
jpeglib.h jerror.h jconfig.h jmorecfg.h  
into your include-file directory, and put the library file libjpeg.a  
(extension may vary depending on system) wherever library files go.  
If you generated a Makefile with "configure", it will do what it thinks  
is the right thing if you say  
make install-lib

#### OPTIONAL STUFF

=====

Progress monitor:

If you like, you can #define PROGRESS\_REPORT (in jconfig.h) to enable display  
of percent-done progress reports. The routine provided in cdjpeg.c merely  
prints percentages to stderr, but you can customize it to do something  
fancier.

Utah RLE file format support:

We distribute the software with support for RLE image files (Utah Raster  
Toolkit format) disabled, because the RLE support won't compile without the  
Utah library. If you have URT version 3.1 or later, you can enable RLE  
support as follows:

1. #define RLE\_SUPPORTED in jconfig.h.
2. Add a -I option to CFLAGS in the Makefile for the directory  
containing the URT .h files (typically the "include"  
subdirectory of the URT distribution).
3. Add -L... -lrle to LDLIBS in the Makefile, where ... specifies  
the directory containing the URT "librle.a" file (typically the  
"lib" subdirectory of the URT distribution).

Support for 9-bit to 12-bit deep pixel data:

The IJG code currently allows 8, 9, 10, 11, or 12 bits sample data precision.

(For color, this means 8 to 12 bits per channel, of course.) If you need to work with deeper than 8-bit data, you can compile the IJG code for 9-bit to 12-bit operation.

To do so:

1. In `jmorecfg.h`, define `BITS_IN_JSAMPLE` as 9, 10, 11, or 12 rather than 8.
2. In `jconfig.h`, undefine `BMP_SUPPORTED`, `RLE_SUPPORTED`, and `TARGA_SUPPORTED`, because the code for those formats doesn't handle deeper than 8-bit data and won't even compile. (The PPM code does work, as explained below. The GIF code works too; it scales 8-bit GIF data to and from 12-bit depth automatically.)
3. Compile. Don't expect "make test" to pass, since the supplied test files are for 8-bit data.

Currently, 9-bit to 12-bit support does not work on 16-bit-int machines.

Run-time selection and conversion of data precision are currently not supported and may be added later.

Exception: The transcoding part (`jpegtran`) supports all settings in a single instance, since it operates on the level of DCT coefficients and not sample values.

The PPM reader (`rdppm.c`) can read deeper than 8-bit data from either text-format or binary-format PPM and PGM files. Binary-format PPM/PGM files which have a `maxval` greater than 255 are assumed to use 2 bytes per sample, MSB first (big-endian order). As of early 1995, 2-byte binary format is not officially supported by the `PBMPLUS` library, but it is expected that a future release of `PBMPLUS` will support it. Note that the PPM reader will read files of any `maxval` regardless of the `BITS_IN_JSAMPLE` setting; incoming data is automatically rescaled to `maxval=MAXJSAMPLE` as appropriate for the `cjpeg` bit depth.

The PPM writer (`wrppm.c`) will normally write 2-byte binary PPM or PGM format, `maxval=MAXJSAMPLE`, when compiled with `BITS_IN_JSAMPLE>8`. Since this format is not yet widely supported, you can disable it by compiling `wrppm.c` with `PPM_NORAWWORD` defined; then the data is scaled down to 8 bits to make a standard 1-byte/sample PPM or PGM file. (Yes, this means still another copy of `djpeg` to keep around. But hopefully you won't need it for very long. Poskanzer's supposed to get that new `PBMPLUS` release out Real Soon Now.)

Of course, if you are working with 9-bit to 12-bit data, you probably have it stored in some other, nonstandard format. In that case you'll probably want to write your own I/O modules to read and write your format.

Note:

The standard Huffman tables are only valid for 8-bit data precision. If you selected more than 8-bit data precision, `cjpeg` uses arithmetic coding by default. The Huffman encoder normally uses entropy optimization to compute usable tables for higher precision. Otherwise, you'll have to



supply different default Huffman tables.

Removing code:

If you need to make a smaller version of the JPEG software, some optional functions can be removed at compile time. See the `xxx_SUPPORTED` #defines in `jconfig.h` and `jmorecfg.h`. If at all possible, we recommend that you leave in decoder support for all valid JPEG files, to ensure that you can read anyone's output. Taking out support for image file formats that you don't use is the most painless way to make the programs smaller. Another possibility is to remove some of the DCT methods: in particular, the "IFAST" method may not be enough faster than the others to be worth keeping on your machine. (If you do remove ISLOW or IFAST, be sure to redefine `JDCT_DEFAULT` or `JDCT_FASTEST` to a supported method, by adding a #define in `jconfig.h`.)

## OPTIMIZATION

=====

Unless you own a Cray, you'll probably be interested in making the JPEG software go as fast as possible. This section covers some machine-dependent optimizations you may want to try. We suggest that before trying any of this, you first get the basic installation to pass the self-test step.

Repeat the self-test after any optimization to make sure that you haven't broken anything.

The integer DCT routines perform a lot of multiplications. These multiplications must yield 32-bit results, but none of their input values are more than 16 bits wide. On many machines, notably the 680x0 and 80x86 CPUs, a 16x16=>32 bit multiply instruction is faster than a full 32x32=>32 bit multiply. Unfortunately there is no portable way to specify such a multiplication in C, but some compilers can generate one when you use the right combination of casts. See the `MULTIPLYxxx` macro definitions in `jdct.h`. If your compiler makes "int" be 32 bits and "short" be 16 bits, defining `SHORTxSHORT_32` is fairly likely to work. When experimenting with alternate definitions, be sure to test not only whether the code still works (use the self-test), but also whether it is actually faster --- on some compilers, alternate definitions may compute the right answer, yet be slower than the default. Timing `cjpeg` on a large PGM (grayscale) input file is the best way to check this, as the DCT will be the largest fraction of the runtime in that mode. (Note: some of the distributed compiler-specific `jconfig` files already contain #define switches to select appropriate `MULTIPLYxxx` definitions.)

If your machine has sufficiently fast floating point hardware, you may find that the float DCT method is faster than the integer DCT methods, even after tweaking the integer multiply macros. In that case you may want to make the float DCT be the default method. (The only objection to this is

that float DCT results may vary slightly across machines.) To do that, add "#define JDCT\_DEFAULT JDCT\_FLOAT" to jconfig.h. Even if you don't change the default, you should redefine JDCT\_FASTEST, which is the method selected by djpeg's -fast switch. Don't forget to update the documentation files (usage.txt and/or cjpeg.1, djpeg.1) to agree with what you've done.

If access to "short" arrays is slow on your machine, it may be a win to define type JCOEF as int rather than short. This will cost a good deal of memory though, particularly in some multi-pass modes, so don't do it unless you have memory to burn and short is REALLY slow.

If your compiler can compile function calls in-line, make sure the INLINE macro in jmorecfg.h is defined as the keyword that marks a function inline-able. Some compilers have a switch that tells the compiler to inline any function it thinks is profitable (e.g., -finline-functions for gcc). Enabling such a switch is likely to make the compiled code bigger but faster.

In general, it's worth trying the maximum optimization level of your compiler, and experimenting with any optional optimizations such as loop unrolling. (Unfortunately, far too many compilers have optimizer bugs ... be prepared to back off if the code fails self-test.) If you do any experimentation along these lines, please report the optimal settings to jpeg-info@jpegclub.org so we can mention them in future releases. Be sure to specify your machine and compiler version.

#### HINTS FOR SPECIFIC SYSTEMS

=====

We welcome reports on changes needed for systems not mentioned here. Submit 'em to jpeg-info@jpegclub.org. Also, if configure or ckconfig.c is wrong about how to configure the JPEG software for your system, please let us know.

Acorn RISC OS:

(Thanks to Simon Middleton for these hints on compiling with Desktop C.)  
After renaming the files according to Acorn conventions, take a copy of makefile.ansi, change all occurrences of 'libjpeg.a' to 'libjpeg.o' and change these definitions as indicated:

```
CFLAGS= -throwback -IC: -Wn
LDLIBS=C:o.Stubs
SYSDEPMEM=jmemansi.o
LN=Link
AR=LibFile -c -o
```

Also add a new line '.c.o; \$(cc) \$< \$(cflags) -c -o \$@'. Remove the

lines '\$(RM) libjpeg.o' and '\$(AR2) libjpeg.o' and the 'jconfig.h' dependency section.

Copy jconfig.txt to jconfig.h. Edit jconfig.h to define TWO\_FILE\_COMMANDLINE and CHAR\_IS\_UNSIGNED.

Run the makefile using !AMU not !Make. If you want to use the 'clean' and 'test' makefile entries then you will have to fiddle with the syntax a bit and rename the test files.

Amiga:

SAS C 6.50 reportedly is too buggy to compile the IJG code properly. A patch to update to 6.51 is available from SAS or AmiNet FTP sites.

The supplied config files are set up to use jmemname.c as the memory manager, with temporary files being created on the device named by "JPEGTMP:".

Atari ST/STE/TT:

Copy the project files makcjpeg.st, makdjpeg.st, maktjpeg.st, and makljpeg.st to cjpeg.prj, djpeg.prj, jpegtran.prj, and libjpeg.prj respectively. The project files should work as-is with Pure C. For Turbo C, change library filenames "pc..." to "tc..." in each project file. Note that libjpeg.prj selects jmemansi.c as the recommended memory manager. You'll probably want to adjust the DEFAULT\_MAX\_MEM setting --- you want it to be a couple hundred K less than your normal free memory. Put "#define DEFAULT\_MAX\_MEM nnnn" into jconfig.h to do this.

To use the 68881/68882 coprocessor for the floating point DCT, add the compiler option "-8" to the project files and replace pcfltlb.lib with pc881lib.lib in cjpeg.prj and djpeg.prj. Or if you don't have a coprocessor, you may prefer to remove the float DCT code by undefining DCT\_FLOAT\_SUPPORTED in jmorecfg.h (since without a coprocessor, the float code will be too slow to be useful). In that case, you can delete pcfltlb.lib from the project files.

Note that you must make libjpeg.lib before making cjpeg.ttp, djpeg.ttp, or jpegtran.ttp. You'll have to perform the self-test by hand.

We haven't bothered to include project files for rdjpgcom and wrjpgcom. Those source files should just be compiled by themselves; they don't depend on the JPEG library. You can use the default.prj project file of the Pure C distribution to make the programs.

There is a bug in some older versions of the Turbo C library which causes the space used by temporary files created with "tmpfile()" not to be freed after an abnormal program exit. If you check your disk afterwards, you will find cluster chains that are allocated but not used by a file. This should not happen in cjpeg/djpeg/jpegtran, since we enable a signal catcher to explicitly close temp files before exiting. But if you use the JPEG library with your own code, be sure to supply a signal catcher, or else use a different system-dependent memory manager.

Cray:

Should you be so fortunate as to be running JPEG on a Cray YMP, there is a compiler bug in old versions of Cray's Standard C (prior to 3.1). If you still have an old compiler, you'll need to insert a line reading "#pragma novector" just before the loop

```
for (i = 1; i <= (int) htbl->bits[i]; i++)
 huffsize[p++] = (char) i;
```

in fix\_huff\_tbl (in V5beta1, line 204 of jchuff.c and line 176 of jd Huff.c). [This bug may or may not still occur with the current IJG code, but it's probably a dead issue anyway...]

HP-UX:

If you have HP-UX 7.05 or later with the "software development" C compiler, you should run the compiler in ANSI mode. If using the configure script, say

```
./configure CC='cc -Aa'
```

(or -Ae if you prefer). If configuring by hand, use makefile.ansi and add "-Aa" to the CFLAGS line in the makefile.

If you have a pre-7.05 system, or if you are using the non-ANSI C compiler delivered with a minimum HP-UX system, then you must use makefile.unix (and do NOT add -Aa); or just run configure without the CC option.

On HP 9000 series 800 machines, the HP C compiler is buggy in revisions prior to A.08.07. If you get complaints about "not a typedef name", you'll have to use makefile.unix, or run configure without the CC option.

Macintosh, generic comments:

The supplied user-interface files (cjpeg.c, djpeg.c, etc) are set up to provide a Unix-style command line interface. You can use this interface on the Mac by means of the ccommand() library routine provided by Metrowerks CodeWarrior or Think C. This is only appropriate for testing the library, however; to make a user-friendly equivalent of cjpeg/djpeg you'd really want

to develop a Mac-style user interface. There isn't a complete example available at the moment, but there are some helpful starting points:

1. Sam Bushell's free "To JPEG" applet provides drag-and-drop conversion to JPEG under System 7 and later. This only illustrates how to use the compression half of the library, but it does a very nice job of that part. The CodeWarrior source code is available from <http://www.pobox.com/~jsam>.
2. Jim Brunner prepared a Mac-style user interface for both compression and decompression. Unfortunately, it hasn't been updated since IJG v4, and the library's API has changed considerably since then. Still it may be of some help, particularly as a guide to compiling the IJG code under Think C. Jim's code is available from the Info-Mac archives, at [sumex-aim.stanford.edu](http://sumex-aim.stanford.edu) or mirrors thereof; see file `/info-mac/dev/src/jpeg-convert-c.hqx`.

`jmemmac.c` is the recommended memory manager back end for Macintosh. It uses `NewPtr/DisposePtr` instead of `malloc/free`, and has a Mac-specific implementation of `jpeg_mem_available()`. It also creates temporary files that follow Mac conventions. (That part of the code relies on System-7-or-later OS functions. See the comments in `jmemmac.c` if you need to run it on System 6.) NOTE that `USE_MAC_MEMMGR` must be defined in `jconfig.h` to use `jmemmac.c`.

You can also use `jmemnobs.c`, if you don't care about handling images larger than available memory. If you use any memory manager back end other than `jmemmac.c`, we recommend replacing "malloc" and "free" by "NewPtr" and "DisposePtr", because Mac C libraries often have peculiar implementations of `malloc/free`. (For instance, `free()` may not return the freed space to the Mac Memory Manager. This is undesirable for the IJG code because `jmemmgr.c` already clumps space requests.)

Macintosh, Metrowerks CodeWarrior:

The Unix-command-line-style interface can be used by defining `USE_CCOMMAND`. You'll also need to define `TWO_FILE_COMMANDLINE` to avoid `stdin/stdout`. This means that when using the `cjpeg/djpeg` programs, you'll have to type the input and output file names in the "Arguments" text-edit box, rather than using the file radio buttons. (Perhaps `USE_FDOPEN` or `USE_SETMODE` would eliminate the problem, but I haven't heard from anyone who's tried it.)

On 680x0 Macs, Metrowerks defines type "double" as a 10-byte IEEE extended float. `jmemmgr.c` won't like this: it wants `sizeof(ALIGN_TYPE)` to be a power of 2. Add `#define ALIGN_TYPE long` to `jconfig.h` to eliminate the complaint.

The supplied configuration file `jconfig.mac` can be used for your `jconfig.h`; it includes all the recommended symbol definitions. If you have AppleScript installed, you can run the supplied script `makeproj.mac` to create CodeWarrior project files for the library and the testbed applications, then build the library and applications. (Thanks to Dan Sears and Don Agro for this nifty hack, which saves us from trying to maintain CodeWarrior project files as part

of the IJG distribution...)

Macintosh, Think C:

The documentation in Jim Brunner's "JPEG Convert" source code (see above) includes detailed build instructions for Think C; it's probably somewhat out of date for the current release, but may be helpful.

If you want to build the minimal command line version, proceed as follows. You'll have to prepare project files for the programs; we don't include any in the distribution since they are not text files. Use the file lists in any of the supplied makefiles as a guide. Also add the ANSI and Unix C libraries in a separate segment. You may need to divide the JPEG files into more than one segment; we recommend dividing compression and decompression modules. Define `USE_CCOMMAND` in `jconfig.h` so that the `ccommand()` routine is called. You must also define `TWO_FILE_COMMANDLINE` because `stdin/stdout` don't handle binary data correctly.

On 680x0 Macs, Think C defines type "double" as a 12-byte IEEE extended float. `jmemmgr.c` won't like this: it wants `sizeof(ALIGN_TYPE)` to be a power of 2. Add `#define ALIGN_TYPE long` to `jconfig.h` to eliminate the complaint.

`jconfig.mac` should work as a `jconfig.h` configuration file for Think C, but the `makeproj.mac` AppleScript script is specific to CodeWarrior. Sorry.

MIPS R3000:

MIPS's `cc` version 1.31 has a rather nasty optimization bug. Don't use `-O` if you have that compiler version. (Use `"cc -V"` to check the version.) Note that the R3000 chip is found in workstations from DEC and others.

MS-DOS, generic comments for 16-bit compilers:

The IJG code is designed to work well in 80x86 "small" or "medium" memory models (i.e., data pointers are 16 bits unless explicitly declared "far"; code pointers can be either size). You may be able to use small model to compile `cjpeg` or `djpeg` by itself, but you will probably have to use medium model for any larger application. This won't make much difference in performance. You *will* take a noticeable performance hit if you use a large-data memory model, and you should avoid "huge" model if at all possible. Be sure that `NEED_FAR_POINTERS` is defined in `jconfig.h` if you use a small-data memory model; be sure it is NOT defined if you use a large-data model. (The supplied makefiles and `jconfig` files for Borland and Microsoft C compile in medium model and define `NEED_FAR_POINTERS`.)

The DOS-specific memory manager, `jmemdos.c`, should be used if possible. It needs some assembly-code routines which are in `jmemdosa.asm`; make sure your makefile assembles that file and includes it in the library. If you don't have a suitable assembler, you can get pre-assembled object files for `jmemdosa` by FTP from `ftp.uu.net:/graphics/jpeg/jdosaobj.zip`. (DOS-oriented distributions of the IJG source code often include these object files.)

When using `jmemdos.c`, `jconfig.h` must define `USE_MSDOS_MEMMGR` and must set `MAX_ALLOC_CHUNK` to less than 64K (65520L is a typical value). If your C library's far-heap `malloc()` can't allocate blocks that large, reduce `MAX_ALLOC_CHUNK` to whatever it can handle.

If you can't use `jmemdos.c` for some reason --- for example, because you don't have an assembler to assemble `jmemdosa.asm` --- you'll have to fall back to `jmemansi.c` or `jmemname.c`. You'll probably still need to set `MAX_ALLOC_CHUNK` in `jconfig.h`, because most DOS C libraries won't `malloc()` more than 64K at a time. **IMPORTANT:** if you use `jmemansi.c` or `jmemname.c`, you will have to compile in a large-data memory model in order to get the right stdio library. Too bad.

`wrjpgcom` needs to be compiled in large model, because it `malloc()`s a 64KB work area to hold the comment text. If your C library's `malloc` can't handle that, reduce `MAX_COM_LENGTH` as necessary in `wrjpgcom.c`.

Most MS-DOS compilers treat `stdin/stdout` as text files, so you must use two-file command line style. But if your compiler has either `fdopen()` or `setmode()`, you can use one-file style if you like. To do this, define `USE_SETMODE` or `USE_FDOPEN` so that `stdin/stdout` will be set to binary mode. (`USE_SETMODE` seems to work with more DOS compilers than `USE_FDOPEN`.) You should test that I/O through `stdin/stdout` produces the same results as I/O to explicitly named files... the "make test" procedures in the supplied makefiles do NOT use `stdin/stdout`.

MS-DOS, generic comments for 32-bit compilers:

None of the above comments about memory models apply if you are using a 32-bit flat-memory-space environment, such as DJGPP or Watcom C. (And you should use one if you have it, as performance will be much better than 8086-compatible code!) For flat-memory-space compilers, do NOT define `NEED_FAR_POINTERS`, and do NOT use `jmemdos.c`. Use `jmemnobs.c` if the environment supplies adequate virtual memory, otherwise use `jmemansi.c` or `jmemname.c`.

You'll still need to be careful about binary I/O through `stdin/stdout`. See the last paragraph of the previous section.

MS-DOS, Borland C:

Be sure to convert all the source files to DOS text format (CR/LF newlines). Although Borland C will often work OK with unmodified Unix (LF newlines) source files, sometimes it will give bogus compile errors. "Illegal character '#'" is the most common such error. (This is true with Borland C 3.1, but perhaps is fixed in newer releases.)

If you want one-file command line style, just undefine TWO\_FILE\_COMMANDLINE. jconfig.bcc already includes #define USE\_SETMODE to make this work. (fdopen does not work correctly.)

MS-DOS, Microsoft C:

makefile.mc6 works with Microsoft C, DOS Visual C++, etc. It should only be used if you want to build a 16-bit (small or medium memory model) program.

If you want one-file command line style, just undefine TWO\_FILE\_COMMANDLINE. jconfig.mc6 already includes #define USE\_SETMODE to make this work. (fdopen does not work correctly.)

Note that this makefile assumes that the working copy of itself is called "makefile". If you want to call it something else, say "makefile.mak", be sure to adjust the dependency line that reads "\$(RFILE) : makefile". Otherwise the make will fail because it doesn't know how to create "makefile". Worse, some releases of Microsoft's make utilities give an incorrect error message in this situation.

Old versions of MS C fail with an "out of macro expansion space" error because they can't cope with the macro TRACEMS8 (defined in jerror.h). If this happens to you, the easiest solution is to change TRACEMS8 to expand to nothing. You'll lose the ability to dump out JPEG coefficient tables with djpeg -debug -debug, but at least you can compile.

Original MS C 6.0 is very buggy; it compiles incorrect code unless you turn off optimization entirely (remove -O from CFLAGS). 6.00A is better, but it still generates bad code if you enable loop optimizations (-Ol or -Ox).

MS C 8.0 crashes when compiling jquant1.c with optimization switch /Oo ... which is on by default. To work around this bug, compile that one file with /Oo-.

Microsoft Windows (all versions), generic comments:

Some Windows system include files define typedef boolean as "unsigned char". The IJG code also defines typedef boolean, but we make it an "enum" by default.



This doesn't affect the IJG programs because we don't import those Windows include files. But if you use the JPEG library in your own program, and some of your program's files import one definition of boolean while some import the other, you can get all sorts of mysterious problems. A good preventive step is to make the IJG library use "unsigned char" for boolean. To do that, add something like this to your jconfig.h file:

```
/* Define "boolean" as unsigned char, not enum, per Windows custom */
#ifndef __RPCNDR_H__ /* don't conflict if rpcndr.h already read */
typedef unsigned char boolean;
#endif
#ifndef FALSE /* in case these macros already exist */
#define FALSE 0 /* values of boolean */
#endif
#ifndef TRUE
#define TRUE 1
#endif
#define HAVE_BOOLEAN /* prevent jmorecfg.h from redefining it */
(This is already in jconfig.vc, by the way.)
```

windef.h contains the declarations

```
#define far
#define FAR far
```

Since jmorecfg.h tries to define FAR as empty, you may get a compiler warning if you include both jpeglib.h and windef.h (which windows.h includes). To suppress the warning, you can put "#ifndef FAR"/"#endif" around the line "#define FAR" in jmorecfg.h.

(Something like this is already in jmorecfg.h, by the way.)

When using the library in a Windows application, you will almost certainly want to modify or replace the error handler module jerror.c, since our default error handler does a couple of inappropriate things:

1. it tries to write error and warning messages on stderr;
2. in event of a fatal error, it exits by calling exit().

A simple stopgap solution for problem 1 is to replace the line

```
fprintf(stderr, "%s\n", buffer);
```

(in output\_message in jerror.c) with

```
MessageBox(GetActiveWindow(),buffer,"JPEG Error",MB_OK|MB_ICONERROR);
```

It's highly recommended that you at least do that much, since otherwise error messages will disappear into nowhere. (Beginning with IJG v6b, this code is already present in jerror.c; just define USE\_WINDOWS\_MESSAGEBOX in jconfig.h to enable it.)

The proper solution for problem 2 is to return control to your calling application after a library error. This can be done with the setjmp/longjmp technique discussed in libjpeg.txt and illustrated in example.c. (NOTE: some older Windows C compilers provide versions of setjmp/longjmp that don't actually work under Windows. You may need to use the Windows system

functions Catch and Throw instead.)

The recommended memory manager under Windows is `jmemnobs.c`; in other words, let Windows do any virtual memory management needed. You should NOT use `jmemdos.c` nor `jmemdosa.asm` under Windows.

For Windows 3.1, we recommend compiling in medium or large memory model; for newer Windows versions, use a 32-bit flat memory model. (See the MS-DOS sections above for more info about memory models.) In the 16-bit memory models only, you'll need to put

```
#define MAX_ALLOC_CHUNK 65520L /* Maximum request to malloc() */
```

into `jconfig.h` to limit allocation chunks to 64Kb. (Without that, you'd have to use huge memory model, which slows things down unnecessarily.) `jmemnobs.c` works without modification in large or flat memory models, but to use medium model, you need to modify its `jpeg_get_large` and `jpeg_free_large` routines to allocate far memory. In any case, you might like to replace its calls to `malloc` and `free` with direct calls on Windows memory allocation functions.

You may also want to modify `jdatasrc.c` and `jdatadst.c` to use Windows file operations rather than `fread/fwrite`. This is only necessary if your C compiler doesn't provide a competent implementation of C `stdio` functions.

You might want to tweak the `RGB_xxx` macros in `jmorecfg.h` so that the library will accept or deliver color pixels in BGR sample order, not RGB; BGR order is usually more convenient under Windows. Note that this change will break the sample applications `cjpeg/djpeg`, but the library itself works fine.

Many people want to convert the IJG library into a DLL. This is reasonably straightforward, but watch out for the following:

1. Don't try to compile as a DLL in small or medium memory model; use large model, or even better, 32-bit flat model. Many places in the IJG code assume the address of a local variable is an ordinary (not FAR) pointer; that isn't true in a medium-model DLL.
2. Microsoft C cannot pass file pointers between applications and DLLs. (See Microsoft Knowledge Base, PSS ID Number Q50336.) So `jdatasrc.c` and `jdatadst.c` don't work if you open a file in your application and then pass the pointer to the DLL. One workaround is to make `jdatasrc.c/jdatadst.c` part of your main application rather than part of the DLL.
3. You'll probably need to modify the macros `GLOBAL()` and `EXTERN()` to attach suitable linkage keywords to the exported routine names. Similarly, you'll want to modify `METHODDEF()` and `JMETHOD()` to ensure function pointers are declared in a way that lets application routines be called back through the function pointers. These macros are in `jmorecfg.h`. Typical definitions

for a 16-bit DLL are:

```
#define GLOBAL(type) type _far _pascal _loads _export
#define EXTERN(type) extern type _far _pascal _loads
#define METHODDEF(type) static type _far _pascal
#define JMETHOD(type,methodname,arglist) \
 type (_far _pascal *methodname) arglist
```

For a 32-bit DLL you may want something like

```
#define GLOBAL(type) __declspec(dllexport) type
#define EXTERN(type) extern __declspec(dllexport) type
```

Although not all the GLOBAL routines are actually intended to be called by the application, the performance cost of making them all DLL entry points is negligible.

The unmodified IJG library presents a very C-specific application interface, so the resulting DLL is only usable from C or C++ applications. There has been some talk of writing wrapper code that would present a simpler interface usable from other languages, such as Visual Basic. This is on our to-do list but hasn't been very high priority --- any volunteers out there?

Microsoft Windows, Borland C:

The provided jconfig.bcc should work OK in a 32-bit Windows environment, but you'll need to tweak it in a 16-bit environment (you'd need to define NEED\_FAR\_POINTERS and MAX\_ALLOC\_CHUNK). Beware that makefile.bcc will need alteration if you want to use it for Windows --- in particular, you should use jmembobs.c not jmemdos.c under Windows.

Borland C++ 4.5 fails with an internal compiler error when trying to compile jdmerge.c in 32-bit mode. If enough people complain, perhaps Borland will fix it. In the meantime, the simplest known workaround is to add a redundant definition of the variable range\_limit in h2v1\_merged\_upsample(), at the head of the block that handles odd image width (about line 268 in v6 jdmerge.c):

```
/* If image width is odd, do the last output column separately */
if (cinfo->output_width & 1) {
 register JSAMPLE * range_limit = cinfo->sample_range_limit; /* ADD THIS */
 cb = GETJSAMPLE(*inptr1);
```

Pretty bizarre, especially since the very similar routine h2v2\_merged\_upsample doesn't trigger the bug.

Recent reports suggest that this bug does not occur with "bcc32a" (the Pentium-optimized version of the compiler).

Another report from a user of Borland C 4.5 was that incorrect code (leading to a color shift in processed images) was produced if any of the following optimization switch combinations were used:

```
-Ot -Og
-Ot -Op
-Ot -Om
```

So try backing off on optimization if you see such a problem. (Are there several different releases all numbered "4.5"??)

Microsoft Windows, Microsoft Visual C++:

jconfig.vc should work OK with any Microsoft compiler for a 32-bit memory model. makefile.vc is intended for command-line use. (If you are using the Developer Studio environment, you may prefer the DevStudio project files; see below.)

IJG JPEG 7 adds extern "C" to jpeglib.h. This avoids the need to put extern "C" { ... } around #include "jpeglib.h" in your C++ application. You can also force VC++ to treat the library as C++ code by renaming all the \*.c files to \*.cpp (and adjusting the makefile to match). In this case you also need to define the symbol DONT\_USE\_EXTERN\_C in the configuration to prevent jpeglib.h from using extern "C".

Microsoft Windows, Microsoft Visual C++ 6 Developer Studio:

We include makefiles that should work as project files in Developer Studio 6.0 or later. There is a library makefile that builds the IJG library as a static Win32 library, and application makefiles that build the sample applications as Win32 console applications. (Even if you only want the library, we recommend building the applications so that you can run the self-test.)

To use:

1. Open the command prompt, change to the main directory and execute the command line  
NMAKE /f makefile.vs setup-vc6  
This will move jconfig.vc to jconfig.h and makefiles to project files.  
(Note that the renaming is critical!)
2. Open the workspace file jpeg.dsw, build the library project.  
(If you are using Developer Studio more recent than 6.0, you'll probably get a message saying that the project files are being updated.)
3. Open the workspace file apps.dsw, build the application projects.
4. To perform the self-test, execute the command line  
NMAKE /f makefile.vs test-build
5. Move the application .exe files from `app`\Release to an appropriate location on your path.

Microsoft Windows, Visual Studio 2017 (v15):

We include makefiles that should work as project files in Visual Studio 2017 (v15) or later. There is a library makefile that builds the IJG

library as a static Win32 library, and application makefiles that build the sample applications as Win32 console applications. (Even if you only want the library, we recommend building the applications so that you can run the self-test.)

To use:

1. Open the Developer Command Prompt, change to the main directory and execute the command line  
NMAKE /f makefile.vs setup-v15  
This will move jconfig.vc to jconfig.h and makefiles to project files.  
(Note that the renaming is critical!)
2. Open the solution file jpeg.sln, build the library project.
  - a) If you are using Visual Studio more recent than 2017 (v15), you'll probably get a message saying that the project files are being updated.
  - b) If necessary, open the project properties and adapt the Windows Target Platform Version in the Configuration Properties, General section; we support the latest version at the time of release.
3. Open the solution file apps.sln, build the application projects.
4. To perform the self-test, execute the command line  
NMAKE /f makefile.vs test-build
5. Move the application .exe files from `app`\Release to an appropriate location on your path.

OS/2, Borland C++:

Watch out for optimization bugs in older Borland compilers; you may need to back off the optimization switch settings. See the comments in makefile.bcc.

SGI:

On some SGI systems, you may need to set "AR2= ar -ts" in the Makefile. If you are using configure, you can do this by saying  
./configure RANLIB='ar -ts'  
This change is not needed on all SGIs. Use it only if the make fails at the stage of linking the completed programs.

On the MIPS R4000 architecture (Indy, etc.), the compiler option "-mips2" reportedly speeds up the float DCT method substantially, enough to make it faster than the default int method (but still slower than the fast int method). If you use -mips2, you may want to alter the default DCT method to be float. To do this, put "#define JDCT\_DEFAULT JDCT\_FLOAT" in jconfig.h.

VMS:

On an Alpha/VMS system with MMS, be sure to use the "/Marco=Alpha=1" qualifier with MMS when building the JPEG package.

VAX/VMS v5.5-1 may have problems with the test step of the build procedure reporting differences when it compares the original and test images. If the error points to the last block of the files, it is most likely bogus and may be safely ignored. It seems to be because the files are Stream\_LF and Backup/Compare has difficulty with the (presumably) null padded files. This problem was not observed on VAX/VMS v6.1 or AXP/VMS v6.1.

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/install.txt

No license file was found, but licenses were detected in source scan.

/\*

\* jmemdos.c

\*

\* Copyright (C) 1992-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file provides an MS-DOS-compatible implementation of the system-

\* dependent portion of the JPEG memory manager. Temporary data can be

\* stored in extended or expanded memory as well as in regular DOS files.

\*

\* If you use this file, you must be sure that NEED\_FAR\_POINTERS is defined

\* if you compile in a small-data memory model; it should NOT be defined if

\* you use a large-data memory model. This file is not recommended if you

\* are using a flat-memory-space 386 environment such as DJGCC or Watcom C.

\* Also, this code will NOT work if struct fields are aligned on greater than

\* 2-byte boundaries.

\*

\* Based on code contributed by Ge' Weijers.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemdos.c

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/\*

\* jconfig.txt

\*

\* Copyright (C) 1991-1994, Thomas G. Lane.

\* Modified 2009-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

```

*
* This file documents the configuration options that are required to
* customize the JPEG software for a particular system.
*
* The actual configuration options for a particular installation are stored
* in jconfig.h. On many machines, jconfig.h can be generated automatically
* or copied from one of the "canned" jconfig files that we supply. But if
* you need to generate a jconfig.h file by hand, this file tells you how.
*
* DO NOT EDIT THIS FILE --- IT WON'T ACCOMPLISH ANYTHING.
* EDIT A COPY NAMED JCONFIG.H.
*/

/*
* These symbols indicate the properties of your machine or compiler.
* #define the symbol if yes, #undef it if no.
*/

/* Does your compiler support function prototypes?
* (If not, you also need to use ansi2knr, see install.txt)
*/
#define HAVE_PROTOTYPES

/* Does your compiler support the declaration "unsigned char" ?
* How about "unsigned short" ?
*/
#define HAVE_UNSIGNED_CHAR
#define HAVE_UNSIGNED_SHORT

/* Define "void" as "char" if your compiler doesn't know about type void.
* NOTE: be sure to define void such that "void *" represents the most general
* pointer type, e.g., that returned by malloc().
*/
/* #define void char */

/* Define "const" as empty if your compiler doesn't know the "const" keyword.
*/
/* #define const */

/* Define this if an ordinary "char" type is unsigned.
* If you're not sure, leaving it undefined will work at some cost in speed.
* If you defined HAVE_UNSIGNED_CHAR then the speed difference is minimal.
*/
#undef CHAR_IS_UNSIGNED

/* Define this if your system has an ANSI-conforming <stddef.h> file.
*/

```

```

#define HAVE_STDDEF_H

/* Define this if your system has an ANSI-conforming <stdlib.h> file.
*/
#define HAVE_STDLIB_H

/* Define this if your system does not have an ANSI/SysV <string.h>,
* but does have a BSD-style <strings.h>.
*/
#undef NEED_BSD_STRINGS

/* Define this if your system does not provide typedef size_t in any of the
* ANSI-standard places (stddef.h, stdlib.h, or stdio.h), but places it in
* <sys/types.h> instead.
*/
#undef NEED_SYS_TYPES_H

/* For 80x86 machines, you need to define NEED_FAR_POINTERS,
* unless you are using a large-data memory model or 80386 flat-memory mode.
* On less brain-damaged CPUs this symbol must not be defined.
* (Defining this symbol causes large data structures to be referenced through
* "far" pointers and to be allocated with a special version of malloc.)
*/
#undef NEED_FAR_POINTERS

/* Define this if your linker needs global names to be unique in less
* than the first 15 characters.
*/
#undef NEED_SHORT_EXTERNAL_NAMES

/* Although a real ANSI C compiler can deal perfectly well with pointers to
* unspecified structures (see "incomplete types" in the spec), a few pre-ANSI
* and pseudo-ANSI compilers get confused. To keep one of these bozos happy,
* define INCOMPLETE_TYPES_BROKEN. This is not recommended unless you
* actually get "missing structure definition" warnings or errors while
* compiling the JPEG code.
*/
#undef INCOMPLETE_TYPES_BROKEN

/* Define "boolean" as unsigned char, not enum, on Windows systems.
*/
#ifdef _WIN32
#ifndef __RPCNDR_H__ /* don't conflict if rpcndr.h already read */
typedef unsigned char boolean;
#endif
#endif
#ifndef FALSE /* in case these macros already exist */
#define FALSE 0 /* values of boolean */
#endif

```



```

#ifndef TRUE
#define TRUE 1
#endif
#define HAVE_BOOLEAN /* prevent jmorecfg.h from redefining it */
#endif

/*
 * The following options affect code selection within the JPEG library,
 * but they don't need to be visible to applications using the library.
 * To minimize application namespace pollution, the symbols won't be
 * defined unless JPEG_INTERNALS has been defined.
 */

#ifdef JPEG_INTERNALS

/* Define this if your compiler implements ">>" on signed values as a logical
 * (unsigned) shift; leave it undefined if ">>" is a signed (arithmetic) shift,
 * which is the normal and rational definition.
 */
#undef RIGHT_SHIFT_IS_UNSIGNED

#endif /* JPEG_INTERNALS */

/*
 * The remaining options do not affect the JPEG library proper,
 * but only the sample applications cjpeg/djpeg (see cjpeg.c, djpeg.c).
 * Other applications can ignore these.
 */

#ifdef JPEG_CJPEG_DJPEG

/* These defines indicate which image (non-JPEG) file formats are allowed. */

#define BMP_SUPPORTED /* BMP image file format */
#define GIF_SUPPORTED /* GIF image file format */
#define PPM_SUPPORTED /* PBMPLUS PPM/PGM image file format */
#undef RLE_SUPPORTED /* Utah RLE image file format */
#define TARGA_SUPPORTED /* Targa image file format */

/* Define this if you want to name both input and output files on the command
 * line, rather than using stdout and optionally stdin. You MUST do this if
 * your system can't cope with binary I/O to stdin/stdout. See comments at
 * head of cjpeg.c or djpeg.c.
 */
#undef TWO_FILE_COMMANDLINE

```

```
/* Define this if your system needs explicit cleanup of temporary files.
* This is crucial under MS-DOS, where the temporary "files" may be areas
* of extended memory; on most other systems it's not as important.
*/
```

```
#undef NEED_SIGNAL_CATCHER
```

```
/* By default, we open image files with fopen(...,"rb") or fopen(...,"wb").
* This is necessary on systems that distinguish text files from binary files,
* and is harmless on most systems that don't. If you have one of the rare
* systems that complains about the "b" spec, define this symbol.
*/
```

```
#undef DONT_USE_B_MODE
```

```
/* Define this if you want percent-done progress reports from cjpeg/djpeg.
*/
```

```
#undef PROGRESS_REPORT
```

```
#endif /* JPEG_CJPEG_DJPEG */
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jconfig.txt
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* jcmaster.c
```

```
*
```

```
* Copyright (C) 1991-1997, Thomas G. Lane.
```

```
* Modified 2003-2017 by Guido Vollbeding.
```

```
* This file is part of the Independent JPEG Group's software.
```

```
* For conditions of distribution and use, see the accompanying README file.
```

```
*
```

```
* This file contains master control logic for the JPEG compressor.
```

```
* These routines are concerned with parameter validation, initial setup,
```

```
* and inter-pass control (determining the number of passes and the work
```

```
* to be done in each pass).
```

```
*/
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcmaster.c
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* rdbmp.c
```

```
*
```

```
* Copyright (C) 1994-1996, Thomas G. Lane.
```

```
* Modified 2009-2017 by Guido Vollbeding.
```

\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains routines to read input images in Microsoft "BMP"  
\* format (MS Windows 3.x, OS/2 1.x, and OS/2 2.x flavors).  
\* Currently, only 8-, 24-, and 32-bit images are supported, not 1-bit or  
\* 4-bit (feeding such low-depth images into JPEG would be silly anyway).  
\* Also, we don't support RLE-compressed files.  
\*  
\* These routines may need modification for non-Unix environments or  
\* specialized applications. As they stand, they assume input from  
\* an ordinary stdio stream. They further assume that reading begins  
\* at the start of the file; start\_input may need work if the  
\* user interface has already read some data (e.g., to determine that  
\* the file is indeed BMP format).  
\*  
\* This code contributed by James Arthur Boucher.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdbmp.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jdcoefct.c

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

\* Modified 2002-2011 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains the coefficient buffer controller for decompression.

\* This controller is the top level of the JPEG decompressor proper.

\* The coefficient buffer lies between entropy decoding and inverse-DCT steps.

\*

\* In buffered-image mode, this controller is the interface between

\* input-oriented processing and output-oriented processing.

\* Also, the input side (only) is used when reading a file for transcoding.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdcoefct.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jidctfst.c

\*

\* Copyright (C) 1994-1998, Thomas G. Lane.

\* Modified 2015-2017 by Guido Vollbeding.  
 \* This file is part of the Independent JPEG Group's software.  
 \* For conditions of distribution and use, see the accompanying README file.  
 \*  
 \* This file contains a fast, not so accurate integer implementation of the  
 \* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine  
 \* must also perform dequantization of the input coefficients.  
 \*  
 \* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT  
 \* on each row (or vice versa, but it's more convenient to emit a row at  
 \* a time). Direct algorithms are also available, but they are much more  
 \* complex and seem not to be any faster when reduced to code.  
 \*  
 \* This implementation is based on Arai, Agui, and Nakajima's algorithm for  
 \* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in  
 \* Japanese, but the algorithm is described in the Pennebaker & Mitchell  
 \* JPEG textbook (see REFERENCES section in file README). The following code  
 \* is based directly on figure 4-8 in P&M.  
 \* While an 8-point DCT cannot be done in less than 11 multiplies, it is  
 \* possible to arrange the computation so that many of the multiplies are  
 \* simple scalings of the final outputs. These multiplies can then be  
 \* folded into the multiplications or divisions by the JPEG quantization  
 \* table entries. The AA&N method leaves only 5 multiplies and 29 adds  
 \* to be done in the DCT itself.  
 \* The primary disadvantage of this method is that with fixed-point math,  
 \* accuracy is lost due to imprecise representation of the scaled  
 \* quantization values. The smaller the quantization table entry, the less  
 \* precise the scaled value, so this implementation does worse with high-  
 \* quality-setting files than with low-quality ones.  
 \*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jidctfst.c

No license file was found, but licenses were detected in source scan.

/\*

\* jcpam.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2003-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains optional default-setting code for the JPEG compressor.

\* Applications do not have to use this file, but those that don't use it

\* must know a lot more about the innards of the JPEG code.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcparam.c

No license file was found, but licenses were detected in source scan.

/\*

\* jpeglib.h

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2002-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file defines the application interface for the JPEG library.

\* Most applications using the library need only include this file,

\* and perhaps jerror.h if they want to know the exact error codes.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jpeglib.h

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/\*

\* wrgif.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 2015-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to write output images in GIF format.

\*

\*\*\*\*\*

\* NOTE: to avoid entanglements with Unisys' patent on LZW compression, \*

\* this code has been modified to output "uncompressed GIF" files. \*

\* There is no trace of the LZW algorithm in this file. \*

\*\*\*\*\*

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to

\* an ordinary stdio stream.

\*/

/\*

\* This code is loosely based on ppmtogif from the PBMPLUS distribution

\* of Feb. 1991. That file contains the following copyright notice:

\* Based on GIFENCODER by David Rowley <mgardi@watdscu.waterloo.edu>.

\* Lempel-Ziv compression based on "compress" by Spencer W. Thomas et al.

\* Copyright (C) 1989 by Jef Poskanzer.

\* Permission to use, copy, modify, and distribute this software and its

\* documentation for any purpose and without fee is hereby granted, provided  
\* that the above copyright notice appear in all copies and that both that  
\* copyright notice and this permission notice appear in supporting  
\* documentation. This software is provided "as is" without express or  
\* implied warranty.

\*

\* We are also required to state that

\* "The Graphics Interchange Format(c) is the Copyright property of  
\* CompuServe Incorporated. GIF(sm) is a Service Mark property of  
\* CompuServe Incorporated."

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/wrgif.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdmaster.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 2002-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains master control logic for the JPEG decompressor.

\* These routines are concerned with selecting the modules to be executed

\* and with determining the number of passes and the work to be done in each

\* pass.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdmaster.c

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/\*

\* wrppm.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2009-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to write output images in PPM/PGM format.

\* The extended 2-byte-per-sample raw PPM/PGM formats are supported.

\* The PBMPLUS library is NOT required to compile this software

\* (but it is highly useful as a set of PPM image manipulation programs).

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to  
\* an ordinary stdio stream.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/wrppm.c

No license file was found, but licenses were detected in source scan.

/\*

\* jmemsys.h

\*

\* Copyright (C) 1992-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This include file defines the interface between the system-independent  
\* and system-dependent portions of the JPEG memory manager. No other  
\* modules need include it. (The system-independent portion is jmemmgr.c;  
\* there are several different versions of the system-dependent portion.)

\*

\* This file works as-is for the system-dependent memory managers supplied  
\* in the IJG distribution. You may need to modify it if you write a  
\* custom memory manager. If system-dependent changes are needed in  
\* this file, the best method is to #ifdef them based on a configuration  
\* symbol supplied in jconfig.h, as we have done with USE\_MSDOS\_MEMMGR  
\* and USE\_MAC\_MEMMGR.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemsys.h

No license file was found, but licenses were detected in source scan.

/\*

\* jinclude.h

\*

\* Copyright (C) 1991-1994, Thomas G. Lane.

\* Modified 2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file exists to provide a single place to fix any problems with  
\* including the wrong system include files. (Common problems are taken  
\* care of by the standard jconfig symbols, but on really weird systems  
\* you may have to edit this file.)

\*

\* NOTE: this file is NOT intended to be included by applications using the  
\* JPEG library. Most applications need only include jpeglib.h.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jinclude.h

No license file was found, but licenses were detected in source scan.

/\*

\* jpegint.h

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 1997-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file provides common declarations for the various JPEG modules.

\* These declarations are considered internal to the JPEG library; most

\* applications using the library shouldn't need to include this file.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jpegint.h

No license file was found, but licenses were detected in source scan.

/\*

\* jmemnobs.c

\*

\* Copyright (C) 1992-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file provides a really simple implementation of the system-

\* dependent portion of the JPEG memory manager. This implementation

\* assumes that no backing-store files are needed: all required space

\* can be obtained from malloc().

\* This is very portable in the sense that it'll compile on almost anything,

\* but you'd better have lots of main memory (or virtual memory) if you want

\* to process big images.

\* Note that the max\_memory\_to\_use option is ignored by this implementation.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemnobs.c

No license file was found, but licenses were detected in source scan.

/\*

\* wrbmp.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2017 by Guido Vollbeding.



\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains routines to write output images in Microsoft "BMP"  
\* format (MS Windows 3.x and OS/2 1.x flavors).  
\* Either 8-bit colormapped or 24-bit full-color format can be written.  
\* No compression is supported.  
\*  
\* These routines may need modification for non-Unix environments or  
\* specialized applications. As they stand, they assume output to  
\* an ordinary stdio stream.  
\*  
\* This code contributed by James Arthur Boucher.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/wrbmp.c  
No license file was found, but licenses were detected in source scan.

/\*  
\* jcmaint.c  
\*  
\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2003-2012 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains the main buffer controller for compression.  
\* The main buffer lies between the pre-processor and the JPEG  
\* compressor proper; it holds downsampled data in the JPEG colorspace.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcmaint.c  
No license file was found, but licenses were detected in source scan.

/\*  
\* cdjpeg.c  
\*  
\* Copyright (C) 1991-1997, Thomas G. Lane.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains common support routines used by the IJG application  
\* programs (cjpeg, djpeg, jpegtran).  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/cdjpeg.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdtarga.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to read input images in Targa format.

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume input from

\* an ordinary stdio stream. They further assume that reading begins

\* at the start of the file; start\_input may need work if the

\* user interface has already read some data (e.g., to determine that

\* the file is indeed Targa format).

\*

\* Based on code contributed by Lee Daniel Crocker.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdtarga.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdmarker.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2009-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to decode JPEG datastream markers.

\* Most of the complexity arises from our desire to support input

\* suspension: if not all of the data for a marker is available,

\* we must exit back to the application. On resumption, we reprocess

\* the marker.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdmarker.c

No license file was found, but licenses were detected in source scan.

/\*

\* jversion.h

\*  
\* Copyright (C) 1991-2018, Thomas G. Lane, Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains software version identification.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jversion.h

No license file was found, but licenses were detected in source scan.

/\*

\* jcdctmgr.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2003-2013 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains the forward-DCT management logic.  
\* This code selects a particular DCT implementation to be used,  
\* and it performs related housekeeping chores including coefficient  
\* quantization.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcdctmgr.c

No license file was found, but licenses were detected in source scan.

/\*

\* jutils.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.  
\* Modified 2009-2011 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains tables and miscellaneous utility routines needed  
\* for both compression and decompression.  
\* Note we prefix all global names with "j" to minimize conflicts with  
\* a surrounding application.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jutils.c

No license file was found, but licenses were detected in source scan.

```
/*
 * jdatasrc.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2009-2015 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains decompression data source routines for the case of
 * reading JPEG data from memory or from a file (or any stdio stream).
 * While these routines are sufficient for most applications,
 * some will want to use a different source manager.
 * IMPORTANT: we assume that fread() will correctly transcribe an array of
 * JOCTETs from 8-bit-wide elements on external storage. If char is wider
 * than 8 bits on your machine, you may need to do some tweaking.
 */
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdatasrc.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * rdppm.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2009-2017 by Bill Allombert, Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains routines to read input images in PPM/PGM format.
 * The extended 2-byte-per-sample raw PPM/PGM formats are supported.
 * The PBMPLUS library is NOT required to compile this software
 * (but it is highly useful as a set of PPM image manipulation programs).
 *
 * These routines may need modification for non-Unix environments or
 * specialized applications. As they stand, they assume input from
 * an ordinary stdio stream. They further assume that reading begins
 * at the start of the file; start_input may need work if the
 * user interface has already read some data (e.g., to determine that
 * the file is indeed PPM format).
 */
/* Portions of this code are based on the PBMPLUS library, which is:
**
** Copyright (C) 1988 by Jef Poskanzer.
**
** Permission to use, copy, modify, and distribute this software and its
** documentation for any purpose and without fee is hereby granted, provided
** that the above copyright notice appear in all copies and that both that
```

\*\* copyright notice and this permission notice appear in supporting  
\*\* documentation. This software is provided "as is" without express or  
\*\* implied warranty.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdppm.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jdhuft.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.  
\* Modified 2006-2016 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains Huffman entropy decoding routines.  
\* Both sequential and progressive modes are supported in this single module.  
\*  
\* Much of the complexity here has to do with supporting input suspension.  
\* If the data source module demands suspension, we want to be able to back  
\* up to the start of the current MCU. To do this, we copy state variables  
\* into local working storage, and update them back to the permanent  
\* storage only upon successful completion of an MCU.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdhuft.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jerror.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.  
\* Modified 2012-2015 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains simple error-reporting and trace-message routines.  
\* These are suitable for Unix-like systems and others where writing to  
\* stderr is the right thing to do. Many applications will want to replace  
\* some or all of these routines.  
\*  
\* If you define USE\_WINDOWS\_MESSAGEBOX in jconfig.h or in the makefile,  
\* you get a Windows-specific hack to display error messages in a dialog box.  
\* It ain't much, but it beats dropping error messages into the bit bucket,  
\* which is what happens to output to stderr under most Windows C compilers.

\*

\* These routines are used by both the compression and decompression code.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jerror.c

No license file was found, but licenses were detected in source scan.

The Independent JPEG Group's JPEG software

=====

README for release 9c of 14-Jan-2018

=====

This distribution contains the ninth public release of the Independent JPEG Group's free JPEG software. You are welcome to redistribute this software and to use it for any purpose, subject to the conditions under LEGAL ISSUES, below.

This software is the work of Tom Lane, Guido Vollbeding, Philip Gladstone, Bill Allombert, Jim Boucher, Lee Crocker, Bob Friesenhahn, Ben Jackson, Julian Minguillon, Luis Ortiz, George Phillips, Davide Rossi, Ge' Weijers, and other members of the Independent JPEG Group.

IJG is not affiliated with the ISO/IEC JTC1/SC29/WG1 standards committee (previously known as JPEG, together with ITU-T SG16).

## DOCUMENTATION ROADMAP

=====

This file contains the following sections:

OVERVIEW        General description of JPEG and the IJG software.  
LEGAL ISSUES    Copyright, lack of warranty, terms of distribution.  
REFERENCES      Where to learn more about JPEG.  
ARCHIVE LOCATIONS Where to find newer versions of this software.  
ACKNOWLEDGMENTS Special thanks.  
FILE FORMAT WARS Software \*not\* to get.  
TO DO           Plans for future IJG releases.

Other documentation files in the distribution are:

User documentation:

install.txt    How to configure and install the IJG software.  
usage.txt      Usage instructions for cjpeg, djpeg, jpegtran,  
                rdjpgcom, and wrjpgcom.  
\*.1            Unix-style man pages for programs (same info as usage.txt).  
wizard.txt     Advanced usage instructions for JPEG wizards only.

change.log     Version-to-version change highlights.  
Programmer and internal documentation:  
libjpeg.txt    How to use the JPEG library in your own programs.  
example.c      Sample code for calling the JPEG library.  
structure.txt   Overview of the JPEG library's internal structure.  
filelist.txt   Road map of IJG files.  
coderrules.txt  Coding style rules --- please read if you contribute code.

Please read at least the files install.txt and usage.txt. Some information can also be found in the JPEG FAQ (Frequently Asked Questions) article. See ARCHIVE LOCATIONS below to find out where to obtain the FAQ article.

If you want to understand how the JPEG code works, we suggest reading one or more of the REFERENCES, then looking at the documentation files (in roughly the order listed) before diving into the code.

## OVERVIEW

=====

This package contains C software to implement JPEG image encoding, decoding, and transcoding. JPEG (pronounced "jay-peg") is a standardized compression method for full-color and grayscale images.

This software implements JPEG baseline, extended-sequential, and progressive compression processes. Provision is made for supporting all variants of these processes, although some uncommon parameter settings aren't implemented yet. We have made no provision for supporting the hierarchical or lossless processes defined in the standard.

We provide a set of library routines for reading and writing JPEG image files, plus two sample applications "cjpeg" and "djpeg", which use the library to perform conversion between JPEG and some other popular image file formats. The library is intended to be reused in other applications.

In order to support file conversion and viewing software, we have included considerable functionality beyond the bare JPEG coding/decoding capability; for example, the color quantization modules are not strictly part of JPEG decoding, but they are essential for output to colormapped file formats or colormapped displays. These extra functions can be compiled out of the library if not required for a particular application.

We have also included "jpegtran", a utility for lossless transcoding between different JPEG processes, and "rdjpgcom" and "wrjpgcom", two simple applications for inserting and extracting textual comments in JFIF files.

The emphasis in designing this software has been on achieving portability and flexibility, while also making it fast enough to be useful. In particular,

the software is not intended to be read as a tutorial on JPEG. (See the REFERENCES section for introductory material.) Rather, it is intended to be reliable, portable, industrial-strength code. We do not claim to have achieved that goal in every aspect of the software, but we strive for it.

We welcome the use of this software as a component of commercial products. No royalty is required, but we do ask for an acknowledgement in product documentation, as described under LEGAL ISSUES.

## LEGAL ISSUES

=====

In plain English:

1. We don't promise that this software works. (But if you find any bugs, please let us know!)
2. You can use this software for whatever you want. You don't have to pay us.
3. You may not pretend that you wrote this software. If you use it in a program, you must acknowledge somewhere in your documentation that you've used the IJG code.

In legalese:

The authors make NO WARRANTY or representation, either express or implied, with respect to this software, its quality, accuracy, merchantability, or fitness for a particular purpose. This software is provided "AS IS", and you, its user, assume the entire risk as to its quality and accuracy.

This software is copyright (C) 1991-2018, Thomas G. Lane, Guido Vollbeding. All Rights Reserved except as specified below.

Permission is hereby granted to use, copy, modify, and distribute this software (or portions thereof) for any purpose, without fee, subject to these conditions:

- (1) If any part of the source code for this software is distributed, then this README file must be included, with this copyright and no-warranty notice unaltered; and any additions, deletions, or changes to the original files must be clearly indicated in accompanying documentation.
- (2) If only executable code is distributed, then the accompanying documentation must state that "this software is based in part on the work of the Independent JPEG Group".
- (3) Permission for use of this software is granted only if the user accepts full responsibility for any undesirable consequences; the authors accept NO LIABILITY for damages of any kind.

These conditions apply to any software derived from or based on the IJG code, not just to the unmodified library. If you use our work, you ought to



acknowledge us.

Permission is NOT granted for the use of any IJG author's name or company name in advertising or publicity relating to this software or products derived from it. This software may be referred to only as "the Independent JPEG Group's software".

We specifically permit and encourage the use of this software as the basis of commercial products, provided that all warranty or liability claims are assumed by the product vendor.

The Unix configuration script "configure" was produced with GNU Autoconf. It is copyright by the Free Software Foundation but is freely distributable. The same holds for its supporting scripts (config.guess, config.sub, ltmain.sh). Another support script, install-sh, is copyright by X Consortium but is also freely distributable.

The IJG distribution formerly included code to read and write GIF files. To avoid entanglement with the Unisys LZW patent (now expired), GIF reading support has been removed altogether, and the GIF writer has been simplified to produce "uncompressed GIFs". This technique does not use the LZW algorithm; the resulting GIF files are larger than usual, but are readable by all standard GIF decoders.

## REFERENCES

=====

We recommend reading one or more of these references before trying to understand the innards of the JPEG software.

The best short technical introduction to the JPEG compression algorithm is Wallace, Gregory K. "The JPEG Still Picture Compression Standard", Communications of the ACM, April 1991 (vol. 34 no. 4), pp. 30-44. (Adjacent articles in that issue discuss MPEG motion picture compression, applications of JPEG, and related topics.) If you don't have the CACM issue handy, a PDF file containing a revised version of Wallace's article is available at <http://www.ijg.org/files/Wallace.JPEG.pdf>. The file (actually a preprint for an article that appeared in IEEE Trans. Consumer Electronics) omits the sample images that appeared in CACM, but it includes corrections and some added material. Note: the Wallace article is copyright ACM and IEEE, and it may not be used for commercial purposes.

A somewhat less technical, more leisurely introduction to JPEG can be found in "The Data Compression Book" by Mark Nelson and Jean-loup Gailly, published by M&T Books (New York), 2nd ed. 1996, ISBN 1-55851-434-1. This book provides good explanations and example C code for a multitude of compression methods

including JPEG. It is an excellent source if you are comfortable reading C code but don't know much about data compression in general. The book's JPEG sample code is far from industrial-strength, but when you are ready to look at a full implementation, you've got one here...

The best currently available description of JPEG is the textbook "JPEG Still Image Data Compression Standard" by William B. Pennebaker and Joan L. Mitchell, published by Van Nostrand Reinhold, 1993, ISBN 0-442-01272-1. Price US\$59.95, 638 pp. The book includes the complete text of the ISO JPEG standards (DIS 10918-1 and draft DIS 10918-2).

Although this is by far the most detailed and comprehensive exposition of JPEG publicly available, we point out that it is still missing an explanation of the most essential properties and algorithms of the underlying DCT technology.

If you think that you know about DCT-based JPEG after reading this book, then you are in delusion. The real fundamentals and corresponding potential of DCT-based JPEG are not publicly known so far, and that is the reason for all the mistaken developments taking place in the image coding domain.

The original JPEG standard is divided into two parts, Part 1 being the actual specification, while Part 2 covers compliance testing methods. Part 1 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 1: Requirements and guidelines" and has document numbers ISO/IEC IS 10918-1, ITU-T T.81. Part 2 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 2: Compliance testing" and has document numbers ISO/IEC IS 10918-2, ITU-T T.83.

IJG JPEG 8 introduced an implementation of the JPEG SmartScale extension which is specified in two documents: A contributed document at ITU and ISO with title "ITU-T JPEG-Plus Proposal for Extending ITU-T T.81 for Advanced Image Coding", April 2006, Geneva, Switzerland. The latest version of this document is Revision 3. And a contributed document ISO/IEC JTC1/SC29/WG1 N 5799 with title "Evolution of JPEG", June/July 2011, Berlin, Germany.

IJG JPEG 9 introduces a reversible color transform for improved lossless compression which is described in a contributed document ISO/IEC JTC1/SC29/WG1 N 6080 with title "JPEG 9 Lossless Coding", June/July 2012, Paris, France.

The JPEG standard does not specify all details of an interchangeable file format. For the omitted details we follow the "JFIF" conventions, version 2. JFIF version 1 has been adopted as Recommendation ITU-T T.871 (05/2011) : Information technology - Digital compression and coding of continuous-tone still images: JPEG File Interchange Format (JFIF). It is available as a free download in PDF file format from <http://www.itu.int/rec/T-REC-T.871>. A PDF file of the older JFIF document is available at <http://www.w3.org/Graphics/JPEG/jfif3.pdf>.

The TIFF 6.0 file format specification can be obtained by FTP from <ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps.gz>. The JPEG incorporation scheme

found in the TIFF 6.0 spec of 3-June-92 has a number of serious problems. IJG does not recommend use of the TIFF 6.0 design (TIFF Compression tag 6). Instead, we recommend the JPEG design proposed by TIFF Technical Note #2 (Compression tag 7). Copies of this Note can be obtained from <http://www.ijg.org/files/>. It is expected that the next revision of the TIFF spec will replace the 6.0 JPEG design with the Note's design. Although IJG's own code does not support TIFF/JPEG, the free libtiff library uses our library to implement TIFF/JPEG per the Note.

## ARCHIVE LOCATIONS

=====

The "official" archive site for this software is [www.ijg.org](http://www.ijg.org). The most recent released version can always be found there in directory "files". This particular version will be archived as <http://www.ijg.org/files/jpegsr9c.tar.gz>, and in Windows-compatible "zip" archive format as <http://www.ijg.org/files/jpegsr9c.zip>.

The JPEG FAQ (Frequently Asked Questions) article is a source of some general information about JPEG.

It is available on the World Wide Web at <http://www.faqs.org/faqs/jpeg-faq/> and other news.answers archive sites, including the official news.answers archive at [rtfm.mit.edu: ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/](ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/). If you don't have Web or FTP access, send e-mail to [mail-server@rtfm.mit.edu](mailto:mail-server@rtfm.mit.edu) with body  
send usenet/news.answers/jpeg-faq/part1  
send usenet/news.answers/jpeg-faq/part2

## ACKNOWLEDGMENTS

=====

Thank to Juergen Bruder for providing me with a copy of the common DCT algorithm article, only to find out that I had come to the same result in a more direct and comprehensible way with a more generative approach.

Thank to Istvan Sebestyen and Joan L. Mitchell for inviting me to the ITU JPEG (Study Group 16) meeting in Geneva, Switzerland.

Thank to Thomas Wiegand and Gary Sullivan for inviting me to the Joint Video Team (MPEG & ITU) meeting in Geneva, Switzerland.

Thank to Thomas Richter and Daniel Lee for inviting me to the ISO/IEC JTC1/SC29/WG1 (previously known as JPEG, together with ITU-T SG16) meeting in Berlin, Germany.

Thank to John Korejwa and Massimo Ballerini for inviting me to

fruitful consultations in Boston, MA and Milan, Italy.

Thank to Hendrik Elstner, Roland Fassauer, Simone Zuck, Guenther Maier-Gerber, Walter Stoeber, Fred Schmitz, and Norbert Braunagel for corresponding business development.

Thank to Nico Zschach and Dirk Stelling of the technical support team at the Digital Images company in Halle for providing me with extra equipment for configuration tests.

Thank to Richard F. Lyon (then of Foveon Inc.) for fruitful communication about JPEG configuration in Sigma Photo Pro software.

Thank to Andrew Finkenstadt for hosting the ijg.org site.

Thank to Thomas G. Lane for the original design and development of this singular software package.

Thank to Lars Goehler, Andreas Heinecke, Sebastian Fuss, Yvonne Roebert, Andrej Werner, and Ulf-Dietrich Braumann for support and public relations.

#### FILE FORMAT WARS

=====

The ISO/IEC JTC1/SC29/WG1 standards committee (previously known as JPEG, together with ITU-T SG16) currently promotes different formats containing the name "JPEG" which is misleading because these formats are incompatible with original DCT-based JPEG and are based on faulty technologies.

IJG therefore does not and will not support such momentary mistakes (see REFERENCES).

There exist also distributions under the name "OpenJPEG" promoting such kind of formats which is misleading because they don't support original JPEG images.

We have no sympathy for the promotion of inferior formats. Indeed, one of the original reasons for developing this free software was to help force convergence on common, interoperable format standards for JPEG files.

Don't use an incompatible file format!

(In any case, our decoder will remain capable of reading existing JPEG image files indefinitely.)

The ISO committee pretends to be "responsible for the popular JPEG" in their public reports which is not true because they don't respond to actual requirements for the maintenance of the original JPEG specification.

Furthermore, the ISO committee pretends to "ensure interoperability" with their standards which is not true because their "standards" support only application-specific and proprietary use cases and contain mathematically incorrect code.

There are currently different distributions in circulation containing the name "libjpeg" which is misleading because they don't have the features and are incompatible with formats supported by actual IJG libjpeg distributions. One of those fakes is released by members of the ISO committee and just uses the name of libjpeg for misdirection of people, similar to the abuse of the name JPEG as described above, while having nothing in common with actual IJG libjpeg distributions and containing mathematically incorrect code. The other one claims to be a "derivative" or "fork" of the original libjpeg, but violates the license conditions as described under LEGAL ISSUES above and violates basic C programming properties. We have no sympathy for the release of misleading, incorrect and illegal distributions derived from obsolete code bases. Don't use an obsolete code base!

According to the UCC (Uniform Commercial Code) law, IJG has the lawful and legal right to foreclose on certain standardization bodies and other institutions or corporations that knowingly perform substantial and systematic deceptive acts and practices, fraud, theft, and damaging of the value of the people of this planet without their knowing, willing and intentional consent.

The titles, ownership, and rights of these institutions and all their assets are now duly secured and held in trust for the free people of this planet. People of the planet, on every country, may have a financial interest in the assets of these former principals, agents, and beneficiaries of the foreclosed institutions and corporations.

IJG asserts what is: that each man, woman, and child has unalienable value and rights granted and deposited in them by the Creator and not any one of the people is subordinate to any artificial principality, corporate fiction or the special interest of another without their appropriate knowing, willing and intentional consent made by contract or accommodation agreement. IJG expresses that which already was.

The people have already determined and demanded that public administration entities, national governments, and their supporting judicial systems must be fully transparent, accountable, and liable.

IJG has secured the value for all concerned free people of the planet.

A partial list of foreclosed institutions and corporations ("Hall of Shame") is currently prepared and will be published later.

TO DO

=====

Version 9 is the second release of a new generation JPEG standard to overcome the limitations of the original JPEG specification, and is the first true source reference JPEG codec.

More features are being prepared for coming releases...

Please send bug reports, offers of help, etc. to [jpeg-info@jpegclub.org](mailto:jpeg-info@jpegclub.org).

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/README

No license file was found, but licenses were detected in source scan.

/\*

\* jdpostct.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains the decompression postprocessing controller.

\* This controller manages the upsampling, color conversion, and color

\* quantization/reduction steps; specifically, it controls the buffering

\* between upsample/color conversion and color quantization/reduction.

\*

\* If no color quantization/reduction is required, then this module has no

\* work to do, and it just hands off to the upsample/color conversion code.

\* An integrated upsample/convert/quantize process would replace this module

\* entirely.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdpostct.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdapimin.c

\*

\* Copyright (C) 1994-1998, Thomas G. Lane.

\* Modified 2009-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains application interface code for the decompression half

\* of the JPEG library. These are the "minimum" API routines that may be

\* needed in either the normal full-decompression case or the

\* transcoding-only case.

\*

\* Most of the routines intended to be called directly by an application

\* are in this file or in jdapistd.c. But also see jcomapi.c for routines

\* shared by compression and decompression, and jdtrans.c for the transcoding

\* case.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdapimin.c

No license file was found, but licenses were detected in source scan.

/\*

\* wrtle.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to write output images in RLE format.

\* The Utah Raster Toolkit library is required (version 3.1 or later).

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to

\* an ordinary stdio stream.

\*

\* Based on code contributed by Mike Lijewski,

\* with updates from Robert Hutchinson.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/wrtle.c

No license file was found, but licenses were detected in source scan.

/\*

\* jfdctfst.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2003-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a fast, not so accurate integer implementation of the

\* forward DCT (Discrete Cosine Transform).

\*

\* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT

\* on each column. Direct algorithms are also available, but they are

\* much more complex and seem not to be any faster when reduced to code.

\*

\* This implementation is based on Arai, Agui, and Nakajima's algorithm for

\* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in

\* Japanese, but the algorithm is described in the Pennebaker & Mitchell

\* JPEG textbook (see REFERENCES section in file README). The following code

\* is based directly on figure 4-8 in P&M.

\* While an 8-point DCT cannot be done in less than 11 multiplies, it is

- \* possible to arrange the computation so that many of the multiplies are
- \* simple scalings of the final outputs. These multiplies can then be
- \* folded into the multiplications or divisions by the JPEG quantization
- \* table entries. The AA&N method leaves only 5 multiplies and 29 adds
- \* to be done in the DCT itself.
- \* The primary disadvantage of this method is that with fixed-point math,
- \* accuracy is lost due to imprecise representation of the scaled
- \* quantization values. The smaller the quantization table entry, the less
- \* precise the scaled value, so this implementation does worse with high-
- \* quality-setting files than with low-quality ones.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jfdctfst.c

No license file was found, but licenses were detected in source scan.

/\*

\* wrjpgcom.c

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

\* Modified 2015-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a very simple stand-alone application that inserts

\* user-supplied text as a COM (comment) marker in a JFIF file.

\* This may be useful as an example of the minimum logic needed to parse

\* JPEG markers.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/wrjpgcom.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdcolmap.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file implements djpeg's "-map file" switch. It reads a source image

\* and constructs a colormap to be supplied to the JPEG decompressor.

\*

\* Currently, these file formats are supported for the map file:

\* GIF: the contents of the GIF's global colormap are used.

\* PPM (either text or raw flavor): the entire file is read and

\* each unique pixel value is entered in the map.



\* Note that reading a large PPM file will be horrendously slow.  
\* Typically, a PPM-format map file should contain just one pixel  
\* of each desired color. Such a file can be extracted from an  
\* ordinary image PPM file with ppmtomap(1).

\*

\* Rescaling a PPM that has a maxval unequal to MAXJSAMPLE is not  
\* currently implemented.

\*/

/\* Portions of this code are based on the PBMPLUS library, which is:

\*\*

\*\* Copyright (C) 1988 by Jef Poskanzer.

\*\*

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\*\* copyright notice and this permission notice appear in supporting  
\*\* documentation. This software is provided "as is" without express or  
\*\* implied warranty.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdcolmap.c

No license file was found, but licenses were detected in source scan.

/\*

\* jcapimin.c

\*

\* Copyright (C) 1994-1998, Thomas G. Lane.

\* Modified 2003-2010 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains application interface code for the compression half  
\* of the JPEG library. These are the "minimum" API routines that may be  
\* needed in either the normal full-compression case or the transcoding-only  
\* case.

\*

\* Most of the routines intended to be called directly by an application  
\* are in this file or in jcapistd.c. But also see jcparam.c for  
\* parameter-setup helper routines, jcomapi.c for routines shared by  
\* compression and decompression, and jctrans.c for the transcoding case.

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcapimin.c

No license file was found, but licenses were detected in source scan.

/\*

```
* jcrepct.c
*
* Copyright (C) 1994-1996, Thomas G. Lane.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the compression preprocessing controller.
* This controller manages the color conversion, downsampling,
* and edge expansion steps.
*
* Most of the complexity here is associated with buffering input rows
* as required by the downsampler. See the comments at the head of
* jcsample.c for the downsampler's needs.
*/
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcrepct.c
No license file was found, but licenses were detected in source scan.
```

```
/*
* transupp.h
*
* Copyright (C) 1997-2013, Thomas G. Lane, Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains declarations for image transformation routines and
* other utility code used by the jpegtran sample application. These are
* NOT part of the core JPEG library. But we keep these routines separate
* from jpegtran.c to ease the task of maintaining jpegtran-like programs
* that have other user interfaces.
*
* NOTE: all the routines declared here have very specific requirements
* about when they are to be executed during the reading and writing of the
* source and destination files. See the comments in transupp.c, or see
* jpegtran.c for an example of correct usage.
*/
```

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/transupp.h
No license file was found, but licenses were detected in source scan.
```

; For conditions of distribution and use, see the accompanying README file.

Found in path(s):

```
* /opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemdosa.asm
No license file was found, but licenses were detected in source scan.
```

```
/*
 * jmemmgr.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2011-2012 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains the JPEG system-independent memory management
 * routines. This code is usable across a wide variety of machines; most
 * of the system dependencies have been isolated in a separate file.
 * The major functions provided here are:
 * * pool-based allocation and freeing of memory;
 * * policy decisions about how to divide available memory among the
 * virtual arrays;
 * * control logic for swapping virtual arrays between main memory and
 * backing storage.
 * The separate system-dependent file provides the actual backing-storage
 * access code, and it contains the policy decision about how much total
 * main memory to use.
 * This file is system-dependent in the sense that some of its functions
 * are unnecessary in some systems. For example, if there is enough virtual
 * memory so that backing storage will never be used, much of the virtual
 * array control logic could be removed. (Of course, if you have that much
 * memory then you shouldn't care about a little bit of unused code...)
 */
```

Found in path(s):

`/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemmgr.c`

No license file was found, but licenses were detected in source scan.

```
/*
 * jfdctflt.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2003-2017 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains a floating-point implementation of the
 * forward DCT (Discrete Cosine Transform).
 *
 * This implementation should be more accurate than either of the integer
 * DCT implementations. However, it may not give the same results on all
 * machines because of differences in roundoff behavior. Speed will depend
 * on the hardware's floating point capacity.
 *
 * A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT
```

\* on each column. Direct algorithms are also available, but they are  
 \* much more complex and seem not to be any faster when reduced to code.  
 \*  
 \* This implementation is based on Arai, Agui, and Nakajima's algorithm for  
 \* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in  
 \* Japanese, but the algorithm is described in the Pennebaker & Mitchell  
 \* JPEG textbook (see REFERENCES section in file README). The following code  
 \* is based directly on figure 4-8 in P&M.  
 \* While an 8-point DCT cannot be done in less than 11 multiplies, it is  
 \* possible to arrange the computation so that many of the multiplies are  
 \* simple scalings of the final outputs. These multiplies can then be  
 \* folded into the multiplications or divisions by the JPEG quantization  
 \* table entries. The AA&N method leaves only 5 multiplies and 29 adds  
 \* to be done in the DCT itself.  
 \* The primary disadvantage of this method is that with a fixed-point  
 \* implementation, accuracy is lost due to imprecise representation of the  
 \* scaled quantization values. However, that problem does not arise if  
 \* we use floating point arithmetic.  
 \*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jfdctflt.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdgif.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to read input images in GIF format.

\*

\*\*\*\*\*

\* NOTE: to avoid entanglements with Unisys' patent on LZW compression, \*

\* the ability to read GIF files has been removed from the IJG distribution. \*

\* Sorry about that. \*

\*\*\*\*\*

\*

\* We are required to state that

\* "The Graphics Interchange Format(c) is the Copyright property of

\* CompuServe Incorporated. GIF(sm) is a Service Mark property of

\* CompuServe Incorporated."

\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/rdgif.c

No license file was found, but licenses were detected in source scan.

```
/*
 * jcinit.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2003-2017 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains initialization logic for the JPEG compressor.
 * This routine is in charge of selecting the modules to be executed and
 * making an initialization call to each one.
 *
 * Logically, this code belongs in jcmaster.c. It's split out because
 * linking this routine implies linking the entire compression library.
 * For a transcoding-only application, we want to be able to use jcmaster.c
 * without linking in the whole library.
 */
```

Found in path(s):

```
*/opt/cola/permits/1104792432_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jcinit.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jdmerge.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2013-2017 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains code for merged upsampling/color conversion.
 *
 * This file combines functions from jdsample.c and jdcolor.c;
 * read those files first to understand what's going on.
 *
 * When the chroma components are to be upsampled by simple replication
 * (ie, box filtering), we can save some work in color conversion by
 * calculating all the output pixels corresponding to a pair of chroma
 * samples at one time. In the conversion equations
 * $R = Y + K1 * Cr$
 * $G = Y + K2 * Cb + K3 * Cr$
 * $B = Y + K4 * Cb$
 * only the Y term varies among the group of pixels corresponding to a pair
 * of chroma samples, so the rest of the terms can be calculated just once.
 * At typical sampling ratios, this eliminates half or three-quarters of the
 * multiplications needed for color conversion.
 */
```

\*  
\* This file currently provides implementations for the following cases:  
\* YCC => RGB color conversion only (YCbCr or BG\_YCC).  
\* Sampling ratios of 2h1v or 2h2v.  
\* No scaling needed at upsample time.  
\* Corner-aligned (non-CCIR601) sampling alignment.  
\* Other special cases could be added, but in most applications these are  
\* the only common cases. (For uncommon cases we fall back on the more  
\* general code in jdsample.c and jdcolor.c.)  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdmerge.c  
No license file was found, but licenses were detected in source scan.

/\*  
\* jmemansi.c  
\*  
\* Copyright (C) 1992-1996, Thomas G. Lane.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file provides a simple generic implementation of the system-  
\* dependent portion of the JPEG memory manager. This implementation  
\* assumes that you have the ANSI-standard library routine tmpfile().  
\* Also, the problem of determining the amount of memory available  
\* is shoved onto the user.  
\*/

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jmemansi.c  
No license file was found, but licenses were detected in source scan.

#### IJG JPEG LIBRARY: FILE LIST

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This file is part of the Independent JPEG Group's software.  
For conditions of distribution and use, see the accompanying README file.

Here is a road map to the files in the IJG JPEG distribution. The distribution includes the JPEG library proper, plus two application programs ("cjpeg" and "djpeg") which use the library to convert JPEG files to and from some other popular image formats. A third application "jpegtran" uses the library to do lossless conversion between different variants of JPEG. There are also two stand-alone applications, "rdjpgcom" and "wrjpgcom".

## THE JPEG LIBRARY

=====

### Include files:

`jpeglib.h` JPEG library's exported data and function declarations.  
`jconfig.h` Configuration declarations. Note: this file is not present in the distribution; it is generated during installation.  
`jmorecfg.h` Additional configuration declarations; need not be changed for a standard installation.  
`jerror.h` Declares JPEG library's error and trace message codes.  
`jinclue.h` Central include file used by all IJG .c files to reference system include files.  
`jpegint.h` JPEG library's internal data structures.  
`jdct.h` Private declarations for forward & reverse DCT subsystems.  
`jmemsys.h` Private declarations for memory management subsystem.  
`jversion.h` Version information.

Applications using the library should include `jpeglib.h` (which in turn includes `jconfig.h` and `jmorecfg.h`). Optionally, `jerror.h` may be included if the application needs to reference individual JPEG error codes. The other include files are intended for internal use and would not normally be included by an application program. (`cjpeg/djpeg/etc` do use `jinclue.h`, since its function is to improve portability of the whole IJG distribution. Most other applications will directly include the system include files they want, and hence won't need `jinclue.h`.)

### C source code files:

These files contain most of the functions intended to be called directly by an application program:

`jpegim.c` Application program interface: core routines for compression.  
`jpegstd.c` Application program interface: standard compression.  
`jpegim.c` Application program interface: core routines for decompression.  
`jpegstd.c` Application program interface: standard decompression.  
`jpegapi.c` Application program interface routines common to compression and decompression.  
`jpegparam.c` Compression parameter setting helper routines.  
`jpegtrans.c` API and library routines for transcoding compression.  
`jpegtrans.c` API and library routines for transcoding decompression.

### Compression side of the library:

`jpeginit.c` Initialization: determines which other modules to use.  
`jpegmaster.c` Master control: setup and inter-pass sequencing logic.

jcmainct.c Main buffer controller (preprocessor => JPEG compressor).  
jcprept.c Preprocessor buffer controller.  
jccoefct.c Buffer controller for DCT coefficient buffer.  
jccolor.c Color space conversion.  
jcsample.c Downsampling.  
jcdctmgr.c DCT manager (DCT implementation selection & control).  
jfdctint.c Forward DCT using slow-but-accurate integer method.  
jfdctfst.c Forward DCT using faster, less accurate integer method.  
jfdctflt.c Forward DCT using floating-point arithmetic.  
jchuff.c Huffman entropy coding.  
jcarith.c Arithmetic entropy coding.  
jcmarker.c JPEG marker writing.  
jdatadst.c Data destination managers for memory and stdio output.

Decompression side of the library:

jdmaster.c Master control: determines which other modules to use.  
jdinput.c Input controller: controls input processing modules.  
jdmainct.c Main buffer controller (JPEG decompressor => postprocessor).  
jdcoefct.c Buffer controller for DCT coefficient buffer.  
jdpostct.c Postprocessor buffer controller.  
jdmarker.c JPEG marker reading.  
jdhuff.c Huffman entropy decoding.  
jdarith.c Arithmetic entropy decoding.  
jddctmgr.c IDCT manager (IDCT implementation selection & control).  
jidctint.c Inverse DCT using slow-but-accurate integer method.  
jidctfst.c Inverse DCT using faster, less accurate integer method.  
jidctflt.c Inverse DCT using floating-point arithmetic.  
jdsample.c Upsampling.  
jdcolor.c Color space conversion.  
jdmerge.c Merged upsampling/color conversion (faster, lower quality).  
jquant1.c One-pass color quantization using a fixed-spacing colormap.  
jquant2.c Two-pass color quantization using a custom-generated colormap.  
Also handles one-pass quantization to an externally given map.  
jdatasrc.c Data source managers for memory and stdio input.

Support files for both compression and decompression:

jaricom.c Tables for common use in arithmetic entropy encoding and decoding routines.  
jerror.c Standard error handling routines (application replaceable).  
jmemmgr.c System-independent (more or less) memory management code.  
jutils.c Miscellaneous utility routines.

jmemmgr.c relies on a system-dependent memory management module. The IJG distribution includes the following implementations of the system-dependent module:



jmemnobs.c "No backing store": assumes adequate virtual memory exists.  
jmemansi.c Makes temporary files with ANSI-standard routine tmpfile().  
jmemname.c Makes temporary files with program-generated file names.  
jmemdos.c Custom implementation for MS-DOS (16-bit environment only):  
    can use extended and expanded memory as well as temp files.  
jmemmac.c Custom implementation for Apple Macintosh.

Exactly one of the system-dependent modules should be configured into an installed JPEG library (see install.txt for hints about which one to use).  
On unusual systems you may find it worthwhile to make a special system-dependent memory manager.

Non-C source code files:

jmemdosa.asm 80x86 assembly code support for jmemdos.c; used only in MS-DOS-specific configurations of the JPEG library.

## CJPEG/DJPEG/JPEGTRAN

=====

Include files:

cdjpeg.h Declarations shared by cjpeg/djpeg/jpegtran modules.  
cderror.h Additional error and trace message codes for cjpeg et al.  
transupp.h Declarations for jpegtran support routines in transupp.c.

C source code files:

cjpeg.c Main program for cjpeg.  
djpeg.c Main program for djpeg.  
jpegtran.c Main program for jpegtran.  
cdjpeg.c Utility routines used by all three programs.  
rdcolmap.c Code to read a colormap file for djpeg's "-map" switch.  
rdswitch.c Code to process some of cjpeg's more complex switches.  
    Also used by jpegtran.  
transupp.c Support code for jpegtran: lossless image manipulations.

Image file reader modules for cjpeg:

rdbmp.c BMP file input.  
rdgif.c GIF file input (now just a stub).  
rdppm.c PPM/PGM file input.  
rdrlc.c Utah RLE file input.  
rdtarga.c Targa file input.

Image file writer modules for djpeg:

wrbmp.c BMP file output.  
wrgif.c GIF file output (a mere shadow of its former self).  
wrppm.c PPM/PGM file output.  
wrrle.c Utah RLE file output.  
wrtarga.c Targa file output.

## RDJPGCOM/WRJPGCOM

=====

C source code files:

rdjpgcom.c Stand-alone rdjpgcom application.  
wrjpgcom.c Stand-alone wrjpgcom application.

These programs do not depend on the IJG library. They do use jconfig.h and jinclude.h, only to improve portability.

## ADDITIONAL FILES

=====

Documentation (see README for a guide to the documentation files):

README Master documentation file.  
\*.txt Other documentation files.  
\*.1 Documentation in Unix man page format.  
change.log Version-to-version change highlights.  
example.c Sample code for calling JPEG library.

Configuration/installation files and programs (see install.txt for more info):

configure Unix shell script to perform automatic configuration.  
configure.ac Source file for use with Autoconf to generate configure.  
ltmain.sh Support scripts for configure (from GNU libtool).  
config.guess  
config.sub  
depcomp  
missing  
ar-lib  
compile  
install-sh Install shell script for those Unix systems lacking one.  
Makefile.in Makefile input for configure.  
Makefile.am Source file for use with Automake to generate Makefile.in.  
ckconfig.c Program to generate jconfig.h on non-Unix systems.  
jconfig.txt Template for making jconfig.h by hand.  
mak\*.\* Sample makefiles for particular systems.

jconfig.\* Sample jconfig.h for particular systems.  
libjpeg.map Script to generate shared library with versioned symbols.  
libjpeg.pc.in libjpeg.pc pkg-config file input for configure.  
aclocal.m4 M4 macro definitions for use with Autoconf.

Test files (see install.txt for test procedure):

test\*.\* Source and comparison files for confidence test.  
These are binary image files, NOT text files.

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/filelist.txt  
No license file was found, but licenses were detected in source scan.

```
/*
 * jdapistd.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2002-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains application interface code for the decompression half
 * of the JPEG library. These are the "standard" API routines that are
 * used in the normal full-decompression case. They are not used by a
 * transcoding-only application. Note that if an application links in
 * jpeg_start_decompress, it will end up linking in the entire decompressor.
 * We thus must separate this file from jdapimin.c to avoid linking the
 * whole decompression library into a transcoder.
 */
```

Found in path(s):

\* /opt/cola/permits/1104792432\_1607505170.95/0/jpeg-9c-tar-gz/jpeg-9c/jdapistd.c

# 1.201 wds v1.1.0

## 1.201.1 Available under license :

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Version 2.1, February 1999

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51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA  
Everyone is permitted to copy and distribute verbatim copies  
of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts  
as the successor of the GNU Library Public License, version 2, hence

the version number 2.1.]

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## 1.206 sysfsutils 2.1.1

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\* kdf/kdf\_snmp.c - Key Derivation Function for SNMP

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/sha/asm/sha512-parisc.pl  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/parisc-mont.pl

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/rsa/rsaerr.h  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/dh/dherr.h  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/include/openssl/dherr.h  
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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/ec/ecerr.h

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\* fips/rsa/fips\_rsa2gtest.c - RSA2 Key Generation algorithm processing

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\* July 2013 Barry Fussell

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* crypto/aes/asm/aes_ctr-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
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* fips/kdf/fips_kdf_snmp.c - SNMP KDF vector tests
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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/fips/kdf/fips\_kdf\_snmp.c

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* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/rsa/fips_rsa_sign.c
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7.2a.202104051307/fips/dh/fips_dh_lib.c
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7.2a.202104051307/fips/rsa/fips_rsa_lib.c

```

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```

/*-----
* fips/embedsig.c - Utility to embed signatures into files on disk

```



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```

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/err/err.h

```

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```

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```

This is just a quick script to scan for cases where the 'error'

```

```

function name in a XXXerr() macro is wrong.

```

```

#

```

```

Run in the top level by going

```

```

perl util/ck_errf.pl */*.c */*/*.c

```

```

#

```

```

my $err_strict = 0;

```

```

my $bad = 0;

```

```

foreach $file (@ARGV)

```

```

{

```

```

 if ($file eq "-strict")

```

```

{
 $err_strict = 1;
 next;
}
open(IN,"<$file") || die "unable to open $file\n";
$func="";
while (<IN>)
{
 last if(/^#error\s+obsolete/);
 if (!/;$&& /\^**([a-zA-Z_].*\s*)?([A-Za-z_0-9]+)\.(D,|)$/)
 {
 /^\([^\)]*\([^\)]*\)^\)/;
 $1 =~ /([A-Za-z_0-9]*)$/;
 $func = $1;
 $func =~ tr/A-Z/a-z/;
 }
 if (/([A-Z0-9]+)err\([^\,]+\)/ && !/ckerr_ignore/)
 {
 $errlib=$1;
 $n=$2;

 if ($func eq "")
 { print "$file:.$:???:$n\n"; $bad = 1; next; }

 if ($n !~ /([^_]+)_F_(.+)$/)
 {
 # print "check - $file:.$:$func:$n\n";
 next;
 }
 $lib=$1;
 $n=$2;

 if ($lib ne $errlib)
 { print "$file:.$:$func:$n [${errlib}]err\n"; $bad = 1; next; }

 $n =~ tr/A-Z/a-z/;
 if (($n ne $func) && ($errlib ne "SYS"))
 { print "$file:.$:$func:$n\n"; $bad = 1; next; }
 # print "$func:$1\n";
 }
}
close(IN);
}

if ($bad && $err_strict)
{
 print STDERR "FATAL: error discrepancy\n";
 exit 1;
}

```

}

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/util/ck\_errf.pl

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*
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```
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* kdf/kdf_tls.c - Key Derivation Function for TLS
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* March 2015
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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/aes/asm/aesni-sha1-x86\_64.pl  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/s390x-gf2m.pl  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/x86\_64-gf2m.pl  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-

7.2a.202104051307/crypto/bn/asm/x86-gf2m.pl

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```
/*-----
* kdf/kdf_srtp.c - Key Derivation Function for SRTP
*
* March 2015
*
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*-----
*/
```

Found in path(s):

`/opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/kdf/kdf_srtp.c`

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```
/*-----
* crypto/des/asm/des_enc-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
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*-----
*/
```

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`/opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/des/asm/des_enc-octeon.c`

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```

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/include/internal/rand\_int.h

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/cmac/cmac.h

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*
*/

```

```

#define FIPS_AUTH_KEY "etaonrishdlcupfm"
#define FIPS_AUTH_CRYPTOFFICER "7f92562d409c903322c0f94a1188ae8178339a4f"
#define FIPS_AUTH_CRYPTouser "cb6cbdaad26cd210a8b31a5d56a876ee1d51a96c"

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/fips/fips_auth.in

```

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```

/* -----
* crypto/sha/asm/sha512-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
* Copyright (c) 2013 by cisco Systems, Inc.
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* -----
*/

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-

```

7.2a.202104051307/crypto/sha/asm/sha512-octeon.c

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/bn/bn\_intern.c

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/bn\_int.h

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/include/internal/bn\_int.h

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/include/internal/constant\_time\_locl.h

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#!/usr/bin/env perl

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#

# =====

# Written by Andy Polyakov <[appro@openssl.org](mailto:appro@openssl.org)> for the OpenSSL

# project. The module is, however, dual licensed under OpenSSL and

# CRYPTOGAMS licenses depending on where you obtain it. For further

# details see <http://www.openssl.org/~appro/cryptogams/>.

# =====

#

# This module implements support for AES instructions as per PowerISA

# specification version 2.07, first implemented by POWER8 processor.

# The module is endian-agnostic in sense that it supports both big-

# and little-endian cases. Data alignment in parallelizable modes is

# handled with VSX loads and stores, which implies MSR.VSX flag being

# set. It should also be noted that ISA specification doesn't prohibit

# alignment exceptions for these instructions on page boundaries.

# Initially alignment was handled in pure AltiVec/VMX way [when data

# is aligned programmatically, which in turn guarantees exception-

# free execution], but it turned to hamper performance when vcipher

# instructions are interleaved. It's reckoned that eventual

# misalignment penalties at page boundaries are in average lower

# than additional overhead in pure AltiVec approach.

#

# May 2016

#

# Add XTS subroutine, 9x on little- and 12x improvement on big-endian

# systems were measured.

#

#####

# Current large-block performance in cycles per byte processed with

# 128-bit key (less is better).

#

# CBC en-/decrypt CTR XTS

# POWER8[le] 3.96/0.72 0.74 1.1

# POWER8[be] 3.75/0.65 0.66 1.0

# POWER9[le] 4.02/0.86 0.84 1.05

```
POWER9[be] 3.99/0.78 0.79 0.97
```

```
$flavour = shift;
```

```
if ($flavour =~ /64/) {
 $SIZE_T=8;
 $LRSIZE =2*$SIZE_T;
 $STU ="stdu";
 $POP ="ld";
 $PUSH ="std";
 $UCMP ="cmpld";
 $SHL ="sldi";
} elsif ($flavour =~ /32/) {
 $SIZE_T=4;
 $LRSIZE =$SIZE_T;
 $STU ="stwu";
 $POP ="lwz";
 $PUSH ="stw";
 $UCMP ="cmplw";
 $SHL ="slwi";
} else { die "nonsense $flavour"; }
```

```
$LITTLE_ENDIAN = ($flavour =~ /le$/) ? $SIZE_T : 0;
```

```
$0 =~ m/(.*[\\])[^\\]+$/; $dir=$1;
($xlate="{dir}ppc-xlate.pl" and -f $xlate) or
($xlate="{dir}../perlasm/ppc-xlate.pl" and -f $xlate) or
die "can't locate ppc-xlate.pl";
```

```
open STDOUT, "| ^X $xlate $flavour ".shift || die "can't call $xlate: $!";
```

```
$FRAME=8*$SIZE_T;
$prefix="aes_p8";
```

```
$sp="r1";
$vrsave="r12";
```

```

{ { # Key setup procedures #
my ($inp,$bits,$out,$ptr,$cnt,$rounds)=map("r$_",(3..8));
my ($zero,$in0,$in1,$key,$rcon,$mask,$tmp)=map("v$_",(0..6));
my ($stage,$outperm,$outmask,$outhead,$outtail)=map("v$_",(7..11));
```

```
$code.=<<<____;
.machine "any"
```

```
.text
```

```

.align 7
rcon:
.long 0x01000000, 0x01000000, 0x01000000, 0x01000000 ?rev
.long 0x1b000000, 0x1b000000, 0x1b000000, 0x1b000000 ?rev
.long 0x0d0e0f0c, 0x0d0e0f0c, 0x0d0e0f0c, 0x0d0e0f0c ?rev
.long 0,0,0,0 ?asis
Lconsts:
mflr r0
bcl 20,31,\$+4
mflr $ptr #vvvvv "distance between . and rcon
addi $ptr,$ptr,-0x48
mtlr r0
blr
.long 0
.byte 0,12,0x14,0,0,0,0,0
.asciz "AES for PowerISA 2.07, CRYPTOGAMS by <appro\@openssl.org>"

.globl .${prefix}_set_encrypt_key
.align 5
.${prefix}_set_encrypt_key:
Lset_encrypt_key:
mflr r11
$PUSH r11,$LRSAVE($sp

li $ptr,-1
${UCMP}i $inp,0
beq- Lenc_key_abort # if ($inp==0) return -1;
${UCMP}i $out,0
beq- Lenc_key_abort # if ($out==0) return -1;
li $ptr,-2
cmpwi $bits,128
blt- Lenc_key_abort
cmpwi $bits,256
bgt- Lenc_key_abort
andi. r0,$bits,0x3f
bne- Lenc_key_abort

lis r0,0xffff0
mfspr $vrsave,256
mtspr 256,r0

bl Lconsts
mtlr r11

neg r9,$inp
lvx $in0,0,$inp
addi $inp,$inp,15 # 15 is not typo
lvsr $key,0,r9 # borrow $key

```



```

li r8,0x20
cmpwi $bits,192
lvx $in1,0,$inp
le?vspltisb $mask,0x0f # borrow $mask
lvx $rcon,0,$ptr
le?vxor $key,$key,$mask # adjust for byte swap
lvx $mask,r8,$ptr
addi $ptr,$ptr,0x10
vperm $in0,$in0,$in1,$key # align [and byte swap in LE]
li $cnt,8
vxor $zero,$zero,$zero
mtctr $cnt

```

```

?lvsr $outperm,0,$out
vspltisb $outmask,-1
lvx $outhead,0,$out
?vperm $outmask,$zero,$outmask,$outperm

```

```

blt Loop128
addi $inp,$inp,8
beq L192
addi $inp,$inp,8
b L256

```

```

.align 4
Loop128:
vperm $key,$in0,$in0,$mask # rotate-n-splat
vsldoi $tmp,$zero,$in0,12 # >>32
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$outhead,$outtail,$outmask
vmr $outhead,$outtail
vcipherlast $key,$key,$rcon
stvx $stage,0,$out
addi $out,$out,16

```

```

vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vadduwm $rcon,$rcon,$rcon
vxor $in0,$in0,$key
bdnz Loop128

```

```

lvx $rcon,0,$ptr # last two round keys

```

```

vperm $key,$in0,$in0,$mask # rotate-n-splat
vsldoi $tmp,$zero,$in0,12 # >>32

```

```
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$outhead,$outtail,$outmask
vmr $outhead,$outtail
vcipherlast $key,$key,$rcon
stvx $stage,0,$out
addi $out,$out,16
```

```
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vadduwm $rcon,$rcon,$rcon
vxor $in0,$in0,$key
```

```
vperm $key,$in0,$in0,$mask # rotate-n-splat
vsldoi $tmp,$zero,$in0,12 # >>32
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$outhead,$outtail,$outmask
vmr $outhead,$outtail
vcipherlast $key,$key,$rcon
stvx $stage,0,$out
addi $out,$out,16
```

```
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vxor $in0,$in0,$key
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$outhead,$outtail,$outmask
vmr $outhead,$outtail
stvx $stage,0,$out
```

```
addi $inp,$out,15 # 15 is not typo
addi $out,$out,0x50
```

```
li $rounds,10
b Ldone
```

```
.align 4
L192:
lvx $tmp,0,$inp
li $cnt,4
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$outhead,$outtail,$outmask
vmr $outhead,$outtail
```

```

stvx $stage,0,$out
addi $out,$out,16
vperm $in1,$in1,$tmp,$key # align [and byte swap in LE]
vspltisb $key,8 # borrow $key
mtctr $cnt
vsububm $mask,$mask,$key # adjust the mask

```

Loop192:

```

vperm $key,$in1,$in1,$mask # roate-n-splat
vsldoi $tmp,$zero,$in0,12 # >>32
vcipherlast $key,$key,$rcon

```

```

vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp

```

```

vsldoi $stage,$zero,$in1,8
vspltw $tmp,$in0,3
vxor $tmp,$tmp,$in1
vsldoi $in1,$zero,$in1,12 # >>32
vadduwm $rcon,$rcon,$rcon
vxor $in1,$in1,$tmp
vxor $in0,$in0,$key
vxor $in1,$in1,$key
vsldoi $stage,$stage,$in0,8

```

```

vperm $key,$in1,$in1,$mask # rotate-n-splat
vsldoi $tmp,$zero,$in0,12 # >>32
vperm $outtail,$stage,$stage,$outperm # rotate
vsel $stage,$southead,$outtail,$outmask
vmr $southead,$outtail
vcipherlast $key,$key,$rcon
stvx $stage,0,$out
addi $out,$out,16

```

```

vsldoi $stage,$in0,$in1,8
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vperm $outtail,$stage,$stage,$outperm # rotate
vsel $stage,$southead,$outtail,$outmask
vmr $southead,$outtail
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
stvx $stage,0,$out
addi $out,$out,16

```

```

vspltw $tmp,$in0,3
vxor $tmp,$tmp,$in1
vsldoi $in1,$zero,$in1,12 # >>32
vadduwm $rcon,$rcon,$rcon
vxor $in1,$in1,$tmp
vxor $in0,$in0,$key
vxor $in1,$in1,$key
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$southead,$outtail,$outmask
vmr $southead,$outtail
stvx $stage,0,$out
addi $inp,$out,15 # 15 is not typo
addi $out,$out,16
bdnz Loop192

li $rounds,12
addi $out,$out,0x20
b Ldone

.align 4
L256:
lvx $tmp,0,$inp
li $cnt,7
li $rounds,14
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$southead,$outtail,$outmask
vmr $southead,$outtail
stvx $stage,0,$out
addi $out,$out,16
vperm $in1,$in1,$tmp,$key # align [and byte swap in LE]
mtctr $cnt

Loop256:
vperm $key,$in1,$in1,$mask # rotate-n-splat
vsldoi $tmp,$zero,$in0,12 # >>32
vperm $outtail,$in1,$in1,$outperm # rotate
vsel $stage,$southead,$outtail,$outmask
vmr $southead,$outtail
vcipherlast $key,$key,$rcon
stvx $stage,0,$out
addi $out,$out,16

vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in0,$in0,$tmp

```

```

vadduwm $rcon,$rcon,$rcon
vxor $in0,$in0,$key
vperm $outtail,$in0,$in0,$outperm # rotate
vsel $stage,$outhead,$outtail,$outmask
vmr $outhead,$outtail
stvx $stage,0,$out
addi $inp,$out,15 # 15 is not typo
addi $out,$out,16
bdz Ldone

vspltw $key,$in0,3 # just splat
vsldoi $tmp,$zero,$in1,12 # >>32
vsbox $key,$key

vxor $in1,$in1,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in1,$in1,$tmp
vsldoi $tmp,$zero,$tmp,12 # >>32
vxor $in1,$in1,$tmp

vxor $in1,$in1,$key
b Loop256

.align 4
Ldone:
lvx $in1,0,$inp # redundant in aligned case
vsel $in1,$outhead,$in1,$outmask
stvx $in1,0,$inp
li $ptr,0
mtspr 256,$vrsave
stw $rounds,0($out)

Lenc_key_abort:
mr r3,$ptr
blr
.long 0
.byte 0,12,0x14,1,0,0,3,0
.long 0
.size ${prefix}_set_encrypt_key,-.${prefix}_set_encrypt_key

.globl ${prefix}_set_decrypt_key
.align 5
.${prefix}_set_decrypt_key:
$STU $sp,-$FRAME($sp)
mflr r10
$PUSH r10,$FRAME+$LRSAVE($sp)
bl Lset_encrypt_key
mtr r10

```

```

cmpwi r3,0
bne- Ldec_key_abort

```

```

slwi $cnt,$rounds,4
subi $inp,$out,240 # first round key
srwi $rounds,$rounds,1
add $out,$inp,$cnt # last round key
mtctr $rounds

```

Ldeckey:

```

lwz r0, 0($inp)
lwz r6, 4($inp)
lwz r7, 8($inp)
lwz r8, 12($inp)
addi $inp,$inp,16
lwz r9, 0($out)
lwz r10,4($out)
lwz r11,8($out)
lwz r12,12($out)
stw r0, 0($out)
stw r6, 4($out)
stw r7, 8($out)
stw r8, 12($out)
subi $out,$out,16
stw r9, -16($inp)
stw r10,-12($inp)
stw r11,-8($inp)
stw r12,-4($inp)
bdnz Ldeckey

```

```

xor r3,r3,r3 # return value

```

Ldec\_key\_abort:

```

addi $sp,$sp,$FRAME
blr
.long 0
.byte 0,12,4,1,0x80,0,3,0
.long 0
.size ${prefix}_set_decrypt_key,-.${prefix}_set_decrypt_key

```

```

}}

```

```

#####

```

```

{{{ # Single block en- and decrypt procedures #

```

```

sub gen_block () {
my $dir = shift;
my $n = $dir eq "de" ? "n" : "";
my ($inp,$out,$key,$rounds,$idx)=map("r$_",(3..7));

```

```

$code.=<<____;
.globl .${prefix}_${dir}crypt
.align 5
.${prefix}_${dir}crypt:
lwz $rounds,240($key)
lis r0,0xfc00
mfspr $vrsave,256
li $idx,15 # 15 is not typo
mtspr 256,r0

lvx v0,0,$inp
neg r11,$out
lvx v1,$idx,$inp
lvsl v2,0,$inp # inpperm
le?vspltisb v4,0x0f
?lvsl v3,0,r11 # outperm
le?vxor v2,v2,v4
li $idx,16
vperm v0,v0,v1,v2 # align [and byte swap in LE]
lvx v1,0,$key
?lvsl v5,0,$key # keyperm
srwi $rounds,$rounds,1
lvx v2,$idx,$key
addi $idx,$idx,16
subi $rounds,$rounds,1
?vperm v1,v1,v2,v5 # align round key

vxor v0,v0,v1
lvx v1,$idx,$key
addi $idx,$idx,16
mtctr $rounds

Loop_${dir}c:
?vperm v2,v2,v1,v5
v${n}cipher v0,v0,v2
lvx v2,$idx,$key
addi $idx,$idx,16
?vperm v1,v1,v2,v5
v${n}cipher v0,v0,v1
lvx v1,$idx,$key
addi $idx,$idx,16
bdnz Loop_${dir}c

?vperm v2,v2,v1,v5
v${n}cipher v0,v0,v2
lvx v2,$idx,$key
?vperm v1,v1,v2,v5
v${n}cipherlast v0,v0,v1

```

```

vspltisb v2,-1
vxor v1,v1,v1
li $idx,15 # 15 is not typo
?vperm v2,v1,v2,v3 # outmask
le?vxor v3,v3,v4
lvx v1,0,$out # outhead
vperm v0,v0,v0,v3 # rotate [and byte swap in LE]
vsel v1,v1,v0,v2
lvx v4,$idx,$out
stvx v1,0,$out
vsel v0,v0,v4,v2
stvx v0,$idx,$out

mtspr 256,$vrsave
blr
.long 0
.byte 0,12,0x14,0,0,0,3,0
.long 0
.size ${prefix}_${dir}crypt,-.${prefix}_${dir}crypt
—
}
&gen_block("en");
&gen_block("de");
}}}
#####
{{{ # CBC en- and decrypt procedures #
my ($inp,$out,$len,$key,$ivp,$enc,$rounds,$idx)=map("r$_",(3..10));
my ($rndkey0,$rndkey1,$inout,$tmp)= map("v$_",(0..3));
my ($ivec,$inptail,$inpperm,$outhead,$outperm,$outmask,$keyperm)=
 map("v$_",(4..10));
$code.=<<___;
.globl ${prefix}_cbc_encrypt
.align 5
.${prefix}_cbc_encrypt:
${UCMP}i $len,16
btlr-

cmpwi $enc,0 # test direction
lis r0,0xffe0
mfspr $vrsave,256
mtspr 256,r0

li $idx,15
vxor $rndkey0,$rndkey0,$rndkey0
le?vsplitisb $tmp,0x0f

lvx $ivec,0,$ivp # load [unaligned] iv

```



```

lvsl $inpperm,0,$ivp
lvx $sintail,$idx,$ivp
le?vxor $inpperm,$inpperm,$tmp
vperm $ivec,$ivec,$sintail,$inpperm

neg r11,$inp
?lvsl $keyperm,0,$key # prepare for unaligned key
lwz $rounds,240($key)

lvsr $inpperm,0,r11 # prepare for unaligned load
lvx $sintail,0,$inp
addi $inp,$inp,15 # 15 is not typo
le?vxor $inpperm,$inpperm,$tmp

?lvsr $outperm,0,$out # prepare for unaligned store
vspltisb $outmask,-1
lvx $outhead,0,$out
?vperm $outmask,$rndkey0,$outmask,$outperm
le?vxor $outperm,$outperm,$tmp

srwi $rounds,$rounds,1
li $idx,16
subi $rounds,$rounds,1
beq Lcbc_dec

Lcbc_enc:
vmr $inout,$sintail
lvx $sintail,0,$inp
addi $inp,$inp,16
mtctr $rounds
subi $len,$len,16 # len-=16

lvx $rndkey0,0,$key
vperm $inout,$inout,$sintail,$inpperm
lvx $rndkey1,$idx,$key
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key
addi $idx,$idx,16
vxor $inout,$inout,$ivec

Loop_cbc_enc:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm

```

```

vcipher $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key
addi $idx,$idx,16
bdnz Loop_cbc_enc

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key
li $idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipherlast $ivec,$inout,$rndkey0
${UCMP}i $len,16

vperm $tmp,$ivec,$ivec,$outperm
vsel $inout,$outhead,$tmp,$outmask
vmr $outhead,$tmp
stvx $inout,0,$out
addi $out,$out,16
bge Lcbc_enc

b Lcbc_done

.align 4
Lcbc_dec:
${UCMP}i $len,128
bge _aesp8_cbc_decrypt8x
vmr $tmp,$inptail
lvx $inptail,0,$inp
addi $inp,$inp,16
mtctr $rounds
subi $len,$len,16 # len-=16

lvx $rndkey0,0,$key
vperm $tmp,$tmp,$inptail,$inpperm
lvx $rndkey1,$idx,$key
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $inout,$tmp,$rndkey0
lvx $rndkey0,$idx,$key
addi $idx,$idx,16

Loop_cbc_dec:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vncipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vncipher $inout,$inout,$rndkey0

```

```

lvx $rndkey0,$idx,$key
addi $idx,$idx,16
bdnz Loop_cbc_dec

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vncipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key
li $idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vncipherlast $inout,$inout,$rndkey0
${UCMP}i $len,16

vxor $inout,$inout,$ivec
vmr $ivec,$tmp
vperm $tmp,$inout,$inout,$outperm
vsel $inout,$outhead,$tmp,$outmask
vmr $outhead,$tmp
stvx $inout,0,$out
addi $out,$out,16
bge Lcbc_dec

Lcbc_done:
addi $out,$out,-1
lvx $inout,0,$out # redundant in aligned case
vsel $inout,$outhead,$inout,$outmask
stvx $inout,0,$out

neg $enc,$ivp # write [unaligned] iv
li $idx,15 # 15 is not typo
vxor $rndkey0,$rndkey0,$rndkey0
vspltisb $outmask,-1
le?vsplitisb $tmp,0x0f
?vsl $outperm,0,$enc
?vperm $outmask,$rndkey0,$outmask,$outperm
le?vxor $outperm,$outperm,$tmp
lvx $outhead,0,$ivp
vperm $ivec,$ivec,$ivec,$outperm
vsel $inout,$outhead,$ivec,$outmask
lvx $inptail,$idx,$ivp
stvx $inout,0,$ivp
vsel $inout,$ivec,$inptail,$outmask
stvx $inout,$idx,$ivp

mtspr 256,$vrsave
blr
.long 0
.byte 0,12,0x14,0,0,0,6,0
.long 0

```

```

#####
{{ # Optimized CBC decrypt procedure #
my $key_="r11";
my ($x00,$x10,$x20,$x30,$x40,$x50,$x60,$x70)=map("r$_",(0,8,26..31));
 $x00=0 if ($flavour =~ /osx/);
my ($in0, $in1, $in2, $in3, $in4, $in5, $in6, $in7)=map("v$_",(0..3,10..13));
my ($out0,$out1,$out2,$out3,$out4,$out5,$out6,$out7)=map("v$_",(14..21));
my $rndkey0="v23"; # v24-v25 rotating buffer for first found keys
 # v26-v31 last 6 round keys
my ($tmp,$keyperm)=$(in3,$in4); # aliases with "caller", redundant assignment

$code.=<<___.
.align 5
_esp8_cbc_decrypt8x:
$STU $sp,-(`$FRAME+21*16+6*$SIZE_T`)$sp
li r10,`$FRAME+8*16+15`
li r11,`$FRAME+8*16+31`
stvx v20,r10,$sp # ABI says so
addi r10,r10,32
stvx v21,r11,$sp
addi r11,r11,32
stvx v22,r10,$sp
addi r10,r10,32
stvx v23,r11,$sp
addi r11,r11,32
stvx v24,r10,$sp
addi r10,r10,32
stvx v25,r11,$sp
addi r11,r11,32
stvx v26,r10,$sp
addi r10,r10,32
stvx v27,r11,$sp
addi r11,r11,32
stvx v28,r10,$sp
addi r10,r10,32
stvx v29,r11,$sp
addi r11,r11,32
stvx v30,r10,$sp
stvx v31,r11,$sp
li r0,-1
stw $vrsave,`$FRAME+21*16-4`($sp) # save vrsave
li $x10,0x10
$PUSH r26,`$FRAME+21*16+0*$SIZE_T`($sp)
li $x20,0x20
$PUSH r27,`$FRAME+21*16+1*$SIZE_T`($sp)
li $x30,0x30
$PUSH r28,`$FRAME+21*16+2*$SIZE_T`($sp)

```

```

li $x40,0x40
$PUSH r29,`$FRAME+21*16+3*$SIZE_T`($sp)
li $x50,0x50
$PUSH r30,`$FRAME+21*16+4*$SIZE_T`($sp)
li $x60,0x60
$PUSH r31,`$FRAME+21*16+5*$SIZE_T`($sp)
li $x70,0x70
mtspr 256,r0

```

```

subi $rounds,$rounds,3 # -4 in total
subi $len,$len,128 # bias

```

```

lvx $rndkey0,$x00,$key # load key schedule
lvx v30,$x10,$key
addi $key,$key,0x20
lvx v31,$x00,$key
?vperm $rndkey0,$rndkey0,v30,$keyperm
addi $key_,$sp,$FRAME+15
mtctr $rounds

```

Load\_cbc\_dec\_key:

```

?vperm v24,v30,v31,$keyperm
lvx v30,$x10,$key
addi $key,$key,0x20
stvx v24,$x00,$key_ # off-load round[1]
?vperm v25,v31,v30,$keyperm
lvx v31,$x00,$key
stvx v25,$x10,$key_ # off-load round[2]
addi $key_,$key_,0x20
bdnz Load_cbc_dec_key

```

```

lvx v26,$x10,$key
?vperm v24,v30,v31,$keyperm
lvx v27,$x20,$key
stvx v24,$x00,$key_ # off-load round[3]
?vperm v25,v31,v26,$keyperm
lvx v28,$x30,$key
stvx v25,$x10,$key_ # off-load round[4]
addi $key_,$sp,$FRAME+15 # rewind $key_
?vperm v26,v26,v27,$keyperm
lvx v29,$x40,$key
?vperm v27,v27,v28,$keyperm
lvx v30,$x50,$key
?vperm v28,v28,v29,$keyperm
lvx v31,$x60,$key
?vperm v29,v29,v30,$keyperm
lvx $out0,$x70,$key # borrow $out0
?vperm v30,v30,v31,$keyperm

```

```

lvx v24,$x00,$key_ # pre-load round[1]
?vperm v31,v31,$out0,$keyperm
lvx v25,$x10,$key_ # pre-load round[2]

#lvx $inptail,0,$inp # "caller" already did this
#addi $inp,$inp,15 # 15 is not typo
subi $inp,$inp,15 # undo "caller"

le?li $idx,8
lvx_u $in0,$x00,$inp # load first 8 "words"
le?lvsl $inpperm,0,$idx
le?vspltsb $tmp,0x0f
lvx_u $in1,$x10,$inp
le?vxor $inpperm,$inpperm,$tmp # transform for lvx_u/stvx_u
lvx_u $in2,$x20,$inp
le?vperm $in0,$in0,$in0,$inpperm
lvx_u $in3,$x30,$inp
le?vperm $in1,$in1,$in1,$inpperm
lvx_u $in4,$x40,$inp
le?vperm $in2,$in2,$in2,$inpperm
vxor $out0,$in0,$rndkey0
lvx_u $in5,$x50,$inp
le?vperm $in3,$in3,$in3,$inpperm
vxor $out1,$in1,$rndkey0
lvx_u $in6,$x60,$inp
le?vperm $in4,$in4,$in4,$inpperm
vxor $out2,$in2,$rndkey0
lvx_u $in7,$x70,$inp
addi $inp,$inp,0x80
le?vperm $in5,$in5,$in5,$inpperm
vxor $out3,$in3,$rndkey0
le?vperm $in6,$in6,$in6,$inpperm
vxor $out4,$in4,$rndkey0
le?vperm $in7,$in7,$in7,$inpperm
vxor $out5,$in5,$rndkey0
vxor $out6,$in6,$rndkey0
vxor $out7,$in7,$rndkey0

mtctr $rounds
b Loop_cbc_dec8x
.align 5
Loop_cbc_dec8x:
vncipher $out0,$out0,v24
vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vncipher $out4,$out4,v24
vncipher $out5,$out5,v24

```

```
vncipher $out6,$out6,v24
vncipher $out7,$out7,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20
```

```
vncipher $out0,$out0,v25
vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
vncipher $out5,$out5,v25
vncipher $out6,$out6,v25
vncipher $out7,$out7,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_cbc_dec8x
```

```
subic $len,$len,128 # $len-=128
vncipher $out0,$out0,v24
vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vncipher $out4,$out4,v24
vncipher $out5,$out5,v24
vncipher $out6,$out6,v24
vncipher $out7,$out7,v24
```

```
subfe. r0,r0,r0 # borrow?-1:0
vncipher $out0,$out0,v25
vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
vncipher $out5,$out5,v25
vncipher $out6,$out6,v25
vncipher $out7,$out7,v25
```

```
and r0,r0,$len
vncipher $out0,$out0,v26
vncipher $out1,$out1,v26
vncipher $out2,$out2,v26
vncipher $out3,$out3,v26
vncipher $out4,$out4,v26
vncipher $out5,$out5,v26
vncipher $out6,$out6,v26
vncipher $out7,$out7,v26
```

```
add $inp,$inp,r0 # $inp is adjusted in such
way that at exit from the
```

```

 # loop inX-in7 are loaded
 # with last "words"
vncipher $out0,$out0,v27
vncipher $out1,$out1,v27
vncipher $out2,$out2,v27
vncipher $out3,$out3,v27
vncipher $out4,$out4,v27
vncipher $out5,$out5,v27
vncipher $out6,$out6,v27
vncipher $out7,$out7,v27

addi $key_,$sp,$FRAME+15 # rewind $key_
vncipher $out0,$out0,v28
vncipher $out1,$out1,v28
vncipher $out2,$out2,v28
vncipher $out3,$out3,v28
vncipher $out4,$out4,v28
vncipher $out5,$out5,v28
vncipher $out6,$out6,v28
vncipher $out7,$out7,v28
lvx v24,$x00,$key_ # re-pre-load round[1]

vncipher $out0,$out0,v29
vncipher $out1,$out1,v29
vncipher $out2,$out2,v29
vncipher $out3,$out3,v29
vncipher $out4,$out4,v29
vncipher $out5,$out5,v29
vncipher $out6,$out6,v29
vncipher $out7,$out7,v29
lvx v25,$x10,$key_ # re-pre-load round[2]

vncipher $out0,$out0,v30
vxor $ivec,$ivec,v31 # xor with last round key
vncipher $out1,$out1,v30
vxor $in0,$in0,v31
vncipher $out2,$out2,v30
vxor $in1,$in1,v31
vncipher $out3,$out3,v30
vxor $in2,$in2,v31
vncipher $out4,$out4,v30
vxor $in3,$in3,v31
vncipher $out5,$out5,v30
vxor $in4,$in4,v31
vncipher $out6,$out6,v30
vxor $in5,$in5,v31
vncipher $out7,$out7,v30
vxor $in6,$in6,v31

```



```

vncipherlast $out0,$out0,$ivec
vncipherlast $out1,$out1,$in0
lvx_u $in0,$x00,$inp # load next input block
vncipherlast $out2,$out2,$in1
lvx_u $in1,$x10,$inp
vncipherlast $out3,$out3,$in2
le?vperm $in0,$in0,$in0,$inpperm
lvx_u $in2,$x20,$inp
vncipherlast $out4,$out4,$in3
le?vperm $in1,$in1,$in1,$inpperm
lvx_u $in3,$x30,$inp
vncipherlast $out5,$out5,$in4
le?vperm $in2,$in2,$in2,$inpperm
lvx_u $in4,$x40,$inp
vncipherlast $out6,$out6,$in5
le?vperm $in3,$in3,$in3,$inpperm
lvx_u $in5,$x50,$inp
vncipherlast $out7,$out7,$in6
le?vperm $in4,$in4,$in4,$inpperm
lvx_u $in6,$x60,$inp
vmr $ivec,$in7
le?vperm $in5,$in5,$in5,$inpperm
lvx_u $in7,$x70,$inp
addi $inp,$inp,0x80

```

```

le?vperm $out0,$out0,$out0,$inpperm
le?vperm $out1,$out1,$out1,$inpperm
stvx_u $out0,$x00,$out
le?vperm $in6,$in6,$in6,$inpperm
vxor $out0,$in0,$rndkey0
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x10,$out
le?vperm $in7,$in7,$in7,$inpperm
vxor $out1,$in1,$rndkey0
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x20,$out
vxor $out2,$in2,$rndkey0
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x30,$out
vxor $out3,$in3,$rndkey0
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x40,$out
vxor $out4,$in4,$rndkey0
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x50,$out
vxor $out5,$in5,$rndkey0
le?vperm $out7,$out7,$out7,$inpperm

```

```

stvx_u $out6,$x60,$out
vxor $out6,$in6,$rndkey0
stvx_u $out7,$x70,$out
addi $out,$out,0x80
vxor $out7,$in7,$rndkey0

mtctr $rounds
beq Loop_cbc_dec8x # did $len-=128 borrow?

addic $len,$len,128
beq Lcbc_dec8x_done
nop
nop

Loop_cbc_dec8x_tail: # up to 7 "words" tail...
vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vncipher $out4,$out4,v24
vncipher $out5,$out5,v24
vncipher $out6,$out6,v24
vncipher $out7,$out7,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
vncipher $out5,$out5,v25
vncipher $out6,$out6,v25
vncipher $out7,$out7,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_cbc_dec8x_tail

vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vncipher $out4,$out4,v24
vncipher $out5,$out5,v24
vncipher $out6,$out6,v24
vncipher $out7,$out7,v24

vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
vncipher $out5,$out5,v25

```

```
vncipher $out6,$out6,v25
vncipher $out7,$out7,v25
```

```
vncipher $out1,$out1,v26
vncipher $out2,$out2,v26
vncipher $out3,$out3,v26
vncipher $out4,$out4,v26
vncipher $out5,$out5,v26
vncipher $out6,$out6,v26
vncipher $out7,$out7,v26
```

```
vncipher $out1,$out1,v27
vncipher $out2,$out2,v27
vncipher $out3,$out3,v27
vncipher $out4,$out4,v27
vncipher $out5,$out5,v27
vncipher $out6,$out6,v27
vncipher $out7,$out7,v27
```

```
vncipher $out1,$out1,v28
vncipher $out2,$out2,v28
vncipher $out3,$out3,v28
vncipher $out4,$out4,v28
vncipher $out5,$out5,v28
vncipher $out6,$out6,v28
vncipher $out7,$out7,v28
```

```
vncipher $out1,$out1,v29
vncipher $out2,$out2,v29
vncipher $out3,$out3,v29
vncipher $out4,$out4,v29
vncipher $out5,$out5,v29
vncipher $out6,$out6,v29
vncipher $out7,$out7,v29
```

```
vncipher $out1,$out1,v30
vxor $ivec,$ivec,v31 # last round key
vncipher $out2,$out2,v30
vxor $in1,$in1,v31
vncipher $out3,$out3,v30
vxor $in2,$in2,v31
vncipher $out4,$out4,v30
vxor $in3,$in3,v31
vncipher $out5,$out5,v30
vxor $in4,$in4,v31
vncipher $out6,$out6,v30
vxor $in5,$in5,v31
vncipher $out7,$out7,v30
```

```

vxor $in6,$in6,v31

cmplwi $len,32 # switch($len)
blt Lcbc_dec8x_one
nop
beq Lcbc_dec8x_two
cmplwi $len,64
blt Lcbc_dec8x_three
nop
beq Lcbc_dec8x_four
cmplwi $len,96
blt Lcbc_dec8x_five
nop
beq Lcbc_dec8x_six

```

Lcbc\_dec8x\_seven:

```

vncipherlast $out1,$out1,$ivec
vncipherlast $out2,$out2,$in1
vncipherlast $out3,$out3,$in2
vncipherlast $out4,$out4,$in3
vncipherlast $out5,$out5,$in4
vncipherlast $out6,$out6,$in5
vncipherlast $out7,$out7,$in6
vmr $ivec,$in7

```

```

le?vperm $out1,$out1,$out1,$inpperm
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x00,$out
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x10,$out
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x20,$out
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x30,$out
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x40,$out
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out6,$x50,$out
stvx_u $out7,$x60,$out
addi $out,$out,0x70
b Lcbc_dec8x_done

```

.align 5

Lcbc\_dec8x\_six:

```

vncipherlast $out2,$out2,$ivec
vncipherlast $out3,$out3,$in2
vncipherlast $out4,$out4,$in3
vncipherlast $out5,$out5,$in4

```

```
vncipherlast $out6,$out6,$in5
vncipherlast $out7,$out7,$in6
vmr $ivec,$in7
```

```
le?vperm $out2,$out2,$out2,$inpperm
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x00,$out
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x10,$out
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x20,$out
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x30,$out
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out6,$x40,$out
stvx_u $out7,$x50,$out
addi $out,$out,0x60
b Lcbc_dec8x_done
```

```
.align 5
```

```
Lcbc_dec8x_five:
```

```
vncipherlast $out3,$out3,$ivec
vncipherlast $out4,$out4,$in3
vncipherlast $out5,$out5,$in4
vncipherlast $out6,$out6,$in5
vncipherlast $out7,$out7,$in6
vmr $ivec,$in7
```

```
le?vperm $out3,$out3,$out3,$inpperm
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x00,$out
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x10,$out
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x20,$out
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out6,$x30,$out
stvx_u $out7,$x40,$out
addi $out,$out,0x50
b Lcbc_dec8x_done
```

```
.align 5
```

```
Lcbc_dec8x_four:
```

```
vncipherlast $out4,$out4,$ivec
vncipherlast $out5,$out5,$in4
vncipherlast $out6,$out6,$in5
vncipherlast $out7,$out7,$in6
vmr $ivec,$in7
```

```
le?vperm $out4,$out4,$out4,$inpperm
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x00,$out
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x10,$out
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out6,$x20,$out
stvx_u $out7,$x30,$out
addi $out,$out,0x40
b Lcbc_dec8x_done
```

```
.align 5
```

```
Lcbc_dec8x_three:
```

```
vncipherlast $out5,$out5,$ivec
vncipherlast $out6,$out6,$in5
vncipherlast $out7,$out7,$in6
vmr $ivec,$in7
```

```
le?vperm $out5,$out5,$out5,$inpperm
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x00,$out
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out6,$x10,$out
stvx_u $out7,$x20,$out
addi $out,$out,0x30
b Lcbc_dec8x_done
```

```
.align 5
```

```
Lcbc_dec8x_two:
```

```
vncipherlast $out6,$out6,$ivec
vncipherlast $out7,$out7,$in6
vmr $ivec,$in7
```

```
le?vperm $out6,$out6,$out6,$inpperm
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out6,$x00,$out
stvx_u $out7,$x10,$out
addi $out,$out,0x20
b Lcbc_dec8x_done
```

```
.align 5
```

```
Lcbc_dec8x_one:
```

```
vncipherlast $out7,$out7,$ivec
vmr $ivec,$in7
```

```
le?vperm $out7,$out7,$out7,$inpperm
stvx_u $out7,0,$out
```

```
addi $out,$out,0x10
```

```
Lcbc_dec8x_done:
```

```
le?vperm $ivec,$ivec,$ivec,$inpperm
```

```
stvx_u $ivec,0,$ivp # write [unaligned] iv
```

```
li r10,`$FRAME+15`
```

```
li r11,`$FRAME+31`
```

```
stvx $inpperm,r10,$sp # wipe copies of round keys
```

```
addi r10,r10,32
```

```
stvx $inpperm,r11,$sp
```

```
addi r11,r11,32
```

```
stvx $inpperm,r10,$sp
```

```
addi r10,r10,32
```

```
stvx $inpperm,r11,$sp
```

```
addi r11,r11,32
```

```
stvx $inpperm,r10,$sp
```

```
addi r10,r10,32
```

```
stvx $inpperm,r11,$sp
```

```
addi r11,r11,32
```

```
stvx $inpperm,r10,$sp
```

```
addi r10,r10,32
```

```
stvx $inpperm,r11,$sp
```

```
addi r11,r11,32
```

```
mtspr 256,$vrsave
```

```
lvx v20,r10,$sp # ABI says so
```

```
addi r10,r10,32
```

```
lvx v21,r11,$sp
```

```
addi r11,r11,32
```

```
lvx v22,r10,$sp
```

```
addi r10,r10,32
```

```
lvx v23,r11,$sp
```

```
addi r11,r11,32
```

```
lvx v24,r10,$sp
```

```
addi r10,r10,32
```

```
lvx v25,r11,$sp
```

```
addi r11,r11,32
```

```
lvx v26,r10,$sp
```

```
addi r10,r10,32
```

```
lvx v27,r11,$sp
```

```
addi r11,r11,32
```

```
lvx v28,r10,$sp
```

```
addi r10,r10,32
```

```
lvx v29,r11,$sp
```

```
addi r11,r11,32
```

```
lvx v30,r10,$sp
```

```
lvx v31,r11,$sp
```

```

$POP r26,`$FRAME+21*16+0*$SIZE_T`($sp)
$POP r27,`$FRAME+21*16+1*$SIZE_T`($sp)
$POP r28,`$FRAME+21*16+2*$SIZE_T`($sp)
$POP r29,`$FRAME+21*16+3*$SIZE_T`($sp)
$POP r30,`$FRAME+21*16+4*$SIZE_T`($sp)
$POP r31,`$FRAME+21*16+5*$SIZE_T`($sp)
addi $sp,$sp,`$FRAME+21*16+6*$SIZE_T`
blr
.long 0
.byte 0,12,0x04,0,0x80,6,6,0
.long 0
.size .${prefix}_cbc_encrypt,-. ${prefix}_cbc_encrypt

```

```

}} }}

```

```

#####

```

```

{{{ # CTR procedure[s] #
my ($inp,$out,$len,$key,$ivp,$x10,$rounds,$idx)=map("r$_",(3..10));
my ($rndkey0,$rndkey1,$inout,$tmp)= map("v$_",(0..3));
my ($ivec,$inptail,$inpperm,$outhead,$outperm,$outmask,$keyperm,$one)=
 map("v$_",(4..11));
my $dat=$tmp;

```

```

$code.=<<____;

```

```

.globl .${prefix}_ctr32_encrypt_blocks
.align 5
.${prefix}_ctr32_encrypt_blocks:
${UCMP}i $len,1
btlr-

```

```

lis r0,0xffff0
mfspr $vrsave,256
mtspr 256,r0

```

```

li $idx,15
vxor $rndkey0,$rndkey0,$rndkey0
le?vspltisb $tmp,0x0f

```

```

lvx $ivec,0,$ivp # load [unaligned] iv
lvsl $inpperm,0,$ivp
lvx $inptail,$idx,$ivp
vspltisb $one,1
le?vxor $inpperm,$inpperm,$tmp
vperm $ivec,$ivec,$inptail,$inpperm
vsldoi $one,$rndkey0,$one,1

```

```

neg r11,$inp
?lvsl $keyperm,0,$key # prepare for unaligned key

```



```

lwz $rounds,240($key)

lvsr $inperm,0,r11 # prepare for unaligned load
lvx $sintail,0,$inp
addi $inp,$inp,15 # 15 is not typo
le?vxor $inperm,$inperm,$tmp

srwi $rounds,$rounds,1
li $idx,16
subi $rounds,$rounds,1

${UCMP}i $len,8
bge _aesp8_ctr32_encrypt8x

?lvsr $outperm,0,$out # prepare for unaligned store
vspltisb $outmask,-1
lvx $outhead,0,$out
?vperm $outmask,$rndkey0,$outmask,$outperm
le?vxor $outperm,$outperm,$tmp

lvx $rndkey0,0,$key
mtctr $rounds
lvx $rndkey1,$idx,$key
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $inout,$ivec,$rndkey0
lvx $rndkey0,$idx,$key
addi $idx,$idx,16
b Loop_ctr32_enc

.align 5
Loop_ctr32_enc:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipher $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key
addi $idx,$idx,16
bdnz Loop_ctr32_enc

vadduwm $ivec,$ivec,$one
vmr $dat,$sintail
lvx $sintail,0,$inp
addi $inp,$inp,16
subic $len,$len,1 # blocks--

```

```

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key
vperm $dat,$dat,$inptail,$inpperm
li $idx,16
?vperm $rndkey1,$rndkey0,$rndkey1,$keyperm
lvx $rndkey0,0,$key
vxor $dat,$dat,$rndkey1 # last round key
vcipherlast $inout,$inout,$dat

lvx $rndkey1,$idx,$key
addi $idx,$idx,16
vperm $inout,$inout,$inout,$outperm
vsel $dat,$southead,$inout,$outmask
mtctr $rounds
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vmr $southead,$inout
vxor $inout,$ivec,$rndkey0
lvx $rndkey0,$idx,$key
addi $idx,$idx,16
stvx $dat,0,$out
addi $out,$out,16
bne Loop_ctr32_enc

addi $out,$out,-1
lvx $inout,0,$out # redundant in aligned case
vsel $inout,$southead,$inout,$outmask
stvx $inout,0,$out

mtspr 256,$vrsave
blr
.long 0
.byte 0,12,0x14,0,0,0,6,0
.long 0

#####
{{ # Optimized CTR procedure #
my $key_="r11";
my ($x00,$x10,$x20,$x30,$x40,$x50,$x60,$x70)=map("r$_",(0,8,26..31));
 $x00=0 if ($flavour =~ /osx/);
my ($in0, $in1, $in2, $in3, $in4, $in5, $in6, $in7)=map("v$_",(0..3,10,12..14));
my ($out0,$out1,$out2,$out3,$out4,$out5,$out6,$out7)=map("v$_",(15..22));
my $rndkey0="v23"; # v24-v25 rotating buffer for first found keys
 # v26-v31 last 6 round keys
my ($tmp,$keyperm)=$in3,$in4; # aliases with "caller", redundant assignment
my ($two,$three,$four)=$southead,$outperm,$outmask);

$code.=<<____;

```

```

.align 5
_esp8_ctr32_encrypt8x:
$STU $sp,-(`$FRAME+21*16+6*$SIZE_T`)($sp)
li r10,`$FRAME+8*16+15`
li r11,`$FRAME+8*16+31`
stvx v20,r10,$sp # ABI says so
addi r10,r10,32
stvx v21,r11,$sp
addi r11,r11,32
stvx v22,r10,$sp
addi r10,r10,32
stvx v23,r11,$sp
addi r11,r11,32
stvx v24,r10,$sp
addi r10,r10,32
stvx v25,r11,$sp
addi r11,r11,32
stvx v26,r10,$sp
addi r10,r10,32
stvx v27,r11,$sp
addi r11,r11,32
stvx v28,r10,$sp
addi r10,r10,32
stvx v29,r11,$sp
addi r11,r11,32
stvx v30,r10,$sp
stvx v31,r11,$sp
li r0,-1
stw $vrsave,`$FRAME+21*16-4`($sp) # save vrsave
li $x10,0x10
$PUSH r26,`$FRAME+21*16+0*$SIZE_T`($sp)
li $x20,0x20
$PUSH r27,`$FRAME+21*16+1*$SIZE_T`($sp)
li $x30,0x30
$PUSH r28,`$FRAME+21*16+2*$SIZE_T`($sp)
li $x40,0x40
$PUSH r29,`$FRAME+21*16+3*$SIZE_T`($sp)
li $x50,0x50
$PUSH r30,`$FRAME+21*16+4*$SIZE_T`($sp)
li $x60,0x60
$PUSH r31,`$FRAME+21*16+5*$SIZE_T`($sp)
li $x70,0x70
mtspr 256,r0

subi $rounds,$rounds,3 # -4 in total

lvx $rndkey0,$x00,$key # load key schedule
lvx v30,$x10,$key

```

```

addi $key,$key,0x20
lvx v31,$x00,$key
?vperm $rndkey0,$rndkey0,v30,$keyperm
addi $key_,$sp,$FRAME+15
mtctr $rounds

```

```

Load_ctr32_enc_key:
?vperm v24,v30,v31,$keyperm
lvx v30,$x10,$key
addi $key,$key,0x20
stvx v24,$x00,$key_ # off-load round[1]
?vperm v25,v31,v30,$keyperm
lvx v31,$x00,$key
stvx v25,$x10,$key_ # off-load round[2]
addi $key_, $key_,0x20
bdnz Load_ctr32_enc_key

```

```

lvx v26,$x10,$key
?vperm v24,v30,v31,$keyperm
lvx v27,$x20,$key
stvx v24,$x00,$key_ # off-load round[3]
?vperm v25,v31,v26,$keyperm
lvx v28,$x30,$key
stvx v25,$x10,$key_ # off-load round[4]
addi $key_,$sp,$FRAME+15 # rewind $key_
?vperm v26,v26,v27,$keyperm
lvx v29,$x40,$key
?vperm v27,v27,v28,$keyperm
lvx v30,$x50,$key
?vperm v28,v28,v29,$keyperm
lvx v31,$x60,$key
?vperm v29,v29,v30,$keyperm
lvx $out0,$x70,$key # borrow $out0
?vperm v30,v30,v31,$keyperm
lvx v24,$x00,$key_ # pre-load round[1]
?vperm v31,v31,$out0,$keyperm
lvx v25,$x10,$key_ # pre-load round[2]

```

```

vadduwm $two,$one,$one
subi $inp,$inp,15 # undo "caller"
$SHL $len,$len,4

```

```

vadduwm $out1,$ivec,$one # counter values ...
vadduwm $out2,$ivec,$two
vxor $out0,$ivec,$rndkey0 # ... xored with rndkey[0]
le?li $idx,8
vadduwm $out3,$out1,$two
vxor $out1,$out1,$rndkey0

```

```

le?lvs1 $inpperm,0,$idx
vadduwm $out4,$out2,$two
vxor $out2,$out2,$rndkey0
le?vspltsb $tmp,0x0f
vadduwm $out5,$out3,$two
vxor $out3,$out3,$rndkey0
le?vxor $inpperm,$inpperm,$tmp # transform for lvx_u/stvx_u
vadduwm $out6,$out4,$two
vxor $out4,$out4,$rndkey0
vadduwm $out7,$out5,$two
vxor $out5,$out5,$rndkey0
vadduwm $ivec,$out6,$two # next counter value
vxor $out6,$out6,$rndkey0
vxor $out7,$out7,$rndkey0

```

```

mtctr $rounds
b Loop_ctr32_enc8x
.align 5
Loop_ctr32_enc8x:
vcipher $out0,$out0,v24
vcipher $out1,$out1,v24
vcipher $out2,$out2,v24
vcipher $out3,$out3,v24
vcipher $out4,$out4,v24
vcipher $out5,$out5,v24
vcipher $out6,$out6,v24
vcipher $out7,$out7,v24
Loop_ctr32_enc8x_middle:
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

```

```

vcipher $out0,$out0,v25
vcipher $out1,$out1,v25
vcipher $out2,$out2,v25
vcipher $out3,$out3,v25
vcipher $out4,$out4,v25
vcipher $out5,$out5,v25
vcipher $out6,$out6,v25
vcipher $out7,$out7,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_ctr32_enc8x

```

```

subic r11,$len,256 # $len-256, borrow $key_
vcipher $out0,$out0,v24
vcipher $out1,$out1,v24
vcipher $out2,$out2,v24
vcipher $out3,$out3,v24
vcipher $out4,$out4,v24

```

```

vcipher $out5,$out5,v24
vcipher $out6,$out6,v24
vcipher $out7,$out7,v24

subfe r0,r0,r0 # borrow?-1:0
vcipher $out0,$out0,v25
vcipher $out1,$out1,v25
vcipher $out2,$out2,v25
vcipher $out3,$out3,v25
vcipher $out4,$out4,v25
vcipher $out5,$out5,v25
vcipher $out6,$out6,v25
vcipher $out7,$out7,v25

and r0,r0,r11
addi $key_,$sp,$FRAME+15 # rewind $key_
vcipher $out0,$out0,v26
vcipher $out1,$out1,v26
vcipher $out2,$out2,v26
vcipher $out3,$out3,v26
vcipher $out4,$out4,v26
vcipher $out5,$out5,v26
vcipher $out6,$out6,v26
vcipher $out7,$out7,v26
lvx v24,$x00,$key_ # re-pre-load round[1]

subic $len,$len,129 # $len-=129
vcipher $out0,$out0,v27
addi $len,$len,1 # $len-=128 really
vcipher $out1,$out1,v27
vcipher $out2,$out2,v27
vcipher $out3,$out3,v27
vcipher $out4,$out4,v27
vcipher $out5,$out5,v27
vcipher $out6,$out6,v27
vcipher $out7,$out7,v27
lvx v25,$x10,$key_ # re-pre-load round[2]

vcipher $out0,$out0,v28
lvx_u $in0,$x00,$inp # load input
vcipher $out1,$out1,v28
lvx_u $in1,$x10,$inp
vcipher $out2,$out2,v28
lvx_u $in2,$x20,$inp
vcipher $out3,$out3,v28
lvx_u $in3,$x30,$inp
vcipher $out4,$out4,v28
lvx_u $in4,$x40,$inp

```

```

vcipher $out5,$out5,v28
lvx_u $in5,$x50,$inp
vcipher $out6,$out6,v28
lvx_u $in6,$x60,$inp
vcipher $out7,$out7,v28
lvx_u $in7,$x70,$inp
addi $inp,$inp,0x80

vcipher $out0,$out0,v29
le?vperm $in0,$in0,$in0,$inpperm
vcipher $out1,$out1,v29
le?vperm $in1,$in1,$in1,$inpperm
vcipher $out2,$out2,v29
le?vperm $in2,$in2,$in2,$inpperm
vcipher $out3,$out3,v29
le?vperm $in3,$in3,$in3,$inpperm
vcipher $out4,$out4,v29
le?vperm $in4,$in4,$in4,$inpperm
vcipher $out5,$out5,v29
le?vperm $in5,$in5,$in5,$inpperm
vcipher $out6,$out6,v29
le?vperm $in6,$in6,$in6,$inpperm
vcipher $out7,$out7,v29
le?vperm $in7,$in7,$in7,$inpperm

add $inp,$inp,r0 # $inp is adjusted in such
way that at exit from the
loop inX-in7 are loaded
with last "words"
subfe. r0,r0,r0 # borrow?-1:0
vcipher $out0,$out0,v30
vxor $in0,$in0,v31 # xor with last round key
vcipher $out1,$out1,v30
vxor $in1,$in1,v31
vcipher $out2,$out2,v30
vxor $in2,$in2,v31
vcipher $out3,$out3,v30
vxor $in3,$in3,v31
vcipher $out4,$out4,v30
vxor $in4,$in4,v31
vcipher $out5,$out5,v30
vxor $in5,$in5,v31
vcipher $out6,$out6,v30
vxor $in6,$in6,v31
vcipher $out7,$out7,v30
vxor $in7,$in7,v31

bne Lctr32_enc8x_break # did $len-129 borrow?

```

```

vcipherlast $in0,$out0,$in0
vcipherlast $in1,$out1,$in1
vadduwm $out1,$ivec,$one # counter values ...
vcipherlast $in2,$out2,$in2
vadduwm $out2,$ivec,$two
vxor $out0,$ivec,$rndkey0 # ... xored with rndkey[0]
vcipherlast $in3,$out3,$in3
vadduwm $out3,$out1,$two
vxor $out1,$out1,$rndkey0
vcipherlast $in4,$out4,$in4
vadduwm $out4,$out2,$two
vxor $out2,$out2,$rndkey0
vcipherlast $in5,$out5,$in5
vadduwm $out5,$out3,$two
vxor $out3,$out3,$rndkey0
vcipherlast $in6,$out6,$in6
vadduwm $out6,$out4,$two
vxor $out4,$out4,$rndkey0
vcipherlast $in7,$out7,$in7
vadduwm $out7,$out5,$two
vxor $out5,$out5,$rndkey0
le?vperm $in0,$in0,$in0,$inpperm
vadduwm $ivec,$out6,$two # next counter value
vxor $out6,$out6,$rndkey0
le?vperm $in1,$in1,$in1,$inpperm
vxor $out7,$out7,$rndkey0
mtctr $rounds

```

```

vcipher $out0,$out0,v24
stvx_u $in0,$x00,$out
le?vperm $in2,$in2,$in2,$inpperm
vcipher $out1,$out1,v24
stvx_u $in1,$x10,$out
le?vperm $in3,$in3,$in3,$inpperm
vcipher $out2,$out2,v24
stvx_u $in2,$x20,$out
le?vperm $in4,$in4,$in4,$inpperm
vcipher $out3,$out3,v24
stvx_u $in3,$x30,$out
le?vperm $in5,$in5,$in5,$inpperm
vcipher $out4,$out4,v24
stvx_u $in4,$x40,$out
le?vperm $in6,$in6,$in6,$inpperm
vcipher $out5,$out5,v24
stvx_u $in5,$x50,$out
le?vperm $in7,$in7,$in7,$inpperm
vcipher $out6,$out6,v24

```



```

stvx_u $in6,$x60,$out
vcipher $out7,$out7,v24
stvx_u $in7,$x70,$out
addi $out,$out,0x80

```

b Loop\_ctr32\_enc8x\_middle

```

.align 5
Lctr32_enc8x_break:
cmpwi $len,-0x60
blt Lctr32_enc8x_one
nop
beq Lctr32_enc8x_two
cmpwi $len,-0x40
blt Lctr32_enc8x_three
nop
beq Lctr32_enc8x_four
cmpwi $len,-0x20
blt Lctr32_enc8x_five
nop
beq Lctr32_enc8x_six
cmpwi $len,0x00
blt Lctr32_enc8x_seven

```

```

Lctr32_enc8x_eight:
vcipherlast $out0,$out0,$in0
vcipherlast $out1,$out1,$in1
vcipherlast $out2,$out2,$in2
vcipherlast $out3,$out3,$in3
vcipherlast $out4,$out4,$in4
vcipherlast $out5,$out5,$in5
vcipherlast $out6,$out6,$in6
vcipherlast $out7,$out7,$in7

```

```

le?vperm $out0,$out0,$out0,$inpperm
le?vperm $out1,$out1,$out1,$inpperm
stvx_u $out0,$x00,$out
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x20,$out
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x30,$out
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x40,$out
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x50,$out
le?vperm $out7,$out7,$out7,$inpperm

```

```
stvx_u $out6,$x60,$out
stvx_u $out7,$x70,$out
addi $out,$out,0x80
b Lctr32_enc8x_done
```

```
.align 5
```

```
Lctr32_enc8x_seven:
```

```
vcipherlast $out0,$out0,$in1
vcipherlast $out1,$out1,$in2
vcipherlast $out2,$out2,$in3
vcipherlast $out3,$out3,$in4
vcipherlast $out4,$out4,$in5
vcipherlast $out5,$out5,$in6
vcipherlast $out6,$out6,$in7
```

```
le?vperm $out0,$out0,$out0,$inpperm
le?vperm $out1,$out1,$out1,$inpperm
stvx_u $out0,$x00,$out
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x20,$out
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x30,$out
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x40,$out
le?vperm $out6,$out6,$out6,$inpperm
stvx_u $out5,$x50,$out
stvx_u $out6,$x60,$out
addi $out,$out,0x70
b Lctr32_enc8x_done
```

```
.align 5
```

```
Lctr32_enc8x_six:
```

```
vcipherlast $out0,$out0,$in2
vcipherlast $out1,$out1,$in3
vcipherlast $out2,$out2,$in4
vcipherlast $out3,$out3,$in5
vcipherlast $out4,$out4,$in6
vcipherlast $out5,$out5,$in7
```

```
le?vperm $out0,$out0,$out0,$inpperm
le?vperm $out1,$out1,$out1,$inpperm
stvx_u $out0,$x00,$out
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x20,$out
```

```
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x30,$out
le?vperm $out5,$out5,$out5,$inpperm
stvx_u $out4,$x40,$out
stvx_u $out5,$x50,$out
addi $out,$out,0x60
b Lctr32_enc8x_done
```

```
.align 5
```

```
Lctr32_enc8x_five:
```

```
vcipherlast $out0,$out0,$in3
vcipherlast $out1,$out1,$in4
vcipherlast $out2,$out2,$in5
vcipherlast $out3,$out3,$in6
vcipherlast $out4,$out4,$in7
```

```
le?vperm $out0,$out0,$out0,$inpperm
le?vperm $out1,$out1,$out1,$inpperm
stvx_u $out0,$x00,$out
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x20,$out
le?vperm $out4,$out4,$out4,$inpperm
stvx_u $out3,$x30,$out
stvx_u $out4,$x40,$out
addi $out,$out,0x50
b Lctr32_enc8x_done
```

```
.align 5
```

```
Lctr32_enc8x_four:
```

```
vcipherlast $out0,$out0,$in4
vcipherlast $out1,$out1,$in5
vcipherlast $out2,$out2,$in6
vcipherlast $out3,$out3,$in7
```

```
le?vperm $out0,$out0,$out0,$inpperm
le?vperm $out1,$out1,$out1,$inpperm
stvx_u $out0,$x00,$out
le?vperm $out2,$out2,$out2,$inpperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$inpperm
stvx_u $out2,$x20,$out
stvx_u $out3,$x30,$out
addi $out,$out,0x40
b Lctr32_enc8x_done
```

```
.align 5
```

```

Lctr32_enc8x_three:
 vcipherlast $out0,$out0,$in5
 vcipherlast $out1,$out1,$in6
 vcipherlast $out2,$out2,$in7

 le?vperm $out0,$out0,$out0,$inpperm
 le?vperm $out1,$out1,$out1,$inpperm
 stvx_u $out0,$x00,$out
 le?vperm $out2,$out2,$out2,$inpperm
 stvx_u $out1,$x10,$out
 stvx_u $out2,$x20,$out
 addi $out,$out,0x30
 b Lctr32_enc8x_done

.align 5
Lctr32_enc8x_two:
 vcipherlast $out0,$out0,$in6
 vcipherlast $out1,$out1,$in7

 le?vperm $out0,$out0,$out0,$inpperm
 le?vperm $out1,$out1,$out1,$inpperm
 stvx_u $out0,$x00,$out
 stvx_u $out1,$x10,$out
 addi $out,$out,0x20
 b Lctr32_enc8x_done

.align 5
Lctr32_enc8x_one:
 vcipherlast $out0,$out0,$in7

 le?vperm $out0,$out0,$out0,$inpperm
 stvx_u $out0,0,$out
 addi $out,$out,0x10

Lctr32_enc8x_done:
 li r10,`$FRAME+15`
 li r11,`$FRAME+31`
 stvx $inpperm,r10,$sp # wipe copies of round keys
 addi r10,r10,32
 stvx $inpperm,r11,$sp
 addi r11,r11,32
 stvx $inpperm,r10,$sp
 addi r10,r10,32
 stvx $inpperm,r11,$sp
 addi r11,r11,32
 stvx $inpperm,r10,$sp
 addi r10,r10,32
 stvx $inpperm,r11,$sp

```

```

addi r11,r11,32
stvx $inpperm,r10,$sp
addi r10,r10,32
stvx $inpperm,r11,$sp
addi r11,r11,32

mtspr 256,$vrsave
lvx v20,r10,$sp # ABI says so
addi r10,r10,32
lvx v21,r11,$sp
addi r11,r11,32
lvx v22,r10,$sp
addi r10,r10,32
lvx v23,r11,$sp
addi r11,r11,32
lvx v24,r10,$sp
addi r10,r10,32
lvx v25,r11,$sp
addi r11,r11,32
lvx v26,r10,$sp
addi r10,r10,32
lvx v27,r11,$sp
addi r11,r11,32
lvx v28,r10,$sp
addi r10,r10,32
lvx v29,r11,$sp
addi r11,r11,32
lvx v30,r10,$sp
lvx v31,r11,$sp
$POP r26,`$FRAME+21*16+0*$SIZE_T`($sp)
$POP r27,`$FRAME+21*16+1*$SIZE_T`($sp)
$POP r28,`$FRAME+21*16+2*$SIZE_T`($sp)
$POP r29,`$FRAME+21*16+3*$SIZE_T`($sp)
$POP r30,`$FRAME+21*16+4*$SIZE_T`($sp)
$POP r31,`$FRAME+21*16+5*$SIZE_T`($sp)
addi $sp,$sp,`$FRAME+21*16+6*$SIZE_T`
blr
.long 0
.byte 0,12,0x04,0,0x80,6,6,0
.long 0
.size ${prefix}_ctr32_encrypt_blocks,-.${prefix}_ctr32_encrypt_blocks

}} }}

```

```
#####
```

```

{{{ # XTS procedures #
int aes_p8_xts_[en|de]crypt(const char *inp, char *out, size_t len,
const AES_KEY *key1, const AES_KEY *key2,

```

```
[const] unsigned char iv[16]);
If $key2 is NULL, then a "tweak chaining" mode is engaged, in which
input tweak value is assumed to be encrypted already, and last tweak
value, one suitable for consecutive call on same chunk of data, is
written back to original buffer. In addition, in "tweak chaining"
mode only complete input blocks are processed.
```

```
my ($inp,$out,$len,$key1,$key2,$ivp,$rounds,$idx) = map("r$_",(3..10));
my ($rndkey0,$rndkey1,$inout) = map("v$_",(0..2));
my ($output,$inptail,$inpperm,$leperm,$keyperm) = map("v$_",(3..7));
my ($tweak,$seven,$eighty7,$tmp,$tweak1) = map("v$_",(8..12));
my $tailen = $key2;
```

```
($inp,$idx) = ($idx,$inp); # reassign
```

```
$code.=<<__;
```

```
.globl .${prefix}_xts_encrypt
```

```
.align 5
```

```
.${prefix}_xts_encrypt:
```

```
mr $inp,r3 # reassign
```

```
li r3,-1
```

```
 ${UCMP}i $len,16
```

```
bltlr-
```

```
lis r0,0xffff
```

```
mfspr r12,256 # save vrsave
```

```
li r11,0
```

```
mtspr 256,r0
```

```
vspltisb $seven,0x07 # 0x070707..07
```

```
le?lvsl $leperm,r11,r11
```

```
le?vspltisb $tmp,0x0f
```

```
le?vxor $leperm,$leperm,$seven
```

```
li $idx,15
```

```
lvx $tweak,0,$ivp # load [unaligned] iv
```

```
lvsl $inpperm,0,$ivp
```

```
lvx $inptail,$idx,$ivp
```

```
le?vxor $inpperm,$inpperm,$tmp
```

```
vperm $tweak,$tweak,$inptail,$inpperm
```

```
neg r11,$inp
```

```
lvsr $inpperm,0,r11 # prepare for unaligned load
```

```
lvx $inout,0,$inp
```

```
addi $inp,$inp,15 # 15 is not typo
```

```
le?vxor $inpperm,$inpperm,$tmp
```

```
 ${UCMP}i $key2,0 # key2==NULL?
```

```

beq Lxts_enc_no_key2

?lvs1 $keyperm,0,$key2 # prepare for unaligned key
lwz $rounds,240($key2)
srwi $rounds,$rounds,1
subi $rounds,$rounds,1
li $idx,16

lvx $rndkey0,0,$key2
lvx $rndkey1,$idx,$key2
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $tweak,$tweak,$rndkey0
lvx $rndkey0,$idx,$key2
addi $idx,$idx,16
mtctr $rounds

Ltweak_xts_enc:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $tweak,$tweak,$rndkey1
lvx $rndkey1,$idx,$key2
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipher $tweak,$tweak,$rndkey0
lvx $rndkey0,$idx,$key2
addi $idx,$idx,16
bdnz Ltweak_xts_enc

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $tweak,$tweak,$rndkey1
lvx $rndkey1,$idx,$key2
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipherlast $tweak,$tweak,$rndkey0

li $ivp,0 # don't chain the tweak
b Lxts_enc

Lxts_enc_no_key2:
li $idx,-16
and $len,$len,$idx # in "tweak chaining"
mode only complete
blocks are processed
Lxts_enc:
lvx $inptail,0,$inp
addi $inp,$inp,16

?lvs1 $keyperm,0,$key1 # prepare for unaligned key
lwz $rounds,240($key1)

```

```

srwi $rounds,$rounds,1
subi $rounds,$rounds,1
li $idx,16

vsllb $eighty7,$seven,$seven # 0x808080..80
vor $eighty7,$eighty7,$seven # 0x878787..87
vspltisb $tmp,1 # 0x010101..01
vsldoi $eighty7,$eighty7,$tmp,15 # 0x870101..01

```

```

${UCMP}i $len,96
bge _aesp8_xts_encrypt6x

```

```

andi $taillen,$len,15
subic r0,$len,32
subi $taillen,$taillen,16
subfe r0,r0,r0
and r0,r0,$taillen
add $inp,$inp,r0

```

```

lvx $rndkey0,0,$key1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16
vperm $inout,$inout,$inptail,$inpperm
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $inout,$inout,$tweak
vxor $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16
mtctr $rounds
b Loop_xts_enc

```

```

.align 5
Loop_xts_enc:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipher $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16
bdnz Loop_xts_enc

```

```

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key1
li $idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm

```



```

vxor $rndkey0,$rndkey0,$tweak
vcipherlast $output,$inout,$rndkey0

le?vperm $tmp,$output,$output,$leperm
be?nop
le?stvx_u $tmp,0,$out
be?stvx_u $output,0,$out
addi $out,$out,16

subic. $len,$len,16
beq Lxts_enc_done

vmr $inout,$inptail
lvx $inptail,0,$inp
addi $inp,$inp,16
lvx $rndkey0,0,$key1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16

subic r0,$len,32
subfe r0,r0,r0
and r0,r0,$taillen
add $inp,$inp,r0

vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $tweak,$tweak,$tmp

vperm $inout,$inout,$inptail,$inpperm
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $inout,$inout,$tweak
vxor $output,$output,$rndkey0 # just in case $len<16
vxor $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16

mtctr $rounds
${UCMP}i $len,16
bge Loop_xts_enc

vxor $output,$output,$tweak
lvsr $inpperm,0,$len # $inpperm is no longer needed
vxor $inptail,$inptail,$inptail # $inptail is no longer needed
vspltisb $tmp,-1
vperm $inptail,$inptail,$tmp,$inpperm
vsel $inout,$inout,$output,$inptail

```

```

subi r11,$out,17
subi $out,$out,16
mtctr $len
li $len,16
Loop_xts_enc_steal:
lbzu r0,1(r11)
stb r0,16(r11)
bdnz Loop_xts_enc_steal

mtctr $rounds
b Loop_xts_enc # one more time...

Lxts_enc_done:
${UCMP}i $ivp,0
beq Lxts_enc_ret

vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $tweak,$tweak,$tmp

le?vperm $tweak,$tweak,$tweak,$leperm
stvx_u $tweak,0,$ivp

Lxts_enc_ret:
mtspr 256,r12 # restore vrsave
li r3,0
blr
.long 0
.byte 0,12,0x04,0,0x80,6,6,0
.long 0
.size ${prefix}_xts_encrypt,-.${prefix}_xts_encrypt

.globl ${prefix}_xts_decrypt
.align 5
${prefix}_xts_decrypt:
mr $inp,r3 # reassign
li r3,-1
${UCMP}i $len,16
bltr-

lis r0,0xffff8
mfspr r12,256 # save vrsave
li r11,0
mtspr 256,r0

```

```

andi. r0,$len,15
neg r0,r0
andi. r0,r0,16
sub $len,$len,r0

vspltisb $seven,0x07 # 0x070707..07
le?lvs1 $leperm,r11,r11
le?vspltisb $tmp,0x0f
le?vxor $leperm,$leperm,$seven

li $idx,15
lvx $tweak,0,$ivp # load [unaligned] iv
lvs1 $inpperm,0,$ivp
lvx $inptail,$idx,$ivp
le?vxor $inpperm,$inpperm,$tmp
vperm $tweak,$tweak,$inptail,$inpperm

neg r11,$inp
lvsr $inpperm,0,r11 # prepare for unaligned load
lvx $inout,0,$inp
addi $inp,$inp,15 # 15 is not typo
le?vxor $inpperm,$inpperm,$tmp

${UCMP}i $key2,0 # key2==NULL?
beq Lxts_dec_no_key2

?lvs1 $keyperm,0,$key2 # prepare for unaligned key
lwz $rounds,240($key2)
srwi $rounds,$rounds,1
subi $rounds,$rounds,1
li $idx,16

lvx $rndkey0,0,$key2
lvx $rndkey1,$idx,$key2
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $tweak,$tweak,$rndkey0
lvx $rndkey0,$idx,$key2
addi $idx,$idx,16
mtctr $rounds

Ltweak_xts_dec:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $tweak,$tweak,$rndkey1
lvx $rndkey1,$idx,$key2
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipher $tweak,$tweak,$rndkey0

```

```

lvx $rndkey0,$idx,$key2
addi $idx,$idx,16
bdnz Ltweak_xts_dec

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vcipher $tweak,$tweak,$rndkey1
lvx $rndkey1,$idx,$key2
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vcipherlast $tweak,$tweak,$rndkey0

li $ivp,0 # don't chain the tweak
b Lxts_dec

Lxts_dec_no_key2:
neg $idx,$len
andi $idx,$idx,15
add $len,$len,$idx # in "tweak chaining"
 # mode only complete
 # blocks are processed
Lxts_dec:
lvx $inptail,0,$inp
addi $inp,$inp,16

?lvs1 $keyperm,0,$key1 # prepare for unaligned key
lwz $rounds,240($key1)
srwi $rounds,$rounds,1
subi $rounds,$rounds,1
li $idx,16

vs1b $eighty7,$seven,$seven # 0x808080..80
vor $eighty7,$eighty7,$seven # 0x878787..87
vspltisb $tmp,1 # 0x010101..01
vsldoi $eighty7,$eighty7,$tmp,15 # 0x870101..01

${UCMP}i $len,96
bge _aesp8_xts_decrypt6x

lvx $rndkey0,0,$key1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16
vperm $inout,$inout,$inptail,$inpperm
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $inout,$inout,$tweak
vxor $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16
mtctr $rounds

```

```

${UCMP}i $len,16
blt Ltail_xts_dec
be?b Loop_xts_dec

.align 5
Loop_xts_dec:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vncipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vncipher $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16
bdnz Loop_xts_dec

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vncipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key1
li $idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $rndkey0,$rndkey0,$tweak
vncipherlast $output,$inout,$rndkey0

le?vperm $tmp,$output,$output,$leperm
be?nop
le?stvx_u $tmp,0,$out
be?stvx_u $output,0,$out
addi $out,$out,16

subic. $len,$len,16
beq Lxts_dec_done

vmr $inout,$inptail
lvx $inptail,0,$inp
addi $inp,$inp,16
lvx $rndkey0,0,$key1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16

vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $tweak,$tweak,$tmp

vperm $inout,$inout,$inptail,$inpperm
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm

```

```

vxor $inout,$inout,$tweak
vxor $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16

mtctr $rounds
${UCMP}i $len,16
bge Loop_xts_dec

Ltail_xts_dec:
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak1,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $tweak1,$tweak1,$tmp

subi $inp,$inp,16
add $inp,$inp,$len

vxor $inout,$inout,$tweak # :-(
vxor $inout,$inout,$tweak1 # :-)

Loop_xts_dec_short:
?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vncipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vncipher $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16
bdnz Loop_xts_dec_short

?vperm $rndkey1,$rndkey1,$rndkey0,$keyperm
vncipher $inout,$inout,$rndkey1
lvx $rndkey1,$idx,$key1
li $idx,16
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm
vxor $rndkey0,$rndkey0,$tweak1
vncipherlast $output,$inout,$rndkey0

le?vperm $tmp,$output,$output,$leperm
be?nop
le?stvx_u $tmp,0,$out
be?stvx_u $output,0,$out

vmr $inout,$inptail
lvx $inptail,0,$inp

```

```

#addi $inp,$inp,16
lvx $rndkey0,0,$key1
lvx $rndkey1,$idx,$key1
addi $idx,$idx,16
vperm $inout,$inout,$inptail,$inpperm
?vperm $rndkey0,$rndkey0,$rndkey1,$keyperm

lvsr $inpperm,0,$len # $inpperm is no longer needed
vxor $inptail,$inptail,$inptail # $inptail is no longer needed
vspltisb $tmp,-1
vperm $inptail,$inptail,$tmp,$inpperm
vsel $inout,$inout,$output,$inptail

vxor $rndkey0,$rndkey0,$tweak
vxor $inout,$inout,$rndkey0
lvx $rndkey0,$idx,$key1
addi $idx,$idx,16

subi r11,$out,1
mtctr $len
li $len,16
Loop_xts_dec_steal:
lbzu r0,1(r11)
stb r0,16(r11)
bdnz Loop_xts_dec_steal

mtctr $rounds
b Loop_xts_dec # one more time...

Lxts_dec_done:
${UCMP}i $ivp,0
beq Lxts_dec_ret

vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $tweak,$tweak,$tmp

le?vperm $tweak,$tweak,$tweak,$leperm
stvx_u $tweak,0,$ivp

Lxts_dec_ret:
mtspr 256,r12 # restore vrsave
li r3,0
blr
.long 0
.byte 0,12,0x04,0,0x80,6,6,0

```

```

.long 0
.size ${prefix}_xts_decrypt,-.${prefix}_xts_decrypt

#####
{{ # Optimized XTS procedures #
my $key_=$key2;
my ($x00,$x10,$x20,$x30,$x40,$x50,$x60,$x70)=map("r$_",(0,3,26..31));
 $x00=0 if ($flavour =~ /osx/);
my ($in0, $in1, $in2, $in3, $in4, $in5)=map("v$_",(0..5));
my ($out0, $out1, $out2, $out3, $out4, $out5)=map("v$_",(7,12..16));
my ($twk0, $twk1, $twk2, $twk3, $twk4, $twk5)=map("v$_",(17..22));
my $rndkey0="v23"; # v24-v25 rotating buffer for first found keys
 # v26-v31 last 6 round keys
my ($keyperm)=($out0); # aliases with "caller", redundant assignment
my $tailen=$x70;

$code.=<<____;
.align 5
_aesp8_xts_encrypt6x:
$STU $sp,-`($FRAME+21*16+6*$SIZE_T)`($sp)
mflr r11
li r7,`$FRAME+8*16+15`
li r3,`$FRAME+8*16+31`
$PUSH r11,`$FRAME+21*16+6*$SIZE_T+$LRSAVE`($sp)
stvx v20,r7,$sp # ABI says so
addi r7,r7,32
stvx v21,r3,$sp
addi r3,r3,32
stvx v22,r7,$sp
addi r7,r7,32
stvx v23,r3,$sp
addi r3,r3,32
stvx v24,r7,$sp
addi r7,r7,32
stvx v25,r3,$sp
addi r3,r3,32
stvx v26,r7,$sp
addi r7,r7,32
stvx v27,r3,$sp
addi r3,r3,32
stvx v28,r7,$sp
addi r7,r7,32
stvx v29,r3,$sp
addi r3,r3,32
stvx v30,r7,$sp
stvx v31,r3,$sp
li r0,-1
stw $vrsave,`$FRAME+21*16-4`($sp) # save vrsave

```



```

li $x10,0x10
$PUSH r26, $FRAME+21*16+0*$SIZE_T`($sp)
li $x20,0x20
$PUSH r27, $FRAME+21*16+1*$SIZE_T`($sp)
li $x30,0x30
$PUSH r28, $FRAME+21*16+2*$SIZE_T`($sp)
li $x40,0x40
$PUSH r29, $FRAME+21*16+3*$SIZE_T`($sp)
li $x50,0x50
$PUSH r30, $FRAME+21*16+4*$SIZE_T`($sp)
li $x60,0x60
$PUSH r31, $FRAME+21*16+5*$SIZE_T`($sp)
li $x70,0x70
mtspr 256,r0

```

```

subi $rounds,$rounds,3 # -4 in total

```

```

lvx $rndkey0,$x00,$key1 # load key schedule
lvx v30,$x10,$key1
addi $key1,$key1,0x20
lvx v31,$x00,$key1
?vperm $rndkey0,$rndkey0,v30,$keyperm
addi $key_,$sp,$FRAME+15
mtctr $rounds

```

Load\_xts\_enc\_key:

```

?vperm v24,v30,v31,$keyperm
lvx v30,$x10,$key1
addi $key1,$key1,0x20
stvx v24,$x00,$key_ # off-load round[1]
?vperm v25,v31,v30,$keyperm
lvx v31,$x00,$key1
stvx v25,$x10,$key_ # off-load round[2]
addi $key_,$key_,0x20
bdnz Load_xts_enc_key

```

```

lvx v26,$x10,$key1
?vperm v24,v30,v31,$keyperm
lvx v27,$x20,$key1
stvx v24,$x00,$key_ # off-load round[3]
?vperm v25,v31,v26,$keyperm
lvx v28,$x30,$key1
stvx v25,$x10,$key_ # off-load round[4]
addi $key_,$sp,$FRAME+15 # rewind $key_
?vperm v26,v26,v27,$keyperm
lvx v29,$x40,$key1
?vperm v27,v27,v28,$keyperm
lvx v30,$x50,$key1

```

```

?vperm v28,v28,v29,$keyperm
lvx v31,$x60,$key1
?vperm v29,v29,v30,$keyperm
lvx $twk5,$x70,$key1 # borrow $twk5
?vperm v30,v30,v31,$keyperm
lvx v24,$x00,$key_ # pre-load round[1]
?vperm v31,v31,$twk5,$keyperm
lvx v25,$x10,$key_ # pre-load round[2]

```

```

vperm $in0,$inout,$inptail,$inpperm
subi $inp,$inp,31 # undo "caller"
vxor $twk0,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $out0,$in0,$twk0
vxor $tweak,$tweak,$tmp

```

```

lvx_u $in1,$x10,$inp
vxor $twk1,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in1,$in1,$in1,$leperm
vand $tmp,$tmp,$eighty7
vxor $out1,$in1,$twk1
vxor $tweak,$tweak,$tmp

```

```

lvx_u $in2,$x20,$inp
andi $taillen,$len,15
vxor $twk2,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in2,$in2,$in2,$leperm
vand $tmp,$tmp,$eighty7
vxor $out2,$in2,$twk2
vxor $tweak,$tweak,$tmp

```

```

lvx_u $in3,$x30,$inp
sub $len,$len,$taillen
vxor $twk3,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in3,$in3,$in3,$leperm
vand $tmp,$tmp,$eighty7

```

```

vxor $out3,$in3,$twk3
vxor $tweak,$tweak,$tmp

lvx_u $in4,$x40,$inp
subi $len,$len,0x60
vxor $twk4,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in4,$in4,$in4,$leperm
vand $tmp,$tmp,$eighty7
vxor $out4,$in4,$twk4
vxor $tweak,$tweak,$tmp

```

```

lvx_u $in5,$x50,$inp
addi $inp,$inp,0x60
vxor $twk5,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in5,$in5,$in5,$leperm
vand $tmp,$tmp,$eighty7
vxor $out5,$in5,$twk5
vxor $tweak,$tweak,$tmp

```

```

vxor v31,v31,$rndkey0
mtctr $rounds
b Loop_xts_enc6x

```

```

.align 5
Loop_xts_enc6x:
vcipher $out0,$out0,v24
vcipher $out1,$out1,v24
vcipher $out2,$out2,v24
vcipher $out3,$out3,v24
vcipher $out4,$out4,v24
vcipher $out5,$out5,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

```

```

vcipher $out0,$out0,v25
vcipher $out1,$out1,v25
vcipher $out2,$out2,v25
vcipher $out3,$out3,v25
vcipher $out4,$out4,v25
vcipher $out5,$out5,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_xts_enc6x

```

```

subic $len,$len,96 # $len-=96
v xor $in0,$twk0,v31 # xor with last round key
vcipher $out0,$out0,v24
vcipher $out1,$out1,v24
vsrab $tmp,$tweak,$seven # next tweak value
v xor $twk0,$tweak,$rndkey0
v addubm $tweak,$tweak,$tweak
vcipher $out2,$out2,v24
vcipher $out3,$out3,v24
vsldoi $tmp,$tmp,$tmp,15
vcipher $out4,$out4,v24
vcipher $out5,$out5,v24

```

```

subfe. r0,r0,r0 # borrow?-1:0
v and $tmp,$tmp,$eighty7
vcipher $out0,$out0,v25
vcipher $out1,$out1,v25
v xor $tweak,$tweak,$tmp
vcipher $out2,$out2,v25
vcipher $out3,$out3,v25
v xor $in1,$twk1,v31
vsrab $tmp,$tweak,$seven # next tweak value
v xor $twk1,$tweak,$rndkey0
vcipher $out4,$out4,v25
vcipher $out5,$out5,v25

```

```

and r0,r0,$len
v addubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vcipher $out0,$out0,v26
vcipher $out1,$out1,v26
v and $tmp,$tmp,$eighty7
vcipher $out2,$out2,v26
vcipher $out3,$out3,v26
v xor $tweak,$tweak,$tmp
vcipher $out4,$out4,v26
vcipher $out5,$out5,v26

```

```

add $inp,$inp,r0 # $inp is adjusted in such
way that at exit from the
loop inX-in5 are loaded
with last "words"
v xor $in2,$twk2,v31
vsrab $tmp,$tweak,$seven # next tweak value
v xor $twk2,$tweak,$rndkey0
v addubm $tweak,$tweak,$tweak
vcipher $out0,$out0,v27

```

```

vcipher $out1,$out1,v27
vsldoi $tmp,$tmp,$tmp,15
vcipher $out2,$out2,v27
vcipher $out3,$out3,v27
vand $tmp,$tmp,$eighty7
vcipher $out4,$out4,v27
vcipher $out5,$out5,v27

addi $key_,$sp,$FRAME+15 # rewind $key_
vxor $tweak,$tweak,$tmp
vcipher $out0,$out0,v28
vcipher $out1,$out1,v28
vxor $in3,$twk3,v31
vsrab $tmp,$tweak,$seven # next tweak value
vxor $twk3,$tweak,$rndkey0
vcipher $out2,$out2,v28
vcipher $out3,$out3,v28
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vcipher $out4,$out4,v28
vcipher $out5,$out5,v28
lvx v24,$x00,$key_ # re-pre-load round[1]
vand $tmp,$tmp,$eighty7

vcipher $out0,$out0,v29
vcipher $out1,$out1,v29
vxor $tweak,$tweak,$tmp
vcipher $out2,$out2,v29
vcipher $out3,$out3,v29
vxor $in4,$twk4,v31
vsrab $tmp,$tweak,$seven # next tweak value
vxor $twk4,$tweak,$rndkey0
vcipher $out4,$out4,v29
vcipher $out5,$out5,v29
lvx v25,$x10,$key_ # re-pre-load round[2]
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15

vcipher $out0,$out0,v30
vcipher $out1,$out1,v30
vand $tmp,$tmp,$eighty7
vcipher $out2,$out2,v30
vcipher $out3,$out3,v30
vxor $tweak,$tweak,$tmp
vcipher $out4,$out4,v30
vcipher $out5,$out5,v30
vxor $in5,$twk5,v31
vsrab $tmp,$tweak,$seven # next tweak value

```

```

vxor $twk5,$tweak,$rndkey0

vcipherlast $out0,$out0,$in0
lvx_u $in0,$x00,$inp # load next input block
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vcipherlast $out1,$out1,$in1
lvx_u $in1,$x10,$inp
vcipherlast $out2,$out2,$in2
le?vperm $in0,$in0,$in0,$leperm
lvx_u $in2,$x20,$inp
vand $tmp,$tmp,$eighty7
vcipherlast $out3,$out3,$in3
le?vperm $in1,$in1,$in1,$leperm
lvx_u $in3,$x30,$inp
vcipherlast $out4,$out4,$in4
le?vperm $in2,$in2,$in2,$leperm
lvx_u $in4,$x40,$inp
vxor $tweak,$tweak,$tmp
vcipherlast $tmp,$out5,$in5 # last block might be needed
 # in stealing mode
le?vperm $in3,$in3,$in3,$leperm
lvx_u $in5,$x50,$inp
addi $inp,$inp,0x60
le?vperm $in4,$in4,$in4,$leperm
le?vperm $in5,$in5,$in5,$leperm

le?vperm $out0,$out0,$out0,$leperm
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxor $out0,$in0,$twk0
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
vxor $out1,$in1,$twk1
le?vperm $out3,$out3,$out3,$leperm
stvx_u $out2,$x20,$out
vxor $out2,$in2,$twk2
le?vperm $out4,$out4,$out4,$leperm
stvx_u $out3,$x30,$out
vxor $out3,$in3,$twk3
le?vperm $out5,$tmp,$tmp,$leperm
stvx_u $out4,$x40,$out
vxor $out4,$in4,$twk4
le?stvx_u $out5,$x50,$out
be?stvx_u $tmp,$x50,$out
vxor $out5,$in5,$twk5
addi $out,$out,0x60

```

```

mtctr $rounds
beq Loop_xts_enc6x # did $len==96 borrow?

addic. $len,$len,0x60
beq Lxts_enc6x_zero
cmpwi $len,0x20
blt Lxts_enc6x_one
nop
beq Lxts_enc6x_two
cmpwi $len,0x40
blt Lxts_enc6x_three
nop
beq Lxts_enc6x_four

Lxts_enc6x_five:
vxor $out0,$in1,$twk0
vxor $out1,$in2,$twk1
vxor $out2,$in3,$twk2
vxor $out3,$in4,$twk3
vxor $out4,$in5,$twk4

bl _aesp8_xts_enc5x

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk5 # unused tweak
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$leperm
stvx_u $out2,$x20,$out
vxor $tmp,$out4,$twk5 # last block prep for stealing
le?vperm $out4,$out4,$out4,$leperm
stvx_u $out3,$x30,$out
stvx_u $out4,$x40,$out
addi $out,$out,0x50
bne Lxts_enc6x_steal
b Lxts_enc6x_done

.align 4
Lxts_enc6x_four:
vxor $out0,$in2,$twk0
vxor $out1,$in3,$twk1
vxor $out2,$in4,$twk2
vxor $out3,$in5,$twk3
vxor $out4,$out4,$out4

bl _aesp8_xts_enc5x

```

```

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk4 # unused tweak
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
vxor $tmp,$out3,$twk4 # last block prep for stealing
le?vperm $out3,$out3,$out3,$leperm
stvx_u $out2,$x20,$out
stvx_u $out3,$x30,$out
addi $out,$out,0x40
bne Lxts_enc6x_steal
b Lxts_enc6x_done

```

```
.align 4
```

```
Lxts_enc6x_three:
```

```

vxor $out0,$in3,$twk0
vxor $out1,$in4,$twk1
vxor $out2,$in5,$twk2
vxor $out3,$out3,$out3
vxor $out4,$out4,$out4

```

```
bl _aesp8_xts_enc5x
```

```

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk3 # unused tweak
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxor $tmp,$out2,$twk3 # last block prep for stealing
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
stvx_u $out2,$x20,$out
addi $out,$out,0x30
bne Lxts_enc6x_steal
b Lxts_enc6x_done

```

```
.align 4
```

```
Lxts_enc6x_two:
```

```

vxor $out0,$in4,$twk0
vxor $out1,$in5,$twk1
vxor $out2,$out2,$out2
vxor $out3,$out3,$out3
vxor $out4,$out4,$out4

```

```
bl _aesp8_xts_enc5x
```

```
le?vperm $out0,$out0,$out0,$leperm
```



```

vmr $twk0,$twk2 # unused tweak
vxor $tmp,$out1,$twk2 # last block prep for stealing
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
stvx_u $out1,$x10,$out
addi $out,$out,0x20
bne Lxts_enc6x_steal
b Lxts_enc6x_done

```

```
.align 4
```

```
Lxts_enc6x_one:
```

```

vxor $out0,$in5,$twk0
nop

```

```
Loop_xts_enc1x:
```

```

vcipher $out0,$out0,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

```

```

vcipher $out0,$out0,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_xts_enc1x

```

```

add $inp,$inp,$taillen
cmpwi $taillen,0
vcipher $out0,$out0,v24

```

```

subi $inp,$inp,16
vcipher $out0,$out0,v25

```

```

lvsr $inpperm,0,$taillen
vcipher $out0,$out0,v26

```

```

lvx_u $in0,0,$inp
vcipher $out0,$out0,v27

```

```

addi $key_,$sp,$FRAME+15 # rewind $key_
vcipher $out0,$out0,v28
lvx v24,$x00,$key_ # re-pre-load round[1]

```

```

vcipher $out0,$out0,v29
lvx v25,$x10,$key_ # re-pre-load round[2]
vxor $twk0,$twk0,v31

```

```

le?vperm $in0,$in0,$in0,$leperm
vcipher $out0,$out0,v30

```

```

vperm $in0,$in0,$in0,$inpperm
vcipherlast $out0,$out0,$twk0

```

```

vmr $twk0,$twk1 # unused tweak
vxo $tmp,$out0,$twk1 # last block prep for stealing
le?vperm $out0,$out0,$out0,$leperm
stvx_u $out0,$x00,$out # store output
addi $out,$out,0x10
bne Lxts_enc6x_steal
b Lxts_enc6x_done

.align 4
Lxts_enc6x_zero:
cmpwi $taillen,0
beq Lxts_enc6x_done

add $inp,$inp,$taillen
subi $inp,$inp,16
lvx_u $in0,0,$inp
lvsr $inperm,0,$taillen # $in5 is no more
le?vperm $in0,$in0,$in0,$leperm
vperm $in0,$in0,$in0,$inperm
vxor $tmp,$tmp,$twk0
Lxts_enc6x_steal:
vxor $in0,$in0,$twk0
vxor $out0,$out0,$out0
vspltisb $out1,-1
vperm $out0,$out0,$out1,$inperm
vsel $out0,$in0,$tmp,$out0 # $tmp is last block, remember?

subi r30,$out,17
subi $out,$out,16
mtctr $taillen
Loop_xts_enc6x_steal:
lbzu r0,1(r30)
stb r0,16(r30)
bdnz Loop_xts_enc6x_steal

li $taillen,0
mtctr $rounds
b Loop_xts_enc1x # one more time...

.align 4
Lxts_enc6x_done:
${UCMP}i $ivp,0
beq Lxts_enc6x_ret

vxor $tweak,$twk0,$rndkey0
le?vperm $tweak,$tweak,$tweak,$leperm
stvx_u $tweak,0,$ivp

```

```

Lxts_enc6x_ret:
 mtlr r11
 li r10,`$FRAME+15`
 li r11,`$FRAME+31`
 stvx $seven,r10,$sp # wipe copies of round keys
 addi r10,r10,32
 stvx $seven,r11,$sp
 addi r11,r11,32
 stvx $seven,r10,$sp
 addi r10,r10,32
 stvx $seven,r11,$sp
 addi r11,r11,32
 stvx $seven,r10,$sp
 addi r10,r10,32
 stvx $seven,r11,$sp
 addi r11,r11,32
 stvx $seven,r10,$sp
 addi r10,r10,32
 stvx $seven,r11,$sp
 addi r11,r11,32

 mtspr 256,$vrsave
 lvx v20,r10,$sp # ABI says so
 addi r10,r10,32
 lvx v21,r11,$sp
 addi r11,r11,32
 lvx v22,r10,$sp
 addi r10,r10,32
 lvx v23,r11,$sp
 addi r11,r11,32
 lvx v24,r10,$sp
 addi r10,r10,32
 lvx v25,r11,$sp
 addi r11,r11,32
 lvx v26,r10,$sp
 addi r10,r10,32
 lvx v27,r11,$sp
 addi r11,r11,32
 lvx v28,r10,$sp
 addi r10,r10,32
 lvx v29,r11,$sp
 addi r11,r11,32
 lvx v30,r10,$sp
 lvx v31,r11,$sp
 $POP r26,`$FRAME+21*16+0*$SIZE_T`($sp)
 $POP r27,`$FRAME+21*16+1*$SIZE_T`($sp)
 $POP r28,`$FRAME+21*16+2*$SIZE_T`($sp)

```

```

$POP r29,`$FRAME+21*16+3*$SIZE_T`($sp)
$POP r30,`$FRAME+21*16+4*$SIZE_T`($sp)
$POP r31,`$FRAME+21*16+5*$SIZE_T`($sp)
addi $sp,$sp,`$FRAME+21*16+6*$SIZE_T`
blr
.long 0
.byte 0,12,0x04,1,0x80,6,6,0
.long 0

```

```

.align 5
_aesp8_xts_enc5x:
vcipher $out0,$out0,v24
vcipher $out1,$out1,v24
vcipher $out2,$out2,v24
vcipher $out3,$out3,v24
vcipher $out4,$out4,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

```

```

vcipher $out0,$out0,v25
vcipher $out1,$out1,v25
vcipher $out2,$out2,v25
vcipher $out3,$out3,v25
vcipher $out4,$out4,v25
lvx v25,$x10,$key_ # round[4]
bdnz _aes8_xts_enc5x

```

```

add $inp,$inp,$taillen
cmpwi $taillen,0
vcipher $out0,$out0,v24
vcipher $out1,$out1,v24
vcipher $out2,$out2,v24
vcipher $out3,$out3,v24
vcipher $out4,$out4,v24

```

```

subi $inp,$inp,16
vcipher $out0,$out0,v25
vcipher $out1,$out1,v25
vcipher $out2,$out2,v25
vcipher $out3,$out3,v25
vcipher $out4,$out4,v25
vxor $twk0,$twk0,v31

```

```

vcipher $out0,$out0,v26
lvsr $inperm,0,$taillen # $in5 is no more
vcipher $out1,$out1,v26
vcipher $out2,$out2,v26
vcipher $out3,$out3,v26

```

```

vcipher $out4,$out4,v26
vxor $in1,$twk1,v31

vcipher $out0,$out0,v27
lvx_u $in0,0,$inp
vcipher $out1,$out1,v27
vcipher $out2,$out2,v27
vcipher $out3,$out3,v27
vcipher $out4,$out4,v27
vxor $in2,$twk2,v31

addi $key_,$sp,$FRAME+15 # rewind $key_
vcipher $out0,$out0,v28
vcipher $out1,$out1,v28
vcipher $out2,$out2,v28
vcipher $out3,$out3,v28
vcipher $out4,$out4,v28
lvx v24,$x00,$key_ # re-pre-load round[1]
vxor $in3,$twk3,v31

vcipher $out0,$out0,v29
le?vperm $in0,$in0,$in0,$leperm
vcipher $out1,$out1,v29
vcipher $out2,$out2,v29
vcipher $out3,$out3,v29
vcipher $out4,$out4,v29
lvx v25,$x10,$key_ # re-pre-load round[2]
vxor $in4,$twk4,v31

vcipher $out0,$out0,v30
vperm $in0,$in0,$in0,$inpperm
vcipher $out1,$out1,v30
vcipher $out2,$out2,v30
vcipher $out3,$out3,v30
vcipher $out4,$out4,v30

vcipherlast $out0,$out0,$twk0
vcipherlast $out1,$out1,$in1
vcipherlast $out2,$out2,$in2
vcipherlast $out3,$out3,$in3
vcipherlast $out4,$out4,$in4
blr
 .long 0
 .byte 0,12,0x14,0,0,0,0

.align 5
_esp8_xts_decrypt6x:
$STU $sp,-`($FRAME+21*16+6*$SIZE_T)`($sp)

```

```

mflr r11
li r7,`$FRAME+8*16+15`
li r3,`$FRAME+8*16+31`
$PUSH r11,`$FRAME+21*16+6*$SIZE_T+$LRSAVE`($sp)
stvx v20,r7,$sp # ABI says so
addi r7,r7,32
stvx v21,r3,$sp
addi r3,r3,32
stvx v22,r7,$sp
addi r7,r7,32
stvx v23,r3,$sp
addi r3,r3,32
stvx v24,r7,$sp
addi r7,r7,32
stvx v25,r3,$sp
addi r3,r3,32
stvx v26,r7,$sp
addi r7,r7,32
stvx v27,r3,$sp
addi r3,r3,32
stvx v28,r7,$sp
addi r7,r7,32
stvx v29,r3,$sp
addi r3,r3,32
stvx v30,r7,$sp
stvx v31,r3,$sp
li r0,-1
stw $vrsave,`$FRAME+21*16-4`($sp) # save vrsave
li $x10,0x10
$PUSH r26,`$FRAME+21*16+0*$SIZE_T`($sp)
li $x20,0x20
$PUSH r27,`$FRAME+21*16+1*$SIZE_T`($sp)
li $x30,0x30
$PUSH r28,`$FRAME+21*16+2*$SIZE_T`($sp)
li $x40,0x40
$PUSH r29,`$FRAME+21*16+3*$SIZE_T`($sp)
li $x50,0x50
$PUSH r30,`$FRAME+21*16+4*$SIZE_T`($sp)
li $x60,0x60
$PUSH r31,`$FRAME+21*16+5*$SIZE_T`($sp)
li $x70,0x70
mtspr 256,r0

subi $rounds,$rounds,3 # -4 in total

lvx $rndkey0,$x00,$key1 # load key schedule
lvx v30,$x10,$key1
addi $key1,$key1,0x20

```

```

lvx v31,$x00,$key1
?vperm $rndkey0,$rndkey0,v30,$keyperm
addi $key_,$sp,$FRAME+15
mtctr $rounds

```

Load\_xts\_dec\_key:

```

?vperm v24,v30,v31,$keyperm
lvx v30,$x10,$key1
addi $key1,$key1,0x20
stvx v24,$x00,$key_ # off-load round[1]
?vperm v25,v31,v30,$keyperm
lvx v31,$x00,$key1
stvx v25,$x10,$key_ # off-load round[2]
addi $key_,$key_,0x20
bdnz Load_xts_dec_key

```

```

lvx v26,$x10,$key1
?vperm v24,v30,v31,$keyperm
lvx v27,$x20,$key1
stvx v24,$x00,$key_ # off-load round[3]
?vperm v25,v31,v26,$keyperm
lvx v28,$x30,$key1
stvx v25,$x10,$key_ # off-load round[4]
addi $key_,$sp,$FRAME+15 # rewind $key_
?vperm v26,v26,v27,$keyperm
lvx v29,$x40,$key1
?vperm v27,v27,v28,$keyperm
lvx v30,$x50,$key1
?vperm v28,v28,v29,$keyperm
lvx v31,$x60,$key1
?vperm v29,v29,v30,$keyperm
lvx $twk5,$x70,$key1 # borrow $twk5
?vperm v30,v30,v31,$keyperm
lvx v24,$x00,$key_ # pre-load round[1]
?vperm v31,v31,$twk5,$keyperm
lvx v25,$x10,$key_ # pre-load round[2]

```

```

vperm $in0,$inout,$inptail,$inpperm
subi $inp,$inp,31 # undo "caller"
vxor $twk0,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vand $tmp,$tmp,$eighty7
vxor $out0,$in0,$twk0
vxor $tweak,$tweak,$tmp

```

```

lvx_u $in1,$x10,$inp

```

```
vxor $twk1,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in1,$in1,$in1,$leperm
vand $tmp,$tmp,$eighty7
vxor $out1,$in1,$twk1
vxor $tweak,$tweak,$tmp
```

```
lvx_u $in2,$x20,$inp
andi $taillen,$len,15
vxor $twk2,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in2,$in2,$in2,$leperm
vand $tmp,$tmp,$eighty7
vxor $out2,$in2,$twk2
vxor $tweak,$tweak,$tmp
```

```
lvx_u $in3,$x30,$inp
sub $len,$len,$taillen
vxor $twk3,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in3,$in3,$in3,$leperm
vand $tmp,$tmp,$eighty7
vxor $out3,$in3,$twk3
vxor $tweak,$tweak,$tmp
```

```
lvx_u $in4,$x40,$inp
subi $len,$len,0x60
vxor $twk4,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
le?vperm $in4,$in4,$in4,$leperm
vand $tmp,$tmp,$eighty7
vxor $out4,$in4,$twk4
vxor $tweak,$tweak,$tmp
```

```
lvx_u $in5,$x50,$inp
addi $inp,$inp,0x60
vxor $twk5,$tweak,$rndkey0
vsrab $tmp,$tweak,$seven # next tweak value
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
```



```

le?vperm $in5,$in5,$in5,$leperm
vand $tmp,$tmp,$eighty7
vxor $out5,$in5,$twk5
vxor $tweak,$tweak,$tmp

vxor v31,v31,$rndkey0
mtctr $rounds
b Loop_xts_dec6x

.align 5
Loop_xts_dec6x:
vncipher $out0,$out0,v24
vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vncipher $out4,$out4,v24
vncipher $out5,$out5,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

vncipher $out0,$out0,v25
vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
vncipher $out5,$out5,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_xts_dec6x

subic $len,$len,96 # $len-=96
vxor $in0,$twk0,v31 # xor with last round key
vncipher $out0,$out0,v24
vncipher $out1,$out1,v24
vsrab $tmp,$tweak,$seven # next tweak value
vxor $twk0,$tweak,$rndkey0
vaddubm $tweak,$tweak,$tweak
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vsldoi $tmp,$tmp,$tmp,15
vncipher $out4,$out4,v24
vncipher $out5,$out5,v24

subfe. r0,r0,r0 # borrow?-1:0
vand $tmp,$tmp,$eighty7
vncipher $out0,$out0,v25
vncipher $out1,$out1,v25
vxor $tweak,$tweak,$tmp
vncipher $out2,$out2,v25

```

```
vncipher $out3,$out3,v25
v_xor $in1,$twk1,v31
vsrab $tmp,$tweak,$seven # next tweak value
v_xor $twk1,$tweak,$rndkey0
vncipher $out4,$out4,v25
vncipher $out5,$out5,v25
```

```
and r0,r0,$len
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vncipher $out0,$out0,v26
vncipher $out1,$out1,v26
vand $tmp,$tmp,$eighty7
vncipher $out2,$out2,v26
vncipher $out3,$out3,v26
v_xor $tweak,$tweak,$tmp
vncipher $out4,$out4,v26
vncipher $out5,$out5,v26
```

```
add $inp,$inp,r0 # $inp is adjusted in such
way that at exit from the
loop inX-in5 are loaded
with last "words"
v_xor $in2,$twk2,v31
vsrab $tmp,$tweak,$seven # next tweak value
v_xor $twk2,$tweak,$rndkey0
vaddubm $tweak,$tweak,$tweak
vncipher $out0,$out0,v27
vncipher $out1,$out1,v27
vsldoi $tmp,$tmp,$tmp,15
vncipher $out2,$out2,v27
vncipher $out3,$out3,v27
vand $tmp,$tmp,$eighty7
vncipher $out4,$out4,v27
vncipher $out5,$out5,v27
```

```
addi $key_,$sp,$FRAME+15 # rewind $key_
v_xor $tweak,$tweak,$tmp
vncipher $out0,$out0,v28
vncipher $out1,$out1,v28
v_xor $in3,$twk3,v31
vsrab $tmp,$tweak,$seven # next tweak value
v_xor $twk3,$tweak,$rndkey0
vncipher $out2,$out2,v28
vncipher $out3,$out3,v28
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vncipher $out4,$out4,v28
```

```

vncipher $out5,$out5,v28
lvx v24,$x00,$key_ # re-pre-load round[1]
vand $tmp,$tmp,$eighty7

vncipher $out0,$out0,v29
vncipher $out1,$out1,v29
vxor $tweak,$tweak,$tmp
vncipher $out2,$out2,v29
vncipher $out3,$out3,v29
vxor $in4,$twk4,v31
vsrab $tmp,$tweak,$seven # next tweak value
vxor $twk4,$tweak,$rndkey0
vncipher $out4,$out4,v29
vncipher $out5,$out5,v29
lvx v25,$x10,$key_ # re-pre-load round[2]
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15

vncipher $out0,$out0,v30
vncipher $out1,$out1,v30
vand $tmp,$tmp,$eighty7
vncipher $out2,$out2,v30
vncipher $out3,$out3,v30
vxor $tweak,$tweak,$tmp
vncipher $out4,$out4,v30
vncipher $out5,$out5,v30
vxor $in5,$twk5,v31
vsrab $tmp,$tweak,$seven # next tweak value
vxor $twk5,$tweak,$rndkey0

vncipherlast $out0,$out0,$in0
lvx_u $in0,$x00,$inp # load next input block
vaddubm $tweak,$tweak,$tweak
vsldoi $tmp,$tmp,$tmp,15
vncipherlast $out1,$out1,$in1
lvx_u $in1,$x10,$inp
vncipherlast $out2,$out2,$in2
le?vperm $in0,$in0,$in0,$leperm
lvx_u $in2,$x20,$inp
vand $tmp,$tmp,$eighty7
vncipherlast $out3,$out3,$in3
le?vperm $in1,$in1,$in1,$leperm
lvx_u $in3,$x30,$inp
vncipherlast $out4,$out4,$in4
le?vperm $in2,$in2,$in2,$leperm
lvx_u $in4,$x40,$inp
vxor $tweak,$tweak,$tmp
vncipherlast $out5,$out5,$in5

```

```

le?vperm $in3,$in3,$in3,$leperm
lvx_u $in5,$x50,$inp
addi $inp,$inp,0x60
le?vperm $in4,$in4,$in4,$leperm
le?vperm $in5,$in5,$in5,$leperm

le?vperm $out0,$out0,$out0,$leperm
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxor $out0,$in0,$twk0
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
vxor $out1,$in1,$twk1
le?vperm $out3,$out3,$out3,$leperm
stvx_u $out2,$x20,$out
vxor $out2,$in2,$twk2
le?vperm $out4,$out4,$out4,$leperm
stvx_u $out3,$x30,$out
vxor $out3,$in3,$twk3
le?vperm $out5,$out5,$out5,$leperm
stvx_u $out4,$x40,$out
vxor $out4,$in4,$twk4
stvx_u $out5,$x50,$out
vxor $out5,$in5,$twk5
addi $out,$out,0x60

mtctr $rounds
beq Loop_xts_dec6x # did $len==96 borrow?

addic $len,$len,0x60
beq Lxts_dec6x_zero
cmpwi $len,0x20
blt Lxts_dec6x_one
nop
beq Lxts_dec6x_two
cmpwi $len,0x40
blt Lxts_dec6x_three
nop
beq Lxts_dec6x_four

Lxts_dec6x_five:
vxor $out0,$in1,$twk0
vxor $out1,$in2,$twk1
vxor $out2,$in3,$twk2
vxor $out3,$in4,$twk3
vxor $out4,$in5,$twk4

bl _aesp8_xts_dec5x

```

```

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk5 # unused tweak
vxo $twk1,$tweak,$rndkey0
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxo $out0,$in0,$twk1
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$leperm
stvx_u $out2,$x20,$out
le?vperm $out4,$out4,$out4,$leperm
stvx_u $out3,$x30,$out
stvx_u $out4,$x40,$out
addi $out,$out,0x50
bne Lxts_dec6x_steal
b Lxts_dec6x_done

```

```
.align 4
```

```
Lxts_dec6x_four:
```

```

vxo $out0,$in2,$twk0
vxo $out1,$in3,$twk1
vxo $out2,$in4,$twk2
vxo $out3,$in5,$twk3
vxo $out4,$out4,$out4

```

```
bl _aesp8_xts_dec5x
```

```

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk4 # unused tweak
vmr $twk1,$twk5
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxo $out0,$in0,$twk5
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
le?vperm $out3,$out3,$out3,$leperm
stvx_u $out2,$x20,$out
stvx_u $out3,$x30,$out
addi $out,$out,0x40
bne Lxts_dec6x_steal
b Lxts_dec6x_done

```

```
.align 4
```

```
Lxts_dec6x_three:
```

```

vxo $out0,$in3,$twk0
vxo $out1,$in4,$twk1
vxo $out2,$in5,$twk2

```

```

vxor $out3,$out3,$out3
vxor $out4,$out4,$out4

bl _aesp8_xts_dec5x

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk3 # unused tweak
vmr $twk1,$twk4
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxor $out0,$in0,$twk4
le?vperm $out2,$out2,$out2,$leperm
stvx_u $out1,$x10,$out
stvx_u $out2,$x20,$out
addi $out,$out,0x30
bne Lxts_dec6x_steal
b Lxts_dec6x_done

.align 4
Lxts_dec6x_two:
vxor $out0,$in4,$twk0
vxor $out1,$in5,$twk1
vxor $out2,$out2,$out2
vxor $out3,$out3,$out3
vxor $out4,$out4,$out4

bl _aesp8_xts_dec5x

le?vperm $out0,$out0,$out0,$leperm
vmr $twk0,$twk2 # unused tweak
vmr $twk1,$twk3
le?vperm $out1,$out1,$out1,$leperm
stvx_u $out0,$x00,$out # store output
vxor $out0,$in0,$twk3
stvx_u $out1,$x10,$out
addi $out,$out,0x20
bne Lxts_dec6x_steal
b Lxts_dec6x_done

.align 4
Lxts_dec6x_one:
vxor $out0,$in5,$twk0
nop
Loop_xts_dec1x:
vncipher $out0,$out0,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

```

```

vncipher $out0,$out0,v25
lvx v25,$x10,$key_ # round[4]
bdnz Loop_xts_dec1x

subi r0,$taillen,1
vncipher $out0,$out0,v24

andi r0,r0,16
cmpwi $taillen,0
vncipher $out0,$out0,v25

sub $inp,$inp,r0
vncipher $out0,$out0,v26

lvx_u $in0,0,$inp
vncipher $out0,$out0,v27

addi $key_,$sp,$FRAME+15 # rewind $key_
vncipher $out0,$out0,v28
lvx v24,$x00,$key_ # re-pre-load round[1]

vncipher $out0,$out0,v29
lvx v25,$x10,$key_ # re-pre-load round[2]
vxor $twk0,$twk0,v31

le?vperm $in0,$in0,$in0,$leperm
vncipher $out0,$out0,v30

mtctr $rounds
vncipherlast $out0,$out0,$twk0

vmr $twk0,$twk1 # unused tweak
vmr $twk1,$twk2
le?vperm $out0,$out0,$out0,$leperm
stvx_u $out0,$x00,$out # store output
addi $out,$out,0x10
vxor $out0,$in0,$twk2
bne Lxts_dec6x_steal
b Lxts_dec6x_done

.align 4
Lxts_dec6x_zero:
cmpwi $taillen,0
beq Lxts_dec6x_done

lvx_u $in0,0,$inp
le?vperm $in0,$in0,$in0,$leperm
vxor $out0,$in0,$twk1

```

```

Lxts_dec6x_steal:
 vncipher $out0,$out0,v24
 lvx v24,$x20,$key_ # round[3]
 addi $key_,$key_,0x20

 vncipher $out0,$out0,v25
 lvx v25,$x10,$key_ # round[4]
 bdnz Lxts_dec6x_steal

 add $inp,$inp,$taillen
 vncipher $out0,$out0,v24

 cmpwi $taillen,0
 vncipher $out0,$out0,v25

 lvx_u $in0,0,$inp
 vncipher $out0,$out0,v26

 lvsr $inpperm,0,$taillen # $in5 is no more
 vncipher $out0,$out0,v27

 addi $key_,$sp,$FRAME+15 # rewind $key_
 vncipher $out0,$out0,v28
 lvx v24,$x00,$key_ # re-pre-load round[1]

 vncipher $out0,$out0,v29
 lvx v25,$x10,$key_ # re-pre-load round[2]
 vxor $twk1,$twk1,v31

 le?vperm $in0,$in0,$in0,$leperm
 vncipher $out0,$out0,v30

 vperm $in0,$in0,$in0,$inpperm
 vncipherlast $tmp,$out0,$twk1

 le?vperm $out0,$tmp,$tmp,$leperm
 le?stvx_u $out0,0,$out
 be?stvx_u $tmp,0,$out

 vxor $out0,$out0,$out0
 vspltisb $out1,-1
 vperm $out0,$out0,$out1,$inpperm
 vsel $out0,$in0,$tmp,$out0
 vxor $out0,$out0,$twk0

 subi r30,$out,1
 mtctr $taillen
 Loop_xts_dec6x_steal:

```



```

lbzu r0,1(r30)
stb r0,16(r30)
bdnz Loop_xts_dec6x_steal

li $taillen,0
mtctr $rounds
b Loop_xts_dec1x # one more time...

.align 4
Lxts_dec6x_done:
${UCMP}i $ivp,0
beq Lxts_dec6x_ret

vxor $tweak,$twk0,$rndkey0
le?vperm $tweak,$tweak,$tweak,$leperm
stvx_u $tweak,0,$ivp

Lxts_dec6x_ret:
mtlr r11
li r10,`$FRAME+15`
li r11,`$FRAME+31`
stvx $seven,r10,$sp # wipe copies of round keys
addi r10,r10,32
stvx $seven,r11,$sp
addi r11,r11,32
stvx $seven,r10,$sp
addi r10,r10,32
stvx $seven,r11,$sp
addi r11,r11,32
stvx $seven,r10,$sp
addi r10,r10,32
stvx $seven,r11,$sp
addi r11,r11,32
stvx $seven,r10,$sp
addi r10,r10,32
stvx $seven,r11,$sp
addi r11,r11,32

mtspr 256,$vrsave
lvx v20,r10,$sp # ABI says so
addi r10,r10,32
lvx v21,r11,$sp
addi r11,r11,32
lvx v22,r10,$sp
addi r10,r10,32
lvx v23,r11,$sp
addi r11,r11,32
lvx v24,r10,$sp

```

```

addi r10,r10,32
lvx v25,r11,$sp
addi r11,r11,32
lvx v26,r10,$sp
addi r10,r10,32
lvx v27,r11,$sp
addi r11,r11,32
lvx v28,r10,$sp
addi r10,r10,32
lvx v29,r11,$sp
addi r11,r11,32
lvx v30,r10,$sp
lvx v31,r11,$sp
$POP r26,`$FRAME+21*16+0*$SIZE_T`($sp)
$POP r27,`$FRAME+21*16+1*$SIZE_T`($sp)
$POP r28,`$FRAME+21*16+2*$SIZE_T`($sp)
$POP r29,`$FRAME+21*16+3*$SIZE_T`($sp)
$POP r30,`$FRAME+21*16+4*$SIZE_T`($sp)
$POP r31,`$FRAME+21*16+5*$SIZE_T`($sp)
addi $sp,$sp,`$FRAME+21*16+6*$SIZE_T`
blr
.long 0
.byte 0,12,0x04,1,0x80,6,6,0
.long 0

```

```

.align 5
_esp8_xts_dec5x:
vncipher $out0,$out0,v24
vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24
vncipher $out4,$out4,v24
lvx v24,$x20,$key_ # round[3]
addi $key_,$key_,0x20

```

```

vncipher $out0,$out0,v25
vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
lvx v25,$x10,$key_ # round[4]
bdnz _esp8_xts_dec5x

```

```

subi r0,$taillen,1
vncipher $out0,$out0,v24
vncipher $out1,$out1,v24
vncipher $out2,$out2,v24
vncipher $out3,$out3,v24

```

```

vncipher $out4,$out4,v24

andi. r0,r0,16
cmpwi $taillen,0
vncipher $out0,$out0,v25
vncipher $out1,$out1,v25
vncipher $out2,$out2,v25
vncipher $out3,$out3,v25
vncipher $out4,$out4,v25
vxor $twk0,$twk0,v31

sub $inp,$inp,r0
vncipher $out0,$out0,v26
vncipher $out1,$out1,v26
vncipher $out2,$out2,v26
vncipher $out3,$out3,v26
vncipher $out4,$out4,v26
vxor $in1,$twk1,v31

vncipher $out0,$out0,v27
lvx_u $in0,0,$inp
vncipher $out1,$out1,v27
vncipher $out2,$out2,v27
vncipher $out3,$out3,v27
vncipher $out4,$out4,v27
vxor $in2,$twk2,v31

addi $key_,$sp,$FRAME+15 # rewind $key_
vncipher $out0,$out0,v28
vncipher $out1,$out1,v28
vncipher $out2,$out2,v28
vncipher $out3,$out3,v28
vncipher $out4,$out4,v28
lvx v24,$x00,$key_ # re-pre-load round[1]
vxor $in3,$twk3,v31

vncipher $out0,$out0,v29
le?vperm $in0,$in0,$in0,$leperm
vncipher $out1,$out1,v29
vncipher $out2,$out2,v29
vncipher $out3,$out3,v29
vncipher $out4,$out4,v29
lvx v25,$x10,$key_ # re-pre-load round[2]
vxor $in4,$twk4,v31

vncipher $out0,$out0,v30
vncipher $out1,$out1,v30
vncipher $out2,$out2,v30

```

```

vncipher $out3,$out3,v30
vncipher $out4,$out4,v30

vncipherlast $out0,$out0,$twk0
vncipherlast $out1,$out1,$in1
vncipherlast $out2,$out2,$in2
vncipherlast $out3,$out3,$in3
vncipherlast $out4,$out4,$in4
mtctr $rounds
blr
 .long 0
 .byte 0,12,0x14,0,0,0,0,0
} } } }

my $const=1;
foreach(split("\n",$code)) {
 s/^(\[^\]*)\`/eval($1)/geo;

constants table endian-specific conversion
if ($const && m/^(long|byte)\s+(.)\s+(\?[a-z]*)$/o) {
 my $conv=$3;
 my @bytes=();

convert to endian-agnostic format
 if ($1 eq "long") {
 foreach (split(/\s*/,$2)) {
 my $l = /^0/?oct:int;
 push @bytes,($l>>24)&0xff,($l>>16)&0xff,($l>>8)&0xff,$l&0xff;
 }
 } else {
 @bytes = map(/^0/?oct:int,split(/\s*/,$2));
 }

little-endian conversion
 if ($flavour =~ /le$/o) {
 SWITCH: for($conv) {
 ^?inv/ && do { @bytes=map($_^0xf,@bytes); last; };
 ^?rev/ && do { @bytes=reverse(@bytes); last; };
 }
 }

#emit
 print ".byte\t",join(', ',map (sprintf("0x%02x",$_),@bytes)), "\n";
 next;
}
$const=0 if (m/Lconst:/o); # end of table

```

```

instructions prefixed with '?' are endian-specific and need
to be adjusted accordingly...
if ($flavour =~ /le$/o) { # little-endian
 s/le\?//o or
 s/be\?/#be#/o or
 s/\?lvsr/lvsl/o or
 s/\?lvsl/lvsr/o or
 s/\?(vperm\s+v[0-9]+\,s*)(v[0-9]+\,s*)(v[0-9]+\,s*)(v[0-9]+)/$1$3$2$4/o or
 s/\?(vsldoi\s+v[0-9]+\,s*)(v[0-9]+\,s*)(v[0-9]+\,s*)([0-9]+)/$1$3$2 16-$4/o or
 s/\?(vsplitw\s+v[0-9]+\,s*)(v[0-9]+\,s*)([0-9]+)/$1$2 3-$3/o;
} else { # big-endian
 s/le\?/#le#/o or
 s/be\?//o or
 s/\?([a-z]+)/$1/o;
}

 print $_, "\n";
}

```

close STDOUT;

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```

7.2a.202104051307/crypto/des/ecb3_enc.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/des/cfb_enc.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/dsa/dsa_key.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/evp/e_null.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/stack/stack.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/des/spr.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/des/cfb64enc.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/des/set_key.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/bn/bn_word.c

```

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```

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```

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*
*/

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/sha/fips_standalone_sha1.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/des/fips_des_selftest.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/sha/fips_sha1_selftest.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/rand/fips_rand.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/include/openssl/fips_rand.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/aes/fips_aes_selftest.c

```

No license file was found, but licenses were detected in source scan.

```

/*
* Utilities for constant-time cryptography.
*
* Author: Emilia Kasper (emilia@openssl.org)
* Based on previous work by Bodo Moeller, Emilia Kasper, Adam Langley
* (Google).
* =====
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```

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- \*/

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/constant\_time\_locl.h

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```

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* by Eric Young (eay@cryptsoft.com).
```

- \* The implementation was written so as to conform with Netscapes SSL.
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\*/

Found in path(s):

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/bn/bn\_prime.pl

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/sha/asm/sha512-x86\_64.pl

No license file was found, but licenses were detected in source scan.

/\* .c>, <crypto/\*/\* .c>, <ssl/\* .c>, <apps/\* .c>)

When this option is NOT specified, the filelist is taken from the commandline instead. Here, wildcards may be embedded. (Be sure to escape those to prevent the shell from expanding them for you when you wish mkerr.pl to do so instead.)

Default: take file list to scan from the command line.

-reindex Discard the numeric values previously assigned to the error and function codes as extracted from the scanned header files; instead renumber all of them starting from 100. (Note that the numbers assigned through 'R' records in the config file remain intact.)

Default: keep previously assigned numbers. (You are warned when collisions are detected.)

-nostatic Generates a different source code, where these additional functions are generated for each library specified in the config file:

```
void ERR_load_<LIB>_strings(void);
void ERR_unload_<LIB>_strings(void);
void ERR_<LIB>_error(int f, int r, char *fn, int ln);
#define <LIB>err(f,r) ERR_<LIB>_error(f,r,OPENSSL_FILE,OPENSSL_LINE)
```

while the code facilitates the use of these in an environment where the error support routines are dynamically loaded at runtime.

Default: 'static' code generation.

-staticloader Prefix generated functions with the 'static' scope modifier.

Default: don't write any scope modifier prefix.



- unref     Print out unreferenced function and reason codes.
  
- write     Actually (over)write the generated code to the header and C  
          source files as assigned to each library through the config  
          file.  
          Default: don't write.
  
- help / -h / -? / --help     Show this help text.
  
- ...        Additional arguments are added to the file list to scan,  
          assuming '-recurse' was NOT specified on the command line.

EOF

```

exit 1;
} else {
last;
}
}

if($recurse) {
@source = (<crypto/*.c>, <crypto/**/*.c>, <ssl/*.c>, <ssl/**/*.c>)
} else {
@source = @ARGV;
}

Read in the config file

open(IN, "<$config") || die "Can't open config file $config";

Parse config file

while(<IN>)
{
if(/^\L\s+(\S+)\s+(\S+)\s+(\S+)/) {
$hinc{$1} = $2;
$libinc{$2} = $1;
$cskip{$3} = $1;
if($3 ne "NONE") {
$src{$1} = $3;
$fmax{$1} = 100;
$rmax{$1} = 100;
$fassigned{$1} = ":";
$rassigned{$1} = ":";
$fnew{$1} = 0;
$rnew{$1} = 0;
}
} elseif (/^F\s+(\S+)/) {
Add extra function with $1

```

```

} elsif (/^R\s+(\S+)\s+(\S+)/) {
$rextra{$1} = $2;
$rcodes{$1} = $2;
}
}

close IN;

Scan each header file in turn and make a list of error codes
and function names

while (($hdr, $lib) = each %libinc)
{
next if($hdr eq "NONE");
print STDERR "Scanning header file $hdr\n" if $debug;
my $line = "", $def= "", $linenr = 0, $gotfile = 0, $cpp = 0;
if (open(IN, "<$hdr")) {
 $gotfile = 1;
 while(<IN>) {
$linenr++;
print STDERR "line: $linenr\r" if $debug;

last if(/BEGIN\s+ERROR\s+CODES/);
if ($line ne "") {
 $_ = $line . $_;
 $line = "";
}

if (/\\$/) {
 $line = $_;
 next;
}

if (/^\/) {
 if (not /^*\/) { # multiline comment...
$line = $_; # ... just accumulate
next;
 } else {
s/^\/.*?\/*///gs; # wipe it
 }
}

if ($cpp) {
 $cpp++ if /^#\s*if/;
 $cpp-- if /^#\s*endif/;
 next;
}
$cpp = 1 if /^#\s*ifdef.*cplusplus/; # skip "C" declaration

```

```

next if (/^\#/); # skip preprocessor directives

s/{[^{}]*}//gs; # ignore {} blocks

if (^\{|\}/) { # Add a } so editor works...
 $line = $_;
} else {
 $def .= $_;
}
}
}

print STDERR " \r" if $debug;
 $defnr = 0;
Delete any DECLARE_ macros
$def =~ s/DECLARE_\w+(\[w,s\]+)///gs;
foreach (split /;/, $def) {
 $defnr++;
 print STDERR "def: $defnr\r" if $debug;

 # The goal is to collect function names from function declarations.

 s/^\[n\s]*//g;
 s/[n\s]*$/g;

 # Skip over recognized non-function declarations
 next if(/typedefW/ or /DECLARE_STACK_OF/ or /TYPEDEF_.*_OF/);

 # Remove STACK_OF(foo)
 s/STACK_OF(\w+)/void/;

 # Reduce argument lists to empty ()
 # fold round brackets recursively: (t(*v)(t),t) -> (t{}{}),t) -> {}
 while(/(\.*/s) {
s/([^\(\)]+)\{\}/g;
s/(\s*\s*\s*(\w+)\s*\{\}\s*)/$1/g; #(*f{ }) -> f
 }
 # pretend as we didn't use curly braces: {} -> ()
 s/{\}\^(\)/g;

 if (/(\w+)\s*(\().*/s) { # first token prior [first] () is
my $name = $1; # a function name!
$name =~ tr/[a-z]/[A-Z]/;
$ftrans{$name} = $1;
 } elsif (/[\(\)]/ and not (/=/)) {
print STDERR "Header $hdr: cannot parse: $_;\n";
 }
}

```

```

}

print STDERR " \r" if $debug;

next if $reindex;

Scan function and reason codes and store them: keep a note of the
maximum code used.

if ($gotfile) {
 while(<IN>) {
 if(/^\s*define\s+(\S+)\s+(\S+)/) {
 $name = $1;
 $code = $2;
 next if $name =~ /^${lib}err/;
 unless($name =~ /^${lib}_(RF)_(\w+)/) {
 print STDERR "Invalid error code $name\n";
 next;
 }
 if($1 eq "R") {
 $rcodes{$name} = $code;
 if ($rassigned{$lib} =~ /:$code:/) {
 print STDERR "!! ERROR: $lib reason code $code assigned twice (collision at $name)\n";
 ++$errcount;
 }
 $rassigned{$lib} .= "$code:";
 if(!(exists $rextra{$name}) &&
 ($code > $rmax{$lib})) {
 $rmax{$lib} = $code;
 }
 } else {
 if ($fassigned{$lib} =~ /:$code:/) {
 print STDERR "!! ERROR: $lib function code $code assigned twice (collision at $name)\n";
 ++$errcount;
 }
 $fassigned{$lib} .= "$code:";
 if($code > $fmax{$lib}) {
 $fmax{$lib} = $code;
 }
 $fcodes{$name} = $code;
 }
 }
 }
}

if ($debug) {
 if (defined($fmax{$lib})) {
 print STDERR "Max function code fmax" . "{" . "$lib" . "} = $fmax{$lib}\n";
 }
}

```

```

$assigned{$lib} =~ m/^(.*):$/;
@assigned = sort {$a <=> $b} split(":", $1);
print STDERR " @assigned\n";
}
if (defined($rmax{$lib})) {
print STDERR "Max reason code rmax" . "{" . "$lib" . "} = $rmax{$lib}\n";
$rassigned{$lib} =~ m/^(.*):$/;
@rassigned = sort {$a <=> $b} split(":", $1);
print STDERR " @rassigned\n";
}
}

if ($lib eq "SSL") {
if ($rmax{$lib} >= 1000) {
print STDERR "!! ERROR: SSL error codes 1000+ are reserved for alerts.\n";
print STDERR "!! Any new alerts must be added to $config.\n";
++$serrcount;
print STDERR "\n";
}
}
close IN;
}

```

```

Scan each C source file and look for function and reason codes
This is done by looking for strings that "look like" function or
reason codes: basically anything consisting of all upper case and
numerics which has _F_ or _R_ in it and which has the name of an
error library at the start. This seems to work fine except for the
oddly named structure BIO_F_CTX which needs to be ignored.
If a code doesn't exist in list compiled from headers then mark it
with the value "X" as a place holder to give it a value later.
Store all function and reason codes found in %ufcodes and %urcodes
so all those unreferenced can be printed out.

```

```

foreach $file (@source) {
Don't parse the error source file.
next if exists $skip{$file};
print STDERR "File loaded: ".$file."r" if $debug;
open(IN, "<$file") || die "Can't open source file $file\n";
my $func;
my $linenr = 0;
while(<IN>) {
skip obsoleted source files entirely!
last if(/^#error\s+obsolete/);
$linenr++;
if (!/;/ && /\^\s*([a-zA-Z_]\s*)?([A-Za-z_0-9]+)\.(.*)$/)
{

```

```

/^[^()]*([()]*[()]*)*$/;
$1 =~ /^[A-Za-z_0-9]*$/;
$func = $1;
}

if(/([A-Z0-9]+)_F_([A-Z0-9_]+)/) {
next unless exists $scsrc{$2};
next if($1 eq "BIO_F_BUFFER_CTX");
$ufcodes{$1} = 1;
if(!exists $fcodes{$1}) {
$fcodes{$1} = "X";
$fnew{$2}++;
}
$ftrans{$3} = $func unless exists $ftrans{$3};
if (uc $func ne $3) {
print STDERR "ERROR: mismatch $file:$linenr $func:$3\n";
$errcount++;
}
print STDERR "Function: $1\t= $fcodes{$1} (lib: $2, name: $3)\n" if $debug;
}
if(/([A-Z0-9]+)_R_[A-Z0-9_]+/) {
next unless exists $scsrc{$2};
$urcodes{$1} = 1;
if(!exists $rcodes{$1}) {
$rcodes{$1} = "X";
$rnew{$2}++;
}
print STDERR "Reason: $1\t= $rcodes{$1} (lib: $2)\n" if $debug;
}
}
close IN;
}
print STDERR " \n" if $debug;

Now process each library in turn.

foreach $lib (keys %csrc)
{
my $hfile = $hinc{$lib};
my $cfile = $csrc{$lib};
if(!$fnew{$lib} && !$rnew{$lib}) {
next unless $rebuild;
} else {
print STDERR "$lib:\t\t$fnew{$lib} New Functions,";
print STDERR " $rnew{$lib} New Reasons.\n";
next unless $dowrite;
}
}

```

```

If we get here then we have some new error codes so we
need to rebuild the header file and C file.

Make a sorted list of error and reason codes for later use.

my @function = sort grep(/^${lib}_/,keys %fcodes);
my @reasons = sort grep(/^${lib}_/,keys %rcodes);

Rewrite the header file

$cpp = 0;
$cplusplus = 0;
if (open(IN, "<$hfile")) {
 # Copy across the old file
 while(<IN>) {
 $cplusplus = $cpp if /^#.*/ifdef.*cplusplus/;
 $cpp++ if /^#\s*/if/;
 $cpp-- if /^#\s*/endif/;
 push @out, $_;
 last if (/BEGIN ERROR CODES/);
 }
 close IN;
} else {
 $cpp = 1;
 $cplusplus = 1;
 push @out,
 "/*\n",
 " * Copyright 1995-$YEAR The OpenSSL Project Authors. All Rights Reserved.\n",
 " *\n",
 " * Licensed under the OpenSSL license (the \"License\"). You may not use\n",
 " * this file except in compliance with the License. You can obtain a copy\n",
 " * in the file LICENSE in the source distribution or at\n",
 " * https://www.openssl.org/source/license.html\n",
 " *\n",
 "\n",
 "#ifndef HEADER_${lib}_ERR_H\n",
 "# define HEADER_${lib}_ERR_H\n",
 "\n",
 "# ifdef __cplusplus\n",
 "extern \"C\" {\n",
 "# endif\n",
 "\n",
 "/* BEGIN ERROR CODES *\n",
 }
 open (OUT, ">$hfile") || die "Can't Open File $hfile for writing\n";

 print OUT @out;
 undef @out;

```

```

print OUT <<"EOF";
/*
* The following lines are auto generated by the script mkerr.pl. Any changes
* made after this point may be overwritten when the script is next run.
*/

EOF
if($static) {
 print OUT <<"EOF";
 ${staticloader}int ERR_load_${lib}_strings(void);

EOF
} else {
 print OUT <<"EOF";
 ${staticloader}int ERR_load_${lib}_strings(void);
 ${staticloader}void ERR_unload_${lib}_strings(void);
 ${staticloader}void ERR_${lib}_error(int function, int reason, char *file, int line);
 # define ${lib}err(f,r) ERR_${lib}_error((f),(r),OPENSSL_FILE,OPENSSL_LINE)

EOF
}
print OUT <<"EOF";
/* Error codes for the $lib functions. */

/* Function codes. */
EOF

foreach $i (@function) {
 $z=48 - length($i);
 if($fcodes{$i} eq "X") {
 $fassigned{$lib} =~ m/^([:^:]*):/;
 $findcode = $1;
 if (!defined($findcode)) {
 $findcode = $fmax{$lib};
 }
 while ($fassigned{$lib} =~ m/:$findcode:/) {
 $findcode++;
 }
 $fcodes{$i} = $findcode;
 $fassigned{$lib} .= "$findcode:";
 print STDERR "New Function code $i\n" if $debug;
 }
 printf OUT "# define $i%s $fcodes{$i}\n", " " x $z;
}

print OUT "\n/* Reason codes. *\n";

foreach $i (@reasons) {

```



```

$z=48 - length($i);
if($rcodes{$i} eq "X") {
 $rassigned{$lib} =~ m/^([:^:]*):/;
 $findcode = $1;
 if (!defined($findcode)) {
 $findcode = $rmax{$lib};
 }
 while ($rassigned{$lib} =~ m/:$findcode:/) {
 $findcode++;
 }
 $rcodes{$i} = $findcode;
 $rassigned{$lib} .= "$findcode:";
 print STDERR "New Reason code $i\n" if $debug;
}
printf OUT "# define $i%s $rcodes{$i}\n", " " x $z;
}
print OUT <<"EOF";

```

EOF

```

do {
 if ($plusplus == $cpp) {
 print OUT "#", " " x $cpp, "ifdef __cplusplus\n";
 print OUT ")\n";
 print OUT "#", " " x $cpp, "endif\n";
 }
 if ($cpp-- > 0) {
 print OUT "#", " " x $cpp, "endif\n";
 }
} while ($cpp);
close OUT;

```

# Rewrite the C source file containing the error details.

```

First, read any existing reason string definitions:
my %err_reason_strings;
if (open(IN,"<$file")) {
 my $line = "";
 while (<IN>) {
 s|\R$||; # Better chomp
 $_ = $line . $_;
 $line = "";
 if (/({ERR_(FUNC|REASON)}\(/) {
 if (/b${lib}_R_\w*)b.*\(".*")/) {
 $err_reason_strings{$1} = $2;
 } elsif (/b${lib}_F_\w*)b.*\(".*")/) {
 if (!exists $ftrans{$1} && ($1 ne $2)) {
 print STDERR "WARNING: Mismatched function string $2\n";
 $ftrans{$1} = $2;
 }
 }
 }
 }
}

```

```

 }
 } else {
 $line = $_;
 }
}
}
close(IN);
}

my $hincf;
if($static) {
 $hincf = $hfile;
 $hincf =~ s!.*include/!!;
 if ($hincf =~ m/^openssl/) {
 $hincf = "<${hincf}>";
 } else {
 $hincf = "\"${hincf}\"";
 }
} else {
 $hincf = "\"$hfile\"";
}

If static we know the error code at compile time so use it
in error definitions.

if ($static)
{
 $pack_errcode = "ERR_LIB_${lib}";
 $load_errcode = "0";
}
else
{
 $pack_errcode = "0";
 $load_errcode = "ERR_LIB_${lib}";
}

open (OUT,">$cfile") || die "Can't open $cfile for writing";

print OUT <<"EOF";
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```

```

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*/

#include <stdio.h>
#include <openssl/err.h>
#include $hincf

/* BEGIN ERROR CODES */
#ifndef OPENSSSL_NO_ERR

define ERR_FUNC(func) ERR_PACK($pack_errcode,func,0)
define ERR_REASON(reason) ERR_PACK($pack_errcode,0,reason)

static ERR_STRING_DATA ${lib}_str_funcs[] = {
EOF
Add each function code: if a function name is found then use it.
foreach $i (@function) {
 my $fn;
 $i =~ /^${lib}_F_(\S+)/;
 $fn = $1;
 if(exists $ftrans{$fn}) {
 $fn = $ftrans{$fn};
 }
print OUT "{ERR_PACK($pack_errcode,$i,0),t"$fn"}\n";
if(length($i) + length($fn) > 57) {
 print OUT " {ERR_FUNC($i),n \"$fn\"},\n";
} else {
 print OUT " {ERR_FUNC($i), \"$fn\"},\n";
}
}
print OUT <<"EOF";
 {0, NULL}
};

static ERR_STRING_DATA ${lib}_str_reasons[] = {
EOF
Add each reason code.
foreach $i (@reasons) {
 my $rn;
 my $rstr = "ERR_REASON($i)";
 if (exists $err_reason_strings{$i}) {
 $rn = $err_reason_strings{$i};
 } else {
 $i =~ /^${lib}_R_(\S+)/;
 $rn = $1;
 $rn =~ tr/[A-Z]/ [a-z]/;
 }
 if(length($i) + length($rn) > 55) {

```

```

 print OUT " ${rstr},\n \\"$rn\"},\n";
 } else {
 print OUT " ${rstr}, \\"$rn\"},\n";
 }
}
if($static) {
 print OUT <<"EOF";
 {0, NULL}
};

#endif

${staticloader}int ERR_load_${lib}_strings(void)
{
#ifdef OPENSSSL_NO_ERR

 if (ERR_func_error_string(${lib}_str_functs[0].error) == NULL) {
 ERR_load_strings($load_errcode, ${lib}_str_functs);
 ERR_load_strings($load_errcode, ${lib}_str_reasons);
 }
#endif
 return 1;
}
EOF
} else {
 print OUT <<"EOF";
 {0, NULL}
};

#endif

#ifdef ${lib}_LIB_NAME
static ERR_STRING_DATA ${lib}_lib_name[] = {
 {0, ${lib}_LIB_NAME},
 {0, NULL}
};
#endif

static int ${lib}_lib_error_code = 0;
static int ${lib}_error_init = 1;

${staticloader}int ERR_load_${lib}_strings(void)
{
 if (${lib}_lib_error_code == 0)
 ${lib}_lib_error_code = ERR_get_next_error_library();

 if (${lib}_error_init) {
 ${lib}_error_init = 0;

```

```

#ifndef OPENSSSL_NO_ERR
 ERR_load_strings(${lib}_lib_error_code, ${lib}_str_funcs);
 ERR_load_strings(${lib}_lib_error_code, ${lib}_str_reasons);
#endif

#ifdef ${lib}_LIB_NAME
 ${lib}_lib_name->error = ERR_PACK(${lib}_lib_error_code, 0, 0);
 ERR_load_strings(0, ${lib}_lib_name);
#endif
}
return 1;
}

${staticloader}void ERR_unload_${lib}_strings(void)
{
 if (${lib}_error_init == 0) {
#ifndef OPENSSSL_NO_ERR
 ERR_unload_strings(${lib}_lib_error_code, ${lib}_str_funcs);
 ERR_unload_strings(${lib}_lib_error_code, ${lib}_str_reasons);
#endif
 }

#ifdef ${lib}_LIB_NAME
 ERR_unload_strings(0, ${lib}_lib_name);
#endif
 ${lib}_error_init = 1;
}

${staticloader}void ERR_${lib}_error(int function, int reason, char *file, int line)
{
 if (${lib}_lib_error_code == 0)
 ${lib}_lib_error_code = ERR_get_next_error_library();
 ERR_PUT_error(${lib}_lib_error_code, function, reason, file, line);
}
EOF

}

close OUT;
undef %err_reason_strings;
}

if($debug && %notrans) {
 print STDERR "The following function codes were not translated:\n";
 foreach(sort keys %notrans)
 {
 print STDERR "$_\n";
 }
}

```

```

}

Make a list of unreferenced function and reason codes

foreach (keys %fcodes) {
 push (@funref, $_) unless exists $ufcodes{$_};
}

foreach (keys %rcodes) {
 push (@runref, $_) unless exists $urcodes{$_};
}

if($sunref && @funref) {
 print STDERR "The following function codes were not referenced:\n";
 foreach(sort @funref)
 {
 print STDERR "$_\n";
 }
}

if($sunref && @runref) {
 print STDERR "The following reason codes were not referenced:\n";
 foreach(sort @runref)
 {
 print STDERR "$_\n";
 }
}

if($serrcount) {
 print STDERR "There were errors, failing...\n\n";
 exit $serrcount;
}

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/* -----
* crypto/aes/asm/aes_gcm-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
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* -----
*/

```

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\*  
\* Originally written by Shay Gueron (1, 2), and Vlad Krasnov (1)  
\* (1) Intel Corporation, Israel Development Center, Haifa, Israel  
\* (2) University of Haifa, Israel  
\*/

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```
*
*/
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CRYPTOGAMS licenses depending on where you obtain it. For further
details see http://www.openssl.org/~appro/cryptogams/.
=====
```

```
#
February 2012
#
The module implements bn_GF2m_mul_2x2 polynomial multiplication
used in bn_gf2m.c. It's kind of low-hanging mechanical port from
C for the time being... The subroutine runs in 37 cycles, which is
4.5x faster than compiler-generated code. Though comparison is
totally unfair, because this module utilizes Galois Field Multiply
instruction.
```

```
while (($output=shift) && ($output!~/^[w\W-]*\.[w+$/)) { }
open STDOUT,">$output";
```

```
($rp,$a1,$a0,$b1,$b0)=("A4","B4","A6","B6","A8"); # argument vector
```

```

($Alo,$Alox0,$Alox1,$Alox2,$Alox3)=map("A$_",(16..20));
($Ahi,$Ahix0,$Ahix1,$Ahix2,$Ahix3)=map("B$_",(16..20));
($B_0,$B_1,$B_2,$B_3)=("B5","A5","A7","B7");
($A,$B)=$Alo,$B_1;
$xFF="B1";

```

```

sub mul_1x1_upper {
my ($A,$B)=@_;
$code.=<<___.
EXTU $B,8,24,$B_2 ; smash $B to 4 bytes
|| AND $B,$xFF,$B_0
|| SHRU $B,24,$B_3
SHRU $A,16, $Ahi ; smash $A to two halfwords
|| EXTU $A,16,16,$Alo

```

```

XORMPY $Alo,$B_2,$Alox2 ; 16x8 bits multiplication
|| XORMPY $Ahi,$B_2,$Ahix2
|| EXTU $B,16,24,$B_1
XORMPY $Alo,$B_0,$Alox0
|| XORMPY $Ahi,$B_0,$Ahix0
XORMPY $Alo,$B_3,$Alox3
|| XORMPY $Ahi,$B_3,$Ahix3
XORMPY $Alo,$B_1,$Alox1
|| XORMPY $Ahi,$B_1,$Ahix1

```

```

—
}

```

```

sub mul_1x1_merged {
my ($OUTlo,$OUThi,$A,$B)=@_;
$code.=<<___.
EXTU $B,8,24,$B_2 ; smash $B to 4 bytes
|| AND $B,$xFF,$B_0
|| SHRU $B,24,$B_3
SHRU $A,16, $Ahi ; smash $A to two halfwords
|| EXTU $A,16,16,$Alo

```

```

XOR $Ahix0,$Alox2,$Ahix0
|| MV $Ahix2,$OUThi
|| XORMPY $Alo,$B_2,$Alox2
XORMPY $Ahi,$B_2,$Ahix2
|| EXTU $B,16,24,$B_1
|| XORMPY $Alo,$B_0,$Alox0
XOR $Ahix1,$Alox3,$Ahix1
|| SHL $Ahix0,16,$OUTlo
|| SHRU $Ahix0,16,$Ahix0
XOR $Alox0,$OUTlo,$OUTlo
|| XOR $Ahix0,$OUThi,$OUThi
|| XORMPY $Ahi,$B_0,$Ahix0

```

```

|| XORMPY $Alo,$B_3,$Alox3
|| SHL $Alox1,8,$Alox1
|| SHL $Ahix3,8,$Ahix3
XOR $Alox1,$OUTlo,$OUTlo
|| XOR $Ahix3,$OUThi,$OUThi
|| XORMPY $Ahi,$B_3,$Ahix3
|| SHL $Ahix1,24,$Alox1
|| SHRU $Ahix1,8, $Ahix1
XOR $Alox1,$OUTlo,$OUTlo
|| XOR $Ahix1,$OUThi,$OUThi
|| XORMPY $Alo,$B_1,$Alox1
|| XORMPY $Ahi,$B_1,$Ahix1
|| MV A1,$Alox0
—
}
sub mul_1x1_lower {
my ($OUTlo,$OUThi)=@_;
$code.=<<__;
;NOP
XOR $Ahix0,$Alox2,$Ahix0
|| MV $Ahix2,$OUThi
NOP
XOR $Ahix1,$Alox3,$Ahix1
|| SHL $Ahix0,16,$OUTlo
|| SHRU $Ahix0,16,$Ahix0
XOR $Alox0,$OUTlo,$OUTlo
|| XOR $Ahix0,$OUThi,$OUThi
|| SHL $Alox1,8,$Alox1
|| SHL $Ahix3,8,$Ahix3
XOR $Alox1,$OUTlo,$OUTlo
|| XOR $Ahix3,$OUThi,$OUThi
|| SHL $Ahix1,24,$Alox1
|| SHRU $Ahix1,8, $Ahix1
XOR $Alox1,$OUTlo,$OUTlo
|| XOR $Ahix1,$OUThi,$OUThi
—
}
$code.=<<__;
.text

.if .ASSEMBLER_VERSION<7000000
.asg 0,__TI_EABI__
.endif
.if __TI_EABI__
.asg bn_GF2m_mul_2x2,_bn_GF2m_mul_2x2
.endif

.global _bn_GF2m_mul_2x2

```

```

_bn_GF2m_mul_2x2:
.asmfunc
MVK 0xFF,$xFF

——
&mul_1x1_upper($a0,$b0); # a0·b0
$code.=<<____;
|| MV $b1,$B
MV $a1,$A

——
&mul_1x1_merged("A28","B28",$A,$B); # a0·b0/a1·b1
$code.=<<____;
|| XOR $b0,$b1,$B
XOR $a0,$a1,$A

——
&mul_1x1_merged("A31","B31",$A,$B); # a1·b1/(a0+a1)·(b0+b1)
$code.=<<____;
XOR A28,A31,A29
|| XOR B28,B31,B29 ; a0·b0+a1·b1

——
&mul_1x1_lower("A30","B30"); # (a0+a1)·(b0+b1)
$code.=<<____;
|| BNOP B3
XOR A29,A30,A30
|| XOR B29,B30,B30 ; (a0+a1)·(b0+b1)-a0·b0-a1·b1
XOR B28,A30,A30
|| STW A28,*${rp}[0]
XOR B30,A31,A31
|| STW A30,*${rp}[1]
STW A31,*${rp}[2]
STW B31,*${rp}[3]
.endasmfunc

——

print $code;
close STDOUT;

```

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```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/c64xplus-gf2m.pl

```

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* by Eric Young (eay@cryptsoft.com).

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```

\$flavour = shift;

```

$0 =~ m/(.*[\\])[^\\]+$/; $dir=$1;
($xlate="{dir}ppc-xlate.pl" and -f $xlate) or
($xlate="{dir}perlasm/ppc-xlate.pl" and -f $xlate) or
die "can't locate ppc-xlate.pl";

```

open STDOUT,"| \$^X \$xlate \$flavour ".shift || die "can't call \$xlate: \$!";

```

if ($flavour=~~/64/) {
 $CMPLI="cmpldi";
 $SHRLI="srdi";
 $SIGNX="extsw";
} else {
 $CMPLI="cmplwi";

```

```

 $$SHRLI="srwi";
 $$SIGNX="mr";
}

$code=<<___.;
.machine "any"
.text

.globl .OPENSSL_fpu_probe
.align 4
.OPENSSL_fpu_probe:
 fmr f0,f0
 blr
 .long 0
 .byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_fpu_probe,.-.OPENSSL_fpu_probe
.globl .OPENSSL_ppc64_probe
.align 4
.OPENSSL_ppc64_probe:
 fcfid f1,f1
 extrdi r0,r0,32,0
 blr
 .long 0
 .byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_ppc64_probe,.-.OPENSSL_ppc64_probe

.globl .OPENSSL_altivec_probe
.align 4
.OPENSSL_altivec_probe:
 .long 0x10000484 # vor v0,v0,v0
 blr
 .long 0
 .byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_altivec_probe,.-.OPENSSL_altivec_probe

.globl .OPENSSL_crypto207_probe
.align 4
.OPENSSL_crypto207_probe:
 lvx_u v0,0,r1
 vcipher v0,v0,v0
 blr
 .long 0
 .byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_crypto207_probe,.-.OPENSSL_crypto207_probe

.globl .OPENSSL_madd300_probe
.align 4
.OPENSSL_madd300_probe:

```

```

xor r0,r0,r0
maddld r3,r0,r0,r0
maddhdu r3,r0,r0,r0
blr
.long 0
.byte 0,12,0x14,0,0,0,0,0

.globl .OPENSSL_wipe_cpu
.align 4
.OPENSSL_wipe_cpu:
xor r0,r0,r0
fmr f0,f31
fmr f1,f31
fmr f2,f31
mr r3,r1
fmr f3,f31
xor r4,r4,r4
fmr f4,f31
xor r5,r5,r5
fmr f5,f31
xor r6,r6,r6
fmr f6,f31
xor r7,r7,r7
fmr f7,f31
xor r8,r8,r8
fmr f8,f31
xor r9,r9,r9
fmr f9,f31
xor r10,r10,r10
fmr f10,f31
xor r11,r11,r11
fmr f11,f31
xor r12,r12,r12
fmr f12,f31
fmr f13,f31
blr
.long 0
.byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_wipe_cpu,-.OPENSSL_wipe_cpu

.globl .OPENSSL_atomic_add
.align 4
.OPENSSL_atomic_add:
Ladd: lwarx r5,0,r3
add r0,r4,r5
stwx. r0,0,r3
bne- Ladd
$SIGNX r3,r0

```



```

blr
.long 0
.byte 0,12,0x14,0,0,0,2,0
.long 0
.size .OPENSSL_atomic_add,-.OPENSSL_atomic_add

.globl .OPENSSL_rdtsc_mftb
.align 4
.OPENSSL_rdtsc_mftb:
mftb r3
blr
.long 0
.byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_rdtsc_mftb,-.OPENSSL_rdtsc_mftb

.globl .OPENSSL_rdtsc_mfspr268
.align 4
.OPENSSL_rdtsc_mfspr268:
mfspr r3,268
blr
.long 0
.byte 0,12,0x14,0,0,0,0,0
.size .OPENSSL_rdtsc_mfspr268,-.OPENSSL_rdtsc_mfspr268

.globl .OPENSSL_cleane_asm
.align 4
.OPENSSL_cleane_asm:
$CMPLI r4,7
li r0,0
bge Lot
$CMPLI r4,0
beqlr-
Little: mtctr r4
stb r0,0(r3)
addi r3,r3,1
bdnz \$.8
blr
Lot: andi. r5,r3,3
beq Laligned
stb r0,0(r3)
subi r4,r4,1
addi r3,r3,1
b Lot
Laligned:
$SHRLI r5,r4,2
mtctr r5
stw r0,0(r3)
addi r3,r3,4

```

```

bdnz \$.8
andi. r4,r4,3
bne Little
blr
.long 0
.byte 0,12,0x14,0,0,0,2,0
.long 0
.size .OPENSSL_cleane_asm,-.OPENSSL_cleane_asm

```

```

globl .CRYPTO_memcmp

```

```

.align 4

```

```

.CRYPTO_memcmp:

```

```

$CMPLI r5,0

```

```

li r0,0

```

```

beq Lno_data

```

```

mtctr r5

```

```

Loop_cmp:

```

```

lbz r6,0(r3)

```

```

addi r3,r3,1

```

```

lbz r7,0(r4)

```

```

addi r4,r4,1

```

```

xor r6,r6,r7

```

```

or r0,r0,r6

```

```

bdnz Loop_cmp

```

```

Lno_data:

```

```

li r3,0

```

```

sub r3,r3,r0

```

```

extrwi r3,r3,1,0

```

```

blr

```

```

.long 0

```

```

.byte 0,12,0x14,0,0,0,3,0

```

```

.long 0

```

```

.size .CRYPTO_memcmp,-.CRYPTO_memcmp

```

```

```

```

{

```

```

my ($out,$cnt,$max)=("r3","r4","r5");

```

```

my ($tick,$lasttick)=("r6","r7");

```

```

my ($diff,$lastdiff)=("r8","r9");

```

```

$code.=<<___;

```

```

.globl .OPENSSL_instrument_bus_mftb

```

```

.align 4

```

```

.OPENSSL_instrument_bus_mftb:

```

```

mtctr $cnt

```

```

mftb $lasttick # collect 1st tick

```

```

li $diff,0

```

```

dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out

Loop: mftb $tick
sub $diff,$tick,$lasttick
mr $lasttick,$tick
dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out
addi $out,$out,4 # ++$out
bdnz Loop

mr r3,$cnt
blr
.long 0
.byte 0,12,0x14,0,0,2,0
.long 0
.size .OPENSSL_instrument_bus_mftb,.-.OPENSSL_instrument_bus_mftb

.globl .OPENSSL_instrument_bus2_mftb
.align 4
.OPENSSL_instrument_bus2_mftb:
mr r0,$cnt
slwi $cnt,$cnt,2

mftb $lasttick # collect 1st tick
li $diff,0

dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out

mftb $tick # collect 1st diff
sub $diff,$tick,$lasttick
mr $lasttick,$tick
mr $lastdiff,$diff
Loop2:
dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff

```

```

stwx. $tick,0,$out
stwx $tick,0,$out

addic. $max,$max,-1
beq Ldone2

mftb $tick
sub $diff,$tick,$lasttick
mr $lasttick,$tick
cmplw 7,$diff,$lastdiff
mr $lastdiff,$diff

mfcrl $tick # pull cr
not $tick,$tick # flip bits
rlwinm $tick,$tick,1,29,29 # isolate flipped eq bit and scale

sub. $cnt,$cnt,$tick # conditional --$cnt
add $out,$out,$tick # conditional ++$out
bne Loop2

Ldone2:
srwi $cnt,$cnt,2
sub r3,r0,$cnt
blr
.long 0
.byte 0,12,0x14,0,0,3,0
.long 0
.size .OPENSSL_instrument_bus2_mftb,.-.OPENSSL_instrument_bus2_mftb

.globl .OPENSSL_instrument_bus_mfspr268
.align 4
.OPENSSL_instrument_bus_mfspr268:
mtctr $cnt

mfspr $lasttick,268 # collect 1st tick
li $diff,0

dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out

Loop3: mfspr $tick,268
sub $diff,$tick,$lasttick
mr $lasttick,$tick
dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock

```

```

add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out
addi $out,$out,4 # ++$out
bdnz Loop3

mr r3,$cnt
blr
.long 0
.byte 0,12,0x14,0,0,0,2,0
.long 0
.size .OPENSSL_instrument_bus_mfspr268,-.OPENSSL_instrument_bus_mfspr268

.globl .OPENSSL_instrument_bus2_mfspr268
.align 4
.OPENSSL_instrument_bus2_mfspr268:
mr r0,$cnt
slwi $cnt,$cnt,2

mfspr $lasttick,268 # collect 1st tick
li $diff,0

dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out

mfspr $tick,268 # collect 1st diff
sub $diff,$tick,$lasttick
mr $lasttick,$tick
mr $lastdiff,$diff
Loop4:
dcbf 0,$out # flush cache line
lwarx $tick,0,$out # load and lock
add $tick,$tick,$diff
stwx. $tick,0,$out
stwx $tick,0,$out

addic. $max,$max,-1
beq Ldone4

mfspr $tick,268
sub $diff,$tick,$lasttick
mr $lasttick,$tick
cmplw 7,$diff,$lastdiff
mr $lastdiff,$diff

```

```
mfcf $tick # pull cr
not $tick,$tick # flip bits
rlwinm $tick,$tick,1,29,29 # isolate flipped eq bit and scale
```

```
sub. $cnt,$cnt,$tick # conditional --$cnt
add $out,$out,$tick # conditional ++$out
bne Loop4
```

Ldone4:

```
srwi $cnt,$cnt,2
sub r3,r0,$cnt
blr
.long 0
.byte 0,12,0x14,0,0,3,0
.long 0
.size .OPENSSL_instrument_bus2_mfspr268,-.OPENSSL_instrument_bus2_mfspr268
}
}
```

```
$code =~ s/^(\[^\]*)\`/eval $1/gem;
print $code;
close STDOUT;
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/ppccpuid.pl
```

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```
/*
```

```
tlhelp32.h - Include file for Tool help functions.
```

Written by Mumit Khan <khan@nanotech.wisc.edu>

This file is part of a free library for the Win32 API.

This library is distributed in the hope that it will be useful,  
but WITHOUT ANY WARRANTY; without even the implied warranty of  
MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

```
*/
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/ms/tlhelp32.h
```

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```
/*-----
```

```
* include/cavium/cvmx-aes.h - Cavium Octeon specific hardware assist
```

\* functionality that is to reside within the FIPS canister.

\*

\* February 2013

\*

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\* All rights reserved.

\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/cvmx-aes.h

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/\*

\* WARNING: do not edit!

\* Generated by crypto/objects/obj\_dat.pl

\*

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\* <https://www.openssl.org/source/license.html>

\*/

Found in path(s):

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/objects/obj\_dat.h

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# project. The module is, however, dual licensed under OpenSSL and

Found in path(s):

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/aes/asm/aes-armv4.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/bn/asm/s390x-mont.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/bn/asm/ppc64-mont.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/bn/asm/armv4-mont.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/sha/asm/sha256-586.pl

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```

#!/usr/bin/env perl
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#
Licensed under the OpenSSL license (the "License"). You may not use
this file except in compliance with the License. You can obtain a copy
in the file LICENSE in the source distribution or at
https://www.openssl.org/source/license.html

void des_ncbc_encrypt(input, output, length, schedule, ivec, enc)
des_cblock (*input);
des_cblock (*output);
long length;
des_key_schedule schedule;
des_cblock (*ivec);
int enc;
#
calls
des_encrypt((DES_LONG *)tin,schedule,DES_ENCRYPT);
#

#&cbc("des_ncbc_encrypt","des_encrypt",0);
#&cbc("BF_cbc_encrypt","BF_encrypt","BF_encrypt",
1,4,5,3,5,-1);
#&cbc("des_ncbc_encrypt","des_encrypt","des_encrypt",
0,4,5,3,5,-1);
#&cbc("des_ede3_cbc_encrypt","des_encrypt3","des_decrypt3",
0,6,7,3,4,5);
#
When doing a cipher that needs bigendian order,
for encrypt, the iv is kept in bigendian form,
while for decrypt, it is kept in little endian.
sub cbc
{
 local($name,$enc_func,$dec_func,$swap,$iv_off,$enc_off,$p1,$p2,$p3)=@_;
 # name is the function name
 # enc_func and dec_func and the functions to call for encrypt/decrypt
 # swap is true if byte order needs to be reversed
 # iv_off is parameter number for the iv
 # enc_off is parameter number for the encrypt/decrypt flag
 # p1,p2,p3 are the offsets for parameters to be passed to the
 # underlying calls.

 &function_begin_B($name,"");
 &comment("");

 $in="esi";
 $out="edi";

```



```

$count="ebp";

&push("ebp");
&push("ebx");
&push("esi");
&push("edi");

$data_off=4;
$data_off+=4 if ($p1 > 0);
$data_off+=4 if ($p2 > 0);
$data_off+=4 if ($p3 > 0);

&mov($count, &wparam(2)); # length

&comment("getting iv ptr from parameter $iv_off");
&mov("ebx", &wparam($iv_off)); # Get iv ptr

&mov($in, &DWP(0,"ebx","",0));# iv[0]
&mov($out, &DWP(4,"ebx","",0));# iv[1]

&push($out);
&push($in);
&push($out); # used in decrypt for iv[1]
&push($in); # used in decrypt for iv[0]

&mov("ebx", "esp"); # This is the address of tin[2]

&mov($in, &wparam(0)); # in
&mov($out, &wparam(1)); # out

We have loaded them all, how lets push things
&comment("getting encrypt flag from parameter $enc_off");
&mov("ecx", &wparam($enc_off)); # Get enc flag
if ($p3 > 0)
{
&comment("get and push parameter $p3");
if ($enc_off != $p3)
{ &mov("eax", &wparam($p3)); &push("eax"); }
else { &push("ecx"); }
}
if ($p2 > 0)
{
&comment("get and push parameter $p2");
if ($enc_off != $p2)
{ &mov("eax", &wparam($p2)); &push("eax"); }
else { &push("ecx"); }
}
if ($p1 > 0)

```

```

{
&comment("get and push parameter $p1");
if ($enc_off != $p1)
{ &mov("eax", &wparam($p1)); &push("eax"); }
else { &push("ecx"); }
}
&push("ebx"); # push data/iv

&cmp("ecx",0);
&jz(&label("decrypt"));

&and($count,0xffffffff8);
&mov("eax", &DWP($data_off,"esp","",0)); # load iv[0]
&mov("ebx", &DWP($data_off+4,"esp","",0)); # load iv[1]

&jz(&label("encrypt_finish"));

#####

&set_label("encrypt_loop");
encrypt start
"eax" and "ebx" hold iv (or the last cipher text)

&mov("ecx", &DWP(0,$in","",0)); # load first 4 bytes
&mov("edx", &DWP(4,$in","",0)); # second 4 bytes

&xor("eax", "ecx");
&xor("ebx", "edx");

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov(&DWP($data_off,"esp","",0), "eax"); # put in array for call
&mov(&DWP($data_off+4,"esp","",0), "ebx"); #

&call($enc_func);

&mov("eax", &DWP($data_off,"esp","",0));
&mov("ebx", &DWP($data_off+4,"esp","",0));

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov(&DWP(0,$out","",0), "eax");
&mov(&DWP(4,$out","",0), "ebx");

eax and ebx are the next iv.

```

```

&add($in, 8);
&add($out, 8);

&sub($count, 8);
&jnz(&label("encrypt_loop"));

#####3
&set_label("encrypt_finish");
&mov($count, &wparam(2)); # length
&and($count, 7);
&jz(&label("finish"));
&call(&label("PIC_point"));
&set_label("PIC_point");
&blindpop("edx");
&lea("ecx",&DWP(&label("cbc_enc_jmp_table")."-".&label("PIC_point"),"edx"));
&mov($count,&DWP(0,"ecx",$count,4));
&add($count,"edx");
&xor("ecx","ecx");
&xor("edx","edx");
#&mov($count,&DWP(&label("cbc_enc_jmp_table"),"",$count,4));
&jmp_ptr($count);

&set_label("ej7");
&movb(&HB("edx"), &BP(6,$in,"",0));
&shl("edx",8);
&set_label("ej6");
&movb(&HB("edx"), &BP(5,$in,"",0));
&set_label("ej5");
&movb(&LB("edx"), &BP(4,$in,"",0));
&set_label("ej4");
&mov("ecx", &DWP(0,$in,"",0));
&jmp(&label("ejend"));
&set_label("ej3");
&movb(&HB("ecx"), &BP(2,$in,"",0));
&shl("ecx",8);
&set_label("ej2");
&movb(&HB("ecx"), &BP(1,$in,"",0));
&set_label("ej1");
&movb(&LB("ecx"), &BP(0,$in,"",0));
&set_label("ejend");

&xor("eax", "ecx");
&xor("ebx", "edx");

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov(&DWP($data_off,"esp","",0), "eax"); # put in array for call

```

```

&mov(&DWP($data_off+4,"esp","",0), "ebx"); #

&call($enc_func);

&mov("eax", &DWP($data_off,"esp","",0));
&mov("ebx", &DWP($data_off+4,"esp","",0));

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov(&DWP(0,$out","",0), "eax");
&mov(&DWP(4,$out","",0), "ebx");

&jmp(&label("finish"));

#####
#####
&set_label("decrypt",1);
decrypt start
&and($count,0xfffff8);
The next 2 instructions are only for if the jz is taken
&mov("eax", &DWP($data_off+8,"esp","",0)); # get iv[0]
&mov("ebx", &DWP($data_off+12,"esp","",0)); # get iv[1]
&jz(&label("decrypt_finish"));

&set_label("decrypt_loop");
&mov("eax", &DWP(0,$in","",0)); # load first 4 bytes
&mov("ebx", &DWP(4,$in","",0)); # second 4 bytes

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov(&DWP($data_off,"esp","",0), "eax"); # put back
&mov(&DWP($data_off+4,"esp","",0), "ebx"); #

&call($dec_func);

&mov("eax", &DWP($data_off,"esp","",0)); # get return
&mov("ebx", &DWP($data_off+4,"esp","",0)); #

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov("ecx", &DWP($data_off+8,"esp","",0)); # get iv[0]
&mov("edx", &DWP($data_off+12,"esp","",0)); # get iv[1]

&xor("ecx", "eax");
&xor("edx", "ebx");

```

```

&mov("eax", &DWP(0,$in,"",0)); # get old cipher text,
&mov("ebx", &DWP(4,$in,"",0)); # next iv actually

&mov(&DWP(0,$out,"",0),"ecx");
&mov(&DWP(4,$out,"",0),"edx");

&mov(&DWP($data_off+8,"esp","",0), "eax"); # save iv
&mov(&DWP($data_off+12,"esp","",0), "ebx"); #

&add($in, 8);
&add($out, 8);

&sub($count, 8);
&jnz(&label("decrypt_loop"));
ENDIT #####3
&set_label("decrypt_finish");
&mov($count, &wparam(2)); # length
&and($count, 7);
&jz(&label("finish"));

&mov("eax", &DWP(0,$in,"",0)); # load first 4 bytes
&mov("ebx", &DWP(4,$in,"",0)); # second 4 bytes

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov(&DWP($data_off,"esp","",0), "eax"); # put back
&mov(&DWP($data_off+4,"esp","",0), "ebx"); #

&call($dec_func);

&mov("eax", &DWP($data_off,"esp","",0)); # get return
&mov("ebx", &DWP($data_off+4,"esp","",0)); #

&bswap("eax") if $swap;
&bswap("ebx") if $swap;

&mov("ecx", &DWP($data_off+8,"esp","",0)); # get iv[0]
&mov("edx", &DWP($data_off+12,"esp","",0)); # get iv[1]

&xor("ecx", "eax");
&xor("edx", "ebx");

this is for when we exit
&mov("eax", &DWP(0,$in,"",0)); # get old cipher text,
&mov("ebx", &DWP(4,$in,"",0)); # next iv actually

```

```

&set_label("dj7");
&rotr("edx", 16);
&movb(&BP(6,$out,"",0), &LB("edx"));
&shr("edx",16);
&set_label("dj6");
&movb(&BP(5,$out,"",0), &HB("edx"));
&set_label("dj5");
&movb(&BP(4,$out,"",0), &LB("edx"));
&set_label("dj4");
&mov(&DWP(0,$out,"",0), "ecx");
&jmp(&label("djend"));
&set_label("dj3");
&rotr("ecx", 16);
&movb(&BP(2,$out,"",0), &LB("ecx"));
&shl("ecx",16);
&set_label("dj2");
&movb(&BP(1,$in,"",0), &HB("ecx"));
&set_label("dj1");
&movb(&BP(0,$in,"",0), &LB("ecx"));
&set_label("djend");

final iv is still in eax:ebx
&jmp(&label("finish"));

FINISH #####3
&set_label("finish",1);
&mov("ecx", &wparam($iv_off)); # Get iv ptr

#####
$total=16+4;
$total+=4 if ($p1 > 0);
$total+=4 if ($p2 > 0);
$total+=4 if ($p3 > 0);
&add("esp", $total);

&mov(&DWP(0,"ecx","",0), "eax"); # save iv
&mov(&DWP(4,"ecx","",0), "ebx"); # save iv

&function_end_A($name);

&align(64);
&set_label("cbc_enc_jump_table");
&data_word("0");
&data_word(&label("ej1")."-".&label("PIC_point"));
&data_word(&label("ej2")."-".&label("PIC_point"));
&data_word(&label("ej3")."-".&label("PIC_point"));
&data_word(&label("ej4")."-".&label("PIC_point"));

```

```
&data_word(&label("ej5")."-".&label("PIC_point"));
&data_word(&label("ej6")."-".&label("PIC_point"));
&data_word(&label("ej7")."-".&label("PIC_point"));
not used
#&set_label("cbc_dec_jump_table",1);
#&data_word("0");
#&data_word(&label("dj1")."-".&label("PIC_point"));
#&data_word(&label("dj2")."-".&label("PIC_point"));
#&data_word(&label("dj3")."-".&label("PIC_point"));
#&data_word(&label("dj4")."-".&label("PIC_point"));
#&data_word(&label("dj5")."-".&label("PIC_point"));
#&data_word(&label("dj6")."-".&label("PIC_point"));
#&data_word(&label("dj7")."-".&label("PIC_point"));
&align(64);
```

```
&function_end_B($name);
```

```
}
```

```
1;
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/perlasmb/cbc.pl
```

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```

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*
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```
*/
```

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```
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```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/asn1/asn1.h
```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/include/openssl/asn1.h
```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/rsa/rsa_crpt.c
```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/des/cfb64ede.c
```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/bn/bn_exp2.c
```

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```
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* crypto/des/asm/cbc_enc-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
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* -----
*/
```

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```
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```

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7.2a.202104051307/fips/ecdsa/fips_ecdsa_sign.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/dsa/fips_dsa_sign.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
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7.2a.202104051307/include/openssl/safestack.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/rsa/rsa_oaep.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-

```

7.2a.202104051307/crypto/stack/safestack.h

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```
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 * crypto/aes/asm/aes_xts-octeon.c - Cavium Octeon specific hardware assist
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* fips/fips_kdf_selftest.c - Power-on selftests for all supported
* KDFs.
*
* Feb, 2021
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*-----
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```
/**
```

```
* rijndael-alg-fst.c
```

```
*
```

```
* @version 3.0 (December 2000)
```

```
*
```

```
* Optimised ANSI C code for the Rijndael cipher (now AES)
```

```
*
```

```
* @author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>
```

```
* @author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>
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```

```
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#!/usr/bin/env perl

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package x86masm;

\*out=@::out;

::lbdecor="\\$L"; # local label decoration

::nmdecor="\_"; # external name decoration

\$initseg="";

\$segment="";

sub ::generic

{ my (\$opcode,@arg)=@\_;

```

fix hexadecimal constants
for (@arg) { s/(?<![\w\$.])0x([0-9a-f]+)/0$1h/oi; }

if ($opcode =~ /lea/ && @arg[1] =~ s/*PTR\s+(\(.*\))$/OFFSET $1/) # no []
{ $opcode="mov"; }
elsif ($opcode !~ /mov[dq]$/)
{ # fix xmm references
$arg[0] =~ s/\b[A-Z]+WORD\s+PTR/XMMWORD PTR/i if ($arg[-1] =~ \b xmm[0-7]\b/i);
$arg[-1] =~ s/\b[A-Z]+WORD\s+PTR/XMMWORD PTR/i if ($arg[0] =~ \b xmm[0-7]\b/i);
}

&::emit($opcode,@arg);
1;
}
#
opcodes not covered by ::generic above, mostly inconsistent namings...
#
sub ::call { &::emit("call",(&::islabel($_[0]) or "$nmdecor$_[0]")); }
sub ::call_ptr { &::emit("call",@_); }
sub ::jmp_ptr { &::emit("jmp",@_); }
sub ::lock { &::data_byte(0xf0); }

sub get_mem
{ my($size,$addr,$reg1,$reg2,$idx)=@_;
my($post,$ret);

if (!defined($idx) && 1*$reg2) { $idx=$reg2; $reg2=$reg1; undef $reg1; }

$ret .= "$size PTR " if ($size ne "");

$addr =~ s/^\s+//;
prepend global references with optional underscore
$addr =~ s/^([\^+ \- 0-9] [^\+ \-] *) /&::islabel($1) or "$nmdecor$1"/ige;
put address arithmetic expression in parenthesis
$addr="($addr)" if ($addr =~ /\^+ [\- \+] .+$/);

if (($addr ne "") && ($addr ne 0))
{ if ($addr !~ /\^+ /) { $ret .= "$addr"; }
else { $post=$addr; }
}
$ret .= "[";

if ($reg2 ne "")
{ $idx!=0 or $idx=1;
$ret .= "$reg2*$idx";
$ret .= "+$reg1" if ($reg1 ne "");
}
}

```

```

else
{ $ret .= "$reg1"; }

$ret .= "$post]";
$ret =~ s/\+\/]/; # in case $addr was the only argument
$ret =~ s/[\s*\/];

$ret;
}
sub ::BP { &get_mem("BYTE",@_); }
sub ::WP { &get_mem("WORD",@_); }
sub ::DWP { &get_mem("DWORD",@_); }
sub ::QWP { &get_mem("QWORD",@_); }
sub ::BC { "@_"; }
sub ::DWC { "@_"; }

sub ::file
{ my $tmp=<<<__;
IF \@Version LT 800
ECHO MASM version 8.00 or later is strongly recommended.
ENDIF
.686
.MODEL FLAT
OPTION DOTNAME
IF \@Version LT 800
.text\$\ SEGMENT PAGE 'CODE'
ELSE
.text\$\ SEGMENT ALIGN(64) 'CODE'
ENDIF

push(@out,$tmp);
$segment = ".text\$";
}

sub ::function_begin_B
{ my $func=shift;
my $global=($func !~ /^_/);
my $begin="${:lbdecor}_{$func}_begin";

&::LABEL($func,$global?"$begin":"$nmdecor$func");
$func="ALIGN\t16\n".$nmdecor.$func."\tPROC";

if ($global) { $func.=" PUBLIC\n${begin}::\n"; }
else { $func.=" PRIVATE\n"; }
push(@out,$func);
$::stack=4;
}
sub ::function_end_B

```

```

{ my $func=shift;

 push(@out,"$nmdecor$func ENDP\n");
 $::stack=0;
 &::wipe_labels();
}

sub ::file_end
{ my $xmmheader=<<<___;
.686
.XMM
IF \@Version LT 800
XMMWORD STRUCT 16
DQ 2 dup (?)
XMMWORD ENDS
ENDIF
}

if (grep {/\b[x]?mm[0-7]\b/i} @out) {
grep {s/.[3-7]86/$xmmheader/} @out;
}

push(@out,"$segment ENDS\n");

if (grep {/\b${nmdecor}OPENSSL_ia32cap_P\b/i} @out)
{ my $comm=<<<___;
.bss SEGMENT 'BSS'
COMM ${nmdecor}OPENSSL_ia32cap_P:DWORD:4
.bss ENDS
}

comment out OPENSSL_ia32cap_P declarations
grep {s/^(EXTERN\s+${nmdecor}OPENSSL_ia32cap_P)\^;$/} @out;
push (@out,$comm);
}
push (@out,$initseg) if ($initseg);
push (@out,"END\n");
}

sub ::comment { foreach (@_) { push(@out,"\t; $_\n"); } }

*::set_label_B = sub
{ my $l=shift; push(@out,$l.$l=~/\Q${::lbdecor}\E[0-9]{3}/?":\n":":\n")); };

sub ::external_label
{ foreach(@_)
{ push(@out, "EXTERN\t".&::LABEL($_,$nmdecor.$_):NEAR\n"); }
}

sub ::public_label

```

```

{ push(@out,"PUBLIC\t".&::LABEL($_[0],$nmdecor.$_[0])."\n"); }

sub ::data_byte
{ push(@out,("DB\t").join(',','splice(@_,0,16))."\n") while(@_); }

sub ::data_short
{ push(@out,("DW\t").join(',','splice(@_,0,8))."\n") while(@_); }

sub ::data_word
{ push(@out,("DD\t").join(',','splice(@_,0,4))."\n") while(@_); }

sub ::align
{ push(@out,"ALIGN\t$_[0]\n"); }

sub ::picmeup
{ my($dst,$sym)=@_;
 &::lea($dst,&::DWP($sym));
}

sub ::initseg
{ my $f=$nmdecor.shift;

 $initseg.=<<<__;
.CRT$XCU SEGMENT DWORD PUBLIC 'DATA'
EXTERN $f:NEAR
DD $f
.CRT$XCU ENDS

—
}

sub ::dataseg
{ push(@out,"$segment\tENDS\n_DATA\tSEGMENT\n"); $segment="_DATA"; }

sub ::safeseh
{ my $nm=shift;
 push(@out,"IF \@Version GE 710\n");
 push(@out, ".SAFESEH ".&::LABEL($nm,$nmdecor.$nm)."\n");
 push(@out,"ENDIF\n");
}

1;

```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/perlasm/x86masm.pl
```

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/sha/asm/sha1-ia64.pl

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Found in path(s):

\* /bin/grep

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/\*-----

\* fips/kdf/fips\_kwvs.c - Key Wrap vector tests

\*

\* February 2015

\*

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\*-----

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/fips/kdf/fips\_kwvs.c

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-

7.2a.202104051307/crypto/dsa/dsa\_locl.h

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```

```
$L="edi";
```

```
$R="esi";
```

```
sub DES_encrypt3
```

```
{
```

```
local($name,$enc)=@_;
```

```
&function_begin_B($name,"");
```

```
&push("ebx");
```

```
&mov("ebx",&wparam(0));
```

```
&push("ebp");
```

```
&push("esi");
```

```
&push("edi");
```

```
&comment("");
```

```
&comment("Load the data words");
```

```
&mov($L,&DWP(0,"ebx","",0));
```

```
&mov($R,&DWP(4,"ebx","",0));
```

```
&stack_push(3);
```

```
&comment("");
```

```
&comment("IP");
```

```
&IP_new($L,$R,"edx",0);
```

```
put them back
```

```
if ($enc)
```

```
{
```

```
&mov(&DWP(4,"ebx","",0),$R);
```

```
&mov("eax",&wparam(1));
```

```
&mov(&DWP(0,"ebx","",0),"edx");
```

```
&mov("edi",&wparam(2));
```

```
&mov("esi",&wparam(3));
```

```
}
```



```

else
{
&mov(&DWP(4,"ebx","",0),$R);
&mov("esi",&wparam(1));
&mov(&DWP(0,"ebx","",0),"edx");
&mov("edi",&wparam(2));
&mov("eax",&wparam(3));
}
&mov(&swtmp(2), (DWC(($enc?"1":"0")));
&mov(&swtmp(1), "eax");
&mov(&swtmp(0), "ebx");
&call("DES_encrypt2");
&mov(&swtmp(2), (DWC(($enc?"0":"1")));
&mov(&swtmp(1), "edi");
&mov(&swtmp(0), "ebx");
&call("DES_encrypt2");
&mov(&swtmp(2), (DWC(($enc?"1":"0")));
&mov(&swtmp(1), "esi");
&mov(&swtmp(0), "ebx");
&call("DES_encrypt2");

&stack_pop(3);
&mov($L,&DWP(0,"ebx","",0));
&mov($R,&DWP(4,"ebx","",0));

&comment("");
&comment("FP");
&FP_new($L,$R,"eax",0);

&mov(&DWP(0,"ebx","",0),"eax");
&mov(&DWP(4,"ebx","",0),$R);

&pop("edi");
&pop("esi");
&pop("ebp");
&pop("ebx");
&ret();
&function_end_B($name);
}

```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/des/asm/desboth.pl
```

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```

/* -----
* crypto/sha/asm/sha1-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.

```

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\* January 2013  
\*  
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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/ec/ecp\_nistp256.c  
\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/ec/ecp\_nistp521.c  
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* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/armcap.c
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/mips_arch.h
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```

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*/
```

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```
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* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/ec/ec_curve.c
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/ec/ec.h
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*/
```

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```
/*-----
* fips/kdf/fips_kdf_802_11i.c - 802_11i KDF vector tests
*
* March 2015
*
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*-----
*/
```

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/fips/kdf/fips\_kdf\_802\_11i.c

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/ec/ecdh\_oss.c

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```
/*
* WARNING: do not edit!
* Generated by crypto/objects/objects.pl
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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/include/openssl/obj\_mac.h

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\* fips/kdf/fips\_kdf\_tls.c - TLS KDF vector tests

\*

\* March 2015

\*

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\*/

Found in path(s):

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/fips/kdf/fips\_kdf\_tls.c

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/test/fips\_kdf\_tls.c

No license file was found, but licenses were detected in source scan.

# project. The module is, however, dual licensed under OpenSSL and

Found in path(s):

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/aes/asm/aes-x86\_64.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/modes/asm/ghash-s390x.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/modes/asm/ghash-sparcv9.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/aes/asm/aesni-x86.pl

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-

```

7.2a.202104051307/crypto/aes/asm/aes-ppc.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/modes/asm/ghash-alpha.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/asm/aes-s390x.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/asm/aes-586.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/modes/asm/ghash-parisc.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/asm/aes-mips.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/modes/asm/ghash-ia64.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/modes/asm/ghashv8-armx.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/asm/aes-parisc.pl
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```

```

#!/usr/bin/env perl
Copyright 2017-2018 The OpenSSL Project Authors. All Rights Reserved.
#
Licensed under the OpenSSL license (the "License"). You may not use
this file except in compliance with the License. You can obtain a copy
in the file LICENSE in the source distribution or at
https://www.openssl.org/source/license.html
#
=====
Written by Andy Polyakov <appro@openssl.org> for the OpenSSL
project. The module is, however, dual licensed under OpenSSL and
CRYPTOGAMS licenses depending on where you obtain it. For further
details see http://www.openssl.org/~appro/cryptogams/.
=====
#
[ABI- and endian-neutral] Keccak-1600 for C64x.
#
June 2017.
#
This is straightforward KECCAK_1X_ALT variant (see sha/keccak1600.c)
with bit interleaving. 64-bit values are simply split between A- and
B-files, with A-file holding least significant halves. This works
out perfectly, because all operations including cross-communications
[in rotate operations] are always complementary. Performance is
[incredible for a 32-bit processor] 10.9 cycles per processed byte
for r=1088, which corresponds to SHA3-256. This is >15x faster than
compiler-generated KECCAK_1X_ALT code, and >10x than other variants.
On average processor ends up issuing ~4.5 instructions per cycle...

```

```

my @A = map([$_, ($_+1), ($_+2), ($_+3), ($_+4)], (5,10,16,21,26));
 $A[1][4] = 31; # B14 is reserved, A14 is used as iota[]
 ($A[3][0],$A[4][1]) = ($A[4][1],$A[3][0]);
my @C = (0..4,$A[3][0],$A[4][0]);
my $iotas = "A14";

```

```

my @rhotates = ([0, 1, 62, 28, 27],
 [36, 44, 6, 55, 20],
 [3, 10, 43, 25, 39],
 [41, 45, 15, 21, 8],
 [18, 2, 61, 56, 14]);

```

```

sub ROL64 {
 my ($src,$rot,$dst,$p) = @_ ;

```

```

 if ($rot&1) {
$code.=<<____;
$P ROTL B$src,$rot/2+1,A$dst
|| ROTL A$src,$rot/2, B$dst

 } else {
$code.=<<____;
$P ROTL A$src,$rot/2,A$dst
|| ROTL B$src,$rot/2,B$dst

 }
}

```

```
#####
```

```

Stack frame layout
#
SP-->+-----+-----+
| | |
+1-->+-----+-----+<- -9 below 4 slots are used by KeccakF1600_int
| | |
+2-->+-----+-----+<- -8
| | |
+3-->+-----+-----+<- -7
|A2 |A3 | A3:A2 are preserved by KeccakF1600_int
+4-->+-----+-----+<- -6
|B2 |B3 | B3:B2 are preserved by KeccakF1600_int
+5-->+-----+-----+<- -5 below is ABI-compliant layout
|A10|A11|
+6-->+-----+-----+<- -4
|A12|A13|
+7-->+-----+-----+<- -3
|A14|B3 |
+8-->+-----+-----+<- -2

```



```

| B10 | B11 |
+9--->+-----+-----+<- -1
| B12 | B13 |
+-----+-----+<---FP
| A15 |
+-----+--

$code.=<<___.;
.text

.if .ASSEMBLER_VERSION<7000000
.asg 0,__TI_EABI__
.endif
.if __TI_EABI__
.nocmp
.asg KeccakF1600,_KeccakF1600
.asg SHA3_absorb,_SHA3_absorb
.asg SHA3_squeeze,_SHA3_squeeze
.endif

.asg B3,RA
.asg A15,FP
.asg B15,SP

.align 32
_KeccakF1600_int:
.asmfunc
STDW A3:A2,*FP[-7]
|| STDW B3:B2,*SP[4]
_KeccakF1600_cheat:
.if __TI_EABI__
ADDKPC _KeccakF1600_int,B0
|| MVKL \$_PCR_OFFSET(iotas,_KeccakF1600_int),$iotas
MVKH \$_PCR_OFFSET(iotas,_KeccakF1600_int),$iotas
.else
ADDKPC _KeccakF1600_int,B0
|| MVKL (iotas-_KeccakF1600_int),$iotas
MVKH (iotas-_KeccakF1600_int),$iotas
.endif
ADD B0,$iotas,$iotas
loop?:
XOR A$A[0][2],A$A[1][2],A$C[2] ; Theta
|| XOR B$A[0][2],B$A[1][2],B$C[2]
|| XOR A$A[0][3],A$A[1][3],A$C[3]
|| XOR B$A[0][3],B$A[1][3],B$C[3]
|| XOR A$A[0][0],A$A[1][0],A$C[0]
|| XOR B$A[0][0],B$A[1][0],B$C[0]
XOR A$A[2][2],A$C[2],A$C[2]

```

```

|| XOR B$A[2][2],B$C[2],B$C[2]
|| XOR A$A[2][3],A$C[3],A$C[3]
|| XOR B$A[2][3],B$C[3],B$C[3]
|| XOR A$A[2][0],A$C[0],A$C[0]
|| XOR B$A[2][0],B$C[0],B$C[0]
XOR A$A[3][2],A$C[2],A$C[2]
|| XOR B$A[3][2],B$C[2],B$C[2]
|| XOR A$A[3][3],A$C[3],A$C[3]
|| XOR B$A[3][3],B$C[3],B$C[3]
|| XOR A$A[3][0],A$C[0],A$C[0]
|| XOR B$A[3][0],B$C[0],B$C[0]
XOR A$A[4][2],A$C[2],A$C[2]
|| XOR B$A[4][2],B$C[2],B$C[2]
|| XOR A$A[4][3],A$C[3],A$C[3]
|| XOR B$A[4][3],B$C[3],B$C[3]
|| XOR A$A[4][0],A$C[0],A$C[0]
|| XOR B$A[4][0],B$C[0],B$C[0]
XOR A$A[0][4],A$A[1][4],A$C[4]
|| XOR B$A[0][4],B$A[1][4],B$C[4]
|| XOR A$A[0][1],A$A[1][1],A$C[1]
|| XOR B$A[0][1],B$A[1][1],B$C[1]
|| STDW A$A[3][0]:A$A[4][0],*SP[1] ; offload some data
STDW B$A[3][0]:B$A[4][0],*SP[2]
|| XOR A$A[2][4],A$C[4],A$C[4]
|| XOR B$A[2][4],B$C[4],B$C[4]
|| XOR A$A[2][1],A$C[1],A$C[1]
|| XOR B$A[2][1],B$C[1],B$C[1]
|| ROTL B$C[2],1,A$C[5] ; ROL64(C[2],1)
|| ROTL A$C[2],0,B$C[5]
XOR A$A[3][4],A$C[4],A$C[4]
|| XOR B$A[3][4],B$C[4],B$C[4]
|| XOR A$A[3][1],A$C[1],A$C[1]
|| XOR B$A[3][1],B$C[1],B$C[1]
|| ROTL B$C[3],1,A$C[6] ; ROL64(C[3],1)
|| ROTL A$C[3],0,B$C[6]
XOR A$A[4][4],A$C[4],A$C[4]
|| XOR B$A[4][4],B$C[4],B$C[4]
|| XOR A$A[4][1],A$C[1],A$C[1]
|| XOR B$A[4][1],B$C[1],B$C[1]
|| XOR A$C[0],A$C[5],A$C[5] ; C[0] ^ ROL64(C[2],1)
|| XOR B$C[0],B$C[5],B$C[5]
XOR A$C[5],A$A[0][1],A$A[0][1]
|| XOR B$C[5],B$A[0][1],B$A[0][1]
|| XOR A$C[5],A$A[1][1],A$A[1][1]
|| XOR B$C[5],B$A[1][1],B$A[1][1]
|| XOR A$C[5],A$A[2][1],A$A[2][1]
|| XOR B$C[5],B$A[2][1],B$A[2][1]
XOR A$C[5],A$A[3][1],A$A[3][1]

```

```

|| XOR B$C[5],B$A[3][1],B$A[3][1]
|| XOR A$C[5],A$A[4][1],A$A[4][1]
|| XOR B$C[5],B$A[4][1],B$A[4][1]
|| ROTL B$C[4],1,A$C[5] ; ROL64(C[4],1)
|| ROTL A$C[4],0,B$C[5]
|| XOR A$C[1],A$C[6],A$C[6] ; C[1] ^ ROL64(C[3],1)
|| XOR B$C[1],B$C[6],B$C[6]
XOR A$C[6],A$A[0][2],A$A[0][2]
|| XOR B$C[6],B$A[0][2],B$A[0][2]
|| XOR A$C[6],A$A[1][2],A$A[1][2]
|| XOR B$C[6],B$A[1][2],B$A[1][2]
|| XOR A$C[6],A$A[2][2],A$A[2][2]
|| XOR B$C[6],B$A[2][2],B$A[2][2]
|| ROTL B$C[1],1,A$C[1] ; ROL64(C[1],1)
|| ROTL A$C[1],0,B$C[1]
XOR A$C[6],A$A[3][2],A$A[3][2]
|| XOR B$C[6],B$A[3][2],B$A[3][2]
|| XOR A$C[6],A$A[4][2],A$A[4][2]
|| XOR B$C[6],B$A[4][2],B$A[4][2]
|| ROTL B$C[0],1,A$C[6] ; ROL64(C[0],1)
|| ROTL A$C[0],0,B$C[6]
|| XOR A$C[5],A$C[2],A$C[2] ; C[2] ^= ROL64(C[4],1)
|| XOR B$C[5],B$C[2],B$C[2]
XOR A$C[2],A$A[0][3],A$A[0][3]
|| XOR B$C[2],B$A[0][3],B$A[0][3]
|| XOR A$C[2],A$A[1][3],A$A[1][3]
|| XOR B$C[2],B$A[1][3],B$A[1][3]
|| XOR A$C[2],A$A[2][3],A$A[2][3]
|| XOR B$C[2],B$A[2][3],B$A[2][3]
XOR A$C[6],A$C[3],A$C[3] ; C[3] ^= ROL64(C[0],1)
|| XOR B$C[6],B$C[3],B$C[3]
|| LDDW *FP[-9],A$A[3][0]:A$A[4][0] ; restore offloaded data
|| LDDW *SP[2],B$A[3][0]:B$A[4][0]
|| XOR A$C[2],A$A[3][3],A$A[3][3]
|| XOR B$C[2],B$A[3][3],B$A[3][3]
XOR A$C[2],A$A[4][3],A$A[4][3]
|| XOR B$C[2],B$A[4][3],B$A[4][3]
|| XOR A$C[3],A$A[0][4],A$A[0][4]
|| XOR B$C[3],B$A[0][4],B$A[0][4]
|| XOR A$C[3],A$A[1][4],A$A[1][4]
|| XOR B$C[3],B$A[1][4],B$A[1][4]
XOR A$C[3],A$A[2][4],A$A[2][4]
|| XOR B$C[3],B$A[2][4],B$A[2][4]
|| XOR A$C[3],A$A[3][4],A$A[3][4]
|| XOR B$C[3],B$A[3][4],B$A[3][4]
|| XOR A$C[3],A$A[4][4],A$A[4][4]
|| XOR B$C[3],B$A[4][4],B$A[4][4]
XOR A$C[1],A$C[4],A$C[4] ; C[4] ^= ROL64(C[1],1)

```

```

|| XOR B$C[1],B$C[4],B$C[4]
|| MV A$A[0][1],A$C[1] ; Rho+Pi, "early start"
|| MV B$A[0][1],B$C[1]

——

&ROL64 ($A[1][1],$rhotates[1][1],$A[0][1],"");
$code.=<<<___;
XOR A$C[4],A$A[0][0],A$A[0][0]
|| XOR B$C[4],B$A[0][0],B$A[0][0]
|| XOR A$C[4],A$A[1][0],A$A[1][0]
|| XOR B$C[4],B$A[1][0],B$A[1][0]
|| MV A$A[0][3],A$C[3]
|| MV B$A[0][3],B$C[3]

——

&ROL64 ($A[3][3],$rhotates[3][3],$A[0][3],"");
$code.=<<<___;
XOR A$C[4],A$A[2][0],A$A[2][0]
|| XOR B$C[4],B$A[2][0],B$A[2][0]
|| XOR A$C[4],A$A[3][0],A$A[3][0]
|| XOR B$C[4],B$A[3][0],B$A[3][0]
|| MV A$A[0][2],A$C[2]
|| MV B$A[0][2],B$C[2]

——

&ROL64 ($A[2][2],$rhotates[2][2],$A[0][2],"");
$code.=<<<___;
XOR A$C[4],A$A[4][0],A$A[4][0]
|| XOR B$C[4],B$A[4][0],B$A[4][0]
|| MV A$A[0][4],A$C[4]
|| MV B$A[0][4],B$C[4]

——

&ROL64 ($A[4][4],$rhotates[4][4],$A[0][4],"");

&ROL64 ($A[1][4],$rhotates[1][4],$A[1][1]);
$code.=<<<___;
|| LDW *${iotas}++[2],A$C[0]

——

&ROL64 ($A[2][3],$rhotates[2][3],$A[2][2]);
$code.=<<<___;
|| LDW *${iotas}[-1],B$C[0]

——

&ROL64 ($A[3][2],$rhotates[3][2],$A[3][3]);
&ROL64 ($A[4][1],$rhotates[4][1],$A[4][4]);

&ROL64 ($A[4][2],$rhotates[4][2],$A[1][4]);
&ROL64 ($A[3][4],$rhotates[3][4],$A[2][3]);
&ROL64 ($A[2][1],$rhotates[2][1],$A[3][2]);
&ROL64 ($A[1][3],$rhotates[1][3],$A[4][1]);

&ROL64 ($A[2][4],$rhotates[2][4],$A[4][2]);

```

&ROL64 (\$A[4][3], \$rhotates[4][3], \$A[3][4]);

&ROL64 (\$A[1][2], \$rhotates[1][2], \$A[2][1]);

&ROL64 (\$A[3][1], \$rhotates[3][1], \$A[1][3]);

&ROL64 (\$A[4][0], \$rhotates[4][0], \$A[2][4]);

&ROL64 (\$A[3][0], \$rhotates[3][0], \$A[4][3]);

&ROL64 (\$A[2][0], \$rhotates[2][0], \$A[1][2]);

&ROL64 (\$A[1][0], \$rhotates[1][0], \$A[3][1]);

#&ROL64 (\$C[3], \$rhotates[0][3], \$A[1][0]); # moved below

&ROL64 (\$C[1], \$rhotates[0][1], \$A[2][0]);

&ROL64 (\$C[4], \$rhotates[0][4], \$A[3][0]);

&ROL64 (\$C[2], \$rhotates[0][2], \$A[4][0]);

\$code.=<<\_\_\_;

|| ANDN \$A[0][2], \$A[0][1], \$C[4] ; Chi+Iota

|| ANDN \$B[0][2], \$B[0][1], \$C[4]

|| ANDN \$A[0][3], \$A[0][2], \$C[1]

|| ANDN \$B[0][3], \$B[0][2], \$C[1]

|| ANDN \$A[0][4], \$A[0][3], \$C[2]

|| ANDN \$B[0][4], \$B[0][3], \$C[2]

---

&ROL64 (\$C[3], \$rhotates[0][3], \$A[1][0]);

\$code.=<<\_\_\_;

|| ANDN \$A[0][0], \$A[0][4], \$C[3]

|| ANDN \$B[0][0], \$B[0][4], \$C[3]

|| XOR \$C[4], \$A[0][0], \$A[0][0]

|| XOR \$C[4], \$B[0][0], \$B[0][0]

|| ANDN \$A[0][1], \$A[0][0], \$C[4]

|| ANDN \$B[0][1], \$B[0][0], \$C[4]

XOR \$C[1], \$A[0][1], \$A[0][1]

|| XOR \$C[1], \$B[0][1], \$B[0][1]

|| XOR \$C[2], \$A[0][2], \$A[0][2]

|| XOR \$C[2], \$B[0][2], \$B[0][2]

|| XOR \$C[3], \$A[0][3], \$A[0][3]

|| XOR \$C[3], \$B[0][3], \$B[0][3]

XOR \$C[4], \$A[0][4], \$A[0][4]

|| XOR \$C[4], \$B[0][4], \$B[0][4]

|| XOR \$C[0], \$A[0][0], \$A[0][0] ; A[0][0] ^= iotas[i++];

|| XOR \$C[0], \$B[0][0], \$B[0][0]

|| EXTU \$iotas, 24, 24, A0 ; A0 is \$C[0], as we done?

ANDN \$A[1][2], \$A[1][1], \$C[4]

|| ANDN \$B[1][2], \$B[1][1], \$C[4]

|| ANDN \$A[1][3], \$A[1][2], \$C[1]

|| ANDN \$B[1][3], \$B[1][2], \$C[1]

|| ANDN \$A[1][4], \$A[1][3], \$C[2]

|| ANDN \$B[1][4], \$B[1][3], \$C[2]

ANDN \$A[1][0], \$A[1][4], \$C[3]

|| ANDN B\$A[1][0],B\$A[1][4],B\$C[3]  
|| XOR A\$C[4],A\$A[1][0],A\$A[1][0]  
|| XOR B\$C[4],B\$A[1][0],B\$A[1][0]  
|| ANDN A\$A[1][1],A\$A[1][0],A\$C[4]  
|| ANDN B\$A[1][1],B\$A[1][0],B\$C[4]  
XOR A\$C[1],A\$A[1][1],A\$A[1][1]  
|| XOR B\$C[1],B\$A[1][1],B\$A[1][1]  
|| XOR A\$C[2],A\$A[1][2],A\$A[1][2]  
|| XOR B\$C[2],B\$A[1][2],B\$A[1][2]  
|| XOR A\$C[3],A\$A[1][3],A\$A[1][3]  
|| XOR B\$C[3],B\$A[1][3],B\$A[1][3]  
XOR A\$C[4],A\$A[1][4],A\$A[1][4]  
|| XOR B\$C[4],B\$A[1][4],B\$A[1][4]

|| ANDN A\$A[2][2],A\$A[2][1],A\$C[4]  
|| ANDN B\$A[2][2],B\$A[2][1],B\$C[4]  
|| ANDN A\$A[2][3],A\$A[2][2],A\$C[1]  
|| ANDN B\$A[2][3],B\$A[2][2],B\$C[1]  
ANDN A\$A[2][4],A\$A[2][3],A\$C[2]  
|| ANDN B\$A[2][4],B\$A[2][3],B\$C[2]  
|| ANDN A\$A[2][0],A\$A[2][4],A\$C[3]  
|| ANDN B\$A[2][0],B\$A[2][4],B\$C[3]  
|| XOR A\$C[4],A\$A[2][0],A\$A[2][0]  
|| XOR B\$C[4],B\$A[2][0],B\$A[2][0]  
ANDN A\$A[2][1],A\$A[2][0],A\$C[4]  
|| ANDN B\$A[2][1],B\$A[2][0],B\$C[4]  
|| XOR A\$C[1],A\$A[2][1],A\$A[2][1]  
|| XOR B\$C[1],B\$A[2][1],B\$A[2][1]  
|| XOR A\$C[2],A\$A[2][2],A\$A[2][2]  
|| XOR B\$C[2],B\$A[2][2],B\$A[2][2]  
XOR A\$C[3],A\$A[2][3],A\$A[2][3]  
|| XOR B\$C[3],B\$A[2][3],B\$A[2][3]  
|| XOR A\$C[4],A\$A[2][4],A\$A[2][4]  
|| XOR B\$C[4],B\$A[2][4],B\$A[2][4]

ANDN A\$A[3][2],A\$A[3][1],A\$C[4]  
|| ANDN B\$A[3][2],B\$A[3][1],B\$C[4]  
|| ANDN A\$A[3][3],A\$A[3][2],A\$C[1]  
|| ANDN B\$A[3][3],B\$A[3][2],B\$C[1]  
|| ANDN A\$A[3][4],A\$A[3][3],A\$C[2]  
|| ANDN B\$A[3][4],B\$A[3][3],B\$C[2]  
ANDN A\$A[3][0],A\$A[3][4],A\$C[3]  
|| ANDN B\$A[3][0],B\$A[3][4],B\$C[3]  
|| XOR A\$C[4],A\$A[3][0],A\$A[3][0]  
|| XOR B\$C[4],B\$A[3][0],B\$A[3][0]  
|| ANDN A\$A[3][1],A\$A[3][0],A\$C[4]  
|| ANDN B\$A[3][1],B\$A[3][0],B\$C[4]  
XOR A\$C[1],A\$A[3][1],A\$A[3][1]

```

|| XOR B$C[1],B$A[3][1],B$A[3][1]
|| XOR A$C[2],A$A[3][2],A$A[3][2]
|| XOR B$C[2],B$A[3][2],B$A[3][2]
|| XOR A$C[3],A$A[3][3],A$A[3][3]
||[A0] BNOP loop?
XOR B$C[3],B$A[3][3],B$A[3][3]
|| XOR A$C[4],A$A[3][4],A$A[3][4]
|| XOR B$C[4],B$A[3][4],B$A[3][4]
||[!A0] LDDW *FP[-7],A3:A2
||[!A0] LDDW *SP[4], RA:B2

```

```

ANDN A$A[4][2],A$A[4][1],A$C[4]
|| ANDN B$A[4][2],B$A[4][1],B$C[4]
|| ANDN A$A[4][3],A$A[4][2],A$C[1]
|| ANDN B$A[4][3],B$A[4][2],B$C[1]
|| ANDN A$A[4][4],A$A[4][3],A$C[2]
|| ANDN B$A[4][4],B$A[4][3],B$C[2]
ANDN A$A[4][0],A$A[4][4],A$C[3]
|| ANDN B$A[4][0],B$A[4][4],B$C[3]
|| XOR A$C[4],A$A[4][0],A$A[4][0]
|| XOR B$C[4],B$A[4][0],B$A[4][0]
|| ANDN A$A[4][1],A$A[4][0],A$C[4]
|| ANDN B$A[4][1],B$A[4][0],B$C[4]
XOR A$C[1],A$A[4][1],A$A[4][1]
|| XOR B$C[1],B$A[4][1],B$A[4][1]
|| XOR A$C[2],A$A[4][2],A$A[4][2]
|| XOR B$C[2],B$A[4][2],B$A[4][2]
|| XOR A$C[3],A$A[4][3],A$A[4][3]
|| XOR B$C[3],B$A[4][3],B$A[4][3]
XOR A$C[4],A$A[4][4],A$A[4][4]
|| XOR B$C[4],B$A[4][4],B$A[4][4]
;;===== branch to loop? is taken here

```

```

BNOP RA,5
.endasmfunc

```

```

.newblock
.global _KeccakF1600
.align 32
_KeccakF1600:
.asmfunc stack_usage(80)
STW FP,*SP--(80) ; save frame pointer
|| MV SP,FP
STDW B13:B12,*SP[9]
|| STDW A13:A12,*FP[-4]
STDW B11:B10,*SP[8]
|| STDW A11:A10,*FP[-5]
STW RA, *SP[15]

```

|| STW A14,\*FP[-6]

|| MV A4,A2

|| ADD 4,A4,B2

LDW \*A2++[2],A\$A[0][0] ; load A[5][5]

|| LDW \*B2++[2],B\$A[0][0]

LDW \*A2++[2],A\$A[0][1]

|| LDW \*B2++[2],B\$A[0][1]

LDW \*A2++[2],A\$A[0][2]

|| LDW \*B2++[2],B\$A[0][2]

LDW \*A2++[2],A\$A[0][3]

|| LDW \*B2++[2],B\$A[0][3]

LDW \*A2++[2],A\$A[0][4]

|| LDW \*B2++[2],B\$A[0][4]

LDW \*A2++[2],A\$A[1][0]

|| LDW \*B2++[2],B\$A[1][0]

LDW \*A2++[2],A\$A[1][1]

|| LDW \*B2++[2],B\$A[1][1]

LDW \*A2++[2],A\$A[1][2]

|| LDW \*B2++[2],B\$A[1][2]

LDW \*A2++[2],A\$A[1][3]

|| LDW \*B2++[2],B\$A[1][3]

LDW \*A2++[2],A\$A[1][4]

|| LDW \*B2++[2],B\$A[1][4]

LDW \*A2++[2],A\$A[2][0]

|| LDW \*B2++[2],B\$A[2][0]

LDW \*A2++[2],A\$A[2][1]

|| LDW \*B2++[2],B\$A[2][1]

LDW \*A2++[2],A\$A[2][2]

|| LDW \*B2++[2],B\$A[2][2]

LDW \*A2++[2],A\$A[2][3]

|| LDW \*B2++[2],B\$A[2][3]

LDW \*A2++[2],A\$A[2][4]

|| LDW \*B2++[2],B\$A[2][4]

LDW \*A2++[2],A\$A[3][0]

|| LDW \*B2++[2],B\$A[3][0]

LDW \*A2++[2],A\$A[3][1]

|| LDW \*B2++[2],B\$A[3][1]

LDW \*A2++[2],A\$A[3][2]

|| LDW \*B2++[2],B\$A[3][2]

LDW \*A2++[2],A\$A[3][3]

|| LDW \*B2++[2],B\$A[3][3]

LDW \*A2++[2],A\$A[3][4]

|| LDW \*B2++[2],B\$A[3][4]

|| BNOP \_KeccakF1600\_int



```

ADDKPC ret?,RA
|| LDW *A2++[2],A$A[4][0]
|| LDW *B2++[2],B$A[4][0]
LDW *A2++[2],A$A[4][1]
|| LDW *B2++[2],B$A[4][1]
LDW *A2++[2],A$A[4][2]
|| LDW *B2++[2],B$A[4][2]
LDW *A2++[2],A$A[4][3]
|| LDW *B2++[2],B$A[4][3]
LDW *A2,A$A[4][4]
|| LDW *B2,B$A[4][4]
|| ADDK -192,A2 ; rewind
|| ADDK -192,B2

```

```

.align 16

```

```

ret?:

```

```

STW A$A[0][0],*A2++[2] ; store A[5][5]
|| STW B$A[0][0],*B2++[2]
STW A$A[0][1],*A2++[2]
|| STW B$A[0][1],*B2++[2]
STW A$A[0][2],*A2++[2]
|| STW B$A[0][2],*B2++[2]
STW A$A[0][3],*A2++[2]
|| STW B$A[0][3],*B2++[2]
STW A$A[0][4],*A2++[2]
|| STW B$A[0][4],*B2++[2]

```

```

STW A$A[1][0],*A2++[2]
|| STW B$A[1][0],*B2++[2]
STW A$A[1][1],*A2++[2]
|| STW B$A[1][1],*B2++[2]
STW A$A[1][2],*A2++[2]
|| STW B$A[1][2],*B2++[2]
STW A$A[1][3],*A2++[2]
|| STW B$A[1][3],*B2++[2]
STW A$A[1][4],*A2++[2]
|| STW B$A[1][4],*B2++[2]

```

```

STW A$A[2][0],*A2++[2]
|| STW B$A[2][0],*B2++[2]
STW A$A[2][1],*A2++[2]
|| STW B$A[2][1],*B2++[2]
STW A$A[2][2],*A2++[2]
|| STW B$A[2][2],*B2++[2]
STW A$A[2][3],*A2++[2]
|| STW B$A[2][3],*B2++[2]
STW A$A[2][4],*A2++[2]

```

```
|| STW B$A[2][4],*B2++[2]
```

```
STW A$A[3][0],*A2++[2]
|| STW B$A[3][0],*B2++[2]
STW A$A[3][1],*A2++[2]
|| STW B$A[3][1],*B2++[2]
STW A$A[3][2],*A2++[2]
|| STW B$A[3][2],*B2++[2]
STW A$A[3][3],*A2++[2]
|| STW B$A[3][3],*B2++[2]
STW A$A[3][4],*A2++[2]
|| STW B$A[3][4],*B2++[2]
```

```
LDW *SP[15],RA
|| LDW *FP[-6],A14
```

```
STW A$A[4][0],*A2++[2]
|| STW B$A[4][0],*B2++[2]
STW A$A[4][1],*A2++[2]
|| STW B$A[4][1],*B2++[2]
STW A$A[4][2],*A2++[2]
|| STW B$A[4][2],*B2++[2]
STW A$A[4][3],*A2++[2]
|| STW B$A[4][3],*B2++[2]
STW A$A[4][4],*A2
|| STW B$A[4][4],*B2
|| ADDK -192,A2 ; rewind
```

```
MV A2,A4 ; return original A4
|| LDDW *SP[8], B11:B10
|| LDDW *FP[-5],A11:A10
LDDW *SP[9], B13:B12
|| LDDW *FP[-4],A13:A12
|| BNOP RA
LDW *++SP(80),FP ; restore frame pointer
NOP 4 ; wait till FP is committed
.endasmfunc
```

```
.newblock
.asg B2,BSZ
.asg A2,INP
.asg A3,LEN
.global _SHA3_absorb
.align 32
_SHA3_absorb:
.asmfunc stack_usage(80)
STW FP,*SP--(80) ; save frame pointer
|| MV SP,FP
```

```
STDW B13:B12,*SP[9]
|| STDW A13:A12,*FP[-4]
STDW B11:B10,*SP[8]
|| STDW A11:A10,*FP[-5]
STW RA, *SP[15]
|| STW A14,*FP[-6]
```

```
STW A4,*SP[1] ; save A[][]
|| MV B4,INP ; reassign arguments
|| MV A6,LEN
|| MV B6,BSZ
|| ADD 4,A4,B4
```

```
LDW *A4++[2],A$A[0][0] ; load A[5][5]
|| LDW *B4++[2],B$A[0][0]
LDW *A4++[2],A$A[0][1]
|| LDW *B4++[2],B$A[0][1]
LDW *A4++[2],A$A[0][2]
|| LDW *B4++[2],B$A[0][2]
LDW *A4++[2],A$A[0][3]
|| LDW *B4++[2],B$A[0][3]
LDW *A4++[2],A$A[0][4]
|| LDW *B4++[2],B$A[0][4]
```

```
LDW *A4++[2],A$A[1][0]
|| LDW *B4++[2],B$A[1][0]
LDW *A4++[2],A$A[1][1]
|| LDW *B4++[2],B$A[1][1]
LDW *A4++[2],A$A[1][2]
|| LDW *B4++[2],B$A[1][2]
LDW *A4++[2],A$A[1][3]
|| LDW *B4++[2],B$A[1][3]
LDW *A4++[2],A$A[1][4]
|| LDW *B4++[2],B$A[1][4]
```

```
LDW *A4++[2],A$A[2][0]
|| LDW *B4++[2],B$A[2][0]
LDW *A4++[2],A$A[2][1]
|| LDW *B4++[2],B$A[2][1]
LDW *A4++[2],A$A[2][2]
|| LDW *B4++[2],B$A[2][2]
LDW *A4++[2],A$A[2][3]
|| LDW *B4++[2],B$A[2][3]
LDW *A4++[2],A$A[2][4]
|| LDW *B4++[2],B$A[2][4]
```

```
LDW *A4++[2],A$A[3][0]
|| LDW *B4++[2],B$A[3][0]
```

```

LDW *A4++[2],A$A[3][1]
|| LDW *B4++[2],B$A[3][1]
LDW *A4++[2],A$A[3][2]
|| LDW *B4++[2],B$A[3][2]
LDW *A4++[2],A$A[3][3]
|| LDW *B4++[2],B$A[3][3]
LDW *A4++[2],A$A[3][4]
|| LDW *B4++[2],B$A[3][4]

```

```

LDW *A4++[2],A$A[4][0]
|| LDW *B4++[2],B$A[4][0]
LDW *A4++[2],A$A[4][1]
|| LDW *B4++[2],B$A[4][1]
LDW *A4++[2],A$A[4][2]
|| LDW *B4++[2],B$A[4][2]
LDW *A4++[2],A$A[4][3]
|| LDW *B4++[2],B$A[4][3]
LDW *A4,A$A[4][4]
|| LDW *B4,B$A[4][4]
|| ADDKPC loop?,RA
STDW RA:BSZ,*SP[4]

```

loop?:

```

CMPLTU LEN,BSZ,A0 ; len < bsz?
|| SHRU BSZ,3,BSZ
[A0] BNOP ret?
|[A0] ZERO BSZ
|[A0] LDW *SP[1],A2 ; pull A[][]
[BSZ] LDNDW *INP++,A1:A0
|[BSZ] SUB LEN,8,LEN
|[BSZ] SUB BSZ,1,BSZ
NOP 4

```

```

for ($y = 0; $y < 5; $y++) {
 for ($x = 0; $x < ($y<4 ? 5 : 4); $x++) {
$code.=<<____;
.if .BIG_ENDIAN
SWAP2 A0,A1
|| SWAP2 A1,A0
SWAP4 A0,A0
SWAP4 A1,A1
|[!BSZ]BNOP _KeccakF1600_cheat
|[!BSZ]STDW LEN:INP,*SP[3]
|| DEAL A0,A0
.else
[!BSZ]BNOP _KeccakF1600_cheat
|[!BSZ]STDW LEN:INP,*SP[3]
|| DEAL A0,A0

```

```

.endif
[BSZ] LDNDW *INP++,A1:A0
|| DEAL A1,A1
[BSZ] SUB LEN,8,LEN
|[BSZ] SUB BSZ,1,BSZ
PACK2 A1,A0,A0
|| PACKH2 A1,A0,A1
XOR A0,A$A[$y][$x],A$A[$y][$x]
XOR A1,B$A[$y][$x],B$A[$y][$x]

}
}
$code.=<<____;
.if .BIG_ENDIAN
SWAP2 A0,A1
|| SWAP2 A1,A0
SWAP4 A0,A0
SWAP4 A1,A1
.endif
BNOP _KeccakF1600_cheat
|| STDW LEN:INP,*SP[3]
|| DEAL A0,A0
DEAL A1,A1
NOP
PACK2 A1,A0,A0
|| PACKH2 A1,A0,A1
XOR A0,A$A[4][4],A$A[4][4]
XOR A1,B$A[4][4],B$A[4][4]

.align 16
ret?:
MV LEN,A4 ; return value
|| ADD 4,A2,B2

STW A$A[0][0],*A2++[2] ; store A[5][5]
|| STW B$A[0][0],*B2++[2]
STW A$A[0][1],*A2++[2]
|| STW B$A[0][1],*B2++[2]
STW A$A[0][2],*A2++[2]
|| STW B$A[0][2],*B2++[2]
STW A$A[0][3],*A2++[2]
|| STW B$A[0][3],*B2++[2]
STW A$A[0][4],*A2++[2]
|| STW B$A[0][4],*B2++[2]

STW A$A[1][0],*A2++[2]
|| STW B$A[1][0],*B2++[2]
STW A$A[1][1],*A2++[2]

```

```
|| STW B$A[1][1],*B2++[2]
STW A$A[1][2],*A2++[2]
|| STW B$A[1][2],*B2++[2]
STW A$A[1][3],*A2++[2]
|| STW B$A[1][3],*B2++[2]
STW A$A[1][4],*A2++[2]
|| STW B$A[1][4],*B2++[2]
```

```
STW A$A[2][0],*A2++[2]
|| STW B$A[2][0],*B2++[2]
STW A$A[2][1],*A2++[2]
|| STW B$A[2][1],*B2++[2]
STW A$A[2][2],*A2++[2]
|| STW B$A[2][2],*B2++[2]
STW A$A[2][3],*A2++[2]
|| STW B$A[2][3],*B2++[2]
STW A$A[2][4],*A2++[2]
|| STW B$A[2][4],*B2++[2]
```

```
LDW *SP[15],RA
|| LDW *FP[-6],A14
```

```
STW A$A[3][0],*A2++[2]
|| STW B$A[3][0],*B2++[2]
STW A$A[3][1],*A2++[2]
|| STW B$A[3][1],*B2++[2]
STW A$A[3][2],*A2++[2]
|| STW B$A[3][2],*B2++[2]
STW A$A[3][3],*A2++[2]
|| STW B$A[3][3],*B2++[2]
STW A$A[3][4],*A2++[2]
|| STW B$A[3][4],*B2++[2]
```

```
LDDW *SP[8], B11:B10
|| LDDW *FP[-5],A11:A10
LDDW *SP[9], B13:B12
|| LDDW *FP[-4],A13:A12
BNOP RA
|| LDW *++SP(80),FP ; restore frame pointer
```

```
STW A$A[4][0],*A2++[2]
|| STW B$A[4][0],*B2++[2]
STW A$A[4][1],*A2++[2]
|| STW B$A[4][1],*B2++[2]
STW A$A[4][2],*A2++[2]
|| STW B$A[4][2],*B2++[2]
STW A$A[4][3],*A2++[2]
|| STW B$A[4][3],*B2++[2]
```

```

STW A$A[4][4],*A2++[2]
|| STW B$A[4][4],*B2++[2]
.endasmfunc

.newblock
.global _SHA3_squeeze
.asg A12,OUT
.asg A13,LEN
.asg A14,BSZ
.align 32
_SHA3_squeeze:
.asmfnc stack_usage(24)
STW FP,*SP--(24) ; save frame pointer
|| MV SP,FP
STW RA, *SP[5]
|| STW A14,*FP[-2]
STDW A13:A12,*FP[-2]
|| MV B4,OUT ; reassign arguments
MV A6,LEN
|| MV B6,BSZ

loop?:
LDW *SP[5],RA ; reload RA
|| SHRU BSZ,3,A1
|| MV A4,A8
|| ADD 4,A4,B8
block?:
CMPLTU LEN,8,A0 ; len < 8?
[A0] BNOP tail?
LDW *A8++[2],A9
|| LDW *B8++[2],B9
|| SUB LEN,8,LEN ; len -= 8
MV LEN,A0
|| SUB A1,1,A1 ; bsz--
|| NOP 4
.if .BIG_ENDIAN
SWAP4 A9,A9
|| SWAP4 B9,B9
SWAP2 A9,A9
|| SWAP2 B9,B9
.endif
[!A0] BNOP ret?
|[!A0] ZERO A1
PACK2 B9,A9,B7
|[A1] BNOP block?
PACKH2 B9,A9,B9
|| SHFL B7,B7
SHFL B9,B9

```

```
STNW B7,*OUT++
STNW B9,*OUT++
NOP
```

```
BNOP_KeccakF1600,4
ADDKPC loop?,RA
```

```
.align 16
tail?:
.if .BIG_ENDIAN
SWAP4 A9,A9
|| SWAP4 B9,B9
SWAP2 A9,A9
|| SWAP2 B9,B9
.endif
PACK2 B9,A9,B7
PACKH2 B9,A9,B9
|| SHFL B7,B7
SHFL B9,B9
```

```
STB B7,*OUT++
|| SHRU B7,8,B7
|| ADD LEN,7,A0
[A0] STB B7,*OUT++
||[A0] SHRU B7,8,B7
||[A0] SUB A0,1,A0
[A0] STB B7,*OUT++
||[A0] SHRU B7,8,B7
||[A0] SUB A0,1,A0
[A0] STB B7,*OUT++
||[A0] SUB A0,1,A0
[A0] STB B9,*OUT++
||[A0] SHRU B9,8,B9
||[A0] SUB A0,1,A0
[A0] STB B9,*OUT++
||[A0] SHRU B9,8,B9
||[A0] SUB A0,1,A0
[A0] STB B9,*OUT++
```

```
ret?:
LDDW *FP[-2],A13:A12
BNOP RA
|| LDW *FP[-2],A14
LDW *++SP(24),FP ; restore frame pointer
NOP 4 ; wait till FP is committed
.endasmfunc
```

```
.if __TI_EABI__
```



```

.sect ".text:sha_asm.const"
.else
.sect ".const:sha_asm"
.endif
.align 256
.uword 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
iotas:
.uword 0x00000001, 0x00000000
.uword 0x00000000, 0x00000089
.uword 0x00000000, 0x8000008b
.uword 0x00000000, 0x80008080
.uword 0x00000001, 0x0000008b
.uword 0x00000001, 0x00008000
.uword 0x00000001, 0x80008088
.uword 0x00000001, 0x80000082
.uword 0x00000000, 0x0000000b
.uword 0x00000000, 0x0000000a
.uword 0x00000001, 0x00008082
.uword 0x00000000, 0x00008003
.uword 0x00000001, 0x0000808b
.uword 0x00000001, 0x8000000b
.uword 0x00000001, 0x8000008a
.uword 0x00000001, 0x80000081
.uword 0x00000000, 0x80000081
.uword 0x00000000, 0x80000008
.uword 0x00000000, 0x00000083
.uword 0x00000000, 0x80008003
.uword 0x00000001, 0x80008088
.uword 0x00000000, 0x80000088
.uword 0x00000001, 0x00008000
.uword 0x00000000, 0x80008082

.cstring "Keccak-1600 absorb and squeeze for C64x, CRYPTOGRAMS by <appro\@openssl.org>"
.align 4

```

```

$output=pop;
open STDOUT,">$output";
print $code;
close STDOUT;

```

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```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/sha/asm/keccak1600-c64x.pl

```

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\* fips/kdf/fips\_kdf\_ikev2.c - IKEV2 KDF vector tests

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\* Originally written by Shay Gueron (1, 2), and Vlad Krasnov (1, 3)  
\* (1) Intel Corporation, Israel Development Center, Haifa, Israel  
\* (2) University of Haifa, Israel  
\* (3) CloudFlare, Inc.  
\*  
\* Reference:  
\* S.Gueron and V.Krasnov, "Fast Prime Field Elliptic Curve Cryptography with  
\* 256 Bit Primes"

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\*

\* Contributed by Steve Marquess.

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\* crypto/aes/asm/aes\_ccm-octeon.c - Cavium Octeon specific hardware assist  
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/\* -----

\* crypto/bn/asm/modexp-octeon.c - Cavium Octeon specific hardware assist  
\* functionality.

\*

\* January 2013

\*

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```
/*-----
* kdf/kdf_ikev2.c - Key Derivation Functions for IKEv2
*
* April 2015
*
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cisssl-fom-7-2a-202104051307-tar-gz/cisssl-fom-7.2a.202104051307/crypto/kdf/kdf_ikev2.c
```

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```

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```

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```
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```

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 \*/

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/include/openssl/bn.h

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\* WARNING: do not edit!

\* Generated by objxref.pl

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7.2a.202104051307/crypto/sha/asm/sha1-586.pl

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```
/* -----
* crypto/aes/asm/aes-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
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*-----
*/
```

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- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/include/openssl/kdf.h
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/kdf/kdf.h
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/include/internal/cryptlib\_int.h
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/\*-----

\* kdf/kdf\_802\_11i.c - Key Derivation Function for 802.11i

\*

\* February 2015

\*

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\$0 =~ m/(.\*[\\])[^\\]+\$/; \$dir=\$1;

push(@INC,"\${dir}","\${dir}../../perlasm");

require "x86asm.pl";

\$output = pop;

&asm\_init(\$ARGV[0]);

\$sse2=0;

for (@ARGV) { \$sse2=1 if (/DOPENSSL\_IA32\_SSE2/); }

&external\_label("OPENSSL\_ia32cap\_P") if (\$sse2);

&bn\_mul\_add\_words("bn\_mul\_add\_words");

&bn\_mul\_words("bn\_mul\_words");

&bn\_sqr\_words("bn\_sqr\_words");

&bn\_div\_words("bn\_div\_words");

&bn\_add\_words("bn\_add\_words");

&bn\_sub\_words("bn\_sub\_words");

&bn\_sub\_part\_words("bn\_sub\_part\_words");

&asm\_finish();

sub bn\_mul\_add\_words

{

local(\$name)=@\_;

```
&function_begin_B($name,$sse2?"EXTRN\t_OPENSSL_ia32cap_P:DWORD:"");
```

```
$r="eax";
$a="edx";
$c="ecx";
```

```
if ($sse2) {
 &picmeup("eax","OPENSSL_ia32cap_P");
 &bt(&DWP(0,"eax"),26);
 &jnc(&label("maw_non_sse2"));
```

```
 &mov($r,&wparam(0));
 &mov($a,&wparam(1));
 &mov($c,&wparam(2));
 &movd("mm0",&wparam(3)); # mm0 = w
 &pxor("mm1","mm1"); # mm1 = carry_in
 &jmp(&label("maw_sse2_entry"));
```

```
&set_label("maw_sse2_unrolled",16);
 &movd("mm3",&DWP(0,$r,"",0)); # mm3 = r[0]
 &paddq("mm1","mm3"); # mm1 = carry_in + r[0]
 &movd("mm2",&DWP(0,$a,"",0)); # mm2 = a[0]
 &pmuludq("mm2","mm0"); # mm2 = w*a[0]
 &movd("mm4",&DWP(4,$a,"",0)); # mm4 = a[1]
 &pmuludq("mm4","mm0"); # mm4 = w*a[1]
 &movd("mm6",&DWP(8,$a,"",0)); # mm6 = a[2]
 &pmuludq("mm6","mm0"); # mm6 = w*a[2]
 &movd("mm7",&DWP(12,$a,"",0)); # mm7 = a[3]
 &pmuludq("mm7","mm0"); # mm7 = w*a[3]
 &paddq("mm1","mm2"); # mm1 = carry_in + r[0] + w*a[0]
 &movd("mm3",&DWP(4,$r,"",0)); # mm3 = r[1]
 &paddq("mm3","mm4"); # mm3 = r[1] + w*a[1]
 &movd("mm5",&DWP(8,$r,"",0)); # mm5 = r[2]
 &paddq("mm5","mm6"); # mm5 = r[2] + w*a[2]
 &movd("mm4",&DWP(12,$r,"",0)); # mm4 = r[3]
 &paddq("mm7","mm4"); # mm7 = r[3] + w*a[3]
 &movd(&DWP(0,$r,"",0),"mm1");
 &movd("mm2",&DWP(16,$a,"",0)); # mm2 = a[4]
 &pmuludq("mm2","mm0"); # mm2 = w*a[4]
 &psrlq("mm1",32); # mm1 = carry0
 &movd("mm4",&DWP(20,$a,"",0)); # mm4 = a[5]
 &pmuludq("mm4","mm0"); # mm4 = w*a[5]
 &paddq("mm1","mm3"); # mm1 = carry0 + r[1] + w*a[1]
 &movd("mm6",&DWP(24,$a,"",0)); # mm6 = a[6]
 &pmuludq("mm6","mm0"); # mm6 = w*a[6]
 &movd(&DWP(4,$r,"",0),"mm1");
 &psrlq("mm1",32); # mm1 = carry1
 &movd("mm3",&DWP(28,$a,"",0)); # mm3 = a[7]
```

```

&add($a,32);
&pmuludq("mm3","mm0"); # mm3 = w*a[7]
&paddq("mm1","mm5"); # mm1 = carry1 + r[2] + w*a[2]
&movd("mm5",&DWP(16,$r,"",0)); # mm5 = r[4]
&paddq("mm2","mm5"); # mm2 = r[4] + w*a[4]
&movd(&DWP(8,$r,"",0),"mm1");
&psrlq("mm1",32); # mm1 = carry2
&paddq("mm1","mm7"); # mm1 = carry2 + r[3] + w*a[3]
&movd("mm5",&DWP(20,$r,"",0)); # mm5 = r[5]
&paddq("mm4","mm5"); # mm4 = r[5] + w*a[5]
&movd(&DWP(12,$r,"",0),"mm1");
&psrlq("mm1",32); # mm1 = carry3
&paddq("mm1","mm2"); # mm1 = carry3 + r[4] + w*a[4]
&movd("mm5",&DWP(24,$r,"",0)); # mm5 = r[6]
&paddq("mm6","mm5"); # mm6 = r[6] + w*a[6]
&movd(&DWP(16,$r,"",0),"mm1");
&psrlq("mm1",32); # mm1 = carry4
&paddq("mm1","mm4"); # mm1 = carry4 + r[5] + w*a[5]
&movd("mm5",&DWP(28,$r,"",0)); # mm5 = r[7]
&paddq("mm3","mm5"); # mm3 = r[7] + w*a[7]
&movd(&DWP(20,$r,"",0),"mm1");
&psrlq("mm1",32); # mm1 = carry5
&paddq("mm1","mm6"); # mm1 = carry5 + r[6] + w*a[6]
&movd(&DWP(24,$r,"",0),"mm1");
&psrlq("mm1",32); # mm1 = carry6
&paddq("mm1","mm3"); # mm1 = carry6 + r[7] + w*a[7]
&movd(&DWP(28,$r,"",0),"mm1");
&lea($r,&DWP(32,$r));
&psrlq("mm1",32); # mm1 = carry_out

```

```

&sub($c,8);
&jz(&label("maw_sse2_exit"));
&set_label("maw_sse2_entry");
&test($c,0xffffffff8);
&jnz(&label("maw_sse2_unrolled"));

```

```

&set_label("maw_sse2_loop",4);
&movd("mm2",&DWP(0,$a)); # mm2 = a[i]
&movd("mm3",&DWP(0,$r)); # mm3 = r[i]
&pmuludq("mm2","mm0"); # a[i] *= w
&lea($a,&DWP(4,$a));
&paddq("mm1","mm3"); # carry += r[i]
&paddq("mm1","mm2"); # carry += a[i]*w
&movd(&DWP(0,$r),"mm1"); # r[i] = carry_low
&sub($c,1);
&psrlq("mm1",32); # carry = carry_high
&lea($r,&DWP(4,$r));
&jnz(&label("maw_sse2_loop"));

```

```

&set_label("maw_sse2_exit");
&movd("eax","mm1"); # c = carry_out
&emms();
&ret();

&set_label("maw_non_sse2",16);
}

function_begin prologue
&push("ebp");
&push("ebx");
&push("esi");
&push("edi");

&comment("");
$Low="eax";
$High="edx";
$a="ebx";
$w="ebp";
$r="edi";
$c="esi";

&xor($c,$c); # clear carry
&mov($r,&wparam(0)); #

&mov("ecx",&wparam(2)); #
&mov($a,&wparam(1)); #

&and("ecx",0xffffffff8); # num / 8
&mov($w,&wparam(3)); #

&push("ecx"); # Up the stack for a tmp variable

&jz(&label("maw_finish"));

&set_label("maw_loop",16);

for ($i=0; $i<32; $i+=4)
{
&comment("Round $i");

&mov("eax",&DWP($i,$a)); # *a
&mul($w); # *a * w
&add("eax",$c); # L(t)+= c
&adc("edx",0); # H(t)+=carry
&add("eax",&DWP($i,$r)); # L(t)+= *r
&adc("edx",0); # H(t)+=carry
&mov(&DWP($i,$r),"eax"); # *r= L(t);

```

```

 &mov($c,"edx"); # c= H(t);
}

&comment("");
&sub("ecx",8);
&lea($a,&DWP(32,$a));
&lea($r,&DWP(32,$r));
&jnz(&label("maw_loop"));

&set_label("maw_finish",0);
&mov("ecx",&wparam(2)); # get num
&and("ecx",7);
&jnz(&label("maw_finish2")); # helps branch prediction
&jmp(&label("maw_end"));

&set_label("maw_finish2",1);
for ($i=0; $i<7; $i++)
{
 &comment("Tail Round $i");
 &mov("eax",&DWP($i*4,$a)); # *a
 &mul($w); # *a * w
 &add("eax",$c); # L(t)+=c
 &adc("edx",0); # H(t)+=carry
 &add("eax",&DWP($i*4,$r)); # L(t)+= *r
 &adc("edx",0); # H(t)+=carry
 &dec("ecx") if ($i != 7-1);
 &mov(&DWP($i*4,$r),"eax"); # *r= L(t);
 &mov($c,"edx"); # c= H(t);
 &jz(&label("maw_end")) if ($i != 7-1);
}
&set_label("maw_end",0);
&mov("eax",$c);

&pop("ecx"); # clear variable from

&function_end($name);
}

sub bn_mul_words
{
 local($name)=@_;

 &function_begin_B($name,$sse2?"EXTRN\t_OPENSSL_ia32cap_P:DWORD:");

 $r="eax";
 $a="edx";
 $c="ecx";

```

```

if ($sse2) {
 &picmeup("eax","OPENSSE2_ia32cap_P");
 &bt(&DWP(0,"eax"),26);
 &jnc(&label("mw_non_sse2"));

 &mov($r,&wparam(0));
 &mov($a,&wparam(1));
 &mov($c,&wparam(2));
 &movd("mm0",&wparam(3)); # mm0 = w
 &pxor("mm1","mm1"); # mm1 = carry = 0

 &set_label("mw_sse2_loop",16);
 &movd("mm2",&DWP(0,$a)); # mm2 = a[i]
 &pmuludq("mm2","mm0"); # a[i] *= w
 &lea($a,&DWP(4,$a));
 &paddq("mm1","mm2"); # carry += a[i]*w
 &movd(&DWP(0,$r),"mm1"); # r[i] = carry_low
 &sub($c,1);
 &psrlq("mm1",32); # carry = carry_high
 &lea($r,&DWP(4,$r));
 &jnz(&label("mw_sse2_loop"));

 &movd("eax","mm1"); # return carry
 &emms();
 &ret();
 &set_label("mw_non_sse2",16);
}

function_begin prologue
&push("ebp");
&push("ebx");
&push("esi");
&push("edi");

&comment("");
$Low="eax";
$High="edx";
$a="ebx";
$w="ecx";
$r="edi";
$c="esi";
$num="ebp";

&xor($c,$c); # clear carry
&mov($r,&wparam(0)); #
&mov($a,&wparam(1)); #
&mov($num,&wparam(2)); #
&mov($w,&wparam(3)); #

```

```

&and($num,0xffffffff8); # num / 8
&jz(&label("mw_finish"));

&set_label("mw_loop",0);
for ($i=0; $i<32; $i+=4)
{
 &comment("Round $i");

 &mov("eax",&DWP($i,$a,"",0)); # *a
 &mul($w); # *a * w
 &add("eax",$c); # L(t)+=c
 # XXX

 &adc("edx",0); # H(t)+=carry
 &mov(&DWP($i,$r,"",0),"eax"); # *r= L(t);

 &mov($c,"edx"); # c= H(t);
}

&comment("");
&add($a,32);
&add($r,32);
&sub($num,8);
&jz(&label("mw_finish"));
&jmp(&label("mw_loop"));

&set_label("mw_finish",0);
&mov($num,&wparam(2)); # get num
&and($num,7);
&jnz(&label("mw_finish2"));
&jmp(&label("mw_end"));

&set_label("mw_finish2",1);
for ($i=0; $i<7; $i++)
{
 &comment("Tail Round $i");
 &mov("eax",&DWP($i*4,$a,"",0));# *a
 &mul($w); # *a * w
 &add("eax",$c); # L(t)+=c
 # XXX
 &adc("edx",0); # H(t)+=carry
 &mov(&DWP($i*4,$r,"",0),"eax");# *r= L(t);
 &mov($c,"edx"); # c= H(t);
 &dec($num) if ($i != 7-1);
 &jz(&label("mw_end")) if ($i != 7-1);
}
&set_label("mw_end",0);

```



```

&mov("eax",$c);

&function_end($name);
}

sub bn_sqr_words
{
local($name)=@_;

&function_begin_B($name,$sse2?"EXTRN\t_OPENSSL_ia32cap_P:DWORD":"","");

$r="eax";
$a="edx";
$c="ecx";

if ($sse2) {
&picmeup("eax","OPENSSL_ia32cap_P");
&bt(&DWP(0,"eax"),26);
&jnc(&label("sqr_non_sse2"));

&mov($r,&wparam(0));
&mov($a,&wparam(1));
&mov($c,&wparam(2));

&set_label("sqr_sse2_loop",16);
&movd("mm0",&DWP(0,$a)); # mm0 = a[i]
&pmuludq("mm0","mm0"); # a[i] *= a[i]
&lea($a,&DWP(4,$a)); # a++
&movq(&QWP(0,$r),"mm0"); # r[i] = a[i]*a[i]
&sub($c,1);
&lea($r,&DWP(8,$r)); # r += 2
&jnz(&label("sqr_sse2_loop"));

&emms();
&ret();
&set_label("sqr_non_sse2",16);
}

function_begin prologue
&push("ebp");
&push("ebx");
&push("esi");
&push("edi");

&comment("");
$r="esi";
$a="edi";
$num="ebx";

```

```

&mov($r,&wparam(0)); #
&mov($a,&wparam(1)); #
&mov($num,&wparam(2)); #

&and($num,0xffffffff8); # num / 8
&jz(&label("sw_finish"));

&set_label("sw_loop",0);
for ($i=0; $i<32; $i+=4)
{
&comment("Round $i");
&mov("eax",&DWP($i,$a,"",0)); # *a
XXX
&mul("eax"); # *a * *a
&mov(&DWP($i*2,$r,"",0),"eax"); #
&mov(&DWP($i*2+4,$r,"",0),"edx");#
}

&comment("");
&add($a,32);
&add($r,64);
&sub($num,8);
&jnz(&label("sw_loop"));

&set_label("sw_finish",0);
&mov($num,&wparam(2)); # get num
&and($num,7);
&jz(&label("sw_end"));

for ($i=0; $i<7; $i++)
{
&comment("Tail Round $i");
&mov("eax",&DWP($i*4,$a,"",0)); # *a
XXX
&mul("eax"); # *a * *a
&mov(&DWP($i*8,$r,"",0),"eax"); #
&dec($num) if ($i != 7-1);
&mov(&DWP($i*8+4,$r,"",0),"edx");
&jz(&label("sw_end")) if ($i != 7-1);
}
&set_label("sw_end",0);

&function_end($name);
}

sub bn_div_words
{

```

```

local($name)=@_;

&function_begin_B($name,"");
&mov("edx",&wparam(0)); #
&mov("eax",&wparam(1)); #
&mov("ecx",&wparam(2)); #
&div("ecx");
&ret();
&function_end_B($name);
}

sub bn_add_words
{
local($name)=@_;

&function_begin($name,"");

&comment("");
$a="esi";
$b="edi";
$c="eax";
$r="ebx";
$tmp1="ecx";
$tmp2="edx";
$num="ebp";

&mov($r,&wparam(0)); # get r
&mov($a,&wparam(1)); # get a
&mov($b,&wparam(2)); # get b
&mov($num,&wparam(3)); # get num
&xor($c,$c); # clear carry
&and($num,0xfffff8); # num / 8

&jz(&label("aw_finish"));

&set_label("aw_loop",0);
for ($i=0; $i<8; $i++)
{
&comment("Round $i");

&mov($tmp1,&DWP($i*4,$a,"",0)); # *a
&mov($tmp2,&DWP($i*4,$b,"",0)); # *b
&add($tmp1,$c);
&mov($c,0);
&adc($c,$c);
&add($tmp1,$tmp2);
&adc($c,0);
&mov(&DWP($i*4,$r,"",0),$tmp1); # *r

```

```

}

&comment("");
&add($a,32);
&add($b,32);
&add($r,32);
&sub($num,8);
&jnz(&label("aw_loop"));

&set_label("aw_finish",0);
&mov($num,&wparam(3)); # get num
&and($num,7);
&jz(&label("aw_end"));

for ($i=0; $i<7; $i++)
{
&comment("Tail Round $i");
&mov($tmp1,&DWP($i*4,$a,"",0)); # *a
&mov($tmp2,&DWP($i*4,$b,"",0));# *b
&add($tmp1,$c);
&mov($c,0);
&adc($c,$c);
&add($tmp1,$tmp2);
&adc($c,0);
&dec($num) if ($i != 6);
&mov(&DWP($i*4,$r,"",0),$tmp1); # *r
&jz(&label("aw_end")) if ($i != 6);
}
&set_label("aw_end",0);

&mov("eax",$c); # $c is "eax"

&function_end($name);
}

sub bn_sub_words
{
local($name)=@_;

&function_begin($name,"");

&comment("");
$a="esi";
$b="edi";
$c="eax";
$r="ebx";
$tmp1="ecx";
$tmp2="edx";

```

```

$num="ebp";

&mov($r,&wparam(0)); # get r
&mov($a,&wparam(1)); # get a
&mov($b,&wparam(2)); # get b
&mov($num,&wparam(3)); # get num
&xor($c,$c); # clear carry
&and($num,0xffffffff); # num / 8

&jz(&label("aw_finish"));

&set_label("aw_loop",0);
for ($i=0; $i<8; $i++)
{
&comment("Round $i");

&mov($tmp1,&DWP($i*4,$a,"",0)); # *a
&mov($tmp2,&DWP($i*4,$b,"",0)); # *b
&sub($tmp1,$c);
&mov($c,0);
&adc($c,$c);
&sub($tmp1,$tmp2);
&adc($c,0);
&mov(&DWP($i*4,$r,"",0),$tmp1); # *r
}

&comment("");
&add($a,32);
&add($b,32);
&add($r,32);
&sub($num,8);
&jnz(&label("aw_loop"));

&set_label("aw_finish",0);
&mov($num,&wparam(3)); # get num
&and($num,7);
&jz(&label("aw_end"));

for ($i=0; $i<7; $i++)
{
&comment("Tail Round $i");
&mov($tmp1,&DWP($i*4,$a,"",0)); # *a
&mov($tmp2,&DWP($i*4,$b,"",0)); # *b
&sub($tmp1,$c);
&mov($c,0);
&adc($c,$c);
&sub($tmp1,$tmp2);
&adc($c,0);
}

```

```

 &dec($num) if ($i != 6);
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 &jz(&label("aw_end")) if ($i != 6);
}
&set_label("aw_end",0);

&mov("eax",$c); # $c is "eax"

&function_end($name);
}

sub bn_sub_part_words
{
 local($name)=@_;

 &function_begin($name,"");

 &comment("");
 $a="esi";
 $b="edi";
 $c="eax";
 $r="ebx";
 $tmp1="ecx";
 $tmp2="edx";
 $num="ebp";

 &mov($r,&wparam(0)); # get r
 &mov($a,&wparam(1)); # get a
 &mov($b,&wparam(2)); # get b
 &mov($num,&wparam(3)); # get num
 &xor($c,$c); # clear carry
 &and($num,0xfffff8); # num / 8

 &jz(&label("aw_finish"));

 &set_label("aw_loop",0);
 for ($i=0; $i<8; $i++)
 {
 &comment("Round $i");

 &mov($tmp1,&DWP($i*4,$a,"",0)); # *a
 &mov($tmp2,&DWP($i*4,$b,"",0)); # *b
 &sub($tmp1,$c);
 &mov($c,0);
 &adc($c,$c);
 &sub($tmp1,$tmp2);
 &adc($c,0);
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 }
}

```

```

}

&comment("");
&add($a,32);
&add($b,32);
&add($r,32);
&sub($num,8);
&jnz(&label("aw_loop"));

&set_label("aw_finish",0);
&mov($num,&wparam(3)); # get num
&and($num,7);
&jz(&label("aw_end"));

for ($i=0; $i<7; $i++)
{
&comment("Tail Round $i");
&mov($tmp1,&DWP(0,$a,"",0)); # *a
&mov($tmp2,&DWP(0,$b,"",0));# *b
&sub($tmp1,$c);
&mov($c,0);
&adc($c,$c);
&sub($tmp1,$tmp2);
&adc($c,0);
&mov(&DWP(0,$r,"",0),$tmp1); # *r
&add($a, 4);
&add($b, 4);
&add($r, 4);
&dec($num) if ($i != 6);
&jz(&label("aw_end")) if ($i != 6);
}
&set_label("aw_end",0);

&cmp(&wparam(4),0);
&je(&label("pw_end"));

&mov($num,&wparam(4)); # get dl
&cmp($num,0);
&je(&label("pw_end"));
&jge(&label("pw_pos"));

&comment("pw_neg");
&mov($tmp2,0);
&sub($tmp2,$num);
&mov($num,$tmp2);
&and($num,0xfffff8); # num / 8
&jz(&label("pw_neg_finish"));

```

```

&set_label("pw_neg_loop",0);
for ($i=0; $i<8; $i++)
{
 &comment("dl<0 Round $i");

 &mov($tmp1,0);
 &mov($tmp2,&DWP($i*4,$b,"",0)); # *b
 &sub($tmp1,$c);
 &mov($c,0);
 &adc($c,$c);
 &sub($tmp1,$tmp2);
 &adc($c,0);
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
}

&comment("");
&add($b,32);
&add($r,32);
&sub($num,8);
&jnz(&label("pw_neg_loop"));

&set_label("pw_neg_finish",0);
&mov($tmp2,&wparam(4)); # get dl
&mov($num,0);
&sub($num,$tmp2);
&and($num,7);
&jz(&label("pw_end"));

for ($i=0; $i<7; $i++)
{
 &comment("dl<0 Tail Round $i");
 &mov($tmp1,0);
 &mov($tmp2,&DWP($i*4,$b,"",0));# *b
 &sub($tmp1,$c);
 &mov($c,0);
 &adc($c,$c);
 &sub($tmp1,$tmp2);
 &adc($c,0);
 &dec($num) if ($i != 6);
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 &jz(&label("pw_end")) if ($i != 6);
}

&jmp(&label("pw_end"));

&set_label("pw_pos",0);

&and($num,0xfffffff8); # num / 8

```



```

&jz(&label("pw_pos_finish"));

&set_label("pw_pos_loop",0);

for ($i=0; $i<8; $i++)
{
 &comment("dl>0 Round $i");

 &mov($tmp1,&DWP($i*4,$a,"",0)); # *a
 &sub($tmp1,$c);
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 &jnc(&label("pw_nc".$i));
}

&comment("");
&add($a,32);
&add($r,32);
&sub($num,8);
&jnz(&label("pw_pos_loop"));

&set_label("pw_pos_finish",0);
&mov($num,&wparam(4)); # get dl
&and($num,7);
&jz(&label("pw_end"));

for ($i=0; $i<7; $i++)
{
 &comment("dl>0 Tail Round $i");
 &mov($tmp1,&DWP($i*4,$a,"",0)); # *a
 &sub($tmp1,$c);
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 &jnc(&label("pw_tail_nc".$i));
 &dec($num) if ($i != 6);
 &jz(&label("pw_end")) if ($i != 6);
}
&mov($c,1);
&jmp(&label("pw_end"));

&set_label("pw_nc_loop",0);
for ($i=0; $i<8; $i++)
{
 &mov($tmp1,&DWP($i*4,$a,"",0)); # *a
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 &set_label("pw_nc".$i,0);
}

&comment("");
&add($a,32);

```

```

&add($r,32);
&sub($num,8);
&jnz(&label("pw_nc_loop"));

&mov($num,&wparam(4)); # get dl
&and($num,7);
&jz(&label("pw_nc_end"));

for ($i=0; $i<7; $i++)
{
 &mov($tmp1,&DWP($i*4,$a,"",0)); # *a
 &mov(&DWP($i*4,$r,"",0),$tmp1); # *r
 &set_label("pw_tail_nc".$i,0);
 &dec($num) if ($i != 6);
 &jz(&label("pw_nc_end")) if ($i != 6);
}

&set_label("pw_nc_end",0);
&mov($c,0);

&set_label("pw_end",0);

&mov("eax",$c); # $c is "eax"

&function_end($name);
}

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-
7.2a.202104051307/crypto/bn/asm/bn-586.pl

```

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```

```

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*/

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-
7.2a.202104051307/crypto/aes/aes_wrap.c

```

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```

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```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-
7.2a.202104051307/crypto/modes/asm/ghash-x86.pl

```

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/\* -----

\* crypto/des/asm/ecb3\_enc-octeon.c - Cavium Octeon specific hardware assist

\* functionality that is to reside within the FIPS canister.

\*

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\*

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```

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```

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```
/* -----
* crypto/aes/asm/aes_cbc-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
```

```
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```
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=====
```

```
#
SHA512 for C64x+.
#
January 2012
#
Performance is 19 cycles per processed byte. Compared to block
transform function from sha512.c compiled with cl6x with -mv6400+
-o2 -DOPENSSL_SMALL_FOOTPRINT it's almost 7x faster and 2x smaller.
Loop unroll won't make it, this implementation, any faster, because
it's effectively dominated by SHRU||SHL pairs and you can't schedule
more of them.
#
!!! Note that this module uses AMR, which means that all interrupt
service routines are expected to preserve it and for own well-being
zero it upon entry.
```

```
while (($output=shift) && ($output!~/^[w\W-]*\.[w+$/)) { }
open STDOUT,">$output";
```

```
($CTXA,$INP,$NUM) = ("A4","B4","A6"); # arguments
```

```

$K512="A3";

($Ahi,$Actxhi,$Bhi,$Bctxhi,$Chi,$Cctxhi,$Dhi,$Dctxhi,
$Ehi,$Ectxhi,$Fhi,$Fctxhi,$Ghi,$Gctxhi,$Hhi,$Hctxhi)=map("A$_",(16..31));
($Alo,$Actxlo,$Blo,$Bctxlo,$Clo,$Cctxlo,$Dlo,$Dctxlo,
$Elo,$Ectxlo,$Flo,$Fctxlo,$Glo,$Gctxlo,$Hlo,$Hctxlo)=map("B$_",(16..31));

($S1hi,$CHhi,$S0hi,$t0hi)=map("A$_",(10..13));
($S1lo,$CHlo,$S0lo,$t0lo)=map("B$_",(10..13));
($T1hi, $T2hi)= ("A6","A7");
($T1lo,$T1carry,$T2lo,$T2carry)=("B6","B7","B8","B9");
($Khi,$Klo)=("A9","A8");
($MAJhi,$MAJlo)=($T2hi,$T2lo);
($t1hi,$t1lo)=($Khi,"B2");
$CTXB=$t1lo;

($Xihi,$Xilo)=("A5","B5"); # circular/ring buffer

$code.=<<___.text
___.if .ASSEMBLER_VERSION<7000000
___.asg 0,__TI_EABI__
___.endif
___.if __TI_EABI__
___.nocmp
___.asg sha512_block_data_order,_sha512_block_data_order
___.endif

___.asg B3,RA
___.asg A15,FP
___.asg B15,SP

___.if .BIG_ENDIAN
___.asg $Khi,KHI
___.asg $Klo,KLO
___.else
___.asg $Khi,KLO
___.asg $Klo,KHI
___.endif

___.global _sha512_block_data_order
___.sha512_block_data_order:
___.sha512_block:
___.asmfunc stack_usage(40+128)
___.MV $NUM,A0 ; reassign $NUM
___.|| MVK -128,B0
___.[!A0] BNOP RA ; if ($NUM==0) return;

```

```

|| [A0] STW FP,*SP--(40) ; save frame pointer
|| [A0] MV SP,FP
 [A0] STDW B13:B12,*SP[4]
|| [A0] MVK 0x00404,B1
 [A0] STDW B11:B10,*SP[3]
|| [A0] STDW A13:A12,*FP[-3]
|| [A0] MVKH 0x60000,B1
 [A0] STDW A11:A10,*SP[1]
|| [A0] MVC B1,AMR ; setup circular addressing
|| [A0] ADD B0,SP,SP ; alloca(128)
.if __TI_EABI__
 [A0] AND B0,SP,SP ; align stack at 128 bytes
|| [A0] ADDKPC __sha512_block,B1
|| [A0] MVKL \$_PCR_OFFSET(K512,__sha512_block),\$K512
 [A0] MVKH \$_PCR_OFFSET(K512,__sha512_block),\$K512
|| [A0] SUBAW SP,2,SP ; reserve two words above buffer
.else
 [A0] AND B0,SP,SP ; align stack at 128 bytes
|| [A0] ADDKPC __sha512_block,B1
|| [A0] MVKL (K512-__sha512_block),\$K512
 [A0] MVKH (K512-__sha512_block),\$K512
|| [A0] SUBAW SP,2,SP ; reserve two words above buffer
.endif
ADDAW SP,3,\$Xilo
ADDAW SP,2,\$Xihi

|| MV \$CTXA,\$CTXB
LDW *${CTXA}[0^.LITTLE_ENDIAN],\$Ahi ; load ctx
|| LDW *${CTXB}[1^.LITTLE_ENDIAN],\$Alo
|| ADD B1,\$K512,\$K512
LDW *${CTXA}[2^.LITTLE_ENDIAN],\$Bhi
|| LDW *${CTXB}[3^.LITTLE_ENDIAN],\$Blo
LDW *${CTXA}[4^.LITTLE_ENDIAN],\$Chi
|| LDW *${CTXB}[5^.LITTLE_ENDIAN],\$Clo
LDW *${CTXA}[6^.LITTLE_ENDIAN],\$Dhi
|| LDW *${CTXB}[7^.LITTLE_ENDIAN],\$Dlo
LDW *${CTXA}[8^.LITTLE_ENDIAN],\$Ehi
|| LDW *${CTXB}[9^.LITTLE_ENDIAN],\$Elo
LDW *${CTXA}[10^.LITTLE_ENDIAN],\$Fhi
|| LDW *${CTXB}[11^.LITTLE_ENDIAN],\$Flo
LDW *${CTXA}[12^.LITTLE_ENDIAN],\$Ghi
|| LDW *${CTXB}[13^.LITTLE_ENDIAN],\$Glo
LDW *${CTXA}[14^.LITTLE_ENDIAN],\$Hhi
|| LDW *${CTXB}[15^.LITTLE_ENDIAN],\$Hlo

LDNDW *$INP++,B11:B10 ; pre-fetch input
LDDW *$K512+,\$Khi:$Klo ; pre-fetch K512[0]
outerloop?:

```

```

MVK 15,B0 ; loop counters
|| MVK 64,B1
|| SUB A0,1,A0
MV $Ahi,$Actxhi
|| MV $Alo,$Actxlo
|| MV $Bhi,$Bctxhi
|| MV $Blo,$Bctxlo
|| MV $Chi,$Cctxhi
|| MV $Clo,$Cctxlo
|| MVD $Dhi,$Dctxhi
|| MVD $Dlo,$Dctxlo
MV $Ehi,$Ectxhi
|| MV $Elo,$Ectxlo
|| MV $Fhi,$Fctxhi
|| MV $Flo,$Fctxlo
|| MV $Ghi,$Gctxhi
|| MV $Glo,$Gctxlo
|| MVD $Hhi,$Hctxhi
|| MVD $Hlo,$Hctxlo
loop0_15?:
.if .BIG_ENDIAN
MV B11,$T1hi
|| MV B10,$T1lo
.else
SWAP4 B10,$T1hi
|| SWAP4 B11,$T1lo
SWAP2 $T1hi,$T1hi
|| SWAP2 $T1lo,$T1lo
.endif
loop16_79?:
STW $T1hi,*$Xihi++[2]
|| STW $T1lo,*$Xilo++[2] ; X[i] = T1
|| ADD $Hhi,$T1hi,$T1hi
|| ADDU $Hlo,$T1lo,$T1carry:$T1lo ; T1 += h
|| SHRU $Ehi,14,$S1hi
|| SHL $Ehi,32-14,$S1lo
XOR $Fhi,$Ghi,$CHhi
|| XOR $Flo,$Glo,$CHlo
|| ADD KHI,$T1hi,$T1hi
|| ADDU KLO,$T1carry:$T1lo,$T1carry:$T1lo ; T1 += K512[i]
|| SHRU $Elo,14,$t0lo
|| SHL $Elo,32-14,$t0hi
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| AND $Ehi,$CHhi,$CHhi
|| AND $Elo,$CHlo,$CHlo
|| ROTL $Ghi,0,$Hhi
|| ROTL $Glo,0,$Hlo ; h = g

```

```

|| SHRU $Ehi,18,$t0hi
|| SHL $Ehi,32-18,$t0lo
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| XOR $Ghi,$CHhi,$CHhi
|| XOR $Glo,$CHlo,$CHlo ; Ch(e,f,g) = ((f^g)&e)^g
|| ROTL $Fhi,0,$Ghi
|| ROTL $Flo,0,$Glo ; g = f
|| SHRU $Elo,18,$t0lo
|| SHL $Elo,32-18,$t0hi
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| OR $Ahi,$Bhi,$MAJhi
|| OR $Alo,$Blo,$MAJlo
|| ROTL $Ehi,0,$Fhi
|| ROTL $Elo,0,$Flo ; f = e
|| SHRU $Ehi,41-32,$t0lo
|| SHL $Ehi,64-41,$t0hi
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| AND $Chi,$MAJhi,$MAJhi
|| AND $Clo,$MAJlo,$MAJlo
|| ROTL $Dhi,0,$Ehi
|| ROTL $Dlo,0,$Elo ; e = d
|| SHRU $Elo,41-32,$t0hi
|| SHL $Elo,64-41,$t0lo
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo ; Sigma1(e)
|| AND $Ahi,$Bhi,$t1hi
|| AND $Alo,$Blo,$t1lo
|| ROTL $Chi,0,$Dhi
|| ROTL $Clo,0,$Dlo ; d = c
|| SHRU $Ahi,28,$S0hi
|| SHL $Ahi,32-28,$S0lo
OR $t1hi,$MAJhi,$MAJhi
|| OR $t1lo,$MAJlo,$MAJlo ; Maj(a,b,c) = ((a|b)&c)|(a&b)
|| ADD $CHhi,$T1hi,$T1hi
|| ADDU $CHlo,$T1carry:$T1lo,$T1carry:$T1lo ; T1 += Ch(e,f,g)
|| ROTL $Bhi,0,$Chi
|| ROTL $Blo,0,$Clo ; c = b
|| SHRU $Alo,28,$t0lo
|| SHL $Alo,32-28,$t0hi
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| ADD $S1hi,$T1hi,$T1hi
|| ADDU $S1lo,$T1carry:$T1lo,$T1carry:$T1lo ; T1 += Sigma1(e)
|| ROTL $Ahi,0,$Bhi
|| ROTL $Alo,0,$Blo ; b = a

```

```

|| SHRU $Ahi,34-32,$t0lo
|| SHL $Ahi,64-34,$t0hi
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| ADD $MAJhi,$T1hi,$T2hi
|| ADDU $MAJlo,$T1carry:$T1lo,$T2carry:$T2lo ; T2 = T1+Maj(a,b,c)
|| SHRU $Alo,34-32,$t0hi
|| SHL $Alo,64-34,$t0lo
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| ADD $Ehi,$T1hi,$T1hi
|| ADDU $Elo,$T1carry:$T1lo,$T1carry:$T1lo ; T1 += e
|| [B0] BNOP loop0_15?
|| SHRU $Ahi,39-32,$t0lo
|| SHL $Ahi,64-39,$t0hi
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| [B0] LDNDW *$INP++,B11:B10 ; pre-fetch input
||[!B1] BNOP break?
|| SHRU $Alo,39-32,$t0hi
|| SHL $Alo,64-39,$t0lo
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo ; Sigma0(a)
|| ADD $T1carry,$T1hi,$Ehi
|| MV $T1lo,$Elo ; e = T1
||[!B0] LDW *${Xihi}[28],$T1hi
||[!B0] LDW *${Xilo}[28],$T1lo ; X[i+14]
ADD $S0hi,$T2hi,$T2hi
|| ADDU $S0lo,$T2carry:$T2lo,$T2carry:$T2lo ; T2 += Sigma0(a)
|| [B1] LDDW *$K512+,$Khi:$Klo ; pre-fetch K512[i]
NOP ; avoid cross-path stall
ADD $T2carry,$T2hi,$Ahi
|| MV $T2lo,$Alo ; a = T2
|| [B0] SUB B0,1,B0
;===== branch to loop00_15? is taken here
NOP
;===== branch to break? is taken here
LDW *${Xihi}[2],$T2hi
|| LDW *${Xilo}[2],$T2lo ; X[i+1]
|| SHRU $T1hi,19,$S1hi
|| SHL $T1hi,32-19,$S1lo
SHRU $T1lo,19,$t0lo
|| SHL $T1lo,32-19,$t0hi
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| SHRU $T1hi,61-32,$t0lo
|| SHL $T1hi,64-61,$t0hi
XOR $t0hi,$S1hi,$S1hi

```

```

|| XOR $t0lo,$S1lo,$S1lo
|| SHRU $T1lo,61-32,$t0hi
|| SHL $T1lo,64-61,$t0lo
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| SHRU $T1hi,6,$t0hi
|| SHL $T1hi,32-6,$t0lo
XOR $t0hi,$S1hi,$S1hi
|| XOR $t0lo,$S1lo,$S1lo
|| SHRU $T1lo,6,$t0lo
|| LDW *${Xihi}[18],$T1hi
|| LDW *${Xilo}[18],$T1lo ; X[i+9]
XOR $t0lo,$S1lo,$S1lo ; sigma1(Xi[i+14])

|| LDW *${Xihi}[0],$CHhi
|| LDW *${Xilo}[0],$CHlo ; X[i]
|| SHRU $T2hi,1,$S0hi
|| SHL $T2hi,32-1,$S0lo
SHRU $T2lo,1,$t0lo
|| SHL $T2lo,32-1,$t0hi
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| SHRU $T2hi,8,$t0hi
|| SHL $T2hi,32-8,$t0lo
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| SHRU $T2lo,8,$t0lo
|| SHL $T2lo,32-8,$t0hi
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| ADD $S1hi,$T1hi,$T1hi
|| ADDU $S1lo,$T1lo,$T1carry:$T1lo ; T1 = X[i+9]+sigma1()
|| [B1] BNOP loop16_79?
|| SHRU $T2hi,7,$t0hi
|| SHL $T2hi,32-7,$t0lo
XOR $t0hi,$S0hi,$S0hi
|| XOR $t0lo,$S0lo,$S0lo
|| ADD $CHhi,$T1hi,$T1hi
|| ADDU $CHlo,$T1carry:$T1lo,$T1carry:$T1lo ; T1 += X[i]
|| SHRU $T2lo,7,$t0lo
XOR $t0lo,$S0lo,$S0lo ; sigma0(Xi[i+1])

ADD $S0hi,$T1hi,$T1hi
|| ADDU $S0lo,$T1carry:$T1lo,$T1carry:$T1lo ; T1 += sigma0()
|| [B1] SUB B1,1,B1
NOP ; avoid cross-path stall
ADD $T1carry,$T1hi,$T1hi
;===== branch to loop16_79? is taken here

```



```

break?:
 ADD $Ahi,$Actxhi,$Ahi ; accumulate ctx
 || ADDU $Alo,$Actxlo,$Actxlo:$Alo
 || [A0] LDNDW *$INP++,B11:B10 ; pre-fetch input
 || [A0] ADDK -640,$K512 ; rewind pointer to K512
 ADD $Bhi,$Bctxhi,$Bhi
 || ADDU $Blo,$Bctxlo,$Bctxlo:$Blo
 || [A0] LDDW *$K512+,$Khi:$Klo ; pre-fetch K512[0]
 ADD $Chi,$Cctxhi,$Chi
 || ADDU $Clo,$Cctxlo,$Cctxlo:$Clo
 || ADD $Actxlo,$Ahi,$Ahi
 ||[!A0] MV $CTXA,$CTXB
 ADD $Dhi,$Dctxhi,$Dhi
 || ADDU $Dlo,$Dctxlo,$Dctxlo:$Dlo
 || ADD $Bctxlo,$Bhi,$Bhi
 ||[!A0] STW $Ahi,*${CTXA}[0^.LITTLE_ENDIAN] ; save ctx
 ||[!A0] STW $Alo,*${CTXB}[1^.LITTLE_ENDIAN]
 ADD $Ehi,$Ectxhi,$Ehi
 || ADDU $Elo,$Ectxlo,$Ectxlo:$Elo
 || ADD $Cctxlo,$Chi,$Chi
 || [A0] BNOP outerloop?
 ||[!A0] STW $Bhi,*${CTXA}[2^.LITTLE_ENDIAN]
 ||[!A0] STW $Blo,*${CTXB}[3^.LITTLE_ENDIAN]
 ADD $Fhi,$Fctxhi,$Fhi
 || ADDU $Flo,$Fctxlo,$Fctxlo:$Flo
 || ADD $Dctxlo,$Dhi,$Dhi
 ||[!A0] STW $Chi,*${CTXA}[4^.LITTLE_ENDIAN]
 ||[!A0] STW $Clo,*${CTXB}[5^.LITTLE_ENDIAN]
 ADD $Ghi,$Gctxhi,$Ghi
 || ADDU $Glo,$Gctxlo,$Gctxlo:$Glo
 || ADD $Ectxlo,$Ehi,$Ehi
 ||[!A0] STW $Dhi,*${CTXA}[6^.LITTLE_ENDIAN]
 ||[!A0] STW $Dlo,*${CTXB}[7^.LITTLE_ENDIAN]
 ADD $Hhi,$Hctxhi,$Hhi
 || ADDU $Hlo,$Hctxlo,$Hctxlo:$Hlo
 || ADD $Fctxlo,$Fhi,$Fhi
 ||[!A0] STW $Ehi,*${CTXA}[8^.LITTLE_ENDIAN]
 ||[!A0] STW $Elo,*${CTXB}[9^.LITTLE_ENDIAN]
 ADD $Gctxlo,$Ghi,$Ghi
 ||[!A0] STW $Fhi,*${CTXA}[10^.LITTLE_ENDIAN]
 ||[!A0] STW $Flo,*${CTXB}[11^.LITTLE_ENDIAN]
 ADD $Hctxlo,$Hhi,$Hhi
 ||[!A0] STW $Ghi,*${CTXA}[12^.LITTLE_ENDIAN]
 ||[!A0] STW $Glo,*${CTXB}[13^.LITTLE_ENDIAN]
 ;;===== branch to outerloop? is taken here

 STW $Hhi,*${CTXA}[14^.LITTLE_ENDIAN]

```

```

|| STW $Hlo,*${CTXB}[15^.LITTLE_ENDIAN]
|| MVK -40,B0
ADD FP,B0,SP ; destroy circular buffer
|| LDDW *FP[-4],A11:A10
LDDW *SP[2],A13:A12
|| LDDW *FP[-2],B11:B10
LDDW *SP[4],B13:B12
|| BNOP RA
LDW *++SP(40),FP ; restore frame pointer
MVK 0,B0
MVC B0,AMR ; clear AMR
NOP 2 ; wait till FP is committed
.endasmfunc

.if __TI_EABI__
.sect ".text:sha_asm.const"
.else
.sect ".const:sha_asm"
.endif
.align 128
K512:
.uword 0x428a2f98,0xd728ae22, 0x71374491,0x23ef65cd
.uword 0xb5c0fbcf,0xec4d3b2f, 0xe9b5dba5,0x8189dbbc
.uword 0x3956c25b,0xf348b538, 0x59f111f1,0xb605d019
.uword 0x923f82a4,0xaf194f9b, 0xab1c5ed5,0xda6d8118
.uword 0xd807aa98,0xa3030242, 0x12835b01,0x45706fbe
.uword 0x243185be,0x4ee4b28c, 0x550c7dc3,0xd5ffb4e2
.uword 0x72be5d74,0xf27b896f, 0x80deb1fe,0x3b1696b1
.uword 0x9bdc06a7,0x25c71235, 0xc19bf174,0xcf692694
.uword 0xe49b69c1,0x9ef14ad2, 0xefbe4786,0x384f25e3
.uword 0x0fc19dc6,0x8b8cd5b5, 0x240ca1cc,0x77ac9c65
.uword 0x2de92c6f,0x592b0275, 0x4a7484aa,0x6ea6e483
.uword 0x5cb0a9dc,0xbd41fbd4, 0x76f988da,0x831153b5
.uword 0x983e5152,0xee66dfab, 0xa831c66d,0x2db43210
.uword 0xb00327c8,0x98fb213f, 0xbf597fc7,0xbeef0ee4
.uword 0xc6e00bf3,0x3da88fc2, 0xd5a79147,0x930aa725
.uword 0x06ca6351,0xe003826f, 0x14292967,0x0a0e6e70
.uword 0x27b70a85,0x46d22ffc, 0x2e1b2138,0x5c26c926
.uword 0x4d2c6dfc,0x5ac42aed, 0x53380d13,0x9d95b3df
.uword 0x650a7354,0x8baf63de, 0x766a0abb,0x3c77b2a8
.uword 0x81c2c92e,0x47edae66, 0x92722c85,0x1482353b
.uword 0xa2bfe8a1,0x4cf10364, 0xa81a664b,0xbc423001
.uword 0xc24b8b70,0xd0f89791, 0xc76c51a3,0x0654be30
.uword 0xd192e819,0xd6ef5218, 0xd6990624,0x5565a910
.uword 0xf40e3585,0x5771202a, 0x106aa070,0x32bbd1b8
.uword 0x19a4c116,0xb8d2d0c8, 0x1e376c08,0x5141ab53
.uword 0x2748774c,0xdf8eeb99, 0x34b0bcb5,0xe19b48a8
.uword 0x391c0cb3,0xc5c95a63, 0x4ed8aa4a,0xe3418acb

```

```
.uword 0x5b9cca4f,0x7763e373, 0x682e6ff3,0xd6b2b8a3
.uword 0x748f82ee,0x5defb2fc, 0x78a5636f,0x43172f60
.uword 0x84c87814,0xa1f0ab72, 0x8cc70208,0x1a6439ec
.uword 0x90beffa,0x23631e28, 0xa4506ceb,0xde82bde9
.uword 0xbef9a3f7,0xb2c67915, 0xc67178f2,0xe372532b
.uword 0xca273ece,0xea26619c, 0xd186b8c7,0x21c0c207
.uword 0xeada7dd6,0xcde0eb1e, 0xf57d4f7f,0xee6ed178
.uword 0x06f067aa,0x72176fba, 0x0a637dc5,0xa2c898a6
.uword 0x113f9804,0xbef90dae, 0x1b710b35,0x131c471b
.uword 0x28db77f5,0x23047d84, 0x32caab7b,0x40c72493
.uword 0x3c9ebe0a,0x15c9bebc, 0x431d67c4,0x9c100d4c
.uword 0x4cc5d4be,0xcb3e42b6, 0x597f299c,0xfc657e2a
.uword 0x5fcb6fab,0x3ad6faec, 0x6c44198c,0x4a475817
.cstring "SHA512 block transform for C64x+, CRYPTOGRAMS by <appro\@openssl.org>"
.align 4
```

—

```
print $code;
close STDOUT;
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/sha/asm/sha512-c64xplus.pl
```

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* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/modes/asm/aesni-gcm-x86_64.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/aes/asm/aesni-mb-x86_64.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/sha/asm/sha256-mb-x86_64.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/sha/asm/sha1-mb-x86_64.pl
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\*  
\* Originally written by Shay Gueron (1, 2), and Vlad Krasnov (1)  
\* (1) Intel Corporation, Israel Development Center, Haifa, Israel  
\* (2) University of Haifa, Israel  
\*/

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7.2a.202104051307/crypto/objects/objects.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-
7.2a.202104051307/crypto/c_cryptlib.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-
7.2a.202104051307/include/openssl/objects.h

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7.2a.202104051307/fips/utl/fips_mem.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/fips/utl/fips_err.c

```

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```

/* -----
* crypto/des/asm/nbcb_enc-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
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```

```
*-----
*/
```

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```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/des/asm/ncbc_enc-octeon.c
```

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```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/sha/asm/sha512-ppc.pl
```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/sha/asm/sha1-x86_64.pl
```

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```
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```

```
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```

```
#
```

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```

```
https://www.openssl.org/source/license.html
```

```
#
```

```
=====
```

```
Written by Andy Polyakov <appro@openssl.org> for the OpenSSL
project. The module is, however, dual licensed under OpenSSL and
CRYPTOGAMS licenses depending on where you obtain it. For further
details see http://www.openssl.org/~appro/cryptogams/.
```

```
=====
```

```
#
```

```
GHASH for for PowerISA v2.07.
```

```
#
```

```
July 2014
```

```
#
```

```
Accurate performance measurements are problematic, because it's
```

```
always virtualized setup with possibly throttled processor.
```

```
Relative comparison is therefore more informative. This initial
```

```
version is ~2.1x slower than hardware-assisted AES-128-CTR, ~12x
```

```
faster than "4-bit" integer-only compiler-generated 64-bit code.
```

```
"Initial version" means that there is room for further improvement.
```

```

May 2016
#
2x aggregated reduction improves performance by 50% (resulting
performance on POWER8 is 1 cycle per processed byte), and 4x
aggregated reduction - by 170% or 2.7x (resulting in 0.55 cpb).
POWER9 delivers 0.51 cpb.

$flavour=shift;
$output =shift;

if ($flavour =~ /64/) {
 $SIZE_T=8;
 $LRSAVE=2*$SIZE_T;
 $STU="stdu";
 $POP="ld";
 $PUSH="std";
 $UCMP="cmpld";
 $SHRI="srdi";
} elsif ($flavour =~ /32/) {
 $SIZE_T=4;
 $LRSAVE=$SIZE_T;
 $STU="stwu";
 $POP="lwz";
 $PUSH="stw";
 $UCMP="cmplw";
 $SHRI="srwi";
} else { die "nonsense $flavour"; }

$sp="r1";
$FRAME=6*$SIZE_T+13*16; # 13*16 is for v20-v31 offload

$0 =~ m/(.*[\\])[^\\]+$/; $dir=$1;
($xlate="{ $dir }ppc-xlate.pl" and -f $xlate) or
($xlate="{ $dir }../perlasm/ppc-xlate.pl" and -f $xlate) or
die "can't locate ppc-xlate.pl";

open STDOUT,"| $^X $xlate $flavour $output" || die "can't call $xlate: $!";

my ($Xip,$Htbl,$inp,$len)=map("r$_",(3..6)); # argument block

my ($Xl,$Xm,$Xh,$IN)=map("v$_",(0..3));
my ($zero,$t0,$t1,$t2,$xC2,$H,$Hh,$HI,$lemask)=map("v$_",(4..12));
my ($Xl1,$Xm1,$Xh1,$IN1,$H2,$H2h,$H2l)=map("v$_",(13..19));
my $vrsave="r12";

$code=<<___.
.machine "any"

```



```

.text

.globl .gcm_init_p8
.align 5
.gcm_init_p8:
li r0,-4096
li r8,0x10
mfspr $vrsave,256
li r9,0x20
mfspr 256,r0
li r10,0x30
lvx_u $H,0,r4 # load H

vspltisb $xC2,-16 # 0xf0
vspltisb $t0,1 # one
vaddubm $xC2,$xC2,$xC2 # 0xe0
vxor $zero,$zero,$zero
vor $xC2,$xC2,$t0 # 0xe1
vsldoi $xC2,$xC2,$zero,15 # 0xe1...
vsldoi $t1,$zero,$t0,1 # ...1
vaddubm $xC2,$xC2,$xC2 # 0xc2...
vspltisb $t2,7
vor $xC2,$xC2,$t1 # 0xc2....01
vspltb $t1,$H,0 # most significant byte
vsl $H,$H,$t0 # H<<=1
vsrab $t1,$t1,$t2 # broadcast carry bit
vand $t1,$t1,$xC2
vxor $IN,$H,$t1 # twisted H

vsldoi $H,$IN,$IN,8 # twist even more ...
vsldoi $xC2,$zero,$xC2,8 # 0xc2.0
vsldoi $Hl,$zero,$H,8 # ... and split
vsldoi $Hh,$H,$zero,8

stvx_u $xC2,0,r3 # save pre-computed table
stvx_u $Hl,r8,r3
li r8,0x40
stvx_u $H, r9,r3
li r9,0x50
stvx_u $Hh,r10,r3
li r10,0x60

vpmsumd $Xl,$IN,$Hl # H.lo·H.lo
vpmsumd $Xm,$IN,$H # H.hi·H.lo+H.lo·H.hi
vpmsumd $Xh,$IN,$Hh # H.hi·H.hi

vpmsumd $t2,$Xl,$xC2 # 1st reduction phase

```

```

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vxor $Xl,$Xl,$t0
vxor $Xh,$Xh,$t1

vsldoi $Xl,$Xl,$Xl,8
vxor $Xl,$Xl,$t2

vsldoi $t1,$Xl,$Xl,8 # 2nd reduction phase
vpmsumd $Xl,$Xl,$xC2
vxor $t1,$t1,$Xh
vxor $IN1,$Xl,$t1

vsldoi $H2,$IN1,$IN1,8
vsldoi $H2l,$zero,$H2,8
vsldoi $H2h,$H2,$zero,8

stvx_u $H2l,r8,r3 # save H^2
li r8,0x70
stvx_u $H2,r9,r3
li r9,0x80
stvx_u $H2h,r10,r3
li r10,0x90

{
my ($t4,$t5,$t6) = ($Hl,$H,$Hh);
$code.=<<____;
vpmsumd $Xl,$IN,$H2l # H.lo-H^2.lo
vpmsumd $Xl1,$IN1,$H2l # H^2.lo-H^2.lo
vpmsumd $Xm,$IN,$H2 # H.hi-H^2.lo+H.lo-H^2.hi
vpmsumd $Xm1,$IN1,$H2 # H^2.hi-H^2.lo+H^2.lo-H^2.hi
vpmsumd $Xh,$IN,$H2h # H.hi-H^2.hi
vpmsumd $Xh1,$IN1,$H2h # H^2.hi-H^2.hi

vpmsumd $t2,$Xl,$xC2 # 1st reduction phase
vpmsumd $t6,$Xl1,$xC2 # 1st reduction phase

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vsldoi $t4,$Xm1,$zero,8
vsldoi $t5,$zero,$Xm1,8
vxor $Xl,$Xl,$t0
vxor $Xh,$Xh,$t1
vxor $Xl1,$Xl1,$t4
vxor $Xh1,$Xh1,$t5

vsldoi $Xl,$Xl,$Xl,8

```

```

vsldoi $X11,$X11,$X11,8
vxor $X1,$X1,$t2
vxor $X11,$X11,$t6

vsldoi $t1,$X1,$X1,8 # 2nd reduction phase
vsldoi $t5,$X11,$X11,8 # 2nd reduction phase
vpmsumd $X1,$X1,$xC2
vpmsumd $X11,$X11,$xC2
vxor $t1,$t1,$Xh
vxor $t5,$t5,$Xh1
vxor $X1,$X1,$t1
vxor $X11,$X11,$t5

vsldoi $H,$X1,$X1,8
vsldoi $H2,$X11,$X11,8
vsldoi $H1,$zero,$H,8
vsldoi $Hh,$H,$zero,8
vsldoi $H2l,$zero,$H2,8
vsldoi $H2h,$H2,$zero,8

stvx_u $H1,r8,r3 # save H^3
li r8,0xa0
stvx_u $H,r9,r3
li r9,0xb0
stvx_u $Hh,r10,r3
li r10,0xc0
stvx_u $H2l,r8,r3 # save H^4
stvx_u $H2,r9,r3
stvx_u $H2h,r10,r3

mtspr 256,$vrsave
blr
.long 0
.byte 0,12,0x14,0,0,0,2,0
.long 0
.size .gcm_init_p8,-.gcm_init_p8

}
$code.=<<___;
.globl .gcm_gmult_p8
.align 5
.gcm_gmult_p8:
lis r0,0xffff8
li r8,0x10
mfspr $vrsave,256
li r9,0x20
mtspr 256,r0
li r10,0x30

```

```

lvx_u $IN,0,$Xip # load Xi

lvx_u $Hl,r8,$Htbl # load pre-computed table
le?lvsl $lemask,r0,r0
lvx_u $H, r9,$Htbl
le?vspltsb $t0,0x07
lvx_u $Hh,r10,$Htbl
le?vxor $lemask,$lemask,$t0
lvx_u $xC2,0,$Htbl
le?vperm $IN,$IN,$IN,$lemask
vxor $zero,$zero,$zero

vpmsumd $Xl,$IN,$Hl # H.lo·Xi.lo
vpmsumd $Xm,$IN,$H # H.hi·Xi.lo+H.lo·Xi.hi
vpmsumd $Xh,$IN,$Hh # H.hi·Xi.hi

vpmsumd $t2,$Xl,$xC2 # 1st reduction phase

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vxor $Xl,$Xl,$t0
vxor $Xh,$Xh,$t1

vsldoi $Xl,$Xl,$Xl,8
vxor $Xl,$Xl,$t2

vsldoi $t1,$Xl,$Xl,8 # 2nd reduction phase
vpmsumd $Xl,$Xl,$xC2
vxor $t1,$t1,$Xh
vxor $Xl,$Xl,$t1

le?vperm $Xl,$Xl,$Xl,$lemask
stvx_u $Xl,0,$Xip # write out Xi

mfspr 256,$vrsave
blr
.long 0
.byte 0,12,0x14,0,0,0,2,0
.long 0
.size .gcm_gmult_p8,-.gcm_gmult_p8

.globl .gcm_ghash_p8
.align 5
.gcm_ghash_p8:
li r0,-4096
li r8,0x10
mfspr $vrsave,256
li r9,0x20

```

```

mtspr 256,r0
li r10,0x30
lvx_u $X1,0,$Xip # load Xi

lvx_u $H1,r8,$Htbl # load pre-computed table
li r8,0x40
le?lvsl $lemask,r0,r0
lvx_u $H, r9,$Htbl
li r9,0x50
le?vsplisb $t0,0x07
lvx_u $Hh,r10,$Htbl
li r10,0x60
le?vxor $lemask,$lemask,$t0
lvx_u $xC2,0,$Htbl
le?vperm $X1,$X1,$X1,$lemask
vxor $zero,$zero,$zero

${UCMP}i $len,64
bge Lgcm_ghash_p8_4x

lvx_u $IN,0,$inp
addi $inp,$inp,16
subic. $len,$len,16
le?vperm $IN,$IN,$IN,$lemask
vxor $IN,$IN,$X1
beq Lshort

lvx_u $H2l,r8,$Htbl # load H^2
li r8,16
lvx_u $H2, r9,$Htbl
add r9,$inp,$len # end of input
lvx_u $H2h,r10,$Htbl
be?b Loop_2x

.align 5
Loop_2x:
lvx_u $IN1,0,$inp
le?vperm $IN1,$IN1,$IN1,$lemask

subic $len,$len,32
vpmsumd $X1,$IN,$H2l # H^2.lo·Xi.lo
vpmsumd $X11,$IN1,$H1 # H.lo·Xi+1.lo
subfe r0,r0,r0 # borrow?-1:0
vpmsumd $Xm,$IN,$H2 # H^2.hi·Xi.lo+H^2.lo·Xi.hi
vpmsumd $Xm1,$IN1,$H # H.hi·Xi+1.lo+H.lo·Xi+1.hi
and r0,r0,$len
vpmsumd $Xh,$IN,$H2h # H^2.hi·Xi.hi
vpmsumd $Xh1,$IN1,$Hh # H.hi·Xi+1.hi

```

```

add $inp,$inp,r0

vxor $Xl,$Xl,$Xl1
vxor $Xm,$Xm,$Xm1

vpmsumd $t2,$Xl,$xC2 # 1st reduction phase

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vxor $Xh,$Xh,$Xh1
vxor $Xl,$Xl,$t0
vxor $Xh,$Xh,$t1

vsldoi $Xl,$Xl,$Xl,8
vxor $Xl,$Xl,$t2
lvx_u $IN,r8,$inp
addi $inp,$inp,32

vsldoi $t1,$Xl,$Xl,8 # 2nd reduction phase
vpmsumd $Xl,$Xl,$xC2
le?vperm $IN,$IN,$IN,$lemask
vxor $t1,$t1,$Xh
vxor $IN,$IN,$t1
vxor $IN,$IN,$Xl
$UCMP r9,$inp
bgt Loop_2x # done yet?

cmlwi $len,0
bne Leven

Lshort:
vpmsumd $Xl,$IN,$Hl # H.lo·Xi.lo
vpmsumd $Xm,$IN,$H # H.hi·Xi.lo+H.lo·Xi.hi
vpmsumd $Xh,$IN,$Hh # H.hi·Xi.hi

vpmsumd $t2,$Xl,$xC2 # 1st reduction phase

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vxor $Xl,$Xl,$t0
vxor $Xh,$Xh,$t1

vsldoi $Xl,$Xl,$Xl,8
vxor $Xl,$Xl,$t2

vsldoi $t1,$Xl,$Xl,8 # 2nd reduction phase
vpmsumd $Xl,$Xl,$xC2
vxor $t1,$t1,$Xh

```

```

Leven:
vxor $X1,$X1,$t1
le?vperm $X1,$X1,$X1,$lemask
stvx_u $X1,0,$Xip # write out Xi

mtspr 256,$vrsave
blr
.long 0
.byte 0,12,0x14,0,0,0,4,0
.long 0

——
{
my ($Xl3,$Xm2,$IN2,$H3l,$H3,$H3h,
 $Xh3,$Xm3,$IN3,$H4l,$H4,$H4h) = map("v$_",(20..31));
my $IN0=$IN;
my ($H21l,$H21h,$loperm,$hiperm) = ($Hl,$Hh,$H2l,$H2h);

$code.=<<____;
.align 5
.gcm_ghash_p8_4x:
Lgcm_ghash_p8_4x:
$STU $sp,-$FRAME($sp)
li r10,`15+6*$SIZE_T`
li r11,`31+6*$SIZE_T`
stvx v20,r10,$sp
addi r10,r10,32
stvx v21,r11,$sp
addi r11,r11,32
stvx v22,r10,$sp
addi r10,r10,32
stvx v23,r11,$sp
addi r11,r11,32
stvx v24,r10,$sp
addi r10,r10,32
stvx v25,r11,$sp
addi r11,r11,32
stvx v26,r10,$sp
addi r10,r10,32
stvx v27,r11,$sp
addi r11,r11,32
stvx v28,r10,$sp
addi r10,r10,32
stvx v29,r11,$sp
addi r11,r11,32
stvx v30,r10,$sp
li r10,0x60
stvx v31,r11,$sp

```

```

li r0,-1
stw $vrsave,`$FRAME-4`($sp) # save vrsave
mtspr 256,r0 # preserve all AltiVec registers

lvsl $t0,0,r8 # 0x0001..0e0f
#lvx_u $H2l,r8,$Htbl # load H^2
li r8,0x70
lvx_u $H2, r9,$Htbl
li r9,0x80
vspltisb $t1,8 # 0x0808..0808
#lvx_u $H2h,r10,$Htbl
li r10,0x90
lvx_u $H3l,r8,$Htbl # load H^3
li r8,0xa0
lvx_u $H3, r9,$Htbl
li r9,0xb0
lvx_u $H3h,r10,$Htbl
li r10,0xc0
lvx_u $H4l,r8,$Htbl # load H^4
li r8,0x10
lvx_u $H4, r9,$Htbl
li r9,0x20
lvx_u $H4h,r10,$Htbl
li r10,0x30

vsldoi $t2,$zero,$t1,8 # 0x0000..0808
vaddubm $hiperm,$t0,$t2 # 0x0001..1617
vaddubm $loperm,$t1,$hiperm # 0x0809..1e1f

$SHRI $len,$len,4 # this allows to use sign bit
as carry
lvx_u $IN0,0,$inp # load input
lvx_u $IN1,r8,$inp
subic. $len,$len,8
lvx_u $IN2,r9,$inp
lvx_u $IN3,r10,$inp
addi $inp,$inp,0x40
le?vperm $IN0,$IN0,$IN0,$lemask
le?vperm $IN1,$IN1,$IN1,$lemask
le?vperm $IN2,$IN2,$IN2,$lemask
le?vperm $IN3,$IN3,$IN3,$lemask

vxor $Xh,$IN0,$XI

vpmsumd $X11,$IN1,$H3l
vpmsumd $Xm1,$IN1,$H3
vpmsumd $Xh1,$IN1,$H3h

```



```

vperm $H211,$H2,$H,$hiperm
vperm $t0,$IN2,$IN3,$loperm
vperm $H21h,$H2,$H,$loperm
vperm $t1,$IN2,$IN3,$hiperm
vpmsumd $Xm2,$IN2,$H2 # H^2.lo·Xi+2.hi+H^2.hi·Xi+2.lo
vpmsumd $Xl3,$t0,$H211 # H^2.lo·Xi+2.lo+H.lo·Xi+3.lo
vpmsumd $Xm3,$IN3,$H # H.hi·Xi+3.lo +H.lo·Xi+3.hi
vpmsumd $Xh3,$t1,$H21h # H^2.hi·Xi+2.hi+H.hi·Xi+3.hi

```

```

vxor $Xm2,$Xm2,$Xm1
vxor $Xl3,$Xl3,$Xl1
vxor $Xm3,$Xm3,$Xm2
vxor $Xh3,$Xh3,$Xh1

```

```

blt Ltail_4x

```

```

Loop_4x:

```

```

lvx_u $IN0,0,$inp
lvx_u $IN1,r8,$inp
subic. $len,$len,4
lvx_u $IN2,r9,$inp
lvx_u $IN3,r10,$inp
addi $inp,$inp,0x40
le?vperm $IN1,$IN1,$IN1,$lemask
le?vperm $IN2,$IN2,$IN2,$lemask
le?vperm $IN3,$IN3,$IN3,$lemask
le?vperm $IN0,$IN0,$IN0,$lemask

```

```

vpmsumd $Xl,$Xh,$H4l # H^4.lo·Xi.lo
vpmsumd $Xm,$Xh,$H4 # H^4.hi·Xi.lo+H^4.lo·Xi.hi
vpmsumd $Xh,$Xh,$H4h # H^4.hi·Xi.hi
vpmsumd $Xl1,$IN1,$H3l
vpmsumd $Xm1,$IN1,$H3
vpmsumd $Xh1,$IN1,$H3h

```

```

vxor $Xl,$Xl,$Xl3
vxor $Xm,$Xm,$Xm3
vxor $Xh,$Xh,$Xh3
vperm $t0,$IN2,$IN3,$loperm
vperm $t1,$IN2,$IN3,$hiperm

```

```

vpmsumd $t2,$Xl,$xC2 # 1st reduction phase
vpmsumd $Xl3,$t0,$H211 # H.lo·Xi+3.lo +H^2.lo·Xi+2.lo
vpmsumd $Xh3,$t1,$H21h # H.hi·Xi+3.hi +H^2.hi·Xi+2.hi

```

```

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vxor $Xl,$Xl,$t0

```

```

vxor $Xh,$Xh,$t1

vsldoi $X1,$X1,$X1,8
vxor $X1,$X1,$t2

vsldoi $t1,$X1,$X1,8 # 2nd reduction phase
vpmsumd $Xm2,$IN2,$H2 # H^2.hi·Xi+2.lo+H^2.lo·Xi+2.hi
vpmsumd $Xm3,$IN3,$H # H.hi·Xi+3.lo +H.lo·Xi+3.hi
vpmsumd $X1,$X1,$xC2

vxor $X13,$X13,$X11
vxor $Xh3,$Xh3,$Xh1
vxor $Xh,$Xh,$IN0
vxor $Xm2,$Xm2,$Xm1
vxor $Xh,$Xh,$t1
vxor $Xm3,$Xm3,$Xm2
vxor $Xh,$Xh,$X1
bge Loop_4x

Ltail_4x:
vpmsumd $X1,$Xh,$H4l # H^4.lo·Xi.lo
vpmsumd $Xm,$Xh,$H4 # H^4.hi·Xi.lo+H^4.lo·Xi.hi
vpmsumd $Xh,$Xh,$H4h # H^4.hi·Xi.hi

vxor $X1,$X1,$X13
vxor $Xm,$Xm,$Xm3

vpmsumd $t2,$X1,$xC2 # 1st reduction phase

vsldoi $t0,$Xm,$zero,8
vsldoi $t1,$zero,$Xm,8
vxor $Xh,$Xh,$Xh3
vxor $X1,$X1,$t0
vxor $Xh,$Xh,$t1

vsldoi $X1,$X1,$X1,8
vxor $X1,$X1,$t2

vsldoi $t1,$X1,$X1,8 # 2nd reduction phase
vpmsumd $X1,$X1,$xC2
vxor $t1,$t1,$Xh
vxor $X1,$X1,$t1

addic $len,$len,4
beq Ldone_4x

lvx_u $IN0,0,$inp
${UCMP}i $len,2

```

```
li $len,-4
blt Lone
lvx_u $IN1,r8,$inp
beq Ltwo
```

Lthree:

```
lvx_u $IN2,r9,$inp
le?vperm $IN0,$IN0,$IN0,$lemask
le?vperm $IN1,$IN1,$IN1,$lemask
le?vperm $IN2,$IN2,$IN2,$lemask
```

```
vxor $Xh,$IN0,$Xl
vmr $H4l,$H3l
vmr $H4, $H3
vmr $H4h,$H3h
```

```
vperm $t0,$IN1,$IN2,$loperm
vperm $t1,$IN1,$IN2,$hiperm
vpmsumd $Xm2,$IN1,$H2 # H^2.lo·Xi+1.hi+H^2.hi·Xi+1.lo
vpmsumd $Xm3,$IN2,$H # H.hi·Xi+2.lo +H.lo·Xi+2.hi
vpmsumd $Xl3,$t0,$H2l1 # H^2.lo·Xi+1.lo+H.lo·Xi+2.lo
vpmsumd $Xh3,$t1,$H2lh # H^2.hi·Xi+1.hi+H.hi·Xi+2.hi
```

```
vxor $Xm3,$Xm3,$Xm2
b Ltail_4x
```

.align 4

Ltwo:

```
le?vperm $IN0,$IN0,$IN0,$lemask
le?vperm $IN1,$IN1,$IN1,$lemask
```

```
vxor $Xh,$IN0,$Xl
vperm $t0,$zero,$IN1,$loperm
vperm $t1,$zero,$IN1,$hiperm
```

```
vsldoi $H4l,$zero,$H2,8
vmr $H4, $H2
vsldoi $H4h,$H2,$zero,8
```

```
vpmsumd $Xl3,$t0, $H2l1 # H.lo·Xi+1.lo
vpmsumd $Xm3,$IN1,$H # H.hi·Xi+1.lo+H.lo·Xi+2.hi
vpmsumd $Xh3,$t1, $H2lh # H.hi·Xi+1.hi
```

b Ltail\_4x

.align 4

Lone:

```
le?vperm $IN0,$IN0,$IN0,$lemask
```

```
vsldoi $H4,$zero,$H,8
vmr $H4, $H
vsldoi $H4h,$H,$zero,8
```

```
vxor $Xh,$IN0,$Xl
vxor $Xl3,$Xl3,$Xl3
vxor $Xm3,$Xm3,$Xm3
vxor $Xh3,$Xh3,$Xh3
```

```
b Ltail_4x
```

```
Ldone_4x:
```

```
le?vperm $Xl,$Xl,$Xl,$lemask
stvx_u $Xl,0,$Xip # write out Xi
```

```
li r10,`15+6*$SIZE_T`
li r11,`31+6*$SIZE_T`
mvspr 256,$vrsave
lvx v20,r10,$sp
addi r10,r10,32
lvx v21,r11,$sp
addi r11,r11,32
lvx v22,r10,$sp
addi r10,r10,32
lvx v23,r11,$sp
addi r11,r11,32
lvx v24,r10,$sp
addi r10,r10,32
lvx v25,r11,$sp
addi r11,r11,32
lvx v26,r10,$sp
addi r10,r10,32
lvx v27,r11,$sp
addi r11,r11,32
lvx v28,r10,$sp
addi r10,r10,32
lvx v29,r11,$sp
addi r11,r11,32
lvx v30,r10,$sp
lvx v31,r11,$sp
addi $sp,$sp,$FRAME
blr
.long 0
.byte 0,12,0x04,0,0x80,0,4,0
.long 0
}
}
```

```
$code.=<<____;
.size .gcm_ghash_p8,-.gcm_ghash_p8

.asciz "GHASH for PowerISA 2.07, CRYPTOGRAMS by <appro\@openssl.org>"
.align 2
```

```
—

foreach (split("\n",$code)) {
s^\([^`]*\)\/eval $1/geo;

if ($flavour =~ /le$/o) { # little-endian
s/le?//o or
s/be\?/#be#/o;
} else {
s/le\?/#le#/o or
s/be\?//o;
}
print $_, "\n";
}
```

```
close STDOUT; # enforce flush
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/modes/asm/ghashp8-ppc.pl
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 \* =====  
 \*  
 \* This product includes cryptographic software written by Eric Young  
 \* (eay@cryptsoft.com). This product includes software written by Tim  
 \* Hudson (tjh@cryptsoft.com).  
 \*  
 \*/

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/o\_str.h

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/\*-----

\* fips/kdf/fips\_kdf\_ssh.c - SSH KDF vector tests

\*

\* March 2015

\*

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/test/fips\_kdf\_ssh.c

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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/include/internal/evp\_locl.h

\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/include/internalevp\_locl.h

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```

The inner loop instruction sequence and the IP/FP modifications are from
Svend Olaf Mikkelsen

$0 =~ m/(.*[\\])(^\\|)+$/; $dir=$1;
push(@INC,"${dir}","${dir}../../perlasm");
require "x86asm.pl";

$output=pop;

&asm_init($ARGV[0]);

$L="edi";
$R="esi";

&external_label("DES_SPtrans");
&fcrypt_body("fcrypt_body");
&asm_finish();

sub fcrypt_body
{
local($name,$do_ip)=@_;

&function_begin($name);

&comment("");
&comment("Load the 2 words");
$trans="ebp";

&xor($L,$L);
&xor($R,$R);

PIC-ification:-)
&picmeup("edx","DES_SPtrans");
#if ($cpp) { &picmeup("edx","DES_SPtrans"); }
#else { &lea("edx",&DWP("DES_SPtrans")); }
&push("edx"); # becomes &swtmp(1)
#
&mov($trans,&wparam(1)); # reloaded with DES_SPtrans in D_ENCRYPT

&push(&DWC(25)); # add a variable

&set_label("start");
for ($i=0; $i<16; $i+=2)
{
&comment("");
&comment("Round $i");
&D_ENCRYPT($i,$L,$R,$i*2,$trans,"eax","ebx","ecx","edx");
}
}

```

```

&comment("");
&comment("Round ".sprintf("%d", $i+1));
&D_ENCRYPT($i+1, $R, $L, ($i+1)*2, $trans, "eax", "ebx", "ecx", "edx");
}
&mov("ebx", &swtmp(0));
&mov("eax", $L);
&dec("ebx");
&mov($L, $R);
&mov($R, "eax");
&mov(&swtmp(0), "ebx");
&jnz(&label("start"));

&comment("");
&comment("FP");
&mov("edx", &wparam(0));

&FP_new($R, $L, "eax", 3);
&mov(&DWP(0, "edx", "", 0), "eax");
&mov(&DWP(4, "edx", "", 0), $L);

&add("esp", 8); # remove variables

&function_end($name);
}

sub D_ENCRYPT
{
local ($r, $l, $r, $s, $trans, $u, $tmp1, $tmp2, $t) = @_;

&mov($u, &wparam(2)); # 2
&mov($t, $R);
&shr($t, 16); # 1
&mov($tmp2, &wparam(3)); # 2
&xor($t, $R); # 1

&and($u, $t); # 2
&and($t, $tmp2); # 2

&mov($tmp1, $u);
&shl($tmp1, 16); # 1
&mov($tmp2, $t);
&shl($tmp2, 16); # 1
&xor($u, $tmp1); # 2
&xor($t, $tmp2); # 2
&mov($tmp1, &DWP(&n2a($S*4), $trans, "", 0)); # 2
&xor($u, $tmp1);
&mov($tmp2, &DWP(&n2a(($S+1)*4), $trans, "", 0)); # 2

```

```

&xor($u, $R);
&xor($t, $R);
&xor($t, $tmp2);

&and($u, "0xfcfcfcfc"); # 2
&xor($tmp1, $tmp1); # 1
&and($t, "0xfcfcfcfc"); # 2
&xor($tmp2, $tmp2);
&movb(&LB($tmp1), &LB($u));
&movb(&LB($tmp2), &HB($u));
&rotr($t, 4);
&mov($trans, &swtmp(1));
&xor($L, &DWP(" ", $trans, $tmp1, 0));
&movb(&LB($tmp1), &LB($t));
&xor($L, &DWP("0x200", $trans, $tmp2, 0));
&movb(&LB($tmp2), &HB($t));
&shr($u, 16);
&xor($L, &DWP("0x100", $trans, $tmp1, 0));
&movb(&LB($tmp1), &HB($u));
&shr($t, 16);
&xor($L, &DWP("0x300", $trans, $tmp2, 0));
&movb(&LB($tmp2), &HB($t));
&and($u, "0xff");
&and($t, "0xff");
&mov($tmp1, &DWP("0x600", $trans, $tmp1, 0));
&xor($L, $tmp1);
&mov($tmp1, &DWP("0x700", $trans, $tmp2, 0));
&xor($L, $tmp1);
&mov($tmp1, &DWP("0x400", $trans, $u, 0));
&xor($L, $tmp1);
&mov($tmp1, &DWP("0x500", $trans, $t, 0));
&xor($L, $tmp1);
&mov($trans, &wparam(1));
}

```

```

sub n2a
{
printf("%d", $_[0]);
}

```

# now has a side affect of rotating \$a by \$shift

```

sub R_PERM_OP
{
local($a,$b,$tt,$shift,$mask,$last)=@_;

```

```

&rotr($a, $shift) if ($shift != 0);
&mov($tt, $a);
&xor($a, $b);

```

```

&and($a, $mask);
if ($notlast eq $b)
{
&xor($b, $a);
&xor($tt, $a);
}
else
{
&xor($tt, $a);
&xor($b, $a);
}
&comment("");
}

sub IP_new
{
local($l,$r,$tt,$lr)=@_;

&R_PERM_OP($l,$r,$tt, 4, "0xf0f0f0f0", $l);
&R_PERM_OP($r,$tt,$l,20, "0xfff0000f", $l);
&R_PERM_OP($l,$tt,$r,14, "0x33333333", $r);
&R_PERM_OP($tt,$r,$l,22, "0x03fc03fc", $r);
&R_PERM_OP($l,$r,$tt, 9, "0xaaaaaaaaa", $r);

if ($lr != 3)
{
if (($lr-3) < 0)
{ &rotr($tt, 3-$lr); }
else { &rotr($tt, $lr-3); }
}
if ($lr != 2)
{
if (($lr-2) < 0)
{ &rotr($r, 2-$lr); }
else { &rotr($r, $lr-2); }
}
}

sub FP_new
{
local($l,$r,$tt,$lr)=@_;

if ($lr != 2)
{
if (($lr-2) < 0)
{ &rotr($r, 2-$lr); }
else { &rotr($r, $lr-2); }
}
}

```

```

if ($lr != 3)
{
if (($lr-3) < 0)
{ &rotr($l, 3-$lr); }
else { &rotr($l, $lr-3); }
}

&R_PERM_OP($l,$r,$tt, 0,"0xaaaaaaaa", $r);
&R_PERM_OP($tt,$r,$l,23,"0x03fc03fc", $r);
&R_PERM_OP($l,$r,$tt,10,"0x33333333", $l);
&R_PERM_OP($r,$tt,$l,18,"0xffff000f", $l);
&R_PERM_OP($l,$tt,$r,12,"0xf0f0f0f0", $r);
&rotr($tt , 4);
}

```

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```

/* -----
* crypto/sha/asm/sha256-octeon.c - Cavium Octeon specific hardware assist
* functionality that is to reside within the FIPS canister.
*
* January 2013
*
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* -----
*/

```

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```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/modes/gcm128.c
```

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https://www.openssl.org/source/license.html
```

```
$0 =~ m/(.*[\\])[^\\]+$/; $dir=$1;
push(@INC,"${dir}","${dir}../perlasm");
require "x86asm.pl";
```

```
$output = pop;
```

```
&asm_init($ARGV[0]);
```

```
&bn_mul_comba("bn_mul_comba8",8);
&bn_mul_comba("bn_mul_comba4",4);
&bn_sqr_comba("bn_sqr_comba8",8);
&bn_sqr_comba("bn_sqr_comba4",4);
```

```
&asm_finish();
```

```
sub mul_add_c
```

```
{
local($a,$ai,$b,$bi,$c0,$c1,$c2,$pos,$i,$na,$nb)=@_;
```

```
pos == -1 if eax and edx are pre-loaded, 0 to load from next
words, and 1 if load return value
```

```
&comment("mul a[$ai]*b[$bi]");
```

```
"eax" and "edx" will always be pre-loaded.
```

```
&mov("eax",&DWP($ai*4,$a,"",0)) ;
```

```
&mov("edx",&DWP($bi*4,$b,"",0));
```

```
&mul("edx");
```

```
&add($c0,"eax");
```

```
&mov("eax",&DWP(($na)*4,$a,"",0)) if $pos == 0; # laod next a
```

```
&mov("eax",&wparam(0)) if $pos > 0; # load r[]
```

```
###
```

```
&adc($c1,"edx");
```

```
&mov("edx",&DWP(($nb)*4,$b,"",0)) if $pos == 0; # laod next b
```

```

&mov("edx",&DWP((\$nb)*4,\$b,"",0)) if $pos == 1; # load next b
###
&adc($c2,0);
is pos > 1, it means it is the last loop
&mov(&DWP($i*4,"eax","",0),$c0) if $pos > 0; # save r[];
&mov("eax",&DWP((\$na)*4,\$a,"",0)) if $pos == 1; # load next a
}

sub sqr_add_c
{
local($r,$a,$ai,$bi,$c0,$c1,$c2,$pos,$i,$na,$nb)=@_;

pos == -1 if eax and edx are pre-loaded, 0 to load from next
words, and 1 if load return value

&comment("sqr a[$ai]*a[$bi]");

"eax" and "edx" will always be pre-loaded.
&mov("eax",&DWP($ai*4,\$a,"",0)) ;
&mov("edx",&DWP($bi*4,\$b,"",0));

if ($ai == $bi)
{ &mul("eax");}
else
{ &mul("edx");}
&add($c0,"eax");
&mov("eax",&DWP((\$na)*4,\$a,"",0)) if $pos == 0; # load next a
###
&adc($c1,"edx");
&mov("edx",&DWP((\$nb)*4,\$a,"",0)) if ($pos == 1) && ($na != $nb);
###
&adc($c2,0);
is pos > 1, it means it is the last loop
&mov(&DWP($i*4,$r,"",0),$c0) if $pos > 0; # save r[];
&mov("eax",&DWP((\$na)*4,\$a,"",0)) if $pos == 1; # load next b
}

sub sqr_add_c2
{
local($r,$a,$ai,$bi,$c0,$c1,$c2,$pos,$i,$na,$nb)=@_;

pos == -1 if eax and edx are pre-loaded, 0 to load from next
words, and 1 if load return value

&comment("sqr a[$ai]*a[$bi]");

"eax" and "edx" will always be pre-loaded.
&mov("eax",&DWP($ai*4,\$a,"",0)) ;

```

```

&mov("edx",&DWP($bi*4,$a,"",0));

if ($ai == $bi)
 { &mul("eax");}
else
 { &mul("edx");}
&add("eax","eax");
###
&adc("edx","edx");
###
&adc($c2,0);
&add($c0,"eax");
&adc($c1,"edx");
&mov("eax",&DWP(($na)*4,$a,"",0)) if $pos == 0; # load next a
&mov("eax",&DWP(($na)*4,$a,"",0)) if $pos == 1; # load next b
&adc($c2,0);
&mov(&DWP($i*4,$r,"",0),$c0) if $pos > 0; # save r[];
&mov("edx",&DWP(($nb)*4,$a,"",0)) if ($pos <= 1) && ($na != $nb);
###
}

```

```
sub bn_mul_comba
```

```

{
local($name,$num)=@_;
local($a,$b,$c0,$c1,$c2);
local($i,$as,$ae,$bs,$be,$ai,$bi);
local($tot,$end);

```

```
&function_begin_B($name,"");
```

```

$c0="ebx";
$c1="ecx";
$c2="ebp";
$a="esi";
$b="edi";

```

```

$as=0;
$ae=0;
$bs=0;
$be=0;
$tot=$num+$num-1;

```

```

&push("esi");
&mov($a,&wparam(1));
&push("edi");
&mov($b,&wparam(2));
&push("ebp");
&push("ebx");

```



```

&xor($c0,$c0);
&mov("eax",&DWP(0,$a,"",0)); # load the first word
&xor($c1,$c1);
&mov("edx",&DWP(0,$b,"",0)); # load the first second

for ($i=0; $i<$tot; $i++)
{
 $ai=$as;
 $bi=$bs;
 $end=$be+1;

 &comment("##### Calculate word $i");

 for ($j=$bs; $j<$end; $j++)
 {
 &xor($c2,$c2) if ($j == $bs);
 if (($j+1) == $end)
 {
 $v=1;
 $v=2 if (($i+1) == $tot);
 }
 else
 { $v=0; }
 if (($j+1) != $end)
 {
 $na=($ai-1);
 $nb=($bi+1);
 }
 else
 {
 $na=$as+($i < ($num-1));
 $nb=$bs+($i >= ($num-1));
 }
 }
 #printf STDERR "[$ai,$bi] -> [$na,$nb]\n";
 &mul_add_c($a,$ai,$b,$bi,$c0,$c1,$c2,$v,$i,$na,$nb);
 if ($v)
 {
 &comment("saved r[$i]");
 # &mov("eax",&wparam(0));
 # &mov(&DWP($i*4,"eax","",0),$c0);
 ($c0,$c1,$c2)=($c1,$c2,$c0);
 }
 $ai--;
 $bi++;
}
$as++ if ($i < ($num-1));
$ae++ if ($i >= ($num-1));

```

```

$bs++ if ($i >= ($num-1));
$be++ if ($i < ($num-1));
}
&comment("save r[$i]");
&mov("eax",&wparam(0));
&mov(&DWP($i*4,"eax","",0),$c0);

&pop("ebx");
&pop("ebp");
&pop("edi");
&pop("esi");
&ret();
&function_end_B($name);
}

sub bn_sqr_comba
{
local($name,$num)=@_;
local($r,$a,$c0,$c1,$c2)=@_;
local($i,$as,$ae,$bs,$be,$ai,$bi);
local($b,$tot,$end,$half);

&function_begin_B($name,"");

$c0="ebx";
$c1="ecx";
$c2="ebp";
$a="esi";
$r="edi";

&push("esi");
&push("edi");
&push("ebp");
&push("ebx");
&mov($r,&wparam(0));
&mov($a,&wparam(1));
&xor($c0,$c0);
&xor($c1,$c1);
&mov("eax",&DWP(0,$a","",0)); # load the first word

$as=0;
$ae=0;
$bs=0;
$be=0;
$tot=$num+$num-1;

for ($i=0; $i<$tot; $i++)

```

```

{
 $ai=$as;
 $bi=$bs;
 $end=$be+1;

 &comment("##### Calculate word $i");
 for ($j=$bs; $j<$end; $j++)
 {
 &xor($c2,$c2) if ($j == $bs);
 if (($ai-1) < ($bi+1))
 {
 $v=1;
 $v=2 if ($i+1) == $tot;
 }
 else
 { $v=0; }
 if (!$v)
 {
 $na=$ai-1;
 $nb=$bi+1;
 }
 else
 {
 $na=$as+($i < ($num-1));
 $nb=$bs+($i >= ($num-1));
 }
 if ($ai == $bi)
 {
 &sqr_add_c($r,$a,$ai,$bi,
 $c0,$c1,$c2,$v,$i,$na,$nb);
 }
 else
 {
 &sqr_add_c2($r,$a,$ai,$bi,
 $c0,$c1,$c2,$v,$i,$na,$nb);
 }
 if ($v)
 {
 &comment("saved r[$i]");
 #&mov(&DWP($i*4,$r,"",0),$c0);
 ($c0,$c1,$c2)=$c1,$c2,$c0;
 last;
 }
 $ai--;
 $bi++;
 }
 $as++ if ($i < ($num-1));
 $ae++ if ($i >= ($num-1));

```

```

$bs++ if ($i >= ($num-1));
$be++ if ($i < ($num-1));
}
&mov(&DWP($i*4,$r,"",0),$c0);
&pop("ebx");
&pop("ebp");
&pop("edi");
&pop("esi");
&ret();
&function_end_B($name);
}

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/bn/asm/co-586.pl

```

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```

* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/lhash/lhash.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/rsa/rsa_gen.c
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/evp/evp.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/thread_once.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/e_os2.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/include/internal/thread_once.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/rsa/rsa_ssl.c
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/include/openssl/lhash.h
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/crypto/rsa/rsa_ossl.c
* /opt/cola/permits/1337210439_1687523530.3818/0/cisccssl-fom-7-2a-202104051307-tar-gz/cisccssl-fom-7.2a.202104051307/include/internal/cryptlib.h

```

```
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/bn_prime.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/bn_exp.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/cryptlib.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/dh/dh_gen.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/hmac/hmac.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/dsa/dsa_gen.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/dsa/dsa_ossl.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/include/openssl/evp.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/dh/dh_key.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/bn_lib.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/rsa/rsa_x931g.c
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* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/dh/dh_check.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/rsa/rsa_pk1.c
```

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* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/x86_64-mont.pl
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/x86-mont.pl
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\* /opt/cola/permits/1337210439\_1687523530.3818/0/cissocssl-fom-7-2a-202104051307-tar-gz/cissocssl-fom-7.2a.202104051307/crypto/nelem.h

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- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/test/fips\_hmactest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/fips/cmac/fips\_cmactest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/test/fips\_shatest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/fips/sha/fips\_shatest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/rsa/rsa\_x931.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/fips/rsa/fips\_rsavtest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/fips/rsa/fips\_rsastest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/test/fips\_rsastest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/test/fips\_cmactest.c
- \* /opt/cola/permits/1337210439\_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/fips/hmac/fips\_hmactest.c

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*
*/

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```

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7.2a.202104051307/crypto/aes/aes_cfb.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes_ofb.c

```

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```

/*-----
* fips/kdf/fips_kdf_srtp.c - SRTP KDF vector tests
*
* March 2015
*
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*-----
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```

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```

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7.2a.202104051307/test/fips_kdf_srtp.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-

```

7.2a.202104051307/fips/kdf/fips\_kdf\_srtp.c

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=====
#
Keccak-1600 for PPC64.
#
June 2017.
#
This is straightforward KECCAK_1X_ALT implementation that works on
any PPC64. Then PowerISA 2.07 adds 2x64-bit vector rotate, and
it's possible to achieve performance better than below, but that is
naturally option only for POWER8 and successors...
#
#####
Numbers are cycles per processed byte.
#
r=1088(*)
#
PPC970/G5 14.6/+120%
POWER7 10.3/+100%
POWER8 11.5/+85%
POWER9 9.4/+45%
#
(*) Corresponds to SHA3-256. Percentage after slash is improvement
over gcc-4.x-generated KECCAK_1X_ALT code. Newer compilers do
much better (but watch out for them generating code specific
to processor they execute on).

$flavour = shift;

if ($flavour =~ /64/) {
 $SIZE_T = 8;
 $LRSIZE = 2*$SIZE_T;
 $UCMP = "cpld";
 $STU = "std";
 $POP = "ld";
 $PUSH = "std";
} else { die "nonsense $flavour"; }

$0 =~ m/(.*/[\\])(^\\|)+$/; $dir=$1;
($xlate="{dir}ppc-xlate.pl" and -f $xlate) or

```

```
($xlate="${dir}../../perlasm/ppc-xlate.pl" and -f $xlate) or
die "can't locate ppc-xlate.pl";
```

```
open STDOUT,"|^X $xlate $flavour ".shift || die "can't call $xlate: $!";
```

```
$FRAME=24*$SIZE_T+6*$SIZE_T+32;
```

```
$LOCALS=6*$SIZE_T;
```

```
$TEMP=$LOCALS+6*$SIZE_T;
```

```
my $sp ="r1";
```

```
my @A = map(["r$_", "r".($_+1), "r".($_+2), "r".($_+3), "r".($_+4)],
 (7, 12, 17, 22, 27));
```

```
 $A[1][1] = "r6"; # r13 is reserved
```

```
my @C = map("r$_", (0,3,4,5));
```

```
my @rhotates = ([0, 1, 62, 28, 27],
```

```
 [36, 44, 6, 55, 20],
```

```
 [3, 10, 43, 25, 39],
```

```
 [41, 45, 15, 21, 8],
```

```
 [18, 2, 61, 56, 14]);
```

```
$code.=<<<__;
```

```
.text
```

```
.type KeccakF1600_int,\@function
```

```
.align 5
```

```
KeccakF1600_int:
```

```
li r0,24
```

```
mtctr r0
```

```
b .Loop
```

```
.align 4
```

```
.Loop:
```

```
xor $C[0],$A[0][0],$A[1][0] ; Theta
```

```
std $A[0][4],`$TEMP+0`($sp)
```

```
xor $C[1],$A[0][1],$A[1][1]
```

```
std $A[1][4],`$TEMP+8`($sp)
```

```
xor $C[2],$A[0][2],$A[1][2]
```

```
std $A[2][4],`$TEMP+16`($sp)
```

```
xor $C[3],$A[0][3],$A[1][3]
```

```
std $A[3][4],`$TEMP+24`($sp)
```

```

```

```
$C[4]=$A[0][4];
```

```
$C[5]=$A[1][4];
```

```
$C[6]=$A[2][4];
```

```
$C[7]=$A[3][4];
```

```
$code.=<<<__;
```

```

xor $C[4],$A[0][4],$A[1][4]
xor $C[0],$C[0],$A[2][0]
xor $C[1],$C[1],$A[2][1]
xor $C[2],$C[2],$A[2][2]
xor $C[3],$C[3],$A[2][3]
xor $C[4],$C[4],$A[2][4]
xor $C[0],$C[0],$A[3][0]
xor $C[1],$C[1],$A[3][1]
xor $C[2],$C[2],$A[3][2]
xor $C[3],$C[3],$A[3][3]
xor $C[4],$C[4],$A[3][4]
xor $C[0],$C[0],$A[4][0]
xor $C[2],$C[2],$A[4][2]
xor $C[1],$C[1],$A[4][1]
xor $C[3],$C[3],$A[4][3]
rotldi $C[5],$C[2],1
xor $C[4],$C[4],$A[4][4]
rotldi $C[6],$C[3],1
xor $C[5],$C[5],$C[0]
rotldi $C[7],$C[4],1

```

```

xor $A[0][1],$A[0][1],$C[5]
xor $A[1][1],$A[1][1],$C[5]
xor $A[2][1],$A[2][1],$C[5]
xor $A[3][1],$A[3][1],$C[5]
xor $A[4][1],$A[4][1],$C[5]

```

```

rotldi $C[5],$C[0],1
xor $C[6],$C[6],$C[1]
xor $C[2],$C[2],$C[7]
rotldi $C[7],$C[1],1
xor $C[3],$C[3],$C[5]
xor $C[4],$C[4],$C[7]

```

```

xor $C[1], $A[0][2],$C[6] ;mr $C[1],$A[0][2]
xor $A[1][2],$A[1][2],$C[6]
xor $A[2][2],$A[2][2],$C[6]
xor $A[3][2],$A[3][2],$C[6]
xor $A[4][2],$A[4][2],$C[6]

```

```

xor $A[0][0],$A[0][0],$C[4]
xor $A[1][0],$A[1][0],$C[4]
xor $A[2][0],$A[2][0],$C[4]
xor $A[3][0],$A[3][0],$C[4]
xor $A[4][0],$A[4][0],$C[4]

```

—  
\$C[4]=undef;

\$C[5]=undef;

```

$C[6]=undef;
$C[7]=undef;
$code.=<<____;
ld $A[0][4],`$TEMP+0`($sp)
xor $C[0], $A[0][3],$C[2] ;mr $C[0],$A[0][3]
ld $A[1][4],`$TEMP+8`($sp)
xor $A[1][3],$A[1][3],$C[2]
ld $A[2][4],`$TEMP+16`($sp)
xor $A[2][3],$A[2][3],$C[2]
ld $A[3][4],`$TEMP+24`($sp)
xor $A[3][3],$A[3][3],$C[2]
xor $A[4][3],$A[4][3],$C[2]

xor $C[2], $A[0][4],$C[3] ;mr $C[2],$A[0][4]
xor $A[1][4],$A[1][4],$C[3]
xor $A[2][4],$A[2][4],$C[3]
xor $A[3][4],$A[3][4],$C[3]
xor $A[4][4],$A[4][4],$C[3]

mr $C[3],$A[0][1] ; Rho+Pi
rotldi $A[0][1],$A[1][1],$rhotates[1][1]
;mr $C[1],$A[0][2]
rotldi $A[0][2],$A[2][2],$rhotates[2][2]
;mr $C[0],$A[0][3]
rotldi $A[0][3],$A[3][3],$rhotates[3][3]
;mr $C[2],$A[0][4]
rotldi $A[0][4],$A[4][4],$rhotates[4][4]

rotldi $A[1][1],$A[1][4],$rhotates[1][4]
rotldi $A[2][2],$A[2][3],$rhotates[2][3]
rotldi $A[3][3],$A[3][2],$rhotates[3][2]
rotldi $A[4][4],$A[4][1],$rhotates[4][1]

rotldi $A[1][4],$A[4][2],$rhotates[4][2]
rotldi $A[2][3],$A[3][4],$rhotates[3][4]
rotldi $A[3][2],$A[2][1],$rhotates[2][1]
rotldi $A[4][1],$A[1][3],$rhotates[1][3]

rotldi $A[4][2],$A[2][4],$rhotates[2][4]
rotldi $A[3][4],$A[4][3],$rhotates[4][3]
rotldi $A[2][1],$A[1][2],$rhotates[1][2]
rotldi $A[1][3],$A[3][1],$rhotates[3][1]

rotldi $A[2][4],$A[4][0],$rhotates[4][0]
rotldi $A[4][3],$A[3][0],$rhotates[3][0]
rotldi $A[1][2],$A[2][0],$rhotates[2][0]
rotldi $A[3][1],$A[1][0],$rhotates[1][0]

```

```

rotldi $A[1][0],$C[0],$rhotates[0][3]
rotldi $A[2][0],$C[3],$rhotates[0][1]
rotldi $A[3][0],$C[2],$rhotates[0][4]
rotldi $A[4][0],$C[1],$rhotates[0][2]

andc $C[0],$A[0][2],$A[0][1] ; Chi+Iota
andc $C[1],$A[0][3],$A[0][2]
andc $C[2],$A[0][0],$A[0][4]
andc $C[3],$A[0][1],$A[0][0]
xor $A[0][0],$A[0][0],$C[0]
andc $C[0],$A[0][4],$A[0][3]
xor $A[0][1],$A[0][1],$C[1]
ld $C[1],`$LOCALS+4*$SIZE_T`($sp)
xor $A[0][3],$A[0][3],$C[2]
xor $A[0][4],$A[0][4],$C[3]
xor $A[0][2],$A[0][2],$C[0]
ldu $C[3],8($C[1]) ; Iota[i++]

andc $C[0],$A[1][2],$A[1][1]
std $C[1],`$LOCALS+4*$SIZE_T`($sp)
andc $C[1],$A[1][3],$A[1][2]
andc $C[2],$A[1][0],$A[1][4]
xor $A[0][0],$A[0][0],$C[3] ; A[0][0] ^= Iota
andc $C[3],$A[1][1],$A[1][0]
xor $A[1][0],$A[1][0],$C[0]
andc $C[0],$A[1][4],$A[1][3]
xor $A[1][1],$A[1][1],$C[1]
xor $A[1][3],$A[1][3],$C[2]
xor $A[1][4],$A[1][4],$C[3]
xor $A[1][2],$A[1][2],$C[0]

andc $C[0],$A[2][2],$A[2][1]
andc $C[1],$A[2][3],$A[2][2]
andc $C[2],$A[2][0],$A[2][4]
andc $C[3],$A[2][1],$A[2][0]
xor $A[2][0],$A[2][0],$C[0]
andc $C[0],$A[2][4],$A[2][3]
xor $A[2][1],$A[2][1],$C[1]
xor $A[2][3],$A[2][3],$C[2]
xor $A[2][4],$A[2][4],$C[3]
xor $A[2][2],$A[2][2],$C[0]

andc $C[0],$A[3][2],$A[3][1]
andc $C[1],$A[3][3],$A[3][2]
andc $C[2],$A[3][0],$A[3][4]
andc $C[3],$A[3][1],$A[3][0]
xor $A[3][0],$A[3][0],$C[0]
andc $C[0],$A[3][4],$A[3][3]

```



```

xor $A[3][1],$A[3][1],$C[1]
xor $A[3][3],$A[3][3],$C[2]
xor $A[3][4],$A[3][4],$C[3]
xor $A[3][2],$A[3][2],$C[0]

andc $C[0],$A[4][2],$A[4][1]
andc $C[1],$A[4][3],$A[4][2]
andc $C[2],$A[4][0],$A[4][4]
andc $C[3],$A[4][1],$A[4][0]
xor $A[4][0],$A[4][0],$C[0]
andc $C[0],$A[4][4],$A[4][3]
xor $A[4][1],$A[4][1],$C[1]
xor $A[4][3],$A[4][3],$C[2]
xor $A[4][4],$A[4][4],$C[3]
xor $A[4][2],$A[4][2],$C[0]

bdnz .Loop

blr
.long 0
.byte 0,12,0x14,0,0,0,0
.size KeccakF1600_int,-KeccakF1600_int

.type KeccakF1600,@function
.align 5
KeccakF1600:
$STU $sp,-$FRAME($sp)
mflr r0
$PUSH r14,`$FRAME-$SIZE_T*18`($sp)
$PUSH r15,`$FRAME-$SIZE_T*17`($sp)
$PUSH r16,`$FRAME-$SIZE_T*16`($sp)
$PUSH r17,`$FRAME-$SIZE_T*15`($sp)
$PUSH r18,`$FRAME-$SIZE_T*14`($sp)
$PUSH r19,`$FRAME-$SIZE_T*13`($sp)
$PUSH r20,`$FRAME-$SIZE_T*12`($sp)
$PUSH r21,`$FRAME-$SIZE_T*11`($sp)
$PUSH r22,`$FRAME-$SIZE_T*10`($sp)
$PUSH r23,`$FRAME-$SIZE_T*9`($sp)
$PUSH r24,`$FRAME-$SIZE_T*8`($sp)
$PUSH r25,`$FRAME-$SIZE_T*7`($sp)
$PUSH r26,`$FRAME-$SIZE_T*6`($sp)
$PUSH r27,`$FRAME-$SIZE_T*5`($sp)
$PUSH r28,`$FRAME-$SIZE_T*4`($sp)
$PUSH r29,`$FRAME-$SIZE_T*3`($sp)
$PUSH r30,`$FRAME-$SIZE_T*2`($sp)
$PUSH r31,`$FRAME-$SIZE_T*1`($sp)
$PUSH r0,`$FRAME+$LRSAVE`($sp)

```

```
bl PICmeup
subi r12,r12,8 ; prepare for ldu
```

```
$PUSH r3,`$LOCALS+0*$SIZE_T`($sp)
;$PUSH r4,`$LOCALS+1*$SIZE_T`($sp)
;$PUSH r5,`$LOCALS+2*$SIZE_T`($sp)
;$PUSH r6,`$LOCALS+3*$SIZE_T`($sp)
$PUSH r12,`$LOCALS+4*$SIZE_T`($sp)
```

```
ld $A[0][0],`8*0`(r3) ; load A[5][5]
ld $A[0][1],`8*1`(r3)
ld $A[0][2],`8*2`(r3)
ld $A[0][3],`8*3`(r3)
ld $A[0][4],`8*4`(r3)
ld $A[1][0],`8*5`(r3)
ld $A[1][1],`8*6`(r3)
ld $A[1][2],`8*7`(r3)
ld $A[1][3],`8*8`(r3)
ld $A[1][4],`8*9`(r3)
ld $A[2][0],`8*10`(r3)
ld $A[2][1],`8*11`(r3)
ld $A[2][2],`8*12`(r3)
ld $A[2][3],`8*13`(r3)
ld $A[2][4],`8*14`(r3)
ld $A[3][0],`8*15`(r3)
ld $A[3][1],`8*16`(r3)
ld $A[3][2],`8*17`(r3)
ld $A[3][3],`8*18`(r3)
ld $A[3][4],`8*19`(r3)
ld $A[4][0],`8*20`(r3)
ld $A[4][1],`8*21`(r3)
ld $A[4][2],`8*22`(r3)
ld $A[4][3],`8*23`(r3)
ld $A[4][4],`8*24`(r3)
```

```
bl KeccakF1600_int
```

```
$POP r3,`$LOCALS+0*$SIZE_T`($sp)
std $A[0][0],`8*0`(r3) ; return A[5][5]
std $A[0][1],`8*1`(r3)
std $A[0][2],`8*2`(r3)
std $A[0][3],`8*3`(r3)
std $A[0][4],`8*4`(r3)
std $A[1][0],`8*5`(r3)
std $A[1][1],`8*6`(r3)
std $A[1][2],`8*7`(r3)
std $A[1][3],`8*8`(r3)
std $A[1][4],`8*9`(r3)
```

```

std $A[2][0],`8*10`(r3)
std $A[2][1],`8*11`(r3)
std $A[2][2],`8*12`(r3)
std $A[2][3],`8*13`(r3)
std $A[2][4],`8*14`(r3)
std $A[3][0],`8*15`(r3)
std $A[3][1],`8*16`(r3)
std $A[3][2],`8*17`(r3)
std $A[3][3],`8*18`(r3)
std $A[3][4],`8*19`(r3)
std $A[4][0],`8*20`(r3)
std $A[4][1],`8*21`(r3)
std $A[4][2],`8*22`(r3)
std $A[4][3],`8*23`(r3)
std $A[4][4],`8*24`(r3)

```

```

$POP r0,`$FRAME+$LRSAVE`($sp)
$POP r14,`$FRAME-$$SIZE_T*18`($sp)
$POP r15,`$FRAME-$$SIZE_T*17`($sp)
$POP r16,`$FRAME-$$SIZE_T*16`($sp)
$POP r17,`$FRAME-$$SIZE_T*15`($sp)
$POP r18,`$FRAME-$$SIZE_T*14`($sp)
$POP r19,`$FRAME-$$SIZE_T*13`($sp)
$POP r20,`$FRAME-$$SIZE_T*12`($sp)
$POP r21,`$FRAME-$$SIZE_T*11`($sp)
$POP r22,`$FRAME-$$SIZE_T*10`($sp)
$POP r23,`$FRAME-$$SIZE_T*9`($sp)
$POP r24,`$FRAME-$$SIZE_T*8`($sp)
$POP r25,`$FRAME-$$SIZE_T*7`($sp)
$POP r26,`$FRAME-$$SIZE_T*6`($sp)
$POP r27,`$FRAME-$$SIZE_T*5`($sp)
$POP r28,`$FRAME-$$SIZE_T*4`($sp)
$POP r29,`$FRAME-$$SIZE_T*3`($sp)
$POP r30,`$FRAME-$$SIZE_T*2`($sp)
$POP r31,`$FRAME-$$SIZE_T*1`($sp)

```

```

mblr r0
addi $sp,$sp,$FRAME
blr
.long 0
.byte 0,12,4,1,0x80,18,1,0
.long 0
.size KeccakF1600,-KeccakF1600

```

```

.type dword_le_load,\@function
.align 5
dword_le_load:
lbzu r0,1(r3)
lbzu r4,1(r3)

```

```

lbzu r5,1(r3)
insrdi r0,r4,8,48
lbzu r4,1(r3)
insrdi r0,r5,8,40
lbzu r5,1(r3)
insrdi r0,r4,8,32
lbzu r4,1(r3)
insrdi r0,r5,8,24
lbzu r5,1(r3)
insrdi r0,r4,8,16
lbzu r4,1(r3)
insrdi r0,r5,8,8
insrdi r0,r4,8,0
blr
.long 0
.byte 0,12,0x14,0,0,0,1,0
.long 0
.size dword_le_load,-dword_le_load

```

```

.globl SHA3_absorb
.type SHA3_absorb,@function
.align 5
SHA3_absorb:
$STU $sp,-$FRAME($sp)
mflr r0
$PUSH r14,`$FRAME-$SIZE_T*18`($sp)
$PUSH r15,`$FRAME-$SIZE_T*17`($sp)
$PUSH r16,`$FRAME-$SIZE_T*16`($sp)
$PUSH r17,`$FRAME-$SIZE_T*15`($sp)
$PUSH r18,`$FRAME-$SIZE_T*14`($sp)
$PUSH r19,`$FRAME-$SIZE_T*13`($sp)
$PUSH r20,`$FRAME-$SIZE_T*12`($sp)
$PUSH r21,`$FRAME-$SIZE_T*11`($sp)
$PUSH r22,`$FRAME-$SIZE_T*10`($sp)
$PUSH r23,`$FRAME-$SIZE_T*9`($sp)
$PUSH r24,`$FRAME-$SIZE_T*8`($sp)
$PUSH r25,`$FRAME-$SIZE_T*7`($sp)
$PUSH r26,`$FRAME-$SIZE_T*6`($sp)
$PUSH r27,`$FRAME-$SIZE_T*5`($sp)
$PUSH r28,`$FRAME-$SIZE_T*4`($sp)
$PUSH r29,`$FRAME-$SIZE_T*3`($sp)
$PUSH r30,`$FRAME-$SIZE_T*2`($sp)
$PUSH r31,`$FRAME-$SIZE_T*1`($sp)
$PUSH r0,`$FRAME+$LRSAVE`($sp)

```

```

bl PICmeup
subi r4,r4,1 ; prepare for lbzu
subi r12,r12,8 ; prepare for ldu

```

```

$PUSH r3,`$LOCALS+0*$SIZE_T`($sp) ; save A[0]
$PUSH r4,`$LOCALS+1*$SIZE_T`($sp) ; save inp
$PUSH r5,`$LOCALS+2*$SIZE_T`($sp) ; save len
$PUSH r6,`$LOCALS+3*$SIZE_T`($sp) ; save bsz
mr r0,r6
$PUSH r12,`$LOCALS+4*$SIZE_T`($sp)

```

```

ld $A[0][0],`8*0`(r3) ; load A[5][5]
ld $A[0][1],`8*1`(r3)
ld $A[0][2],`8*2`(r3)
ld $A[0][3],`8*3`(r3)
ld $A[0][4],`8*4`(r3)
ld $A[1][0],`8*5`(r3)
ld $A[1][1],`8*6`(r3)
ld $A[1][2],`8*7`(r3)
ld $A[1][3],`8*8`(r3)
ld $A[1][4],`8*9`(r3)
ld $A[2][0],`8*10`(r3)
ld $A[2][1],`8*11`(r3)
ld $A[2][2],`8*12`(r3)
ld $A[2][3],`8*13`(r3)
ld $A[2][4],`8*14`(r3)
ld $A[3][0],`8*15`(r3)
ld $A[3][1],`8*16`(r3)
ld $A[3][2],`8*17`(r3)
ld $A[3][3],`8*18`(r3)
ld $A[3][4],`8*19`(r3)
ld $A[4][0],`8*20`(r3)
ld $A[4][1],`8*21`(r3)
ld $A[4][2],`8*22`(r3)
ld $A[4][3],`8*23`(r3)
ld $A[4][4],`8*24`(r3)

```

```

mr r3,r4
mr r4,r5
mr r5,r0

```

```

b .Loop_absorb

```

```

.align 4

```

```

.Loop_absorb:

```

```

$UCMP r4,r5 ; len < bsz?

```

```

blt .Labsorbed

```

```

sub r4,r4,r5 ; len -= bsz

```

```

srwi r5,r5,3

```

```

$PUSH r4,`$LOCALS+2*$SIZE_T`($sp) ; save len

```

```

mtctr r5
bl dword_le_load ; *inp++
xor $A[0][0],$A[0][0],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[0][1],$A[0][1],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[0][2],$A[0][2],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[0][3],$A[0][3],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[0][4],$A[0][4],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[1][0],$A[1][0],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[1][1],$A[1][1],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[1][2],$A[1][2],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[1][3],$A[1][3],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[1][4],$A[1][4],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[2][0],$A[2][0],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[2][1],$A[2][1],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[2][2],$A[2][2],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[2][3],$A[2][3],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[2][4],$A[2][4],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[3][0],$A[3][0],r0

```

```

bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[3][1],$A[3][1],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[3][2],$A[3][2],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[3][3],$A[3][3],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[3][4],$A[3][4],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[4][0],$A[4][0],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[4][1],$A[4][1],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[4][2],$A[4][2],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[4][3],$A[4][3],r0
bdz .Lprocess_block
bl dword_le_load ; *inp++
xor $A[4][4],$A[4][4],r0

.Lprocess_block:
$PUSH r3,`$LOCALS+1*$SIZE_T`($sp) ; save inp

bl KeccakF1600_int

$POP r0,`$LOCALS+4*$SIZE_T`($sp) ; pull iotas[24]
$POP r5,`$LOCALS+3*$SIZE_T`($sp) ; restore bsz
$POP r4,`$LOCALS+2*$SIZE_T`($sp) ; restore len
$POP r3,`$LOCALS+1*$SIZE_T`($sp) ; restore inp
addic r0,r0,`-8*24` ; rewind iotas
$PUSH r0,`$LOCALS+4*$SIZE_T`($sp)

b .Loop_absorb

.align 4
.Labsorbed:
$POP r3,`$LOCALS+0*$SIZE_T`($sp)
std $A[0][0],`8*0`(r3) ; return A[5][5]
std $A[0][1],`8*1`(r3)
std $A[0][2],`8*2`(r3)

```

```

std $A[0][3],`8*3`(r3)
std $A[0][4],`8*4`(r3)
std $A[1][0],`8*5`(r3)
std $A[1][1],`8*6`(r3)
std $A[1][2],`8*7`(r3)
std $A[1][3],`8*8`(r3)
std $A[1][4],`8*9`(r3)
std $A[2][0],`8*10`(r3)
std $A[2][1],`8*11`(r3)
std $A[2][2],`8*12`(r3)
std $A[2][3],`8*13`(r3)
std $A[2][4],`8*14`(r3)
std $A[3][0],`8*15`(r3)
std $A[3][1],`8*16`(r3)
std $A[3][2],`8*17`(r3)
std $A[3][3],`8*18`(r3)
std $A[3][4],`8*19`(r3)
std $A[4][0],`8*20`(r3)
std $A[4][1],`8*21`(r3)
std $A[4][2],`8*22`(r3)
std $A[4][3],`8*23`(r3)
std $A[4][4],`8*24`(r3)

```

```

mr r3,r4 ; return value

```

```

$POP r0,`$FRAME+$LRSIZE`($sp)
$POP r14,`$FRAME-$SIZE_T*18`($sp)
$POP r15,`$FRAME-$SIZE_T*17`($sp)
$POP r16,`$FRAME-$SIZE_T*16`($sp)
$POP r17,`$FRAME-$SIZE_T*15`($sp)
$POP r18,`$FRAME-$SIZE_T*14`($sp)
$POP r19,`$FRAME-$SIZE_T*13`($sp)
$POP r20,`$FRAME-$SIZE_T*12`($sp)
$POP r21,`$FRAME-$SIZE_T*11`($sp)
$POP r22,`$FRAME-$SIZE_T*10`($sp)
$POP r23,`$FRAME-$SIZE_T*9`($sp)
$POP r24,`$FRAME-$SIZE_T*8`($sp)
$POP r25,`$FRAME-$SIZE_T*7`($sp)
$POP r26,`$FRAME-$SIZE_T*6`($sp)
$POP r27,`$FRAME-$SIZE_T*5`($sp)
$POP r28,`$FRAME-$SIZE_T*4`($sp)
$POP r29,`$FRAME-$SIZE_T*3`($sp)
$POP r30,`$FRAME-$SIZE_T*2`($sp)
$POP r31,`$FRAME-$SIZE_T*1`($sp)
mblr r0
addi $sp,$sp,$FRAME
blr
.long 0
.byte 0,12,4,1,0x80,18,4,0

```



```

.long 0
.size SHA3_absorb,.-SHA3_absorb

{
my ($A_flat,$out,$len,$bsz) = map("r$_",(28..31));
$code.=<<____;
.globl SHA3_squeeze
.type SHA3_squeeze,\@function
.align 5
SHA3_squeeze:
$STU $sp,`-10*${SIZE_T}`($sp)
mflr r0
$PUSH r28,`6*${SIZE_T}`($sp)
$PUSH r29,`7*${SIZE_T}`($sp)
$PUSH r30,`8*${SIZE_T}`($sp)
$PUSH r31,`9*${SIZE_T}`($sp)
$PUSH r0,`10*${SIZE_T}+${LRSAVE}`($sp)

mr $A_flat,r3
subi r3,r3,8 ; prepare for ldu
subi $out,r4,1 ; prepare for stbu
mr $len,r5
mr $bsz,r6
b .Loop_squeeze

.align 4
.Loop_squeeze:
ldu r0,8(r3)
${UCMP}i $len,8
blt .Lsqueeze_tail

stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)
srldi r0,r0,8
stbu r0,1($out)

subic. $len,$len,8

```

```

beq .Lsqueeze_done

subic r6,r6,8
bgt .Loop_squeeze

mr r3,$A_flat
bl KeccakF1600
subi r3,$A_flat,8 ; prepare for ldu
mr r6,$bsz
b .Loop_squeeze

.align 4
.Lsqueeze_tail:
mtctr $len
.Loop_tail:
stbu r0,1($out)
srldi r0,r0,8
bdnz .Loop_tail

.Lsqueeze_done:
$POP r0,`10*$SIZE_T+$LRSAVE`($sp)
$POP r28,`6*$SIZE_T`($sp)
$POP r29,`7*$SIZE_T`($sp)
$POP r30,`8*$SIZE_T`($sp)
$POP r31,`9*$SIZE_T`($sp)
mtr r0
addi $sp,$sp,`10*$SIZE_T`
blr
.long 0
.byte 0,12,4,1,0x80,4,4,0
.long 0
.size SHA3_squeeze,.-SHA3_squeeze

}

Ugly hack here, because PPC assembler syntax seem to vary too
much from platforms to platform...
$code.=<<___;
.align 6
PICmeup:
mflr r0
bcl 20,31,\'$+4
mflr r12 ; vvvvvv "distance" between . and 1st data entry
addi r12,r12,`64-8`
mtr r0
blr
.long 0
.byte 0,12,0x14,0,0,0,0,0

```

```

.space `64-9*4`
.type iotas,\@object
iotas:
.quad 0x0000000000000001
.quad 0x0000000000008082
.quad 0x800000000000808a
.quad 0x8000000080008000
.quad 0x000000000000808b
.quad 0x0000000080000001
.quad 0x8000000080008081
.quad 0x8000000000008009
.quad 0x000000000000008a
.quad 0x0000000000000088
.quad 0x0000000080008009
.quad 0x000000008000000a
.quad 0x000000008000808b
.quad 0x800000000000008b
.quad 0x8000000000008089
.quad 0x8000000000008003
.quad 0x8000000000008002
.quad 0x8000000000000080
.quad 0x000000000000800a
.quad 0x800000008000000a
.quad 0x8000000080008081
.quad 0x8000000000008080
.quad 0x0000000080000001
.quad 0x8000000080008008
.size iotas,-.iotas
.asciz "Keccak-1600 absorb and squeeze for PPC64, CRYPTOGRAMS by <appro\@openssl.org>"

```

—

```

$code =~ s/^\([\^\`]*\)/eval $1/gem;
print $code;
close STDOUT;

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/sha/asm/keccak1600-ppc64.pl

```

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```

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```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/bn/asm/vis3-mont.pl

```

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```
/*-----
* fips_test_ig95.c - Unit test for IG 9.5 support
*
* April, 2015
*
* Copyright (c) 2015 by cisco Systems, Inc.
* All rights reserved.
*-----
*/
/*=====
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cisssl-fom-7-2a-202104051307-tar-gz/cisssl-fom-7.2a.202104051307/fips/fips_test_ig95.c
* /opt/cola/permits/1337210439_1687523530.3818/0/cisssl-fom-7-2a-202104051307-tar-gz/cisssl-fom-7.2a.202104051307/test/fips_test_ig95.c
```

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```
/*=====
```

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* =====
*
*/

```

Found in path(s):

```

* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes_locl.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes.h
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes_ecb.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes_ctr.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes_cbc.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-
7.2a.202104051307/crypto/aes/aes_misc.c
* /opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-

```

7.2a.202104051307/include/openssl/aes.h

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```
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 *
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 * in the file LICENSE in the source distribution or at
 * https://www.openssl.org/source/license.html
 */
/* Copyright 2011 Google Inc.
 *
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 *
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 *
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 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
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 * limitations under the License.
 */
/*
 * A 64-bit implementation of the NIST P-224 elliptic curve point multiplication
 *
 * Inspired by Daniel J. Bernstein's public domain nistp224 implementation
 * and Adam Langley's public domain 64-bit C implementation of curve25519
 */
```

Found in path(s):

```
*/opt/cola/permits/1337210439_1687523530.3818/0/ciscossl-fom-7-2a-202104051307-tar-gz/ciscossl-fom-7.2a.202104051307/crypto/ec/ecp_nistp224.c
```

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 */
```

```

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* =====
*
*/

```

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```

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7.2a.202104051307/fips/ecdh/fips_ecdh_selftest.c

```

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```

/*-----
* kdf/kdf_ssh.c - Key Derivation Function for SSH
*

```

```
* March 2015
*
* Copyright (c) 2015, 2018 by cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/kdf/kdf_ssh.c
```

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```

```
require 'x86asm.pl';
&asm_init(<flavor>[, $i386only]);
&function_begin("foo");
...
&function_end("foo");
&asm_finish
```

```
$out=();
$i386=0;
```

```
AUTOLOAD is this context has quite unpleasant side effect, namely
that typos in function calls effectively go to assembler output,
but on the pros side we don't have to implement one subroutine per
each opcode...
```

```
sub ::AUTOLOAD
```

```
{ my $opcode = $AUTOLOAD;
```

```
 die "more than 4 arguments passed to $opcode" if ($#_>3);
```

```
 $opcode =~ s/.*://;
```

```
 if ($opcode =~ /^push/) { $stack+=4; }
```

```
 elsif ($opcode =~ /^pop/) { $stack-=4; }
```

```
 &generic($opcode, @_) or die "undefined subroutine \&$AUTOLOAD";
```

```
}
```

```
sub ::emit
```



```

{ my $opcode=shift;

if ($#_==1) { push(@out,"\t$opcode\n"); }
else { push(@out,"\t$opcode\t".join(',@_).\n"); }
}

sub ::LB
{ $_[0]=~ m/^\e?([a-d])x$/o or die "$_[0] does not have a 'low byte'";
 $1."l";
}
sub ::HB
{ $_[0]=~ m/^\e?([a-d])x$/o or die "$_[0] does not have a 'high byte'";
 $1."h";
}
sub ::stack_push{ my $num=$_[0]*4; $stack+=$num; &sub("esp",$num); }
sub ::stack_pop { my $num=$_[0]*4; $stack-=$num; &add("esp",$num); }
sub ::blindpop { &pop($_[0]); $stack+=4; }
sub ::wparam { &DWP($stack+4*$_[0],"esp"); }
sub ::swtmp { &DWP(4*$_[0],"esp"); }

sub ::bswap
{ if ($i386) # emulate bswap for i386
 { &comment("bswap @_");
 &xchg(&HB(@_),&LB(@_));
 &ror (@_,16);
 &xchg(&HB(@_),&LB(@_));
 }
else
 { &generic("bswap",@_); }
}
These are made-up opcodes introduced over the years essentially
by ignorance, just alias them to real ones...
sub ::movb { &mov(@_); }
sub ::xorb { &xor(@_); }
sub ::rotr { &rol(@_); }
sub ::rotr { &ror(@_); }
sub ::exch { &xchg(@_); }
sub ::halt { &hlt; }
sub ::movz { &movzx(@_); }
sub ::pushf { &pushfd; }
sub ::popf { &popfd; }

3 argument instructions
sub ::movq
{ my($p1,$p2,$optimize)=@_;

if ($optimize && $p1=~/^mm[0-7]$/ && $p2=~/^mm[0-7]$/)
 # movq between mmx registers can sink Intel CPUs

```

```

 { &::pshufw($p1,$p2,0xe4); }
 else
 { &::generic("movq",@_); }
}

SSE>2 instructions
my %regrm = ("eax"=>0, "ecx"=>1, "edx"=>2, "ebx"=>3,
 "esp"=>4, "ebp"=>5, "esi"=>6, "edi"=>7);
sub ::pextrd
{ my($dst,$src,$imm)=@_;
 if ("dst:$src" =~ /(e[a-dsd][ixp]):xmm([0-7])/)
 { &::data_byte(0x66,0x0f,0x3a,0x16,0xc0|($2<<3)|$regrm{$1},$imm); }
 else
 { &::generic("pextrd",@_); }
}

sub ::pinsrd
{ my($dst,$src,$imm)=@_;
 if ("dst:$src" =~ /xmm([0-7]):(e[a-dsd][ixp])/)
 { &::data_byte(0x66,0x0f,0x3a,0x22,0xc0|($1<<3)|$regrm{$2},$imm); }
 else
 { &::generic("pinsrd",@_); }
}

sub ::pshufb
{ my($dst,$src)=@_;
 if ("dst:$src" =~ /xmm([0-7]):xmm([0-7])/)
 { &data_byte(0x66,0x0f,0x38,0x00,0xc0|($1<<3)|$2); }
 else
 { &::generic("pshufb",@_); }
}

sub ::palignr
{ my($dst,$src,$imm)=@_;
 if ("dst:$src" =~ /xmm([0-7]):xmm([0-7])/)
 { &::data_byte(0x66,0x0f,0x3a,0x0f,0xc0|($1<<3)|$2,$imm); }
 else
 { &::generic("palignr",@_); }
}

sub ::pclmulqdq
{ my($dst,$src,$imm)=@_;
 if ("dst:$src" =~ /xmm([0-7]):xmm([0-7])/)
 { &::data_byte(0x66,0x0f,0x3a,0x44,0xc0|($1<<3)|$2,$imm); }
 else
 { &::generic("pclmulqdq",@_); }
}

```

```

sub ::rdrand
{ my ($dst)=@_;
 if ($dst =~ /(e[a-dsd][ixp])/)
 { &::data_byte(0x0f,0xc7,0xf0|$regm{$dst}); }
 else
 { &::generic("rdrand",@_); }
}

sub ::rdseed
{ my ($dst)=@_;
 if ($dst =~ /(e[a-dsd][ixp])/)
 { &::data_byte(0x0f,0xc7,0xf8|$regm{$dst}); }
 else
 { &::generic("rdrand",@_); }
}

sub rxb {
local *opcode=shift;
my ($dst,$src1,$src2,$rxb)=@_;

 $rxb|=0x7<<5;
 $rxb&=~(0x04<<5) if($dst>=8);
 $rxb&=~(0x01<<5) if($src1>=8);
 $rxb&=~(0x02<<5) if($src2>=8);
 push @opcode,$rxb;
}

sub ::vprotd
{ my $args=join(', ',@_);
 if ($args =~ /xmm([0-7]),xmm([0-7]),([x0-9a-f]+)/)
 { my @opcode=(0x8f);
 rxb(\@opcode,$1,$2,-1,0x08);
 push @opcode,0x78,0xc2;
 push @opcode,0xc0|($2&7)|(($1&7)<<3); # ModR/M
 my $c=$3;
 push @opcode,$c=~/^0/?oct($c):$c;
 &::data_byte(@opcode);
 }
 else
 { &::generic("vprotd",@_); }
}

sub ::endbranch
{
 &::data_byte(0xf3,0x0f,0x1e,0xfb);
}

label management

```

```

$lbdecor="L"; # local label decoration, set by package
$label="000";

sub ::islabel # see is argument is a known label
{ my $i;
 foreach $i (values %label) { return $i if ($i eq $_[0]); }
 $label{ $_[0] }; # can be undef
}

sub ::label # instantiate a function-scope label
{ if (!defined($label{ $_[0] }))
 { $label{ $_[0] } = "$lbdecor${label}{ $_[0] }"; $label++; }
 $label{ $_[0] };
}

sub ::LABEL # instantiate a file-scope label
{ $label{ $_[0] } = $_[1] if (!defined($label{ $_[0] }));
 $label{ $_[0] };
}

sub ::static_label { &::LABEL($_[0], $lbdecor.$_[0]); }

sub ::set_label_B { push(@out, "@_:\n"); }
sub ::set_label
{ my $label = &::label($_[0]);
 &::align($_[1]) if ($_[1] > 1);
 &::set_label_B($label);
 $label;
}

sub ::wipe_labels # wipes function-scope labels
{ foreach $i (keys %label)
 { delete $label{ $i } if ($label{ $i } =~ /^Q${lbdecor}\E[0-9]{3}/); }
}

subroutine management
sub ::function_begin
{ &function_begin_B(@_);
 $stack=4;
 &push("ebp");
 &push("ebx");
 &push("esi");
 &push("edi");
}

sub ::function_end
{ &pop("edi");
 &pop("esi");
}

```

```

 &pop("ebx");
 &pop("ebp");
 &ret();
 &function_end_B(@_);
 $stack=0;
 &wipe_labels();
}

sub ::function_end_A
{ &pop("edi");
 &pop("esi");
 &pop("ebx");
 &pop("ebp");
 &ret();
 $stack+=16; # readjust esp as if we didn't pop anything
}

sub ::asciz
{ my @str=unpack("C*",shift);
 push @str,0;
 while ($#str>15) {
 &data_byte(@str[0..15]);
 foreach (0..15) { shift @str; }
 }
 &data_byte(@str) if (@str);
}

sub ::asm_finish
{ &file_end();
 print @out;
}

sub ::asm_init
{ my ($type,$cpu)=@_;

 $i386=$cpu;

 $self=$cpp=$coff=$aout=$macosx=$win32=$mwerks=$android=0;
 if (($type eq "elf"))
 { $self=1; require "x86gas.pl"; }
 elsif (($type eq "elf-1"))
 { $self=-1; require "x86gas.pl"; }
 elsif (($type eq "a\out"))
 { $aout=1; require "x86gas.pl"; }
 elsif (($type eq "coff" or $type eq "gaswin"))
 { $coff=1; require "x86gas.pl"; }
 elsif (($type eq "win32n"))
 { $win32=1; require "x86nasm.pl"; }
}

```

```

elseif (($type eq "win32"))
{ $win32=1; require "x86masm.pl"; }
elseif (($type eq "macosx"))
{ $aout=1; $macosx=1; require "x86gas.pl"; }
elseif (($type eq "android"))
{ $elf=1; $android=1; require "x86gas.pl"; }
else
{ print STDERR <<"EOF";
Pick one target type from
elf - Linux, FreeBSD, Solaris x86, etc.
a.out - DJGPP, elder OpenBSD, etc.
coff - GAS/COFF such as Win32 targets
win32n - Windows 95/Windows NT NASM format
macosx - Mac OS X
EOF
exit(1);
}

$pic=0;
for (@ARGV) { $pic=1 if (/\[fK]PIC/i); }

&file();
}

```

```
sub ::hidden { }
```

```
1;
```

Found in path(s):

```
* /opt/cola/permits/1337210439_1687523530.3818/0/cissocsl-fom-7-2a-202104051307-tar-gz/cissocsl-fom-7.2a.202104051307/crypto/perlasm/x86asm.pl
```

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```

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```

```
*
```

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```
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```

```
* https://www.openssl.org/source/license.html
```

```
*/
```

Found in path(s):

```
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```

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```
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```
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```

```
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Ty Coon, President of Vice
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## 1.219 glibc 2.23

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The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a ``work based on the library" and a ``work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

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``Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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and what the program that uses the Library does.

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-----Document Object Model-----

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-----Web Background Synchronization-----

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Version 2.1, February 1999

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```

* @version 3.0 (December 2000)
*
* Optimised ANSI C code for the Rijndael cipher (now AES)
*
* @author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>
* @author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>
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# 1.236 procps 3.3.17

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## 1.237 wayland-ivi-extension master-cisco.15

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/\*

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## 1.238 zlib 1.2.12

### 1.238.1 Available under license :

\* zlib.h -- interface of the 'zlib' general purpose compression library  
 version 1.2.12, March 11th, 2022

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The data format used by the zlib library is described by RFCs (Request for Comments) 1950 to 1952 in the files <http://tools.ietf.org/html/rfc1950> (zlib format), rfc1951 (deflate format) and rfc1952 (gzip format).

\*/

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## 1.239 ffmpeg n4.4.2

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version 2 or later (GPL v2+). See the file `COPYING.GPLv2` for details. None of these parts are used by default, you have to explicitly pass `--enable-gpl` to configure to activate them. In this case, FFmpeg's license changes to GPL v2+.

Specifically, the GPL parts of FFmpeg are:

- libpostproc
- optional x86 optimization in the files
  - `libavcodec/x86/flac\_dsp\_gpl.asm`
  - `libavcodec/x86/idct\_mmx.c`
  - `libavfilter/x86/vf\_removegrain.asm`
- the following building and testing tools
  - `compat/solaris/make\_sunver.pl`
  - `doc/t2h.pm`
  - `doc/texi2pod.pl`
  - `libswresample/tests/swresample.c`
  - `tests/checkasm/\*`
  - `tests/tiny\_ssim.c`
- the following filters in libavfilter:
  - `signature\_lookup.c`
  - `vf\_blackframe.c`
  - `vf\_boxblur.c`
  - `vf\_colormatrix.c`
  - `vf\_cover\_rect.c`
  - `vf\_croptdetect.c`
  - `vf\_delogo.c`
  - `vf\_eq.c`
  - `vf\_find\_rect.c`
  - `vf\_fspp.c`
  - `vf\_histeq.c`
  - `vf\_hqdn3d.c`
  - `vf\_kerndeint.c`
  - `vf\_lensfun.c` (GPL version 3 or later)
  - `vf\_mcdeint.c`
  - `vf\_mpdecimate.c`
  - `vf\_nnedi.c`
  - `vf\_owdenoise.c`
  - `vf\_perspective.c`
  - `vf\_phase.c`
  - `vf\_pp.c`
  - `vf\_pp7.c`
  - `vf\_pullup.c`
  - `vf\_repeatfields.c`
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  - `vf\_signature.c`
  - `vf\_smartblur.c`
  - `vf\_spp.c`
  - `vf\_stereo3d.c`

- `vf\_super2xsai.c`
- `vf\_tinterlace.c`
- `vf\_uspp.c`
- `vf\_vaguedenoiser.c`
- `vsrc\_mptestsrc.c`

Should you, for whatever reason, prefer to use version 3 of the (L)GPL, then the configure parameter `--enable-version3` will activate this licensing option for you. Read the file `COPYING.LGPLv3` or, if you have enabled GPL parts, `COPYING.GPLv3` to learn the exact legal terms that apply in this case.

There are a handful of files under other licensing terms, namely:

- \* The files `libavcodec/jfdctfst.c`, `libavcodec/jfdctint\_template.c` and `libavcodec/jrevdct.c` are taken from libjpeg, see the top of the files for licensing details. Specifically note that you must credit the IJG in the documentation accompanying your program if you only distribute executables. You must also indicate any changes including additions and deletions to those three files in the documentation.
- \* `tests/reference.pnm` is under the expat license.

#### ## External libraries

FFmpeg can be combined with a number of external libraries, which sometimes affect the licensing of binaries resulting from the combination.

#### ### Compatible libraries

The following libraries are under GPL version 2:

- avisynth
- frei0r
- libcdio
- libdavs2
- librubberband
- libvidstab
- libx264
- libx265
- libxavs
- libxavs2
- libxvid

When combining them with FFmpeg, FFmpeg needs to be licensed as GPL as well by passing `--enable-gpl` to configure.

The following libraries are under LGPL version 3:

- gmp
- libaribb24



- liblensfun

When combining them with FFmpeg, use the configure option `--enable-version3` to upgrade FFmpeg to the LGPL v3.

The VMAF, mbedTLS, RK MPI, OpenCORE and VisualOn libraries are under the Apache License 2.0. That license is incompatible with the LGPL v2.1 and the GPL v2, but not with version 3 of those licenses. So to combine these libraries with FFmpeg, the license version needs to be upgraded by passing `--enable-version3` to configure.

The smbclient library is under the GPL v3, to combine it with FFmpeg, the options `--enable-gpl` and `--enable-version3` have to be passed to configure to upgrade FFmpeg to the GPL v3.

### ### Incompatible libraries

There are certain libraries you can combine with FFmpeg whose licenses are not compatible with the GPL and/or the LGPL. If you wish to enable these libraries, even in circumstances that their license may be incompatible, pass `--enable-nonfree` to configure. This will cause the resulting binary to be unredistributable.

The Fraunhofer FDK AAC and OpenSSL libraries are under licenses which are incompatible with the GPLv2 and v3. To the best of our knowledge, they are compatible with the LGPL.

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Version 2, June 1991

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```
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```

```
<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
```

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```
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## 1.244 url-loader 4.1.1

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# 1.245 rxcpp v4.1.0

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<one line to give the program's name and a brief idea of what it does.>  
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If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) 19yy name of author

Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.  
This is free software, and you are welcome to redistribute it  
under certain conditions; type `show c' for details.

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You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program  
`Gnomovision' (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989  
Ty Coon, President of Vice

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## 1.248 libjpeg 9d

### 1.248.1 Available under license :

No license file was found, but licenses were detected in source scan.

```
/*
 * jchuff.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2006-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains Huffman entropy encoding routines.
 * Both sequential and progressive modes are supported in this single module.
 *
 * Much of the complexity here has to do with supporting output suspension.
 * If the data destination module demands suspension, we want to be able to
 * back up to the start of the current MCU. To do this, we copy state
 * variables into local working storage, and update them back to the
 * permanent JPEG objects only upon successful completion of an MCU.
 *
```

- \* We do not support output suspension for the progressive JPEG mode, since
- \* the library currently does not allow multiple-scan files to be written
- \* with output suspension.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jchuff.c  
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## IJG JPEG LIBRARY: CODING RULES

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Since numerous people will be contributing code and bug fixes, it's important to establish a common coding style. The goal of using similar coding styles is much more important than the details of just what that style is.

In general we follow the recommendations of "Recommended C Style and Coding Standards" revision 6.1 (Cannon et al. as modified by Spencer, Keppel and Brader). This document is available in the IJG FTP archive (see `jpeg/doc/cstyle.ms.tbl.Z`, or `cstyle.txt.Z` for those without `nroff/tbl`).

Block comments should be laid out thusly:

```
/*
 * Block comments in this style.
*/
```

We indent statements in K&R style, e.g.,

```
if (test) {
 then-part;
} else {
 else-part;
}
```

with two spaces per indentation level. (This indentation convention is handled automatically by GNU Emacs and many other text editors.)

Multi-word names should be written in lower case with underscores, e.g., `multi_word_name` (not `multiWordName`). Preprocessor symbols and enum constants are similar but upper case (`MULTI_WORD_NAME`). Names should be unique within the first fifteen characters. (On some older systems, global names must be unique within six characters. We accommodate this without cluttering the source code by using macros to substitute shorter names.)

We use function prototypes everywhere; we rely on automatic source code

transformation to feed prototype-less C compilers. Transformation is done by the simple and portable tool 'ansi2knr.c' (courtesy of Ghostscript). ansi2knr is not very bright, so it imposes a format requirement on function declarations: the function name MUST BEGIN IN COLUMN 1. Thus all functions should be written in the following style:

```
LOCAL(int *)
function_name (int a, char *b)
{
 code...
}
```

Note that each function definition must begin with GLOBAL(type), LOCAL(type), or METHODDEF(type). These macros expand to "static type" or just "type" as appropriate. They provide a readable indication of the routine's usage and can readily be changed for special needs. (For instance, special linkage keywords can be inserted for use in Windows DLLs.)

ansi2knr does not transform method declarations (function pointers in structs). We handle these with a macro JMETHOD, defined as

```
#ifdef HAVE_PROTOTYPES
#define JMETHOD(type,methodname,arglist) type (*methodname) arglist
#else
#define JMETHOD(type,methodname,arglist) type (*methodname) ()
#endif
```

which is used like this:

```
struct function_pointers {
 JMETHOD(void, init_entropy_encoder, (int somearg, jparms *jpp));
 JMETHOD(void, term_entropy_encoder, (void));
};
```

Note the set of parentheses surrounding the parameter list.

A similar solution is used for forward and external function declarations (see the EXTERN and JPP macros).

If the code is to work on non-ANSI compilers, we cannot rely on a prototype declaration to coerce actual parameters into the right types. Therefore, use explicit casts on actual parameters whenever the actual parameter type is not identical to the formal parameter. Beware of implicit conversions to "int".

It seems there are some non-ANSI compilers in which the sizeof() operator is defined to return int, yet size\_t is defined as long. Needless to say, this is brain-damaged. Always use the SIZEOF() macro in place of sizeof(), so that the result is guaranteed to be of type size\_t.

The JPEG library is intended to be used within larger programs. Furthermore, we want it to be reentrant so that it can be used by applications that process



multiple images concurrently. The following rules support these requirements:

1. Avoid direct use of file I/O, "malloc", error report printouts, etc; pass these through the common routines provided.
2. Minimize global namespace pollution. Functions should be declared static wherever possible. (Note that our method-based calling conventions help this a lot: in many modules only the initialization function will ever need to be called directly, so only that function need be externally visible.) All global function names should begin with "jpeg\_", and should have an abbreviated name (unique in the first six characters) substituted by macro when NEED\_SHORT\_EXTERNAL\_NAMES is set.
3. Don't use global variables; anything that must be used in another module should be in the common data structures.
4. Don't use static variables except for read-only constant tables. Variables that should be private to a module can be placed into private structures (see the system architecture document, structure.txt).
5. Source file names should begin with "j" for files that are part of the library proper; source files that are not part of the library, such as cjpeg.c and djpeg.c, do not begin with "j". Keep source file names to eight characters (plus ".c" or ".h", etc) to make life easy for MS-DOSers. Keep compression and decompression code in separate source files --- some applications may want only one half of the library.

Note: these rules (particularly #4) are not followed religiously in the modules that are used in cjpeg/djpeg but are not part of the JPEG library proper. Those modules are not really intended to be used in other applications.

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/coderules.txt

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/\*

\* jerror.h

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

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\*

\* This file defines the error and message codes for the JPEG library.

\* Edit this file to add new codes, or to translate the message strings to

\* some other language.

\* A set of error-reporting macros are defined too. Some applications using

\* the JPEG library may wish to include this file to get the error codes  
\* and/or the macros.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jerror.h  
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/\*

\* jfdctfst.c

\*

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\*

\* This file contains a fast, not so accurate integer implementation of the

\* forward DCT (Discrete Cosine Transform).

\*

\* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT

\* on each column. Direct algorithms are also available, but they are

\* much more complex and seem not to be any faster when reduced to code.

\*

\* This implementation is based on Arai, Agui, and Nakajima's algorithm for

\* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in

\* Japanese, but the algorithm is described in the Pennebaker & Mitchell

\* JPEG textbook (see REFERENCES section in file README). The following code

\* is based directly on figure 4-8 in P&M.

\* While an 8-point DCT cannot be done in less than 11 multiplies, it is

\* possible to arrange the computation so that many of the multiplies are

\* simple scalings of the final outputs. These multiplies can then be

\* folded into the multiplications or divisions by the JPEG quantization

\* table entries. The AA&N method leaves only 5 multiplies and 29 adds

\* to be done in the DCT itself.

\* The primary disadvantage of this method is that with fixed-point math,

\* accuracy is lost due to imprecise representation of the scaled

\* quantization values. The smaller the quantization table entry, the less

\* precise the scaled value, so this implementation does worse with high-

\* quality-setting files than with low-quality ones.

\*/

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\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jfdctfst.c

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/\*

\* wrjpgcom.c

\*

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- \*
- \* This file contains a very simple stand-alone application that inserts
- \* user-supplied text as a COM (comment) marker in a JFIF file.
- \* This may be useful as an example of the minimum logic needed to parse
- \* JPEG markers.
- \*/

Found in path(s):

- \* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrjpgcom.c
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#### INSTALLATION INSTRUCTIONS for the Independent JPEG Group's JPEG software

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This file explains how to configure and install the IJG software. We have tried to make this software extremely portable and flexible, so that it can be adapted to almost any environment. The downside of this decision is that the installation process is complicated. We have provided shortcuts to simplify the task on common systems. But in any case, you will need at least a little familiarity with C programming and program build procedures for your system.

If you are only using this software as part of a larger program, the larger program's installation procedure may take care of configuring the IJG code. For example, Ghostscript's installation script will configure the IJG code. You don't need to read this file if you just want to compile Ghostscript.

If you are on a Unix machine, you may not need to read this file at all.

Try doing

```
./configure
```

```
make
```

```
make test
```

If that doesn't complain, do

```
make install
```

(better do "make -n install" first to see if the makefile will put the files where you want them). Read further if you run into snags or want to customize the code for your system.

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Installing the software  
Optional stuff  
Optimization  
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## BEFORE YOU START

=====

Before installing the software you must unpack the distributed source code. Since you are reading this file, you have probably already succeeded in this task. However, there is a potential for error if you needed to convert the files to the local standard text file format (for example, if you are on MS-DOS you may have converted LF end-of-line to CR/LF). You must apply such conversion to all the files EXCEPT those whose names begin with "test". The test files contain binary data; if you change them in any way then the self-test will give bad results.

Please check the last section of this file to see if there are hints for the specific machine or compiler you are using.

## CONFIGURING THE SOFTWARE

=====

To configure the IJG code for your system, you need to create two files:

- \* jconfig.h: contains values for system-dependent #define symbols.
- \* Makefile: controls the compilation process.

(On a non-Unix machine, you may create "project files" or some other substitute for a Makefile. jconfig.h is needed in any environment.)

We provide three different ways to generate these files:

- \* On a Unix system, you can just run the "configure" script.
- \* We provide sample jconfig files and makefiles for popular machines; if your machine matches one of the samples, just copy the right sample files to jconfig.h and Makefile.
- \* If all else fails, read the instructions below and make your own files.

Configuring the software using the automatic "configure" script

-----  
If you are on a Unix machine, you can just type

```
./configure
```

and let the configure script construct appropriate configuration files.

If you're using "csh" on an old version of System V, you might need to type

```
sh configure
```

instead to prevent csh from trying to execute configure itself.

Expect configure to run for a few minutes, particularly on slower machines; it works by compiling a series of test programs.

Configure was created with GNU Autoconf and it follows the usual conventions for GNU configure scripts. It makes a few assumptions that you may want to override. You can do this by providing optional switches to configure:

\* Configure will build both static and shared libraries, if possible.

If you want to build libjpeg only as a static library, say

```
./configure --disable-shared
```

If you want to build libjpeg only as a shared library, say

```
./configure --disable-static
```

Configure uses GNU libtool to take care of system-dependent shared library building methods.

\* Configure will use gcc (GNU C compiler) if it's available, otherwise cc.

To force a particular compiler to be selected, use the CC option, for example

```
./configure CC='cc'
```

The same method can be used to include any unusual compiler switches.

For example, on HP-UX you probably want to say

```
./configure CC='cc -Aa'
```

to get HP's compiler to run in ANSI mode.

\* The default CFLAGS setting is "-g" for non-gcc compilers, "-g -O2" for gcc.

You can override this by saying, for example,

```
./configure CFLAGS='-O2'
```

if you want to compile without debugging support.

\* Configure will set up the makefile so that "make install" will install files into /usr/local/bin, /usr/local/man, etc. You can specify an installation prefix other than "/usr/local" by giving configure the option "--prefix=PATH".

\* If you don't have a lot of swap space, you may need to enable the IJG software's internal virtual memory mechanism. To do this, give the option "--enable-maxmem=N" where N is the default maxmemory limit in megabytes. This is discussed in more detail under "Selecting a memory manager", below. You probably don't need to worry about this on reasonably-sized Unix machines, unless you plan to process very large images.

Configure has some other features that are useful if you are cross-compiling

or working in a network of multiple machine types; but if you need those features, you probably already know how to use them.

Configuring the software using one of the supplied jconfig and makefile files

-----

If you have one of these systems, you can just use the provided configuration files:

Makefile jconfig file System and/or compiler

makefile.manx jconfig.manx Amiga, Manx Aztec C  
makefile.sas jconfig.sas Amiga, SAS C  
makeproj.mac jconfig.mac Apple Macintosh, Metrowerks CodeWarrior  
mak\*jpeg.st jconfig.st Atari ST/STE/TT, Pure C or Turbo C  
makefile.bcc jconfig.bcc MS-DOS or OS/2, Borland C  
makefile.dj jconfig.dj MS-DOS, DJGPP (Delorie's port of GNU C)  
makefile.mc6 jconfig.mc6 MS-DOS, Microsoft C (16-bit only)  
makefile.wat jconfig.wat MS-DOS, OS/2, or Windows NT, Watcom C  
makefile.vc jconfig.vc Windows, MS Visual C++  
makefile.vs jconfig.vc Windows, MS Visual C++ 6 Developer Studio  
make\*.vc6  
makefile.vs jconfig.vc Windows, Visual Studio 2019 (v16)  
make\*.v16  
makefile.b32 jconfig.vc Windows, Borland C++ 32-bit (bcc32)  
makefile.mms jconfig.vms Digital VMS, with MMS software  
makefile.vms jconfig.vms Digital VMS, without MMS software

Copy the proper jconfig file to jconfig.h and the makefile to Makefile (or whatever your system uses as the standard makefile name). For more info see the appropriate system-specific hints section near the end of this file.

Configuring the software by hand

-----

First, generate a jconfig.h file. If you are moderately familiar with C, the comments in jconfig.txt should be enough information to do this; just copy jconfig.txt to jconfig.h and edit it appropriately. Otherwise, you may prefer to use the ckconfig.c program. You will need to compile and execute ckconfig.c by hand --- we hope you know at least enough to do that. ckconfig.c may not compile the first try (in fact, the whole idea is for it to fail if anything is going to). If you get compile errors, fix them by editing ckconfig.c according to the directions given in ckconfig.c. Once you get it to run, it will write a suitable jconfig.h file, and will also print out some advice about which makefile to use.

You may also want to look at the canned jconfig files, if there is one for a system similar to yours.

Second, select a makefile and copy it to Makefile (or whatever your system uses as the standard makefile name). The most generic makefiles we provide are

makefile.ansi: if your C compiler supports function prototypes  
makefile.unix: if not.

(You have function prototypes if ckconfig.c put "#define HAVE\_PROTOTYPES" in jconfig.h.) You may want to start from one of the other makefiles if there is one for a system similar to yours.

Look over the selected Makefile and adjust options as needed. In particular you may want to change the CC and CFLAGS definitions. For instance, if you are using GCC, set CC=gcc. If you had to use any compiler switches to get ckconfig.c to work, make sure the same switches are in CFLAGS.

If you are on a system that doesn't use makefiles, you'll need to set up project files (or whatever you do use) to compile all the source files and link them into executable files cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom. See the file lists in any of the makefiles to find out which files go into each program. Note that the provided makefiles all make a "library" file libjpeg first, but you don't have to do that if you don't want to; the file lists identify which source files are actually needed for compression, decompression, or both. As a last resort, you can make a batch script that just compiles everything and links it all together; makefile.vms is an example of this (it's for VMS systems that have no make-like utility).

Here are comments about some specific configuration decisions you'll need to make:

Command line style

-----

These programs can use a Unix-like command line style which supports redirection and piping, like this:

```
cjpeg inputfile >outputfile
cjpeg <inputfile >outputfile
source program | cjpeg >outputfile
```

The simpler "two file" command line style is just

```
cjpeg inputfile outputfile
```

You may prefer the two-file style, particularly if you don't have pipes.

You MUST use two-file style on any system that doesn't cope well with binary data fed through stdin/stdout; this is true for some MS-DOS compilers, for example. If you're not on a Unix system, it's safest to assume you need two-file style. (But if your compiler provides either the Posix-standard fdopen() library routine or a Microsoft-compatible setmode() routine, you

can safely use the Unix command line style, by defining USE\_FDOPEN or USE\_SETMODE respectively.)

To use the two-file style, make jconfig.h say "#define TWO\_FILE\_COMMANDLINE".

### Selecting a memory manager

-----

The IJG code is capable of working on images that are too big to fit in main memory; data is swapped out to temporary files as necessary. However, the code to do this is rather system-dependent. We provide five different memory managers:

- \* `jmemansi.c` This version uses the ANSI-standard library routine `tmpfile()`, which not all non-ANSI systems have. On some systems `tmpfile()` may put the temporary file in a non-optimal location; if you don't like what it does, use `jmemname.c`.
- \* `jmemname.c` This version creates named temporary files. For anything except a Unix machine, you'll need to configure the `select_file_name()` routine appropriately; see the comments near the head of `jmemname.c`. If you use this version, define `NEED_SIGNAL_CATCHER` in `jconfig.h` to make sure the temp files are removed if the program is aborted.
- \* `jmemnobs.c` (That stands for No Backing Store :-).) This will compile on almost any system, but it assumes you have enough main memory or virtual memory to hold the biggest images you work with.
- \* `jmemdos.c` This should be used with most 16-bit MS-DOS compilers. See the system-specific notes about MS-DOS for more info. **IMPORTANT:** if you use this, define `USE_MSDOS_MEMMGR` in `jconfig.h`, and include the assembly file `jmemdosa.asm` in the programs. The supplied makefiles and `jconfig` files for 16-bit MS-DOS compilers already do both.
- \* `jmemmac.c` Custom version for Apple Macintosh; see the system-specific notes for Macintosh for more info.

To use a particular memory manager, change the `SYSDEPMEM` variable in your makefile to equal the corresponding object file name (for example, `jmemansi.o` or `jmemansi.obj` for `jmemansi.c`).

If you have plenty of (real or virtual) main memory, just use `jmemnobs.c`. "Plenty" means about ten bytes for every pixel in the largest images you plan to process, so a lot of systems don't meet this criterion.

If yours doesn't, try `jmemansi.c` first. If that doesn't compile, you'll have to use `jmemname.c`; be sure to adjust `select_file_name()` for local conditions.



You may also need to change unlink() to remove() in close\_backing\_store().

Except with jmemnobs.c or jmemmac.c, you need to adjust the DEFAULT\_MAX\_MEM setting to a reasonable value for your system (either by adding a #define for DEFAULT\_MAX\_MEM to jconfig.h, or by adding a -D switch to the Makefile). This value limits the amount of data space the program will attempt to allocate. Code and static data space isn't counted, so the actual memory needs for cjpeg or djpeg are typically 100 to 150Kb more than the max-memory setting. Larger max-memory settings reduce the amount of I/O needed to process a large image, but too large a value can result in "insufficient memory" failures. On most Unix machines (and other systems with virtual memory), just set DEFAULT\_MAX\_MEM to several million and forget it. At the other end of the spectrum, for MS-DOS machines you probably can't go much above 300K to 400K. (On MS-DOS the value refers to conventional memory only. Extended/expanded memory is handled separately by jmemdos.c.)

## BUILDING THE SOFTWARE

=====

Now you should be able to compile the software. Just say "make" (or whatever's necessary to start the compilation). Have a cup of coffee.

Here are some things that could go wrong:

If your compiler complains about undefined structures, you should be able to shut it up by putting "#define INCOMPLETE\_TYPES\_BROKEN" in jconfig.h.

If you have trouble with missing system include files or inclusion of the wrong ones, read jininclude.h. This shouldn't happen if you used configure or ckconfig.c to set up jconfig.h.

There are a fair number of routines that do not use all of their parameters; some compilers will issue warnings about this, which you can ignore. There are also a few configuration checks that may give "unreachable code" warnings. Any other warning deserves investigation.

If you don't have a getenv() library routine, define NO\_GETENV.

Also see the system-specific hints, below.

## TESTING THE SOFTWARE

=====

As a quick test of functionality we've included a small sample image in several forms:

testorig.jpg Starting point for the djpeg tests.

testing.ppm The output of djpeg testorig.jpg  
testing.bmp The output of djpeg -bmp -colors 256 testorig.jpg  
testing.jpg The output of cjpeg testing.ppm  
testprog.jpg Progressive-mode equivalent of testorig.jpg.  
testimgp.jpg The output of cjpeg -progressive -optimize testing.ppm  
(The first- and second-generation .jpg files aren't identical since the  
default compression parameters are lossy.) If you can generate duplicates  
of the testing\* files then you probably have working programs.

With most of the makefiles, "make test" will perform the necessary  
comparisons.

If you're using a makefile that doesn't provide the test option, run djpeg  
and cjpeg by hand and compare the output files to testing\* with whatever  
binary file comparison tool you have. The files should be bit-for-bit  
identical.

If the programs complain "MAX\_ALLOC\_CHUNK is wrong, please fix", then you  
need to reduce MAX\_ALLOC\_CHUNK to a value that fits in type size\_t.  
Try adding "#define MAX\_ALLOC\_CHUNK 65520L" to jconfig.h. A less likely  
configuration error is "ALIGN\_TYPE is wrong, please fix": defining ALIGN\_TYPE  
as long should take care of that one.

If the cjpeg test run fails with "Missing Huffman code table entry", it's a  
good bet that you needed to define RIGHT\_SHIFT\_IS\_UNSIGNED. Go back to the  
configuration step and run ckconfig.c. (This is a good plan for any other  
test failure, too.)

If you are using Unix (one-file) command line style on a non-Unix system,  
it's a good idea to check that binary I/O through stdin/stdout actually  
works. You should get the same results from "djpeg <testorig.jpg >out.ppm"  
as from "djpeg -outfile out.ppm testorig.jpg". Note that the makefiles all  
use the latter style and therefore do not exercise stdin/stdout! If this  
check fails, try recompiling with USE\_SETMODE or USE\_FDOPEN defined.  
If it still doesn't work, better use two-file style.

If you chose a memory manager other than jmemnobs.c, you should test that  
temporary-file usage works. Try "djpeg -bmp -colors 256 -max 0 testorig.jpg"  
and make sure its output matches testing.bmp. If you have any really large  
images handy, try compressing them with -optimize and/or decompressing with  
-colors 256 to make sure your DEFAULT\_MAX\_MEM setting is not too large.

NOTE: this is far from an exhaustive test of the JPEG software; some modules,  
such as 1-pass color quantization, are not exercised at all. It's just a  
quick test to give you some confidence that you haven't missed something  
major.

## INSTALLING THE SOFTWARE

=====

Once you're done with the above steps, you can install the software by copying the executable files (cjpeg, djpeg, jpegtran, rdjpgcom, and wrjpgcom) to wherever you normally install programs. On Unix systems, you'll also want to put the man pages (cjpeg.1, djpeg.1, jpegtran.1, rdjpgcom.1, wrjpgcom.1) in the man-page directory. The pre-fab makefiles don't support this step since there's such a wide variety of installation procedures on different systems.

If you generated a Makefile with the "configure" script, you can just say  
make install  
to install the programs and their man pages into the standard places. (You'll probably need to be root to do this.) We recommend first saying  
make -n install  
to see where configure thought the files should go. You may need to edit the Makefile, particularly if your system's conventions for man page filenames don't match what configure expects.

If you want to install the IJG library itself, for use in compiling other programs besides ours, then you need to put the four include files  
jpeglib.h jerror.h jconfig.h jmorecfg.h  
into your include-file directory, and put the library file libjpeg.a (extension may vary depending on system) wherever library files go. If you generated a Makefile with "configure", it will do what it thinks is the right thing if you say  
make install-lib

## OPTIONAL STUFF

=====

Progress monitor:

If you like, you can #define PROGRESS\_REPORT (in jconfig.h) to enable display of percent-done progress reports. The routine provided in cdjpeg.c merely prints percentages to stderr, but you can customize it to do something fancier.

Utah RLE file format support:

We distribute the software with support for RLE image files (Utah Raster Toolkit format) disabled, because the RLE support won't compile without the Utah library. If you have URT version 3.1 or later, you can enable RLE support as follows:

1. #define RLE\_SUPPORTED in jconfig.h.
2. Add a -I option to CFLAGS in the Makefile for the directory

containing the URT .h files (typically the "include" subdirectory of the URT distribution).

3. Add `-L... -lrlc` to `LDLIBS` in the Makefile, where ... specifies the directory containing the URT "librlc.a" file (typically the "lib" subdirectory of the URT distribution).

Support for 9-bit to 12-bit deep pixel data:

The IJG code currently allows 8, 9, 10, 11, or 12 bits sample data precision. (For color, this means 8 to 12 bits per channel, of course.) If you need to work with deeper than 8-bit data, you can compile the IJG code for 9-bit to 12-bit operation.

To do so:

1. In `jmorecfg.h`, define `BITS_IN_JSAMPLE` as 9, 10, 11, or 12 rather than 8.
2. In `jconfig.h`, undefine `BMP_SUPPORTED`, `RLE_SUPPORTED`, and `TARGA_SUPPORTED`, because the code for those formats doesn't handle deeper than 8-bit data and won't even compile. (The PPM code does work, as explained below. The GIF code works too; it scales 8-bit GIF data to and from 12-bit depth automatically.)
3. Compile. Don't expect "make test" to pass, since the supplied test files are for 8-bit data.

Currently, 9-bit to 12-bit support does not work on 16-bit-int machines.

Run-time selection and conversion of data precision are currently not supported and may be added later.

Exception: The transcoding part (`jpegtran`) supports all settings in a single instance, since it operates on the level of DCT coefficients and not sample values.

The PPM reader (`rdppm.c`) can read deeper than 8-bit data from either text-format or binary-format PPM and PGM files. Binary-format PPM/PGM files which have a `maxval` greater than 255 are assumed to use 2 bytes per sample, MSB first (big-endian order). As of early 1995, 2-byte binary format is not officially supported by the `PBMPLUS` library, but it is expected that a future release of `PBMPLUS` will support it. Note that the PPM reader will read files of any `maxval` regardless of the `BITS_IN_JSAMPLE` setting; incoming data is automatically rescaled to `maxval=MAXJSAMPLE` as appropriate for the `cjpeg` bit depth.

The PPM writer (`wrppm.c`) will normally write 2-byte binary PPM or PGM format, `maxval=MAXJSAMPLE`, when compiled with `BITS_IN_JSAMPLE>8`. Since this format is not yet widely supported, you can disable it by compiling `wrppm.c` with `PPM_NORAWWORD` defined; then the data is scaled down to 8 bits to make a standard 1-byte/sample PPM or PGM file. (Yes, this means still another copy of `djpeg` to keep around. But hopefully you won't need it for very long. Poskanzer's supposed to get that new `PBMPLUS` release out Real Soon Now.)

Of course, if you are working with 9-bit to 12-bit data, you probably have it stored in some other, nonstandard format. In that case you'll probably want to write your own I/O modules to read and write your format.

Note:

The standard Huffman tables are only valid for 8-bit data precision. If you selected more than 8-bit data precision, cjpeg uses arithmetic coding by default. The Huffman encoder normally uses entropy optimization to compute usable tables for higher precision. Otherwise, you'll have to supply different default Huffman tables.

Removing code:

If you need to make a smaller version of the JPEG software, some optional functions can be removed at compile time. See the `xxx_SUPPORTED` #defines in `jconfig.h` and `jmorecfg.h`. If at all possible, we recommend that you leave in decoder support for all valid JPEG files, to ensure that you can read anyone's output. Taking out support for image file formats that you don't use is the most painless way to make the programs smaller. Another possibility is to remove some of the DCT methods: in particular, the "IFAST" method may not be enough faster than the others to be worth keeping on your machine. (If you do remove ISLOW or IFAST, be sure to redefine `JDCT_DEFAULT` or `JDCT_FASTEST` to a supported method, by adding a #define in `jconfig.h`.)

## OPTIMIZATION

=====

Unless you own a Cray, you'll probably be interested in making the JPEG software go as fast as possible. This section covers some machine-dependent optimizations you may want to try. We suggest that before trying any of this, you first get the basic installation to pass the self-test step.

Repeat the self-test after any optimization to make sure that you haven't broken anything.

The integer DCT routines perform a lot of multiplications. These multiplications must yield 32-bit results, but none of their input values are more than 16 bits wide. On many machines, notably the 680x0 and 80x86 CPUs, a 16x16=>32 bit multiply instruction is faster than a full 32x32=>32 bit multiply. Unfortunately there is no portable way to specify such a multiplication in C, but some compilers can generate one when you use the right combination of casts. See the `MULTIPLYxxx` macro definitions in `jdct.h`. If your compiler makes "int" be 32 bits and "short" be 16 bits, defining `SHORTxSHORT_32` is fairly likely to work. When experimenting with alternate definitions, be sure to test not only whether the code still works (use the self-test), but also whether it is actually faster --- on some compilers, alternate definitions may compute the right answer, yet be slower than the default. Timing cjpeg on a large PGM (grayscale) input file is the

best way to check this, as the DCT will be the largest fraction of the runtime in that mode. (Note: some of the distributed compiler-specific jconfig files already contain #define switches to select appropriate MULTIPLYxxx definitions.)

If your machine has sufficiently fast floating point hardware, you may find that the float DCT method is faster than the integer DCT methods, even after tweaking the integer multiply macros. In that case you may want to make the float DCT be the default method. (The only objection to this is that float DCT results may vary slightly across machines.) To do that, add "#define JDCT\_DEFAULT JDCT\_FLOAT" to jconfig.h. Even if you don't change the default, you should redefine JDCT\_FASTEST, which is the method selected by djpeg's -fast switch. Don't forget to update the documentation files (usage.txt and/or cjpeg.1, djpeg.1) to agree with what you've done.

If access to "short" arrays is slow on your machine, it may be a win to define type JCOEF as int rather than short. This will cost a good deal of memory though, particularly in some multi-pass modes, so don't do it unless you have memory to burn and short is REALLY slow.

If your compiler can compile function calls in-line, make sure the INLINE macro in jmorecfg.h is defined as the keyword that marks a function inline-able. Some compilers have a switch that tells the compiler to inline any function it thinks is profitable (e.g., -finline-functions for gcc). Enabling such a switch is likely to make the compiled code bigger but faster.

In general, it's worth trying the maximum optimization level of your compiler, and experimenting with any optional optimizations such as loop unrolling. (Unfortunately, far too many compilers have optimizer bugs ... be prepared to back off if the code fails self-test.) If you do any experimentation along these lines, please report the optimal settings to jpeg-info@jpegclub.org so we can mention them in future releases. Be sure to specify your machine and compiler version.

#### HINTS FOR SPECIFIC SYSTEMS

=====

We welcome reports on changes needed for systems not mentioned here. Submit 'em to jpeg-info@jpegclub.org. Also, if configure or ckconfig.c is wrong about how to configure the JPEG software for your system, please let us know.

Acorn RISC OS:

(Thanks to Simon Middleton for these hints on compiling with Desktop C.)

After renaming the files according to Acorn conventions, take a copy of makefile.ansi, change all occurrences of 'libjpeg.a' to 'libjpeg.o' and

change these definitions as indicated:

```
CFLAGS= -throwback -IC: -Wn
LDLIBS=C:o.Stubs
SYSDEPMEM=jmemansi.o
LN=Link
AR=LibFile -c -o
```

Also add a new line `'.c.o;; $(cc) $< $(cflags) -c -o $@'`. Remove the lines `'$(RM) libjpeg.o'` and `'$(AR2) libjpeg.o'` and the 'jconfig.h' dependency section.

Copy `jconfig.txt` to `jconfig.h`. Edit `jconfig.h` to define `TWO_FILE_COMMANDLINE` and `CHAR_IS_UNSIGNED`.

Run the makefile using `!AMU` not `!Make`. If you want to use the 'clean' and 'test' makefile entries then you will have to fiddle with the syntax a bit and rename the test files.

Amiga:

SAS C 6.50 reportedly is too buggy to compile the IJG code properly. A patch to update to 6.51 is available from SAS or AmiNet FTP sites.

The supplied config files are set up to use `jmemname.c` as the memory manager, with temporary files being created on the device named by `"JPEGTMP:"`.

Atari ST/STE/TT:

Copy the project files `makcjpeg.st`, `makdjpeg.st`, `maktjpeg.st`, and `makljjpeg.st` to `cjpeg.prj`, `djpeg.prj`, `jpegtran.prj`, and `libjpeg.prj` respectively. The project files should work as-is with Pure C. For Turbo C, change library filenames `"pc..."` to `"tc..."` in each project file. Note that `libjpeg.prj` selects `jmemansi.c` as the recommended memory manager. You'll probably want to adjust the `DEFAULT_MAX_MEM` setting --- you want it to be a couple hundred K less than your normal free memory. Put `"#define DEFAULT_MAX_MEM nnnn"` into `jconfig.h` to do this.

To use the 68881/68882 coprocessor for the floating point DCT, add the compiler option `"-8"` to the project files and replace `pcfltlb.lib` with `pc881lib.lib` in `cjpeg.prj` and `djpeg.prj`. Or if you don't have a coprocessor, you may prefer to remove the float DCT code by undefining `DCT_FLOAT_SUPPORTED` in `jmorecfg.h` (since without a coprocessor, the float code will be too slow to be useful). In that case, you can delete `pcfltlb.lib` from the project files.

Note that you must make libjpeg.lib before making cjpeg.ttp, djpeg.ttp, or jpegtran.ttp. You'll have to perform the self-test by hand.

We haven't bothered to include project files for rdjpgcom and wrjpgcom. Those source files should just be compiled by themselves; they don't depend on the JPEG library. You can use the default.prj project file of the Pure C distribution to make the programs.

There is a bug in some older versions of the Turbo C library which causes the space used by temporary files created with "tmpfile()" not to be freed after an abnormal program exit. If you check your disk afterwards, you will find cluster chains that are allocated but not used by a file. This should not happen in cjpeg/djpeg/jpegtran, since we enable a signal catcher to explicitly close temp files before exiting. But if you use the JPEG library with your own code, be sure to supply a signal catcher, or else use a different system-dependent memory manager.

Cray:

Should you be so fortunate as to be running JPEG on a Cray YMP, there is a compiler bug in old versions of Cray's Standard C (prior to 3.1). If you still have an old compiler, you'll need to insert a line reading "#pragma novector" just before the loop

```
for (i = 1; i <= (int) htbl->bits[i]; i++)
 huffsize[p++] = (char) i;
```

in fix\_huff\_tbl (in V5beta1, line 204 of jchuff.c and line 176 of jdchuff.c). [This bug may or may not still occur with the current IJG code, but it's probably a dead issue anyway...]

HP-UX:

If you have HP-UX 7.05 or later with the "software development" C compiler, you should run the compiler in ANSI mode. If using the configure script, say

```
./configure CC='cc -Aa'
```

(or -Ae if you prefer). If configuring by hand, use makefile.ansi and add "-Aa" to the CFLAGS line in the makefile.

If you have a pre-7.05 system, or if you are using the non-ANSI C compiler delivered with a minimum HP-UX system, then you must use makefile.unix (and do NOT add -Aa); or just run configure without the CC option.

On HP 9000 series 800 machines, the HP C compiler is buggy in revisions prior to A.08.07. If you get complaints about "not a typedef name", you'll have to use makefile.unix, or run configure without the CC option.



Macintosh, generic comments:

The supplied user-interface files (cjpeg.c, djpeg.c, etc) are set up to provide a Unix-style command line interface. You can use this interface on the Mac by means of the ccommand() library routine provided by Metrowerks CodeWarrior or Think C. This is only appropriate for testing the library, however; to make a user-friendly equivalent of cjpeg/djpeg you'd really want to develop a Mac-style user interface. There isn't a complete example available at the moment, but there are some helpful starting points:

1. Sam Bushell's free "To JPEG" applet provides drag-and-drop conversion to JPEG under System 7 and later. This only illustrates how to use the compression half of the library, but it does a very nice job of that part.

The CodeWarrior source code is available from <http://www.pobox.com/~jsam>.

2. Jim Brunner prepared a Mac-style user interface for both compression and decompression. Unfortunately, it hasn't been updated since IJG v4, and the library's API has changed considerably since then. Still it may be of some help, particularly as a guide to compiling the IJG code under Think C.

Jim's code is available from the Info-Mac archives, at [sumex-aim.stanford.edu](http://sumex-aim.stanford.edu) or mirrors thereof; see file /info-mac/dev/src/jpeg-convert-c.hqx.

jmemmac.c is the recommended memory manager back end for Macintosh. It uses NewPtr/DisposePtr instead of malloc/free, and has a Mac-specific implementation of jpeg\_mem\_available(). It also creates temporary files that follow Mac conventions. (That part of the code relies on System-7-or-later OS functions. See the comments in jmemmac.c if you need to run it on System 6.) NOTE that USE\_MAC\_MEMMGR must be defined in jconfig.h to use jmemmac.c.

You can also use jmemnobs.c, if you don't care about handling images larger than available memory. If you use any memory manager back end other than jmemmac.c, we recommend replacing "malloc" and "free" by "NewPtr" and "DisposePtr", because Mac C libraries often have peculiar implementations of malloc/free. (For instance, free() may not return the freed space to the Mac Memory Manager. This is undesirable for the IJG code because jmemmgr.c already clumps space requests.)

Macintosh, Metrowerks CodeWarrior:

The Unix-command-line-style interface can be used by defining USE\_CCCommand. You'll also need to define TWO\_FILE\_COMMANDLINE to avoid stdin/stdout. This means that when using the cjpeg/djpeg programs, you'll have to type the input and output file names in the "Arguments" text-edit box, rather than using the file radio buttons. (Perhaps USE\_FDOPEN or USE\_SETMODE would eliminate the problem, but I haven't heard from anyone who's tried it.)

On 680x0 Macs, Metrowerks defines type "double" as a 10-byte IEEE extended

float. `jmemmgr.c` won't like this: it wants `sizeof(ALIGN_TYPE)` to be a power of 2. Add `"#define ALIGN_TYPE long"` to `jconfig.h` to eliminate the complaint.

The supplied configuration file `jconfig.mac` can be used for your `jconfig.h`; it includes all the recommended symbol definitions. If you have AppleScript installed, you can run the supplied script `makeproj.mac` to create CodeWarrior project files for the library and the testbed applications, then build the library and applications. (Thanks to Dan Sears and Don Agro for this nifty hack, which saves us from trying to maintain CodeWarrior project files as part of the IJG distribution...)

Macintosh, Think C:

The documentation in Jim Brunner's "JPEG Convert" source code (see above) includes detailed build instructions for Think C; it's probably somewhat out of date for the current release, but may be helpful.

If you want to build the minimal command line version, proceed as follows. You'll have to prepare project files for the programs; we don't include any in the distribution since they are not text files. Use the file lists in any of the supplied makefiles as a guide. Also add the ANSI and Unix C libraries in a separate segment. You may need to divide the JPEG files into more than one segment; we recommend dividing compression and decompression modules. Define `USE_CCOMMAND` in `jconfig.h` so that the `ccommand()` routine is called. You must also define `TWO_FILE_COMMANDLINE` because `stdin/stdout` don't handle binary data correctly.

On 680x0 Macs, Think C defines type "double" as a 12-byte IEEE extended float. `jmemmgr.c` won't like this: it wants `sizeof(ALIGN_TYPE)` to be a power of 2. Add `"#define ALIGN_TYPE long"` to `jconfig.h` to eliminate the complaint.

`jconfig.mac` should work as a `jconfig.h` configuration file for Think C, but the `makeproj.mac` AppleScript script is specific to CodeWarrior. Sorry.

MIPS R3000:

MIPS's `cc` version 1.31 has a rather nasty optimization bug. Don't use `-O` if you have that compiler version. (Use `"cc -V"` to check the version.) Note that the R3000 chip is found in workstations from DEC and others.

MS-DOS, generic comments for 16-bit compilers:

The IJG code is designed to work well in 80x86 "small" or "medium" memory models (i.e., data pointers are 16 bits unless explicitly declared "far"; code pointers can be either size). You may be able to use small model to

compile cjpeg or djpeg by itself, but you will probably have to use medium model for any larger application. This won't make much difference in performance. You *will* take a noticeable performance hit if you use a large-data memory model, and you should avoid "huge" model if at all possible. Be sure that NEED\_FAR\_POINTERS is defined in jconfig.h if you use a small-data memory model; be sure it is NOT defined if you use a large-data model. (The supplied makefiles and jconfig files for Borland and Microsoft C compile in medium model and define NEED\_FAR\_POINTERS.)

The DOS-specific memory manager, jmemdos.c, should be used if possible. It needs some assembly-code routines which are in jmemdosa.asm; make sure your makefile assembles that file and includes it in the library. If you don't have a suitable assembler, you can get pre-assembled object files for jmemdosa by FTP from ftp.uu.net:/graphics/jpeg/jdosaobj.zip. (DOS-oriented distributions of the IJG source code often include these object files.)

When using jmemdos.c, jconfig.h must define USE\_MSDOS\_MEMMGR and must set MAX\_ALLOC\_CHUNK to less than 64K (65520L is a typical value). If your C library's far-heap malloc() can't allocate blocks that large, reduce MAX\_ALLOC\_CHUNK to whatever it can handle.

If you can't use jmemdos.c for some reason --- for example, because you don't have an assembler to assemble jmemdosa.asm --- you'll have to fall back to jmemansi.c or jmemname.c. You'll probably still need to set MAX\_ALLOC\_CHUNK in jconfig.h, because most DOS C libraries won't malloc() more than 64K at a time. **IMPORTANT:** if you use jmemansi.c or jmemname.c, you will have to compile in a large-data memory model in order to get the right stdio library. Too bad.

wrjpgcom needs to be compiled in large model, because it malloc()s a 64KB work area to hold the comment text. If your C library's malloc can't handle that, reduce MAX\_COM\_LENGTH as necessary in wrjpgcom.c.

Most MS-DOS compilers treat stdin/stdout as text files, so you must use two-file command line style. But if your compiler has either fdopen() or setmode(), you can use one-file style if you like. To do this, define USE\_SETMODE or USE\_FDOPEN so that stdin/stdout will be set to binary mode. (USE\_SETMODE seems to work with more DOS compilers than USE\_FDOPEN.) You should test that I/O through stdin/stdout produces the same results as I/O to explicitly named files... the "make test" procedures in the supplied makefiles do NOT use stdin/stdout.

MS-DOS, generic comments for 32-bit compilers:

None of the above comments about memory models apply if you are using a 32-bit flat-memory-space environment, such as DJGPP or Watcom C. (And you should use one if you have it, as performance will be much better than

8086-compatible code!) For flat-memory-space compilers, do NOT define NEED\_FAR\_POINTERS, and do NOT use jmemdos.c. Use jmemnobs.c if the environment supplies adequate virtual memory, otherwise use jmemansi.c or jmemname.c.

You'll still need to be careful about binary I/O through stdin/stdout. See the last paragraph of the previous section.

MS-DOS, Borland C:

Be sure to convert all the source files to DOS text format (CR/LF newlines). Although Borland C will often work OK with unmodified Unix (LF newlines) source files, sometimes it will give bogus compile errors. "Illegal character '#'" is the most common such error. (This is true with Borland C 3.1, but perhaps is fixed in newer releases.)

If you want one-file command line style, just undefine TWO\_FILE\_COMMANDLINE. jconfig.bcc already includes #define USE\_SETMODE to make this work. (fdopen does not work correctly.)

MS-DOS, Microsoft C:

makefile.mc6 works with Microsoft C, DOS Visual C++, etc. It should only be used if you want to build a 16-bit (small or medium memory model) program.

If you want one-file command line style, just undefine TWO\_FILE\_COMMANDLINE. jconfig.mc6 already includes #define USE\_SETMODE to make this work. (fdopen does not work correctly.)

Note that this makefile assumes that the working copy of itself is called "makefile". If you want to call it something else, say "makefile.mak", be sure to adjust the dependency line that reads "\$(RFILE) : makefile". Otherwise the make will fail because it doesn't know how to create "makefile". Worse, some releases of Microsoft's make utilities give an incorrect error message in this situation.

Old versions of MS C fail with an "out of macro expansion space" error because they can't cope with the macro TRACEMS8 (defined in jerror.h). If this happens to you, the easiest solution is to change TRACEMS8 to expand to nothing. You'll lose the ability to dump out JPEG coefficient tables with djpeg -debug -debug, but at least you can compile.

Original MS C 6.0 is very buggy; it compiles incorrect code unless you turn off optimization entirely (remove -O from CFLAGS). 6.00A is better, but it still generates bad code if you enable loop optimizations (-Ol or -Ox).

MS C 8.0 crashes when compiling jquant1.c with optimization switch /Oo ... which is on by default. To work around this bug, compile that one file with /Oo-.

Microsoft Windows (all versions), generic comments:

Some Windows system include files define typedef boolean as "unsigned char". The IJG code also defines typedef boolean, but we make it an "enum" by default. This doesn't affect the IJG programs because we don't import those Windows include files. But if you use the JPEG library in your own program, and some of your program's files import one definition of boolean while some import the other, you can get all sorts of mysterious problems. A good preventive step is to make the IJG library use "unsigned char" for boolean. To do that, add something like this to your jconfig.h file:

```
/* Define "boolean" as unsigned char, not enum, per Windows custom */
#ifndef __RPCNDR_H__ /* don't conflict if rpcndr.h already read */
typedef unsigned char boolean;
#endif
#ifndef FALSE /* in case these macros already exist */
#define FALSE 0 /* values of boolean */
#endif
#ifndef TRUE
#define TRUE 1
#endif
#define HAVE_BOOLEAN /* prevent jmorecfg.h from redefining it */
```

(This is already in jconfig.vc, by the way.)

winddef.h contains the declarations

```
#define far
#define FAR far
```

Since jmorecfg.h tries to define FAR as empty, you may get a compiler warning if you include both jpeglib.h and winddef.h (which windows.h includes). To suppress the warning, you can put "#ifndef FAR"/"#endif" around the line "#define FAR" in jmorecfg.h.

(Something like this is already in jmorecfg.h, by the way.)

When using the library in a Windows application, you will almost certainly want to modify or replace the error handler module jerror.c, since our default error handler does a couple of inappropriate things:

1. it tries to write error and warning messages on stderr;
2. in event of a fatal error, it exits by calling exit().

A simple stopgap solution for problem 1 is to replace the line

```
fprintf(stderr, "%s\n", buffer);
```

(in output\_message in jerror.c) with

```
MessageBox(GetActiveWindow(),buffer,"JPEG Error",MB_OK|MB_ICONERROR);
```

It's highly recommended that you at least do that much, since otherwise

error messages will disappear into nowhere. (Beginning with IJG v6b, this code is already present in `jerror.c`; just define `USE_WINDOWS_MESSAGEBOX` in `jconfig.h` to enable it.)

The proper solution for problem 2 is to return control to your calling application after a library error. This can be done with the `setjmp/longjmp` technique discussed in `libjpeg.txt` and illustrated in `example.c`. (NOTE: some older Windows C compilers provide versions of `setjmp/longjmp` that don't actually work under Windows. You may need to use the Windows system functions `Catch` and `Throw` instead.)

The recommended memory manager under Windows is `jmemnobs.c`; in other words, let Windows do any virtual memory management needed. You should NOT use `jmemdos.c` nor `jmemdosa.asm` under Windows.

For Windows 3.1, we recommend compiling in medium or large memory model; for newer Windows versions, use a 32-bit flat memory model. (See the MS-DOS sections above for more info about memory models.) In the 16-bit memory models only, you'll need to put

```
#define MAX_ALLOC_CHUNK 65520L /* Maximum request to malloc() */
```

into `jconfig.h` to limit allocation chunks to 64Kb. (Without that, you'd have to use huge memory model, which slows things down unnecessarily.) `jmemnobs.c` works without modification in large or flat memory models, but to use medium model, you need to modify its `jpeg_get_large` and `jpeg_free_large` routines to allocate far memory. In any case, you might like to replace its calls to `malloc` and `free` with direct calls on Windows memory allocation functions.

You may also want to modify `jdatasrc.c` and `jdatadst.c` to use Windows file operations rather than `fread/fwrite`. This is only necessary if your C compiler doesn't provide a competent implementation of C `stdio` functions.

You might want to tweak the `RGB_xxx` macros in `jmorecfg.h` so that the library will accept or deliver color pixels in BGR sample order, not RGB; BGR order is usually more convenient under Windows. Note that this change will break the sample applications `cjpeg/djpeg`, but the library itself works fine.

Many people want to convert the IJG library into a DLL. This is reasonably straightforward, but watch out for the following:

1. Don't try to compile as a DLL in small or medium memory model; use large model, or even better, 32-bit flat model. Many places in the IJG code assume the address of a local variable is an ordinary (not FAR) pointer; that isn't true in a medium-model DLL.
2. Microsoft C cannot pass file pointers between applications and DLLs. (See Microsoft Knowledge Base, PSS ID Number Q50336.) So `jdatasrc.c` and

jdastd.c don't work if you open a file in your application and then pass the pointer to the DLL. One workaround is to make jdatasrc.c/jdatadst.c part of your main application rather than part of the DLL.

3. You'll probably need to modify the macros GLOBAL() and EXTERN() to attach suitable linkage keywords to the exported routine names. Similarly, you'll want to modify METHODDEF() and JMETHOD() to ensure function pointers are declared in a way that lets application routines be called back through the function pointers. These macros are in jmorecfg.h. Typical definitions for a 16-bit DLL are:

```
#define GLOBAL(type) type _far _pascal _loads _export
#define EXTERN(type) extern type _far _pascal _loads
#define METHODDEF(type) static type _far _pascal
#define JMETHOD(type,methodname,arglist) \
 type (_far _pascal *methodname) arglist
```

For a 32-bit DLL you may want something like

```
#define GLOBAL(type) __declspec(dllexport) type
#define EXTERN(type) extern __declspec(dllexport) type
```

Although not all the GLOBAL routines are actually intended to be called by the application, the performance cost of making them all DLL entry points is negligible.

The unmodified IJG library presents a very C-specific application interface, so the resulting DLL is only usable from C or C++ applications. There has been some talk of writing wrapper code that would present a simpler interface usable from other languages, such as Visual Basic. This is on our to-do list but hasn't been very high priority --- any volunteers out there?

Microsoft Windows, Borland C:

The provided jconfig.bcc should work OK in a 32-bit Windows environment, but you'll need to tweak it in a 16-bit environment (you'd need to define NEED\_FAR\_POINTERS and MAX\_ALLOC\_CHUNK). Beware that makefile.bcc will need alteration if you want to use it for Windows --- in particular, you should use jmemnobs.c not jmemdos.c under Windows.

Borland C++ 4.5 fails with an internal compiler error when trying to compile jdmerge.c in 32-bit mode. If enough people complain, perhaps Borland will fix it. In the meantime, the simplest known workaround is to add a redundant definition of the variable range\_limit in h2v1\_merged\_upsample(), at the head of the block that handles odd image width (about line 268 in v6 jdmerge.c):

```
/* If image width is odd, do the last output column separately */
if (cinfo->output_width & 1) {
 register JSAMPLE * range_limit = cinfo->sample_range_limit; /* ADD THIS */
 cb = GETJSAMPLE(*inptr1);
```

Pretty bizarre, especially since the very similar routine h2v2\_merged\_upsample doesn't trigger the bug.

Recent reports suggest that this bug does not occur with "bcc32a" (the Pentium-optimized version of the compiler).

Another report from a user of Borland C 4.5 was that incorrect code (leading to a color shift in processed images) was produced if any of the following optimization switch combinations were used:

- Ot -Og
- Ot -Op
- Ot -Om

So try backing off on optimization if you see such a problem. (Are there several different releases all numbered "4.5"??)

Microsoft Windows, Microsoft Visual C++:

jconfig.vc should work OK with any Microsoft compiler for a 32-bit memory model. makefile.vc is intended for command-line use. (If you are using the Developer Studio environment, you may prefer the DevStudio project files; see below.)

IJG JPEG 7 adds extern "C" to jpeglib.h. This avoids the need to put extern "C" { ... } around #include "jpeglib.h" in your C++ application. You can also force VC++ to treat the library as C++ code by renaming all the \*.c files to \*.cpp (and adjusting the makefile to match). In this case you also need to define the symbol DONT\_USE\_EXTERN\_C in the configuration to prevent jpeglib.h from using extern "C".

Microsoft Windows, Microsoft Visual C++ 6 Developer Studio:

We include makefiles that should work as project files in Developer Studio 6.0 or later. There is a library makefile that builds the IJG library as a static Win32 library, and application makefiles that build the sample applications as Win32 console applications. (Even if you only want the library, we recommend building the applications so that you can run the self-test.)

To use:

1. Open the command prompt, change to the source directory and execute the command line

```
NMAKE /f makefile.vs setup-vc6
```

If you get an error message saying that the "NMAKE" command could not be found, execute the command

```
"%ProgramFiles%\Microsoft Visual Studio\VC98\Bin\VCVARS32"
```

to set the environment for using Microsoft Visual C++ tools, and repeat the NMAKE call.

This will move jconfig.vc to jconfig.h and makefiles to project files.

(Note that the renaming is critical!)



Alternatively you can use

```
NMAKE /f makefile.vs setupcopy-vc6
```

This will create renamed copies of the files, which allows to repeat the setup later.

2. Open the workspace file jpeg.dsw, build the library project.  
(If you are using Developer Studio more recent than 6.0, you'll probably get a message saying that the project files are being updated.)
3. Open the workspace file apps.dsw, build the application projects.
4. To perform the self-test, execute the command line  
NMAKE /f makefile.vs test-build
5. Move the application .exe files from the Release folder to an appropriate location on your path.

Microsoft Windows, Visual Studio 2019 (v16):

We include makefiles that should work as project files in Visual Studio 2019 (v16) or later. There is a library makefile that builds the IJG library as a static Win32/x64 library, and application makefiles that build the sample applications as Win32/x64 console applications. (Even if you only want the library, we recommend building the applications so that you can run the self-test.)

To use:

1. Open the Developer Command Prompt for VS 2019, change to the source directory and execute the command line  
NMAKE /f makefile.vs setup-v16  
This will move jconfig.vc to jconfig.h and makefiles to project files.  
(Note that the renaming is critical!)  
Alternatively you can use  
NMAKE /f makefile.vs setupcopy-v16  
This will create renamed copies of the files, which allows to repeat the setup later.
2. Open the solution file jpeg.sln, build the library project.
  - a) If you are using Visual Studio more recent than 2019 (v16), you'll probably get a message saying that the project files are being updated.
  - b) If necessary, open the project properties and adapt the Windows Target Platform Version in the Configuration Properties, General section; we support the latest version at the time of release.
  - c) If you want to build x64 code, change the platform setting from Win32 to x64. You can build Win32 and x64 versions side by side.
3. Open the solution file apps.sln, build the application projects.
4. To perform the self-test, execute the command line  
NMAKE /f makefile.vs test-32  
for the Win32 build, or on a 64-bit system  
NMAKE /f makefile.vs test-64

for the x64 build.

5. Move the application .exe files from the Release folder to an appropriate location on your path.

OS/2, Borland C++:

Watch out for optimization bugs in older Borland compilers; you may need to back off the optimization switch settings. See the comments in makefile.bcc.

SGI:

On some SGI systems, you may need to set "AR2= ar -ts" in the Makefile.

If you are using configure, you can do this by saying

```
./configure RANLIB='ar -ts'
```

This change is not needed on all SGIs. Use it only if the make fails at the stage of linking the completed programs.

On the MIPS R4000 architecture (Indy, etc.), the compiler option "-mips2" reportedly speeds up the float DCT method substantially, enough to make it faster than the default int method (but still slower than the fast int method). If you use -mips2, you may want to alter the default DCT method to be float. To do this, put "#define JDCT\_DEFAULT JDCT\_FLOAT" in jconfig.h.

VMS:

On an Alpha/VMS system with MMS, be sure to use the "/Marco=Alpha=1" qualifier with MMS when building the JPEG package.

VAX/VMS v5.5-1 may have problems with the test step of the build procedure reporting differences when it compares the original and test images. If the error points to the last block of the files, it is most likely bogus and may be safely ignored. It seems to be because the files are Stream\_LF and Backup/Compare has difficulty with the (presumably) null padded files. This problem was not observed on VAX/VMS v6.1 or AXP/VMS v6.1.

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/install.txt
```

No license file was found, but licenses were detected in source scan.

```
/*
```

```
* jconfig.txt
```

```
*
```

```
* Copyright (C) 1991-1994, Thomas G. Lane.
```

```
* Modified 2009-2013 by Guido Vollbeding.
```

```

* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file documents the configuration options that are required to
* customize the JPEG software for a particular system.
*
* The actual configuration options for a particular installation are stored
* in jconfig.h. On many machines, jconfig.h can be generated automatically
* or copied from one of the "canned" jconfig files that we supply. But if
* you need to generate a jconfig.h file by hand, this file tells you how.
*
* DO NOT EDIT THIS FILE --- IT WON'T ACCOMPLISH ANYTHING.
* EDIT A COPY NAMED JCONFIG.H.
*/

/*
* These symbols indicate the properties of your machine or compiler.
* #define the symbol if yes, #undef it if no.
*/

/* Does your compiler support function prototypes?
* (If not, you also need to use ansi2knr, see install.txt)
*/
#define HAVE_PROTOTYPES

/* Does your compiler support the declaration "unsigned char" ?
* How about "unsigned short" ?
*/
#define HAVE_UNSIGNED_CHAR
#define HAVE_UNSIGNED_SHORT

/* Define "void" as "char" if your compiler doesn't know about type void.
* NOTE: be sure to define void such that "void *" represents the most general
* pointer type, e.g., that returned by malloc().
*/
/* #define void char */

/* Define "const" as empty if your compiler doesn't know the "const" keyword.
*/
/* #define const */

/* Define this if an ordinary "char" type is unsigned.
* If you're not sure, leaving it undefined will work at some cost in speed.
* If you defined HAVE_UNSIGNED_CHAR then the speed difference is minimal.
*/
#undef CHAR_IS_UNSIGNED

```

```

/* Define this if your system has an ANSI-conforming <stddef.h> file.
*/
#define HAVE_STDDEF_H

/* Define this if your system has an ANSI-conforming <stdlib.h> file.
*/
#define HAVE_STDLIB_H

/* Define this if your system does not have an ANSI/SysV <string.h>,
* but does have a BSD-style <strings.h>.
*/
#undef NEED_BSD_STRINGS

/* Define this if your system does not provide typedef size_t in any of the
* ANSI-standard places (stddef.h, stdlib.h, or stdio.h), but places it in
* <sys/types.h> instead.
*/
#undef NEED_SYS_TYPES_H

/* For 80x86 machines, you need to define NEED_FAR_POINTERS,
* unless you are using a large-data memory model or 80386 flat-memory mode.
* On less brain-damaged CPUs this symbol must not be defined.
* (Defining this symbol causes large data structures to be referenced through
* "far" pointers and to be allocated with a special version of malloc.)
*/
#undef NEED_FAR_POINTERS

/* Define this if your linker needs global names to be unique in less
* than the first 15 characters.
*/
#undef NEED_SHORT_EXTERNAL_NAMES

/* Although a real ANSI C compiler can deal perfectly well with pointers to
* unspecified structures (see "incomplete types" in the spec), a few pre-ANSI
* and pseudo-ANSI compilers get confused. To keep one of these bozos happy,
* define INCOMPLETE_TYPES_BROKEN. This is not recommended unless you
* actually get "missing structure definition" warnings or errors while
* compiling the JPEG code.
*/
#undef INCOMPLETE_TYPES_BROKEN

/* Define "boolean" as unsigned char, not enum, on Windows systems.
*/
#ifdef _WIN32
#ifndef __RPCNDR_H__ /* don't conflict if rpcndr.h already read */
typedef unsigned char boolean;
#endif
#endif
#ifndef FALSE /* in case these macros already exist */

```

```

#define FALSE 0 /* values of boolean */
#endif
#ifndef TRUE
#define TRUE 1
#endif
#define HAVE_BOOLEAN /* prevent jmorecfg.h from redefining it */
#endif

/*
 * The following options affect code selection within the JPEG library,
 * but they don't need to be visible to applications using the library.
 * To minimize application namespace pollution, the symbols won't be
 * defined unless JPEG_INTERNALS has been defined.
 */

#ifndef JPEG_INTERNALS

/* Define this if your compiler implements ">>" on signed values as a logical
 * (unsigned) shift; leave it undefined if ">>" is a signed (arithmetic) shift,
 * which is the normal and rational definition.
 */
#undef RIGHT_SHIFT_IS_UNSIGNED

#endif /* JPEG_INTERNALS */

/*
 * The remaining options do not affect the JPEG library proper,
 * but only the sample applications cjpeg/djpeg (see cjpeg.c, djpeg.c).
 * Other applications can ignore these.
 */

#ifndef JPEG_CJPEG_DJPEG

/* These defines indicate which image (non-JPEG) file formats are allowed. */

#define BMP_SUPPORTED /* BMP image file format */
#define GIF_SUPPORTED /* GIF image file format */
#define PPM_SUPPORTED /* PBMPLUS PPM/PGM image file format */
#undef RLE_SUPPORTED /* Utah RLE image file format */
#define TARGA_SUPPORTED /* Targa image file format */

/* Define this if you want to name both input and output files on the command
 * line, rather than using stdout and optionally stdin. You MUST do this if
 * your system can't cope with binary I/O to stdin/stdout. See comments at
 * head of cjpeg.c or djpeg.c.
 */

```

```
*/
#undef TWO_FILE_COMMANDLINE

/* Define this if your system needs explicit cleanup of temporary files.
 * This is crucial under MS-DOS, where the temporary "files" may be areas
 * of extended memory; on most other systems it's not as important.
 */
#undef NEED_SIGNAL_CATCHER

/* By default, we open image files with fopen(...,"rb") or fopen(...,"wb").
 * This is necessary on systems that distinguish text files from binary files,
 * and is harmless on most systems that don't. If you have one of the rare
 * systems that complains about the "b" spec, define this symbol.
 */
#undef DONT_USE_B_MODE

/* Define this if you want percent-done progress reports from cjpeg/djpeg.
 */
#undef PROGRESS_REPORT
```

```
#endif /* JPEG_CJPEG_DJPEG */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jconfig.txt
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jdmaster.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2002-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains master control logic for the JPEG decompressor.
 * These routines are concerned with selecting the modules to be executed
 * and with determining the number of passes and the work to be done in each
 * pass.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmaster.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jdatadst.c
 *
```

\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2009-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains compression data destination routines for the case of  
\* emitting JPEG data to memory or to a file (or any stdio stream).  
\* While these routines are sufficient for most applications,  
\* some will want to use a different destination manager.  
\* IMPORTANT: we assume that fwrite() will correctly transcribe an array of  
\* JOCTETs into 8-bit-wide elements on external storage. If char is wider  
\* than 8 bits on your machine, you may need to do some tweaking.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdatadst.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jctrans.c  
\*

\* Copyright (C) 1995-1998, Thomas G. Lane.  
\* Modified 2000-2017 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains library routines for transcoding compression,  
\* that is, writing raw DCT coefficient arrays to an output JPEG file.  
\* The routines in jcapimin.c will also be needed by a transcoder.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jctrans.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jdmainct.c  
\*

\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2002-2016 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains the main buffer controller for decompression.  
\* The main buffer lies between the JPEG decompressor proper and the  
\* post-processor; it holds downsampled data in the JPEG colorspace.  
\*  
\* Note that this code is bypassed in raw-data mode, since the application

\* supplies the equivalent of the main buffer in that case.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmainct.c

No license file was found, but licenses were detected in source scan.

; For conditions of distribution and use, see the accompanying README file.

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemdosa.asm

No license file was found, but licenses were detected in source scan.

/\*

\* jpegint.h

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 1997-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file provides common declarations for the various JPEG modules.

\* These declarations are considered internal to the JPEG library; most

\* applications using the library shouldn't need to include this file.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jpegint.h

No license file was found, but licenses were detected in source scan.

/\*

\* jmehmsys.h

\*

\* Copyright (C) 1992-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This include file defines the interface between the system-independent

\* and system-dependent portions of the JPEG memory manager. No other

\* modules need include it. (The system-independent portion is jmehmgr.c;

\* there are several different versions of the system-dependent portion.)

\*

\* This file works as-is for the system-dependent memory managers supplied

\* in the IJG distribution. You may need to modify it if you write a

\* custom memory manager. If system-dependent changes are needed in

\* this file, the best method is to #ifdef them based on a configuration

\* symbol supplied in jconfig.h, as we have done with USE\_MSDOS\_MEMMGR

\* and USE\_MAC\_MEMMGR.



\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemsys.h  
No license file was found, but licenses were detected in source scan.

/\*

\* jcomapi.c

\*

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\* Modified 2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains application interface routines that are used for both

\* compression and decompression.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcomapi.c  
No license file was found, but licenses were detected in source scan.

/\*

\* wrtarga.c

\*

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\*

\* This file contains routines to write output images in Targa format.

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to

\* an ordinary stdio stream.

\*

\* Based on code contributed by Lee Daniel Crocker.

\*/

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/\*

\* jdapimin.c

\*

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\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains application interface code for the decompression half  
\* of the JPEG library. These are the "minimum" API routines that may be  
\* needed in either the normal full-decompression case or the  
\* transcoding-only case.  
\*  
\* Most of the routines intended to be called directly by an application  
\* are in this file or in jdapistd.c. But also see jcomapi.c for routines  
\* shared by compression and decompression, and jdtrans.c for the transcoding  
\* case.  
\*/

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\* jcmaster.c

\*

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\* Modified 2003-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains master control logic for the JPEG compressor.  
\* These routines are concerned with parameter validation, initial setup,  
\* and inter-pass control (determining the number of passes and the work  
\* to be done in each pass).  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcmaster.c  
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/\*

\* jdcolor.c

\*

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\* Modified 2011-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains output colorspace conversion routines.  
\*/

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/\*

\* jmorecfg.h

\*

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\* Modified 1997-2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains additional configuration options that customize the

\* JPEG software for special applications or support machine-dependent

\* optimizations. Most users will not need to touch this file.

\*/

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\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/jmorecfg.h

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/\*

\* jpeglib.h

\*

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\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file defines the application interface for the JPEG library.

\* Most applications using the library need only include this file,

\* and perhaps jerror.h if they want to know the exact error codes.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/jpeglib.h

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/\*

\* jutils.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2009-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains tables and miscellaneous utility routines needed

\* for both compression and decompression.

\* Note we prefix all global names with "j" to minimize conflicts with

\* a surrounding application.

\*/

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\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jutils.c

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/\*

\* wrtle.c

\*

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\* Modified 2017-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to write output images in RLE format.

\* The Utah Raster Toolkit library is required (version 3.1 or later).

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to

\* an ordinary stdio stream.

\*

\* Based on code contributed by Mike Lijewski,

\* with updates from Robert Hutchinson.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrtle.c

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/\*

\* rdswitch.c

\*

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\* Modified 2003-2019 by Guido Vollbeding.

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\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to process some of cjpeg's more complicated

\* command-line switches. Switches processed here are:

\* -qtables file Read quantization tables from text file

\* -scans file Read scan script from text file

\* -quality N[,N,...] Set quality ratings

\* -qslots N[,N,...] Set component quantization table selectors

\* -sample HxV[,HxV,...] Set component sampling factors

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/rdswitch.c

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/\*

\* jfdctflt.c

\*

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\* Modified 2003-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a floating-point implementation of the

\* forward DCT (Discrete Cosine Transform).

\*

\* This implementation should be more accurate than either of the integer

\* DCT implementations. However, it may not give the same results on all

\* machines because of differences in roundoff behavior. Speed will depend

\* on the hardware's floating point capacity.

\*

\* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT

\* on each column. Direct algorithms are also available, but they are

\* much more complex and seem not to be any faster when reduced to code.

\*

\* This implementation is based on Arai, Agui, and Nakajima's algorithm for

\* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in

\* Japanese, but the algorithm is described in the Pennebaker & Mitchell

\* JPEG textbook (see REFERENCES section in file README). The following code

\* is based directly on figure 4-8 in P&M.

\* While an 8-point DCT cannot be done in less than 11 multiplies, it is

\* possible to arrange the computation so that many of the multiplies are

\* simple scalings of the final outputs. These multiplies can then be

\* folded into the multiplications or divisions by the JPEG quantization

\* table entries. The AA&N method leaves only 5 multiplies and 29 adds

\* to be done in the DCT itself.

\* The primary disadvantage of this method is that with a fixed-point

\* implementation, accuracy is lost due to imprecise representation of the

\* scaled quantization values. However, that problem does not arise if

\* we use floating point arithmetic.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/jfdctflt.c

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/\*

\* jdapistd.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

- \* Modified 2002-2013 by Guido Vollbeding.
- \* This file is part of the Independent JPEG Group's software.
- \* For conditions of distribution and use, see the accompanying README file.
- \*
- \* This file contains application interface code for the decompression half
- \* of the JPEG library. These are the "standard" API routines that are
- \* used in the normal full-decompression case. They are not used by a
- \* transcoding-only application. Note that if an application links in
- \* jpeg\_start\_decompress, it will end up linking in the entire decompressor.
- \* We thus must separate this file from jdapimin.c to avoid linking the
- \* whole decompression library into a transcoder.
- \*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdapistd.c

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## IJG JPEG LIBRARY: SYSTEM ARCHITECTURE

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This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

This file provides an overview of the architecture of the IJG JPEG software; that is, the functions of the various modules in the system and the interfaces between modules. For more precise details about any data structure or calling convention, see the include files and comments in the source code.

We assume that the reader is already somewhat familiar with the JPEG standard.

The README file includes references for learning about JPEG. The file libjpeg.txt describes the library from the viewpoint of an application programmer using the library; it's best to read that file before this one.

Also, the file coderules.txt describes the coding style conventions we use.

In this document, JPEG-specific terminology follows the JPEG standard:

A "component" means a color channel, e.g., Red or Luminance.

A "sample" is a single component value (i.e., one number in the image data).

A "coefficient" is a frequency coefficient (a DCT transform output number).

A "block" is an array of samples or coefficients.

An "MCU" (minimum coded unit) is an interleaved set of blocks of size determined by the sampling factors, or a single block in a noninterleaved scan.

We do not use the terms "pixel" and "sample" interchangeably. When we say pixel, we mean an element of the full-size image, while a sample is an element of the downsampled image. Thus the number of samples may vary across components while the number of pixels does not. (This terminology is not used rigorously throughout the code, but it is used in places where confusion would

otherwise result.)

\*\*\* System features \*\*\*

The IJG distribution contains two parts:

- \* A subroutine library for JPEG compression and decompression.
- \* cjpeg/djpeg, two sample applications that use the library to transform JFIF JPEG files to and from several other image formats.

cjpeg/djpeg are of no great intellectual complexity: they merely add a simple command-line user interface and I/O routines for several uncompressed image formats. This document concentrates on the library itself.

We desire the library to be capable of supporting all JPEG baseline, extended sequential, and progressive DCT processes. The library does not support the hierarchical or lossless processes defined in the standard.

Within these limits, any set of compression parameters allowed by the JPEG spec should be readable for decompression. (We can be more restrictive about what formats we can generate.) Although the system design allows for all parameter values, some uncommon settings are not yet implemented and may never be; nonintegral sampling ratios are the prime example. Furthermore, we treat 8-bit vs. 12-bit data precision as a compile-time switch, not a run-time option, because most machines can store 8-bit pixels much more compactly than 12-bit.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, libtiff uses this library to implement JPEG compression within the TIFF file format.)

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. This code can be omitted if not needed.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

### \*\*\* Portability issues \*\*\*

Portability is an essential requirement for the library. The key portability issues that show up at the level of system architecture are:

1. Memory usage. We want the code to be able to run on PC-class machines with limited memory. Images should therefore be processed sequentially (in strips), to avoid holding the whole image in memory at once. Where a full-image buffer is necessary, we should be able to use either virtual memory or temporary files.
2. Near/far pointer distinction. To run efficiently on 80x86 machines, the code should distinguish "small" objects (kept in near data space) from "large" ones (kept in far data space). This is an annoying restriction, but fortunately it does not impact code quality for less brain-damaged machines, and the source code clutter turns out to be minimal with sufficient use of pointer typedefs.
3. Data precision. We assume that "char" is at least 8 bits, "short" and "int" at least 16, "long" at least 32. The code will work fine with larger data sizes, although memory may be used inefficiently in some cases. However, the JPEG compressed datastream must ultimately appear on external storage as a sequence of 8-bit bytes if it is to conform to the standard. This may pose a problem on machines where char is wider than 8 bits. The library represents compressed data as an array of values of typedef JOCTET. If no data type exactly 8 bits wide is available, custom data source and data destination modules must be written to unpack and pack the chosen JOCTET datatype into 8-bit external representation.

### \*\*\* System overview \*\*\*

The compressor and decompressor are each divided into two main sections: the JPEG compressor or decompressor proper, and the preprocessing or postprocessing functions. The interface between these two sections is the image data that the official JPEG spec regards as its input or output: this data is in the colorspace to be used for compression, and it is downsampled to the sampling factors to be used. The preprocessing and postprocessing steps are responsible for converting a normal image representation to or from this form. (Those few applications that want to deal with YCbCr downsampled data can skip the preprocessing or postprocessing step.)

Looking more closely, the compressor library contains the following main elements:

Preprocessing:

- \* Color space conversion (e.g., RGB to YCbCr).
- \* Edge expansion and downsampling. Optionally, this step can do simple



smoothing --- this is often helpful for low-quality source data.

JPEG proper:

- \* MCU assembly, DCT, quantization.
- \* Entropy coding (sequential or progressive, Huffman or arithmetic).

In addition to these modules we need overall control, marker generation, and support code (memory management & error handling). There is also a module responsible for physically writing the output data --- typically this is just an interface to `fwrite()`, but some applications may need to do something else with the data.

The decompressor library contains the following main elements:

JPEG proper:

- \* Entropy decoding (sequential or progressive, Huffman or arithmetic).
- \* Dequantization, inverse DCT, MCU disassembly.

Postprocessing:

- \* Upsampling. Optionally, this step may be able to do more general rescaling of the image.
- \* Color space conversion (e.g., YCbCr to RGB). This step may also provide gamma adjustment [ currently it does not ].
- \* Optional color quantization (e.g., reduction to 256 colors).
- \* Optional color precision reduction (e.g., 24-bit to 15-bit color).  
[This feature is not currently implemented.]

We also need overall control, marker parsing, and a data source module.

The support code (memory management & error handling) can be shared with the compression half of the library.

There may be several implementations of each of these elements, particularly in the decompressor, where a wide range of speed/quality tradeoffs is very useful. It must be understood that some of the best speedups involve merging adjacent steps in the pipeline. For example, upsampling, color space conversion, and color quantization might all be done at once when using a low-quality ordered-dither technique. The system architecture is designed to allow such merging where appropriate.

Note: it is convenient to regard edge expansion (padding to block boundaries) as a preprocessing/postprocessing function, even though the JPEG spec includes it in compression/decompression. We do this because downsampling/upsampling can be simplified a little if they work on padded data: it's not necessary to have special cases at the right and bottom edges. Therefore the interface buffer is always an integral number of blocks wide and high, and we expect compression preprocessing to pad the source data properly. Padding will occur only to the next block (`block_size-sample`) boundary. In an interleaved-scan situation, additional dummy blocks may be used to fill out MCUs, but the MCU assembly and disassembly logic will create or discard these blocks internally.

(This is advantageous for speed reasons, since we avoid DCTing the dummy blocks. It also permits a small reduction in file size, because the compressor can choose dummy block contents so as to minimize their size in compressed form. Finally, it makes the interface buffer specification independent of whether the file is actually interleaved or not.) Applications that wish to deal directly with the downsampled data must provide similar buffering and padding for odd-sized images.

\*\*\* Poor man's object-oriented programming \*\*\*

It should be clear by now that we have a lot of quasi-independent processing steps, many of which have several possible behaviors. To avoid cluttering the code with lots of switch statements, we use a simple form of object-style programming to separate out the different possibilities.

For example, two different color quantization algorithms could be implemented as two separate modules that present the same external interface; at runtime, the calling code will access the proper module indirectly through an "object".

We can get the limited features we need while staying within portable C. The basic tool is a function pointer. An "object" is just a struct containing one or more function pointer fields, each of which corresponds to a method name in real object-oriented languages. During initialization we fill in the function pointers with references to whichever module we have determined we need to use in this run. Then invocation of the module is done by indirecting through a function pointer; on most machines this is no more expensive than a switch statement, which would be the only other way of making the required run-time choice. The really significant benefit, of course, is keeping the source code clean and well structured.

We can also arrange to have private storage that varies between different implementations of the same kind of object. We do this by making all the module-specific object structs be separately allocated entities, which will be accessed via pointers in the master compression or decompression struct. The "public" fields or methods for a given kind of object are specified by a commonly known struct. But a module's initialization code can allocate a larger struct that contains the common struct as its first member, plus additional private fields. With appropriate pointer casting, the module's internal functions can access these private fields. (For a simple example, see `jdatadst.c`, which implements the external interface specified by struct `jpeg_destination_mgr`, but adds extra fields.)

(Of course this would all be a lot easier if we were using C++, but we are not yet prepared to assume that everyone has a C++ compiler.)

An important benefit of this scheme is that it is easy to provide multiple versions of any method, each tuned to a particular case. While a lot of

precalculation might be done to select an optimal implementation of a method, the cost per invocation is constant. For example, the upsampling step might have a "generic" method, plus one or more "hardwired" methods for the most popular sampling factors; the hardwired methods would be faster because they'd use straight-line code instead of for-loops. The cost to determine which method to use is paid only once, at startup, and the selection criteria are hidden from the callers of the method.

This plan differs a little bit from usual object-oriented structures, in that only one instance of each object class will exist during execution. The reason for having the class structure is that on different runs we may create different instances (choose to execute different modules). You can think of the term "method" as denoting the common interface presented by a particular set of interchangeable functions, and "object" as denoting a group of related methods, or the total shared interface behavior of a group of modules.

\*\*\* Overall control structure \*\*\*

We previously mentioned the need for overall control logic in the compression and decompression libraries. In IJG implementations prior to v5, overall control was mostly provided by "pipeline control" modules, which proved to be large, unwieldy, and hard to understand. To improve the situation, the control logic has been subdivided into multiple modules. The control modules consist of:

1. Master control for module selection and initialization. This has two responsibilities:

1A. Startup initialization at the beginning of image processing.

The individual processing modules to be used in this run are selected and given initialization calls.

1B. Per-pass control. This determines how many passes will be performed and calls each active processing module to configure itself

appropriately at the beginning of each pass. End-of-pass processing, where necessary, is also invoked from the master control module.

Method selection is partially distributed, in that a particular processing module may contain several possible implementations of a particular method, which it will select among when given its initialization call. The master control code need only be concerned with decisions that affect more than one module.

2. Data buffering control. A separate control module exists for each inter-processing-step data buffer. This module is responsible for invoking the processing steps that write or read that data buffer.

Each buffer controller sees the world as follows:

```
input data => processing step A => buffer => processing step B => output data
 | | |
 ----- controller -----
```

The controller knows the dataflow requirements of steps A and B: how much data they want to accept in one chunk and how much they output in one chunk. Its function is to manage its buffer and call A and B at the proper times.

A data buffer control module may itself be viewed as a processing step by a higher-level control module; thus the control modules form a binary tree with elementary processing steps at the leaves of the tree.

The control modules are objects. A considerable amount of flexibility can be had by replacing implementations of a control module. For example:

- \* Merging of adjacent steps in the pipeline is done by replacing a control module and its pair of processing-step modules with a single processing-step module. (Hence the possible merges are determined by the tree of control modules.)
- \* In some processing modes, a given interstep buffer need only be a "strip" buffer large enough to accommodate the desired data chunk sizes. In other modes, a full-image buffer is needed and several passes are required. The control module determines which kind of buffer is used and manipulates virtual array buffers as needed. One or both processing steps may be unaware of the multi-pass behavior.

In theory, we might be able to make all of the data buffer controllers interchangeable and provide just one set of implementations for all. In practice, each one contains considerable special-case processing for its particular job. The buffer controller concept should be regarded as an overall system structuring principle, not as a complete description of the task performed by any one controller.

\*\*\* Compression object structure \*\*\*

Here is a sketch of the logical structure of the JPEG compression library:

```
 |-- Colospace conversion
|-- Preprocessing controller --|
| |-- Downsampling
Main controller --|
| |-- Forward DCT, quantize
|-- Coefficient controller --|
| |-- Entropy encoding
```

This sketch also describes the flow of control (subroutine calls) during

typical image data processing. Each of the components shown in the diagram is an "object" which may have several different implementations available. One or more source code files contain the actual implementation(s) of each object.

The objects shown above are:

- \* Main controller: buffer controller for the subsampled-data buffer, which holds the preprocessed input data. This controller invokes preprocessing to fill the subsampled-data buffer, and JPEG compression to empty it. There is usually no need for a full-image buffer here; a strip buffer is adequate.
- \* Preprocessing controller: buffer controller for the downsampling input data buffer, which lies between colorspace conversion and downsampling. Note that a unified conversion/downsampling module would probably replace this controller entirely.
- \* Colorspace conversion: converts application image data into the desired JPEG color space; also changes the data from pixel-interleaved layout to separate component planes. Processes one pixel row at a time.
- \* Downsampling: performs reduction of chroma components as required. Optionally may perform pixel-level smoothing as well. Processes a "row group" at a time, where a row group is defined as  $V_{max}$  pixel rows of each component before downsampling, and  $V_k$  sample rows afterwards (remember  $V_k$  differs across components). Some downsampling or smoothing algorithms may require context rows above and below the current row group; the preprocessing controller is responsible for supplying these rows via proper buffering. The downsampler is responsible for edge expansion at the right edge (i.e., extending each sample row to a multiple of `block_size` samples); but the preprocessing controller is responsible for vertical edge expansion (i.e., duplicating the bottom sample row as needed to make a multiple of `block_size` rows).
- \* Coefficient controller: buffer controller for the DCT-coefficient data. This controller handles MCU assembly, including insertion of dummy DCT blocks when needed at the right or bottom edge. When performing Huffman-code optimization or emitting a multiscan JPEG file, this controller is responsible for buffering the full image. The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the JPEG file is noninterleaved.
- \* Forward DCT and quantization: Perform DCT, quantize, and emit coefficients. Works on one or more DCT blocks at a time. (Note: the coefficients are now emitted in normal array order, which the entropy encoder is expected to convert to zigzag order as necessary. Prior versions of the IJG code did the conversion to zigzag order within the quantization step.)
- \* Entropy encoding: Perform Huffman or arithmetic entropy coding and emit the

coded data to the data destination module. Works on one MCU per call. For progressive JPEG, the same DCT blocks are fed to the entropy coder during each pass, and the coder must emit the appropriate subset of coefficients.

In addition to the above objects, the compression library includes these objects:

- \* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules.
- \* Marker writing: generates JPEG markers (except for RSTn, which is emitted by the entropy encoder when needed).
- \* Data destination manager: writes the output JPEG datastream to its final destination (e.g., a file). The destination manager supplied with the library knows how to write to a stdio stream or to a memory buffer; for other behaviors, the surrounding application may provide its own destination manager.
- \* Memory manager: allocates and releases memory, controls virtual arrays (with backing store management, where required).
- \* Error handler: performs formatting and output of error and trace messages; determines handling of nonfatal errors. The surrounding application may override some or all of this object's methods to change error handling.
- \* Progress monitor: supports output of "percent-done" progress reports. This object represents an optional callback to the surrounding application: if wanted, it must be supplied by the application.

The error handler, destination manager, and progress monitor objects are defined as separate objects in order to simplify application-specific customization of the JPEG library. A surrounding application may override individual methods or supply its own all-new implementation of one of these objects. The object interfaces for these objects are therefore treated as part of the application interface of the library, whereas the other objects are internal to the library.

The error handler and memory manager are shared by JPEG compression and decompression; the progress monitor, if used, may be shared as well.

\*\*\* Decompression object structure \*\*\*

Here is a sketch of the logical structure of the JPEG decompression library:

|-- Entropy decoding

```

|-- Coefficient controller --|
| |-- Dequantize, Inverse DCT
Main controller --|
| |-- Upsampling
|-- Postprocessing controller --| |-- Colorspace conversion
| |-- Color quantization
| |-- Color precision reduction

```

As before, this diagram also represents typical control flow. The objects shown are:

\* **Main controller:** buffer controller for the subsampled-data buffer, which holds the output of JPEG decompression proper. This controller's primary task is to feed the postprocessing procedure. Some upsampling algorithms may require context rows above and below the current row group; when this is true, the main controller is responsible for managing its buffer so as to make context rows available. In the current design, the main buffer is always a strip buffer; a full-image buffer is never required.

\* **Coefficient controller:** buffer controller for the DCT-coefficient data. This controller handles MCU disassembly, including deletion of any dummy DCT blocks at the right or bottom edge. When reading a multiscan JPEG file, this controller is responsible for buffering the full image. (Buffering DCT coefficients, rather than samples, is necessary to support progressive JPEG.) The equivalent of one fully interleaved MCU row of subsampled data is processed per call, even when the source JPEG file is noninterleaved.

\* **Entropy decoding:** Read coded data from the data source module and perform Huffman or arithmetic entropy decoding. Works on one MCU per call. For progressive JPEG decoding, the coefficient controller supplies the prior coefficients of each MCU (initially all zeroes), which the entropy decoder modifies in each scan.

\* **Dequantization and inverse DCT:** like it says. Note that the coefficients buffered by the coefficient controller have NOT been dequantized; we merge dequantization and inverse DCT into a single step for speed reasons. When scaled-down output is asked for, simplified DCT algorithms may be used that need fewer coefficients and emit fewer samples per DCT block, not the full 8x8. Works on one DCT block at a time.

\* **Postprocessing controller:** buffer controller for the color quantization input buffer, when quantization is in use. (Without quantization, this controller just calls the upsampler.) For two-pass quantization, this controller is responsible for buffering the full-image data.

\* **Upsampling:** restores chroma components to full size. (May support more general output rescaling, too. Note that if undersized DCT outputs have

been emitted by the DCT module, this module must adjust so that properly sized outputs are created.) Works on one row group at a time. This module also calls the color conversion module, so its top level is effectively a buffer controller for the upsampling->color conversion buffer. However, in all but the highest-quality operating modes, upsampling and color conversion are likely to be merged into a single step.

\* Colorspace conversion: convert from JPEG color space to output color space, and change data layout from separate component planes to pixel-interleaved. Works on one pixel row at a time.

\* Color quantization: reduce the data to colormapped form, using either an externally specified colormap or an internally generated one. This module is not used for full-color output. Works on one pixel row at a time; may require two passes to generate a color map. Note that the output will always be a single component representing colormap indexes. In the current design, the output values are JSAMPLEs, so an 8-bit compilation cannot quantize to more than 256 colors. This is unlikely to be a problem in practice.

\* Color reduction: this module handles color precision reduction, e.g., generating 15-bit color (5 bits/primary) from JPEG's 24-bit output. Not quite clear yet how this should be handled... should we merge it with colorspace conversion???

Note that some high-speed operating modes might condense the entire postprocessing sequence to a single module (upsample, color convert, and quantize in one step).

In addition to the above objects, the decompression library includes these objects:

\* Master control: determines the number of passes required, controls overall and per-pass initialization of the other modules. This is subdivided into input and output control: `jdinput.c` controls only input-side processing, while `jdmaster.c` handles overall initialization and output-side control.

\* Marker reading: decodes JPEG markers (except for RSTn).

\* Data source manager: supplies the input JPEG datastream. The source manager supplied with the library knows how to read from a stdio stream or from a memory buffer; for other behaviors, the surrounding application may provide its own source manager.

\* Memory manager: same as for compression library.

\* Error handler: same as for compression library.



\* Progress monitor: same as for compression library.

As with compression, the data source manager, error handler, and progress monitor are candidates for replacement by a surrounding application.

\*\*\* Decompression input and output separation \*\*\*

To support efficient incremental display of progressive JPEG files, the decompressor is divided into two sections that can run independently:

1. Data input includes marker parsing, entropy decoding, and input into the coefficient controller's DCT coefficient buffer. Note that this processing is relatively cheap and fast.
2. Data output reads from the DCT coefficient buffer and performs the IDCT and all postprocessing steps.

For a progressive JPEG file, the data input processing is allowed to get arbitrarily far ahead of the data output processing. (This occurs only if the application calls `jpeg_consume_input()`; otherwise input and output run in lockstep, since the input section is called only when the output section needs more data.) In this way the application can avoid making extra display passes when data is arriving faster than the display pass can run. Furthermore, it is possible to abort an output pass without losing anything, since the coefficient buffer is read-only as far as the output section is concerned. See `libjpeg.txt` for more detail.

A full-image coefficient array is only created if the JPEG file has multiple scans (or if the application specifies buffered-image mode anyway). When reading a single-scan file, the coefficient controller normally creates only a one-MCU buffer, so input and output processing must run in lockstep in this case. `jpeg_consume_input()` is effectively a no-op in this situation.

The main impact of dividing the decompressor in this fashion is that we must be very careful with shared variables in the `cinfo` data structure. Each variable that can change during the course of decompression must be classified as belonging to data input or data output, and each section must look only at its own variables. For example, the data output section may not depend on any of the variables that describe the current scan in the JPEG file, because these may change as the data input section advances into a new scan.

The progress monitor is (somewhat arbitrarily) defined to treat input of the file as one pass when buffered-image mode is not used, and to ignore data input work completely when buffered-image mode is used. Note that the library has no reliable way to predict the number of passes when dealing with a progressive JPEG file, nor can it predict the number of output passes

in buffered-image mode. So the work estimate is inherently bogus anyway.

No comparable division is currently made in the compression library, because there isn't any real need for it.

\*\*\* Data formats \*\*\*

Arrays of pixel sample values use the following data structure:

```
typedef something JSAMPLE; a pixel component value, 0..MAXJSAMPLE
typedef JSAMPLE *JSAMPROW; ptr to a row of samples
typedef JSAMPROW *JSAMPARRAY; ptr to a list of rows
typedef JSAMPARRAY *JSAMPIMAGE; ptr to a list of color-component arrays
```

The basic element type JSAMPLE will typically be one of unsigned char, (signed) char, or short. Short will be used if samples wider than 8 bits are to be supported (this is a compile-time option). Otherwise, unsigned char is used if possible. If the compiler only supports signed chars, then it is necessary to mask off the value when reading. Thus, all reads of JSAMPLE values must be coded as "GETJSAMPLE(value)", where the macro will be defined as "((value) & 0xFF)" on signed-char machines and "((int) (value))" elsewhere.

With these conventions, JSAMPLE values can be assumed to be  $\geq 0$ . This helps simplify correct rounding during downsampling, etc. The JPEG standard's specification that sample values run from -128..127 is accommodated by subtracting 128 from the sample value in the DCT step. Similarly, during decompression the output of the IDCT step will be immediately shifted back to 0..255. (NB: different values are required when 12-bit samples are in use. The code is written in terms of MAXJSAMPLE and CENTERJSAMPLE, which will be defined as 255 and 128 respectively in an 8-bit implementation, and as 4095 and 2048 in a 12-bit implementation.)

We use a pointer per row, rather than a two-dimensional JSAMPLE array. This choice costs only a small amount of memory and has several benefits:

- \* Code using the data structure doesn't need to know the allocated width of the rows. This simplifies edge expansion/compression, since we can work in an array that's wider than the logical picture width.
- \* Indexing doesn't require multiplication; this is a performance win on many machines.
- \* Arrays with more than 64K total elements can be supported even on machines where malloc() cannot allocate chunks larger than 64K.
- \* The rows forming a component array may be allocated at different times without extra copying. This trick allows some speedups in smoothing steps that need access to the previous and next rows.

Note that each color component is stored in a separate array; we don't use the traditional layout in which the components of a pixel are stored together.

This simplifies coding of modules that work on each component independently, because they don't need to know how many components there are. Furthermore, we can read or write each component to a temporary file independently, which is helpful when dealing with noninterleaved JPEG files.

In general, a specific sample value is accessed by code such as

```
GETJSAMPLE(image[colorcomponent][row][col])
```

where col is measured from the image left edge, but row is measured from the first sample row currently in memory. Either of the first two indexings can be precomputed by copying the relevant pointer.

Since most image-processing applications prefer to work on images in which the components of a pixel are stored together, the data passed to or from the surrounding application uses the traditional convention: a single pixel is represented by N consecutive JSAMPLE values, and an image row is an array of (# of color components)\*(image width) JSAMPLEs. One or more rows of data can be represented by a pointer of type JSAMPARRAY in this scheme. This scheme is converted to component-wise storage inside the JPEG library. (Applications that want to skip JPEG preprocessing or postprocessing will have to contend with component-wise storage.)

Arrays of DCT-coefficient values use the following data structure:

```
typedef short JCOEF; a 16-bit signed integer
typedef JCOEF JBLOCK[DCTSIZE2]; an 8x8 block of coefficients
typedef JBLOCK *JBLOCKROW; ptr to one horizontal row of 8x8 blocks
typedef JBLOCKROW *JBLOCKARRAY; ptr to a list of such rows
typedef JBLOCKARRAY *JBLOCKIMAGE; ptr to a list of color component arrays
```

The underlying type is at least a 16-bit signed integer; while "short" is big enough on all machines of interest, on some machines it is preferable to use "int" for speed reasons, despite the storage cost. Coefficients are grouped into 8x8 blocks (but we always use #defines DCTSIZE and DCTSIZE2 rather than "8" and "64").

The contents of a coefficient block may be in either "natural" or zigzagged order, and may be true values or divided by the quantization coefficients, depending on where the block is in the processing pipeline. In the current library, coefficient blocks are kept in natural order everywhere; the entropy codecs zigzag or deziczag the data as it is written or read. The blocks contain quantized coefficients everywhere outside the DCT/IDCT subsystems. (This latter decision may need to be revisited to support variable quantization a la JPEG Part 3.)

Notice that the allocation unit is now a row of 8x8 coefficient blocks, corresponding to block\_size rows of samples. Otherwise the structure

is much the same as for samples, and for the same reasons.

On machines where malloc() can't handle a request bigger than 64Kb, this data structure limits us to rows of less than 512 JBLOCKSs, or a picture width of 4000+ pixels. This seems an acceptable restriction.

On 80x86 machines, the bottom-level pointer types (JSAMPROW and JBLOCKROW) must be declared as "far" pointers, but the upper levels can be "near" (implying that the pointer lists are allocated in the DS segment).

We use a #define symbol FAR, which expands to the "far" keyword when compiling on 80x86 machines and to nothing elsewhere.

\*\*\* Suspendable processing \*\*\*

In some applications it is desirable to use the JPEG library as an incremental, memory-to-memory filter. In this situation the data source or destination may be a limited-size buffer, and we can't rely on being able to empty or refill the buffer at arbitrary times. Instead the application would like to have control return from the library at buffer overflow/underrun, and then resume compression or decompression at a later time.

This scenario is supported for simple cases. (For anything more complex, we recommend that the application "bite the bullet" and develop real multitasking capability.) The libjpeg.txt file goes into more detail about the usage and limitations of this capability; here we address the implications for library structure.

The essence of the problem is that the entropy codec (coder or decoder) must be prepared to stop at arbitrary times. In turn, the controllers that call the entropy codec must be able to stop before having produced or consumed all the data that they normally would handle in one call. That part is reasonably straightforward: we make the controller call interfaces include "progress counters" which indicate the number of data chunks successfully processed, and we require callers to test the counter rather than just assume all of the data was processed.

Rather than trying to restart at an arbitrary point, the current Huffman codecs are designed to restart at the beginning of the current MCU after a suspension due to buffer overflow/underrun. At the start of each call, the codec's internal state is loaded from permanent storage (in the JPEG object structures) into local variables. On successful completion of the MCU, the permanent state is updated. (This copying is not very expensive, and may even lead to *improved* performance if the local variables can be registerized.) If a suspension occurs, the codec simply returns without updating the state, thus effectively reverting to the start of the MCU. Note that this implies leaving some data unprocessed in the source/destination buffer (ie, the

compressed partial MCU). The data source/destination module interfaces are specified so as to make this possible. This also implies that the data buffer must be large enough to hold a worst-case compressed MCU; a couple thousand bytes should be enough.

In a successive-approximation AC refinement scan, the progressive Huffman decoder has to be able to undo assignments of newly nonzero coefficients if it suspends before the MCU is complete, since decoding requires distinguishing previously-zero and previously-nonzero coefficients. This is a bit tedious but probably won't have much effect on performance. Other variants of Huffman decoding need not worry about this, since they will just store the same values again if forced to repeat the MCU.

This approach would probably not work for an arithmetic codec, since its modifiable state is quite large and couldn't be copied cheaply. Instead it would have to suspend and resume exactly at the point of the buffer end.

The JPEG marker reader is designed to cope with suspension at an arbitrary point. It does so by backing up to the start of the marker parameter segment, so the data buffer must be big enough to hold the largest marker of interest. Again, a couple KB should be adequate. (A special "skip" convention is used to bypass COM and APPn markers, so these can be larger than the buffer size without causing problems; otherwise a 64K buffer would be needed in the worst case.)

The JPEG marker writer currently does *\*not\** cope with suspension. We feel that this is not necessary; it is much easier simply to require the application to ensure there is enough buffer space before starting. (An empty 2K buffer is more than sufficient for the header markers; and ensuring there are a dozen or two bytes available before calling `jpeg_finish_compress()` will suffice for the trailer.) This would not work for writing multi-scan JPEG files, but we simply do not intend to support that capability with suspension.

\*\*\* Memory manager services \*\*\*

The JPEG library's memory manager controls allocation and deallocation of memory, and it manages large "virtual" data arrays on machines where the operating system does not provide virtual memory. Note that the same memory manager serves both compression and decompression operations.

In all cases, allocated objects are tied to a particular compression or decompression master record, and they will be released when that master record is destroyed.

The memory manager does not provide explicit deallocation of objects. Instead, objects are created in "pools" of free storage, and a whole pool

can be freed at once. This approach helps prevent storage-leak bugs, and it speeds up operations whenever malloc/free are slow (as they often are). The pools can be regarded as lifetime identifiers for objects. Two pools/lifetimes are defined:

- \* JPOOL\_PERMANENT lasts until master record is destroyed
- \* JPOOL\_IMAGE lasts until done with image (JPEG datastream)

Permanent lifetime is used for parameters and tables that should be carried across from one datastream to another; this includes all application-visible parameters. Image lifetime is used for everything else. (A third lifetime, JPOOL\_PASS = one processing pass, was originally planned. However it was dropped as not being worthwhile. The actual usage patterns are such that the peak memory usage would be about the same anyway; and having per-pass storage substantially complicates the virtual memory allocation rules --- see below.)

The memory manager deals with three kinds of object:

1. "Small" objects. Typically these require no more than 10K-20K total.
2. "Large" objects. These may require tens to hundreds of K depending on image size. Semantically they behave the same as small objects, but we distinguish them for two reasons:
  - \* On MS-DOS machines, large objects are referenced by FAR pointers, small objects by NEAR pointers.
  - \* Pool allocation heuristics may differ for large and small objects.Note that individual "large" objects cannot exceed the size allowed by type size\_t, which may be 64K or less on some machines.
3. "Virtual" objects. These are large 2-D arrays of JSAMPLEs or JBLOCKs (typically large enough for the entire image being processed). The memory manager provides stripwise access to these arrays. On machines without virtual memory, the rest of the array may be swapped out to a temporary file.

(Note: JSAMPARRAY and JBLOCKARRAY data structures are a combination of large objects for the data proper and small objects for the row pointers. For convenience and speed, the memory manager provides single routines to create these structures. Similarly, virtual arrays include a small control block and a JSAMPARRAY or JBLOCKARRAY working buffer, all created with one call.)

In the present implementation, virtual arrays are only permitted to have image lifespan. (Permanent lifespan would not be reasonable, and pass lifespan is not very useful since a virtual array's raison d'etre is to store data for multiple passes through the image.) We also expect that only "small" objects will be given permanent lifespan, though this restriction is not required by the memory manager.

In a non-virtual-memory machine, some performance benefit can be gained by making the in-memory buffers for virtual arrays be as large as possible. (For small images, the buffers might fit entirely in memory, so blind swapping would be very wasteful.) The memory manager will adjust the height of the buffers to fit within a prespecified maximum memory usage. In order

to do this in a reasonably optimal fashion, the manager needs to allocate all of the virtual arrays at once. Therefore, there isn't a one-step allocation routine for virtual arrays; instead, there is a "request" routine that simply allocates the control block, and a "realize" routine (called just once) that determines space allocation and creates all of the actual buffers. The realize routine must allow for space occupied by non-virtual large objects. (We don't bother to factor in the space needed for small objects, on the grounds that it isn't worth the trouble.)

To support all this, we establish the following protocol for doing business with the memory manager:

1. Modules must request virtual arrays (which may have only image lifespan) during the initial setup phase, i.e., in their `jinit_xxx` routines.
  2. All "large" objects (including JSAMPARRAYs and JBLOCKARRAYs) must also be allocated during initial setup.
  3. `realize_virt_arrays` will be called at the completion of initial setup.
- The above conventions ensure that sufficient information is available for it to choose a good size for virtual array buffers.

Small objects of any lifespan may be allocated at any time. We expect that the total space used for small objects will be small enough to be negligible in the `realize_virt_arrays` computation.

In a virtual-memory machine, we simply pretend that the available space is infinite, thus causing `realize_virt_arrays` to decide that it can allocate all the virtual arrays as full-size in-memory buffers. The overhead of the virtual-array access protocol is very small when no swapping occurs.

A virtual array can be specified to be "pre-zeroed"; when this flag is set, never-yet-written sections of the array are set to zero before being made available to the caller. If this flag is not set, never-written sections of the array contain garbage. (This feature exists primarily because the equivalent logic would otherwise be needed in `jdcoefct.c` for progressive JPEG mode; we may as well make it available for possible other uses.)

The first write pass on a virtual array is required to occur in top-to-bottom order; read passes, as well as any write passes after the first one, may access the array in any order. This restriction exists partly to simplify the virtual array control logic, and partly because some file systems may not support seeking beyond the current end-of-file in a temporary file. The main implication of this restriction is that rearrangement of rows (such as converting top-to-bottom data order to bottom-to-top) must be handled while reading data out of the virtual array, not while putting it in.

\*\*\* Memory manager internal structure \*\*\*

To isolate system dependencies as much as possible, we have broken the memory manager into two parts. There is a reasonably system-independent

"front end" (jmemmgr.c) and a "back end" that contains only the code likely to change across systems. All of the memory management methods outlined above are implemented by the front end. The back end provides the following routines for use by the front end (none of these routines are known to the rest of the JPEG code):

jpeg\_mem\_init, jpeg\_mem\_term system-dependent initialization/shutdown

jpeg\_get\_small, jpeg\_free\_small interface to malloc and free library routines (or their equivalents)

jpeg\_get\_large, jpeg\_free\_large interface to FAR malloc/free in MSDOS machines; else usually the same as jpeg\_get\_small/jpeg\_free\_small

jpeg\_mem\_available estimate available memory

jpeg\_open\_backing\_store create a backing-store object

read\_backing\_store, manipulate a backing-store object  
write\_backing\_store,  
close\_backing\_store

On some systems there will be more than one type of backing-store object (specifically, in MS-DOS a backing store file might be an area of extended memory as well as a disk file). jpeg\_open\_backing\_store is responsible for choosing how to implement a given object. The read/write/close routines are method pointers in the structure that describes a given object; this lets them be different for different object types.

It may be necessary to ensure that backing store objects are explicitly released upon abnormal program termination. For example, MS-DOS won't free extended memory by itself. To support this, we will expect the main program or surrounding application to arrange to call self\_destruct (typically via jpeg\_destroy) upon abnormal termination. This may require a SIGINT signal handler or equivalent. We don't want to have the back end module install its own signal handler, because that would pre-empt the surrounding application's ability to control signal handling.

The IJG distribution includes several memory manager back end implementations. Usually the same back end should be suitable for all applications on a given system, but it is possible for an application to supply its own back end at need.

\*\*\* Implications of DNL marker \*\*\*

Some JPEG files may use a DNL marker to postpone definition of the image



height (this would be useful for a fax-like scanner's output, for instance). In these files the SOF marker claims the image height is 0, and you only find out the true image height at the end of the first scan.

We could read these files as follows:

1. Upon seeing zero image height, replace it by 65535 (the maximum allowed).
2. When the DNL is found, update the image height in the global image descriptor.

This implies that control modules must avoid making copies of the image height, and must re-test for termination after each MCU row. This would be easy enough to do.

In cases where image-size data structures are allocated, this approach will result in very inefficient use of virtual memory or much-larger-than-necessary temporary files. This seems acceptable for something that probably won't be a mainstream usage. People might have to forgo use of memory-hogging options (such as two-pass color quantization or noninterleaved JPEG files) if they want efficient conversion of such files. (One could improve efficiency by demanding a user-supplied upper bound for the height, less than 65536; in most cases it could be much less.)

The standard also permits the SOF marker to overestimate the image height, with a DNL to give the true, smaller height at the end of the first scan.

This would solve the space problems if the overestimate wasn't too great. However, it implies that you don't even know whether DNL will be used.

This leads to a couple of very serious objections:

1. Testing for a DNL marker must occur in the inner loop of the decompressor's Huffman decoder; this implies a speed penalty whether the feature is used or not.
2. There is no way to hide the last-minute change in image height from an application using the decoder. Thus *every* application using the IJG library would suffer a complexity penalty whether it cared about DNL or not.

We currently do not support DNL because of these problems.

A different approach is to insist that DNL-using files be preprocessed by a separate program that reads ahead to the DNL, then goes back and fixes the SOF marker. This is a much simpler solution and is probably far more efficient. Even if one wants piped input, buffering the first scan of the JPEG file needs a lot smaller temp file than is implied by the maximum-height method. For this approach we'd simply treat DNL as a no-op in the decompressor (at most, check that it matches the SOF image height).

We will not worry about making the compressor capable of outputting DNL. Something similar to the first scheme above could be applied if anyone ever wants to make that work.

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/structure.txt

No license file was found, but licenses were detected in source scan.

/\*

\* jaricom.c

\*

\* Developed 1997-2011 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains probability estimation tables for common use in

\* arithmetic entropy encoding and decoding routines.

\*

\* This data represents Table D.3 in the JPEG spec (D.2 in the draft),

\* ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81, and Table 24

\* in the JBIG spec, ISO/IEC IS 11544 and CCITT Recommendation ITU-T T.82.

\*/

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/\*

\* jcapimin.c

\*

\* Copyright (C) 1994-1998, Thomas G. Lane.

\* Modified 2003-2010 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains application interface code for the compression half

\* of the JPEG library. These are the "minimum" API routines that may be

\* needed in either the normal full-compression case or the transcoding-only

\* case.

\*

\* Most of the routines intended to be called directly by an application

\* are in this file or in jcapistd.c. But also see jcparam.c for

\* parameter-setup helper routines, jcomapi.c for routines shared by

\* compression and decompression, and jctrans.c for the transcoding case.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcapimin.c

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/\*

\* jquant2.c

\*  
\* Copyright (C) 1991-1996, Thomas G. Lane.  
\* Modified 2011 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains 2-pass color quantization (color mapping) routines.  
\* These routines provide selection of a custom color map for an image,  
\* followed by mapping of the image to that color map, with optional  
\* Floyd-Steinberg dithering.  
\* It is also possible to use just the second pass to map to an arbitrary  
\* externally-given color map.  
\*  
\* Note: ordered dithering is not supported, since there isn't any fast  
\* way to compute intercolor distances; it's unclear that ordered dither's  
\* fundamental assumptions even hold with an irregularly spaced color map.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jquant2.c  
No license file was found, but licenses were detected in source scan.

/\*  
\* jidctflt.c  
\*  
\* Copyright (C) 1994-1998, Thomas G. Lane.  
\* Modified 2010-2017 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains a floating-point implementation of the  
\* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine  
\* must also perform dequantization of the input coefficients.  
\*  
\* This implementation should be more accurate than either of the integer  
\* IDCT implementations. However, it may not give the same results on all  
\* machines because of differences in roundoff behavior. Speed will depend  
\* on the hardware's floating point capacity.  
\*  
\* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT  
\* on each row (or vice versa, but it's more convenient to emit a row at  
\* a time). Direct algorithms are also available, but they are much more  
\* complex and seem not to be any faster when reduced to code.  
\*  
\* This implementation is based on Arai, Agui, and Nakajima's algorithm for  
\* scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in  
\* Japanese, but the algorithm is described in the Pennebaker & Mitchell  
\* JPEG textbook (see REFERENCES section in file README). The following code

- \* is based directly on figure 4-8 in P&M.
- \* While an 8-point DCT cannot be done in less than 11 multiplies, it is
- \* possible to arrange the computation so that many of the multiplies are
- \* simple scalings of the final outputs. These multiplies can then be
- \* folded into the multiplications or divisions by the JPEG quantization
- \* table entries. The AA&N method leaves only 5 multiplies and 29 adds
- \* to be done in the DCT itself.
- \* The primary disadvantage of this method is that with a fixed-point
- \* implementation, accuracy is lost due to imprecise representation of the
- \* scaled quantization values. However, that problem does not arise if
- \* we use floating point arithmetic.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jidctflt.c

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/\*

\* jdsample.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2002-2015 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains upsampling routines.

\*

\* Upsampling input data is counted in "row groups". A row group

\* is defined to be  $(v\_samp\_factor * DCT\_v\_scaled\_size / min\_DCT\_v\_scaled\_size)$

\* sample rows of each component. Upsampling will normally produce

\*  $max\_v\_samp\_factor$  pixel rows from each row group (but this could vary

\* if the upsampler is applying a scale factor of its own).

\*

\* An excellent reference for image resampling is

\* Digital Image Warping, George Wolberg, 1990.

\* Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdsample.c

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/\*

\* jcsample.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

```

*
* This file contains downsampling routines.
*
* Downsampling input data is counted in "row groups". A row group
* is defined to be max_v_samp_factor pixel rows of each component,
* from which the downsampler produces v_samp_factor sample rows.
* A single row group is processed in each call to the downsampler module.
*
* The downsampler is responsible for edge-expansion of its output data
* to fill an integral number of DCT blocks horizontally. The source buffer
* may be modified if it is helpful for this purpose (the source buffer is
* allocated wide enough to correspond to the desired output width).
* The caller (the prep controller) is responsible for vertical padding.
*
* The downsampler may request "context rows" by setting need_context_rows
* during startup. In this case, the input arrays will contain at least
* one row group's worth of pixels above and below the passed-in data;
* the caller will create dummy rows at image top and bottom by replicating
* the first or last real pixel row.
*
* An excellent reference for image resampling is
* Digital Image Warping, George Wolberg, 1990.
* Pub. by IEEE Computer Society Press, Los Alamitos, CA. ISBN 0-8186-8944-7.
*
* The downsampling algorithm used here is a simple average of the source
* pixels covered by the output pixel. The hi-falutin sampling literature
* refers to this as a "box filter". In general the characteristics of a box
* filter are not very good, but for the specific cases we normally use (1:1
* and 2:1 ratios) the box is equivalent to a "triangle filter" which is not
* nearly so bad. If you intend to use other sampling ratios, you'd be well
* advised to improve this code.
*
* A simple input-smoothing capability is provided. This is mainly intended
* for cleaning up color-dithered GIF input files (if you find it inadequate,
* we suggest using an external filtering program such as pnmconvol). When
* enabled, each input pixel P is replaced by a weighted sum of itself and its
* eight neighbors. P's weight is 1-8*SF and each neighbor's weight is SF,
* where SF = (smoothing_factor / 1024).
* Currently, smoothing is only supported for 2h2v sampling factors.
*/

Found in path(s):
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcsample.c
No license file was found, but licenses were detected in source scan.

/*
* jcmarker.c
*

```

\* Copyright (C) 1991-1998, Thomas G. Lane.  
\* Modified 2003-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains routines to write JPEG datastream markers.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcmarker.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdatasrc.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2009-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains decompression data source routines for the case of  
\* reading JPEG data from memory or from a file (or any stdio stream).  
\* While these routines are sufficient for most applications,  
\* some will want to use a different source manager.  
\* IMPORTANT: we assume that fread() will correctly transcribe an array of  
\* JOCTETs from 8-bit-wide elements on external storage. If char is wider  
\* than 8 bits on your machine, you may need to do some tweaking.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdatasrc.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdhuft.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.  
\* Modified 2006-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains Huffman entropy decoding routines.  
\* Both sequential and progressive modes are supported in this single module.  
\*  
\* Much of the complexity here has to do with supporting input suspension.  
\* If the data source module demands suspension, we want to be able to back  
\* up to the start of the current MCU. To do this, we copy state variables  
\* into local working storage, and update them back to the permanent

\* storage only upon successful completion of an MCU.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdhuff.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdppm.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 2009-2019 by Bill Allombert, Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to read input images in PPM/PGM format.

\* The extended 2-byte-per-sample raw PPM/PGM formats are supported.

\* The PBMPLUS library is NOT required to compile this software

\* (but it is highly useful as a set of PPM image manipulation programs).

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume input from

\* an ordinary stdio stream. They further assume that reading begins

\* at the start of the file; start\_input may need work if the

\* user interface has already read some data (e.g., to determine that

\* the file is indeed PPM format).

\*/

/\* Portions of this code are based on the PBMPLUS library, which is:

\*\*

\*\* Copyright (C) 1988 by Jef Poskanzer.

\*\*

\*\* Permission to use, copy, modify, and distribute this software and its

\*\* documentation for any purpose and without fee is hereby granted, provided

\*\* that the above copyright notice appear in all copies and that both that

\*\* copyright notice and this permission notice appear in supporting

\*\* documentation. This software is provided "as is" without express or

\*\* implied warranty.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdppm.c

No license file was found, but licenses were detected in source scan.

/\*

\* jccolor.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2011-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains input colorspace conversion routines.  
\*/

Found in path(s):

\*/opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jccolor.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jinclude.h

\*

\* Copyright (C) 1991-1994, Thomas G. Lane.

\* Modified 2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file exists to provide a single place to fix any problems with  
\* including the wrong system include files. (Common problems are taken  
\* care of by the standard jconfig symbols, but on really weird systems  
\* you may have to edit this file.)

\*

\* NOTE: this file is NOT intended to be included by applications using the

\* JPEG library. Most applications need only include jpeglib.h.

\*/

Found in path(s):

\*/opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jinclude.h  
No license file was found, but licenses were detected in source scan.

/\*

\* rdgif.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to read input images in GIF format.

\*

\* These routines may need modification for non-Unix environments or  
\* specialized applications. As they stand, they assume input from  
\* an ordinary stdio stream. They further assume that reading begins  
\* at the start of the file; start\_input may need work if the  
\* user interface has already read some data (e.g., to determine that  
\* the file is indeed GIF format).

\*/



```
/*
 * This code is loosely based on giftppm from the PBMPLUS distribution
 * of Feb. 1991. That file contains the following copyright notice:
 * +-----+
 * | Copyright 1990, David Koblas. |
 * | Permission to use, copy, modify, and distribute this software |
 * | and its documentation for any purpose and without fee is hereby |
 * | granted, provided that the above copyright notice appear in all |
 * | copies and that both that copyright notice and this permission |
 * | notice appear in supporting documentation. This software is |
 * | provided "as is" without express or implied warranty. |
 * +-----+
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdgif.c
No license file was found, but licenses were detected in source scan.
```

```
/*
 * jdct.h
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2002-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This include file contains common declarations for the forward and
 * inverse DCT modules. These declarations are private to the DCT managers
 * (jcdctmgr.c, jddctmgr.c) and the individual DCT algorithms.
 * The individual DCT algorithms are kept in separate files to ease
 * machine-dependent tuning (e.g., assembly coding).
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdct.h
No license file was found, but licenses were detected in source scan.
```

```
/*
 * ckconfig.c
 *
 * Copyright (C) 1991-1994, Thomas G. Lane.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/ckconfig.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * rdjpgcom.c
 *
 * Copyright (C) 1994-1997, Thomas G. Lane.
 * Modified 2009 by Bill Allombert, Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains a very simple stand-alone application that displays
 * the text in COM (comment) markers in a JFIF file.
 * This may be useful as an example of the minimum logic needed to parse
 * JPEG markers.
 */
```

Found in path(s):

```
*/opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdjpgcom.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jidctfst.c
 *
 * Copyright (C) 1994-1998, Thomas G. Lane.
 * Modified 2015-2017 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains a fast, not so accurate integer implementation of the
 * inverse DCT (Discrete Cosine Transform). In the IJG code, this routine
 * must also perform dequantization of the input coefficients.
 *
 * A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT
 * on each row (or vice versa, but it's more convenient to emit a row at
 * a time). Direct algorithms are also available, but they are much more
 * complex and seem not to be any faster when reduced to code.
 *
 * This implementation is based on Arai, Agui, and Nakajima's algorithm for
 * scaled DCT. Their original paper (Trans. IEICE E-71(11):1095) is in
 * Japanese, but the algorithm is described in the Pennebaker & Mitchell
 * JPEG textbook (see REFERENCES section in file README). The following code
 * is based directly on figure 4-8 in P&M.
 *
 * While an 8-point DCT cannot be done in less than 11 multiplies, it is
 * possible to arrange the computation so that many of the multiplies are
 * simple scalings of the final outputs. These multiplies can then be
 * folded into the multiplications or divisions by the JPEG quantization
 * table entries. The AA&N method leaves only 5 multiplies and 29 adds
 * to be done in the DCT itself.
```

\* The primary disadvantage of this method is that with fixed-point math,  
\* accuracy is lost due to imprecise representation of the scaled  
\* quantization values. The smaller the quantization table entry, the less  
\* precise the scaled value, so this implementation does worse with high-  
\* quality-setting files than with low-quality ones.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jidctfst.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jcapistd.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2013 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains application interface code for the compression half

\* of the JPEG library. These are the "standard" API routines that are

\* used in the normal full-compression case. They are not used by a

\* transcoding-only application. Note that if an application links in

\* jpeg\_start\_compress, it will end up linking in the entire compressor.

\* We thus must separate this file from jcapimin.c to avoid linking the

\* whole compression library into a transcoder.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcapistd.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jfdctint.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modification developed 2003-2018 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a slow-but-accurate integer implementation of the

\* forward DCT (Discrete Cosine Transform).

\*

\* A 2-D DCT can be done by 1-D DCT on each row followed by 1-D DCT

\* on each column. Direct algorithms are also available, but they are

\* much more complex and seem not to be any faster when reduced to code.

\*

\* This implementation is based on an algorithm described in

- \* C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT
- \* Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,
- \* Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.
- \* The primary algorithm described there uses 11 multiplies and 29 adds.
- \* We use their alternate method with 12 multiplies and 32 adds.
- \* The advantage of this method is that no data path contains more than one
- \* multiplication; this allows a very simple and accurate implementation in
- \* scaled fixed-point arithmetic, with a minimal number of shifts.
- \*
- \* We also provide FDCT routines with various input sample block sizes for
- \* direct resolution reduction or enlargement and for direct resolving the
- \* common 2x1 and 1x2 subsampling cases without additional resampling: NxN
- \* (N=1...16), 2NxN, and Nx2N (N=1...8) pixels for one 8x8 output DCT block.
- \*
- \* For N<8 we fill the remaining block coefficients with zero.
- \* For N>8 we apply a partial N-point FDCT on the input samples, computing
- \* just the lower 8 frequency coefficients and discarding the rest.
- \*
- \* We must scale the output coefficients of the N-point FDCT appropriately
- \* to the standard 8-point FDCT level by 8/N per 1-D pass. This scaling
- \* is folded into the constant multipliers (pass 2) and/or final/initial
- \* shifting.
- \*
- \* CAUTION: We rely on the FIX() macro except for the N=1,2,4,8 cases
- \* since there would be too many additional constants to pre-calculate.
- \*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jfdctint.c

No license file was found, but licenses were detected in source scan.

/\*

\* jmemdos.c

\*

\* Copyright (C) 1992-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file provides an MS-DOS-compatible implementation of the system-

\* dependent portion of the JPEG memory manager. Temporary data can be

\* stored in extended or expanded memory as well as in regular DOS files.

\*

\* If you use this file, you must be sure that NEED\_FAR\_POINTERS is defined

\* if you compile in a small-data memory model; it should NOT be defined if

\* you use a large-data memory model. This file is not recommended if you

\* are using a flat-memory-space 386 environment such as DJGCC or Watcom C.

\* Also, this code will NOT work if struct fields are aligned on greater than

\* 2-byte boundaries.

\*

\* Based on code contributed by Ge' Weijers.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemdos.c

No license file was found, but licenses were detected in source scan.

/\*

\* jidctint.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modification developed 2002-2018 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a slow-but-accurate integer implementation of the

\* inverse DCT (Discrete Cosine Transform). In the IJG code, this routine

\* must also perform dequantization of the input coefficients.

\*

\* A 2-D IDCT can be done by 1-D IDCT on each column followed by 1-D IDCT

\* on each row (or vice versa, but it's more convenient to emit a row at

\* a time). Direct algorithms are also available, but they are much more

\* complex and seem not to be any faster when reduced to code.

\*

\* This implementation is based on an algorithm described in

\* C. Loeffler, A. Ligtenberg and G. Moschytz, "Practical Fast 1-D DCT

\* Algorithms with 11 Multiplications", Proc. Int'l. Conf. on Acoustics,

\* Speech, and Signal Processing 1989 (ICASSP '89), pp. 988-991.

\* The primary algorithm described there uses 11 multiplies and 29 adds.

\* We use their alternate method with 12 multiplies and 32 adds.

\* The advantage of this method is that no data path contains more than one

\* multiplication; this allows a very simple and accurate implementation in

\* scaled fixed-point arithmetic, with a minimal number of shifts.

\*

\* We also provide IDCT routines with various output sample block sizes for

\* direct resolution reduction or enlargement and for direct resolving the

\* common 2x1 and 1x2 subsampling cases without additional resampling: NxN

\* (N=1...16), 2NxN, and Nx2N (N=1...8) pixels for one 8x8 input DCT block.

\*

\* For N<8 we simply take the corresponding low-frequency coefficients of

\* the 8x8 input DCT block and apply an NxN point IDCT on the sub-block

\* to yield the downsampled outputs.

\* This can be seen as direct low-pass downsampling from the DCT domain

\* point of view rather than the usual spatial domain point of view,

\* yielding significant computational savings and results at least

\* as good as common bilinear (averaging) spatial downsampling.

\*

\* For  $N > 8$  we apply a partial  $N \times N$  IDCT on the 8 input coefficients as  
\* lower frequencies and higher frequencies assumed to be zero.  
\* It turns out that the computational effort is similar to the  $8 \times 8$  IDCT  
\* regarding the output size.  
\* Furthermore, the scaling and descaling is the same for all IDCT sizes.  
\*  
\* CAUTION: We rely on the FIX() macro except for the  $N=1,2,4,8$  cases  
\* since there would be too many additional constants to pre-calculate.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jidctint.c  
No license file was found, but licenses were detected in source scan.

/\*

\* rdbmp.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2009-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to read input images in Microsoft "BMP"  
\* format (MS Windows 3.x, OS/2 1.x, and OS/2 2.x flavors).  
\* Currently, only 8-, 24-, and 32-bit images are supported, not 1-bit or  
\* 4-bit (feeding such low-depth images into JPEG would be silly anyway).  
\* Also, we don't support RLE-compressed files.

\*

\* These routines may need modification for non-Unix environments or  
\* specialized applications. As they stand, they assume input from  
\* an ordinary stdio stream. They further assume that reading begins  
\* at the start of the file; start\_input may need work if the  
\* user interface has already read some data (e.g., to determine that  
\* the file is indeed BMP format).

\*

\* This code contributed by James Arthur Boucher.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdbmp.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jmemmgr.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.  
\* Modified 2011-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.

```

* For conditions of distribution and use, see the accompanying README file.
*
* This file contains the JPEG system-independent memory management
* routines. This code is usable across a wide variety of machines; most
* of the system dependencies have been isolated in a separate file.
* The major functions provided here are:
* * pool-based allocation and freeing of memory;
* * policy decisions about how to divide available memory among the
* virtual arrays;
* * control logic for swapping virtual arrays between main memory and
* backing storage.
* The separate system-dependent file provides the actual backing-storage
* access code, and it contains the policy decision about how much total
* main memory to use.
* This file is system-dependent in the sense that some of its functions
* are unnecessary in some systems. For example, if there is enough virtual
* memory so that backing storage will never be used, much of the virtual
* array control logic could be removed. (Of course, if you have that much
* memory then you shouldn't care about a little bit of unused code...)
*/

```

Found in path(s):

```

* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemmgr.c

```

No license file was found, but licenses were detected in source scan.

```

/*
* djpeg.c
*
* Copyright (C) 1991-1997, Thomas G. Lane.
* Modified 2009-2019 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for the JPEG decompressor.
* It should work on any system with Unix- or MS-DOS-style command lines.
*
* Two different command line styles are permitted, depending on the
* compile-time switch TWO_FILE_COMMANDLINE:
* djpeg [options] inputfile outputfile
* djpeg [options] [inputfile]
* In the second style, output is always to standard output, which you'd
* normally redirect to a file or pipe to some other program. Input is
* either from a named file or from standard input (typically redirected).
* The second style is convenient on Unix but is unhelpful on systems that
* don't support pipes. Also, you MUST use the first style if your system
* doesn't do binary I/O to stdin/stdout.
* To simplify script writing, the "-outfile" switch is provided. The syntax
* djpeg [options] -outfile outputfile inputfile

```

\* works regardless of which command line style is used.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/djpeg.c

No license file was found, but licenses were detected in source scan.

/\*

\* cdjpeg.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains common support routines used by the IJG application

\* programs (cjpeg, djpeg, jpegtran).

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/cdjpeg.c

No license file was found, but licenses were detected in source scan.

/\*

\* jcprepct.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains the compression preprocessing controller.

\* This controller manages the color conversion, downsampling,

\* and edge expansion steps.

\*

\* Most of the complexity here is associated with buffering input rows

\* as required by the downsampler. See the comments at the head of

\* jcsample.c for the downsampler's needs.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrc-v9d-tar-gz/jpeg-9d/jcprepct.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdrle.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.



\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains routines to read input images in Utah RLE format.  
\* The Utah Raster Toolkit library is required (version 3.1 or later).  
\*  
\* These routines may need modification for non-Unix environments or  
\* specialized applications. As they stand, they assume input from  
\* an ordinary stdio stream. They further assume that reading begins  
\* at the start of the file; start\_input may need work if the  
\* user interface has already read some data (e.g., to determine that  
\* the file is indeed RLE format).  
\*  
\* Based on code contributed by Mike Lijewski,  
\* with updates from Robert Hutchinson.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdrle.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jdarith.c

\*

\* Developed 1997-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains portable arithmetic entropy decoding routines for JPEG

\* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).

\*

\* Both sequential and progressive modes are supported in this single module.

\*

\* Suspension is not currently supported in this module.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdarith.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jversion.h

\*

\* Copyright (C) 1991-2020, Thomas G. Lane, Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains software version identification.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jversion.h

No license file was found, but licenses were detected in source scan.

/\*

\* jcmaint.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2003-2012 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains the main buffer controller for compression.

\* The main buffer lies between the pre-processor and the JPEG

\* compressor proper; it holds downsampled data in the JPEG colorspace.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcmaint.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdmerge.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2013-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains code for merged upsampling/color conversion.

\*

\* This file combines functions from jdsample.c and jdcolor.c;

\* read those files first to understand what's going on.

\*

\* When the chroma components are to be upsampled by simple replication

\* (ie, box filtering), we can save some work in color conversion by

\* calculating all the output pixels corresponding to a pair of chroma

\* samples at one time. In the conversion equations

\*  $R = Y + K1 * Cr$

\*  $G = Y + K2 * Cb + K3 * Cr$

\*  $B = Y + K4 * Cb$

\* only the Y term varies among the group of pixels corresponding to a pair

\* of chroma samples, so the rest of the terms can be calculated just once.

\* At typical sampling ratios, this eliminates half or three-quarters of the

\* multiplications needed for color conversion.

\*

\* This file currently provides implementations for the following cases:

- \* YCC => RGB color conversion only (YCbCr or BG\_YCC).
- \* Sampling ratios of 2h1v or 2h2v.
- \* No scaling needed at upsample time.
- \* Corner-aligned (non-CCIR601) sampling alignment.
- \* Other special cases could be added, but in most applications these are
- \* the only common cases. (For uncommon cases we fall back on the more
- \* general code in jdsample.c and jdcolor.c.)
- \*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmerge.c

No license file was found, but licenses were detected in source scan.

/\*

\* rdcolmap.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file implements djpeg's "-map file" switch. It reads a source image

\* and constructs a colormap to be supplied to the JPEG decompressor.

\*

\* Currently, these file formats are supported for the map file:

\* GIF: the contents of the GIF's global colormap are used.

\* PPM (either text or raw flavor): the entire file is read and

\* each unique pixel value is entered in the map.

\* Note that reading a large PPM file will be horrendously slow.

\* Typically, a PPM-format map file should contain just one pixel

\* of each desired color. Such a file can be extracted from an

\* ordinary image PPM file with ppmtomap(1).

\*

\* Rescaling a PPM that has a maxval unequal to MAXJSAMPLE is not

\* currently implemented.

\*/

/\* Portions of this code are based on the PBMPLUS library, which is:

\*\*

\*\* Copyright (C) 1988 by Jef Poskanzer.

\*\*

\*\* Permission to use, copy, modify, and distribute this software and its

\*\* documentation for any purpose and without fee is hereby granted, provided

\*\* that the above copyright notice appear in all copies and that both that

\*\* copyright notice and this permission notice appear in supporting

\*\* documentation. This software is provided "as is" without express or

\*\* implied warranty.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdcolmap.c

No license file was found, but licenses were detected in source scan.

/\*

\* transupp.c

\*

\* Copyright (C) 1997-2019, Thomas G. Lane, Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains image transformation routines and other utility code

\* used by the jpegtran sample application. These are NOT part of the core

\* JPEG library. But we keep these routines separate from jpegtran.c to

\* ease the task of maintaining jpegtran-like programs that have other user

\* interfaces.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/transupp.c

No license file was found, but licenses were detected in source scan.

#### IJG JPEG LIBRARY: FILE LIST

Copyright (C) 1994-2019, Thomas G. Lane, Guido Vollbeding.

This file is part of the Independent JPEG Group's software.

For conditions of distribution and use, see the accompanying README file.

Here is a road map to the files in the IJG JPEG distribution. The distribution includes the JPEG library proper, plus two application programs ("cjpeg" and "djpeg") which use the library to convert JPEG files to and from some other popular image formats. A third application "jpegtran" uses the library to do lossless conversion between different variants of JPEG. There are also two stand-alone applications, "rdjpgcom" and "wrjpgcom".

#### THE JPEG LIBRARY

=====

Include files:

jpeglib.h JPEG library's exported data and function declarations.

jconfig.h Configuration declarations. Note: this file is not present in the distribution; it is generated during installation.

jpegconf.h Additional configuration declarations; need not be changed for a standard installation.

jpegerr.h Declares JPEG library's error and trace message codes.

`jinclue.h` Central include file used by all IJG .c files to reference system include files.  
`jpegint.h` JPEG library's internal data structures.  
`jdct.h` Private declarations for forward & reverse DCT subsystems.  
`jmemsys.h` Private declarations for memory management subsystem.  
`jversion.h` Version information.

Applications using the library should include `jpeglib.h` (which in turn includes `jconfig.h` and `jmorecfg.h`). Optionally, `jerror.h` may be included if the application needs to reference individual JPEG error codes. The other include files are intended for internal use and would not normally be included by an application program. (`cjpeg/djpeg/etc` do use `jinclue.h`, since its function is to improve portability of the whole IJG distribution. Most other applications will directly include the system include files they want, and hence won't need `jinclue.h`.)

C source code files:

These files contain most of the functions intended to be called directly by an application program:

`jpegim.c` Application program interface: core routines for compression.  
`jpegstd.c` Application program interface: standard compression.  
`jpegim.c` Application program interface: core routines for decompression.  
`jpegstd.c` Application program interface: standard decompression.  
`jpegapi.c` Application program interface routines common to compression and decompression.  
`jpegparam.c` Compression parameter setting helper routines.  
`jpegtrans.c` API and library routines for transcoding compression.  
`jpegdtrans.c` API and library routines for transcoding decompression.

Compression side of the library:

`jpeginit.c` Initialization: determines which other modules to use.  
`jpegmaster.c` Master control: setup and inter-pass sequencing logic.  
`jpegmainct.c` Main buffer controller (preprocessor => JPEG compressor).  
`jpegprept.c` Preprocessor buffer controller.  
`jpegcoeft.c` Buffer controller for DCT coefficient buffer.  
`jpegcolor.c` Color space conversion.  
`jpegsample.c` Downsampling.  
`jpegdctmgr.c` DCT manager (DCT implementation selection & control).  
`jpegfdctint.c` Forward DCT using slow-but-accurate integer method.  
`jpegfdctfst.c` Forward DCT using faster, less accurate integer method.  
`jpegfdctflt.c` Forward DCT using floating-point arithmetic.  
`jpegchuff.c` Huffman entropy coding.  
`jpegarith.c` Arithmetic entropy coding.  
`jpegmarker.c` JPEG marker writing.

jdastd.c Data destination managers for memory and stdio output.

Decompression side of the library:

jdmaster.c Master control: determines which other modules to use.

jdinput.c Input controller: controls input processing modules.

jdmainct.c Main buffer controller (JPEG decompressor => postprocessor).

jdcoeft.c Buffer controller for DCT coefficient buffer.

jdpostct.c Postprocessor buffer controller.

jdmarker.c JPEG marker reading.

jdhuft.c Huffman entropy decoding.

jdarith.c Arithmetic entropy decoding.

jdctmgr.c IDCT manager (IDCT implementation selection & control).

jdctint.c Inverse DCT using slow-but-accurate integer method.

jdctfst.c Inverse DCT using faster, less accurate integer method.

jdctflt.c Inverse DCT using floating-point arithmetic.

jdsample.c Upsampling.

jdcolor.c Color space conversion.

jdmerge.c Merged upsampling/color conversion (faster, lower quality).

jqant1.c One-pass color quantization using a fixed-spacing colormap.

jqant2.c Two-pass color quantization using a custom-generated colormap.

Also handles one-pass quantization to an externally given map.

jdatsrc.c Data source managers for memory and stdio input.

Support files for both compression and decompression:

jaricom.c Tables for common use in arithmetic entropy encoding and decoding routines.

jerror.c Standard error handling routines (application replaceable).

jmemmgr.c System-independent (more or less) memory management code.

jutils.c Miscellaneous utility routines.

jmemmgr.c relies on a system-dependent memory management module. The IJG distribution includes the following implementations of the system-dependent module:

jmemnobs.c "No backing store": assumes adequate virtual memory exists.

jmemansi.c Makes temporary files with ANSI-standard routine tmpfile().

jmemname.c Makes temporary files with program-generated file names.

jmemdos.c Custom implementation for MS-DOS (16-bit environment only):  
can use extended and expanded memory as well as temp files.

jmemmac.c Custom implementation for Apple Macintosh.

Exactly one of the system-dependent modules should be configured into an installed JPEG library (see install.txt for hints about which one to use).

On unusual systems you may find it worthwhile to make a special system-dependent memory manager.

Non-C source code files:

jmemdosa.asm 80x86 assembly code support for jmemdos.c; used only in MS-DOS-specific configurations of the JPEG library.

## CJPEG/DJPEG/JPEGTRAN

=====

Include files:

cdjpeg.h Declarations shared by cjpeg/djpeg/jpegtran modules.  
cderror.h Additional error and trace message codes for cjpeg et al.  
transupp.h Declarations for jpegtran support routines in transupp.c.

C source code files:

cjpeg.c Main program for cjpeg.  
djpeg.c Main program for djpeg.  
jpegtran.c Main program for jpegtran.  
cdjpeg.c Utility routines used by all three programs.  
rdcolmap.c Code to read a colormap file for djpeg's "-map" switch.  
rdswitch.c Code to process some of cjpeg's more complex switches.  
Also used by jpegtran.  
transupp.c Support code for jpegtran: lossless image manipulations.

Image file reader modules for cjpeg:

rdbmp.c BMP file input.  
rdgif.c GIF file input.  
rdppm.c PPM/PGM file input.  
rdrlc.c Utah RLE file input.  
rdtarga.c Targa file input.

Image file writer modules for djpeg:

wrbmp.c BMP file output.  
wrgif.c GIF file output.  
wrppm.c PPM/PGM file output.  
wrrlc.c Utah RLE file output.  
wrtarga.c Targa file output.

## RDJPGCOM/WRJPGCOM

=====

C source code files:

rdjpgcom.c Stand-alone rdjpgcom application.  
wrjpgcom.c Stand-alone wrjpgcom application.

These programs do not depend on the IJG library. They do use  
jconfig.h and jinclude.h, only to improve portability.

## ADDITIONAL FILES

=====

Documentation (see README for a guide to the documentation files):

README Master documentation file.  
\*.txt Other documentation files.  
\*.1 Documentation in Unix man page format.  
change.log Version-to-version change highlights.  
example.c Sample code for calling JPEG library.

Configuration/installation files and programs (see install.txt for more info):

configure Unix shell script to perform automatic configuration.  
configure.ac Source file for use with Autoconf to generate configure.  
ltmain.sh Support scripts for configure (from GNU libtool).  
config.guess  
config.sub  
depcomp  
missing  
ar-lib  
compile  
install-sh Install shell script for those Unix systems lacking one.  
Makefile.in Makefile input for configure.  
Makefile.am Source file for use with Automake to generate Makefile.in.  
ckconfig.c Program to generate jconfig.h on non-Unix systems.  
jconfig.txt Template for making jconfig.h by hand.  
mak\*.\* Sample makefiles for particular systems.  
jconfig.\* Sample jconfig.h for particular systems.  
libjpeg.map Script to generate shared library with versioned symbols.  
libjpeg.pc.in libjpeg.pc pkg-config file input for configure.  
aclocal.m4 M4 macro definitions for use with Autoconf.

Test files (see install.txt for test procedure):

test\*.\* Source and comparison files for confidence test.  
These are binary image files, NOT text files.

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/filelist.txt



No license file was found, but licenses were detected in source scan.

```
/*
 * jccoefct.c
 *
 * Copyright (C) 1994-1997, Thomas G. Lane.
 * Modified 2003-2011 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains the coefficient buffer controller for compression.
 * This controller is the top level of the JPEG compressor proper.
 * The coefficient buffer lies between forward-DCT and entropy encoding steps.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jccoefct.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jmemnobs.c
 *
 * Copyright (C) 1992-1996, Thomas G. Lane.
 * Modified 2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file provides a really simple implementation of the system-
 * dependent portion of the JPEG memory manager. This implementation
 * assumes that no backing-store files are needed: all required space
 * can be obtained from malloc().
 * This is very portable in the sense that it'll compile on almost anything,
 * but you'd better have lots of main memory (or virtual memory) if you want
 * to process big images.
 * Note that the max_memory_to_use option is respected by this implementation.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemnobs.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jdtrans.c
 *
 * Copyright (C) 1995-1997, Thomas G. Lane.
 * Modified 2000-2009 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
```

\*  
\* This file contains library routines for transcoding decompression,  
\* that is, reading raw DCT coefficient arrays from an input JPEG file.  
\* The routines in jdapimin.c will also be needed by a transcoder.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdtrans.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdcoefct.c

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

\* Modified 2002-2011 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains the coefficient buffer controller for decompression.

\* This controller is the top level of the JPEG decompressor proper.

\* The coefficient buffer lies between entropy decoding and inverse-DCT steps.

\*

\* In buffered-image mode, this controller is the interface between

\* input-oriented processing and output-oriented processing.

\* Also, the input side (only) is used when reading a file for transcoding.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdcoefct.c

No license file was found, but licenses were detected in source scan.

/\*

\* jcparam.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2003-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains optional default-setting code for the JPEG compressor.

\* Applications do not have to use this file, but those that don't use it

\* must know a lot more about the innards of the JPEG code.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcparam.c

No license file was found, but licenses were detected in source scan.

```
/*
 * wrgif.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2015-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains routines to write output images in GIF format.
 *
 * These routines may need modification for non-Unix environments or
 * specialized applications. As they stand, they assume output to
 * an ordinary stdio stream.
 */
/*
 * This code is loosely based on ppmtogif from the PBMPLUS distribution
 * of Feb. 1991. That file contains the following copyright notice:
 * Based on GIFENCODE by David Rowley <mgardi@watdscu.waterloo.edu>.
 * Lempel-Ziv compression based on "compress" by Spencer W. Thomas et al.
 * Copyright (C) 1989 by Jef Poskanzer.
 * Permission to use, copy, modify, and distribute this software and its
 * documentation for any purpose and without fee is hereby granted, provided
 * that the above copyright notice appear in all copies and that both that
 * copyright notice and this permission notice appear in supporting
 * documentation. This software is provided "as is" without express or
 * implied warranty.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrgif.c
No license file was found, but licenses were detected in source scan.
```

```
/*
 * jdinput.c
 *
 * Copyright (C) 1991-1997, Thomas G. Lane.
 * Modified 2002-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains input control logic for the JPEG decompressor.
 * These routines are concerned with controlling the decompressor's input
 * processing (marker reading and coefficient decoding). The actual input
 * reading is done in jdmarker.c, jdhuft.c, and jdarith.c.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdinput.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * rdtarga.c
 *
 * Copyright (C) 1991-1996, Thomas G. Lane.
 * Modified 2017-2019 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains routines to read input images in Targa format.
 *
 * These routines may need modification for non-Unix environments or
 * specialized applications. As they stand, they assume input from
 * an ordinary stdio stream. They further assume that reading begins
 * at the start of the file; start_input may need work if the
 * user interface has already read some data (e.g., to determine that
 * the file is indeed Targa format).
 *
 * Based on code contributed by Lee Daniel Crocker.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/rdtarga.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jcdctmgr.c
 *
 * Copyright (C) 1994-1996, Thomas G. Lane.
 * Modified 2003-2013 by Guido Vollbeding.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * This file contains the forward-DCT management logic.
 * This code selects a particular DCT implementation to be used,
 * and it performs related housekeeping chores including coefficient
 * quantization.
 */
```

Found in path(s):

```
* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcdctmgr.c
```

No license file was found, but licenses were detected in source scan.

```
/*
 * jmemansi.c
 *
 * Copyright (C) 1992-1996, Thomas G. Lane.
```

\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file provides a simple generic implementation of the system-  
\* dependent portion of the JPEG memory manager. This implementation  
\* assumes that you have the ANSI-standard library routine tmpfile().  
\* Also, the problem of determining the amount of memory available  
\* is shoved onto the user.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemansi.c  
No license file was found, but licenses were detected in source scan.

/\*

\* jerror.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.  
\* Modified 2012-2015 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains simple error-reporting and trace-message routines.  
\* These are suitable for Unix-like systems and others where writing to  
\* stderr is the right thing to do. Many applications will want to replace  
\* some or all of these routines.  
\*  
\* If you define USE\_WINDOWS\_MESSAGEBOX in jconfig.h or in the makefile,  
\* you get a Windows-specific hack to display error messages in a dialog box.  
\* It ain't much, but it beats dropping error messages into the bit bucket,  
\* which is what happens to output to stderr under most Windows C compilers.  
\*  
\* These routines are used by both the compression and decompression code.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jerror.c  
No license file was found, but licenses were detected in source scan.

/\*

\* cdjpeg.h

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.  
\* Modified 2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains common declarations for the sample applications

\* cjpeg and djpeg. It is NOT used by the core JPEG library.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/cdjpeg.h

No license file was found, but licenses were detected in source scan.

/\*

\* jdpostct.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains the decompression postprocessing controller.

\* This controller manages the upsampling, color conversion, and color

\* quantization/reduction steps; specifically, it controls the buffering

\* between upsample/color conversion and color quantization/reduction.

\*

\* If no color quantization/reduction is required, then this module has no

\* work to do, and it just hands off to the upsample/color conversion code.

\* An integrated upsample/convert/quantize process would replace this module

\* entirely.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdpostct.c

No license file was found, but licenses were detected in source scan.

/\*

\* jdmarker.c

\*

\* Copyright (C) 1991-1998, Thomas G. Lane.

\* Modified 2009-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to decode JPEG datastream markers.

\* Most of the complexity arises from our desire to support input

\* suspension: if not all of the data for a marker is available,

\* we must exit back to the application. On resumption, we reprocess

\* the marker.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jdmarker.c

No license file was found, but licenses were detected in source scan.

```

/*
 * jmemmac.c
 *
 * Copyright (C) 1992-1997, Thomas G. Lane.
 * This file is part of the Independent JPEG Group's software.
 * For conditions of distribution and use, see the accompanying README file.
 *
 * jmemmac.c provides an Apple Macintosh implementation of the system-
 * dependent portion of the JPEG memory manager.
 *
 * If you use jmemmac.c, then you must define USE_MAC_MEMMGR in the
 * JPEG_INTERNALS part of jconfig.h.
 *
 * jmemmac.c uses the Macintosh toolbox routines NewPtr and DisposePtr
 * instead of malloc and free. It accurately determines the amount of
 * memory available by using CompactMem. Notice that if left to its
 * own devices, this code can chew up all available space in the
 * application's zone, with the exception of the rather small "slop"
 * factor computed in jpeg_mem_available(). The application can ensure
 * that more space is left over by reducing max_memory_to_use.
 *
 * Large images are swapped to disk using temporary files and System 7.0+'s
 * temporary folder functionality.
 *
 * Note that jmemmac.c depends on two features of MacOS that were first
 * introduced in System 7: FindFolder and the FSSpec-based calls.
 * If your application uses jmemmac.c and is run under System 6 or earlier,
 * and the jpeg library decides it needs a temporary file, it will abort,
 * printing error messages about requiring System 7. (If no temporary files
 * are created, it will run fine.)
 *
 * If you want to use jmemmac.c in an application that might be used with
 * System 6 or earlier, then you should remove dependencies on FindFolder
 * and the FSSpec calls. You will need to replace FindFolder with some
 * other mechanism for finding a place to put temporary files, and you
 * should replace the FSSpec calls with their HFS equivalents:
 *
 * FSpDelete -> HDelete
 * FSpGetFInfo -> HGetFInfo
 * FSpCreate -> HCreate
 * FSpOpenDF -> HOpen *** Note: not HOpenDF ***
 * FSMakeFSSpec -> (fill in spec by hand.)
 *
 * (Use HOpen instead of HOpenDF. HOpen is just a glue-interface to PBHOpen,
 * which is on all HFS macs. HOpenDF is a System 7 addition which avoids the
 * ages-old problem of names starting with a period.)
 *
 * Contributed by Sam Bushell (jsam@iagu.on.net) and

```

\* Dan Gildor (gylid@in-touch.com).

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemmac.c

No license file was found, but licenses were detected in source scan.

The Independent JPEG Group's JPEG software

=====

README for release 9d of 12-Jan-2020

=====

This distribution contains the ninth public release of the Independent JPEG Group's free JPEG software. You are welcome to redistribute this software and to use it for any purpose, subject to the conditions under LEGAL ISSUES, below.

This software is the work of Tom Lane, Guido Vollbeding, Philip Gladstone, Bill Allombert, Jim Boucher, Lee Crocker, Bob Friesenhahn, Ben Jackson, John Korejwa, Julian Minguillon, Luis Ortiz, George Phillips, Davide Rossi, Ge' Weijers, and other members of the Independent JPEG Group.

IJG is not affiliated with the ISO/IEC JTC1/SC29/WG1 standards committee (previously known as JPEG, together with ITU-T SG16).

DOCUMENTATION ROADMAP

=====

This file contains the following sections:

OVERVIEW            General description of JPEG and the IJG software.  
LEGAL ISSUES        Copyright, lack of warranty, terms of distribution.  
REFERENCES          Where to learn more about JPEG.  
ARCHIVE LOCATIONS  Where to find newer versions of this software.  
ACKNOWLEDGMENTS    Special thanks.  
FILE FORMAT WARS    Software \*not\* to get.  
TO DO                Plans for future IJG releases.

Other documentation files in the distribution are:

User documentation:

install.txt        How to configure and install the IJG software.  
usage.txt          Usage instructions for cjpeg, djpeg, jpegtran,  
                    rdjpgcom, and wrjpgcom.  
\*.1                Unix-style man pages for programs (same info as usage.txt).  
wizard.txt         Advanced usage instructions for JPEG wizards only.  
change.log         Version-to-version change highlights.



Programmer and internal documentation:

libjpeg.txt    How to use the JPEG library in your own programs.  
example.c     Sample code for calling the JPEG library.  
structure.txt  Overview of the JPEG library's internal structure.  
filelist.txt   Road map of IJG files.  
coderrules.txt Coding style rules --- please read if you contribute code.

Please read at least the files install.txt and usage.txt. Some information can also be found in the JPEG FAQ (Frequently Asked Questions) article. See ARCHIVE LOCATIONS below to find out where to obtain the FAQ article.

If you want to understand how the JPEG code works, we suggest reading one or more of the REFERENCES, then looking at the documentation files (in roughly the order listed) before diving into the code.

## OVERVIEW

=====

This package contains C software to implement JPEG image encoding, decoding, and transcoding. JPEG (pronounced "jay-peg") is a standardized compression method for full-color and grayscale images.

This software implements JPEG baseline, extended-sequential, and progressive compression processes. Provision is made for supporting all variants of these processes, although some uncommon parameter settings aren't implemented yet. We have made no provision for supporting the hierarchical or lossless processes defined in the standard.

We provide a set of library routines for reading and writing JPEG image files, plus two sample applications "cjpeg" and "djpeg", which use the library to perform conversion between JPEG and some other popular image file formats. The library is intended to be reused in other applications.

In order to support file conversion and viewing software, we have included considerable functionality beyond the bare JPEG coding/decoding capability; for example, the color quantization modules are not strictly part of JPEG decoding, but they are essential for output to colormapped file formats or colormapped displays. These extra functions can be compiled out of the library if not required for a particular application.

We have also included "jpegtran", a utility for lossless transcoding between different JPEG processes, and "rdjpgcom" and "wrjpgcom", two simple applications for inserting and extracting textual comments in JFIF files.

The emphasis in designing this software has been on achieving portability and flexibility, while also making it fast enough to be useful. In particular, the software is not intended to be read as a tutorial on JPEG. (See the

REFERENCES section for introductory material.) Rather, it is intended to be reliable, portable, industrial-strength code. We do not claim to have achieved that goal in every aspect of the software, but we strive for it.

We welcome the use of this software as a component of commercial products. No royalty is required, but we do ask for an acknowledgement in product documentation, as described under LEGAL ISSUES.

## LEGAL ISSUES

=====

In plain English:

1. We don't promise that this software works. (But if you find any bugs, please let us know!)
2. You can use this software for whatever you want. You don't have to pay us.
3. You may not pretend that you wrote this software. If you use it in a program, you must acknowledge somewhere in your documentation that you've used the IJG code.

In legalese:

The authors make NO WARRANTY or representation, either express or implied, with respect to this software, its quality, accuracy, merchantability, or fitness for a particular purpose. This software is provided "AS IS", and you, its user, assume the entire risk as to its quality and accuracy.

This software is copyright (C) 1991-2020, Thomas G. Lane, Guido Vollbeding. All Rights Reserved except as specified below.

Permission is hereby granted to use, copy, modify, and distribute this software (or portions thereof) for any purpose, without fee, subject to these conditions:

- (1) If any part of the source code for this software is distributed, then this README file must be included, with this copyright and no-warranty notice unaltered; and any additions, deletions, or changes to the original files must be clearly indicated in accompanying documentation.
- (2) If only executable code is distributed, then the accompanying documentation must state that "this software is based in part on the work of the Independent JPEG Group".
- (3) Permission for use of this software is granted only if the user accepts full responsibility for any undesirable consequences; the authors accept NO LIABILITY for damages of any kind.

These conditions apply to any software derived from or based on the IJG code, not just to the unmodified library. If you use our work, you ought to acknowledge us.

Permission is NOT granted for the use of any IJG author's name or company name in advertising or publicity relating to this software or products derived from it. This software may be referred to only as "the Independent JPEG Group's software".

We specifically permit and encourage the use of this software as the basis of commercial products, provided that all warranty or liability claims are assumed by the product vendor.

The Unix configuration script "configure" was produced with GNU Autoconf. It is copyright by the Free Software Foundation but is freely distributable. The same holds for its supporting scripts (config.guess, config.sub, ltmain.sh). Another support script, install-sh, is copyright by X Consortium but is also freely distributable.

## REFERENCES

=====

We recommend reading one or more of these references before trying to understand the innards of the JPEG software.

The best short technical introduction to the JPEG compression algorithm is Wallace, Gregory K. "The JPEG Still Picture Compression Standard", Communications of the ACM, April 1991 (vol. 34 no. 4), pp. 30-44. (Adjacent articles in that issue discuss MPEG motion picture compression, applications of JPEG, and related topics.) If you don't have the CACM issue handy, a PDF file containing a revised version of Wallace's article is available at <http://www.ijg.org/files/Wallace.JPEG.pdf>. The file (actually a preprint for an article that appeared in IEEE Trans. Consumer Electronics) omits the sample images that appeared in CACM, but it includes corrections and some added material. Note: the Wallace article is copyright ACM and IEEE, and it may not be used for commercial purposes.

A somewhat less technical, more leisurely introduction to JPEG can be found in "The Data Compression Book" by Mark Nelson and Jean-loup Gailly, published by M&T Books (New York), 2nd ed. 1996, ISBN 1-55851-434-1. This book provides good explanations and example C code for a multitude of compression methods including JPEG. It is an excellent source if you are comfortable reading C code but don't know much about data compression in general. The book's JPEG sample code is far from industrial-strength, but when you are ready to look at a full implementation, you've got one here...

The best currently available description of JPEG is the textbook "JPEG Still Image Data Compression Standard" by William B. Pennebaker and Joan L. Mitchell, published by Van Nostrand Reinhold, 1993, ISBN 0-442-01272-1.

Price US\$59.95, 638 pp. The book includes the complete text of the ISO JPEG standards (DIS 10918-1 and draft DIS 10918-2).

Although this is by far the most detailed and comprehensive exposition of JPEG publicly available, we point out that it is still missing an explanation of the most essential properties and algorithms of the underlying DCT technology.

If you think that you know about DCT-based JPEG after reading this book, then you are in delusion. The real fundamentals and corresponding potential of DCT-based JPEG are not publicly known so far, and that is the reason for all the mistaken developments taking place in the image coding domain.

The original JPEG standard is divided into two parts, Part 1 being the actual specification, while Part 2 covers compliance testing methods. Part 1 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 1: Requirements and guidelines" and has document numbers ISO/IEC IS 10918-1, ITU-T T.81. Part 2 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 2: Compliance testing" and has document numbers ISO/IEC IS 10918-2, ITU-T T.83.

IJG JPEG 8 introduced an implementation of the JPEG SmartScale extension which is specified in two documents: A contributed document at ITU and ISO with title "ITU-T JPEG-Plus Proposal for Extending ITU-T T.81 for Advanced Image Coding", April 2006, Geneva, Switzerland. The latest version of this document is Revision 3. And a contributed document ISO/IEC JTC1/SC29/WG1 N 5799 with title "Evolution of JPEG", June/July 2011, Berlin, Germany.

IJG JPEG 9 introduces a reversible color transform for improved lossless compression which is described in a contributed document ISO/IEC JTC1/SC29/WG1 N 6080 with title "JPEG 9 Lossless Coding", June/July 2012, Paris, France.

The JPEG standard does not specify all details of an interchangeable file format. For the omitted details we follow the "JFIF" conventions, version 2. JFIF version 1 has been adopted as Recommendation ITU-T T.871 (05/2011) : Information technology - Digital compression and coding of continuous-tone still images: JPEG File Interchange Format (JFIF). It is available as a free download in PDF file format from <http://www.itu.int/rec/T-REC-T.871>. A PDF file of the older JFIF document is available at <http://www.w3.org/Graphics/JPEG/jfif3.pdf>.

The TIFF 6.0 file format specification can be obtained by FTP from <ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps.gz>. The JPEG incorporation scheme found in the TIFF 6.0 spec of 3-June-92 has a number of serious problems. IJG does not recommend use of the TIFF 6.0 design (TIFF Compression tag 6). Instead, we recommend the JPEG design proposed by TIFF Technical Note #2 (Compression tag 7). Copies of this Note can be obtained from <http://www.ijg.org/files/>. It is expected that the next revision of the TIFF spec will replace the 6.0 JPEG design with the Note's design. Although IJG's own code does not support TIFF/JPEG, the free libtiff library uses our library to implement TIFF/JPEG per the Note.

## ARCHIVE LOCATIONS

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The "official" archive site for this software is [www.ijg.org](http://www.ijg.org).  
The most recent released version can always be found there in  
directory "files". This particular version will be archived as  
<http://www.ijg.org/files/jpegsrc.v9d.tar.gz>, and in Windows-compatible  
"zip" archive format as <http://www.ijg.org/files/jpegsr9d.zip>.

The JPEG FAQ (Frequently Asked Questions) article is a source of some  
general information about JPEG.

It is available on the World Wide Web at <http://www.faqs.org/faqs/jpeg-faq/>  
and other news.answers archive sites, including the official news.answers  
archive at [rtfm.mit.edu](http://rtfm.mit.edu): <ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/>.  
If you don't have Web or FTP access, send e-mail to [mail-server@rtfm.mit.edu](mailto:mail-server@rtfm.mit.edu)  
with body  
send usenet/news.answers/jpeg-faq/part1  
send usenet/news.answers/jpeg-faq/part2

## ACKNOWLEDGMENTS

=====

Thank to Juergen Bruder for providing me with a copy of the common DCT  
algorithm article, only to find out that I had come to the same result  
in a more direct and comprehensible way with a more generative approach.

Thank to Istvan Sebestyen and Joan L. Mitchell for inviting me to the  
ITU JPEG (Study Group 16) meeting in Geneva, Switzerland.

Thank to Thomas Wiegand and Gary Sullivan for inviting me to the  
Joint Video Team (MPEG & ITU) meeting in Geneva, Switzerland.

Thank to Thomas Richter and Daniel Lee for inviting me to the  
ISO/IEC JTC1/SC29/WG1 (previously known as JPEG, together with ITU-T SG16)  
meeting in Berlin, Germany.

Thank to John Korejwa and Massimo Ballerini for inviting me to  
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Thank to Richard F. Lyon (then of Foveon Inc.) for fruitful communication about JPEG configuration in Sigma Photo Pro software.

Thank to Andrew Finkenstadt for hosting the ijg.org site.

Thank to Thomas G. Lane for the original design and development of this singular software package.

Thank to Lars Goehler, Andreas Heinecke, Sebastian Fuss, Yvonne Roebert, Andrej Werner, and Ulf-Dietrich Braumann for support and public relations.

## FILE FORMAT WARS

=====

The ISO/IEC JTC1/SC29/WG1 standards committee (previously known as JPEG, together with ITU-T SG16) currently promotes different formats containing the name "JPEG" which is misleading because these formats are incompatible with original DCT-based JPEG and are based on faulty technologies. IJG therefore does not and will not support such momentary mistakes (see REFERENCES).

There exist also distributions under the name "OpenJPEG" promoting such kind of formats which is misleading because they don't support original JPEG images.

We have no sympathy for the promotion of inferior formats. Indeed, one of the original reasons for developing this free software was to help force convergence on common, interoperable format standards for JPEG files.

Don't use an incompatible file format!

(In any case, our decoder will remain capable of reading existing JPEG image files indefinitely.)

The ISO committee pretends to be "responsible for the popular JPEG" in their public reports which is not true because they don't respond to actual requirements for the maintenance of the original JPEG specification.

Furthermore, the ISO committee pretends to "ensure interoperability" with their standards which is not true because their "standards" support only application-specific and proprietary use cases and contain mathematically incorrect code.

There are currently different distributions in circulation containing the name "libjpeg" which is misleading because they don't have the features and are incompatible with formats supported by actual IJG libjpeg distributions. One of those fakes is released by members of the ISO committee and just uses the name of libjpeg for misdirection of people, similar to the abuse of the name JPEG as described above, while having nothing in common with actual IJG libjpeg distributions and containing mathematically incorrect code.

The other one claims to be a "derivative" or "fork" of the original libjpeg, but violates the license conditions as described under LEGAL ISSUES above and violates basic C programming properties. We have no sympathy for the release of misleading, incorrect and illegal distributions derived from obsolete code bases. Don't use an obsolete code base!

According to the UCC (Uniform Commercial Code) law, IJG has the lawful and legal right to foreclose on certain standardization bodies and other institutions or corporations that knowingly perform substantial and systematic deceptive acts and practices, fraud, theft, and damaging of the value of the people of this planet without their knowing, willing and intentional consent.

The titles, ownership, and rights of these institutions and all their assets are now duly secured and held in trust for the free people of this planet. People of the planet, on every country, may have a financial interest in the assets of these former principals, agents, and beneficiaries of the foreclosed institutions and corporations.

IJG asserts what is: that each man, woman, and child has unalienable value and rights granted and deposited in them by the Creator and not any one of the people is subordinate to any artificial principality, corporate fiction or the special interest of another without their appropriate knowing, willing and intentional consent made by contract or accommodation agreement. IJG expresses that which already was.

The people have already determined and demanded that public administration entities, national governments, and their supporting judicial systems must be fully transparent, accountable, and liable.

IJG has secured the value for all concerned free people of the planet.

A partial list of foreclosed institutions and corporations ("Hall of Shame") is currently prepared and will be published later.

TO DO

=====

Version 9 is the second release of a new generation JPEG standard to overcome the limitations of the original JPEG specification, and is the first true source reference JPEG codec.

More features are being prepared for coming releases...

Please send bug reports, offers of help, etc. to [jpeg-info@jpegclub.org](mailto:jpeg-info@jpegclub.org).

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/README

No license file was found, but licenses were detected in source scan.

/\*

```

* jpeg.c
*
* Copyright (C) 1991-1998, Thomas G. Lane.
* Modified 2003-2013 by Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains a command-line user interface for the JPEG compressor.
* It should work on any system with Unix- or MS-DOS-style command lines.
*
* Two different command line styles are permitted, depending on the
* compile-time switch TWO_FILE_COMMANDLINE:
* jpeg [options] inputfile outputfile
* jpeg [options] [inputfile]
* In the second style, output is always to standard output, which you'd
* normally redirect to a file or pipe to some other program. Input is
* either from a named file or from standard input (typically redirected).
* The second style is convenient on Unix but is unhelpful on systems that
* don't support pipes. Also, you MUST use the first style if your system
* doesn't do binary I/O to stdin/stdout.
* To simplify script writing, the "-outfile" switch is provided. The syntax
* jpeg [options] -outfile outputfile inputfile
* works regardless of which command line style is used.
*/

```

Found in path(s):

```

* /opt/cola/permits/1103550007_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/cjpeg.c
No license file was found, but licenses were detected in source scan.

```

```

/*
* transupp.h
*
* Copyright (C) 1997-2019, Thomas G. Lane, Guido Vollbeding.
* This file is part of the Independent JPEG Group's software.
* For conditions of distribution and use, see the accompanying README file.
*
* This file contains declarations for image transformation routines and
* other utility code used by the jpegtran sample application. These are
* NOT part of the core JPEG library. But we keep these routines separate
* from jpegtran.c to ease the task of maintaining jpegtran-like programs
* that have other user interfaces.
*
* NOTE: all the routines declared here have very specific requirements
* about when they are to be executed during the reading and writing of the
* source and destination files. See the comments in transupp.c, or see
* jpegtran.c for an example of correct usage.
*/

```



Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/transupp.h

No license file was found, but licenses were detected in source scan.

/\*

\* cerror.h

\*

\* Copyright (C) 1994-1997, Thomas G. Lane.

\* Modified 2009-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file defines the error and message codes for the cjpeg/djpeg

\* applications. These strings are not needed as part of the JPEG library

\* proper.

\* Edit this file to add new codes, or to translate the message strings to

\* some other language.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/cerror.h

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/\*

\* jquant1.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2011 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains 1-pass color quantization (color mapping) routines.

\* These routines provide mapping to a fixed color map using equally spaced

\* color values. Optional Floyd-Steinberg or ordered dithering is available.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jquant1.c

No license file was found, but licenses were detected in source scan.

/\*

\* wrbmp.c

\*

\* Copyright (C) 1994-1996, Thomas G. Lane.

\* Modified 2017-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

- \* This file contains routines to write output images in Microsoft "BMP"
- \* format (MS Windows 3.x and OS/2 1.x flavors).
- \* Either 8-bit colormapped or 24-bit full-color format can be written.
- \* No compression is supported.
- \*
- \* These routines may need modification for non-Unix environments or
- \* specialized applications. As they stand, they assume output to
- \* an ordinary stdio stream.
- \*
- \* This code contributed by James Arthur Boucher.
- \*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrbmp.c  
No license file was found, but licenses were detected in source scan.

/\*  
\* jddctmgr.c  
\*  
\* Copyright (C) 1994-1996, Thomas G. Lane.  
\* Modified 2002-2013 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains the inverse-DCT management logic.  
\* This code selects a particular IDCT implementation to be used,  
\* and it performs related housekeeping chores. No code in this file  
\* is executed per IDCT step, only during output pass setup.  
\*  
\* Note that the IDCT routines are responsible for performing coefficient  
\* dequantization as well as the IDCT proper. This module sets up the  
\* dequantization multiplier table needed by the IDCT routine.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jddctmgr.c  
No license file was found, but licenses were detected in source scan.

/\*  
\* jmemname.c  
\*  
\* Copyright (C) 1992-1997, Thomas G. Lane.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file provides a generic implementation of the system-dependent  
\* portion of the JPEG memory manager. This implementation assumes that  
\* you must explicitly construct a name for each temp file.

- \* Also, the problem of determining the amount of memory available
- \* is shoved onto the user.
- \*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jmemname.c

No license file was found, but licenses were detected in source scan.

/\*

\* jpegtran.c

\*

\* Copyright (C) 1995-2019, Thomas G. Lane, Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains a command-line user interface for JPEG transcoding.

\* It is very similar to cjpeg.c, and partly to djpeg.c, but provides

\* lossless transcoding between different JPEG file formats. It also

\* provides some lossless and sort-of-lossless transformations of JPEG data.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jpegtran.c

No license file was found, but licenses were detected in source scan.

/\*

\* wrppm.c

\*

\* Copyright (C) 1991-1996, Thomas G. Lane.

\* Modified 2009-2019 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.

\*

\* This file contains routines to write output images in PPM/PGM format.

\* The extended 2-byte-per-sample raw PPM/PGM formats are supported.

\* The PBMPLUS library is NOT required to compile this software

\* (but it is highly useful as a set of PPM image manipulation programs).

\*

\* These routines may need modification for non-Unix environments or

\* specialized applications. As they stand, they assume output to

\* an ordinary stdio stream.

\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/wrppm.c

No license file was found, but licenses were detected in source scan.

USING THE IJG JPEG LIBRARY

Copyright (C) 1994-2019, Thomas G. Lane, Guido Vollbeding.  
This file is part of the Independent JPEG Group's software.  
For conditions of distribution and use, see the accompanying README file.

This file describes how to use the IJG JPEG library within an application program. Read it if you want to write a program that uses the library.

The file `example.c` provides heavily commented skeleton code for calling the JPEG library. Also see `jpeglib.h` (the include file to be used by application programs) for full details about data structures and function parameter lists. The library source code, of course, is the ultimate reference.

Note that there have been \*major\* changes from the application interface presented by IJG version 4 and earlier versions. The old design had several inherent limitations, and it had accumulated a lot of cruft as we added features while trying to minimize application-interface changes. We have sacrificed backward compatibility in the version 5 rewrite, but we think the improvements justify this.

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You should read at least the overview and basic usage sections before trying to program with the library. The sections on advanced features can be read if and when you need them.

## OVERVIEW

=====

Functions provided by the library

-----

The IJG JPEG library provides C code to read and write JPEG-compressed image files. The surrounding application program receives or supplies image data a scanline at a time, using a straightforward uncompressed image format. All details of color conversion and other preprocessing/postprocessing can be handled by the library.

The library includes a substantial amount of code that is not covered by the JPEG standard but is necessary for typical applications of JPEG. These functions preprocess the image before JPEG compression or postprocess it after decompression. They include colorspace conversion, downsampling/upsampling, and color quantization. The application indirectly selects use of this code by specifying the format in which it wishes to supply or receive image data. For example, if colormapped output is requested, then the decompression library automatically invokes color quantization.

A wide range of quality vs. speed tradeoffs are possible in JPEG processing, and even more so in decompression postprocessing. The decompression library provides multiple implementations that cover most of the useful tradeoffs, ranging from very-high-quality down to fast-preview operation. On the compression side we have generally not provided low-quality choices, since compression is normally less time-critical. It should be understood that the low-quality modes may not meet the JPEG standard's accuracy requirements; nonetheless, they are useful for viewers.

A word about functions *\*not\** provided by the library. We handle a subset of the ISO JPEG standard; most baseline, extended-sequential, and progressive JPEG processes are supported. (Our subset includes all features now in common use.) Unsupported ISO options include:

- \* Hierarchical storage
- \* Lossless JPEG
- \* DNL marker
- \* Nonintegral subsampling ratios

We support 8-bit to 12-bit data precision, but this is a compile-time choice rather than a run-time choice; hence it is difficult to use different precisions in a single application.

By itself, the library handles only interchange JPEG datastreams --- in particular the widely used JFIF file format. The library can be used by surrounding code to process interchange or abbreviated JPEG datastreams that are embedded in more complex file formats. (For example, this library is used by the free LIBTIFF library to support JPEG compression in TIFF.)

#### Outline of typical usage

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The rough outline of a JPEG compression operation is:

```
Allocate and initialize a JPEG compression object
Specify the destination for the compressed data (eg, a file)
Set parameters for compression, including image size & colorspace
jpeg_start_compress(...);
while (scan lines remain to be written)
 jpeg_write_scanlines(...);
jpeg_finish_compress(...);
Release the JPEG compression object
```

A JPEG compression object holds parameters and working state for the JPEG library. We make creation/destruction of the object separate from starting or finishing compression of an image; the same object can be re-used for a series of image compression operations. This makes it easy to re-use the same parameter settings for a sequence of images. Re-use of a JPEG object also has important implications for processing abbreviated JPEG datastreams, as discussed later.

The image data to be compressed is supplied to `jpeg_write_scanlines()` from in-memory buffers. If the application is doing file-to-file compression, reading image data from the source file is the application's responsibility. The library emits compressed data by calling a "data destination manager", which typically will write the data into a file; but the application can provide its own destination manager to do something else.

Similarly, the rough outline of a JPEG decompression operation is:

```
Allocate and initialize a JPEG decompression object
Specify the source of the compressed data (eg, a file)
Call jpeg_read_header() to obtain image info
Set parameters for decompression
jpeg_start_decompress(...);
while (scan lines remain to be read)
```

```
jpeg_read_scanlines(...);
jpeg_finish_decompress(...);
Release the JPEG decompression object
```

This is comparable to the compression outline except that reading the datastream header is a separate step. This is helpful because information about the image's size, colorspace, etc is available when the application selects decompression parameters. For example, the application can choose an output scaling ratio that will fit the image into the available screen size.

The decompression library obtains compressed data by calling a data source manager, which typically will read the data from a file; but other behaviors can be obtained with a custom source manager. Decompressed data is delivered into in-memory buffers passed to `jpeg_read_scanlines()`.

It is possible to abort an incomplete compression or decompression operation by calling `jpeg_abort()`; or, if you do not need to retain the JPEG object, simply release it by calling `jpeg_destroy()`.

JPEG compression and decompression objects are two separate struct types. However, they share some common fields, and certain routines such as `jpeg_destroy()` can work on either type of object.

The JPEG library has no static variables: all state is in the compression or decompression object. Therefore it is possible to process multiple compression and decompression operations concurrently, using multiple JPEG objects.

Both compression and decompression can be done in an incremental memory-to-memory fashion, if suitable source/destination managers are used. See the section on "I/O suspension" for more details.

## BASIC LIBRARY USAGE

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### Data formats

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Before diving into procedural details, it is helpful to understand the image data format that the JPEG library expects or returns.

The standard input image format is a rectangular array of pixels, with each pixel having the same number of "component" or "sample" values (color channels). You must specify how many components there are and the colorspace interpretation of the components. Most applications will use RGB data (three components per pixel) or grayscale data (one component per pixel).

**PLEASE NOTE THAT RGB DATA IS THREE SAMPLES PER PIXEL, GRAYSCALE ONLY ONE.**

A remarkable number of people manage to miss this, only to find that their programs don't work with grayscale JPEG files.

There is no provision for colormapped input. JPEG files are always full-color or full grayscale (or sometimes another colorspace such as CMYK). You can feed in a colormapped image by expanding it to full-color format. However JPEG often doesn't work very well with source data that has been colormapped, because of dithering noise. This is discussed in more detail in the JPEG FAQ and the other references mentioned in the README file.

Pixels are stored by scanlines, with each scanline running from left to right. The component values for each pixel are adjacent in the row; for example, R,G,B,R,G,B,R,G,B,... for 24-bit RGB color. Each scanline is an array of data type JSAMPLE --- which is typically "unsigned char", unless you've changed jmorecfg.h. (You can also change the RGB pixel layout, say to B,G,R order, by modifying jmorecfg.h. But see the restrictions listed in that file before doing so.)

A 2-D array of pixels is formed by making a list of pointers to the starts of scanlines; so the scanlines need not be physically adjacent in memory. Even if you process just one scanline at a time, you must make a one-element pointer array to conform to this structure. Pointers to JSAMPLE rows are of type JSAMPROW, and the pointer to the pointer array is of type JSAMPARRAY.

The library accepts or supplies one or more complete scanlines per call. It is not possible to process part of a row at a time. Scanlines are always processed top-to-bottom. You can process an entire image in one call if you have it all in memory, but usually it's simplest to process one scanline at a time.

For best results, source data values should have the precision specified by BITS\_IN\_JSAMPLE (normally 8 bits). For instance, if you choose to compress data that's only 6 bits/channel, you should left-justify each value in a byte before passing it to the compressor. If you need to compress data that has more than 8 bits/channel, compile with BITS\_IN\_JSAMPLE = 9 to 12. (See "Library compile-time options", later.)

The data format returned by the decompressor is the same in all details, except that colormapped output is supported. (Again, a JPEG file is never colormapped. But you can ask the decompressor to perform on-the-fly color quantization to deliver colormapped output.) If you request colormapped output then the returned data array contains a single JSAMPLE per pixel; its value is an index into a color map. The color map is represented as a 2-D JSAMPARRAY in which each row holds the values of one color component, that is, colormap[i][j] is the value of the i'th color component for pixel value (map index) j. Note that since the colormap indexes are stored in JSAMPLEs, the maximum number of colors is limited by the size of JSAMPLE



(ie, at most 256 colors for an 8-bit JPEG library).

## Compression details

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Here we revisit the JPEG compression outline given in the overview.

### 1. Allocate and initialize a JPEG compression object.

A JPEG compression object is a "struct jpeg\_compress\_struct". (It also has a bunch of subsidiary structures which are allocated via malloc(), but the application doesn't control those directly.) This struct can be just a local variable in the calling routine, if a single routine is going to execute the whole JPEG compression sequence. Otherwise it can be static or allocated from malloc().

You will also need a structure representing a JPEG error handler. The part of this that the library cares about is a "struct jpeg\_error\_mgr". If you are providing your own error handler, you'll typically want to embed the jpeg\_error\_mgr struct in a larger structure; this is discussed later under "Error handling". For now we'll assume you are just using the default error handler. The default error handler will print JPEG error/warning messages on stderr, and it will call exit() if a fatal error occurs.

You must initialize the error handler structure, store a pointer to it into the JPEG object's "err" field, and then call jpeg\_create\_compress() to initialize the rest of the JPEG object.

Typical code for this step, if you are using the default error handler, is

```
struct jpeg_compress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_compress(&cinfo);
```

jpeg\_create\_compress allocates a small amount of memory, so it could fail if you are out of memory. In that case it will exit via the error handler; that's why the error handler must be initialized first.

### 2. Specify the destination for the compressed data (eg, a file).

As previously mentioned, the JPEG library delivers compressed data to a "data destination" module. The library includes one data destination module which knows how to write to a stdio stream. You can use your own destination module if you want to do something else, as discussed later.

If you use the standard destination module, you must open the target stdio stream beforehand. Typical code for this step looks like:

```
FILE * outfile;
...
if ((outfile = fopen(filename, "wb")) == NULL) {
 fprintf(stderr, "can't open %s\n", filename);
 exit(1);
}
jpeg_stdio_dest(&cinfo, outfile);
```

where the last line invokes the standard destination module.

**WARNING:** it is critical that the binary compressed data be delivered to the output file unchanged. On non-Unix systems the stdio library may perform newline translation or otherwise corrupt binary data. To suppress this behavior, you may need to use a "b" option to fopen (as shown above), or use setmode() or another routine to put the stdio stream in binary mode. See cjpeg.c and djpeg.c for code that has been found to work on many systems.

You can select the data destination after setting other parameters (step 3), if that's more convenient. You may not change the destination between calling jpeg\_start\_compress() and jpeg\_finish\_compress().

### 3. Set parameters for compression, including image size & colorspace.

You must supply information about the source image by setting the following fields in the JPEG object (cinfo structure):

```
image_width Width of image, in pixels
image_height Height of image, in pixels
input_components Number of color channels (samples per pixel)
in_color_space Color space of source image
```

The image dimensions are, hopefully, obvious. JPEG supports image dimensions of 1 to 64K pixels in either direction. The input color space is typically RGB or grayscale, and input\_components is 3 or 1 accordingly. (See "Special color spaces", later, for more info.) The in\_color\_space field must be assigned one of the J\_COLOR\_SPACE enum constants, typically JCS\_RGB or JCS\_GRAYSCALE.

JPEG has a large number of compression parameters that determine how the image is encoded. Most applications don't need or want to know about all these parameters. You can set all the parameters to reasonable defaults by calling jpeg\_set\_defaults(); then, if there are particular values you want to change, you can do so after that. The "Compression parameter selection"

section tells about all the parameters.

You must set `in_color_space` correctly before calling `jpeg_set_defaults()`, because the defaults depend on the source image colorspace. However the other three source image parameters need not be valid until you call `jpeg_start_compress()`. There's no harm in calling `jpeg_set_defaults()` more than once, if that happens to be convenient.

Typical code for a 24-bit RGB source image is

```
cinfo.image_width = Width; /* image width and height, in pixels */
cinfo.image_height = Height;
cinfo.input_components = 3; /* # of color components per pixel */
cinfo.in_color_space = JCS_RGB; /* colorspace of input image */

jpeg_set_defaults(&cinfo);
/* Make optional parameter settings here */
```

4. `jpeg_start_compress(...)`;

After you have established the data destination and set all the necessary source image info and other parameters, call `jpeg_start_compress()` to begin a compression cycle. This will initialize internal state, allocate working storage, and emit the first few bytes of the JPEG datastream header.

Typical code:

```
jpeg_start_compress(&cinfo, TRUE);
```

The "TRUE" parameter ensures that a complete JPEG interchange datastream will be written. This is appropriate in most cases. If you think you might want to use an abbreviated datastream, read the section on abbreviated datastreams, below.

Once you have called `jpeg_start_compress()`, you may not alter any JPEG parameters or other fields of the JPEG object until you have completed the compression cycle.

5. while (scan lines remain to be written)

```
jpeg_write_scanlines(...);
```

Now write all the required image data by calling `jpeg_write_scanlines()` one or more times. You can pass one or more scanlines in each call, up to the total image height. In most applications it is convenient to pass just one or a few scanlines at a time. The expected format for the passed data is discussed under "Data formats", above.

Image data should be written in top-to-bottom scanline order. The JPEG spec contains some weasel wording about how top and bottom are application-defined terms (a curious interpretation of the English language...) but if you want your files to be compatible with everyone else's, you WILL use top-to-bottom order. If the source data must be read in bottom-to-top order, you can use the JPEG library's virtual array mechanism to invert the data efficiently. Examples of this can be found in the sample application cjpeg.

The library maintains a count of the number of scanlines written so far in the `next_scanline` field of the JPEG object. Usually you can just use this variable as the loop counter, so that the loop test looks like `"while (cinfo.next_scanline < cinfo.image_height)"`.

Code for this step depends heavily on the way that you store the source data. `example.c` shows the following code for the case of a full-size 2-D source array containing 3-byte RGB pixels:

```
JSAMPROW row_pointer[1]; /* pointer to a single row */
int row_stride; /* physical row width in buffer */

row_stride = image_width * 3; /* JSAMPLEs per row in image_buffer */

while (cinfo.next_scanline < cinfo.image_height) {
 row_pointer[0] = & image_buffer[cinfo.next_scanline * row_stride];
 jpeg_write_scanlines(&cinfo, row_pointer, 1);
}
```

`jpeg_write_scanlines()` returns the number of scanlines actually written. This will normally be equal to the number passed in, so you can usually ignore the return value. It is different in just two cases:

- \* If you try to write more scanlines than the declared image height, the additional scanlines are ignored.
- \* If you use a suspending data destination manager, output buffer overrun will cause the compressor to return before accepting all the passed lines. This feature is discussed under "I/O suspension", below. The normal `stdio` destination manager will NOT cause this to happen.

In any case, the return value is the same as the change in the value of `next_scanline`.

## 6. `jpeg_finish_compress(...)`;

After all the image data has been written, call `jpeg_finish_compress()` to complete the compression cycle. This step is **ESSENTIAL** to ensure that the last bufferload of data is written to the data destination.

`jpeg_finish_compress()` also releases working memory associated with the JPEG object.

Typical code:

```
jpeg_finish_compress(&cinfo);
```

If using the stdio destination manager, don't forget to close the output stdio stream (if necessary) afterwards.

If you have requested a multi-pass operating mode, such as Huffman code optimization, `jpeg_finish_compress()` will perform the additional passes using data buffered by the first pass. In this case `jpeg_finish_compress()` may take quite a while to complete. With the default compression parameters, this will not happen.

It is an error to call `jpeg_finish_compress()` before writing the necessary total number of scanlines. If you wish to abort compression, call `jpeg_abort()` as discussed below.

After completing a compression cycle, you may dispose of the JPEG object as discussed next, or you may use it to compress another image. In that case return to step 2, 3, or 4 as appropriate. If you do not change the destination manager, the new datastream will be written to the same target. If you do not change any JPEG parameters, the new datastream will be written with the same parameters as before. Note that you can change the input image dimensions freely between cycles, but if you change the input colorspace, you should call `jpeg_set_defaults()` to adjust for the new colorspace; and then you'll need to repeat all of step 3.

#### 7. Release the JPEG compression object.

When you are done with a JPEG compression object, destroy it by calling `jpeg_destroy_compress()`. This will free all subsidiary memory (regardless of the previous state of the object). Or you can call `jpeg_destroy()`, which works for either compression or decompression objects --- this may be more convenient if you are sharing code between compression and decompression cases. (Actually, these routines are equivalent except for the declared type of the passed pointer. To avoid gripes from ANSI C compilers, `jpeg_destroy()` should be passed a `j_common_ptr`.)

If you allocated the `jpeg_compress_struct` structure from `malloc()`, freeing it is your responsibility --- `jpeg_destroy()` won't. Ditto for the error handler structure.

Typical code:

```
jpeg_destroy_compress(&cinfo);
```

## 8. Aborting.

If you decide to abort a compression cycle before finishing, you can clean up in either of two ways:

\* If you don't need the JPEG object any more, just call `jpeg_destroy_compress()` or `jpeg_destroy()` to release memory. This is legitimate at any point after calling `jpeg_create_compress()` --- in fact, it's safe even if `jpeg_create_compress()` fails.

\* If you want to re-use the JPEG object, call `jpeg_abort_compress()`, or call `jpeg_abort()` which works on both compression and decompression objects. This will return the object to an idle state, releasing any working memory. `jpeg_abort()` is allowed at any time after successful object creation.

Note that cleaning up the data destination, if required, is your responsibility; neither of these routines will call `term_destination()`. (See "Compressed data handling", below, for more about that.)

`jpeg_destroy()` and `jpeg_abort()` are the only safe calls to make on a JPEG object that has reported an error by calling `error_exit` (see "Error handling" for more info). The internal state of such an object is likely to be out of whack. Either of these two routines will return the object to a known state.

## Decompression details

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Here we revisit the JPEG decompression outline given in the overview.

### 1. Allocate and initialize a JPEG decompression object.

This is just like initialization for compression, as discussed above, except that the object is a "struct `jpeg_decompress_struct`" and you call `jpeg_create_decompress()`. Error handling is exactly the same.

Typical code:

```
struct jpeg_decompress_struct cinfo;
struct jpeg_error_mgr jerr;
...
cinfo.err = jpeg_std_error(&jerr);
jpeg_create_decompress(&cinfo);
```

(Both here and in the IJG code, we usually use variable name "cinfo" for both compression and decompression objects.)

2. Specify the source of the compressed data (eg, a file).

As previously mentioned, the JPEG library reads compressed data from a "data source" module. The library includes one data source module which knows how to read from a stdio stream. You can use your own source module if you want to do something else, as discussed later.

If you use the standard source module, you must open the source stdio stream beforehand. Typical code for this step looks like:

```
FILE * infile;
...
if ((infile = fopen(filename, "rb")) == NULL) {
 fprintf(stderr, "can't open %s\n", filename);
 exit(1);
}
jpeg_stdio_src(&cinfo, infile);
```

where the last line invokes the standard source module.

**WARNING:** it is critical that the binary compressed data be read unchanged. On non-Unix systems the stdio library may perform newline translation or otherwise corrupt binary data. To suppress this behavior, you may need to use a "b" option to fopen (as shown above), or use setmode() or another routine to put the stdio stream in binary mode. See cjpeg.c and djpeg.c for code that has been found to work on many systems.

You may not change the data source between calling jpeg\_read\_header() and jpeg\_finish\_decompress(). If you wish to read a series of JPEG images from a single source file, you should repeat the jpeg\_read\_header() to jpeg\_finish\_decompress() sequence without reinitializing either the JPEG object or the data source module; this prevents buffered input data from being discarded.

3. Call jpeg\_read\_header() to obtain image info.

Typical code for this step is just

```
jpeg_read_header(&cinfo, TRUE);
```

This will read the source datastream header markers, up to the beginning of the compressed data proper. On return, the image dimensions and other info have been stored in the JPEG object. The application may wish to consult this information before selecting decompression parameters.

More complex code is necessary if

- \* A suspending data source is used --- in that case `jpeg_read_header()` may return before it has read all the header data. See "I/O suspension", below. The normal stdio source manager will NOT cause this to happen.
- \* Abbreviated JPEG files are to be processed --- see the section on abbreviated datastreams. Standard applications that deal only in interchange JPEG files need not be concerned with this case either.

It is permissible to stop at this point if you just wanted to find out the image dimensions and other header info for a JPEG file. In that case, call `jpeg_destroy()` when you are done with the JPEG object, or call `jpeg_abort()` to return it to an idle state before selecting a new data source and reading another header.

#### 4. Set parameters for decompression.

`jpeg_read_header()` sets appropriate default decompression parameters based on the properties of the image (in particular, its colorspace). However, you may well want to alter these defaults before beginning the decompression. For example, the default is to produce full color output from a color file. If you want colormapped output you must ask for it. Other options allow the returned image to be scaled and allow various speed/quality tradeoffs to be selected. "Decompression parameter selection", below, gives details.

If the defaults are appropriate, nothing need be done at this step.

Note that all default values are set by each call to `jpeg_read_header()`. If you reuse a decompression object, you cannot expect your parameter settings to be preserved across cycles, as you can for compression. You must set desired parameter values each time.

#### 5. `jpeg_start_decompress(...)`;

Once the parameter values are satisfactory, call `jpeg_start_decompress()` to begin decompression. This will initialize internal state, allocate working memory, and prepare for returning data.

Typical code is just

```
jpeg_start_decompress(&cinfo);
```

If you have requested a multi-pass operating mode, such as 2-pass color quantization, `jpeg_start_decompress()` will do everything needed before data output can begin. In this case `jpeg_start_decompress()` may take quite a while to complete. With a single-scan (non progressive) JPEG file and default decompression parameters, this will not happen; `jpeg_start_decompress()` will return quickly.



After this call, the final output image dimensions, including any requested scaling, are available in the JPEG object; so is the selected colormap, if colormapped output has been requested. Useful fields include

`output_width` image width and height, as scaled  
`output_height`  
`out_color_components` # of color components in `out_color_space`  
`output_components` # of color components returned per pixel  
`colormap` the selected colormap, if any  
`actual_number_of_colors` number of entries in colormap

`output_components` is 1 (a colormap index) when quantizing colors; otherwise it equals `out_color_components`. It is the number of JSAMPLE values that will be emitted per pixel in the output arrays.

Typically you will need to allocate data buffers to hold the incoming image. You will need `output_width * output_components` JSAMPLEs per scanline in your output buffer, and a total of `output_height` scanlines will be returned.

Note: if you are using the JPEG library's internal memory manager to allocate data buffers (as `djpeg` does), then the manager's protocol requires that you request large buffers \*before\* calling `jpeg_start_decompress()`. This is a little tricky since the `output_XXX` fields are not normally valid then. You can make them valid by calling `jpeg_calc_output_dimensions()` after setting the relevant parameters (scaling, output color space, and quantization flag).

```
6. while (scan lines remain to be read)
 jpeg_read_scanlines(...);
```

Now you can read the decompressed image data by calling `jpeg_read_scanlines()` one or more times. At each call, you pass in the maximum number of scanlines to be read (ie, the height of your working buffer); `jpeg_read_scanlines()` will return up to that many lines. The return value is the number of lines actually read. The format of the returned data is discussed under "Data formats", above. Don't forget that grayscale and color JPEGs will return different data formats!

Image data is returned in top-to-bottom scanline order. If you must write out the image in bottom-to-top order, you can use the JPEG library's virtual array mechanism to invert the data efficiently. Examples of this can be found in the sample application `djpeg`.

The library maintains a count of the number of scanlines returned so far in the `output_scanline` field of the JPEG object. Usually you can just use this variable as the loop counter, so that the loop test looks like "`while (cinfo.output_scanline < cinfo.output_height)`". (Note that the test

should NOT be against `image_height`, unless you never use scaling. The `image_height` field is the height of the original unscaled image.) The return value always equals the change in the value of `output_scanline`.

If you don't use a suspending data source, it is safe to assume that `jpeg_read_scanlines()` reads at least one scanline per call, until the bottom of the image has been reached.

If you use a buffer larger than one scanline, it is NOT safe to assume that `jpeg_read_scanlines()` fills it. (The current implementation returns only a few scanlines per call, no matter how large a buffer you pass.) So you must always provide a loop that calls `jpeg_read_scanlines()` repeatedly until the whole image has been read.

#### 7. `jpeg_finish_decompress(...)`;

After all the image data has been read, call `jpeg_finish_decompress()` to complete the decompression cycle. This causes working memory associated with the JPEG object to be released.

Typical code:

```
jpeg_finish_decompress(&cinfo);
```

If using the `stdio` source manager, don't forget to close the source `stdio` stream if necessary.

It is an error to call `jpeg_finish_decompress()` before reading the correct total number of scanlines. If you wish to abort decompression, call `jpeg_abort()` as discussed below.

After completing a decompression cycle, you may dispose of the JPEG object as discussed next, or you may use it to decompress another image. In that case return to step 2 or 3 as appropriate. If you do not change the source manager, the next image will be read from the same source.

#### 8. Release the JPEG decompression object.

When you are done with a JPEG decompression object, destroy it by calling `jpeg_destroy_decompress()` or `jpeg_destroy()`. The previous discussion of destroying compression objects applies here too.

Typical code:

```
jpeg_destroy_decompress(&cinfo);
```

## 9. Aborting.

You can abort a decompression cycle by calling `jpeg_destroy_decompress()` or `jpeg_destroy()` if you don't need the JPEG object any more, or `jpeg_abort_decompress()` or `jpeg_abort()` if you want to reuse the object. The previous discussion of aborting compression cycles applies here too.

Mechanics of usage: include files, linking, etc

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Applications using the JPEG library should include the header file `jpeglib.h` to obtain declarations of data types and routines. Before including `jpeglib.h`, include system headers that define at least the typedefs `FILE` and `size_t`. On ANSI-conforming systems, including `<stdio.h>` is sufficient; on older Unix systems, you may need `<sys/types.h>` to define `size_t`.

If the application needs to refer to individual JPEG library error codes, also include `jerror.h` to define those symbols.

`jpeglib.h` indirectly includes the files `jconfig.h` and `jmorecfg.h`. If you are installing the JPEG header files in a system directory, you will want to install all four files: `jpeglib.h`, `jerror.h`, `jconfig.h`, `jmorecfg.h`.

The most convenient way to include the JPEG code into your executable program is to prepare a library file ("`libjpeg.a`", or a corresponding name on non-Unix machines) and reference it at your link step. If you use only half of the library (only compression or only decompression), only that much code will be included from the library, unless your linker is hopelessly brain-damaged. The supplied makefiles build `libjpeg.a` automatically (see `install.txt`).

While you can build the JPEG library as a shared library if the whim strikes you, we don't really recommend it. The trouble with shared libraries is that at some point you'll probably try to substitute a new version of the library without recompiling the calling applications. That generally doesn't work because the parameter struct declarations usually change with each new version. In other words, the library's API is *\*not\** guaranteed binary compatible across versions; we only try to ensure source-code compatibility. (In hindsight, it might have been smarter to hide the parameter structs from applications and introduce a ton of access functions instead. Too late now, however.)

On some systems your application may need to set up a signal handler to ensure that temporary files are deleted if the program is interrupted. This is most critical if you are on MS-DOS and use the `jmemdos.c` memory manager back end; it will try to grab extended memory for temp files, and that space will NOT be freed automatically. See `cjpeg.c` or `djpeg.c` for an example signal handler.

It may be worth pointing out that the core JPEG library does not actually require the stdio library: only the default source/destination managers and error handler need it. You can use the library in a stdio-less environment if you replace those modules and use `jmemnobs.c` (or another memory manager of your own devising). More info about the minimum system library requirements may be found in `jinclude.h`.

## ADVANCED FEATURES

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### Compression parameter selection

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This section describes all the optional parameters you can set for JPEG compression, as well as the "helper" routines provided to assist in this task. Proper setting of some parameters requires detailed understanding of the JPEG standard; if you don't know what a parameter is for, it's best not to mess with it! See REFERENCES in the README file for pointers to more info about JPEG.

It's a good idea to call `jpeg_set_defaults()` first, even if you plan to set all the parameters; that way your code is more likely to work with future JPEG libraries that have additional parameters. For the same reason, we recommend you use a helper routine where one is provided, in preference to twiddling `cinfo` fields directly.

The helper routines are:

`jpeg_set_defaults (j_compress_ptr cinfo)`

This routine sets all JPEG parameters to reasonable defaults, using only the input image's color space (field `in_color_space`, which must already be set in `cinfo`). Many applications will only need to use this routine and perhaps `jpeg_set_quality()`.

`jpeg_set_colorspace (j_compress_ptr cinfo, J_COLOR_SPACE colorspace)`

Sets the JPEG file's colorspace (field `jpeg_color_space`) as specified, and sets other color-space-dependent parameters appropriately. See "Special color spaces", below, before using this. A large number of parameters, including all per-component parameters, are set by this routine; if you want to twiddle individual parameters you should call `jpeg_set_colorspace()` before rather than after.

`jpeg_default_colorspace (j_compress_ptr cinfo)`

Selects an appropriate JPEG colorspace based on `cinfo->in_color_space`, and calls `jpeg_set_colorspace()`. This is actually a subroutine of `jpeg_set_defaults()`. It's broken out in case you want to change

just the colorspace-dependent JPEG parameters.

`jpeg_set_quality(j_compress_ptr cinfo, int quality, boolean force_baseline)`

Constructs JPEG quantization tables appropriate for the indicated quality setting. The quality value is expressed on the 0..100 scale recommended by IJG (cjpeg's "-quality" switch uses this routine). Note that the exact mapping from quality values to tables may change in future IJG releases as more is learned about DCT quantization. If the `force_baseline` parameter is TRUE, then the quantization table entries are constrained to the range 1..255 for full JPEG baseline compatibility. In the current implementation, this only makes a difference for quality settings below 25, and it effectively prevents very small/low quality files from being generated. The IJG decoder is capable of reading the non-baseline files generated at low quality settings when `force_baseline` is FALSE, but other decoders may not be.

`jpeg_set_linear_quality(j_compress_ptr cinfo, int scale_factor, boolean force_baseline)`

Same as `jpeg_set_quality()` except that the generated tables are the sample tables given in the JPEC spec section K.1, multiplied by the specified scale factor (which is expressed as a percentage; thus `scale_factor = 100` reproduces the spec's tables). Note that larger scale factors give lower quality. This entry point is useful for conforming to the Adobe PostScript DCT conventions, but we do not recommend linear scaling as a user-visible quality scale otherwise. `force_baseline` again constrains the computed table entries to 1..255.

`int jpeg_quality_scaling(int quality)`

Converts a value on the IJG-recommended quality scale to a linear scaling percentage. Note that this routine may change or go away in future releases --- IJG may choose to adopt a scaling method that can't be expressed as a simple scalar multiplier, in which case the premise of this routine collapses. Caveat user.

`jpeg_default_qtables(j_compress_ptr cinfo, boolean force_baseline)`

Set default quantization tables with linear `q_scale_factor[]` values (see below).

`jpeg_add_quant_table(j_compress_ptr cinfo, int which_tbl, const unsigned int *basic_table, int scale_factor, boolean force_baseline)`

Allows an arbitrary quantization table to be created. `which_tbl` indicates which table slot to fill. `basic_table` points to an array of 64 unsigned ints given in normal array order. These values are multiplied by `scale_factor/100` and then clamped to the range 1..65535 (or to 1..255 if `force_baseline` is TRUE).

CAUTION: prior to library version 6a, `jpeg_add_quant_table` expected the basic table to be given in JPEG zigzag order. If you need to

write code that works with either older or newer versions of this routine, you must check the library version number. Something like "#if JPEG\_LIB\_VERSION >= 61" is the right test.

`jpeg_simple_progression (j_compress_ptr cinfo)`

Generates a default scan script for writing a progressive-JPEG file.

This is the recommended method of creating a progressive file, unless you want to make a custom scan sequence. You must ensure that the JPEG color space is set correctly before calling this routine.

Compression parameters (cinfo fields) include:

boolean `arith_code`

If TRUE, use arithmetic coding.

If FALSE, use Huffman coding.

int `block_size`

Set DCT block size. All N from 1 to 16 are possible.

Default is 8 (baseline format).

Larger values produce higher compression, smaller values produce higher quality.

An exact DCT stage is possible with 1 or 2.

With the default quality of 75 and default Luminance qtable

the DCT+Quantization stage is lossless for value 1.

Note that values other than 8 require a SmartScale capable decoder, introduced with IJG JPEG 8. Setting the `block_size` parameter for compression works with version 8c and later.

`J_DCT_METHOD` `dct_method`

Selects the algorithm used for the DCT step. Choices are:

`JDCT_ISLOW`: slow but accurate integer algorithm

`JDCT_IFAST`: faster, less accurate integer method

`JDCT_FLOAT`: floating-point method

`JDCT_DEFAULT`: default method (normally `JDCT_ISLOW`)

`JDCT_FASTEST`: fastest method (normally `JDCT_IFAST`)

The `FLOAT` method is very slightly more accurate than the `ISLOW` method, but may give different results on different machines due to varying roundoff behavior. The integer methods should give the same results on all machines. On machines with sufficiently fast FP hardware, the floating-point method may also be the fastest. The `IFAST` method is considerably less accurate than the other two; its use is not recommended if high quality is a concern. `JDCT_DEFAULT` and `JDCT_FASTEST` are macros configurable by each installation.

unsigned int `scale_num`, `scale_denom`

Scale the image by the fraction `scale_num/scale_denom`. Default is

1/1, or no scaling. Currently, the supported scaling ratios are

M/N with all N from 1 to 16, where M is the destination DCT size, which is 8 by default (see `block_size` parameter above).  
(The library design allows for arbitrary scaling ratios but this is not likely to be implemented any time soon.)

`J_COLOR_SPACE` `jpeg_color_space`

`int num_components`

The JPEG color space and corresponding number of components; see "Special color spaces", below, for more info. We recommend using `jpeg_set_colorspace()` if you want to change these.

`J_COLOR_TRANSFORM` `color_transform`

Internal color transform identifier, writes LSE marker if nonzero (requires decoder with inverse color transform support, introduced with IJG JPEG 9).

Two values are currently possible: `JCT_NONE` and `JCT_SUBTRACT_GREEN`.

Set this value for lossless RGB application \*before\* calling `jpeg_set_colorspace()`, because entropy table assignment in `jpeg_set_colorspace()` depends on `color_transform`.

`boolean optimize_coding`

`TRUE` causes the compressor to compute optimal Huffman coding tables for the image. This requires an extra pass over the data and therefore costs a good deal of space and time. The default is `FALSE`, which tells the compressor to use the supplied or default Huffman tables. In most cases optimal tables save only a few percent of file size compared to the default tables. Note that when this is `TRUE`, you need not supply Huffman tables at all, and any you do supply will be overwritten.

`unsigned int restart_interval`

`int restart_in_rows`

To emit restart markers in the JPEG file, set one of these nonzero. Set `restart_interval` to specify the exact interval in MCU blocks. Set `restart_in_rows` to specify the interval in MCU rows. (If `restart_in_rows` is not 0, then `restart_interval` is set after the image width in MCUs is computed.) Defaults are zero (no restarts). One restart marker per MCU row is often a good choice.  
NOTE: the overhead of restart markers is higher in grayscale JPEG files than in color files, and MUCH higher in progressive JPEGs. If you use restarts, you may want to use larger intervals in those cases.

`const jpeg_scan_info * scan_info`

`int num_scans`

By default, `scan_info` is `NULL`; this causes the compressor to write a single-scan sequential JPEG file. If not `NULL`, `scan_info` points to an array of scan definition records of length `num_scans`. The

compressor will then write a JPEG file having one scan for each scan definition record. This is used to generate noninterleaved or progressive JPEG files. The library checks that the scan array defines a valid JPEG scan sequence. (`jpeg_simple_progression` creates a suitable scan definition array for progressive JPEG.) This is discussed further under "Progressive JPEG support".

boolean `do_fancy_downsampling`

If TRUE, use direct DCT scaling with DCT size > 8 for downsampling of chroma components.

If FALSE, use only DCT size <= 8 and simple separate downsampling. Default is TRUE.

For better image stability in multiple generation compression cycles it is preferable that this value matches the corresponding `do_fancy_upsampling` value in decompression.

int `smoothing_factor`

If non-zero, the input image is smoothed; the value should be 1 for minimal smoothing to 100 for maximum smoothing. Consult `jcsample.c` for details of the smoothing algorithm. The default is zero.

boolean `write_JFIF_header`

If TRUE, a JFIF APP0 marker is emitted. `jpeg_set_defaults()` and `jpeg_set_colorspace()` set this TRUE if a JFIF-legal JPEG color space (ie, YCbCr or grayscale) is selected, otherwise FALSE.

UINT8 `JFIF_major_version`

UINT8 `JFIF_minor_version`

The version number to be written into the JFIF marker.

`jpeg_set_defaults()` initializes the version to 1.01 (major=minor=1).

You should set it to 1.02 (major=1, minor=2) if you plan to write any JFIF 1.02 extension markers.

UINT8 `density_unit`

UINT16 `X_density`

UINT16 `Y_density`

The resolution information to be written into the JFIF marker; not used otherwise. `density_unit` may be 0 for unknown, 1 for dots/inch, or 2 for dots/cm. The default values are 0,1,1 indicating square pixels of unknown size.

boolean `write_Adobe_marker`

If TRUE, an Adobe APP14 marker is emitted. `jpeg_set_defaults()` and `jpeg_set_colorspace()` set this TRUE if JPEG color space RGB, CMYK, or YCCK is selected, otherwise FALSE. It is generally a bad idea to set both `write_JFIF_header` and `write_Adobe_marker`. In fact, you probably shouldn't change the default settings at all --- the default behavior ensures that the JPEG file's color space can be



recognized by the decoder.

`JQUANT_TBL * quant_tbl_ptrs[NUM_QUANT_TBLS]`  
Pointers to coefficient quantization tables, one per table slot, or NULL if no table is defined for a slot. Usually these should be set via one of the above helper routines; `jpeg_add_quant_table()` is general enough to define any quantization table. The other routines will set up table slot 0 for luminance quality and table slot 1 for chrominance.

`int q_scale_factor[NUM_QUANT_TBLS]`  
Linear quantization scaling factors (percentage, initialized 100) for use with `jpeg_default_qtables()`. See `rdswitch.c` and `cjpeg.c` for an example of usage. Note that the `q_scale_factor[]` fields are the "linear" scales, so you have to convert from user-defined ratings via `jpeg_quality_scaling()`. Here is an example code which corresponds to `cjpeg -quality 90,70`:

```
jpeg_set_defaults(cinfo);

/* Set luminance quality 90. */
cinfo->q_scale_factor[0] = jpeg_quality_scaling(90);
/* Set chrominance quality 70. */
cinfo->q_scale_factor[1] = jpeg_quality_scaling(70);

jpeg_default_qtables(cinfo, force_baseline);
```

CAUTION: You must also set 1x1 subsampling for efficient separate color quality selection, since the default value used by library is 2x2:

```
cinfo->comp_info[0].v_samp_factor = 1;
cinfo->comp_info[0].h_samp_factor = 1;
```

`JHUFF_TBL * dc_huff_tbl_ptrs[NUM_HUFF_TBLS]`  
`JHUFF_TBL * ac_huff_tbl_ptrs[NUM_HUFF_TBLS]`  
Pointers to Huffman coding tables, one per table slot, or NULL if no table is defined for a slot. Slots 0 and 1 are filled with the JPEG sample tables by `jpeg_set_defaults()`. If you need to allocate more table structures, `jpeg_alloc_huff_table()` may be used. Note that optimal Huffman tables can be computed for an image by setting `optimize_coding`, as discussed above; there's seldom any need to mess with providing your own Huffman tables.

The actual dimensions of the JPEG image that will be written to the file are given by the following fields. These are computed from the input image dimensions and the compression parameters by `jpeg_start_compress()`. You can

also call `jpeg_calc_jpeg_dimensions()` to obtain the values that will result from the current parameter settings. This can be useful if you are trying to pick a scaling ratio that will get close to a desired target size.

JDIMENSION `jpeg_width` Actual dimensions of output image.

JDIMENSION `jpeg_height`

Per-component parameters are stored in the struct `cinfo.comp_info[i]` for component number `i`. Note that components here refer to components of the JPEG color space, \*not\* the source image color space. A suitably large `comp_info[]` array is allocated by `jpeg_set_defaults()`; if you choose not to use that routine, it's up to you to allocate the array.

int `component_id`

The one-byte identifier code to be recorded in the JPEG file for this component. For the standard color spaces, we recommend you leave the default values alone.

int `h_samp_factor`

int `v_samp_factor`

Horizontal and vertical sampling factors for the component; must be 1..4 according to the JPEG standard. Note that larger sampling factors indicate a higher-resolution component; many people find this behavior quite unintuitive. The default values are 2,2 for luminance components and 1,1 for chrominance components, except for grayscale where 1,1 is used.

int `quant_tbl_no`

Quantization table number for component. The default value is 0 for luminance components and 1 for chrominance components.

int `dc_tbl_no`

int `ac_tbl_no`

DC and AC entropy coding table numbers. The default values are 0 for luminance components and 1 for chrominance components.

int `component_index`

Must equal the component's index in `comp_info[]`. (Beginning in release v6, the compressor library will fill this in automatically; you don't have to.)

Decompression parameter selection

-----

Decompression parameter selection is somewhat simpler than compression parameter selection, since all of the JPEG internal parameters are

recorded in the source file and need not be supplied by the application. (Unless you are working with abbreviated files, in which case see "Abbreviated datastreams", below.) Decompression parameters control the postprocessing done on the image to deliver it in a format suitable for the application's use. Many of the parameters control speed/quality tradeoffs, in which faster decompression may be obtained at the price of a poorer-quality image. The defaults select the highest quality (slowest) processing.

The following fields in the JPEG object are set by `jpeg_read_header()` and may be useful to the application in choosing decompression parameters:

JDIMENSION `image_width` Width and height of image  
JDIMENSION `image_height`  
int `num_components` Number of color components  
J\_COLOR\_SPACE `jpeg_color_space` Colorspace of image  
boolean `saw_JFIF_marker` TRUE if a JFIF APP0 marker was seen  
UINT8 `JFIF_major_version` Version information from JFIF marker  
UINT8 `JFIF_minor_version`  
UINT8 `density_unit` Resolution data from JFIF marker  
UINT16 `X_density`  
UINT16 `Y_density`  
boolean `saw_Adobe_marker` TRUE if an Adobe APP14 marker was seen  
UINT8 `Adobe_transform` Color transform code from Adobe marker

The JPEG color space, unfortunately, is something of a guess since the JPEG standard proper does not provide a way to record it. In practice most files adhere to the JFIF or Adobe conventions, and the decoder will recognize these correctly. See "Special color spaces", below, for more info.

The decompression parameters that determine the basic properties of the returned image are:

J\_COLOR\_SPACE `out_color_space`  
Output color space. `jpeg_read_header()` sets an appropriate default based on `jpeg_color_space`; typically it will be RGB or grayscale. The application can change this field to request output in a different colorspace. For example, set it to `JCS_GRAYSCALE` to get grayscale output from a color file. (This is useful for previewing: grayscale output is faster than full color since the color components need not be processed.) Note that not all possible color space transforms are currently implemented; you may need to extend `jdcolor.c` if you want an unusual conversion.

unsigned int `scale_num`, `scale_denom`  
Scale the image by the fraction `scale_num/scale_denom`. Currently, the supported scaling ratios are M/N with all M from 1 to 16, where

N is the source DCT size, which is 8 for baseline JPEG. (The library design allows for arbitrary scaling ratios but this is not likely to be implemented any time soon.) The values are initialized by `jpeg_read_header()` with the source DCT size. For baseline JPEG this is 8/8. If you change only the `scale_num` value while leaving the other unchanged, then this specifies the DCT scaled size to be applied on the given input. For baseline JPEG this is equivalent to M/8 scaling, since the source DCT size for baseline JPEG is 8. Smaller scaling ratios permit significantly faster decoding since fewer pixels need be processed and a simpler IDCT method can be used.

boolean `quantize_colors`

If set TRUE, colormapped output will be delivered. Default is FALSE, meaning that full-color output will be delivered.

The next three parameters are relevant only if `quantize_colors` is TRUE.

int `desired_number_of_colors`

Maximum number of colors to use in generating a library-supplied color map (the actual number of colors is returned in a different field).

Default 256. Ignored when the application supplies its own color map.

boolean `two_pass_quantize`

If TRUE, an extra pass over the image is made to select a custom color map for the image. This usually looks a lot better than the one-size-fits-all colormap that is used otherwise. Default is TRUE. Ignored when the application supplies its own color map.

J\_DITHER\_MODE `dither_mode`

Selects color dithering method. Supported values are:

JDITHER\_NONE no dithering: fast, very low quality

JDITHER\_ORDERED ordered dither: moderate speed and quality

JDITHER\_FS Floyd-Steinberg dither: slow, high quality

Default is JDITHER\_FS. (At present, ordered dither is implemented only in the single-pass, standard-colormap case. If you ask for ordered dither when `two_pass_quantize` is TRUE or when you supply an external color map, you'll get F-S dithering.)

When `quantize_colors` is TRUE, the target color map is described by the next two fields. `colormap` is set to NULL by `jpeg_read_header()`. The application can supply a color map by setting `colormap` non-NULL and setting `actual_number_of_colors` to the map size. Otherwise, `jpeg_start_decompress()` selects a suitable color map and sets these two fields itself.

[Implementation restriction: at present, an externally supplied colormap is only accepted for 3-component output color spaces.]

JSAMPARRAY `colormap`

The color map, represented as a 2-D pixel array of `out_color_components`

rows and actual\_number\_of\_colors columns. Ignored if not quantizing.

CAUTION: if the JPEG library creates its own colormap, the storage pointed to by this field is released by jpeg\_finish\_decompress().

Copy the colormap somewhere else first, if you want to save it.

int actual\_number\_of\_colors

The number of colors in the color map.

Additional decompression parameters that the application may set include:

J\_DCT\_METHOD dct\_method

Selects the algorithm used for the DCT step. Choices are the same as described above for compression.

boolean do\_fancy\_upsampling

If TRUE, use direct DCT scaling with DCT size > 8 for upsampling of chroma components.

If FALSE, use only DCT size <= 8 and simple separate upsampling.

Default is TRUE.

For better image stability in multiple generation compression cycles it is preferable that this value matches the corresponding do\_fancy\_downsampling value in compression.

boolean do\_block\_smoothing

If TRUE, interblock smoothing is applied in early stages of decoding progressive JPEG files; if FALSE, not. Default is TRUE. Early progression stages look "fuzzy" with smoothing, "blocky" without.

In any case, block smoothing ceases to be applied after the first few AC coefficients are known to full accuracy, so it is relevant only when using buffered-image mode for progressive images.

boolean enable\_1pass\_quant

boolean enable\_external\_quant

boolean enable\_2pass\_quant

These are significant only in buffered-image mode, which is described in its own section below.

The output image dimensions are given by the following fields. These are computed from the source image dimensions and the decompression parameters by jpeg\_start\_decompress(). You can also call jpeg\_calc\_output\_dimensions() to obtain the values that will result from the current parameter settings.

This can be useful if you are trying to pick a scaling ratio that will get close to a desired target size. It's also important if you are using the JPEG library's memory manager to allocate output buffer space, because you are supposed to request such buffers \*before\* jpeg\_start\_decompress().

JDIMENSION output\_width Actual dimensions of output image.

JDIMENSION output\_height

int out\_color\_components Number of color components in out\_color\_space.

int output\_components Number of color components returned.

int rec\_outbuf\_height Recommended height of scanline buffer.

When quantizing colors, output\_components is 1, indicating a single color map index per pixel. Otherwise it equals out\_color\_components. The output arrays are required to be output\_width \* output\_components JSAMPLEs wide.

rec\_outbuf\_height is the recommended minimum height (in scanlines) of the buffer passed to jpeg\_read\_scanlines(). If the buffer is smaller, the library will still work, but time will be wasted due to unnecessary data copying. In high-quality modes, rec\_outbuf\_height is always 1, but some faster, lower-quality modes set it to larger values (typically 2 to 4).

If you are going to ask for a high-speed processing mode, you may as well go to the trouble of honoring rec\_outbuf\_height so as to avoid data copying. (An output buffer larger than rec\_outbuf\_height lines is OK, but won't provide any material speed improvement over that height.)

Special color spaces

-----

The JPEG standard itself is "color blind" and doesn't specify any particular color space. It is customary to convert color data to a luminance/chrominance color space before compressing, since this permits greater compression. The existing JPEG file interchange format standards specify YCbCr or GRAYSCALE data (JFIF version 1), GRAYSCALE, RGB, YCbCr, CMYK, or YCCK (Adobe), or BG\_RGB or BG\_YCC (big gamut color spaces, JFIF version 2). For special applications such as multispectral images, other color spaces can be used, but it must be understood that such files will be unportable.

The JPEG library can handle the most common colorspace conversions (namely RGB  $\Leftrightarrow$  YCbCr and CMYK  $\Leftrightarrow$  YCCK). It can also deal with data of an unknown color space, passing it through without conversion. If you deal extensively with an unusual color space, you can easily extend the library to understand additional color spaces and perform appropriate conversions.

For compression, the source data's color space is specified by field in\_color\_space. This is transformed to the JPEG file's color space given by jpeg\_color\_space. jpeg\_set\_defaults() chooses a reasonable JPEG color space depending on in\_color\_space, but you can override this by calling jpeg\_set\_colorspace(). Of course you must select a supported transformation. jccolor.c currently supports the following transformations:

RGB => YCbCr

RGB => GRAYSCALE

RGB => BG\_YCC

YCbCr => GRAYSCALE

YCbCr => BG\_YCC

CMYK => YCCK

plus the null transforms: GRAYSCALE => GRAYSCALE, RGB => RGB,  
BG\_RGB => BG\_RGB, YCbCr => YCbCr, BG\_YCC => BG\_YCC, CMYK => CMYK,  
YCCK => YCCK, and UNKNOWN => UNKNOWN.

The file interchange format standards (JFIF and Adobe) specify APPn markers that indicate the color space of the JPEG file. It is important to ensure that these are written correctly, or omitted if the JPEG file's color space is not one of the ones supported by the interchange standards.

`jpeg_set_colorspace()` will set the compression parameters to include or omit the APPn markers properly, so long as it is told the truth about the JPEG color space. For example, if you are writing some random 3-component color space without conversion, don't try to fake out the library by setting `in_color_space` and `jpeg_color_space` to `JCS_YCbCr`; use `JCS_UNKNOWN`. You may want to write an APPn marker of your own devising to identify the colorspace --- see "Special markers", below.

When told that the color space is UNKNOWN, the library will default to using luminance-quality compression parameters for all color components. You may well want to change these parameters. See the source code for `jpeg_set_colorspace()`, in `jcparam.c`, for details.

For decompression, the JPEG file's color space is given in `jpeg_color_space`, and this is transformed to the output color space `out_color_space`.

`jpeg_read_header`'s setting of `jpeg_color_space` can be relied on if the file conforms to JFIF or Adobe conventions, but otherwise it is no better than a guess. If you know the JPEG file's color space for certain, you can override `jpeg_read_header`'s guess by setting `jpeg_color_space`. `jpeg_read_header` also selects a default output color space based on (its guess of) `jpeg_color_space`; set `out_color_space` to override this. Again, you must select a supported transformation. `jdcolor.c` currently supports

YCbCr => RGB

YCbCr => GRAYSCALE

BG\_YCC => RGB

BG\_YCC => GRAYSCALE

RGB => GRAYSCALE

GRAYSCALE => RGB

YCCK => CMYK

as well as the null transforms. (Since GRAYSCALE=>RGB is provided, an application can force grayscale JPEGs to look like color JPEGs if it only wants to handle one case.)

The two-pass color quantizer, `jquant2.c`, is specialized to handle RGB data (it weights distances appropriately for RGB colors). You'll need to modify the code if you want to use it for non-RGB output color spaces. Note that `jquant2.c` is used to map to an application-supplied colormap as well as for the normal two-pass colormap selection process.

CAUTION: it appears that Adobe Photoshop writes inverted data in CMYK JPEG files: 0 represents 100% ink coverage, rather than 0% ink as you'd expect. This is arguably a bug in Photoshop, but if you need to work with Photoshop CMYK files, you will have to deal with it in your application. We cannot "fix" this in the library by inverting the data during the CMYK<=>YCKK transform, because that would break other applications, notably Ghostscript. Photoshop versions prior to 3.0 write EPS files containing JPEG-encoded CMYK data in the same inverted-YCKK representation used in bare JPEG files, but the surrounding PostScript code performs an inversion using the PS image operator. I am told that Photoshop 3.0 will write uninverted YCKK in EPS/JPEG files, and will omit the PS-level inversion. (But the data polarity used in bare JPEG files will not change in 3.0.) In either case, the JPEG library must not invert the data itself, or else Ghostscript would read these EPS files incorrectly.

#### Error handling

-----

When the default error handler is used, any error detected inside the JPEG routines will cause a message to be printed on stderr, followed by exit(). You can supply your own error handling routines to override this behavior and to control the treatment of nonfatal warnings and trace/debug messages. The file example.c illustrates the most common case, which is to have the application regain control after an error rather than exiting.

The JPEG library never writes any message directly; it always goes through the error handling routines. Three classes of messages are recognized:

- \* Fatal errors: the library cannot continue.
- \* Warnings: the library can continue, but the data is corrupt, and a damaged output image is likely to result.
- \* Trace/informational messages. These come with a trace level indicating the importance of the message; you can control the verbosity of the program by adjusting the maximum trace level that will be displayed.

You may, if you wish, simply replace the entire JPEG error handling module (jerror.c) with your own code. However, you can avoid code duplication by only replacing some of the routines depending on the behavior you need. This is accomplished by calling jpeg\_std\_error() as usual, but then overriding some of the method pointers in the jpeg\_error\_mgr struct, as illustrated by example.c.

All of the error handling routines will receive a pointer to the JPEG object (a j\_common\_ptr which points to either a jpeg\_compress\_struct or a jpeg\_decompress\_struct; if you need to tell which, test the is\_decompressor field). This struct includes a pointer to the error manager struct in its "err" field. Frequently, custom error handler routines will need to access



additional data which is not known to the JPEG library or the standard error handler. The most convenient way to do this is to embed either the JPEG object or the `jpeg_error_mgr` struct in a larger structure that contains additional fields; then casting the passed pointer provides access to the additional fields. Again, see `example.c` for one way to do it. (Beginning with IJG version 6b, there is also a void pointer "client\_data" in each JPEG object, which the application can also use to find related data. The library does not touch `client_data` at all.)

The individual methods that you might wish to override are:

`error_exit (j_common_ptr cinfo)`

Receives control for a fatal error. Information sufficient to generate the error message has been stored in `cinfo->err`; call `output_message` to display it. Control must NOT return to the caller; generally this routine will `exit()` or `longjmp()` somewhere. Typically you would override this routine to get rid of the `exit()` default behavior. Note that if you continue processing, you should clean up the JPEG object with `jpeg_abort()` or `jpeg_destroy()`.

`output_message (j_common_ptr cinfo)`

Actual output of any JPEG message. Override this to send messages somewhere other than `stderr`. Note that this method does not know how to generate a message, only where to send it.

`format_message (j_common_ptr cinfo, char * buffer)`

Constructs a readable error message string based on the error info stored in `cinfo->err`. This method is called by `output_message`. Few applications should need to override this method. One possible reason for doing so is to implement dynamic switching of error message language.

`emit_message (j_common_ptr cinfo, int msg_level)`

Decide whether or not to emit a warning or trace message; if so, calls `output_message`. The main reason for overriding this method would be to abort on warnings. `msg_level` is -1 for warnings, 0 and up for trace messages.

Only `error_exit()` and `emit_message()` are called from the rest of the JPEG library; the other two are internal to the error handler.

The actual message texts are stored in an array of strings which is pointed to by the field `err->jpeg_message_table`. The messages are numbered from 0 to `err->last_jpeg_message`, and it is these code numbers that are used in the JPEG library code. You could replace the message texts (for instance, with messages in French or German) by changing the message table pointer. See `jerror.h` for the default texts. CAUTION: this table will almost certainly change or grow from one library version to the next.

It may be useful for an application to add its own message texts that are handled by the same mechanism. The error handler supports a second "add-on" message table for this purpose. To define an addon table, set the pointer `err->addon_message_table` and the message numbers `err->first_addon_message` and `err->last_addon_message`. If you number the addon messages beginning at 1000 or so, you won't have to worry about conflicts with the library's built-in messages. See the sample applications `cjpeg/djpeg` for an example of using addon messages (the addon messages are defined in `cderror.h`).

Actual invocation of the error handler is done via macros defined in `jerror.h`:

`ERREXITn(...)` for fatal errors

`WARNMSn(...)` for corrupt-data warnings

`TRACEMSn(...)` for trace and informational messages.

These macros store the message code and any additional parameters into the error handler struct, then invoke the `error_exit()` or `emit_message()` method.

The variants of each macro are for varying numbers of additional parameters.

The additional parameters are inserted into the generated message using standard `printf()` format codes.

See `jerror.h` and `jerror.c` for further details.

Compressed data handling (source and destination managers)

-----

The JPEG compression library sends its compressed data to a "destination manager" module. The default destination manager just writes the data to a memory buffer or to a `stdio` stream, but you can provide your own manager to do something else. Similarly, the decompression library calls a "source manager" to obtain the compressed data; you can provide your own source manager if you want the data to come from somewhere other than a memory buffer or a `stdio` stream.

In both cases, compressed data is processed a bufferload at a time: the destination or source manager provides a work buffer, and the library invokes the manager only when the buffer is filled or emptied. (You could define a one-character buffer to force the manager to be invoked for each byte, but that would be rather inefficient.) The buffer's size and location are controlled by the manager, not by the library. For example, the memory source manager just makes the buffer pointer and length point to the original data in memory. In this case the buffer-reload procedure will be invoked only if the decompressor ran off the end of the datastream, which would indicate an erroneous datastream.

The work buffer is defined as an array of datatype `JOCTET`, which is generally "char" or "unsigned char". On a machine where `char` is not exactly 8 bits wide, you must define `JOCTET` as a wider data type and then modify the data

source and destination modules to transcribe the work arrays into 8-bit units on external storage.

A data destination manager struct contains a pointer and count defining the next byte to write in the work buffer and the remaining free space:

```
JOCTET * next_output_byte; /* => next byte to write in buffer */
size_t free_in_buffer; /* # of byte spaces remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer is filled. The manager's `empty_output_buffer` method must reset the pointer and count. The manager is expected to remember the buffer's starting address and total size in private fields not visible to the library.

A data destination manager provides three methods:

`init_destination (j_compress_ptr cinfo)`

Initialize destination. This is called by `jpeg_start_compress()` before any data is actually written. It must initialize `next_output_byte` and `free_in_buffer`. `free_in_buffer` must be initialized to a positive value.

`empty_output_buffer (j_compress_ptr cinfo)`

This is called whenever the buffer has filled (`free_in_buffer` reaches zero). In typical applications, it should write out the *entire* buffer (use the saved start address and buffer length; ignore the current state of `next_output_byte` and `free_in_buffer`). Then reset the pointer & count to the start of the buffer, and return TRUE indicating that the buffer has been dumped. `free_in_buffer` must be set to a positive value when TRUE is returned. A FALSE return should only be used when I/O suspension is desired (this operating mode is discussed in the next section).

`term_destination (j_compress_ptr cinfo)`

Terminate destination --- called by `jpeg_finish_compress()` after all data has been written. In most applications, this must flush any data remaining in the buffer. Use either `next_output_byte` or `free_in_buffer` to determine how much data is in the buffer.

`term_destination()` is NOT called by `jpeg_abort()` or `jpeg_destroy()`. If you want the destination manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a `jpeg_destination_mgr` struct, fill in its method pointers, and insert a pointer to the struct into the "dest" field of the JPEG compression object. This can be done in-line in your setup code if you like, but it's probably cleaner to provide a separate routine similar to the `jpeg_stdio_dest()` or `jpeg_mem_dest()` routines of the supplied destination

managers.

Decompression source managers follow a parallel design, but with some additional frammishes. The source manager struct contains a pointer and count defining the next byte to read from the work buffer and the number of bytes remaining:

```
const JOCTET * next_input_byte; /* => next byte to read from buffer */
size_t bytes_in_buffer; /* # of bytes remaining in buffer */
```

The library increments the pointer and decrements the count until the buffer is emptied. The manager's `fill_input_buffer` method must reset the pointer and count. In most applications, the manager must remember the buffer's starting address and total size in private fields not visible to the library.

A data source manager provides five methods:

`init_source (j_decompress_ptr cinfo)`

Initialize source. This is called by `jpeg_read_header()` before any data is actually read. Unlike `init_destination()`, it may leave `bytes_in_buffer` set to 0 (in which case a `fill_input_buffer()` call will occur immediately).

`fill_input_buffer (j_decompress_ptr cinfo)`

This is called whenever `bytes_in_buffer` has reached zero and more data is wanted. In typical applications, it should read fresh data into the buffer (ignoring the current state of `next_input_byte` and `bytes_in_buffer`), reset the pointer & count to the start of the buffer, and return `TRUE` indicating that the buffer has been reloaded. It is not necessary to fill the buffer entirely, only to obtain at least one more byte. `bytes_in_buffer` **MUST** be set to a positive value if `TRUE` is returned. A `FALSE` return should only be used when I/O suspension is desired (this mode is discussed in the next section).

`skip_input_data (j_decompress_ptr cinfo, long num_bytes)`

Skip `num_bytes` worth of data. The buffer pointer and count should be advanced over `num_bytes` input bytes, refilling the buffer as needed. This is used to skip over a potentially large amount of uninteresting data (such as an APPn marker). In some applications it may be possible to optimize away the reading of the skipped data, but it's not clear that being smart is worth much trouble; large skips are uncommon. `bytes_in_buffer` may be zero on return. A zero or negative skip count should be treated as a no-op.

`resync_to_restart (j_decompress_ptr cinfo, int desired)`

This routine is called only when the decompressor has failed to find a restart (RSTn) marker where one is expected. Its mission is to find a suitable point for resuming decompression. For most

applications, we recommend that you just use the default resync procedure, `jpeg_resync_to_restart()`. However, if you are able to back up in the input data stream, or if you have a-priori knowledge about the likely location of restart markers, you may be able to do better. Read the `read_restart_marker()` and `jpeg_resync_to_restart()` routines in `jdmarker.c` if you think you'd like to implement your own resync procedure.

`term_source (j_decompress_ptr cinfo)`

Terminate source --- called by `jpeg_finish_decompress()` after all data has been read. Often a no-op.

For both `fill_input_buffer()` and `skip_input_data()`, there is no such thing as an EOF return. If the end of the file has been reached, the routine has a choice of exiting via `ERREXIT()` or inserting fake data into the buffer. In most cases, generating a warning message and inserting a fake EOI marker is the best course of action --- this will allow the decompressor to output however much of the image is there. In pathological cases, the decompressor may swallow the EOI and again demand data ... just keep feeding it fake EOIs. `jdatsrc.c` illustrates the recommended error recovery behavior.

`term_source()` is NOT called by `jpeg_abort()` or `jpeg_destroy()`. If you want the source manager to be cleaned up during an abort, you must do it yourself.

You will also need code to create a `jpeg_source_mgr` struct, fill in its method pointers, and insert a pointer to the struct into the "src" field of the JPEG decompression object. This can be done in-line in your setup code if you like, but it's probably cleaner to provide a separate routine similar to the `jpeg_stdio_src()` or `jpeg_mem_src()` routines of the supplied source managers.

For more information, consult the memory and stdio source and destination managers in `jdatsrc.c` and `jdadatdst.c`.

## I/O suspension

-----

Some applications need to use the JPEG library as an incremental memory-to-memory filter: when the compressed data buffer is filled or emptied, they want control to return to the outer loop, rather than expecting that the buffer can be emptied or reloaded within the data source/destination manager subroutine. The library supports this need by providing an "I/O suspension" mode, which we describe in this section.

The I/O suspension mode is not a panacea: nothing is guaranteed about the maximum amount of time spent in any one call to the library, so it will not eliminate response-time problems in single-threaded applications. If you need guaranteed response time, we suggest you "bite the bullet" and implement

a real multi-tasking capability.

To use I/O suspension, cooperation is needed between the calling application and the data source or destination manager; you will always need a custom source/destination manager. (Please read the previous section if you haven't already.) The basic idea is that the `empty_output_buffer()` or `fill_input_buffer()` routine is a no-op, merely returning `FALSE` to indicate that it has done nothing. Upon seeing this, the JPEG library suspends operation and returns to its caller. The surrounding application is responsible for emptying or refilling the work buffer before calling the JPEG library again.

Compression suspension:

For compression suspension, use an `empty_output_buffer()` routine that returns `FALSE`; typically it will not do anything else. This will cause the compressor to return to the caller of `jpeg_write_scanlines()`, with the return value indicating that not all the supplied scanlines have been accepted. The application must make more room in the output buffer, adjust the output buffer pointer/count appropriately, and then call `jpeg_write_scanlines()` again, pointing to the first unconsumed scanline.

When forced to suspend, the compressor will backtrack to a convenient stopping point (usually the start of the current MCU); it will regenerate some output data when restarted. Therefore, although `empty_output_buffer()` is only called when the buffer is filled, you should NOT write out the entire buffer after a suspension. Write only the data up to the current position of `next_output_byte/free_in_buffer`. The data beyond that point will be regenerated after resumption.

Because of the backtracking behavior, a good-size output buffer is essential for efficiency; you don't want the compressor to suspend often. (In fact, an overly small buffer could lead to infinite looping, if a single MCU required more data than would fit in the buffer.) We recommend a buffer of at least several Kbytes. You may want to insert explicit code to ensure that you don't call `jpeg_write_scanlines()` unless there is a reasonable amount of space in the output buffer; in other words, flush the buffer before trying to compress more data.

The compressor does not allow suspension while it is trying to write JPEG markers at the beginning and end of the file. This means that:

- \* At the beginning of a compression operation, there must be enough free space in the output buffer to hold the header markers (typically 600 or so bytes). The recommended buffer size is bigger than this anyway, so this is not a problem as long as you start with an empty buffer. However, this restriction might catch you if you insert large special markers, such as a JFIF thumbnail image, without flushing the buffer afterwards.
- \* When you call `jpeg_finish_compress()`, there must be enough space in the

output buffer to emit any buffered data and the final EOI marker. In the current implementation, half a dozen bytes should suffice for this, but for safety's sake we recommend ensuring that at least 100 bytes are free before calling `jpeg_finish_compress()`.

A more significant restriction is that `jpeg_finish_compress()` cannot suspend. This means you cannot use suspension with multi-pass operating modes, namely Huffman code optimization and multiple-scan output. Those modes write the whole file during `jpeg_finish_compress()`, which will certainly result in buffer overrun. (Note that this restriction applies only to compression, not decompression. The decompressor supports input suspension in all of its operating modes.)

Decompression suspension:

For decompression suspension, use a `fill_input_buffer()` routine that simply returns `FALSE` (except perhaps during error recovery, as discussed below). This will cause the decompressor to return to its caller with an indication that suspension has occurred. This can happen at four places:

- \* `jpeg_read_header()`: will return `JPEG_SUSPENDED`.
- \* `jpeg_start_decompress()`: will return `FALSE`, rather than its usual `TRUE`.
- \* `jpeg_read_scanlines()`: will return the number of scanlines already completed (possibly 0).
- \* `jpeg_finish_decompress()`: will return `FALSE`, rather than its usual `TRUE`.

The surrounding application must recognize these cases, load more data into the input buffer, and repeat the call. In the case of `jpeg_read_scanlines()`, increment the passed pointers past any scanlines successfully read.

Just as with compression, the decompressor will typically backtrack to a convenient restart point before suspending. When `fill_input_buffer()` is called, `next_input_byte/bytes_in_buffer` point to the current restart point, which is where the decompressor will backtrack to if `FALSE` is returned. The data beyond that position must NOT be discarded if you suspend; it needs to be re-read upon resumption. In most implementations, you'll need to shift this data down to the start of your work buffer and then load more data after it. Again, this behavior means that a several-Kbyte work buffer is essential for decent performance; furthermore, you should load a reasonable amount of new data before resuming decompression. (If you loaded, say, only one new byte each time around, you could waste a LOT of cycles.)

The `skip_input_data()` source manager routine requires special care in a suspension scenario. This routine is NOT granted the ability to suspend the decompressor; it can decrement `bytes_in_buffer` to zero, but no more. If the requested skip distance exceeds the amount of data currently in the input buffer, then `skip_input_data()` must set `bytes_in_buffer` to zero and record the additional skip distance somewhere else. The decompressor will immediately call `fill_input_buffer()`, which should return `FALSE`, which will cause a suspension return. The surrounding application must then arrange to discard

the recorded number of bytes before it resumes loading the input buffer. (Yes, this design is rather baroque, but it avoids complexity in the far more common case where a non-suspending source manager is used.)

If the input data has been exhausted, we recommend that you emit a warning and insert dummy EOI markers just as a non-suspending data source manager would do. This can be handled either in the surrounding application logic or within `fill_input_buffer()`; the latter is probably more efficient. If `fill_input_buffer()` knows that no more data is available, it can set the pointer/count to point to a dummy EOI marker and then return `TRUE` just as though it had read more data in a non-suspending situation.

The decompressor does not attempt to suspend within standard JPEG markers; instead it will backtrack to the start of the marker and reprocess the whole marker next time. Hence the input buffer must be large enough to hold the longest standard marker in the file. Standard JPEG markers should normally not exceed a few hundred bytes each (DHT tables are typically the longest). We recommend at least a 2K buffer for performance reasons, which is much larger than any correct marker is likely to be. For robustness against damaged marker length counts, you may wish to insert a test in your application for the case that the input buffer is completely full and yet the decoder has suspended without consuming any data --- otherwise, if this situation did occur, it would lead to an endless loop. (The library can't provide this test since it has no idea whether "the buffer is full", or even whether there is a fixed-size input buffer.)

The input buffer would need to be 64K to allow for arbitrary COM or APPn markers, but these are handled specially: they are either saved into allocated memory, or skipped over by calling `skip_input_data()`. In the former case, suspension is handled correctly, and in the latter case, the problem of buffer overrun is placed on `skip_input_data`'s shoulders, as explained above. Note that if you provide your own marker handling routine for large markers, you should consider how to deal with buffer overflow.

Multiple-buffer management:

In some applications it is desirable to store the compressed data in a linked list of buffer areas, so as to avoid data copying. This can be handled by having `empty_output_buffer()` or `fill_input_buffer()` set the pointer and count to reference the next available buffer; `FALSE` is returned only if no more buffers are available. Although seemingly straightforward, there is a pitfall in this approach: the backtrack that occurs when `FALSE` is returned could back up into an earlier buffer. For example, when `fill_input_buffer()` is called, the current pointer & count indicate the backtrack restart point. Since `fill_input_buffer()` will set the pointer and count to refer to a new buffer, the restart position must be saved somewhere else. Suppose a second call to `fill_input_buffer()` occurs in the same library call, and no additional input data is available, so `fill_input_buffer` must return `FALSE`.



If the JPEG library has not moved the pointer/count forward in the current buffer, then \*the correct restart point is the saved position in the prior buffer\*. Prior buffers may be discarded only after the library establishes a restart point within a later buffer. Similar remarks apply for output into a chain of buffers.

The library will never attempt to backtrack over a `skip_input_data()` call, so any skipped data can be permanently discarded. You still have to deal with the case of skipping not-yet-received data, however.

It's much simpler to use only a single buffer; when `fill_input_buffer()` is called, move any unconsumed data (beyond the current pointer/count) down to the beginning of this buffer and then load new data into the remaining buffer space. This approach requires a little more data copying but is far easier to get right.

### Progressive JPEG support

-----

Progressive JPEG rearranges the stored data into a series of scans of increasing quality. In situations where a JPEG file is transmitted across a slow communications link, a decoder can generate a low-quality image very quickly from the first scan, then gradually improve the displayed quality as more scans are received. The final image after all scans are complete is identical to that of a regular (sequential) JPEG file of the same quality setting. Progressive JPEG files are often slightly smaller than equivalent sequential JPEG files, but the possibility of incremental display is the main reason for using progressive JPEG.

The IJG encoder library generates progressive JPEG files when given a suitable "scan script" defining how to divide the data into scans. Creation of progressive JPEG files is otherwise transparent to the encoder. Progressive JPEG files can also be read transparently by the decoder library. If the decoding application simply uses the library as defined above, it will receive a final decoded image without any indication that the file was progressive. Of course, this approach does not allow incremental display. To perform incremental display, an application needs to use the decoder library's "buffered-image" mode, in which it receives a decoded image multiple times.

Each displayed scan requires about as much work to decode as a full JPEG image of the same size, so the decoder must be fairly fast in relation to the data transmission rate in order to make incremental display useful. However, it is possible to skip displaying the image and simply add the incoming bits to the decoder's coefficient buffer. This is fast because only Huffman decoding need be done, not IDCT, upsampling, colorspace conversion, etc. The IJG decoder library allows the application to switch dynamically between

displaying the image and simply absorbing the incoming bits. A properly coded application can automatically adapt the number of display passes to suit the time available as the image is received. Also, a final higher-quality display cycle can be performed from the buffered data after the end of the file is reached.

Progressive compression:

To create a progressive JPEG file (or a multiple-scan sequential JPEG file), set the `scan_info` `cinfo` field to point to an array of scan descriptors, and perform compression as usual. Instead of constructing your own scan list, you can call the `jpeg_simple_progression()` helper routine to create a recommended progression sequence; this method should be used by all applications that don't want to get involved in the nitty-gritty of progressive scan sequence design. (If you want to provide user control of scan sequences, you may wish to borrow the scan script reading code found in `rdswitch.c`, so that you can read scan script files just like `cjpeg's`.) When `scan_info` is not `NULL`, the compression library will store DCT'd data into a buffer array as `jpeg_write_scanlines()` is called, and will emit all the requested scans during `jpeg_finish_compress()`. This implies that multiple-scan output cannot be created with a suspending data destination manager, since `jpeg_finish_compress()` does not support suspension. We should also note that the compressor currently forces Huffman optimization mode when creating a progressive JPEG file, because the default Huffman tables are unsuitable for progressive files.

Progressive decompression:

When buffered-image mode is not used, the decoder library will read all of a multi-scan file during `jpeg_start_decompress()`, so that it can provide a final decoded image. (Here "multi-scan" means either progressive or multi-scan sequential.) This makes multi-scan files transparent to the decoding application. However, existing applications that used suspending input with version 5 of the IJG library will need to be modified to check for a suspension return from `jpeg_start_decompress()`.

To perform incremental display, an application must use the library's buffered-image mode. This is described in the next section.

Buffered-image mode

-----

In buffered-image mode, the library stores the partially decoded image in a coefficient buffer, from which it can be read out as many times as desired. This mode is typically used for incremental display of progressive JPEG files, but it can be used with any JPEG file. Each scan of a progressive JPEG file adds more data (more detail) to the buffered image. The application can

display in lockstep with the source file (one display pass per input scan), or it can allow input processing to outrun display processing. By making input and display processing run independently, it is possible for the application to adapt progressive display to a wide range of data transmission rates.

The basic control flow for buffered-image decoding is

```
jpeg_create_decompress()
set data source
jpeg_read_header()
set overall decompression parameters
cinfo.buffered_image = TRUE; /* select buffered-image mode */
jpeg_start_decompress()
for (each output pass) {
 adjust output decompression parameters if required
 jpeg_start_output() /* start a new output pass */
 for (all scanlines in image) {
 jpeg_read_scanlines()
 display scanlines
 }
 jpeg_finish_output() /* terminate output pass */
}
jpeg_finish_decompress()
jpeg_destroy_decompress()
```

This differs from ordinary unbuffered decoding in that there is an additional level of looping. The application can choose how many output passes to make and how to display each pass.

The simplest approach to displaying progressive images is to do one display pass for each scan appearing in the input file. In this case the outer loop condition is typically

```
while (! jpeg_input_complete(&cinfo))
and the start-output call should read
jpeg_start_output(&cinfo, cinfo.input_scan_number);
```

The second parameter to `jpeg_start_output()` indicates which scan of the input file is to be displayed; the scans are numbered starting at 1 for this purpose. (You can use a loop counter starting at 1 if you like, but using the library's input scan counter is easier.) The library automatically reads data as necessary to complete each requested scan, and `jpeg_finish_output()` advances to the next scan or end-of-image marker (hence `input_scan_number` will be incremented by the time control arrives back at `jpeg_start_output()`). With this technique, data is read from the input file only as needed, and input and output processing run in lockstep.

After reading the final scan and reaching the end of the input file, the buffered image remains available; it can be read additional times by

repeating the `jpeg_start_output()/jpeg_read_scanlines()/jpeg_finish_output()` sequence. For example, a useful technique is to use fast one-pass color quantization for display passes made while the image is arriving, followed by a final display pass using two-pass quantization for highest quality. This is done by changing the library parameters before the final output pass. Changing parameters between passes is discussed in detail below.

In general the last scan of a progressive file cannot be recognized as such until after it is read, so a post-input display pass is the best approach if you want special processing in the final pass.

When done with the image, be sure to call `jpeg_finish_decompress()` to release the buffered image (or just use `jpeg_destroy_decompress()`).

If input data arrives faster than it can be displayed, the application can cause the library to decode input data in advance of what's needed to produce output. This is done by calling the routine `jpeg_consume_input()`.

The return value is one of the following:

`JPEG_REACHED_SOS`: reached an SOS marker (the start of a new scan)

`JPEG_REACHED_EOI`: reached the EOI marker (end of image)

`JPEG_ROW_COMPLETED`: completed reading one MCU row of compressed data

`JPEG_SCAN_COMPLETED`: completed reading last MCU row of current scan

`JPEG_SUSPENDED`: suspended before completing any of the above

(`JPEG_SUSPENDED` can occur only if a suspending data source is used.) This

routine can be called at any time after initializing the JPEG object. It

reads some additional data and returns when one of the indicated significant

events occurs. (If called after the EOI marker is reached, it will

immediately return `JPEG_REACHED_EOI` without attempting to read more data.)

The library's output processing will automatically call `jpeg_consume_input()` whenever the output processing overtakes the input; thus, simple lockstep display requires no direct calls to `jpeg_consume_input()`. But by adding calls to `jpeg_consume_input()`, you can absorb data in advance of what is being displayed. This has two benefits:

- \* You can limit buildup of unprocessed data in your input buffer.
- \* You can eliminate extra display passes by paying attention to the state of the library's input processing.

The first of these benefits only requires interspersing calls to `jpeg_consume_input()` with your display operations and any other processing you may be doing. To avoid wasting cycles due to backtracking, it's best to call `jpeg_consume_input()` only after a hundred or so new bytes have arrived. This is discussed further under "I/O suspension", above. (Note: the JPEG library currently is not thread-safe. You must not call `jpeg_consume_input()` from one thread of control if a different library routine is working on the same JPEG object in another thread.)

When input arrives fast enough that more than one new scan is available

before you start a new output pass, you may as well skip the output pass corresponding to the completed scan. This occurs for free if you pass `cinfo.input_scan_number` as the target scan number to `jpeg_start_output()`. The `input_scan_number` field is simply the index of the scan currently being consumed by the input processor. You can ensure that this is up-to-date by emptying the input buffer just before calling `jpeg_start_output()`: call `jpeg_consume_input()` repeatedly until it returns `JPEG_SUSPENDED` or `JPEG_REACHED_EOI`.

The target scan number passed to `jpeg_start_output()` is saved in the `cinfo.output_scan_number` field. The library's output processing calls `jpeg_consume_input()` whenever the current input scan number and row within that scan is less than or equal to the current output scan number and row. Thus, input processing can "get ahead" of the output processing but is not allowed to "fall behind". You can achieve several different effects by manipulating this interlock rule. For example, if you pass a target scan number greater than the current input scan number, the output processor will wait until that scan starts to arrive before producing any output. (To avoid an infinite loop, the target scan number is automatically reset to the last scan number when the end of image is reached. Thus, if you specify a large target scan number, the library will just absorb the entire input file and then perform an output pass. This is effectively the same as what `jpeg_start_decompress()` does when you don't select buffered-image mode.) When you pass a target scan number equal to the current input scan number, the image is displayed no faster than the current input scan arrives. The final possibility is to pass a target scan number less than the current input scan number; this disables the input/output interlock and causes the output processor to simply display whatever it finds in the image buffer, without waiting for input. (However, the library will not accept a target scan number less than one, so you can't avoid waiting for the first scan.)

When data is arriving faster than the output display processing can advance through the image, `jpeg_consume_input()` will store data into the buffered image beyond the point at which the output processing is reading data out again. If the input arrives fast enough, it may "wrap around" the buffer to the point where the input is more than one whole scan ahead of the output. If the output processing simply proceeds through its display pass without paying attention to the input, the effect seen on-screen is that the lower part of the image is one or more scans better in quality than the upper part. Then, when the next output scan is started, you have a choice of what target scan number to use. The recommended choice is to use the current input scan number at that time, which implies that you've skipped the output scans corresponding to the input scans that were completed while you processed the previous output scan. In this way, the decoder automatically adapts its speed to the arriving data, by skipping output scans as necessary to keep up with the arriving data.

When using this strategy, you'll want to be sure that you perform a final

output pass after receiving all the data; otherwise your last display may not be full quality across the whole screen. So the right outer loop logic is something like this:

```
do {
 absorb any waiting input by calling jpeg_consume_input()
 final_pass = jpeg_input_complete(&cinfo);
 adjust output decompression parameters if required
 jpeg_start_output(&cinfo, cinfo.input_scan_number);
 ...
 jpeg_finish_output()
} while (! final_pass);
```

rather than quitting as soon as `jpeg_input_complete()` returns TRUE. This arrangement makes it simple to use higher-quality decoding parameters for the final pass. But if you don't want to use special parameters for the final pass, the right loop logic is like this:

```
for (;;) {
 absorb any waiting input by calling jpeg_consume_input()
 jpeg_start_output(&cinfo, cinfo.input_scan_number);
 ...
 jpeg_finish_output()
 if (jpeg_input_complete(&cinfo) &&
 cinfo.input_scan_number == cinfo.output_scan_number)
 break;
}
```

In this case you don't need to know in advance whether an output pass is to be the last one, so it's not necessary to have reached EOF before starting the final output pass; rather, what you want to test is whether the output pass was performed in sync with the final input scan. This form of the loop will avoid an extra output pass whenever the decoder is able (or nearly able) to keep up with the incoming data.

When the data transmission speed is high, you might begin a display pass, then find that much or all of the file has arrived before you can complete the pass. (You can detect this by noting the `JPEG_REACHED_EOI` return code from `jpeg_consume_input()`, or equivalently by testing `jpeg_input_complete()`.) In this situation you may wish to abort the current display pass and start a new one using the newly arrived information. To do so, just call `jpeg_finish_output()` and then start a new pass with `jpeg_start_output()`.

A variant strategy is to abort and restart display if more than one complete scan arrives during an output pass; this can be detected by noting `JPEG_REACHED_SOS` returns and/or examining `cinfo.input_scan_number`. This idea should be employed with caution, however, since the display process might never get to the bottom of the image before being aborted, resulting in the lower part of the screen being several passes worse than the upper. In most cases it's probably best to abort an output pass only if the whole file has arrived and you want to begin the final output pass immediately.

When receiving data across a communication link, we recommend always using the current input scan number for the output target scan number; if a higher-quality final pass is to be done, it should be started (aborting any incomplete output pass) as soon as the end of file is received. However, many other strategies are possible. For example, the application can examine the parameters of the current input scan and decide whether to display it or not. If the scan contains only chroma data, one might choose not to use it as the target scan, expecting that the scan will be small and will arrive quickly. To skip to the next scan, call `jpeg_consume_input()` until it returns `JPEG_REACHED_SOS` or `JPEG_REACHED_EOI`. Or just use the next higher number as the target scan for `jpeg_start_output()`; but that method doesn't let you inspect the next scan's parameters before deciding to display it.

In buffered-image mode, `jpeg_start_decompress()` never performs input and thus never suspends. An application that uses input suspension with buffered-image mode must be prepared for suspension returns from these routines:

- \* `jpeg_start_output()` performs input only if you request 2-pass quantization and the target scan isn't fully read yet. (This is discussed below.)
- \* `jpeg_read_scanlines()`, as always, returns the number of scanlines that it was able to produce before suspending.
- \* `jpeg_finish_output()` will read any markers following the target scan, up to the end of the file or the SOS marker that begins another scan. (But it reads no input if `jpeg_consume_input()` has already reached the end of the file or a SOS marker beyond the target output scan.)
- \* `jpeg_finish_decompress()` will read until the end of file, and thus can suspend if the end hasn't already been reached (as can be tested by calling `jpeg_input_complete()`).

`jpeg_start_output()`, `jpeg_finish_output()`, and `jpeg_finish_decompress()` all return `TRUE` if they completed their tasks, `FALSE` if they had to suspend. In the event of a `FALSE` return, the application must load more input data and repeat the call. Applications that use non-suspending data sources need not check the return values of these three routines.

It is possible to change decoding parameters between output passes in the buffered-image mode. The decoder library currently supports only very limited changes of parameters. **ONLY THE FOLLOWING** parameter changes are allowed after `jpeg_start_decompress()` is called:

- \* `dct_method` can be changed before each call to `jpeg_start_output()`. For example, one could use a fast DCT method for early scans, changing to a higher quality method for the final scan.
- \* `dither_mode` can be changed before each call to `jpeg_start_output()`; of course this has no impact if not using color quantization. Typically one would use ordered dither for initial passes, then switch to Floyd-Steinberg dither for the final pass. Caution: changing dither mode can cause more memory to be allocated by the library. Although the amount

of memory involved is not large (a scanline or so), it may cause the initial `max_memory_to_use` specification to be exceeded, which in the worst case would result in an out-of-memory failure.

\* `do_block_smoothing` can be changed before each call to `jpeg_start_output()`.

This setting is relevant only when decoding a progressive JPEG image.

During the first DC-only scan, block smoothing provides a very "fuzzy" look instead of the very "blocky" look seen without it; which is better seems a matter of personal taste. But block smoothing is nearly always a win during later stages, especially when decoding a successive-approximation image: smoothing helps to hide the slight blockiness that otherwise shows up on smooth gradients until the lowest coefficient bits are sent.

\* Color quantization mode can be changed under the rules described below.

You \*cannot\* change between full-color and quantized output (because that would alter the required I/O buffer sizes), but you can change which quantization method is used.

When generating color-quantized output, changing quantization method is a very useful way of switching between high-speed and high-quality display.

The library allows you to change among its three quantization methods:

1. Single-pass quantization to a fixed color cube.

Selected by `cinfo.two_pass_quantize = FALSE` and `cinfo.colormap = NULL`.

2. Single-pass quantization to an application-supplied colormap.

Selected by setting `cinfo.colormap` to point to the colormap (the value of `two_pass_quantize` is ignored); also set `cinfo.actual_number_of_colors`.

3. Two-pass quantization to a colormap chosen specifically for the image.

Selected by `cinfo.two_pass_quantize = TRUE` and `cinfo.colormap = NULL`. (This is the default setting selected by `jpeg_read_header`, but it is probably NOT what you want for the first pass of progressive display!)

These methods offer successively better quality and lesser speed. However, only the first method is available for quantizing in non-RGB color spaces.

**IMPORTANT:** because the different quantizer methods have very different working-storage requirements, the library requires you to indicate which one(s) you intend to use before you call `jpeg_start_decompress()`. (If we did not require this, the `max_memory_to_use` setting would be a complete fiction.)

You do this by setting one or more of these three `cinfo` fields to `TRUE`:

`enable_1pass_quant` Fixed color cube colormap

`enable_external_quant` Externally-supplied colormap

`enable_2pass_quant` Two-pass custom colormap

All three are initialized `FALSE` by `jpeg_read_header()`. But

`jpeg_start_decompress()` automatically sets `TRUE` the one selected by the current `two_pass_quantize` and `colormap` settings, so you only need to set the enable flags for any other quantization methods you plan to change to later.

After setting the enable flags correctly at `jpeg_start_decompress()` time, you can change to any enabled quantization method by setting `two_pass_quantize` and `colormap` properly just before calling `jpeg_start_output()`. The following special rules apply:



1. You must explicitly set `cinfo.colormap` to `NULL` when switching to 1-pass or 2-pass mode from a different mode, or when you want the 2-pass quantizer to be re-run to generate a new colormap.
2. To switch to an external colormap, or to change to a different external colormap than was used on the prior pass, you must call `jpeg_new_colormap()` after setting `cinfo.colormap`.

NOTE: if you want to use the same colormap as was used in the prior pass, you should not do either of these things. This will save some nontrivial switchover costs.

(These requirements exist because `cinfo.colormap` will always be non-`NULL` after completing a prior output pass, since both the 1-pass and 2-pass quantizers set it to point to their output colormaps. Thus you have to do one of these two things to notify the library that something has changed. Yup, it's a bit klugy, but it's necessary to do it this way for backwards compatibility.)

Note that in buffered-image mode, the library generates any requested colormap during `jpeg_start_output()`, not during `jpeg_start_decompress()`.

When using two-pass quantization, `jpeg_start_output()` makes a pass over the buffered image to determine the optimum color map; it therefore may take a significant amount of time, whereas ordinarily it does little work. The progress monitor hook is called during this pass, if defined. It is also important to realize that if the specified target scan number is greater than or equal to the current input scan number, `jpeg_start_output()` will attempt to consume input as it makes this pass. If you use a suspending data source, you need to check for a `FALSE` return from `jpeg_start_output()` under these conditions. The combination of 2-pass quantization and a not-yet-fully-read target scan is the only case in which `jpeg_start_output()` will consume input.

Application authors who support buffered-image mode may be tempted to use it for all JPEG images, even single-scan ones. This will work, but it is inefficient: there is no need to create an image-sized coefficient buffer for single-scan images. Requesting buffered-image mode for such an image wastes memory. Worse, it can cost time on large images, since the buffered data has to be swapped out or written to a temporary file. If you are concerned about maximum performance on baseline JPEG files, you should use buffered-image mode only when the incoming file actually has multiple scans. This can be tested by calling `jpeg_has_multiple_scans()`, which will return a correct result at any time after `jpeg_read_header()` completes.

It is also worth noting that when you use `jpeg_consume_input()` to let input processing get ahead of output processing, the resulting pattern of access to the coefficient buffer is quite nonsequential. It's best to use the memory manager `jmemnobs.c` if you can (ie, if you have enough real or virtual main memory). If not, at least make sure that `max_memory_to_use` is set as high as possible. If the JPEG memory manager has to use a temporary file, you will

probably see a lot of disk traffic and poor performance. (This could be improved with additional work on the memory manager, but we haven't gotten around to it yet.)

In some applications it may be convenient to use `jpeg_consume_input()` for all input processing, including reading the initial markers; that is, you may wish to call `jpeg_consume_input()` instead of `jpeg_read_header()` during startup. This works, but note that you must check for `JPEG_REACHED_SOS` and `JPEG_REACHED_EOI` return codes as the equivalent of `jpeg_read_header()`'s codes. Once the first SOS marker has been reached, you must call `jpeg_start_decompress()` before `jpeg_consume_input()` will consume more input; it'll just keep returning `JPEG_REACHED_SOS` until you do. If you read a tables-only file this way, `jpeg_consume_input()` will return `JPEG_REACHED_EOI` without ever returning `JPEG_REACHED_SOS`; be sure to check for this case. If this happens, the decompressor will not read any more input until you call `jpeg_abort()` to reset it. It is OK to call `jpeg_consume_input()` even when not using buffered-image mode, but in that case it's basically a no-op after the initial markers have been read: it will just return `JPEG_SUSPENDED`.

#### Abbreviated datastreams and multiple images

-----

A JPEG compression or decompression object can be reused to process multiple images. This saves a small amount of time per image by eliminating the "create" and "destroy" operations, but that isn't the real purpose of the feature. Rather, reuse of an object provides support for abbreviated JPEG datastreams. Object reuse can also simplify processing a series of images in a single input or output file. This section explains these features.

A JPEG file normally contains several hundred bytes worth of quantization and Huffman tables. In a situation where many images will be stored or transmitted with identical tables, this may represent an annoying overhead. The JPEG standard therefore permits tables to be omitted. The standard defines three classes of JPEG datastreams:

- \* "Interchange" datastreams contain an image and all tables needed to decode the image. These are the usual kind of JPEG file.
- \* "Abbreviated image" datastreams contain an image, but are missing some or all of the tables needed to decode that image.
- \* "Abbreviated table specification" (henceforth "tables-only") datastreams contain only table specifications.

To decode an abbreviated image, it is necessary to load the missing table(s) into the decoder beforehand. This can be accomplished by reading a separate tables-only file. A variant scheme uses a series of images in which the first image is an interchange (complete) datastream, while subsequent ones are abbreviated and rely on the tables loaded by the first image. It is assumed that once the decoder has read a table, it will remember that table until a new definition for the same table number is encountered.

It is the application designer's responsibility to figure out how to associate the correct tables with an abbreviated image. While abbreviated datastreams can be useful in a closed environment, their use is strongly discouraged in any situation where data exchange with other applications might be needed. Caveat designer.

The JPEG library provides support for reading and writing any combination of tables-only datastreams and abbreviated images. In both compression and decompression objects, a quantization or Huffman table will be retained for the lifetime of the object, unless it is overwritten by a new table definition.

To create abbreviated image datastreams, it is only necessary to tell the compressor not to emit some or all of the tables it is using. Each quantization and Huffman table struct contains a boolean field "sent\_table", which normally is initialized to FALSE. For each table used by the image, the header-writing process emits the table and sets sent\_table = TRUE unless it is already TRUE. (In normal usage, this prevents outputting the same table definition multiple times, as would otherwise occur because the chroma components typically share tables.) Thus, setting this field to TRUE before calling jpeg\_start\_compress() will prevent the table from being written at all.

If you want to create a "pure" abbreviated image file containing no tables, just call "jpeg\_suppress\_tables(&cinfo, TRUE)" after constructing all the tables. If you want to emit some but not all tables, you'll need to set the individual sent\_table fields directly.

To create an abbreviated image, you must also call jpeg\_start\_compress() with a second parameter of FALSE, not TRUE. Otherwise jpeg\_start\_compress() will force all the sent\_table fields to FALSE. (This is a safety feature to prevent abbreviated images from being created accidentally.)

To create a tables-only file, perform the same parameter setup that you normally would, but instead of calling jpeg\_start\_compress() and so on, call jpeg\_write\_tables(&cinfo). This will write an abbreviated datastream containing only SOI, DQT and/or DHT markers, and EOI. All the quantization and Huffman tables that are currently defined in the compression object will be emitted unless their sent\_tables flag is already TRUE, and then all the sent\_tables flags will be set TRUE.

A sure-fire way to create matching tables-only and abbreviated image files is to proceed as follows:

```
create JPEG compression object
set JPEG parameters
set destination to tables-only file
```

```

jpeg_write_tables(&cinfo);
set destination to image file
jpeg_start_compress(&cinfo, FALSE);
write data...
jpeg_finish_compress(&cinfo);

```

Since the JPEG parameters are not altered between writing the table file and the abbreviated image file, the same tables are sure to be used. Of course, you can repeat the `jpeg_start_compress()` ... `jpeg_finish_compress()` sequence many times to produce many abbreviated image files matching the table file.

You cannot suppress output of the computed Huffman tables when Huffman optimization is selected. (If you could, there'd be no way to decode the image...) Generally, you don't want to set `optimize_coding = TRUE` when you are trying to produce abbreviated files.

In some cases you might want to compress an image using tables which are not stored in the application, but are defined in an interchange or tables-only file readable by the application. This can be done by setting up a JPEG decompression object to read the specification file, then copying the tables into your compression object. See `jpeg_copy_critical_parameters()` for an example of copying quantization tables.

To read abbreviated image files, you simply need to load the proper tables into the decompression object before trying to read the abbreviated image. If the proper tables are stored in the application program, you can just allocate the table structs and fill in their contents directly. For example, to load a fixed quantization table into table slot "n":

```

if (cinfo.quant_tbl_ptrs[n] == NULL)
 cinfo.quant_tbl_ptrs[n] = jpeg_alloc_quant_table((j_common_ptr) &cinfo);
quant_ptr = cinfo.quant_tbl_ptrs[n]; /* quant_ptr is JQUANT_TBL* */
for (i = 0; i < 64; i++) {
 /* Qtable[] is desired quantization table, in natural array order */
 quant_ptr->quantval[i] = Qtable[i];
}

```

Code to load a fixed Huffman table is typically (for AC table "n"):

```

if (cinfo.ac_huff_tbl_ptrs[n] == NULL)
 cinfo.ac_huff_tbl_ptrs[n] = jpeg_alloc_huff_table((j_common_ptr) &cinfo);
huff_ptr = cinfo.ac_huff_tbl_ptrs[n]; /* huff_ptr is JHUFF_TBL* */
for (i = 1; i <= 16; i++) {
 /* counts[i] is number of Huffman codes of length i bits, i=1..16 */
 huff_ptr->bits[i] = counts[i];
}
for (i = 0; i < 256; i++) {

```

```

/* symbols[] is the list of Huffman symbols, in code-length order */
huff_ptr->huffval[i] = symbols[i];
}

```

(Note that trying to set `cinfo.quant_tbl_ptrs[n]` to point directly at a constant `JQUANT_TBL` object is not safe. If the incoming file happened to contain a quantization table definition, your master table would get overwritten! Instead allocate a working table copy and copy the master table into it, as illustrated above. Ditto for Huffman tables, of course.)

You might want to read the tables from a tables-only file, rather than hard-wiring them into your application. The `jpeg_read_header()` call is sufficient to read a tables-only file. You must pass a second parameter of `FALSE` to indicate that you do not require an image to be present. Thus, the typical scenario is

```

create JPEG decompression object
set source to tables-only file
jpeg_read_header(&cinfo, FALSE);
set source to abbreviated image file
jpeg_read_header(&cinfo, TRUE);
set decompression parameters
jpeg_start_decompress(&cinfo);
read data...
jpeg_finish_decompress(&cinfo);

```

In some cases, you may want to read a file without knowing whether it contains an image or just tables. In that case, pass `FALSE` and check the return value from `jpeg_read_header()`: it will be `JPEG_HEADER_OK` if an image was found, `JPEG_HEADER_TABLES_ONLY` if only tables were found. (A third return value, `JPEG_SUSPENDED`, is possible when using a suspending data source manager.) Note that `jpeg_read_header()` will not complain if you read an abbreviated image for which you haven't loaded the missing tables; the missing-table check occurs later, in `jpeg_start_decompress()`.

It is possible to read a series of images from a single source file by repeating the `jpeg_read_header() ... jpeg_finish_decompress()` sequence, without releasing/recreating the JPEG object or the data source module. (If you did reinitialize, any partial bufferload left in the data source buffer at the end of one image would be discarded, causing you to lose the start of the next image.) When you use this method, stored tables are automatically carried forward, so some of the images can be abbreviated images that depend on tables from earlier images.

If you intend to write a series of images into a single destination file, you might want to make a specialized data destination module that doesn't flush the output buffer at `term_destination()` time. This would speed things

up by some trifling amount. Of course, you'd need to remember to flush the buffer after the last image. You can make the later images be abbreviated ones by passing FALSE to jpeg\_start\_compress().

## Special markers

-----

Some applications may need to insert or extract special data in the JPEG datastream. The JPEG standard provides marker types "COM" (comment) and "APP0" through "APP15" (application) to hold application-specific data. Unfortunately, the use of these markers is not specified by the standard. COM markers are fairly widely used to hold user-supplied text. The JFIF file format spec uses APP0 markers with specified initial strings to hold certain data. Adobe applications use APP14 markers beginning with the string "Adobe" for miscellaneous data. Other APPn markers are rarely seen, but might contain almost anything.

If you wish to store user-supplied text, we recommend you use COM markers and place readable 7-bit ASCII text in them. Newline conventions are not standardized --- expect to find LF (Unix style), CR/LF (DOS style), or CR (Mac style). A robust COM reader should be able to cope with random binary garbage, including nulls, since some applications generate COM markers containing non-ASCII junk. (But yours should not be one of them.)

For program-supplied data, use an APPn marker, and be sure to begin it with an identifying string so that you can tell whether the marker is actually yours. It's probably best to avoid using APP0 or APP14 for any private markers. (NOTE: the upcoming SPIFF standard will use APP8 markers; we recommend you not use APP8 markers for any private purposes, either.)

Keep in mind that at most 65533 bytes can be put into one marker, but you can have as many markers as you like.

By default, the IJG compression library will write a JFIF APP0 marker if the selected JPEG colorspace is grayscale or YCbCr, or an Adobe APP14 marker if the selected colorspace is RGB, CMYK, or YCCK. You can disable this, but we don't recommend it. The decompression library will recognize JFIF and Adobe markers and will set the JPEG colorspace properly when one is found.

You can write special markers immediately following the datastream header by calling jpeg\_write\_marker() after jpeg\_start\_compress() and before the first call to jpeg\_write\_scanlines(). When you do this, the markers appear after the SOI and the JFIF APP0 and Adobe APP14 markers (if written), but before all else. Specify the marker type parameter as "JPEG\_COM" for COM or "JPEG\_APP0 + n" for APPn. (Actually, jpeg\_write\_marker will let you write any marker type, but we don't recommend writing any other kinds of marker.)

For example, to write a user comment string pointed to by `comment_text`:

```
jpeg_write_marker(cinfo, JPEG_COM, comment_text, strlen(comment_text));
```

If it's not convenient to store all the marker data in memory at once, you can instead call `jpeg_write_m_header()` followed by multiple calls to `jpeg_write_m_byte()`. If you do it this way, it's your responsibility to call `jpeg_write_m_byte()` exactly the number of times given in the length parameter to `jpeg_write_m_header()`. (This method lets you empty the output buffer partway through a marker, which might be important when using a suspending data destination module. In any case, if you are using a suspending destination, you should flush its buffer after inserting any special markers. See "I/O suspension".)

Or, if you prefer to synthesize the marker byte sequence yourself, you can just cram it straight into the data destination module.

If you are writing JFIF 1.02 extension markers (thumbnail images), don't forget to set `cinfo.JFIF_minor_version = 2` so that the encoder will write the correct JFIF version number in the JFIF header marker. The library's default is to write version 1.01, but that's wrong if you insert any 1.02 extension markers. (We could probably get away with just defaulting to 1.02, but there used to be broken decoders that would complain about unknown minor version numbers. To reduce compatibility risks it's safest not to write 1.02 unless you are actually using 1.02 extensions.)

When reading, two methods of handling special markers are available:

1. You can ask the library to save the contents of COM and/or APPn markers into memory, and then examine them at your leisure afterwards.
2. You can supply your own routine to process COM and/or APPn markers on-the-fly as they are read.

The first method is simpler to use, especially if you are using a suspending data source; writing a marker processor that copes with input suspension is not easy (consider what happens if the marker is longer than your available input buffer). However, the second method conserves memory since the marker data need not be kept around after it's been processed.

For either method, you'd normally set up marker handling after creating a decompression object and before calling `jpeg_read_header()`, because the markers of interest will typically be near the head of the file and so will be scanned by `jpeg_read_header`. Once you've established a marker handling method, it will be used for the life of that decompression object (potentially many datastreams), unless you change it. Marker handling is determined separately for COM markers and for each APPn marker code.

To save the contents of special markers in memory, call

```
jpeg_save_markers(cinfo, marker_code, length_limit)
```

where `marker_code` is the marker type to save, `JPEG_COM` or `JPEG_APP0+n`. (To arrange to save all the special marker types, you need to call this routine 17 times, for COM and APP0-APP15.) If the incoming marker is longer than `length_limit` data bytes, only `length_limit` bytes will be saved; this parameter allows you to avoid chewing up memory when you only need to see the first few bytes of a potentially large marker. If you want to save all the data, set `length_limit` to `0xFFFF`; that is enough since marker lengths are only 16 bits. As a special case, setting `length_limit` to 0 prevents that marker type from being saved at all. (That is the default behavior, in fact.)

After `jpeg_read_header()` completes, you can examine the special markers by following the `cinfo->marker_list` pointer chain. All the special markers in the file appear in this list, in order of their occurrence in the file (but omitting any markers of types you didn't ask for). Both the original data length and the saved data length are recorded for each list entry; the latter will not exceed `length_limit` for the particular marker type. Note that these lengths exclude the marker length word, whereas the stored representation within the JPEG file includes it. (Hence the maximum data length is really only 65533.)

It is possible that additional special markers appear in the file beyond the SOS marker at which `jpeg_read_header` stops; if so, the marker list will be extended during reading of the rest of the file. This is not expected to be common, however. If you are short on memory you may want to reset the length limit to zero for all marker types after finishing `jpeg_read_header`, to ensure that the `max_memory_to_use` setting cannot be exceeded due to addition of later markers.

The marker list remains stored until you call `jpeg_finish_decompress` or `jpeg_abort`, at which point the memory is freed and the list is set to empty. (`jpeg_destroy` also releases the storage, of course.)

Note that the library is internally interested in APP0 and APP14 markers; if you try to set a small nonzero length limit on these types, the library will silently force the length up to the minimum it wants. (But you can set a zero length limit to prevent them from being saved at all.) Also, in a 16-bit environment, the maximum length limit may be constrained to less than 65533 by `malloc()` limitations. It is therefore best not to assume that the effective length limit is exactly what you set it to be.

If you want to supply your own marker-reading routine, you do it by calling `jpeg_set_marker_processor()`. A marker processor routine must have the signature

```
boolean jpeg_marker_parser_method (j_decompress_ptr cinfo)
```

Although the marker code is not explicitly passed, the routine can find it in `cinfo->unread_marker`. At the time of call, the marker proper has been read from the data source module. The processor routine is responsible for



reading the marker length word and the remaining parameter bytes, if any. Return TRUE to indicate success. (FALSE should be returned only if you are using a suspending data source and it tells you to suspend. See the standard marker processors in `jdmarker.c` for appropriate coding methods if you need to use a suspending data source.)

If you override the default APP0 or APP14 processors, it is up to you to recognize JFIF and Adobe markers if you want colorspace recognition to occur properly. We recommend copying and extending the default processors if you want to do that. (A better idea is to save these marker types for later examination by calling `jpeg_save_markers()`; that method doesn't interfere with the library's own processing of these markers.)

`jpeg_set_marker_processor()` and `jpeg_save_markers()` are mutually exclusive --- if you call one it overrides any previous call to the other, for the particular marker type specified.

A simple example of an external COM processor can be found in `djpeg.c`. Also, see `jpegtran.c` for an example of using `jpeg_save_markers`.

Raw (downsampled) image data

-----

Some applications need to supply already-downsampled image data to the JPEG compressor, or to receive raw downsampled data from the decompressor. The library supports this requirement by allowing the application to write or read raw data, bypassing the normal preprocessing or postprocessing steps. The interface is different from the standard one and is somewhat harder to use. If your interest is merely in bypassing color conversion, we recommend that you use the standard interface and simply set `jpeg_color_space = in_color_space` (or `jpeg_color_space = out_color_space` for decompression). The mechanism described in this section is necessary only to supply or receive downsampled image data, in which not all components have the same dimensions.

To compress raw data, you must supply the data in the colorspace to be used in the JPEG file (please read the earlier section on Special color spaces) and downsampled to the sampling factors specified in the JPEG parameters. You must supply the data in the format used internally by the JPEG library, namely a JSAMPIMAGE array. This is an array of pointers to two-dimensional arrays, each of type JSAMPARRAY. Each 2-D array holds the values for one color component. This structure is necessary since the components are of different sizes. If the image dimensions are not a multiple of the MCU size, you must also pad the data correctly (usually, this is done by replicating the last column and/or row). The data must be padded to a multiple of a DCT block in each component: that is, each downsampled row must contain a

multiple of DCT\_h\_scaled\_size valid samples, and there must be a multiple of DCT\_v\_scaled\_size sample rows for each component. (For applications such as conversion of digital TV images, the standard image size is usually a multiple of the DCT block size, so that no padding need actually be done.)

The procedure for compression of raw data is basically the same as normal compression, except that you call jpeg\_write\_raw\_data() in place of jpeg\_write\_scanlines(). Before calling jpeg\_start\_compress(), you must do the following:

- \* Set cinfo->raw\_data\_in to TRUE. (It is set FALSE by jpeg\_set\_defaults().) This notifies the library that you will be supplying raw data.
- \* Ensure jpeg\_color\_space is correct --- an explicit jpeg\_set\_colorspace() call is a good idea. Note that since color conversion is bypassed, in\_color\_space is ignored, except that jpeg\_set\_defaults() uses it to choose the default jpeg\_color\_space setting.
- \* Ensure the sampling factors, cinfo->comp\_info[i].h\_samp\_factor and cinfo->comp\_info[i].v\_samp\_factor, are correct. Since these indicate the dimensions of the data you are supplying, it's wise to set them explicitly, rather than assuming the library's defaults are what you want.

To pass raw data to the library, call jpeg\_write\_raw\_data() in place of jpeg\_write\_scanlines(). The two routines work similarly except that jpeg\_write\_raw\_data takes a JSAMPIMAGE data array rather than JSAMPARRAY. The scanlines count passed to and returned from jpeg\_write\_raw\_data is measured in terms of the component with the largest v\_samp\_factor.

jpeg\_write\_raw\_data() processes one MCU row per call, which is to say v\_samp\_factor\*min\_DCT\_v\_scaled\_size sample rows of each component. The passed num\_lines value must be at least max\_v\_samp\_factor\*min\_DCT\_v\_scaled\_size, and the return value will be exactly that amount (or possibly some multiple of that amount, in future library versions). This is true even on the last call at the bottom of the image; don't forget to pad your data as necessary.

The required dimensions of the supplied data can be computed for each component as

```
cinfo->comp_info[i].width_in_blocks *
cinfo->comp_info[i].DCT_h_scaled_size samples per row
cinfo->comp_info[i].height_in_blocks *
cinfo->comp_info[i].DCT_v_scaled_size rows in image
```

after jpeg\_start\_compress() has initialized those fields. If the valid data is smaller than this, it must be padded appropriately. For some sampling factors and image sizes, additional dummy DCT blocks are inserted to make the image a multiple of the MCU dimensions. The library creates such dummy blocks itself; it does not read them from your supplied data. Therefore you need never pad by more than DCT\_scaled\_size samples.

An example may help here. Assume 2h2v downsampling of YCbCr data, that is

```
cinfo->comp_info[0].h_samp_factor = 2 for Y
cinfo->comp_info[0].v_samp_factor = 2
```

```
cinfo->comp_info[1].h_samp_factor = 1 for Cb
cinfo->comp_info[1].v_samp_factor = 1
cinfo->comp_info[2].h_samp_factor = 1 for Cr
cinfo->comp_info[2].v_samp_factor = 1
```

and suppose that the nominal image dimensions (`cinfo->image_width` and `cinfo->image_height`) are 101x101 pixels. Then `jpeg_start_compress()` will compute `downsampled_width = 101` and `width_in_blocks = 13` for Y, `downsampled_width = 51` and `width_in_blocks = 7` for Cb and Cr (and the same for the height fields). You must pad the Y data to at least  $13*8 = 104$  columns and rows, the Cb/Cr data to at least  $7*8 = 56$  columns and rows. The MCU height is `max_v_samp_factor = 2` DCT rows so you must pass at least 16 scanlines on each call to `jpeg_write_raw_data()`, which is to say 16 actual sample rows of Y and 8 each of Cb and Cr. A total of 7 MCU rows are needed, so you must pass a total of  $7*16 = 112$  "scanlines". The last DCT block row of Y data is dummy, so it doesn't matter what you pass for it in the data arrays, but the scanlines count must total up to 112 so that all of the Cb and Cr data gets passed.

Output suspension is supported with raw-data compression: if the data destination module suspends, `jpeg_write_raw_data()` will return 0. In this case the same data rows must be passed again on the next call.

Decompression with raw data output implies bypassing all postprocessing: you cannot ask for color quantization, for instance. More seriously, you must deal with the color space and sampling factors present in the incoming file. If your application only handles, say, 2h1v YCbCr data, you must check for and fail on other color spaces or other sampling factors. The library will not convert to a different color space for you.

To obtain raw data output, set `cinfo->raw_data_out = TRUE` before `jpeg_start_decompress()` (it is set FALSE by `jpeg_read_header()`). Be sure to verify that the color space and sampling factors are ones you can handle. Then call `jpeg_read_raw_data()` in place of `jpeg_read_scanlines()`. The decompression process is otherwise the same as usual.

`jpeg_read_raw_data()` returns one MCU row per call, and thus you must pass a buffer of at least `max_v_samp_factor*min_DCT_v_scaled_size` scanlines (scanline counting is the same as for raw-data compression). The buffer you pass must be large enough to hold the actual data plus padding to DCT-block boundaries. As with compression, any entirely dummy DCT blocks are not processed so you need not allocate space for them, but the total scanline count includes them. The above example of computing buffer dimensions for raw-data compression is equally valid for decompression.

Input suspension is supported with raw-data decompression: if the data source module suspends, `jpeg_read_raw_data()` will return 0. You can also use buffered-image mode to read raw data in multiple passes.

Really raw data: DCT coefficients

-----

It is possible to read or write the contents of a JPEG file as raw DCT coefficients. This facility is mainly intended for use in lossless transcoding between different JPEG file formats. Other possible applications include lossless cropping of a JPEG image, lossless reassembly of a multi-strip or multi-tile TIFF/JPEG file into a single JPEG datastream, etc.

To read the contents of a JPEG file as DCT coefficients, open the file and do `jpeg_read_header()` as usual. But instead of calling `jpeg_start_decompress()` and `jpeg_read_scanlines()`, call `jpeg_read_coefficients()`. This will read the entire image into a set of virtual coefficient-block arrays, one array per component. The return value is a pointer to an array of virtual-array descriptors. Each virtual array can be accessed directly using the JPEG memory manager's `access_virt_barray` method (see Memory management, below, and also read `structure.txt`'s discussion of virtual array handling). Or, for simple transcoding to a different JPEG file format, the array list can just be handed directly to `jpeg_write_coefficients()`.

Each block in the block arrays contains quantized coefficient values in normal array order (not JPEG zigzag order). The block arrays contain only DCT blocks containing real data; any entirely-dummy blocks added to fill out interleaved MCUs at the right or bottom edges of the image are discarded during reading and are not stored in the block arrays. (The size of each block array can be determined from the `width_in_blocks` and `height_in_blocks` fields of the component's `comp_info` entry.) This is also the data format expected by `jpeg_write_coefficients()`.

When you are done using the virtual arrays, call `jpeg_finish_decompress()` to release the array storage and return the decompression object to an idle state; or just call `jpeg_destroy()` if you don't need to reuse the object.

If you use a suspending data source, `jpeg_read_coefficients()` will return NULL if it is forced to suspend; a non-NULL return value indicates successful completion. You need not test for a NULL return value when using a non-suspending data source.

It is also possible to call `jpeg_read_coefficients()` to obtain access to the decoder's coefficient arrays during a normal decode cycle in buffered-image mode. This frammish might be useful for progressively displaying an incoming image and then re-encoding it without loss. To do this, decode in buffered-image mode as discussed previously, then call `jpeg_read_coefficients()` after the last `jpeg_finish_output()` call. The arrays will be available for your use until you call `jpeg_finish_decompress()`.

To write the contents of a JPEG file as DCT coefficients, you must provide the DCT coefficients stored in virtual block arrays. You can either pass block arrays read from an input JPEG file by `jpeg_read_coefficients()`, or allocate virtual arrays from the JPEG compression object and fill them yourself. In either case, `jpeg_write_coefficients()` is substituted for `jpeg_start_compress()` and `jpeg_write_scanlines()`. Thus the sequence is

- \* Create compression object
- \* Set all compression parameters as necessary
- \* Request virtual arrays if needed
- \* `jpeg_write_coefficients()`
- \* `jpeg_finish_compress()`
- \* Destroy or re-use compression object

`jpeg_write_coefficients()` is passed a pointer to an array of virtual block array descriptors; the number of arrays is equal to `cinfo.num_components`.

The virtual arrays need only have been requested, not realized, before `jpeg_write_coefficients()` is called. A side-effect of `jpeg_write_coefficients()` is to realize any virtual arrays that have been requested from the compression object's memory manager. Thus, when obtaining the virtual arrays from the compression object, you should fill the arrays after calling `jpeg_write_coefficients()`. The data is actually written out when you call `jpeg_finish_compress()`; `jpeg_write_coefficients()` only writes the file header.

When writing raw DCT coefficients, it is crucial that the JPEG quantization tables and sampling factors match the way the data was encoded, or the resulting file will be invalid. For transcoding from an existing JPEG file, we recommend using `jpeg_copy_critical_parameters()`. This routine initializes all the compression parameters to default values (like `jpeg_set_defaults()`), then copies the critical information from a source decompression object. The decompression object should have just been used to read the entire JPEG input file --- that is, it should be awaiting `jpeg_finish_decompress()`.

`jpeg_write_coefficients()` marks all tables stored in the compression object as needing to be written to the output file (thus, it acts like `jpeg_start_compress(cinfo, TRUE)`). This is for safety's sake, to avoid emitting abbreviated JPEG files by accident. If you really want to emit an abbreviated JPEG file, call `jpeg_suppress_tables()`, or set the tables' individual `sent_table` flags, between calling `jpeg_write_coefficients()` and `jpeg_finish_compress()`.

#### Progress monitoring

-----

Some applications may need to regain control from the JPEG library every so often. The typical use of this feature is to produce a percent-done bar or

other progress display. (For a simple example, see `cjpeg.c` or `djpeg.c`.) Although you do get control back frequently during the data-transferring pass (the `jpeg_read_scanlines` or `jpeg_write_scanlines` loop), any additional passes will occur inside `jpeg_finish_compress` or `jpeg_start_decompress`; those routines may take a long time to execute, and you don't get control back until they are done.

You can define a progress-monitor routine which will be called periodically by the library. No guarantees are made about how often this call will occur, so we don't recommend you use it for mouse tracking or anything like that. At present, a call will occur once per MCU row, scanline, or sample row group, whichever unit is convenient for the current processing mode; so the wider the image, the longer the time between calls. During the data transferring pass, only one call occurs per call of `jpeg_read_scanlines` or `jpeg_write_scanlines`, so don't pass a large number of scanlines at once if you want fine resolution in the progress count. (If you really need to use the callback mechanism for time-critical tasks like mouse tracking, you could insert additional calls inside some of the library's inner loops.)

To establish a progress-monitor callback, create a struct `jpeg_progress_mgr`, fill in its `progress_monitor` field with a pointer to your callback routine, and set `cinfo->progress` to point to the struct. The callback will be called whenever `cinfo->progress` is non-NULL. (This pointer is set to NULL by `jpeg_create_compress` or `jpeg_create_decompress`; the library will not change it thereafter. So if you allocate dynamic storage for the progress struct, make sure it will live as long as the JPEG object does. Allocating from the JPEG memory manager with lifetime `JPOOL_PERMANENT` will work nicely.) You can use the same callback routine for both compression and decompression.

The `jpeg_progress_mgr` struct contains four fields which are set by the library:

```
long pass_counter; /* work units completed in this pass */
long pass_limit; /* total number of work units in this pass */
int completed_passes; /* passes completed so far */
int total_passes; /* total number of passes expected */
```

During any one pass, `pass_counter` increases from 0 up to (not including) `pass_limit`; the step size is usually but not necessarily 1. The `pass_limit` value may change from one pass to another. The expected total number of passes is in `total_passes`, and the number of passes already completed is in `completed_passes`. Thus the fraction of work completed may be estimated as

```
completed_passes + (pass_counter/pass_limit)

total_passes
```

ignoring the fact that the passes may not be equal amounts of work.

When decompressing, `pass_limit` can even change within a pass, because it depends on the number of scans in the JPEG file, which isn't always known in advance. The computed fraction-of-work-done may jump suddenly (if the library discovers it has overestimated the number of scans) or even decrease (in the

opposite case). It is not wise to put great faith in the work estimate.

When using the decompressor's buffered-image mode, the progress monitor work estimate is likely to be completely unhelpful, because the library has no way to know how many output passes will be demanded of it. Currently, the library sets `total_passes` based on the assumption that there will be one more output pass if the input file end hasn't yet been read (`jpeg_input_complete()` isn't TRUE), but no more output passes if the file end has been reached when the output pass is started. This means that `total_passes` will rise as additional output passes are requested. If you have a way of determining the input file size, estimating progress based on the fraction of the file that's been read will probably be more useful than using the library's value.

## Memory management

-----

This section covers some key facts about the JPEG library's built-in memory manager. For more info, please read `structure.txt`'s section about the memory manager, and consult the source code if necessary.

All memory and temporary file allocation within the library is done via the memory manager. If necessary, you can replace the "back end" of the memory manager to control allocation yourself (for example, if you don't want the library to use `malloc()` and `free()` for some reason).

Some data is allocated "permanently" and will not be freed until the JPEG object is destroyed. Most data is allocated "per image" and is freed by `jpeg_finish_compress`, `jpeg_finish_decompress`, or `jpeg_abort`. You can call the memory manager yourself to allocate structures that will automatically be freed at these times. Typical code for this is

```
ptr = (*cinfo->mem->alloc_small) ((j_common_ptr) cinfo, JPOOL_IMAGE, size);
```

Use `JPOOL_PERMANENT` to get storage that lasts as long as the JPEG object.

Use `alloc_large` instead of `alloc_small` for anything bigger than a few Kbytes.

There are also `alloc_sarray` and `alloc_barray` routines that automatically build 2-D sample or block arrays.

The library's minimum space requirements to process an image depend on the image's width, but not on its height, because the library ordinarily works with "strip" buffers that are as wide as the image but just a few rows high. Some operating modes (eg, two-pass color quantization) require full-image buffers. Such buffers are treated as "virtual arrays": only the current strip need be in memory, and the rest can be swapped out to a temporary file.

If you use the simplest memory manager back end (`jmemnobs.c`), then no temporary files are used; virtual arrays are simply `malloc()`'d. Images bigger than memory can be processed only if your system supports virtual memory. The other memory manager back ends support temporary files of various flavors

and thus work in machines without virtual memory. They may also be useful on Unix machines if you need to process images that exceed available swap space.

When using temporary files, the library will make the in-memory buffers for its virtual arrays just big enough to stay within a "maximum memory" setting. Your application can set this limit by setting `cinfo->mem->max_memory_to_use` after creating the JPEG object. (Of course, there is still a minimum size for the buffers, so the max-memory setting is effective only if it is bigger than the minimum space needed.) If you allocate any large structures yourself, you must allocate them before `jpeg_start_compress()` or `jpeg_start_decompress()` in order to have them counted against the max memory limit. Also keep in mind that space allocated with `alloc_small()` is ignored, on the assumption that it's too small to be worth worrying about; so a reasonable safety margin should be left when setting `max_memory_to_use`.

If you use the `jmemname.c` or `jmemdos.c` memory manager back end, it is important to clean up the JPEG object properly to ensure that the temporary files get deleted. (This is especially crucial with `jmemdos.c`, where the "temporary files" may be extended-memory segments; if they are not freed, DOS will require a reboot to recover the memory.) Thus, with these memory managers, it's a good idea to provide a signal handler that will trap any early exit from your program. The handler should call either `jpeg_abort()` or `jpeg_destroy()` for any active JPEG objects. A handler is not needed with `jmemnobs.c`, and shouldn't be necessary with `jmemansi.c` or `jmemmac.c` either, since the C library is supposed to take care of deleting files made with `tmpfile()`.

## Memory usage

-----

Working memory requirements while performing compression or decompression depend on image dimensions, image characteristics (such as colorspace and JPEG process), and operating mode (application-selected options).

As of v6b, the decompressor requires:

1. About 24K in more-or-less-fixed-size data. This varies a bit depending on operating mode and image characteristics (particularly color vs. grayscale), but it doesn't depend on image dimensions.
2. Strip buffers (of size proportional to the image width) for IDCT and upsampling results. The worst case for commonly used sampling factors is about 34 bytes \* width in pixels for a color image. A grayscale image only needs about 8 bytes per pixel column.
3. A full-image DCT coefficient buffer is needed to decode a multi-scan JPEG file (including progressive JPEGs), or whenever you select buffered-image mode. This takes 2 bytes/coefficient. At typical 2x2 sampling, that's 3 bytes per pixel for a color image. Worst case (1x1 sampling) requires 6 bytes/pixel. For grayscale, figure 2 bytes/pixel.



4. To perform 2-pass color quantization, the decompressor also needs a 128K color lookup table and a full-image pixel buffer (3 bytes/pixel). This does not count any memory allocated by the application, such as a buffer to hold the final output image.

The above figures are valid for 8-bit JPEG data precision and a machine with 32-bit ints. For 9-bit to 12-bit JPEG data, double the size of the strip buffers and quantization pixel buffer. The "fixed-size" data will be somewhat smaller with 16-bit ints, larger with 64-bit ints. Also, CMYK or other unusual color spaces will require different amounts of space.

The full-image coefficient and pixel buffers, if needed at all, do not have to be fully RAM resident; you can have the library use temporary files instead when the total memory usage would exceed a limit you set. (But if your OS supports virtual memory, it's probably better to just use `jmemnobs` and let the OS do the swapping.)

The compressor's memory requirements are similar, except that it has no need for color quantization. Also, it needs a full-image DCT coefficient buffer if Huffman-table optimization is asked for, even if progressive mode is not requested.

If you need more detailed information about memory usage in a particular situation, you can enable the `MEM_STATS` code in `jmymmgr.c`.

#### Library compile-time options

-----

A number of compile-time options are available by modifying `jmorecfg.h`.

The IJG code currently supports 8-bit to 12-bit sample data precision by defining `BITS_IN_JSAMPLE` as 8, 9, 10, 11, or 12.

Note that a value larger than 8 causes `JSAMPLE` to be larger than a char, so it affects the surrounding application's image data.

The sample applications `cjpeg` and `djpeg` can support deeper than 8-bit data only for PPM and GIF file formats; you must disable the other file formats to compile a 9-bit to 12-bit `cjpeg` or `djpeg`. (`install.txt` has more information about that.)

Run-time selection and conversion of data precision are currently not supported and may be added later.

Exception: The transcoding part (`jpegtran`) supports all settings in a single instance, since it operates on the level of DCT coefficients and not sample values.

(If you need to include an 8-bit library and a 9-bit to 12-bit library for compression or decompression in a single application, you could probably do it by defining `NEED_SHORT_EXTERNAL_NAMES` for just one of the copies. You'd have to access the 8-bit and the 9-bit to 12-bit copies from separate

application source files. This is untested ... if you try it, we'd like to hear whether it works!)

Note that the standard Huffman tables are only valid for 8-bit data precision. If you selected more than 8-bit data precision, cjpeg uses arithmetic coding by default. The Huffman encoder normally uses entropy optimization to compute usable tables for higher precision. Otherwise, you'll have to supply different default Huffman tables. You may also want to supply your own DCT quantization tables; the existing quality-scaling code has been developed for 8-bit use, and probably doesn't generate especially good tables for 9-bit to 12-bit.

The maximum number of components (color channels) in the image is determined by MAX\_COMPONENTS. The JPEG standard allows up to 255 components, but we expect that few applications will need more than four or so.

On machines with unusual data type sizes, you may be able to improve performance or reduce memory space by tweaking the various typedefs in jmorecfg.h. In particular, on some RISC CPUs, access to arrays of "short"s is quite slow; consider trading memory for speed by making JCOEF, INT16, and UINT16 be "int" or "unsigned int". UINT8 is also a candidate to become int. You probably don't want to make JSAMPLE be int unless you have lots of memory to burn.

You can reduce the size of the library by compiling out various optional functions. To do this, undefine xxx\_SUPPORTED symbols as necessary.

You can also save a few K by not having text error messages in the library; the standard error message table occupies about 5Kb. This is particularly reasonable for embedded applications where there's no good way to display a message anyway. To do this, remove the creation of the message table (jpeg\_std\_message\_table[]) from jerror.c, and alter format\_message to do something reasonable without it. You could output the numeric value of the message code number, for example. If you do this, you can also save a couple more K by modifying the TRACEMSn() macros in jerror.h to expand to nothing; you don't need trace capability anyway, right?

#### Portability considerations

-----

The JPEG library has been written to be extremely portable; the sample applications cjpeg and djpeg are slightly less so. This section summarizes the design goals in this area. (If you encounter any bugs that cause the library to be less portable than is claimed here, we'd appreciate hearing about them.)

The code works fine on ANSI C, C++, and pre-ANSI C compilers, using any of

the popular system include file setups, and some not-so-popular ones too. See install.txt for configuration procedures.

The code is not dependent on the exact sizes of the C data types. As distributed, we make the assumptions that  
char is at least 8 bits wide  
short is at least 16 bits wide  
int is at least 16 bits wide  
long is at least 32 bits wide  
(These are the minimum requirements of the ANSI C standard.) Wider types will work fine, although memory may be used inefficiently if char is much larger than 8 bits or short is much bigger than 16 bits. The code should work equally well with 16- or 32-bit ints.

In a system where these assumptions are not met, you may be able to make the code work by modifying the typedefs in jmorecfg.h. However, you will probably have difficulty if int is less than 16 bits wide, since references to plain int abound in the code.

char can be either signed or unsigned, although the code runs faster if an unsigned char type is available. If char is wider than 8 bits, you will need to redefine JOCTET and/or provide custom data source/destination managers so that JOCTET represents exactly 8 bits of data on external storage.

The JPEG library proper does not assume ASCII representation of characters. But some of the image file I/O modules in cjpeg/djpeg do have ASCII dependencies in file-header manipulation; so does cjpeg's select\_file\_type() routine.

The JPEG library does not rely heavily on the C library. In particular, C stdio is used only by the data source/destination modules and the error handler, all of which are application-replaceable. (cjpeg/djpeg are more heavily dependent on stdio.) malloc and free are called only from the memory manager "back end" module, so you can use a different memory allocator by replacing that one file.

The code generally assumes that C names must be unique in the first 15 characters. However, global function names can be made unique in the first 6 characters by defining NEED\_SHORT\_EXTERNAL\_NAMES.

More info about porting the code may be gleaned by reading jconfig.txt, jmorecfg.h, and jinclude.h.

Notes for MS-DOS implementors

-----

The IJG code is designed to work efficiently in 80x86 "small" or "medium"

memory models (i.e., data pointers are 16 bits unless explicitly declared "far"; code pointers can be either size). You may be able to use small model to compile cjpeg or djpeg by itself, but you will probably have to use medium model for any larger application. This won't make much difference in performance. You \*will\* take a noticeable performance hit if you use a large-data memory model (perhaps 10%-25%), and you should avoid "huge" model if at all possible.

The JPEG library typically needs 2Kb-3Kb of stack space. It will also malloc about 20K-30K of near heap space while executing (and lots of far heap, but that doesn't count in this calculation). This figure will vary depending on selected operating mode, and to a lesser extent on image size. There is also about 5Kb-6Kb of constant data which will be allocated in the near data segment (about 4Kb of this is the error message table). Thus you have perhaps 20K available for other modules' static data and near heap space before you need to go to a larger memory model. The C library's static data will account for several K of this, but that still leaves a good deal for your needs. (If you are tight on space, you could reduce the sizes of the I/O buffers allocated by jdatsrc.c and jdatadst.c, say from 4K to 1K. Another possibility is to move the error message table to far memory; this should be doable with only localized hacking on jerror.c.)

About 2K of the near heap space is "permanent" memory that will not be released until you destroy the JPEG object. This is only an issue if you save a JPEG object between compression or decompression operations.

Far data space may also be a tight resource when you are dealing with large images. The most memory-intensive case is decompression with two-pass color quantization, or single-pass quantization to an externally supplied color map. This requires a 128Kb color lookup table plus strip buffers amounting to about 40 bytes per column for typical sampling ratios (eg, about 25600 bytes for a 640-pixel-wide image). You may not be able to process wide images if you have large data structures of your own.

Of course, all of these concerns vanish if you use a 32-bit flat-memory-model compiler, such as DJGPP or Watcom C. We highly recommend flat model if you can use it; the JPEG library is significantly faster in flat model.

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/libjpeg.txt  
No license file was found, but licenses were detected in source scan.

/\*

\* jcinit.c

\*

\* Copyright (C) 1991-1997, Thomas G. Lane.

\* Modified 2003-2017 by Guido Vollbeding.

\* This file is part of the Independent JPEG Group's software.

\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains initialization logic for the JPEG compressor.  
\* This routine is in charge of selecting the modules to be executed and  
\* making an initialization call to each one.  
\*  
\* Logically, this code belongs in jcmaster.c. It's split out because  
\* linking this routine implies linking the entire compression library.  
\* For a transcoding-only application, we want to be able to use jcmaster.c  
\* without linking in the whole library.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcinit.c

No license file was found, but licenses were detected in source scan.

/\*  
\* jcarith.c  
\*  
\* Developed 1997-2019 by Guido Vollbeding.  
\* This file is part of the Independent JPEG Group's software.  
\* For conditions of distribution and use, see the accompanying README file.  
\*  
\* This file contains portable arithmetic entropy encoding routines for JPEG  
\* (implementing the ISO/IEC IS 10918-1 and CCITT Recommendation ITU-T T.81).  
\*  
\* Both sequential and progressive modes are supported in this single module.  
\*  
\* Suspension is not currently supported in this module.  
\*/

Found in path(s):

\* /opt/cola/permits/1103550007\_1605777850.47/0/jpegsrvc-v9d-tar-gz/jpeg-9d/jcarith.c

## 1.249 jsxapi 5.1.1

### 1.249.1 Available under license :

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## 1.250 rsync 2.6.9

### 1.250.1 Available under license :

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Version 3, 29 June 2007

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## 1.251 dhcp 4.4.3-P1

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<!-- Generate ISC copyright comments from Docbook copyright metadata. -->

```

<xsl:stylesheet version="1.0"
 xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
 xmlns:xi="http://www.w3.org/2001/XInclude"
 xmlns:db="http://docbook.org/ns/docbook">

 <xsl:template name="isc.copyright.format">
 <xsl:param name="text"/>
 <xsl:value-of select="$isc.copyright.leader"/>
 <xsl:value-of select="normalize-space(substring-before($text, '
'))"/>
 <xsl:text>
</xsl:text>
 <xsl:variable name="rest" select="substring-after($text, '
')"/>
 <xsl:if test="translate($rest, '	 ', '')">
 <xsl:call-template name="isc.copyright.format">
 <xsl:with-param name="text" select="$rest"/>
 </xsl:call-template>
 </xsl:if>
 </xsl:template>

 <xsl:variable name="isc.copyright.text">
 <xsl:text>
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 </xsl:text>
 </xsl:variable>

 <xsl:variable name="isc.copyright">
 <xsl:call-template name="isc.copyright.format">
 <xsl:with-param name="text">
 <xsl:for-each select="db:book/db:info/db:copyright | db:refentry/db:docinfo/db:copyright">
 <xsl:text>Copyright (C) </xsl:text>
 <xsl:call-template name="copyright.years">
 <xsl:with-param name="years" select="db:year"/>
 </xsl:call-template>
 <xsl:text> </xsl:text>
 <xsl:value-of select="db:holder"/>
 <xsl:value-of select="$isc.copyright.breakline"/>
 <xsl:text>
</xsl:text>
 </xsl:for-each>
 </xsl:with-param>
 </xsl:call-template>
 </xsl:variable>

```

```
<xsl:value-of select="$isc.copyright.text"/>
 </xsl:with-param>
</xsl:call-template>
</xsl:variable>
</xsl:stylesheet>
```

<!--

- Local variables:

- mode: sgml

- End:

-->

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```
<one line to give the program's name and a brief idea of what it does.>
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```

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```
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```

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<signature of Ty Coon>, 1 April 1989

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## 1.253 libdrm 2.4.39-1

### 1.253.1 Available under license :

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\* Eric Anholt <eric@anholt.net>

\*

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/intel/intel\_bufmgr.h

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/\* radeon\_drm.h -- Public header for the radeon driver -\*- linux-c -\*-

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\* Authors:  
\* Kevin E. Martin <martin@valinux.com>  
\* Gareth Hughes <gareth@valinux.com>  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/xf86drmMode.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/xf86drmMode.h

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/\* xf86drmHash.c -- Small hash table support for integer -> integer mapping

\* Created: Sun Apr 18 09:35:45 1999 by faith@precisioninsight.com

\*

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\*

\* Authors: Rickard E. (Rik) Faith <faith@valinux.com>

\*

\* DESCRIPTION

\*

\* This file contains a straightforward implementation of a fixed-sized  
\* hash table using self-organizing linked lists [Knuth73, pp. 398-399] for  
\* collision resolution. There are two potentially interesting things

\* about this implementation:

\*

\* 1) The table is power-of-two sized. Prime sized tables are more traditional, but do not have a significant advantage over power-of-two sized table, especially when double hashing is not used for collision resolution.

\*

\* 2) The hash computation uses a table of random integers [Hanson97, pp. 39-41].

\*

\* FUTURE ENHANCEMENTS

\*

\* With a table size of 512, the current implementation is sufficient for a few hundred keys. Since this is well above the expected size of the tables for which this implementation was designed, the implementation of dynamic hash tables was postponed until the need arises. A common (and naive) approach to dynamic hash table implementation simply creates a new hash table when necessary, rehashes all the data into the new table, and destroys the old table. The approach in [Larson88] is superior in two ways: 1) only a portion of the table is expanded when needed, distributing the expansion cost over several insertions, and 2) portions of the table can be locked, enabling a scalable thread-safe implementation.

\*

\* REFERENCES

\*

\* [Hanson97] David R. Hanson. C Interfaces and Implementations: Techniques for Creating Reusable Software. Reading, Massachusetts: Addison-Wesley, 1997.

\*

\* [Knuth73] Donald E. Knuth. The Art of Computer Programming. Volume 3: Sorting and Searching. Reading, Massachusetts: Addison-Wesley, 1973.

\*

\* [Larson88] Per-Ake Larson. "Dynamic Hash Tables". CACM 31(4), April 1988, pp. 446-457.

\*

\*/

Found in path(s):

\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/xf86drmHash.c

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\* Authors:

\* Chris Wilson <chris@chris-wilson.co.uk>

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\* Authors:

\* Eric Anholt <eric@anholt.net>

\*

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/gem\_basic.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/gem\_readwrite.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
2.4.39/intel/intel\_bufmgr\_priv.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/gem\_mmap.c  
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/\* xf86drmSL.c -- Skip list support

\* Created: Mon May 10 09:28:13 1999 by faith@precisioninsight.com

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\*

\* Authors: Rickard E. (Rik) Faith <faith@valinux.com>

\*

\* DESCRIPTION

\*

\* This file contains a straightforward skip list implementation.n

\*

\* FUTURE ENHANCEMENTS

\*

\* REFERENCES

\*

\* [Pugh90] William Pugh. Skip Lists: A Probabilistic Alternative to Balanced Trees. CACM 33(6), June 1990, pp. 668-676.

\*

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/xf86drmSL.c

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/nouveau/abi16.c

\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/nouveau/pushbuf.c

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\* Eric Anholt <eric@anholt.net>

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```
/* xf86drmRandom.c -- "Minimal Standard" PRNG Implementation
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 *
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\*

\* Authors: Rickard E. (Rik) Faith <faith@valinux.com>

\*

#### \* DESCRIPTION

\*

\* This file contains a simple, straightforward implementation of the Park  
\* & Miller "Minimal Standard" PRNG [PM88, PMS93], which is a Lehmer  
\* multiplicative linear congruential generator (MLCG) with a period of  
\*  $2^{31}-1$ .

\*

\* This implementation is intended to provide a reliable, portable PRNG  
\* that is suitable for testing a hash table implementation and for  
\* implementing skip lists.

\*

#### \* FUTURE ENHANCEMENTS

\*

\* If initial seeds are not selected randomly, two instances of the PRNG  
\* can be correlated. [Knuth81, pp. 32-33] describes a shuffling technique  
\* that can eliminate this problem.

\*

\* If PRNGs are used for simulation, the period of the current  
\* implementation may be too short. [LE88] discusses methods of combining  
\* MLCGs to produce much longer periods, and suggests some alternative  
\* values for A and M. [LE90 and Sch92] also provide information on  
\* long-period PRNGs.

\*

#### \* REFERENCES

\*

\* [Knuth81] Donald E. Knuth. The Art of Computer Programming. Volume 2:  
\* Seminumerical Algorithms. Reading, Massachusetts: Addison-Wesley, 1981.

\*

\* [LE88] Pierre L'Ecuyer. "Efficient and Portable Combined Random Number  
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\*

\* [LE90] Pierre L'Ecuyer. "Random Numbers for Simulation". CACM 33(10),  
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\*

\* [PM88] Stephen K. Park and Keith W. Miller. "Random Number Generators:  
\* Good Ones are Hard to Find". CACM 31(10), October 1988, pp. 1192-1201.

\*

\* [Sch92] Bruce Schneier. "Pseudo-Random Sequence Generator for 32-Bit  
\* CPUs". Dr. Dobbs's Journal 17(2), February 1992, pp. 34, 37-38, 40.

\*

\* [PMS93] Stephen K. Park, Keith W. Miller, and Paul K. Stockmeyer. In

\* "Technical Correspondence: Remarks on Choosing and Implementing Random  
\* Number Generators". CACM 36(7), July 1993, pp. 105-110.  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/xf86drmRandom.c  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-

2.4.39/radeon/radeon\_surface.h

\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-

2.4.39/radeon/radeon\_surface.c

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\* Inki Dae <inki.dae@samsung.com>  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
2.4.39/exynos/exynos\_drmif.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/exynos/exynos\_drm.c  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/getclient.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/setversion.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/getstats.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/updatedraw.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/drmtest.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/drmtest.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/openclose.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/intel/intel\_bufmgr.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/getversion.c  
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2.4.39/include/drm/nouveau\_drm.h

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/\* mga\_drm.h -- Public header for the Matrox g200/g400 driver -\*- linux-c -\*-

\* Created: Tue Jan 25 01:50:01 1999 by jhartmann@precisioninsight.com

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2.4.39/include/drm/mga\_drm.h

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/\* dristat.c --

\* Created: Mon Jan 15 05:05:07 2001 by faith@acm.org

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\* Authors: Rickard E. (Rik) Faith <faith@valinux.com>

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/dristat.c

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*/
```

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```
*/opt/cola/permits/1720252594_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/exynos/exynos_drm.h
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\* Kristian Høgsberg <krh@bitplanet.net>

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/radeon/bof.c

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\* Frank C. Earl <fearl@airmail.net>

\* Leif Delgass <ldelgass@retinalburn.net>

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```

```
AC_PREREQ([2.63])
AC_INIT([libdrm],
 [2.4.39],
 [https://bugs.freedesktop.org/enter_bug.cgi?product=DRI],
 [libdrm])
```

```
AC_CONFIG_HEADERS([config.h])
AC_CONFIG_SRCDIR([Makefile.am])
AC_CONFIG_MACRO_DIR([m4])
AC_CONFIG_AUX_DIR([build-aux])
```

```
AM_INIT_AUTOMAKE([1.10 foreign dist-bzip2])
AM_MAINTAINER_MODE([enable])
```

```
Enable quiet compiles on automake 1.11.
m4_ifdef([AM_SILENT_RULES], [AM_SILENT_RULES([yes])])
```

```
Check for programs
AC_PROG_CC
```

```
AC_USE_SYSTEM_EXTENSIONS
AC_SYS_LARGEFILE
AC_FUNC_ALLOCA
```

```
Initialize libtool
LT_PREREQ([2.2])
LT_INIT([disable-static])
```

```
PKG_CHECK_MODULES(PTHREADSTUBS, pthread-stubs)
AC_SUBST(PTHREADSTUBS_CFLAGS)
AC_SUBST(PTHREADSTUBS_LIBS)
```

```

pkgconfigdir=${libdir}/pkgconfig
AC_SUBST(pkgconfigdir)
AC_ARG_ENABLE([udev],
 [AS_HELP_STRING([--enable-udev],
 [Enable support for using udev instead of mknod (default: disabled)]),
 [UDEV=$enableval], [UDEV=no])

AC_ARG_ENABLE(libkms,
 AS_HELP_STRING([--disable-libkms],
 [Disable KMS mm abstraction library (default: auto)]),
 [LIBKMS=$enableval], [LIBKMS=auto])

AC_ARG_ENABLE(intel,
 AS_HELP_STRING([--disable-intel],
 [Enable support for intel's KMS API (default: auto)]),
 [INTEL=$enableval], [INTEL=auto])

AC_ARG_ENABLE(radeon,
 AS_HELP_STRING([--disable-radeon],
 [Enable support for radeon's KMS API (default: auto)]),
 [RADEON=$enableval], [RADEON=auto])

AC_ARG_ENABLE(nouveau,
 AS_HELP_STRING([--disable-nouveau],
 [Enable support for nouveau's KMS API (default: auto)]),
 [NOUVEAU=$enableval], [NOUVEAU=auto])

AC_ARG_ENABLE(vmwgfx-experimental-api,
 AS_HELP_STRING([--enable-vmwgfx-experimental-api],
 [Install vmwgfx's experimental kernel API header (default: disabled)]),
 [VMWGFEX=$enableval], [VMWGFEX=no])

AC_ARG_ENABLE(omap-experimental-api,
 AS_HELP_STRING([--enable-omap-experimental-api],
 [Enable support for OMAP's experimental API (default: disabled)]),
 [OMAP=$enableval], [OMAP=no])

AC_ARG_ENABLE(exynos-experimental-api,
 AS_HELP_STRING([--enable-exynos-experimental-api],
 [Enable support for EXYNOS's experimental API (default: disabled)]),
 [EXYNOS=$enableval], [EXYNOS=no])

dnl =====
dnl check compiler flags
AC_DEFUN([LIBDRM_CC_TRY_FLAG], [
AC_MSG_CHECKING([whether $CC supports $1])

```



```

libdrm_save_CFLAGS="$CFLAGS"
CFLAGS="$CFLAGS $1"

AC_COMPILE_IFELSE([], [libdrm_cc_flag=yes], [libdrm_cc_flag=no])
CFLAGS="$libdrm_save_CFLAGS"

if test "x$libdrm_cc_flag" = "xyes"; then
 ifelse([$2], , :, [$2])
else
 ifelse([$3], , :, [$3])
fi
AC_MSG_RESULT([$libdrm_cc_flag])
])

dnl We use clock_gettime to check for timeouts in drmWaitVBlank

AC_CHECK_FUNCS([clock_gettime], [CLOCK_LIB=],
 [AC_CHECK_LIB([rt], [clock_gettime], [CLOCK_LIB=-lrt],
 [AC_MSG_ERROR([Couldn't find clock_gettime])])])
AC_SUBST([CLOCK_LIB])

AC_CHECK_FUNCS([open_memstream], [HAVE_OPEN_MEMSTREAM=yes])

dnl Use lots of warning flags with with gcc and compatible compilers

dnl Note: if you change the following variable, the cache is automatically
dnl skipped and all flags rechecked. So there's no need to do anything
dnl else. If for any reason you need to force a recheck, just change
dnl MAYBE_WARN in an ignorable way (like adding whitespace)

MAYBE_WARN="-Wall -Wextra \
-Wsign-compare -Werror-implicit-function-declaration \
-Wpointer-arith -Wwrite-strings -Wstrict-prototypes \
-Wmissing-prototypes -Wmissing-declarations -Wnested-externs \
-Wpacked -Wswitch-enum -Wmissing-format-attribute \
-Wstrict-aliasing=2 -Winit-self \
-Wdeclaration-after-statement -Wold-style-definition \
-Wno-missing-field-initializers -Wno-unused-parameter \
-Wno-attributes -Wno-long-long -Winline"

invalidate cached value if MAYBE_WARN has changed
if test "x$libdrm_cv_warn_maybe" != "x$MAYBE_WARN"; then
 unset libdrm_cv_warn_cflags
fi
AC_CACHE_CHECK([for supported warning flags], libdrm_cv_warn_cflags, [
 echo
 WARN_CFLAGS=""

```

```

Some warning options are not supported by all versions of
gcc, so test all desired options against the current
compiler.
#
Note that there are some order dependencies
here. Specifically, an option that disables a warning will
have no net effect if a later option then enables that
warnings, (perhaps implicitly). So we put some grouped
options (-Wall and -Wextra) up front and the -Wno options
last.

for W in $MAYBE_WARN; do
LIBDRM_CC_TRY_FLAG([$W], [WARN_CFLAGS="$WARN_CFLAGS $W"])
done

libdrm_cv_warn_cflags=$WARN_CFLAGS
libdrm_cv_warn_maybe=$MAYBE_WARN

AC_MSG_CHECKING([which warning flags were supported])
WARN_CFLAGS="$libdrm_cv_warn_cflags"

if test "x$UDEDEV" = xyes; then
AC_DEFINE(UDEV, 1, [Have UDEV support])
fi

AC_CANONICAL_HOST
if test "x$LIBKMS" = xauto ; then
case $host_os in
linux*) LIBKMS="yes" ;;
*) LIBKMS="no" ;;
esac
fi

AM_CONDITIONAL(HAVE_LIBKMS, [test "x$LIBKMS" = xyes])

AM_CONDITIONAL(HAVE_VMWGFX, [test "x$VMWGFX" = xyes])
if test "x$VMWGFX" = xyes; then
AC_DEFINE(HAVE_VMWGFX, 1, [Have vmwgfx kernel headers])
fi

AM_CONDITIONAL(HAVE_NOUVEAU, [test "x$NOUVEAU" = xyes])
if test "x$NOUVEAU" = xyes; then
AC_DEFINE(HAVE_NOUVEAU, 1, [Have nouveau (nvidia) support])
fi

AM_CONDITIONAL(HAVE_OMAP, [test "x$OMAP" = xyes])
if test "x$OMAP" = xyes; then
AC_DEFINE(HAVE_OMAP, 1, [Have OMAP support])

```

fi

```
AM_CONDITIONAL(HAVE_EXYNOS, [test "x$EXYNOS" = xyes])
```

```
if test "x$EXYNOS" = xyes; then
```

```
 AC_DEFINE(HAVE_EXYNOS, 1, [Have EXYNOS support])
```

fi

```
PKG_CHECK_MODULES(CAIRO, cairo, [HAVE_CAIRO=yes], [HAVE_CAIRO=no])
```

```
if test "x$HAVE_CAIRO" = xyes; then
```

```
 AC_DEFINE(HAVE_CAIRO, 1, [Have cairo support])
```

fi

```
AM_CONDITIONAL(HAVE_CAIRO, [test "x$HAVE_CAIRO" = xyes])
```

```
For enumerating devices in test case
```

```
PKG_CHECK_MODULES(LIBUDEV, libudev, [HAVE_LIBUDEV=yes], [HAVE_LIBUDEV=no])
```

```
if test "x$HAVE_LIBUDEV" = xyes; then
```

```
 AC_DEFINE(HAVE_LIBUDEV, 1, [Have libudev support])
```

fi

```
AM_CONDITIONAL(HAVE_LIBUDEV, [test "x$HAVE_LIBUDEV" = xyes])
```

```
if test "x$INTEL" != "xno" -o "x$RADEON" != "xno" -o "x$NOUVEAU" != "xno" -o "x$OMAP" != "xno"; then
```

```
 # Check for atomic intrinsics
```

```
 AC_CACHE_CHECK([for native atomic primitives], drm_cv_atomic_primitives,
```

```
 [
```

```
 drm_cv_atomic_primitives="none"
```

```
 AC_LINK_IFELSE([AC_LANG_PROGRAM([[
```

```
int atomic_add(int i) { return __sync_fetch_and_add (&i, 1); }
```

```
int atomic_cmpxchg(int i, int j, int k) { return __sync_val_compare_and_swap (&i, j, k); }
```

```
]], [[]]),
```

```
 [drm_cv_atomic_primitives="Intel"], [])
```

```
if test "x$drm_cv_atomic_primitives" = "xnone"; then
```

```
 AC_CHECK_HEADER([atomic_ops.h], drm_cv_atomic_primitives="libatomic-ops")
```

fi

```
atomic functions defined in <atomic.h> & libc on Solaris
```

```
if test "x$drm_cv_atomic_primitives" = "xnone"; then
```

```
 AC_CHECK_FUNC([atomic_cas_uint],
```

```
 drm_cv_atomic_primitives="Solaris")
```

fi

```
)
```

```
if test "x$drm_cv_atomic_primitives" = xIntel; then
```

```
 AC_DEFINE(HAVE_LIBDRM_ATOMIC_PRIMITIVES, 1,
```

```
 [Enable if your compiler supports the Intel __sync_* atomic primitives])
```

fi

```
if test "x$drm_cv_atomic_primitives" = "xlibatomic-ops"; then
```

```

AC_DEFINE(HAVE_LIB_ATOMIC_OPS, 1, [Enable if you have libatomic-ops-dev installed])
fi

if test "x$drm_cv_atomic_primitives" = "xnone"; then
 if test "x$INTEL" != "xauto"; then
 if test "x$INTEL" != "xno"; then
 AC_MSG_ERROR([libdrm_intel depends upon atomic operations, which were not found for your
compiler/cpu. Try compiling with -march=native, or install the libatomics-op-dev package, or, failing both of those,
disable support for Intel GPUs by passing --disable-intel to ./configure])
 fi
 else
 AC_MSG_WARN([Disabling libdrm_intel. It depends on atomic operations, which were not found for
your compiler/cpu. Try compiling with -march=native, or install the libatomics-op-dev package.])
 INTEL=no
 fi
 if test "x$RADEON" != "xauto"; then
 if test "x$RADEON" != "xno"; then
 AC_MSG_ERROR([libdrm_radeon depends upon atomic operations, which were not found for your
compiler/cpu. Try compiling with -march=native, or install the libatomics-op-dev package, or, failing both of those,
disable support for Radeon support by passing --disable-radeon to ./configure])
 fi
 else
 AC_MSG_WARN([Disabling libdrm_radeon. It depends on atomic operations, which were not found for
your compiler/cpu. Try compiling with -march=native, or install the libatomics-op-dev package.])
 RADEON=no
 fi
 if test "x$NOUVEAU" != "xauto"; then
 if test "x$NOUVEAU" != "xno"; then
 AC_MSG_ERROR([libdrm_nouveau depends upon atomic operations, which were not found for your
compiler/cpu. Try compiling with -march=native, or install the libatomics-op-dev package, or, failing both of those,
disable support for NVIDIA GPUs by passing --disable-nouveau to ./configure])
 fi
 else
 AC_MSG_WARN([Disabling libdrm_nouveau. It depends on atomic operations, which were not found
for your compiler/cpu. Try compiling with -march=native, or install the libatomics-op-dev package.])
 NOUVEAU=no
 fi
else
 if test "x$INTEL" != "xno"; then
 case $host_cpu in
 i?86|x86_64) INTEL=yes ;;
 *) INTEL=no ;;
 esac
 fi
 if test "x$RADEON" != "xno"; then
 RADEON=yes
 fi
 if test "x$NOUVEAU" != "xno"; then

```

```

 NOUVEAU=yes
 fi
fi

if test "x$INTEL" != "xno"; then
 PKG_CHECK_MODULES(PCIAACCESS, [pciaccess >= 0.10])
fi
AC_SUBST(PCIAACCESS_CFLAGS)
AC_SUBST(PCIAACCESS_LIBS)

PKG_CHECK_MODULES(VAALGRIND, [valgrind], [have_valgrind=yes], [have_valgrind=no])
if test "x$have_valgrind" = "xyes"; then
 AC_DEFINE([HAVE_VALGRIND], 1, [Use valgrind intrinsics to suppress false warnings])
fi

AM_CONDITIONAL(HAVE_INTEL, [test "x$INTEL" != "xno"])
AM_CONDITIONAL(HAVE_RADEON, [test "x$RADEON" != "xno"])
AM_CONDITIONAL(HAVE_NOUVEAU, [test "x$NOUVEAU" != "xno"])
if test "x$RADEON" = "xyes"; then
 AC_DEFINE(HAVE_RADEON, 1, [Have radeon support])
fi

AC_ARG_WITH([kernel-source],
 [AS_HELP_STRING([--with-kernel-source],
 [specify path to linux kernel source]),
 [kernel_source="$with_kernel_source"])
AC_SUBST(kernel_source)

AC_SUBST(WARN_CFLAGS)
AC_CONFIG_FILES([
 Makefile
 libkms/Makefile
 libkms/libkms.pc
 intel/Makefile
 intel/libdrm_intel.pc
 radeon/Makefile
 radeon/libdrm_radeon.pc
 nouveau/Makefile
 nouveau/libdrm_nouveau.pc
 omap/Makefile
 omap/libdrm_omap.pc
 exynos/Makefile
 exynos/libdrm_exynos.pc
 tests/Makefile
 tests/modeprint/Makefile
 tests/modetest/Makefile
 tests/kmstest/Makefile

```

```
tests/radeon/Makefile
tests/vbltest/Makefile
include/Makefile
include/drm/Makefile
libdrm.pc])
AC_OUTPUT
```

```
echo ""
echo "$PACKAGE_STRING will be compiled with:"
echo ""
echo " libkms $LIBKMS"
echo " Intel API $INTEL"
echo " vmwgfx API $VMWGFX"
echo " Radeon API $RADEON"
echo " Nouveau API $NOUVEAU"
echo " OMAP API $OMAP"
echo " EXYNOS API $EXYNOS"
echo ""
```

Found in path(s):

```
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```
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```

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*
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* Authors:
```

\* Gareth Hughes <gareth@valinux.com>  
\* Kevin E. Martin <martin@valinux.com>  
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\* Jesse Barnes <jesse.barnes@intel.com>

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/modetest/buffers.c

\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/modetest/buffers.h

\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/modetest/modetest.c

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
2.4.39/radeon/radeon\_cs\_gem.c

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\*/opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
2.4.39/radeon/radeon\_bo\_gem.h  
\*/opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
2.4.39/radeon/radeon\_bo\_gem.c

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\* Ben Widawsky <ben@bwidawsk.net>  
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\* Rob Clark <rob@ti.com>

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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/omap/omap\_drm.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/omap/omap\_drm.c  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/radeon/rbo.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-  
2.4.39/tests/radeon/radeon\_ttm.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/radeon/rbo.h  
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/\* savage\_drm.h -- Public header for the savage driver

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2.4.39/include/drm/savage\_drm.h

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/\* drmstat.c -- DRM device status and testing program

\* Created: Tue Jan 5 08:19:24 1999 by faith@precisioninsight.com

\*

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Found in path(s):

\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/drmstat.c  
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\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/nouveau.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/vmwgfx.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/radeon.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/internal.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/linux.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/intel.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/tests/kmstest/main.c



\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/include/drm/vmwgfx\_drm.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/dumb.c  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/libkms.h  
\* /opt/cola/permits/1720252594\_1686743542.1674168/0/libdrm-2-4-39-tar-gz/libdrm-2.4.39/libkms/api.c

## 1.254 html-webpack-plugin 5.5.3

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* SHA-512
* Implementation derived from LibTomCrypt (Tom St Denis)
*
* LibTomCrypt is a library that provides various cryptographic
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*
* The library is free for all purposes without any express
* guarantee it works.
*
* Tom St Denis, tomstdenis@gmail.com, http://libtomcrypt.org
*/
```

## 1.257 libtommath 0.42.0

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-- Tom St Denis

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# 1.260 linux-kernel 3.6.6

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```
/* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)
* nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)
*
* Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.
* http://www.hypermall.com/
* 10/1/97 - commented out CFG_PHYIE bit - we don't care when the PHY
* interrupts us (except possibly for removal/insertion of the cable?)
* 10/4/97 - began heavy inline documentation of the code. Corrected typos
* and spelling mistakes.
* 10/5/97 - added code to handle PHY interrupts, disable PHY on
* loss of link, and correctly re-enable PHY when link is
* re-established. (put back CFG_PHYIE)
*
```

\* Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.  
 \*  
 \* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997  
 \*  
 \* Linux driver for the IDT77201 NICStAR PCI ATM controller.  
 \* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;  
 \* see init\_nicstar() for PHY initialization to change this. This driver  
 \* expects the Linux ATM stack to support scatter-gather lists  
 \* (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.  
 \*  
 \* Implementing minimal-copy of received data:  
 \* IDT always receives data into a small buffer, then large buffers  
 \* as needed. This means that data must always be copied to create  
 \* the linear buffer needed by most non-ATM protocol stacks (e.g. IP)  
 \* Fix is simple: make large buffers large enough to hold entire  
 \* SDU, and leave <small\_buffer\_data> bytes empty at the start. Then  
 \* copy small buffer contents to head of large buffer.  
 \* Trick is to avoid fragmenting Linux, due to need for a lot of large  
 \* buffers. This is done by 2 things:  
 \* 1) skb->destructor / skb->atm.recycle\_buffer  
 \* combined, allow nicstar\_free\_rx\_skb to be called to  
 \* recycle large data buffers  
 \* 2) skb\_clone of received buffers  
 \* See nicstar\_free\_rx\_skb and linearize\_buffer for implementation  
 \* details.  
 \*  
 \*  
 \*  
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 \*  
 \* M. Welsh, 6 July 1996  
 \*  
 \*  
 \*/

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procedure and CyberLogin is no longer used.)

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for the nxt2004 frontend driver

Kirk Lapray <kirk.lapray@gmail.com>  
for the or51211 and or51132 frontend drivers, and  
for merging the nxt2002 and nxt2004 modules into a  
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The DSP/Bridge project wish to thank all of its contributors, current bridge driver is the result of the work of all of them. If any name is accidentally omitted, let us know by sending a mail to [omar.ramirez@ti.com](mailto:omar.ramirez@ti.com) or [x095840@ti.com](mailto:x095840@ti.com).

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#define __LICENSE_H

static inline int license_is_gpl_compatible(const char *license)
{
 return (strcmp(license, "GPL") == 0
 || strcmp(license, "GPL v2") == 0
 || strcmp(license, "GPL and additional rights") == 0
 || strcmp(license, "Dual BSD/GPL") == 0
 || strcmp(license, "Dual MIT/GPL") == 0
 || strcmp(license, "Dual MPL/GPL") == 0);
}

#endif
/* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)
 * nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)
 *
 * Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.
```

- \* <http://www.hypermall.com/>
- \* 10/1/97 - commented out CFG\_PHYIE bit - we don't care when the PHY
- \* interrupts us (except possibly for removal/insertion of the cable?)
- \* 10/4/97 - began heavy inline documentation of the code. Corrected typos
- \* and spelling mistakes.
- \* 10/5/97 - added code to handle PHY interrupts, disable PHY on
- \* loss of link, and correctly re-enable PHY when link is
- \* re-established. (put back CFG\_PHYIE)
- \*
- \* Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.
- \*
- \* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997
- \*
- \* Linux driver for the IDT77201 NICStAR PCI ATM controller.
- \* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;
- \* see init\_nicstar() for PHY initialization to change this. This driver
- \* expects the Linux ATM stack to support scatter-gather lists
- \* (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.
- \*
- \* Implementing minimal-copy of received data:
- \* IDT always receives data into a small buffer, then large buffers
- \* as needed. This means that data must always be copied to create
- \* the linear buffer needed by most non-ATM protocol stacks (e.g. IP)
- \* Fix is simple: make large buffers large enough to hold entire
- \* SDU, and leave <small\_buffer\_data> bytes empty at the start. Then
- \* copy small buffer contents to head of large buffer.
- \* Trick is to avoid fragmenting Linux, due to need for a lot of large
- \* buffers. This is done by 2 things:
- \* 1) skb->destructor / skb->atm.recycle\_buffer
- \* combined, allow nicstar\_free\_rx\_skb to be called to
- \* recycle large data buffers
- \* 2) skb\_clone of received buffers
- \* See nicstar\_free\_rx\_skb and linearize\_buffer for implementation
- \* details.
- \*
- \*
- \*
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\*  
\* M. Welsh, 6 July 1996

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for the nxt2004 frontend driver

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for merging the nxt2002 and nxt2004 modules into a  
single nxt200x frontend driver.

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## 1.262 protobuf 2.6.1

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## 1.263 ipset 7.17

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# 1.264 free-type 2.13.0

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2006-Jan-27

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Files that don't get a copyright, or which are taken from elsewhere.
#
All lines in this file are patterns (relative to the top-level directory),
including the comment lines; this means that e.g. `FTL.TXT' matches all
files that have this string in the file name (including the path relative
to the current directory, always starting with `./').
#
Don't put empty lines into this file!
#
builds/unix/pkg.m4
#
docs/FTL.TXT
docs/GPLv2.TXT
#
include/freetype/internal/fthash.h
#
src/base/fthash.c
src/base/md5.c
src/base/md5.h
#
src/bdf/bdf.c
src/bdf/bdf.h
src/bdf/bdfdrivr.c
src/bdf/bdfdrivr.h
src/bdf/bdferror.h
src/bdf/bdflib.c
src/bdf/module.mk
src/bdf/README
src/bdf/rules.mk
#
src/pcf/module.mk
src/pcf/pcf.c
src/pcf/pcf.h
src/pcf/pcfdrivr.c
src/pcf/pcfdrivr.h
src/pcf/pcferror.h
src/pcf/pcfread.c
src/pcf/pcfread.h
src/pcf/pcfutil.c
src/pcf/pcfutil.h
src/pcf/README
src/pcf/rules.mk
#
```

```
src/gzip/adler32.c
src/gzip/ftzconf.c
src/gzip/infblock.c
src/gzip/infblock.h
src/gzip/infcodes.c
src/gzip/infcodes.h
src/gzip/inffixed.h
src/gzip/inflate.c
src/gzip/inftrees.c
src/gzip/inftrees.h
src/gzip/infutil.c
src/gzip/infutil.h
src/gzip/zconf.h
src/gzip/zlib.h
src/gzip/zutil.c
src/gzip/zutil.h
#
src/tools/apinames.c
src/tools/ftrandom/ftrandom.c
#
subprojects/dlg
#
EOF
```

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\*/

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# 1.273 ndisc 1.0.2

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```
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version 1.2.11, January 15th, 2017
```

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# 1.275 webpack-dev-server 4.15.1

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## 1.276 beautiful-soup 4.9.3

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## 1.278 bzip2 1.0.8

## 1.279 react-modal 3.16.1

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## 1.281 react-dragtastic 2.4.3

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Name: custompalette

Columns: 4

#

0 0 0 Index 3

65 38 30 Index 4

103 62 49 Index 6

79 73 72 Index 7

114 101 97 Index 8

208 127 100 Index 9

151 144 142 Index 10

221 207 199 Index 11

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GIMP Palette

Name: badpaletteentry

Columns: 4

#

0 0 0 Index 3

65 38

103 62 49 Index 6

79 73 72 Index 7

114 101 97 Index 8

208 127 100 Index 9

151 144 142 Index 10

221 207 199 Index 11

## 1.283 vim 9.0.1544

## 1.284 libpcap 1.9.1

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Upstream-Name: cjose

Source: <https://github.com/cisco/cjose>

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## 1.288 imx-firmware-sdma 8.16

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/**
 * Creates an array of the own enumerable property names of `object`.
 *
 * ***Note:*** Non-object values are coerced to objects. See the
 * [ES spec](http://ecma-international.org/ecma-262/7.0/#sec-object.keys)
```

```

* for more details.
*
* @static
* @since 0.1.0
* @memberOf _
* @category Object
* @param {Object} object The object to query.
* @returns {Array} Returns the array of property names.
* @example
*
* function Foo() {
* this.a = 1;
* this.b = 2;
* }
*
* Foo.prototype.c = 3;
*
* _.keys(new Foo);
* // => ['a', 'b'] (iteration order is not guaranteed)
*
* _.keys('hi');
* // => ['0', '1']
*/
/*
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*
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\* Based on the comment attachment algorithm used in espree and estraverse.

\*

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```
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```

```
/*!
```

```
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```

```
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```

```
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```

```
*/
```

```
Found in path(s):
```

```
* /opt/cola/permits/1720709376_1687557883.3385823/0/macros-assets-tar-gz/package/lib/transpiler.js
```

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```

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```
/*
```

```
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```

```
*
```

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\* /opt/cola/permits/1720709376\_1687557883.3385823/0/macros-assets-tar-gz/package/lib/extensions/xapi-  
websockets.js

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\* Based on the Base 64 VLQ implementation in Closure Compiler:



```
* https://code.google.com/p/closure-
compiler/source/browse/trunk/src/com/google/debugging/sourcemap/Base64VLQ.java
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```
* /opt/cola/permits/1720709376_1687557883.3385823/0/macros-assets-tar-gz/package/lib/qjs_transpiler.js
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```
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* loglevel - https://github.com/pimterry/loglevel
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```
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```

## 1.290 d3-format 3.1.0

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## 1.292 react-select 5.7.3

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```

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Ty Coon, President of Vice
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```

/*****
* NCSA HTTPd Server
* Software Development Group

```

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```
*/
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*/
```

For the srclib\apr-util\xml\expat\conf\tools\install-sh component:

```
#
install - install a program, script, or datafile
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```

For the test\zb.c component:

```
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=====
```

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Written by Adam Twiss (adam@zeus.co.uk). March 1996

Thanks to the following people for their input:

Mike Belshe (mbelshe@netscape.com)

Michael Campanella (campanella@stevms.enet.dec.com)

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For the expat xml parser component:

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//curl

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```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
```

```
<html xmlns="http://www.w3.org/1999/xhtml" lang="en" xml:lang="en"><head><!--
XX
X
```

This file is generated from xml source: DO NOT EDIT

```
XX
X
```

```
-->
<title>The Apache License, Version 2.0 - Apache HTTP Server Version 2.4</title>
<link href="/style/css/manual.css" rel="stylesheet" media="all" type="text/css" title="Main stylesheet" />
<link href="/style/css/manual-loose-100pc.css" rel="alternate stylesheet" media="all" type="text/css" title="No Sidebar - Default font size" />
<link href="/style/css/manual-print.css" rel="stylesheet" media="print" type="text/css" /><link rel="stylesheet" type="text/css" href="/style/css/prettify.css" />
<script src="/style/scripts/prettify.min.js" type="text/javascript">
</script>
```

```
<link href="/images/favicon.ico" rel="shortcut icon" /></head>
<body id="manual-page" class="no-sidebar"><div id="page-header">
<p class="menu">Modules | Directives | FAQ | Glossary | Sitemap</p>
<p class="apache">Apache HTTP Server Version 2.4</p>
```

```
</div>
<div class="up"></div>
<div id="path">
Apache > HTTP Server > Documentation > Version 2.4</div><div id="page-
content"><div id="preamble"><h1>The Apache License, Version 2.0</h1>
<div class="toplang">
<p>Available Languages: en </p>
</div>
```

```
<p class="centered">Apache License

Version 2.0, January 2004

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```

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```

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```

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</div>

</div>

<div class="bottomlang">

<p><span>Available Languages: </span><a href="/en/license.html" title="English">&nbsp;en&nbsp;</a></p>

</div><div class="top"><a href="#page-header"></a></div><div

class="section"><h2><a id="comments\_section" name="comments\_section">Comments</a></h2><div

class="warning"><strong>Notice:</strong><br />This is not a Q&A section. Comments placed here should be pointed towards suggestions on improving the documentation or server, and may be removed again by our moderators if they are either implemented or considered invalid/off-topic. Questions on how to manage the Apache HTTP Server should be directed at either our IRC channel, #httpd, on Freenode, or sent to our <a href="http://httpd.apache.org/lists.html">mailing lists</a></div>

<script type="text/javascript"><!--><![CDATA[//><!--

var comments\_shortcode = 'httpd';

var comments\_identifier = 'http://httpd.apache.org/docs/2.4/license.html';

(function(w, d) {

if (w.location.hostname.toLowerCase() == "httpd.apache.org") {

d.write('<div id="comments\_thread"></div>');

var s = d.createElement('script');

s.type = 'text/javascript';

s.async = true;

s.src = 'https://comments.apache.org/show\_comments.lua?site=' + comments\_shortcode + '&page=' +

comments\_identifier;

(d.getElementsByTagName('head')[0] || d.getElementsByTagName('body')[0]).appendChild(s);

```

}
else {
 d.write('<div id="comments_thread">Comments are disabled for this page at the moment.</div>');
}
})(window, document);
</script></div><div id="footer">
<p class="apache">Copyright 2015 The Apache Software Foundation.
Licensed under the Apache License, Version 2.0.</p>
<p class="menu">Modules | Directives | FAQ | Glossary | Sitemap</p></div><script type="text/javascript"><!--<![CDATA[<!--
if (typeof(prettyPrint) !== 'undefined') {
 prettyPrint();
}
--></script>
</body></html>
Apache HTTP Server
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```

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# 1.304 zutils 1.11

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```
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\* nvctassert.h

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\* NVidia ct\_assert (compile time assertion) function.

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nvdc/drm_nvdc_headers/include/nvrm_drf.h

```

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```
/*! \brief
* Define compile time symbols for CPU type and operating system type.
* This file should only contain preprocessor commands so that
* there are no dependencies on other files.
*
* cpuopsys.h
*
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*/
```

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```
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nvdc/drm_nvdc_headers/include/p4-mirror/sdk/nvidia/inc/cpuopsys.h
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nvdc/nvll/Makefile
* /opt/cola/permits/1723834927_1687538463.440192/0/libdrm-nvdc-r32-l4t-cisco-18-tar-gz/drm-nvdc/Makefile
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*/
/**
* NvColorDataType defines the data type of color components.
*
* The default datatype of color components is 'Integer' which should be used
* when the color value is to be interpreted as an integer value ranging from 0
* to the maximum value representable by the width of the components (as
```



- \* specified by the packing of the component). Use 'Integer' also when the
- \* interpretation of color value bits is not known, does not matter or is
- \* context dependent.
- \*
- \* A data type of 'Signed' indicates that the color value is to be interpreted
- \* as a signed two's complement integer value. The width of the component
- \* includes the sign bit (e.g. S8 ranges from -128 to 127).
- \*
- \* A data type of 'Float' indicates that float values are stored in the
- \* components of the color. The combination of data type 'Float' and the
- \* bit width of the component packing defines the final data format of the
- \* individual component.
- \*
- \* The list below defines the accepted combinations, when adding new
- \* float formats please add an entry into this list.
- \*
- \* - DataType = Float, Component bit width = 32:
- \*   A IEEE 754 single precision float (binary32) with 1 sign bit,
- \*   8 exponent bits and 23 mantissa bits.
- \*
- \* - DataType = Float, Component bit width = 16:
- \*   A IEEE 754 half precision float (binary16) with 1 sign bit,
- \*   5 exponent bits and 10 mantissa bits.
- \*
- \* - DataType = Float, Component bit width = 10:
- \*   An unsigned nvfloat with 5 exponent bits and 5 mantissa bits.
- \*
- \* - DataType = Float, Component bit width = 11:
- \*   An unsigned nvfloat with 5 exponent bits and 6 mantissa bits.
- \*
- \* - DataType = FloatISP, Component bit width = 16:
- \*   A Nvidia proprietary Floating point representation for optimal
- \*   usage in ISP, with 4 exponent bits and 12 mantissa bits.
- \*/

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// Population count implementation from the public domain

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## 1.314 imx-gpu viv-6.4.3.p4.2-aarch64

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## 1.315 libevent 2.1.12

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\*/

Index: tdbsa/tdb.c

=====

--- tdbsa.orig/tdb.c

+++ tdbsa/tdb.c

@@ -4,11 +4,11 @@ Rev: 23371

Last Changed Date: 2007-06-06 20:14:06 -0400 (Wed, 06 Jun 2007)

\*/

/\*

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Theodore Ts'o  
23-June-2007

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```
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```
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That's all there is to it!

This package was added to the e2fsprogs debian source package by Theodore Ts'o <tytso@mit.edu> on Sat Mar 15 15:33:37 EST 2003

It is part of the main e2fsprogs distribution, which can be found at:

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This package was put together by Yann Dirson <dirson@debian.org>, from sources obtained from a mirror of:  
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#

# This is a Makefile stub which handles the creation of BSD shared libraries.

#

# In order to use this stub, the following makefile variables must be defined.

#

# BSDLIB\_VERSION = 1.0

# BSDLIB\_IMAGE = libce

# BSDLIB\_MYDIR = et

# BSDLIB\_INSTALL\_DIR = \$(SHLIBDIR)

#

all:: image

```
real-subdirs:: Makefile
@echo " MKDIR pic"
@mkdir -p pic
```

```
BSD_LIB = $(BSDLIB_IMAGE).so.$(BSDLIB_VERSION)
BSDLIB_PIC_FLAG = -fpic
```

```
image: $(BSD_LIB)
```

```
$(BSD_LIB): $(OBS)
(cd pic; ld -Bshareable -o $(BSD_LIB) $(LD_FLAGS_SHLIB) $(OBS))
$(MV) pic/$(BSD_LIB) .
$(RM) -f ../$(BSD_LIB)
(cd ..; $(LN) $(LINK_BUILD_FLAGS) \
`echo $(my_dir) | sed -e 's;lib/;;'/'$(BSD_LIB) $(BSD_LIB))
```

```
install-shlibs install:: $(BSD_LIB)
@echo " INSTALL_PROGRAM $(BSDLIB_INSTALL_DIR)/$(BSD_LIB)"
@$(INSTALL_PROGRAM) $(BSD_LIB) \
$(DESTDIR)$$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)
@-$(LD_CONFIG)
```

```
install-strip: install
```

```
install-shlibs-strip: install-shlibs
```

```
uninstall-shlibs uninstall::
$(RM) -f $(DESTDIR)$$(BSDLIB_INSTALL_DIR)/$(BSD_LIB)
```

```
clean::
$(RM) -rf pic
$(RM) -f $(BSD_LIB)
$(RM) -f ../$(BSD_LIB)
```

This is the Debian GNU/Linux repackaged version of the Common Error Description library. It is currently distributed together with the EXT2 file system utilities, which are otherwise packaged as "e2fsprogs".

This package was put together by Yann Dirson <dirson@debian.org>, from sources obtained from a mirror of:  
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Gadi Oxman, August 1995

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## 1.317 libinput 1.20.1

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README for release 6b of 27-Mar-1998

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### DOCUMENTATION ROADMAP

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This file contains the following sections:

- OVERVIEW        General description of JPEG and the IJG software.
- LEGAL ISSUES    Copyright, lack of warranty, terms of distribution.
- REFERENCES     Where to learn more about JPEG.
- ARCHIVE LOCATIONS    Where to find newer versions of this software.
- RELATED SOFTWARE    Other stuff you should get.
- FILE FORMAT WARS    Software \*not\* to get.
- TO DO            Plans for future IJG releases.

Other documentation files in the distribution are:

User documentation:

- install.doc     How to configure and install the IJG software.
- usage.doc       Usage instructions for cjpeg, djpeg, jpegtran,

rdjpgcom, and wrjpgcom.

\*.1            Unix-style man pages for programs (same info as usage.doc).

wizard.doc    Advanced usage instructions for JPEG wizards only.

change.log    Version-to-version change highlights.

Programmer and internal documentation:

libjpeg.doc   How to use the JPEG library in your own programs.

example.c     Sample code for calling the JPEG library.

structure.doc  Overview of the JPEG library's internal structure.

filelist.doc   Road map of IJG files.

coderrules.doc Coding style rules --- please read if you contribute code.

Please read at least the files install.doc and usage.doc. Useful information can also be found in the JPEG FAQ (Frequently Asked Questions) article. See ARCHIVE LOCATIONS below to find out where to obtain the FAQ article.

If you want to understand how the JPEG code works, we suggest reading one or more of the REFERENCES, then looking at the documentation files (in roughly the order listed) before diving into the code.

## OVERVIEW

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This package contains C software to implement JPEG image compression and decompression. JPEG (pronounced "jay-peg") is a standardized compression method for full-color and gray-scale images. JPEG is intended for compressing "real-world" scenes; line drawings, cartoons and other non-realistic images are not its strong suit. JPEG is lossy, meaning that the output image is not exactly identical to the input image. Hence you must not use JPEG if you have to have identical output bits. However, on typical photographic images, very good compression levels can be obtained with no visible change, and remarkably high compression levels are possible if you can tolerate a low-quality image. For more details, see the references, or just experiment with various compression settings.

This software implements JPEG baseline, extended-sequential, and progressive compression processes. Provision is made for supporting all variants of these processes, although some uncommon parameter settings aren't implemented yet. For legal reasons, we are not distributing code for the arithmetic-coding variants of JPEG; see LEGAL ISSUES. We have made no provision for supporting the hierarchical or lossless processes defined in the standard.

We provide a set of library routines for reading and writing JPEG image files, plus two sample applications "cjpeg" and "djpeg", which use the library to perform conversion between JPEG and some other popular image file formats. The library is intended to be reused in other applications.

In order to support file conversion and viewing software, we have included

considerable functionality beyond the bare JPEG coding/decoding capability; for example, the color quantization modules are not strictly part of JPEG decoding, but they are essential for output to colormapped file formats or colormapped displays. These extra functions can be compiled out of the library if not required for a particular application. We have also included "jpegtran", a utility for lossless transcoding between different JPEG processes, and "rdjpgcom" and "wrjpgcom", two simple applications for inserting and extracting textual comments in JFIF files.

The emphasis in designing this software has been on achieving portability and flexibility, while also making it fast enough to be useful. In particular, the software is not intended to be read as a tutorial on JPEG. (See the REFERENCES section for introductory material.) Rather, it is intended to be reliable, portable, industrial-strength code. We do not claim to have achieved that goal in every aspect of the software, but we strive for it.

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The Unix configuration script "configure" was produced with GNU Autoconf. It is copyright by the Free Software Foundation but is freely distributable. The same holds for its supporting scripts (config.guess, config.sub, ltconfig, ltmain.sh). Another support script, install-sh, is copyright by M.I.T. but is also freely distributable.

It appears that the arithmetic coding option of the JPEG spec is covered by patents owned by IBM, AT&T, and Mitsubishi. Hence arithmetic coding cannot legally be used without obtaining one or more licenses. For this reason, support for arithmetic coding has been removed from the free JPEG software. (Since arithmetic coding provides only a marginal gain over the unpatented Huffman mode, it is unlikely that very many implementations will support it.) So far as we are aware, there are no patent restrictions on the remaining code.

The IJG distribution formerly included code to read and write GIF files.



To avoid entanglement with the Unisys LZW patent, GIF reading support has been removed altogether, and the GIF writer has been simplified to produce "uncompressed GIFs". This technique does not use the LZW algorithm; the resulting GIF files are larger than usual, but are readable by all standard GIF decoders.

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## REFERENCES

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We highly recommend reading one or more of these references before trying to understand the innards of the JPEG software.

The best short technical introduction to the JPEG compression algorithm is Wallace, Gregory K. "The JPEG Still Picture Compression Standard", Communications of the ACM, April 1991 (vol. 34 no. 4), pp. 30-44. (Adjacent articles in that issue discuss MPEG motion picture compression, applications of JPEG, and related topics.) If you don't have the CACM issue handy, a PostScript file containing a revised version of Wallace's article is available at <ftp://ftp.uu.net/graphics/jpeg/wallace.ps.gz>. The file (actually a preprint for an article that appeared in IEEE Trans. Consumer Electronics) omits the sample images that appeared in CACM, but it includes corrections and some added material. Note: the Wallace article is copyright ACM and IEEE, and it may not be used for commercial purposes.

A somewhat less technical, more leisurely introduction to JPEG can be found in "The Data Compression Book" by Mark Nelson and Jean-loup Gailly, published by M&T Books (New York), 2nd ed. 1996, ISBN 1-55851-434-1. This book provides good explanations and example C code for a multitude of compression methods including JPEG. It is an excellent source if you are comfortable reading C code but don't know much about data compression in general. The book's JPEG sample code is far from industrial-strength, but when you are ready to look at a full implementation, you've got one here...

The best full description of JPEG is the textbook "JPEG Still Image Data Compression Standard" by William B. Pennebaker and Joan L. Mitchell, published by Van Nostrand Reinhold, 1993, ISBN 0-442-01272-1. Price US\$59.95, 638 pp. The book includes the complete text of the ISO JPEG standards (DIS 10918-1 and draft DIS 10918-2). This is by far the most complete exposition of JPEG in existence, and we highly recommend it.

The JPEG standard itself is not available electronically; you must order a paper copy through ISO or ITU. (Unless you feel a need to own a certified

official copy, we recommend buying the Pennebaker and Mitchell book instead; it's much cheaper and includes a great deal of useful explanatory material.) In the USA, copies of the standard may be ordered from ANSI Sales at (212) 642-4900, or from Global Engineering Documents at (800) 854-7179. (ANSI doesn't take credit card orders, but Global does.) It's not cheap: as of 1992, ANSI was charging \$95 for Part 1 and \$47 for Part 2, plus 7% shipping/handling. The standard is divided into two parts, Part 1 being the actual specification, while Part 2 covers compliance testing methods. Part 1 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 1: Requirements and guidelines" and has document numbers ISO/IEC IS 10918-1, ITU-T T.81. Part 2 is titled "Digital Compression and Coding of Continuous-tone Still Images, Part 2: Compliance testing" and has document numbers ISO/IEC IS 10918-2, ITU-T T.83.

Some extensions to the original JPEG standard are defined in JPEG Part 3, a newer ISO standard numbered ISO/IEC IS 10918-3 and ITU-T T.84. IJG currently does not support any Part 3 extensions.

The JPEG standard does not specify all details of an interchangeable file format. For the omitted details we follow the "JFIF" conventions, revision 1.02. A copy of the JFIF spec is available from:

Literature Department  
C-Cube Microsystems, Inc.  
1778 McCarthy Blvd.  
Milpitas, CA 95035  
phone (408) 944-6300, fax (408) 944-6314

A PostScript version of this document is available by FTP at <ftp://ftp.uu.net/graphics/jpeg/jfif.ps.gz>. There is also a plain text version at <ftp://ftp.uu.net/graphics/jpeg/jfif.txt.gz>, but it is missing the figures.

The TIFF 6.0 file format specification can be obtained by FTP from <ftp://ftp.sgi.com/graphics/tiff/TIFF6.ps.gz>. The JPEG incorporation scheme found in the TIFF 6.0 spec of 3-June-92 has a number of serious problems. IJG does not recommend use of the TIFF 6.0 design (TIFF Compression tag 6). Instead, we recommend the JPEG design proposed by TIFF Technical Note #2 (Compression tag 7). Copies of this Note can be obtained from <ftp.sgi.com> or from <ftp://ftp.uu.net/graphics/jpeg/>. It is expected that the next revision of the TIFF spec will replace the 6.0 JPEG design with the Note's design. Although IJG's own code does not support TIFF/JPEG, the free libtiff library uses our library to implement TIFF/JPEG per the Note. libtiff is available from <ftp://ftp.sgi.com/graphics/tiff/>.

#### ARCHIVE LOCATIONS

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The "official" archive site for this software is <ftp.uu.net> (Internet

address 192.48.96.9). The most recent released version can always be found there in directory graphics/jpeg. This particular version will be archived as ftp://ftp.uu.net/graphics/jpeg/jpegsrc.v6b.tar.gz. If you don't have direct Internet access, UUNET's archives are also available via UUCP; contact help@uunet.uu.net for information on retrieving files that way.

Numerous Internet sites maintain copies of the UUNET files. However, only ftp.uu.net is guaranteed to have the latest official version.

You can also obtain this software in DOS-compatible "zip" archive format from the SimTel archives (ftp://ftp.simtel.net/pub/simtelnet/msdos/graphics/), or on CompuServe in the Graphics Support forum (GO CIS:GRAPHSUP), library 12 "JPEG Tools". Again, these versions may sometimes lag behind the ftp.uu.net release.

The JPEG FAQ (Frequently Asked Questions) article is a useful source of general information about JPEG. It is updated constantly and therefore is not included in this distribution. The FAQ is posted every two weeks to Usenet newsgroups comp.graphics.misc, news.answers, and other groups. It is available on the World Wide Web at <http://www.faqs.org/faqs/jpeg-faq/> and other news.answers archive sites, including the official news.answers archive at rtfm.mit.edu: <ftp://rtfm.mit.edu/pub/usenet/news.answers/jpeg-faq/>. If you don't have Web or FTP access, send e-mail to mail-server@rtfm.mit.edu with body

send usenet/news.answers/jpeg-faq/part1

send usenet/news.answers/jpeg-faq/part2

#### RELATED SOFTWARE

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Numerous viewing and image manipulation programs now support JPEG. (Quite a few of them use this library to do so.) The JPEG FAQ described above lists some of the more popular free and shareware viewers, and tells where to obtain them on Internet.

If you are on a Unix machine, we highly recommend Jef Poskanzer's free PBPLUS software, which provides many useful operations on PPM-format image files. In particular, it can convert PPM images to and from a wide range of other formats, thus making cjpeg/djpeg considerably more useful. The latest version is distributed by the NetPBM group, and is available from numerous sites, notably <ftp://wuarchive.wustl.edu/graphics/graphics/packages/NetPBM/>. Unfortunately PBPLUS/NETPBM is not nearly as portable as the IJG software is; you are likely to have difficulty making it work on any non-Unix machine.

A different free JPEG implementation, written by the PVRG group at Stanford, is available from <ftp://havefun.stanford.edu/pub/jpeg/>. This program is designed for research and experimentation rather than production use;

it is slower, harder to use, and less portable than the IJG code, but it is easier to read and modify. Also, the PVRG code supports lossless JPEG, which we do not. (On the other hand, it doesn't do progressive JPEG.)

## FILE FORMAT WARS

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Some JPEG programs produce files that are not compatible with our library. The root of the problem is that the ISO JPEG committee failed to specify a concrete file format. Some vendors "filled in the blanks" on their own, creating proprietary formats that no one else could read. (For example, none of the early commercial JPEG implementations for the Macintosh were able to exchange compressed files.)

The file format we have adopted is called JFIF (see REFERENCES). This format has been agreed to by a number of major commercial JPEG vendors, and it has become the de facto standard. JFIF is a minimal or "low end" representation. We recommend the use of TIFF/JPEG (TIFF revision 6.0 as modified by TIFF Technical Note #2) for "high end" applications that need to record a lot of additional data about an image. TIFF/JPEG is fairly new and not yet widely supported, unfortunately.

The upcoming JPEG Part 3 standard defines a file format called SPIFF. SPIFF is interoperable with JFIF, in the sense that most JFIF decoders should be able to read the most common variant of SPIFF. SPIFF has some technical advantages over JFIF, but its major claim to fame is simply that it is an official standard rather than an informal one. At this point it is unclear whether SPIFF will supersede JFIF or whether JFIF will remain the de-facto standard. IJG intends to support SPIFF once the standard is frozen, but we have not decided whether it should become our default output format or not. (In any case, our decoder will remain capable of reading JFIF indefinitely.)

Various proprietary file formats incorporating JPEG compression also exist. We have little or no sympathy for the existence of these formats. Indeed, one of the original reasons for developing this free software was to help force convergence on common, open format standards for JPEG files. Don't use a proprietary file format!

## TO DO

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The major thrust for v7 will probably be improvement of visual quality. The current method for scaling the quantization tables is known not to be very good at low Q values. We also intend to investigate block boundary smoothing, "poor man's variable quantization", and other means of improving quality-vs-file-size performance without sacrificing compatibility.

In future versions, we are considering supporting some of the upcoming JPEG Part 3 extensions --- principally, variable quantization and the SPIFF file format.

As always, speeding things up is of great interest.

Please send bug reports, offers of help, etc. to [jpeg-info@uunet.uu.net](mailto:jpeg-info@uunet.uu.net).

# 1.319 linux-kernel 3.4.113

## 1.319.1 Available under license :

FlashPoint Driver Developer's Kit  
Version 1.0

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```
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```
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```

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<signature of Ty Coon>, 1 April 1989
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TI DSP/Bridge Driver - Contributors File

The DSP/Bridge project wish to thank all of its contributors, current bridge driver is the result of the work of all of them. If any name is accidentally omitted, let us know by sending a mail to [omar.ramirez@ti.com](mailto:omar.ramirez@ti.com) or [x095840@ti.com](mailto:x095840@ti.com).

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```
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```

```
#define __LICENSE_H
```

```
static inline int license_is_gpl_compatible(const char *license)
```

```
{
 return (strcmp(license, "GPL") == 0
 || strcmp(license, "GPL v2") == 0
 || strcmp(license, "GPL and additional rights") == 0
 || strcmp(license, "Dual BSD/GPL") == 0
 || strcmp(license, "Dual MIT/GPL") == 0
 || strcmp(license, "Dual MPL/GPL") == 0);
}
```

```
#endif
```

```
/* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)
```

```
* nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)
```

```
*
```

```
* Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.
```

```
* http://www.hypermall.com/
```

```
* 10/1/97 - commented out CFG_PHYIE bit - we don't care when the PHY
```

```
* interrupts us (except possibly for removal/insertion of the cable?)
```

```
* 10/4/97 - began heavy inline documentation of the code. Corrected typos
```

```
* and spelling mistakes.
```

```
* 10/5/97 - added code to handle PHY interrupts, disable PHY on
```

```
* loss of link, and correctly re-enable PHY when link is
```

```
* re-established. (put back CFG_PHYIE)
```

```
*
```

```
* Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.
```

```
*
```

```
* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997
```

```
*
```

```
* Linux driver for the IDT77201 NICStAR PCI ATM controller.
```

```
* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;
```

```
* see init_nicstar() for PHY initialization to change this. This driver
```

```
* expects the Linux ATM stack to support scatter-gather lists
```

```
* (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.
```

```
*
```

```
* Implementing minimal-copy of received data:
```

```
* IDT always receives data into a small buffer, then large buffers
```

```
* as needed. This means that data must always be copied to create
```

```
* the linear buffer needed by most non-ATM protocol stacks (e.g. IP)
```

```
* Fix is simple: make large buffers large enough to hold entire
```

```
* SDU, and leave <small_buffer_data> bytes empty at the start. Then
```



```
* copy small buffer contents to head of large buffer.
* Trick is to avoid fragmenting Linux, due to need for a lot of large
* buffers. This is done by 2 things:
* 1) skb->destructor / skb->atm.recycle_buffer
* combined, allow nicstar_free_rx_skb to be called to
* recycle large data buffers
* 2) skb_clone of received buffers
* See nicstar_free_rx_skb and linearize_buffer for implementation
* details.
*
*
*
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* Foundation, Inc., 675 Mass Ave, Cambridge, MA 02139, USA.
*
* M. Welsh, 6 July 1996
*
*
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```

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single nxt200x frontend driver.

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```
<one line to give the program's name and a brief idea of what it does.>
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```

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`Gnomovision' (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989

Ty Coon, President of Vice

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## 1.322 tamlib-manufacturing 5.3.1

### 1.322.1 Available under license :

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```
/*-----
* ACT2 - Chip guard feature manufacturing routines
*
* May 2017, Burhan Wani
*
* Copyright (c) 2017 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297883_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-
gz/tam_mfg_library/tam_lib_mfg_chipguard.c
```

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```
/*-----
* tam_lib_mfg_installed_data --
*
* August 2020, ACT2 Team
*
* Copyright (c) 2020 by Cisco Systems, Inc.
* All rights reserved.
*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297883_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-
gz/tam_mfg_library/tam_lib_mfg_installed_data.c
```

No license file was found, but licenses were detected in source scan.

```
/*-----
```

\* tam\_lib\_mfg\_utils.c --

\*

\* July 2013, ACT2 Team

\*

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\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_utils.c

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/\*-----

\* tam\_lib\_mfg\_sudi\_request.c

\*

\* July 2013, ACT2 Team

\*

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\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_sudi\_request\_v2.c

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/\*-----

\* tam\_lib\_notice.c --

\*

\* Description

\* This file is generated prior to building  
\* from the Git context.

\*

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\*-----

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Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_notice.c

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```
/*-----
* tam_lib_mfg_mapped_objects.c
*
* April 2017, Andrew K. Thanos, III
*
* Copyright (c) 2017 by Cisco Systems, Inc.
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297883_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-
gz/tam_mfg_library/tam_lib_mfg_mapped_objects.c
No license file was found, but licenses were detected in source scan.
```

```
/*-----
* tam_lib_mfg_ecskmp.c --
*
* July 2013, ACT2 Team
*
* Copyright (c) 2013 by Cisco Systems, Inc.
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297883_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-
gz/tam_mfg_library/tam_lib_mfg_ecskmp.c
No license file was found, but licenses were detected in source scan.
```

```
/*-----
* tam_lib_mfg_cliip.c -- Chip Level Identity Information Package
*
* July 2013, ACT2 Team
*
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*-----
*/
```

Found in path(s):

```
* /opt/cola/permits/1702297883_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-
gz/tam_mfg_library/tam_lib_mfg_cliip.c
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```

```
/*-----
* tam_lib_mfg_reserved_users.c
*
*-----
*/
```

\* April 2017, Andrew K. Thanos, III  
\*  
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\*-----  
\*/

Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_reserved\_users.c

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/\*-----

\* tam\_lib\_mfg\_install\_certs.c

\*

\* January 2017, Andrew K. Thanos, III

\*

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\*-----

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Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_install\_certs.c

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/\*-----

\* tam\_lib\_mfg\_sudi\_install.c

\*

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\*

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\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_sudi\_install.c

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/\*-----

\* tam\_lib\_mfg\_version.c -- manufacturing library version string

\*

\* July 2013, ACT2 Team

\*

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\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_version.c

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/\*-----

\* tam\_lib\_mfg\_login.c

\*

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\*

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\*/

Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_login.c

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/\*-----

\* tam\_lib\_manufacturing.h --

\*

\* TAM Library v5.3.1-Release

\* Commit Date: Thu Aug 11 14:01:26 2022 -0700

\* by CISCO\gouthehd gouthehd@cisco.com

\*

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\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_manufacturing.h

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/\*-----

\* tam\_lib\_mfg\_errinfo.c --

\*

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\*



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\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_errinfo.c

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/\*-----

\* tam\_lib\_mfg\_cmd\_duration.c --

\*

\* November 2016, ACT2 Team

\*

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\*-----

\*/

Found in path(s):

\* /opt/cola/permits/1702297883\_1687715901.1685977/0/tam-mfg-library-5-3-1-tar-gz/tam\_mfg\_library/tam\_lib\_mfg\_cmd\_duration.c

# 1.323 wayland 0.95.0

## 1.323.1 Available under license :

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# 1.324 iproute 5.19.0

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## 1.329 imx-gpu-g2d 6.4.3.p4.2-aarch64

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## THE BASIC LIBRARY FUNCTIONS

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations, which became Zope Corporation. In 2001, the Python Software Foundation (PSF, see <https://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation was a sponsoring member of the PSF.

All Python releases are Open Source (see <http://www.opensource.org> for the Open Source Definition). Historically, most, but not all, Python releases have also been GPL-compatible; the table below summarizes the various releases.

| Release        | Derived from | Year      | Owner | GPL-compatible? (1) |
|----------------|--------------|-----------|-------|---------------------|
| 0.9.0 thru 1.2 |              | 1991-1995 | CWI   | yes                 |

|                |           |           |            |         |
|----------------|-----------|-----------|------------|---------|
| 1.3 thru 1.5.2 | 1.2       | 1995-1999 | CNRI       | yes     |
| 1.6            | 1.5.2     | 2000      | CNRI       | no      |
| 2.0            | 1.6       | 2000      | BeOpen.com | no      |
| 1.6.1          | 1.6       | 2001      | CNRI       | yes (2) |
| 2.1            | 2.0+1.6.1 | 2001      | PSF        | no      |
| 2.0.1          | 2.0+1.6.1 | 2001      | PSF        | yes     |
| 2.1.1          | 2.1+2.0.1 | 2001      | PSF        | yes     |
| 2.1.2          | 2.1.1     | 2002      | PSF        | yes     |
| 2.1.3          | 2.1.2     | 2002      | PSF        | yes     |
| 2.2 and above  | 2.1.1     | 2001-now  | PSF        | yes     |

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Portions of code from MODP\_ASCII - Ascii transformations (upper/lower, etc)

<https://github.com/client9/stringencoders>

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/\*! \brief

\* Define compile time symbols for CPU type and operating system type.

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\*

\* cpuopsys.h

\*

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\* /opt/cola/permits/1702297790\_1687538586.5811179/0/libnvc-r32-l4t-cisco-3-tar-gz/nvdc/nvdc\_headers/include/nvmisc\_macros.h

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/\*\*

\* NvColorDataType defines the data type of color components.

\*

\* The default datatype of color components is 'Integer' which should be used  
\* when the color value is to be interpreted as an integer value ranging from 0  
\* to the maximum value representable by the width of the components (as  
\* specified by the packing of the component). Use 'Integer' also when the  
\* interpretation of color value bits is not known, does not matter or is  
\* context dependent.

\*

\* A data type of 'Signed' indicates that the color value is to be interpreted  
\* as a signed two's complement integer value. The width of the component  
\* includes the sign bit (e.g. S8 ranges from -128 to 127).

\*  
 \* A data type of 'Float' indicates that float values are stored in the  
 \* components of the color. The combination of data type 'Float' and the  
 \* bit width of the component packing defines the final data format of the  
 \* individual component.  
 \*  
 \* The list below defines the accepted combinations, when adding new  
 \* float formats please add an entry into this list.  
 \*  
 \* - DataType = Float, Component bit width = 32:  
 \*   A IEEE 754 single precision float (binary32) with 1 sign bit,  
 \*   8 exponent bits and 23 mantissa bits.  
 \*  
 \* - DataType = Float, Component bit width = 16:  
 \*   A IEEE 754 half precision float (binary16) with 1 sign bit,  
 \*   5 exponent bits and 10 mantissa bits.  
 \*  
 \* - DataType = Float, Component bit width = 10:  
 \*   An unsigned nvfloat with 5 exponent bits and 5 mantissa bits.  
 \*  
 \* - DataType = Float, Component bit width = 11:  
 \*   An unsigned nvfloat with 5 exponent bits and 6 mantissa bits.  
 \*  
 \* - DataType = FloatISP, Component bit width = 16:  
 \*   A Nvidia proprietary Floating point representation for optimal  
 \*   usage in ISP, with 4 exponent bits and 12 mantissa bits.  
 \*/

Found in path(s):

\* /opt/cola/permits/1702297790\_1687538586.5811179/0/libnvdc-r32-l4t-cisco-3-tar-  
 gz/nvdc/nvdc\_headers/include/nvcolor.h

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 gz/nvdc/nvdc\_headers/include/nvrm\_memmgr.h

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```
*/opt/cola/permits/1702297790_1687538586.5811179/0/libnvc-r32-l4t-cisco-3-tar-
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```

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Found in path(s):

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* /opt/cola/permits/1702297790_1687538586.5811179/0/libnvc-r32-l4t-cisco-3-tar-
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```

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```
* /opt/cola/permits/1702297790_1687538586.5811179/0/libnvc-r32-l4t-cisco-3-tar-gz/nvdc/src/displays.c
```

## 1.339 react-numeric-input 2.2.3

### 1.339.1 Available under license :

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# 1.340 fdk-aac v2.0.1

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Am Wolfsmantel 33  
91058 Erlangen, Germany

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# 1.341 libgpiod 1.6.3

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## 1.343 v4l-utils 1.25.0

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mail06.corp.redhat.com with LMTP; Wed, 19 May 2010 02:43:28 -0400 (EDT)  
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by zmta01.collab.prod.int.phx2.redhat.com (Postfix) with ESMTP id B6AB39081C;  
Wed, 19 May 2010 02:43:28 -0400 (EDT)  
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by localhost (zmta01.collab.prod.int.phx2.redhat.com [127.0.0.1]) (amavisd-new, port 10024)  
with ESMTP id ieqQbA5XErc0; Wed, 19 May 2010 02:43:28 -0400 (EDT)  
Received: from int-mx04.intmail.prod.int.phx2.redhat.com (int-mx04.intmail.prod.int.phx2.redhat.com [10.5.11.17])  
by zmta01.collab.prod.int.phx2.redhat.com (Postfix) with ESMTP id A451890805;  
Wed, 19 May 2010 02:43:28 -0400 (EDT)  
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by int-mx04.intmail.prod.int.phx2.redhat.com (8.13.8/8.13.8) with ESMTP id o4J6hSHT030087;  
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Wed, 19 May 2010 02:43:17 -0400  
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by gs8.inmotionhosting.com with esmtpsa (TLSv1:AES256-SHA:256)  
(Exim 4.69)  
(envelope-from <bill@thedirks.org>)  
id 1OEd8K-0004wo-An; Tue, 18 May 2010 23:52:00 -0700  
Message-ID: <4BF38878.9030208@thedirks.org>  
Date: Tue, 18 May 2010 23:43:04 -0700  
From: Bill Dirks <bill@thedirks.org>  
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US; rv:1.9.1.9) Gecko/20100317 Thunderbird/3.0.4  
MIME-Version: 1.0  
To: Hans de Goede <hdegoede@redhat.com>  
CC: Huzaifa Sidhpurwala <huzaifas@redhat.com>  
Subject: Re: License question about v411-compatible.c  
References: <4BF2445B.2080203@redhat.com>  
In-Reply-To: <4BF2445B.2080203@redhat.com>  
Content-Type: text/plain; charset=ISO-8859-1; format=flowed  
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X-Source-Args:  
X-Source-Dir:  
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X-Scanned-By: MIMEDefang 2.67 on 10.5.11.17  
X-Scanned-By: MIMEDefang 2.67 on 10.5.110.6

Hi, Hans. Nice to 'meet' you.

Yes, that's fine. Take what you need from my code and use it in your



LGPL licensed library. I'm all in favor of removing v4l1 from the kernel.

Bill.

On 5/18/2010 12:40 AM, Hans de Goede wrote:

- > Hi Bill,
- >
- > AFAIK you've been out of the v4l loop, so I assume you
- > don't know me, this let me start with a shot self introduction:
- >
- > I'm a Linux enthusiast / developer. Amongst other things I've
- > ported over many webcam drivers from v4l1 to v4l2 and I'm the
- > author and maintainer of libv4l.
- >
- > Let me also quickly introduce libv4l about 3 years ago I had
- > too much free time and was looking for a hobby project and I
- > decided that improving webcam support under Linux would be
- > a nice project. At that time there were many webcam driver but
- > most of them were out of tree, including the gspca driver
- > which is a usb webcam driver framework supporting a lot
- > of different chipsets.
- >
- > One problem with getting these merged is that a lot of webcam
- > chipsets produce proprietary (compressed) video formats, which
- > apps don't understand. The out of tree drivers all "fixed" this
- > by doing decompression and video format conversion inside the
- > kernel.
- >
- > This was not acceptable thus it was time to write a library
- > to sit between v4l2 apps and devices which could do format
- > conversion if necessary. This resulted in libv4l2 and
- > libv4lconvert being written, with libv4l2 being the glue sitting
- > in between and libv4lconvert doing the actual conversion.
- >
- > But this did not help v4l1 apps, so I also wrote libv4l1 for those.
- >
- > Both libv4l1 and libv4l2 work by emulating the raw device API, all
- > one needs to do is write v4lx\_open instead of plain open when opening
- > the device and them use v4lx\_ioctl, etc. on the resulting fd instead
- > of their plain versions. This serves 2 purposes:
- > 1) It makes porting of apps the the library trivial
- > 2) It allows for an LD\_PRELOAD shim (used for proprietary apps such
- > as skype).
- >
- > And now (finally) my question to you, lately we (the v4l devs) have
- > been working on removing the last bits of v4l1 from the kernel.
- > We would like to also remove the v4l1 ioctl compatibility (\*), but

> currently libv4l1 depends on the v4l1 ioctl compatibility for some  
> ioctls.  
>  
> Fixing this comes down to looking at what the kernel compat code  
> does and then implementing that in libv4l1. This will likely involve  
> some direct copying and libv4l1 is licensed under the LGPL rather  
> than the GPL. Thus my question is would it be ok to use your v4l1 compat  
> code under the LGPL inside libv4l1 ?  
>  
> Thanks & Regards,  
>  
> Hans  
>  
>  
> (\*) As in practice v4l1 apps need libv4l1 anyways both for format  
> conversion and because some v4l2 drivers don't implement VIDIOCGMIBUF  
> including rather important ones like the UVC driver, thus we've  
> come to the conclusion that we might just as well drop the  
> compatibility from the kernel  
>

#####

Return-Path: kraxel@redhat.com

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zmta02.collab.prod.int.phx2.redhat.com) (10.5.5.32) by  
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by zmta02.collab.prod.int.phx2.redhat.com (Postfix) with ESMTP id BA56C9C63A  
for <hdegoede@redhat.com>; Wed, 19 May 2010 04:25:49 -0400 (EDT)

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Wed, 19 May 2010 04:25:49 -0400 (EDT)

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for <hdegoede@mail.corp.redhat.com>; Wed, 19 May 2010 04:25:49 -0400 (EDT)

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by int-mx08.intmail.prod.int.phx2.redhat.com (8.13.8/8.13.8) with ESMTP id o4J8PjFh018889  
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for <hdegoede@redhat.com>; Wed, 19 May 2010 04:25:47 -0400

Message-ID: <4BF3A088.4050101@redhat.com>

Date: Wed, 19 May 2010 10:25:44 +0200

From: Gerd Hoffmann <kraxel@redhat.com>

User-Agent: Mozilla/5.0 (X11; U; Linux x86\_64; en-US; rv:1.9.1.9) Gecko/20100430 Fedora/3.0.4-2.fc12

Thunderbird/3.0.4

MIME-Version: 1.0

To: Hans de Goede <hdegoede@redhat.com>  
Subject: Re: Re-licensing v4l1-compat.c code which you wrote  
References: <4BF3A064.7080602@redhat.com>  
In-Reply-To: <4BF3A064.7080602@redhat.com>  
Content-Type: text/plain; charset=ISO-8859-1; format=flowed  
Content-Transfer-Encoding: 7bit  
X-Scanned-By: MIMEDefang 2.67 on 10.5.11.21

Hi,

> My question to you is would it be ok to use your v4l1 compat  
> contributions under the LGPL inside libv4l1 ?

Fine with me.

cheers,  
Gerd

#####

Return-Path: hverkuil@xs4all.nl  
Received: from zmta02.collab.prod.int.phx2.redhat.com (LHLO  
zmta02.collab.prod.int.phx2.redhat.com) (10.5.5.32) by  
mail06.corp.redhat.com with LMTP; Wed, 19 May 2010 04:28:02 -0400 (EDT)  
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(SquirrelMail authenticated user hverkuil)  
by webmail.xs4all.nl with HTTP;  
Wed, 19 May 2010 10:27:50 +0200

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In-Reply-To: <4BF3A064.7080602@redhat.com>  
References: <4BF3A064.7080602@redhat.com>  
Date: Wed, 19 May 2010 10:27:50 +0200  
Subject: Re: Re-licensing v411-compat.c code which you wrote  
From: "Hans Verkuil" <hverkuil@xs4all.nl>  
To: "Hans de Goede" <hdegoede@redhat.com>  
Cc: "Gerd Hoffmann" <kraxel@redhat.com>,  
    "Mauro Carvalho Chehab" <mchehab@redhat.com>,  
    "Trent Piepho" <xyzy@speakeasy.org>,  
    "Huzaifa Sidhpurwala" <huzaifas@redhat.com>  
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X-Scanned-By: MIMEDefang 2.67 on 10.5.11.16  
X-Scanned-By: MIMEDefang 2.67 on 10.5.110.14

> Hi All,  
>  
> I'm writing you all because you've contributed patches  
> to the kernels v411 ioctl compat code living in v411-compat.c  
>  
> Most of you already know me, and know that I'm working on  
> making libv411 become independent of the kernel v411 ioctl  
> compat code, so that it can be removed from the kernel.  
>  
> For those who don't know me or the v411 cleanup effort,  
> read below for the long story.  
>  
> Making libv411 independent of the v411-compat.c code in the  
> kernel comes down to looking at what the kernel compat code  
> does and then implementing that in libv411. This will likely involve  
> some direct copying and libv411 is licensed under the LGPL rather  
> than the GPL. I already have permission from Bill Dirks who wrote  
> the initial v411-compat code to do this.  
>  
> My question to you is would it be ok to use your v411 compat  
> contributions under the LGPL inside libv411 ?

Permission granted.

Looking forward to seeing this in libv411 so we can kill this legacy code  
in the kernel.

Regards,

Hans Verkuil

>

> Thanks & Regards,

>

> Hans

>

>

> The long story:

>

> I'm a Linux enthusiast / developer. Amongst other things I've

> ported over many webcam drivers from v4l1 to v4l2 and I'm the

> author and maintainer of libv4l.

>

> Let me also quickly introduce libv4l about 3 years ago I had

> too much free time and was looking for a hobby project and I

> decided that improving webcam support under Linux would be

> a nice project. At that time there were many webcam driver but

> most of them were out of tree, including the gspca driver

> which is a usb webcam driver framework supporting a lot

> of different chipsets.

>

> One problem with getting these merged is that a lot of webcam

> chipsets produce proprietary (compressed) video formats, which

> apps don't understand. The out of tree drivers all "fixed" this

> by doing decompression and video format conversion inside the

> kernel.

>

> This was not acceptable thus it was time to write a library

> to sit between v4l2 apps and devices which could do format

> conversion if necessary. This resulted in libv4l2 and

> libv4lconvert being written, with libv4l2 being the glue sitting

> in between and libv4lconvert doing the actual conversion.

>

> But this did not help v4l1 apps, so I also wrote libv4l1 for those.

>

> Both libv4l1 and libv4l2 work by emulating the raw device API, all

> one needs to do is write v4lx\_open instead of plain open when opening

> the device and then use v4lx\_ioctl, etc. on the resulting fd instead

> of their plain versions. This serves 2 purposes:

> 1) It makes porting of apps the the library trivial

> 2) It allows for an LD\_PRELOAD shim (used for proprietary apps such

> as skype).

>

> Lately we (the v4l devs) have been working on removing the last bits

> of v4l1 from the kernel. We would like to also remove the v4l1 ioctl

> compatibility (\*), but currently libv4l1 depends on the v4l1 ioctl  
> compatibility for some ioctls, we are working on fixing this  
> which involves re-using code from v4l1-compat.c, hence the  
> re-licensing permission question.  
>  
> (\*) As in practice v4l1 apps need libv4l1 anyways both for format  
> conversion and because some v4l2 drivers don't implement VIDIOCGMBUF  
> including rather important ones like the UVC driver, thus we've  
> come to the conclusion that we might just as well drop the  
> compatibility from the kernel.  
>

--

Hans Verkuil - video4linux developer - sponsored by TANDBERG, part of Cisco

#####

Return-Path: mchehab@redhat.com

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Message-ID: <4BF3F4B9.3060803@redhat.com>

Date: Wed, 19 May 2010 11:24:57 -0300

From: Mauro Carvalho Chehab <mchehab@kernel.org>

User-Agent: Thunderbird 2.0.0.22 (X11/20090609)

MIME-Version: 1.0

To: Hans de Goede <hdegoede@redhat.com>

CC: Gerd Hoffmann <kraxel@redhat.com>, Hans Verkuil <hverkuil@xs4all.nl>,  
Trent Piepho <xyzz@speakeasy.org>,  
Huzaifa Sidhpurwala <huzaifas@redhat.com>

Subject: Re: Re-licensing v4l1-compat.c code which you wrote

References: <4BF3A064.7080602@redhat.com>

In-Reply-To: <4BF3A064.7080602@redhat.com>

Content-Type: text/plain; charset=ISO-8859-1  
Content-Transfer-Encoding: 7bit  
X-Scanned-By: MIMEDefang 2.67 on 10.5.11.21

Hans de Goede wrote:

> Hi All,  
>  
> I'm writing you all because you've contributed patches  
> to the kernels v4l1 ioctl compat code living in v4l1-compat.c  
>  
> Most of you already know me, and know that I'm working on  
> making libv4l1 become independent of the kernel v4l1 ioctl  
> compat code, so that it can be removed from the kernel.  
>  
> For those who don't know me or the v4l1 cleanup effort,  
> read below for the long story.  
>  
> Making libv4l1 independent of the v4l1-compat.c code in the  
> kernel comes down to looking at what the kernel compat code  
> does and then implementing that in libv4l1. This will likely involve  
> some direct copying and libv4l1 is licensed under the LGPL rather  
> than the GPL. I already have permission from Bill Dirks who wrote  
> the initial v4l1-compat code to do this.  
>  
> My question to you is would it be ok to use your v4l1 compat  
> contributions under the LGPL inside libv4l1 ?

LGPL for v4l1-compat code is fine for me.

Cheers,  
Mauro

#####

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Version 2.1, February 1999

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^L

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## 1.344 zlib 1.2.5

### 1.344.1 Available under license :

```
/* zlib.h -- interface of the 'zlib' general purpose compression library
 version 1.2.11, January 15th, 2017
```

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Bellis, Ray  
Benali, Elias  
Beverly, Jamie  
Boardman, Spider  
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Braun, Rob  
Bezina, Pavel  
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ek, Vtislav  
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The following people have worked to translate sudo into other languages as part of the Translation Project, see <https://translationproject.org> for more details.

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## 1.357 vx-scale 0.0.199

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## 1.359 libconfig 1.7.3

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Version 2.1, February 1999

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Random Hacker.
```

```
<signature of Ty Coon>, 1 April 1990
```

Ty Coon, President of Vice

That's all there is to it!

```
@c \input texinfo.tex @c -*texinfo-*
```

```
@c
```

```
@c %**start of header
```

```
@c All text is ignored before the setfilename.
```

```
@setfilename LGPL.info
```

```
@center GNU LESSER GENERAL PUBLIC LICENSE
```

```
@center Version 2.1, February 1999
```

```
@sp 1
```

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```
@center Preamble
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```
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A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a ``work that uses the Library''. Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

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Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

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Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

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Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

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@center How to Apply These Terms to Your New Libraries

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@format

@t{

<one line to give the library's name and a brief idea of what it does.>

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}

@end format

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```
@format
```

```
@t{
```

```
Yoyodyne, Inc., hereby disclaims all copyright interest in the
library `Frob' (a library for tweaking knobs) written by James Random Hacker.
```

```
<signature of Ty Coon>, 1 April 1990
```

```
Ty Coon, President of Vice
```

```
}
```

```
@end format
```

That's all there is to it!

```
@c @bye
```

```
GNU GENERAL PUBLIC LICENSE
```

```
Version 2, June 1991
```

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/\* nicstar.c v0.22 Jawaid Bazyar (bazyar@hypermall.com)

\* nicstar.c, M. Welsh (matt.welsh@cl.cam.ac.uk)

\*

\* Hacked October, 1997 by Jawaid Bazyar, Interlink Advertising Services Inc.

\* <http://www.hypermall.com/>

\* 10/1/97 - commented out CFG\_PHYIE bit - we don't care when the PHY

\* interrupts us (except possibly for removal/insertion of the cable?)

\* 10/4/97 - began heavy inline documentation of the code. Corrected typos

\* and spelling mistakes.

\* 10/5/97 - added code to handle PHY interrupts, disable PHY on

\* loss of link, and correctly re-enable PHY when link is

\* re-established. (put back CFG\_PHYIE)

\*

\* Modified to work with the IDT7721 nicstar -- AAL5 (tested) only.

\*

\* R. D. Rechenmacher <ron@fnal.gov>, Aug. 6, 1997

\*

\* Linux driver for the IDT77201 NICStAR PCI ATM controller.

\* PHY component is expected to be 155 Mbps S/UNI-Lite or IDT 77155;

\* see init\_nicstar() for PHY initialization to change this. This driver

\* expects the Linux ATM stack to support scatter-gather lists

\* (skb->atm.iovcnt != 0) for Rx skb's passed to vcc->push.

\*

\* Implementing minimal-copy of received data:

\* IDT always receives data into a small buffer, then large buffers

\* as needed. This means that data must always be copied to create

\* the linear buffer needed by most non-ATM protocol stacks (e.g. IP)

\* Fix is simple: make large buffers large enough to hold entire

\* SDU, and leave <small\_buffer\_data> bytes empty at the start. Then

\* copy small buffer contents to head of large buffer.

\* Trick is to avoid fragmenting Linux, due to need for a lot of large

\* buffers. This is done by 2 things:

\* 1) skb->destructor / skb->atm.recycle\_buffer

\* combined, allow nicstar\_free\_rx\_skb to be called to

\* recycle large data buffers

\* 2) skb\_clone of received buffers

\* See nicstar\_free\_rx\_skb and linearize\_buffer for implementation

\* details.

\*

\*

\*

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\*  
\* M. Welsh, 6 July 1996  
\*  
\*  
\*/

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```

The hypothetical commands ``show w'` and ``show c'` should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than ``show w'` and ``show c'`; they could even be mouse-clicks or menu items--whatever suits your program.

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<signature of Ty Coon>, 1 April 1989  
Ty Coon, President of Vice

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