



Users Guide

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Chapter 1

Welcome to ImageMagick

Overview

ImageMagick™ is an X11 package for displaying and interactively manipulating one or more images. Using ImageMagick you can display any image on any workstation screen running an X server.

ImageMagick can read and write over fifty of the more popular image formats including JPEG, TIFF, PNM, GIF, Photo CD, and PostScript. ImageMagick lets you interactively resize, rotate, sharpen, color reduce, and add special effects to an image, and save your completed work in the same or a different image format.

While ImageMagick has a simple point-and-click interface, its power lies in its command line abilities. Today's popular image manipulation software packages require you to work with individual images. With ImageMagick, you can manipulate entire directories of images with one simple script. For example, on Unix, you can specify

```
foreach file (*.jpg)
  convert $file $file:r.gif
end
```

ImageMagick lets you perform any of the following functions:

- convert from one image format to another
- resize, rotate, sharpen, color reduce, and add special effects to an image

- create a framed thumbnail of an image
- create a transparent image for use on the World Wide Web
- create a GIF animation sequence from a group of images
- combine several images to create a composite image
- segment an image based on its color histogram
- describe the format of the image and attributes
- retrieve, list, or print files from a remote network site

ImageMagick is written in the portable C programming language and interfaces with the X11 Window library. It will compile with any modern C compiler—no proprietary toolkits are required!

ImageMagick's Core Features

ImageMagick's core features include the following.

Display. Display is a machine architecture-independent image and display program. It can display an image on any workstation display running an X server.

For detailed information, see [Chapter 4, Display](#).

Import. Import reads an image from any visible window on an X server and outputs it as an image file. You can capture a single window, the entire screen, or any rectangular portion of the screen. You can use Display for redisplay, printing, editing, formatting, archiving, and image processing of the captured image.

For detailed information, see [Chapter 5, Import](#).

Animate. Animate displays a sequence of images on any workstation display running an X server. Animate first determines the hardware capabilities of the workstation. If the number of unique colors in an image is fewer than or equal to the number the workstation can support, the image is displayed in an X window. Otherwise the number of colors in the image is first reduced to match the color resolution of the workstation.

In other words, a continuous-tone 24 bpi image can display on an 8-bit pseudo-color device or monochrome device. In most instances the reduced color image closely resembles the original. In turn, a monochrome or pseudo-color image sequence can display on a continuous-tone 24 bpi device.

For detailed information, see [Chapter 6, Animate](#).

Montage. Montage creates a composite image by combining several separate images. The images are tiled on the composite image with the name of the image optionally appearing just below the individual tile.

For detailed information, see [Chapter 7, Montage](#).

Convert. Convert converts an input file in one format to an output file in another format. By default, the image format is determined by its magic number. To specify a particular image format, you can precede the filename with an image format name and a colon (e.g., ps:image) or specify the image type as the filename suffix (e.g., image.ps). For detailed information, see [Chapter 8, Convert](#).

Mogrify. Mogrify transforms an image or a sequence of images. These transformations include image scaling, image rotation, color reduction, and others. The transmogrified image overwrites the original image.

For detailed information, see [Chapter 9, Mogrify](#).

Identify. Identify describes the format and characteristics of one or more image files. It also reports if an image is incomplete or corrupt. The information displayed includes the scene number, file name, width and height of the image, whether the image is colormapped, the number of colors in the image, the number of bytes in the image, its format (i.e., jpeg, pnm, etc.), and finally the number of seconds it takes to read and process the image.

For detailed information, see [Chapter 10, Identify](#).

Combine. Combine combines images to create new images.

For detailed information, see [Chapter 11, Combine](#).

PerlMagick. PerlMagick is an objected-oriented Perl interface to ImageMagick. You can use it to read, manipulate, or write an image or image sequence from within a Perl script. This makes it very suitable for web CGI scripts. For examples of what you can do with PerlMagick, see <http://www.sympatico.org/cristy/MogrifyMagick/>.

For detailed information, see [Chapter 12, PerlMagick](#).

ImageMagick Studio

You can visit the ImageMagick Studio web site at <http://www.wizards.dupont.com> to try out any of the ImageMagick functions. A sample image is just a click away.

It's Free

ImageMagick is free! You can do anything with the software you want, including selling it. The software *is* copyrighted, however, you can redistribute it without fee. For detailed information, see the copyright notice at the beginning of the guide.

Chapter 2

Installing ImageMagick

web page
www.wizards.dupont.com

Getting ImageMagick

You can download ImageMagick from <ftp://ftp.wizards.dupont.com/pub/ImageMagick>. ImageMagick client executables are available for some platforms. Macintosh, NT, VMS, and Linux source and binaries are also available.

External Image Viewer

To use *Display* as your external image viewer, edit the global mailcap file or your personal mailcap file—.mailcap located in your home directory—and add this entry:

```
image/*; display %s
```

Mailing List

There is a mailing list for discussions and bug reports about ImageMagick. To subscribe send the message

```
subscribe magick
```

to majordomo@wizards.dupont.com. You'll receive a welcome message telling you how to post messages to the list magick@wizards.dupont.com.

Memory Requirements

You should allocate sufficient swap space on your system before running ImageMagick; otherwise, you may experience random server or application crashes. Anything less than 80 MB of swap space is likely to cause random crashes.

On many systems, you will find that 80 MB is insufficient and you'll have to allocate more swap space. You should also have at least 32 MB of real memory although 64 MB or more is recommended.

Unix Compilation

Type

```
gunzip ImageMagick-4.1.tar.gz
tar xvf ImageMagick-4.1.tar
cd ImageMagick
```

Note: If you don't have gunzip, you can download it from <ftp://prep.ai.mit.edu/pub/gnu>.

Creating makefiles

There are currently two mechanisms for creating makefiles to build ImageMagick: GNU Configure (see [GNU Configure](#)) and X11 Imake (see [X11 Imake](#)).

GNU Configure

GNU Configure is easiest to use and is recommended when you want to install ImageMagick outside of the X11 distribution or working imake configuration files are not available. Using *configure* enables automated configuration, building, and installation of PerlMagick. If you're willing to accept *configure*'s default options, type

```
./configure
```

Watch the *configure* script output to verify that it finds everything you think it should. If it doesn't, adjust your environment so it does.

If you're unhappy with *configure*'s choice of compiler, compilation flags, or libraries, you can give *configure* initial values for variables by setting them in the environment. Using a Bourne-compatible shell, you can do that on the command line like this

```
CC=c89 CFLAGS=-O2 LIBS=-lposix ./configure
```

Or on systems that have the *env* program, you can do it like this

```
env CPPFLAGS=-I/usr/local/include LDFLAGS=-s ./configure
```

The *configure* variables you should be aware of are

Variable	Definition
CC	Name of C compiler (e.g., 'cc -Xa ') to use
CFLAGS	Compiler flags (e.g., '-g -O2 ') to compile with

Variable (Cont.)	Definition
CPPFLAGS	Include paths (<code>-I/somedir</code>) to look for header files
LDFLAGS	Library paths (<code>-L/somedir</code>) to look for libraries Note: Systems that support the notion of a library run-path may additionally require <code>-R/somedir</code> or <code>'-rpath /somedir'</code> in order to find shared libraries at run time.
LIBS	Extra libraries (<code>-lsomelib</code>) required to link

You must specify an absolute path rather than a relative path for any variable that requires a directory path (e.g., CPPFLAGS or LDFLAGS).

By default, *make install* will install the package's files in `/usr/local/bin`, `/usr/local/man`, etc. You can specify an installation prefix other than `/usr/local` by giving *configure* the option `--prefix=PATH`.

Configure can usually find the X include and library files automatically, but if it doesn't, you can use the configure options `--x-includes=DIR` and `--x-libraries=DIR` to specify their locations.

The *configure* script provides a number of ImageMagick-specific options. When you disable an option,

- `--disable-something` is the same as `--enable-something=no`
- `--without-something` is the same as `--with-something=no`

The *configure* options are as follows (execute `configure --help` to see all options).

This...	Does this
<code>--enable-16bit-pixel</code>	enables 16 bit pixels (default is no)
<code>--enable-gcov</code>	enables gcov source profiling support (default is no)
<code>--enable-gprof</code>	enables gprof source profiling support (default is no)
<code>--enable-lzw</code>	enables LZW support (default is no)
<code>--enable-prof</code>	enables prof source profiling support (default is no)
<code>--enable-sfio</code>	enable sfio-based stdio support (default is no)
<code>--enable-shared</code>	builds shared libraries (default is no)
<code>--enable-static</code>	builds static libraries (default is yes)
<code>--enable-socks</code>	enables use of SOCKS v5 library and 'rftp'
<code>--enable-socks</code>	enables SOCKS v5 proxy support (default is no)
<code>--with-bzlib</code>	enables BZLIB (default is yes)
<code>--with-dmalloc</code>	use dmalloc, as in ftp://ftp.letters.com/src/dmalloc/dmalloc.tar.gz
<code>--with-dps</code>	enables Display Postscript (default is yes)

This... (Cont.)	Does this
<code>--with-fpx</code>	enables FlashPIX (default is yes)
<code>--with-frozenpaths</code>	enables frozen delegate paths (default is yes)
<code>--with-hdf</code>	enables HDF (default is yes)
<code>--with-jbig</code>	enables JBIG (default is yes)
<code>--with-jpeg</code>	enables JPEG (default is yes)
<code>--with-perl</code>	enables build/install of PerlMagick (default is no)
<code>--with-png</code>	enables PNG (default is yes)
<code>--with-tiff</code>	enables TIFF (default is yes)
<code>--with-ttf</code>	enables TrueType (default is yes)
<code>--with-x</code>	uses the X Window System
<code>--with-zlib</code>	enables Zlib (default is yes)

ImageMagick options represent one of the following:

- features to be enabled
- packages to be included in the build

When you enable a feature (via `--enable-something`), it enables code already present in ImageMagick. When you enable a package (via `--with-something`), the *configure* script will search for it. If it's properly installed and ready to use (i.e., headers and built libraries are found by the compiler) it will be included in the build.

Note: The *configure* script is delivered with all features disabled and all packages enabled. In general, the only reason to disable a package is if a package exists but it is unsuitable for the build—perhaps it's an old version or it's compiled with the wrong compilation flags.

Special Configure Options Considerations

`--disable-shared`

- The shared libraries are not built. Shared libraries are valuable because they are shared across more than one invocation of an ImageMagick or PerlMagick client. In addition, the clients take much less disk space and shared libraries are required in order for PERL to dynamically load the PerlMagick extension.
- ImageMagick built with plug-ins (see [Delegates](#) below) can pose the following additional challenges:
 - ❑ You can build all the plug-ins statically and link them into the ImageMagick shared library (i.e., `libMagick.so`) or
 - ❑ you can build the plug-ins as shared libraries. (**Note:** Some systems already have plug-ins installed as shared libraries.)
- Shared library's compilation flags differ from vendor to vendor (gcc's is `-fPIC`). However, you must compile all shared library source with the same flag. (**Note:** For gcc use `-fPIC` rather than `-fpic`.)

`--disable-static`

- Static archive libraries (with extension .a) are not built. If you are building shared libraries, there is little value to building static libraries. Reasons to build static libraries include:
 - ❑ they can be easier to debug
 - ❑ the clients do not have external dependencies (i.e., libMagick.so)
 - ❑ building PIC versions of the plug-in libraries may take additional expertise and effort
 - ❑ you are unable to build shared libraries

`--with-perl`

- Conveniently compile and install PerlMagick in one step. Without this option you must first install ImageMagick, change to the PerlMagick subdirectory, build, and finally, install PerlMagick.

Note: PerlMagick is configured even if you don't specify `--with-perl`. If you don't specify `--enable-shared`, a new PERL interpreter (i.e., PerlMagick) is built and statically linked against the PerlMagick extension. This new interpreter is installed alongside your existing PERL interpreter. If you specify `--enable-shared`, the PerlMagick extension is built as a dynamically loadable object that's loaded into your current PERL interpreter at run-time. Use of dynamically-loaded extensions is preferable over statically linked extensions so `--enable-shared` should be specified if possible. If the argument `--with-perl=/path/to/perl` is supplied, then `/path/to/perl` is taken as the PERL interpreter to use.

`--with-x=no`

- Build and use the X11 stubs library (i.e., ImageMagick/xlib) instead of the core X11 libraries. This may be necessary on systems where X11 is not installed (e.g., a web server).

Note: *Display*, *animate*, and *import* will not work with this library. The remaining programs have reduced functionality.

Dealing with Configuration Failures

While `configure` is designed to ease the installation of ImageMagick, it often discovers problems that would otherwise be encountered later when you compile ImageMagick. The `configure` script tests for headers and libraries by executing the compiler (CC) with the specified compilation flags (CFLAGS), pre-processor flags (CPPFLAGS), and linker flags (LDFLAGS). Any errors are logged to the file `config.log`. If `configure` fails to discover a header or library, review the log file to determine why. After you correct the problem, be sure to remove the 'config.cache' file before you run `configure` so it will re-inspect the environment rather than using the cached values.

Common causes of configuration failures are

- a plug-in header is not in the header include path (CPPFLAGS -I option)
- a plug-in library is not in the linker search/run path (LDFLAGS -L/-R option)
- a plug-in library is missing a function (old version?)
- the compilation environment is faulty

Reporting Bugs

If you've tried all reasonable corrective actions and the problem appears to be due to a flaw in the *configure* script, email a bug report to the *configure* script maintainer at bfriesen@simple.dallas.tx.us.

Bug reports should contain the following:

- operating system type (as reported by 'uname -a')
- the compiler/compiler-version

A copy of the *configure* script output and/or the config.log file may be valuable in order to find the problem.

X11 Imake

Use this option if working imake configuration files are available and you don't mind editing a configuration file. Install the package using the imake default installation directory (i.e., usually the X11 distribution directory). Use of this scheme requires a separate step to install PerlMagick. See the ReadMe file in the PerlMagick subdirectory.

Review the defines in magick/magick.h and magick/delegates.h and make sure they meet the requirements of your local system.

Edit magick.tmpl and set the variables to suit your local environment.

Now type

```
xmkmf
make Makefiles
```

or just

```
xmkmf -a
```

Using X11R6 Imake

ImageMagick requires an ANSI compiler. If the compile fails, first check to ensure your compile is ANSI compatible. If it fails for some other reason, try

```
cd magick
make -k
cd ..
make -k
```

To confirm your build of the ImageMagick distribution was successful, type

```
display
```

If the program faults, verify you didn't inadvertently link to an older version of the libMagick library. In this case type

```
cd ImageMagick/magick
make install
cd ..
make
```

If the image colors are not correct use

```
display -visual default
```

You can find other sample images in the images directory.

For additional information, see the following ImageMagick chapters.

- [Chapter 4, Display](#)
- [Chapter 8, Convert](#)
- [Chapter 7, Montage](#)
- [Chapter 10, Identify](#)
- [Chapter 6, Animate](#)
- [Chapter 5, Import](#)
- [Chapter 9, Mogrify](#)
- [Chapter 11, Combine](#)

Also read the ImageMagick Frequently Asked Questions web page at <http://www.wizards.dupont.com/cristy/www/Magick.html>. This is “required reading.” Most ImageMagick questions received via email are answered in this document.

Place display X application defaults in `/usr/lib/X11/app-defaults/Display`. Use the appropriate name for other clients (e.g., *Animate*, *Montage*, etc). To execute display as a menu item of any window manager (e.g., *olwm*, *mwm*, *twm*, etc), use

```
display logo:Untitled
```

Delegates

To further enhance the capabilities of ImageMagick, you may want to get the following programs or libraries. Many of these delegates can be found at <ftp://ftp.wizards.dupont.com/pub/ImageMagick/delegates>.

Background Texture

ImageMagick requires a background texture for the *Tile* format and for the `-texture` option of *Montage*. You can use your own or get samples from KPT.

RALCGM

ImageMagick requires `ralcgm` to read Computer Graphic Metafile images (may not compile under linux). You also need Ghostscript (see below).

TransFig

ImageMagick requires fig2dev to read TransFig images.

GET

ImageMagick requires Get to read images specified with a world wide web (WWW) uniform resource locator (URL). Get must be in `/usr/local/bin`. See `WWW` command in `magick/magick.h` to change its location.

Note: Don't confuse this Get program with the SCCS Get program. If you don't have an http server, you can use xtp, available in the ImageMagick distribution, for URLs whose protocol is ftp.

FPX

ImageMagick requires the FlashPix SDK to read and write the FPX image format.

FreeType

ImageMagick requires the FreeType software, version 1.1 or later, to annotate with TrueType fonts.

HDF

ImageMagick requires the NCSA HDF library to read and write the HDF image format.

HTML2PS

ImageMagick requires HTML2PS to read HyperText Markup Language (HTML) documents.

JBIG

ImageMagick requires the JBIG-Kit software to read and write the JBIG image format.

JPEG

ImageMagick requires the Independent JPEG Group's software to read and write the JPEG image format.

Iterative JPEG Compression

See Kinoshita and Yamamuro, *Journal of Imaging Science and Technology, Image Quality with Reiterative JPEG Compression*, Volume 39, Number 4, July 1995, 306–312, who claim that

- the iterative factor of the repetitive JPEG operation had no influence on image quality, and
- the first compression determined base image quality.

MPEG

ImageMagick requires the MPEG encoder/decoder to read or write the MPEG image format.

PNG

ImageMagick requires the PNG library to read the PNG image format.

PostScript

ImageMagick requires Ghostscript software to read PostScript (PS) and Portable Document Format (PDF) images. It is used to annotate an image when an X server is not available. See [FreeType](#), above for another means to annotate an image.

Note: Ghostscript must support the ppmraw device (type `gs -h` to verify). If Ghostscript is unavailable, the Display Postscript extension is used to rasterize a Postscript document (assuming you define HasDPS). The DPS extension is less robust than Ghostscript in that it will only rasterize one page of a multi-page document.

RA_PPM

ImageMagick requires `ra_ppm` from Greg Ward's Radiance software to read the Radiance image format (which may not compile under Linux).

RAWTORLE

ImageMagick requires rawtorle from the Utah Raster Toolkit to write the RLE image format (which may not compile under Linux).

SANE

ImageMagick requires scanimage to import images from a scanner device.

TIFF

ImageMagick requires Sam Leffler's TIFF software to read and write the TIFF image format. It optionally requires the JPEG and ZLIB libraries.

ZLIB

ImageMagick requires the ZLIB library to read the PNG image format or read or write ZLIB compressed MIFF images.

Compiling ImageMagick

The following procedure describes how to build ImageMagick extension libraries in subdirectories of the ImageMagick directory. An alternative to these procedures is to install one or more of these under your system's regular include/lib directory (e.g., the directory specified by `--prefix` to *configure* or `/usr/local`). This allows the libraries to be shared by other packages. When you use the *configure* script, the two schemes may be mixed.

Also, please note that when the *configure* option `--enable-shared` is enabled, these procedures must be supplemented with the compilation flags that are required on your system to generate PIC code. In the case of gcc, this usually means that `-fPIC` must be added to the compiler options (i.e., `CFLAGS`) when you build each plug-in library.

To display images in the HDF, JPEG, MPEG, PNG, TIFF or TTF format, get the appropriate archives and build ImageMagick as follows:

HDF

```
cd ImageMagick
unzip -c HDF4.1r1.tar.gz | tar xvf -
mv HDF4.0r2 hdf
cd hdf
configure
make -k hdf-libnofortran
cd ..
```

JBIG

```
cd ImageMagick
unzip -c jbigkit-1.0.tar.gz | tar xvof -
mv jbig-kit jbig
cd jbig
make
cd ..
```

JPEG

```
cd ImageMagick
gunzip -c jpegsrc.v6b.tar.gz | tar xvof -
mv jpeg-6b jpeg
cd jpeg
configure
make
cd ..
```

MPEG

```
cd ImageMagick
unzip -c mpeg_lib-1.2.1.tar.gz | tar xvof -
mv mpeg_lib mpeg
cd mpeg
./configure
make
cd ..
```

PNG

```
cd ImageMagick
unzip -c libpng-1.0.2.tar.gz | tar xvf -
mv libpng-1.0.2 png
cd png
make
cd ..
```

TIFF

```
cd ImageMagick
gunzip -c tiff-v3.4beta037.tar.Z | tar xvof -
mv tiff-v3.4beta037 tiff
cd tiff
./configure
make
cd ..
```

TTF

```
cd ImageMagick
gunzip -c freetype-1.1.tar.gz | tar xvof -
mv freetype-1.1 ttf
cd ttf
./configure --disable-shared
make
cd ..
```

ZLIB

```
cd ImageMagick
gunzip -c zlib-1.1.3.tar.gz | tar xvf -
mv zlib-1.1.3.tar.gz zlib
cd zlib
make
cd ..
```

Support for Shared Libraries

If your computer system supports shared libraries you must type

```
make install
```

Finally, perform the following:

```
cd ImageMagick
edit Magick.tmpl and define Has???? as instructed
xmkmf
make Makefiles
make clean
make
```

If you prefer to use GNU Configure rather than Imake, type

```
configure
make clean
make -k
```

If the compile fails due to a function redefinition it may be that either jpeg/jconfig.h or mpeg/mpeg.h is redefining const. Fix this problem and try again.

You can now convert or display images in the JPEG, TIFF, PNG, etc. image formats.

If you have HDF, JBIG, JPEG, MPEG, PNG, and TIFF sources installed as directed above, you can also type

```
Install sun
```

Substitute the appropriate machine type (i.e., aix, hpux, sgi, etc.).

VMS Compilation

You might want to check the values of certain program definitions before you compile. Change the definitions of *ApplicationDefaults*, *DocumentationBrowser*, *EditorCommand*, *PostscriptColorDevice*, *PrintCommand*, and *RGBColorDatabase* in magick/magick.h to suit your local requirements. Next, type

```
@make  
set display/create/node=node_name::
```

where node_name is the DECNET X server to contact.

Finally type

```
display
```

Alternatively, download a zipped distribution (with JPEG, MPEG, TIFF, and XPM) from <ftp://ftp.wizards.dupont.com/pub/ImageMagick/vms>.

The VMS JPEG, TIFF, and XPM source libraries are available from axp.psl.ku.dk in [anonymous.decwindows.lib].

Thanks to pmoreau@cenaath.cena.dgac.fr for supplying invaluable help as well as the VMS versions of the JPEG, MPEG, TIFF, and XPM libraries.

NT Compilation

The NT distribution contains MetroWerks Codewarrior Professional projects and a Visual C++ workspace for compilation. For those who don't have access to CodeWarrior or Visual C++, the binaries for the command line utilities are enclosed.

If you have an NT X server like Exceed you will also need to include

```
SET DISPLAY=:0.0
```

in the System Control panel (NT) or Autoexec.bat (Win95). Autoexec.bat requires you restart your computer. There is a free X server available for Windows at <http://www.microimages.com/freestuf/mix>. Without an X server you can still *display* or *animate* to, or *import* from a remote X server. *Convert*, *mogrify*, *montage*, *combine*, and *identify*, will work—with or without an X server—directly from the command prompt.

To view any image in a Microsoft window, type

```
convert image.ext win:
```

Import works if you have at least one X window open. Alternatively, type

```
convert x:root image.gif
```

Make sure gswin32 (Ghostscript) is in your execution path (see Autoexec.bat), otherwise, you will be unable to convert or view a Postscript document.

Make sure iexplore (Internet Explorer) is in your execution path (see Autoexec.bat), otherwise, you will be unable to browse the ImageMagick documentation.

To compile the source with Codewarrior, start with Magick/Magick.mcp, then animate.mcp, convert.mcp, etc. The Visual C++ workspace is ImageMagick.dsw.

Tip! The NT executables will work under Windows 95 and Windows 98.

Macintosh Compilation

The Macintosh distribution contains MetroWerks Codewarrior Professional projects for compilation. For those who do not have access to CodeWarrior, the binaries for the command line utilities are enclosed.

Note: The inline intrinsic functions are commented in math.h in order to compile.

Note: *Display*, *animate*, and *import* currently do not work on the Macintosh.

Animation

To prevent color flashing on visuals that have colormaps, *animate* creates a single colormap from the image sequence. This can be rather time consuming. You can speed up this operation by reducing the colors in an image before you animate it. Use *mogrify* to color reduce images.

```
mogrify +map -colors 256 scenes/dna.[0-9]*
```

Alternatively, you can use a Standard Colormap, or a static, direct, or true color visual. You can define a Standard Colormap with *xstdcmap*. For example, to use the “best” Standard Colormap, type

```
xstdcmap -best  
animate -map best scenes/dna.[0-9]*
```

or to use a true color visual

```
animate -visual truecolor scenes/dna.[0-9]*
```

Image filenames can appear in any order on the command line if the scene keyword is specified in the MIFF image. Otherwise the images display in the order they appear on the command line. A scene is specified when converting from another image format to MIFF by using the “scene” option with any filter. Be sure to choose a scene number other than zero. For example, to convert a TIFF image to a MIFF image as scene #2, type

```
convert -scene 2 image.tiff image.miff
```


16-bit Imaging

By default, ImageMagick uses a color depth of 8 bits (e.g., [0..255] for each of red, green, blue, and transparency components). Any 16-bit image is scaled immediately to 8-bits before any image viewing or processing occurs. If you want to work directly with 16-bit images (e.g., [0..65535]), edit `Magick.tmpl` and define *QuantumLeap* or use

```
-enable-16bit
```

with `configure`.

Next, type

```
make clean
make
```

In 16-bit mode expect to use about 33% more memory on the average. Also expect some processing to be slower than in 8-bit mode (e.g., Oil Painting, Segment, etc.).

In general, 16-bit mode is useful only if you have 16-bit images you want to manipulate, then save the transformed image back to a 16-bit image format (e.g., PNG, VIFF).

64-bit Machines

Each pixel, within ImageMagick, is represented by the `RunlengthPacket` structure found in `magick/image.h`. Only 8 bits are required for each color component and 16 bits for the colormap index for a total of 6 bytes. If *QuantumLeap* is defined (see [16-bit Imaging](#)), the color component size increases to 16 bits for a total of 10 bytes. Some 64-bit machines pad the structure, which can cause a significant waste of memory. For the cray, change the `RunlengthPacket` structure to the following before you compile.

```
typedef struct _RunlengthPacket
{
    unsigned char
        red : QuantumDepth,
        green : QuantumDepth,
        blue : QuantumDepth,
        length : QuantumDepth;
    unsigned short
        index : 16;
} RunlengthPacket;
```

Note: This may not work on other 64-bit machines that pad. The Dec Alpha apparently does not pad the structure so ImageMagick should be fine on this particular 64-bit machine.

MIFF Image Format

MIFF is an image format that

- is machine independent. It can be read on virtually any computer. No byte swapping is necessary.
- has a text header. Most image formats are coded in binary and you cannot easily tell attributes about the image. Use *more* on MIFF image files and the attributes are displayed in text form.
- can handle runlength-encoded images. Although most scanned images do not benefit from runlength-encoding, most computer-generated images do. Images of mostly uniform colors have a high compression ratio and therefore take up less memory and disk space.
- allows a scene number to be specified. This allows you to specify an animation sequence out-of-order on the command line. The correct order is determined by the scene number of each image.
- computes a digital signature for images. This is useful for comparing images. If two image files have the same signature, they are identical images.

There is a *montage* keyword that allows an image to act as a visual image directory. See [Chapter 4, Display](#) for details.

To get an image into MIFF format, use *convert* or read it from an X window using the import program.

Alternatively, type the necessary header information in a file with a text editor. Next, dump the binary bytes into another file. Finally, type

```
cat header binary_image | display -write image.miff -
```

For example, suppose you have a raw red, green, blue image file on disk that is 640 by 480. The header file would look like this

```
id=ImageMagick columns=640 rows=480 :
```

The image file would have red, green, blue tuples (rgrgbgrgb...). See [Chapter 4, Display](#) for details.

Chapter 3

The ImageMagick Interface

Overview

Several components—use of options, the Command Widget, using the mouse, and the ImageMagick environment—are common to all areas of ImageMagick. They're described in this chapter.

Using Options

Options are processed in command-line order. Any option you specify on the command line remains in effect until you change it.

By default, the image format is determined by its magic number. To specify a particular image format, precede the filename with an image format name and a colon, for example,

```
ps:image
```

or specify the image type as the filename suffix

```
image.ps
```

See [Appendix A, Supported Image Formats](#) for a list of valid image formats.

When you specify `X` as your image type, the filename has special meaning. It specifies an X window by ID, name, or root. If you specify no filename, you can select the window by clicking the mouse in it.

Specify `image as -` for standard input and `combined as -` for standard output. If *image* has the extension `.Z` or `.gz`, the file is uncompressed with `uncompress` or `gunzip`, respectively. If *combined* has the extension `.Z` or `.gz`, the file size is compressed using with `compress` or `gzip`, respectively. Finally, precede the image file name with `|` to pipe to or from a system command.

Use an optional index enclosed in brackets after a file name to specify a desired subimage of a multiresolution image format like Photo CD, for example,

```
img0001.pcd[4]
```

or a range for MPEG images, for example,

```
video.mpg[50-75]
```

A subimage specification can be disjoint, for example,

```
image.tiff[2,7,4]
```

For raw images, specify a subimage with a geometry, for example

```
-size 640x512 image.rgb[320x256+50+50]
```

Using Filenames

Single images are read with the filename you specify. Alternatively, you can affect an image sequence with a single filename. Define the range of the image sequence with `-scene`. Each image in the range is read with the filename followed by a period (.) and the scene number. You can change this behavior by embedding a printf format specification in the filename. For example,

```
-scene 0-9 image%02d.miff
```

animates the files `image00.miff`, `image01.miff`, through `image09.miff`.

Image filenames may appear in any order on the command line if the image format is MIFF and the `-scene` keyword is specified in the image. Otherwise the images will be affected in the order you enter them on the command line. See [Appendix C, Magick Image File Format](#).

Mouse Buttons

ImageMagick requires a three-button mouse. The effects of each mouse button are described below.

Tip! If you have a two-button mouse, the left button corresponds to button 1 and the right button corresponds to button 3. To simulate button 2, hold down the Alt key on your keyboard and press the right mouse button.

Mouse Button 1

Press button 1 to map or unmap the Command Widget. See the next section for more information about the Command Widget.

Mouse Button 2

Press button 2 and drag the mouse to define a region of an image to magnify.

Mouse Button 3

Press button 3 and drag the mouse to choose from a select set of Display commands. This button behaves differently if the image is a visual image directory. Choose a directory tile, press this button and drag the mouse to select a command from a popup menu.

This menu item...	Does this...
Open	Displays the image represented by the tile.
Next	Returns from an image to the visual image directory, or moves to the next image.
Former	Moves to the previous image.
Delete	Deletes an image tile.

This menu item... (Cont.)	Does this...
Update	Synchronizes all image tiles with their respective images.

Command Widget

The Command Widget has a number of menu commands. Those menu commands followed by a right-pointing triangle have submenu commands.

Note: Menu commands are indicated in the following list with a bullet (■). Submenu commands are indicated with a > character.

- Animate
 - > Open
 - > Play
 - > Step
 - > Repeat
 - > Auto Reverse
- Speed
 - > Faster

- > Slower
- Direction
 - > Forward
 - > Reverse
- Image Info
- Help
- Quit

Selecting a Submenu Command

- 1 To select a submenu command, move the pointer to the appropriate menu.
 - 2 Press the mouse button and hold it down as you drag through the menu to a command, then its submenu command.
 - 3 Release the mouse button to execute the submenu command under the pointer.
- ❑ If you decide not to execute a command, drag the pointer away from the menu.

Keyboard Short Cuts

The following table shows keyboard short cuts you can use.

Press this...	to do this...
Ctrl+o	load an image from a file
space	display the next image in the sequence
<	speed up the display of the images (See -delay for more information.)
>	slow the display of the images (See -delay for more information.)
?	display information about the image; press any key or button to erase the information; the following information is printed: image name, image size, the total number of unique colors in the image
F1	display helpful information about an ImageMagick tool
Ctrl+q	discard all images and exit ImageMagick

Environment

DISPLAY

Lets you get the default host, display number, and screen.

Chapter 4

Display

Overview

Display is an image processing and display program. It can display an image on any workstation screen running an X server. *Display* can read and write many of the more popular image formats—JPEG, TIFF, PNM, Photo CD, to name a few.

With *display* you can do the following with an image:

- load an image from a file
- display the next or previous image
- display a sequence of images as a slide show
- write an image to a file
- print an image to a PostScript printer
- delete an image file
- create a visual image directory
- select an image to display by its thumbnail rather than its name
- undo last image transformation
- copy and paste a region of an image

- refresh an image
- restore an image to its original size
- decrease an image's size by half
- double an image's size
- resize an image
- crop an image
- cut an image
- flop an image in the horizontal direction
- flip an image in the vertical direction
- rotate an image 90 degrees clockwise
- rotate an image 90 degrees counter-clockwise
- rotate an image
- shear an image
- roll an image
- trim an image's edges

- invert the colors of an image
- vary an image's color brightness
- vary an image's color saturation
- vary an image's hue
- gamma correct an image
- sharpen an image's contrast
- dull an image's contrast
- perform histogram equalization on an image
- perform histogram normalization on an image
- negate an image's colors
- convert an image to grayscale
- set the maximum number of unique colors in an image
- reduce the speckles within an image
- eliminate peak noise from an image
- detect edges within an image

- emboss an image
- segment an image by color
- simulate an oil painting
- simulate a charcoal drawing
- annotate an image with text
- draw on an image
- edit an image pixel color
- edit an image's matte information
- composite an image with another
- add a border to an image
- add a border to an image
- surround image with an ornamental border
- apply image processing techniques to a region of interest
- display information about an image
- zoom a portion of an image

- show a histogram of an image
- display image to background of a window
- set user preferences
- display information about this program
- discard all images and exit program
- change the level of magnification
- display images specified by a World Wide Web (WWW) uniform resource locator (URL)

Syntax

```
display [ options ...] file [ options ...] file
```

Examples

- To scale an image of a cockatoo to exactly 640 pixels in width and 480 pixels in height and position the window at location (200,200), use

```
display -geometry 640x480+200+200! cockatoo.miff
```

- To display an image of a cockatoo without a border centered on a backdrop, use

```
display +borderwidth -backdrop cockatoo.miff
```

- To tile a slate texture onto the root window, use

```
display -size 1280x1024 -window root slate.png
```

- To display a visual image directory of all your JPEG images, use

```
display 'vid:*.jpg'
```

- To display a MAP image that is 640 pixels in width and 480 pixels in height with 256 colors, use

```
display -size 640x480+256 cockatoo.map
```

- To display an image of a cockatoo specified with a World Wide Web (WWW) uniform resource locator (URL), use

```
display ftp://wizards.dupont.com/images/cockatoo.jpg
```

- To display histogram of an image, use

```
convert file.jpg HISTOGRAM:- | display -
```

Display Options

-backdrop

Lets you center an image on a backdrop.

This backdrop covers the entire workstation screen and is useful for hiding other X window activity while viewing the image. The color of the backdrop is specified as the background color. See [Appendix B, X Resources](#) for details.

-border *<width>x<height>*

Lets you surround an image with a colored border.

The color of the border is obtained from the X server and is defined as *borderColor* (class *BorderColor*). See the X Windows system manual at <http://www.x.org> for details about the specification.

-colormap *type*

Lets you specify a type of colormap:

- Shared
- Private

This option applies only when the default X server visual is PseudoColor or GrayScale. See [-visual](#) for more details.

By default, a *Shared* colormap is allocated. The image shares colors with other X clients. Some image colors may be approximated and your image may not look the way you intended.

Choose *Private* and the image colors appear exactly as they are defined. However, other clients may go technicolor when the image colormap is installed.

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

- GRAY
- OHTA
- RGB
- Transparent

- XYZ
- YCbCr
- YIQ
- YPbPr
- YUV
- CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-comment *string*

Lets you annotate an image with a comment.

By default, each image is commented with its file name. Use this option to assign a specific comment to the image.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number

Special Character (Cont.)	Value
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-comment "%m:%f %wx%h"
```

produces for an image—titled bird.miff whose width is 512 and height is 480—the comment

```
MIFF:bird.miff 512x480
```

Note: If the first character of *string* is @, the image comment is read from a file titled by the remaining characters in the string.

-compress *type*

Lets you specify one of the following types of image compression:

- None
- Bip
- Fax
- JPEG
- LZW
- RunlengthEncoded
- Zip

Specify

`+compress`

to store the binary image in an uncompressed format. The default is the compression type of the specified image file.

-contrast

Lets you enhance or reduce the intensity differences between the lighter and darker elements of an image.

Use

```
-contrast
```

to enhance the image or

```
+contrast
```

to reduce the image contrast.

-crop *<width>x<height>{+-}<x offset>{+-}<y offset>{%}*

Lets you specify the size and location of a cropped image. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

To specify the width or height as a percentage, append %. For example to crop an image by 10% on all sides, use

```
-crop 10%
```

Use cropping to apply image processing options to, or display, a particular area of an image. Omit the *x offset* and *y offset* to generate one or more subimages of a uniform size.

Use cropping to crop an area of an image. Use

```
-crop 0x0
```

to trim edges that are the background color. Add an *x offset* and *y offset* to leave a portion of the trimmed edges with the image. The equivalent X resource for this option is *cropGeometry* (class *CropGeometry*). See [Appendix B, X Resources](#) for details.

-delay *<1/100ths of a second>x<seconds>*

Displays the next image after pausing.

This option is useful for regulating the display of the sequence of GIF images in Netscape. 1/100ths of a second must pass before the image sequence can be displayed again.

The default is no delay between each showing of the image sequence. The maximum delay is 65535.

The *seconds* value is optional. It lets you specify the number of seconds to pause before repeating the animation sequence.

-density *<width>x<height>*

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-despeckle

Lets you reduce the speckles in an image.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-dispose

Lets you specify one of the following GIF disposal methods:

This method...	Specifies...
0	no disposal specified
1	do not dispose
2	restore to background color
3	restore to previous

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-edge *factor*

Lets you detect edges within an image. Specify *factor* as a percentage of the enhancement from 0.0–99.9%.

-enhance

Lets you apply a digital filter to enhance a noisy image.

-filter *type*

Lets you specify one of the following filters to use when you resize an image:

- Point
- Box
- Triangle
- Hermite
- Hanning
- Hamming
- Blackman

- Gaussian
- Quadratic
- Cubic
- Catrom
- Mitchell (default)
- Lanczos
- Bessel
- Sinc

See [-geometry](#).

-flip

Lets you create a mirror image by reflecting the scanlines in the vertical direction.

-flop

Lets you create a mirror image by reflecting the image scanlines in the horizontal direction.

-frame *<width>x<height>+<outer bevel width>+<inner bevel width>*

Lets you surround an image with an ornamental border. See the X Windows system manual at <http://www.x.org> for details about the specification.

Note: The color of the border is specified with the `-mattecolor` command line option.

-gamma *value*

Lets you specify the level of gamma correction for an image.

The same color image displayed on different workstations may look different because of differences in the display monitor. Use gamma correction to adjust for this color difference. Reasonable values range from 0.8–2.3.

You can apply separate gamma values to the red, green, and blue channels of an image with a gamma value list delineated with slashes, for example,

`1.7/2.3/1.2`

Use `+gamma` to set the image gamma level without actually adjusting the image pixels. This option is useful if the image has a known gamma that isn't set as an image attribute, such as PNG images.

-geometry *<width>x<height>[!]{<|>}{%}*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append %. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use > to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, < resizes the image. For example, if you specify

```
640x480>
```

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

The equivalent X resource for this option is geometry (class Geometry). See [Appendix B, X Resources](#) for details.

-interlace *type*

Lets you specify one of the following interlacing schemes:

- none (default)
- line
- plane
- partition

Interlace also lets you specify the *type* of interlacing scheme for raw image formats such as RGB or YUV.

Scheme	Description
none	does not interlace (e.g., RGBRGBRGBRGBRGB...)
line	uses scanline interlacing (e.g., RRR...GGG...BBB...RRR...GGG...BBB...)
plane	uses plane interlacing (e.g., RRRRRR...GGGGGG...BBBBBB...)
partition	similar to plane except that different planes are saved to individual files (e.g., image.R, image.G, and image.B)

Tip! Use `line`, or `plane` to create an interlaced GIF or progressive JPEG image.

-immutable

Lets you indicate the displayed image cannot be modified.

-label *name*

Lets you assign a label to an image.

-map *type*

Lets you display an image using one of the following standard colormap types:

- `best`
- `default`
- `gray`
- `red`
- `green`
- `blue`

The X server must support the colormap you choose, otherwise an error occurs. For *type* specify `list` and `display` searches the list of colormap types in top-to-bottom order until one is located. For one way of creating standard colormaps see *xstdcmap*, an X11 client program that's available with an X11 distribution.

-matte

Lets you store the matte channel (i.e., the transparent channel) if an image has one.

-monochrome

Lets you transform an image to black and white.

-negate

Lets you apply color inversion to an image.

The red, green, and blue intensities of an image are negated. Use `+negate` to negate only the grayscale pixels of the image.

-page `<width>x<height>{+-}<x offset>{+-}<y offset>{!}{<}{>}{%}`

Lets you set the size and location of an image canvas. Use this option to specify the dimensions of a

- PostScript page in dots per inch (dpi) or a
- TEXT page in pixels

This option is used in concert with `-density`.

The choices for a PostScript page are

Media	Size (pixel width by pixel height)
11x17	792 1224
Ledger	1224 792
Legal	612 1008
Letter	612 792
LetterSmall	612 792
ArchE	2592 3456
ArchD	1728 2592
ArchC	1296 1728
ArchB	864 1296
ArchA	648 864
A0	2380 3368
A1	1684 2380
A2	1190 1684

Media (Cont.)	Size (pixel width by pixel height)
A3	842 1190
A4	595 842
A4Small	595 842
A5	421 595
A6	297 421
A7	210 297
A8	148 210
A9	105 148
A10	74 105
B0	2836 4008
B1	2004 2836
B2	1418 2004
B3	1002 1418
B4	709 1002
B5	501 709

Media (Cont.)	Size (pixel width by pixel height)
C0	2600 3677
C1	1837 2600
C2	1298 1837
C3	918 1298
C4	649 918
C5	459 649
C6	323 459
Flsa	612 936
Flse	612 936
HalfLetter	396 612

You can specify the page size by media (e.g., A4, Ledger, etc.). Otherwise, `-page` behaves much like `-geometry` (e.g., `-page letter+43+43>`).

- To position a GIF image, use

```
-page {+-}<x offset>{+-}<y offset>
```

for example,

`-page +100+200`

For a PostScript page, the image is sized as in `-geometry` and positioned relative to the lower-left hand corner of the page by `{+}<x offset>{+}<y offset>`. The default page dimension for a TEXT image is 612x792.

- To position a TEXT page, use

`-page 612x792>`

to center the image within the page.

Tip! If the image size exceeds the PostScript page, it's reduced to fit the page.

-quality *value*

Lets you specify one of the following compression levels:

- JPEG with a *value* from 0–100 (i.e., worst to best); the default is 75
- MIFF with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)
- PNG with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)

The following are valid filter types:

- 0 for none; used for all scanlines

- 1 for sub; used for all scanlines
- 2 for up; used for all scanlines
- 3 for average; used for all scanlines
- 4 for Paeth; used for all scanlines
- 5 for adaptive filter; used when quality is greater than 50 and the image doesn't have a colormap; otherwise no filtering is used
- 6 or higher for adaptive filtering; used with minimum-sum-of-absolute-values

Note: The default is quality is 75—nearly the best compression with adaptive filtering.

For more information, see the PNG specification (RFC 2083) at <http://www.w3.org/pub/WWW/TR>.

-raise *<width>x<height>*

Lets you lighten or darken image edges to create a 3-D effect. See the X Windows system manual at <http://www.x.org> for details about the *geometry* specification.

Use `-raise` to create a raised effect; otherwise use `+raise`.

-remote *string*

Lets you execute a command in a remote display process.

Note: The only command recognized at this time is the name of an image file to load.

-roll {+-}<*x offset*>{+-}<*y offset*>

Lets you roll an image vertically or horizontally. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

A negative x offset rolls the image left to right. A negative y offset rolls the image top to bottom.

-rotate *degrees*{<}>}

Applies Paeth image rotation to the image.

Use > to rotate the image only if its width exceeds the height. If the image width is less than its height, < rotates the image.

For example, if you have an image size of 480x640 and you specify

-90>

the image is not rotated by the specified angle. However, if the image is 640x480, it's rotated by -90 degrees.

Note: Empty triangles left over from rotating the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-sample *geometry*

Lets you scale an image with pixel sampling. See **-geometry** for details about the geometry specification.

-scene *value*

Lets you specify the image scene number.

-segment *value*

Lets you eliminate insignificant clusters.

The number of pixels in each cluster must exceed the cluster threshold to be considered valid.

-sharpen *factor*

Lets you sharpen an image. Specify *factor* as a percentage of enhancement from 0.0–99.9%.

-size *<width>x<height>{+offset}{!}%*

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-texture *filename*

Lets you specify a file, which contains a texture, to tile onto an image's background.

-title *string*

Lets you assign a title to the displayed image. The title is typically displayed in the window title bar.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for `treedepth` to take effect.

-update *seconds*

Lets you specify how often to determin an image has been updated and redisplay it.

For example, if an image you are displaying is overwritten, display will automatically detect the input file has been changed and update the displayed image accordingly.

-verbose

Lets you print the following detailed information about an image:

- image name
- image size
- image depth
- image format
- image comment
- image scene number
- image class (DirectClass or PseudoClass)
- total unique colors
- number of seconds to read and transform the image

- whether a matte is associated with the image
- the number of runlength packets

-visual *type*

Lets you display an image using one of the following visual types:

- StaticGray
- GrayScale
- StaticColor
- PseudoColor
- TrueColor
- DirectColor
- default
- visual ID

Note: The X server *must* support the visual you choose, otherwise an error occurs. If you don't specify a visual, the visual class that can display the most simultaneous colors on the default X server screen is used.

-window *ID*

Lets you set the background pixmap of this window to the image.

ID can be a window ID or name. Specify `root` to select X's root window as the target window. By default the image is tiled onto the background of the target window. If `-backdrop` or `-geometry` is specified, the image is surrounded by the background color. See [Appendix B, X Resources](#) for details.

Note: The image will not display on the root window if the image has more unique colors than the target window colormap allows.

Use `-colors` to reduce the number of colors. You can also specify the following standard X resources as command line options:

- `-background`
- `-bordercolor`
- `-borderwidth`
- `-font`
- `-foreground`
- `-iconGeometry`
- `-iconic`

- -mattecolor
- -name
- -title

-window_group *ID*

Lets you exit the program when this window ID is destroyed.

ID can be a window ID or name.

Working with Images

The following setions provide procedures for displaying images using the Command Widget. For details about using the Command Widget, see [Chapter 3, The ImageMagick Interface](#).

- [Loading Images](#)
- [Creating a Visual Image Directory](#)
- [Cutting Images](#)
- [Copying Images](#)

- Pasting Images
- Cropping Images
- Chopping Images
- Rotating Images
- Segmenting Images
- Annotating Images
- Creating Composite Images
- Editing Color Images
- Editing Matte Images
- Drawing Images
- Transforming a Region of Interest
- Panning Images

Loading Images

- 1 To select an image to display, choose File/Open in the Command Widget.

A file browser is displayed.

- 2 To choose an image file, move the pointer to the filename click.
- 3 Click Open or press the Return key.

❑ Alternatively, you can type the image file name directly into the Filename box.

- 4 To descend directories, double-click a directory name.

A scrollbar lets you move through a list of filenames that exceeds the size of the list area.

- 5 To shorten the list of file names, use shell globbing characters. For example, to list only files that end with .jpg, type

`*.jpg`

- 6 To select your image from the X server screen instead of from a file, choose Grab in the Open Widget.

Creating a Visual Image Directory

- 1 To create a visual image directory, choose File/Visual Directory in the Command Widget.

A file browser is displayed.

- 2 To create a visual image directory from all the images in the current directory, click Directory or press the Return key.

- ❑ Alternatively, you can select a set of image names by using shell globbing characters. For example, to list only files that end with .jpg, type

`*.jpg`

- 3 To descend directories, double-click a directory name.

A scrollbar lets you move through a list of filenames that exceeds the size of the list area.

After you select a set of files, they are turned into thumbnails and tiled onto a single image.

- 4 Move the pointer to a thumbnail, press button 3, and drag.

- 5 Select Open.

The image represented by the thumbnail is displayed at its full size.

- 6 Choose File/Next in the Command Widget to return to the visual image directory.

Cutting Images

Note: Cut information for an image window is not retained for colormapped X server visuals (e.g., StaticColor, GrayScale, PseudoColor). Correct cutting behavior may require a TrueColor or DirectColor visual or a Standard Colormap.

- 1 To begin, choose Edit/Cut in the Command Widget.

- ❑ Alternatively, press F3 in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Cut mode.

- 2 To define a cut region, press button 1 and drag.

The cut region is defined by a highlighted rectangle that expands or contracts as it follows the pointer.

- 3 Once you are satisfied with the cut region, release the button.

You are now in Rectify mode.

- 4 To make adjustments, move the pointer to one of the cut rectangle corners, press a button, and drag.

- 5 Click Cut to commit your copy region.

- ❑ To exit without cutting the image, click Dismiss.

Copying Images

- 1 To begin, choose Edit/Copy in the Command Widget.

- ❑ Alternatively, press F4 in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Copy mode.

- 2 To define a copy region, press button 1 and drag.

The copy region is defined by a highlighted rectangle that expands or contracts as it follows the pointer.

- 3 Once you are satisfied with the copy region, release the button.

You are now in Rectify mode.

- 4 To make adjustments, move the pointer to one of the copy rectangle corners, press a button, and drag.

- 5 Click Copy to commit your copy region.

❑ To exit without copying the image, click Dismiss.

Pasting Images

- 1 To begin, choose Edit/Paste in the Command Widget.

❑ Alternatively, press F5 in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Paste mode.

- ☐ To exit immediately, press Dismiss.
- 2 Choose a composite operation from the Operators submenu.
 - ☐ Optionally choose a composite operator. The default operator is replace.
- 3 Choose a location to composite your image and press button 1.
 - ☐ Press and hold the button before releasing and an outline of the image will appear to help you identify your location.
 - ☐ To force a PseudoClass image to remain PseudoClass, use `-colors`.

The actual colors of the pasted image are saved. However, the color that appears in the image window may be different. For example, on a monochrome screen, the image window will appear black or white even though your pasted image may have many colors. If you save the image to a file, it is written with the correct colors. To assure the correct colors are saved in the final image, any PseudoClass image is promoted to DirectClass.

Composite Operator Behavior

The following describe how each operator behaves. *Image Window* is the image currently displayed on your X server and *image* is the image obtained with the File Browser Widget.

over. The result is the union of the two image shapes, with *image* obscuring *image window* in the region of overlap.

in. The result is simply *image* cut by the shape of *image window*. None of the image data of *image window* is in the result.

out. The resulting image is *image* with the shape of *image window* cut out.

atop. The result is the same shape as *image window*, with *image* obscuring *image window* where the image shapes overlap. Note this differs from **over** because the portion of *image* outside *image window*'s shape does not appear in the result.

xor. The result is the image data from both *image* and *image window* that is outside the overlap region. The overlap region is blank.

plus. The result is just the sum of the image data. Output values are cropped to 255 (no overflow). This operation is independent of the matte channels.

minus. The result of *image - image window*, with underflow cropped to zero. The matte channel is ignored (set to 255, full coverage).

add. The result of *image + image window*, with overflow wrapping around (mod 256).

subtract. The result of *image - image window*, with underflow wrapping around (mod 256). The add and subtract operators can be used to perform reversible transformations.

difference. The result of $\text{abs}(\text{image} - \text{image window})$. This is useful for comparing two very similar images.

bumpmap. The result of *image window* shaded by *image*.

replace. The resulting image is *image window* replaced with *image*. Here the matte information is ignored.

The image compositor requires a matte, or alpha channel in the image for some operations. This extra channel usually defines a mask that represents a cookie-cutter for the image. This is the case when matte is 255 (full coverage) for pixels inside the shape, zero outside, and between zero and 255 on the boundary. If *image* does not have a matte channel, it is initialized with 0 for any pixel matching in color to pixel location (0,0), otherwise 255. See [Editing Matte Images](#) for a method of defining a matte channel.

Note: Matte information for *image window* is not retained for colormapped X server visuals (e.g., *StaticColor*, *GrayScale*, *PseudoColor*). Correct compositing behavior may require a *TrueColor* or *DirectColor* visual or a *Standard Colormap*.

Cropping Images

- 1 To begin, press choose Transform/Crop in the Command Widget.

❏ Alternatively, press the [key in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Crop mode.

- 2 To define a cropping region, press button 1 and drag.

The cropping region is defined by a highlighted rectangle that expands or contracts as it follows the pointer.

- 3 Once you are satisfied with the cropping region, release the button.

You are now in Rectify mode.

- 4 To make adjustments, move the pointer to one of the cropping rectangle corners, press a button, and drag.
- 5 Click Crop to commit your cropping region.
 - ❑ To exit without cropping the image, click Dismiss.

Chopping Images

You can chop an image interactively—there is no command line argument to chop an image.

- 1 To begin, choose Transform/Chop in the Command Widget.
 - ❑ Alternatively, press the] key in the Image window.

You are now in Chop mode.

- ❑ To exit immediately, click Dismiss
- 2 Select a location in the image window to begin your chop, and press and hold any button.
 - 3 Move the pointer to another location in the image.

As you move a line will connect the initial location and the pointer.

- 4 Release the button.
 - ☐ To cancel the image chopping, move the pointer back to the starting point of the line and release the button.
- 5 The area within the image that's chopped is determined by the direction you choose from the Command Widget.
 - ☐ To chop the image between the two horizontal endpoints of the chop line, choose Direction/Horizontal. (This is the default.)
 - ☐ To chop the image between the two vertical endpoints of the chop line, choose Direction/Vertical.

Rotating Images

- 1 Press the / key to rotate the image 90 degrees or \ to rotate -90 degrees.
- 2 To interactively choose the degree of rotation, choose Transform/Rotate.
 - ☐ Alternatively, press the * key in the image window.

A small horizontal line is drawn next to the pointer. You are now in Rotate mode.

 - ☐ To exit immediately, click Dismiss.
- 3 Choose a background color from the Pixel Color submenu.

- ☐ Choose Browser to specify additional background colors and set the X resources pen1 through pen9 to change the menu colors.
 - ☐ To select the background color using a color on the screen, choose Browser and click Grab. Move the pointer to the desired color on the screen and press any button.
- 4 Choose a point in the image window, and press and hold this button.
 - 5 Move the pointer to another location in the image and release the button.

As you move a line connects the initial location and the pointer. When you release the button, the degree of image rotation is determined by the slope of the line you just drew.

- ☐ To cancel the image rotation, move the pointer back to the starting point of the line and release the button.
- 6 From the Direction submenu of the Command Widget, choose Horizontal or Vertical.

The slope of the line you just drew is relative to the direction you choose.

Segmenting Images

Choose Effects/Segment to segment an image by analyzing the histograms of the color components and identifying units that are homogeneous with the fuzzy c-means technique. The scale-space filter analyzes the histograms of the three color components of the image and identifies a set of classes. The extents of each class is used to coarsely

segment the image with thresholding. The color associated with each class is determined by the mean color of all pixels within the extents of a particular class. Finally, any unclassified pixels are assigned to the closest class with the fuzzy c-means technique.

The fuzzy c-Means algorithm can be summarized as follows:

- Build a histogram, one for each color component of the image.
- For each histogram, successively apply the scale-space filter and build an interval tree of zero crossings in the second derivative at each scale. Analyze this scale-space “fingerprint” to determine which peaks or valleys in the histogram are most predominant.
- The fingerprint defines intervals on the axis of the histogram. Each interval contains either a minima or a maxima in the original signal. If each color component lies within the maxima interval, that pixel is considered “classified” and is assigned a unique class number.
- Any pixel that fails to be classified in the above thresholding pass is classified using the fuzzy c-Means technique. It is assigned to one of the classes discovered in the histogram analysis phase.

The fuzzy c-Means technique attempts to cluster a pixel by finding the local minima of the generalized within group sum of squared error objective function. A pixel is assigned to the closest class of which the fuzzy membership has a maximum value.

For additional information see Young Won Lim, Sang Uk Lee, “On The Color Image Segmentation Algorithm Based on the Thresholding and the Fuzzy c-Means Techniques,” *Pattern Recognition*, Volume 23, Number 9, pages 935-952, 1990.

Annotating Images

You can annotate an image interactively—there is no command line argument to annotate an image.

- 1 To begin, choose Image Edit/Annotate in the Command Widget.

- ❑ Alternatively, press the **a** key in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Annotate mode.

- ❑ To exit immediately, click Dismiss.

- 2 Optionally choose a font name from the Font Name submenu. The default is fixed.

- ❑ Choose Browser from the Font Name submenu to specify additional font names. You can change the menu names by setting the X resources font1 through font9.

- 3 Optionally choose a font color from the Font Color submenu. The default is black.

- ❑ Choose Browser from the Font Color submenu to specify additional font colors. You can change the menu colors by setting the X resources pen1 through pen9. If you select the color browser and press Grab, you can choose the font color by moving the pointer to a color on the screen and pressing any button.

- 4 To rotate text, choose Rotate Text from the menu and select an angle.

Tip: Typically you will only want to rotate one line of text at a time. Depending on the angle you choose, subsequent lines may end up overwriting each other.

- 5 Choose a location to begin entering text and press a button.

An underscore character will appear at the location of the pointer. The pointer changes to a pencil to indicate you are in Text mode.

❑ To exit immediately, click Dismiss.

In Text mode, any key you press will display the character at the location of the underscore and advance the underscore cursor.

- 6 Enter your text.
- 7 When you're finished, click Apply to finish your image annotation.

❑ To correct errors, press Backspace.

❑ To delete an entire line of text, press Delete.

❑ Any text that exceeds the boundaries of the image window is automatically wrapped to the next line.

The actual color you request for the font is saved in the image. However, the color that appears in your Image window may be different. For example, on a monochrome screen the text will appear black or white even if you choose the color red as the font color. However, the image saved to a file with `-write` is written with red lettering. To assure the correct color text in the final image, any PseudoClass image is promoted to DirectClass ([Appendix C, Magick Image File Format](#)). To force a PseudoClass image to remain PseudoClass, use `-colors`.

Creating Composite Images

You can create an image composite interactively—there is no command line argument to composite an image.

- 1 To begin, choose Image Edit/Composite in the Command Widget.
 - ☐ Alternatively, press x in the Image window.
- 2 In the popup window that appears, enter an image name, do one of the following:
 - ☐ Type a file name.

Click Composite. If the composite image has no matte information, you are informed and the file browser is displayed again. Enter the name of a mask image. The image is typically grayscale and the same size as the composite image. If the image is not grayscale, it is converted to grayscale and the resulting intensities are used as matte information.

- ☐ Click Grab and move the pointer to an image window and press any button.
- ☐ Click Cancel if you choose not to create a composite image.

A small window appears showing the location of the cursor in the image window. You are now in Composite mode.

- ☐ To exit immediately, click Dismiss.
- 3 Choose a composite operation from the Operators submenu of the Command Widget.
 - ☐ Optionally choose a composite operator. The default operator is replace. (See [Composite Operator Behavior](#) for details about composite operators.)
- 4 Choose a location to composite your image and press button 1. Press and hold the button before releasing and an outline of the image appears to help you identify your location.

The actual colors of the composite image are saved. However, the color that appears in the image window may be different. For example, on a monochrome screen, *image window* will appear black or white even though your pasted image may have many colors. If you save the image to a file, it is written with the correct colors. To assure the correct colors are saved in the final image, any PseudoClass image is promoted to DirectClass.

- 5 Optionally choose Blend. The composite operator becomes over.

The image matte channel percent transparency is initialized to *factor*. The *image window* is initialized to (100-*factor*) where *factor* is the value you specify in the Dialog Widget.

- 6 To optionally shift the image pixels as defined by a displacement map, choose Displace.

With this option, *image* is used as a displacement map.

- ❑ Black, within the displacement map, is a maximum positive displacement.
- ❑ White is a maximum negative displacement and middle gray is neutral. the displacement is scaled to determine the pixel shift. By default the displacement applies in both the horizontal and vertical directions. However, if you specify a *mask*, *image* is the horizontal X displacement and *mask* is the vertical Y displacement.

Composite Operator Behavior

The following describe how each operator behaves. *Image Window* is the image currently displayed on your X server and *image* is the image obtained with the File Browser Widget.

over. The result is the union of the two image shapes, with *image* obscuring *image window* in the region of overlap.

in. The result is simply *image* cut by the shape of *image window*. None of the image data of *image window* is in the result.

out. The resulting image is *image* with the shape of *image window* cut out.

atop. The result is the same shape as *image window*, with *image* obscuring *image window* where the image shapes overlap. Note this differs from **over** because the portion of *image* outside *image window*'s shape does not appear in the result.

xor. The result is the image data from both *image* and *image window* that is outside the overlap region. The overlap region is blank.

plus. The result is just the sum of the image data. Output values are cropped to 255 (no overflow). This operation is independent of the matte channels.

minus. The result of $image - image\ window$, with underflow cropped to zero. The matte channel is ignored (set to 255, full coverage).

add. The result of $image + image\ window$, with overflow wrapping around (mod 256).

subtract. The result of $image - image\ window$, with underflow wrapping around (mod 256). The add and subtract operators can be used to perform reversible transformations.

difference. The result of $abs(image - image\ window)$. This is useful for comparing two very similar images.

bumpmap. The result of $image\ window$ shaded by $image$.

replace. The resulting image is $image\ window$ replaced with $image$. Here the matte information is ignored.

The image compositor requires a matte, or alpha channel in the image for some operations. This extra channel usually defines a mask that represents a cookie-cutter for the image. This is the case when matte is 255 (full coverage) for pixels inside the shape, zero outside, and between zero and 255 on the boundary. If $image$ does not have a matte channel, it is initialized with 0 for any pixel matching in color to pixel location (0,0), otherwise 255. See [Editing Matte Images](#) for a method of defining a matte channel.

Note: Matte information for $image\ window$ is not retained for colormapped X server visuals (e.g., StaticColor, GrayScale, PseudoColor). Correct compositing behavior may require a TrueColor or DirectColor visual or a Standard Colormap.

Editing Color Images

Changing the the color of a set of pixels is performed interactively. There is no command line argument to edit a pixel.

- 1 To begin, choose Image Image Edit/Color in the Command Widget.

- ❑ Alternatively, press c in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Color Edit mode.

- ❑ To exit immediately, press Dismiss.

- 2 Choose a color editing method from the Method submenu in the Command Widget.

- ❑ The point method recolors any pixel selected with the pointer unless the button is released.

- ❑ The replace method recolors any pixel that matches the color of the pixel you select with a button press. Floodfill recolors any pixel that matches the color of the pixel you select with a button press and is a neighbor.

- ❑ Filltoborder changes the matte valueof any neighbor pixel that is not the border color.

- ❑ Reset changes the entire image to the designated color.

- 3 Choose a pixel color from the Pixel Color submenu.

- ❑ Additional pixel colors can be specified with the color browser by setting the X resources `pen1` through `pen9`. (See [Appendix B, X Resources](#).)
- 4 Press button 1 to select a pixel within the Image window to change its color.
- ❑ You can recolor additional pixels as prescribed by the method you choose. you can recolor additional pixels by increasing the Delta value.
 - ❑ If the Magnify Widget is mapped, it can be helpful in positioning your pointer within the image (see [Mouse Button 2](#)).
 - ❑ Alternatively you can select a pixel to recolor from within the Magnify Widget. Move the pointer to the Magnify Widget and position the pixel with the cursor control keys. Finally, press a button to recolor the selected pixel (or pixels).

Note: The actual color you request for the pixels is saved in the image. However, the color that appears in your Image window may be different. For example, on a monochrome screen the pixel will appear black or white even if you choose the color red as the pixel color. However, the image saved to a file with `-write` is written with red pixels. To assure the correct color text in the final image, any PseudoClass image is promoted to DirectClass. To force a PseudoClass image to remain PseudoClass, use `-colors`.

Editing Matte Images

Matte information within an image is useful for some operations such as image compositing. This extra channel usually defines a mask that represents a sort of a cookie-cutter for the image. This is the case when `matte` is 255 (full coverage) for pixels inside the shape, zero outside, and between zero and 255 on the boundary.

Setting the matte information in an image is done interactively. There is no command line argument to edit a pixel.

1 To begin, choose Image Edit/Matte in the Command Widget.

☐ Alternatively, click m in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Matte Edit mode.

☐ To exit immediately, press Dismiss.

2 Choose a matte editing method from the Method submenu of the Command Widget.

☐ The point method changes the matte value of the any pixel selected with the pointer until the button is released.

☐ The replace method changes the matte value of any pixel that matches the color of the pixel you select with a button press.

☐ Floodfill changes the matte value of any pixel that matches the color of the pixel you select with a button press and is a neighbor.

☐ Filltoborder recolors any neighbor pixel that is not the border color.

☐ Reset changes the entire image to the designated matte value.

3 Choose Matte Value. A dialog prompts you for a matte value.

4 Enter a value between 0 and 255. This value is assigned as the matte value of the selected pixel or pixels.

- 5 Press any button to select a pixel within the Image window to change its matte value.
 - ❑ Optionally, you can change the matte value of additional pixels by increasing the Delta value. The Delta value is first added then subtracted from the red, green, and blue of the target color. Any pixels within the range also have their matte value updated. If the Magnify Widget is mapped, it can be helpful in positioning your pointer within the image (see [Mouse Button 2](#)).
 - ❑ Alternatively you can select a pixel to change the matte value from within the Magnify Widget. Move the pointer to the Magnify Widget and position the pixel with the cursor control keys.
- 6 Press a button to change the matte value of the selected pixel (or pixels).

Note: Matte information is only valid in a DirectClass image. Therefore, any PseudoClass image is promoted to DirectClass. Note that matte information for PseudoClass is not retained for colormapped X server visuals (e.g., StaticColor, StaticColor, GrayScale, PseudoColor) unless you immediately save your image to a file (refer to Write). Correct matte editing behavior may require a TrueColor or DirectColor visual or a Standard Colormap.

Drawing Images

You can interactively draw on an image—there is no command line argument to draw on an image.

- 1 To begin, choose Image Edit/Draw in the Command Widget.
 - ❑ Alternatively, press d in the image window.

The cursor changes to a crosshair to indicate you're in Draw mode.

- ☐ To exit immediately, press Dismiss.
- 2 Choose a drawing primitive from the Primitive submenu.
- 3 Choose a color from the Color submenu.
 - ☐ To specify additional colors, choose Browser and set the X resources pen1 through pen9. (See [Appendix B, X Resources](#) for details.)
 - ☐ Choose Transparent to update the image matte channel, which is useful for image compositing.
 - ☐ If you Choose Browser and click Grab, you can select a primitive color by moving the pointer to the desired color on the screen and press any button.
- 4 Optionally choose a stipple from the Stipple submenu.
 - ☐ Choose Browser to specify additional stipples. Stipples obtained from the file browser must be on disk in the X11 bitmap format.
- 5 Optionally choose a line width from the Width submenu.
 - ☐ To choose a specific width select the Dialog Widget.
- 6 Choose a point in the image window and press and hold button 1.
- 7 Move the pointer to another location in the image.

As you move, a line connects the initial location and the pointer.

❑ To cancel image drawing, move the pointer back to the starting point of the line and release the button.

8 Release the button.

The image is updated with the primitive you just drew.

Note: For polygons, the image is updated when you press and release the button without moving the pointer.

Transforming a Region of Interest

1 To begin, choose Pixel Transform/Region of Interest in the Command Widget.

❑ Alternatively, press R in the image window.

A small window appears showing the location of the cursor in the image window. You are now in Region of Interest mode.

2 To define a region of interest, press button 1 and drag.

The region of interest is defined by a highlighted rectangle that expands or contracts as it follows the pointer.

3 Once you are satisfied with the region of interest, release the button. You are now in Apply mode.

4 You can make adjustments to the region of interest by moving the pointer to one of the rectangle corners, pressing a button, and dragging.

- 5 Choose an image processing technique from the Command Widget.

Tip: You can choose more than one image processing technique to apply to an area. Alternatively, you can move the region of interest before applying another image processing technique.

❑ To exit, press Dismiss.

Panning Images

When an image exceeds the width or height of the X server screen, Display maps a small panning icon. The rectangle within the panning icon shows the area that is currently displayed in the the image window.

- 1 To pan about the image, press any button and drag the pointer within the panning icon. The pan rectangle moves with the pointer and the image window is updated to reflect the location of the rectangle within the panning icon.

❑ Use the arrow keys to pan the image one pixel at a time in any direction within the image window.

- 2 When you have selected the area of the image you want to view, release the button.

Note: The panning icon is withdrawn if the image becomes smaller than the dimensions of the X server screen.

User Preferences

Preferences affect the default behavior of Display. Preferences can be either true or false and are stored in your home directory as `.displayrc`.

display image centered on a backdrop. This backdrop covers the entire workstation screen and is useful for hiding other X window activity while you view an image. The color of the backdrop is specified as the background color. (See [Appendix B, X Resources](#) for details.)

confirm on program exit. Prompts for a confirmation before exiting the Display.

correct image for display gamma. If the image has a known gamma, the gamma is corrected to match that of the X server. (See the X resource [displayGamma \(class DisplayGamma\)](#)).

apply Floyd/Steinberg error diffusion to image. The basic strategy of dithering is to trade intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. Images that suffer from severe contouring when you reduce colors can be improved with this preference.

use a shared colormap for colormapped X visuals. This option applies only when the default X server visual is PseudoColor or GrayScale. See [-visual](#) for more details. By default, a shared colormap is allocated. The image shares colors with other X clients. Some image colors could be approximated, therefore your image may look very different from what you expect. Otherwise, the image colors appear exactly as they are defined. However, other clients may go technicolor when the image colormap is installed.

display images as an X server pixmap. Images are maintained as an XImage by default. Set this resource to True to utilize a server Pixmap instead. This option is useful if your image exceeds the dimensions of your server screen and you intend to pan the image. Panning is much faster with Pixmap than with an XImage. Pixmap are considered a precious resource, use them with discretion.

Chapter 5

Import

Overview

Import reads an image from any visible window on an X server and outputs it as an image file. You can capture a single window, the entire screen, or any rectangular portion of the screen. Use *display* for redisplay, printing, editing, formatting, archiving, image processing, etc. of the captured image.

The target window can be specified by id, name, or may be selected by clicking the mouse in the desired window. If you press a button and then drag, a rectangle will form which expands and contracts as the mouse moves. To save the portion of the screen defined by the rectangle, just release the button. The keyboard bell is rung once at the beginning of the screen capture and twice when it completes.

Syntax

```
import [ options ... ] file
```

Examples

- To select an X window with the mouse and save it in the MIFF image format to a file titled *window.miff*, use:

```
import window.miff
```

- To select an X window and save it in the Encapsulated Postscript format to include in another document, use:

```
import figure.eps
```

- To capture the entire X server screen in the JPEG image format in a file titled root.jpeg, use:

```
import -window root root.jpeg
```

Import Options

Import options can appear on the command line or in your X resources file. See the X Windows system manual at <http://www.x.org> for details about the specification.

Options on the command line supersede values specified in your X resources file.

-adjoin

Lets you join images into a single multi-image file.

Note: By default, all images in an image sequence are stored in the same file. However, some formats, such as JPEG, do not support more than one image and are saved to separate files. Use `+adjoin` to force this behavior.

-border <width>x<height>

Lets you surround an image with a colored border.

The color of the border is obtained from the X server and is defined as *borderColor* (class *BorderColor*). See the X Windows system manual at <http://www.x.org> for details about the specification.

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

- GRAY
- OHTA
- RGB

- Transparent
- XYZ
- YCbCr
- YIQ
- YPbPr
- YUV
- CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-comment *string*

Lets you annotate an image with a comment.

By default, each image is commented with its file name. Use this option to assign a specific comment to the image.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number

Special Character (Cont.)	Value
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-comment "%m:%f %wx%h"
```

produces for an image—titled bird.miff whose width is 512 and height is 480—the comment

```
MIFF:bird.miff 512x480
```

Note: If the first character of *string* is @, the image comment is read from a file titled by the remaining characters in the string.

-compress *type*

Lets you specify one of the following types of image compression:

- None
- Bip
- Fax
- JPEG
- LZW
- RunlengthEncoded
- Zip

Specify

`+compress`

to store the binary image in an uncompressed format. The default is the compression type of the specified image file.

-crop *<width>x<height>{+}<x offset>{+}<y offset>{%}*

Lets you specify the size and location of a cropped image. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

To specify the width or height as a percentage, append %. For example to crop an image by 10% on all sides, use

```
-crop 10%
```

Use cropping to apply image processing options to, or display, a particular area of an image. Omit the *x offset* and *y offset* to generate one or more subimages of a uniform size.

Use cropping to crop an area of an image. Use

```
-crop 0x0
```

to trim edges that are the background color. Add an *x offset* and *y offset* to leave a portion of the trimmed edges with the image. The equivalent X resource for this option is *cropGeometry* (class *CropGeometry*). See [Appendix B, X Resources](#) for details.

-delay *<1/100ths of a second>x<seconds>*

Displays the next image after pausing.

This option is useful for regulating the display of the sequence of GIF images in Netscape. 1/100ths of a second must pass before the image sequence can be displayed again.

The default is no delay between each showing of the image sequence. The maximum delay is 65535.

The *seconds* value is optional. It lets you specify the number of seconds to pause before repeating the animation sequence.

-density *<width>x<height>*

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-descend

Lets you obtain an image by descending window hierarchy.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-dispose

Lets you specify one of the following GIF disposal methods:

This method...	Specifies...
0	no disposal specified
1	do not dispose
2	restore to background color
3	restore to previous

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-frame *<width>x<height>+<outer bevel width>+<inner bevel width>*

Lets you surround an image with an ornamental border. See the X Windows system manual at <http://www.x.org> for details about the specification.

Note: The color of the border is specified with the `-mattecolor` command line option.

-geometry *<width>x<height>[!]{<>}{%}*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append %. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use > to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, < resizes the image. For example, if you specify

640x480>

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

-interlace *type*

Lets you specify one of the following interlacing schemes:

- none (default)
- line
- plane
- partition

Interlace also lets you specify the *type* of interlacing scheme for raw image formats such as RGB or YUV.

Scheme	Description
none	does not interlace (e.g., RGBRGBRGBRGBRGB...)

Scheme (Cont.)	Description
line	uses scanline interlacing (e.g., RRR...GGG...BBB...RRR...GGG...BBB...)
plane	uses plane interlacing (e.g., RRRRRR...GGGGGG...BBBBBB...)
partition	similar to plane except that different planes are saved to individual files (e.g., image.R, image.G, and image.B)

Tip! Use `line`, or `plane` to create an interlaced GIF or progressive JPEG image.

-label *name*

Lets you assign a label to an image.

-monochrome

Lets you transform an image to black and white.

-negate

Lets you apply color inversion to an image.

The red, green, and blue intensities of an image are negated. Use `+negate` to negate only the grayscale pixels of the image.

-page <width>x<height>{+}<x offset>{+}<y offset>{!}{<}{>}{%}

Lets you set the size and location of an image canvas. Use this option to specify the dimensions of a

- PostScript page in dots per inch (dpi) or a
- TEXT page in pixels

This option is used in concert with `-density`.

The choices for a PostScript page are

Media	Size (pixel width by pixel height)
11x17	792 1224
Ledger	1224 792
Legal	612 1008
Letter	612 792
LetterSmall	612 792
ArchE	2592 3456
ArchD	1728 2592
ArchC	1296 1728

Media (Cont.)	Size (pixel width by pixel height)
ArchB	864 1296
ArchA	648 864
A0	2380 3368
A1	1684 2380
A2	1190 1684
A3	842 1190
A4	595 842
A4Small	595 842
A5	421 595
A6	297 421
A7	210 297
A8	148 210
A9	105 148
A10	74 105
B0	2836 4008

Media (Cont.)	Size (pixel width by pixel height)
B1	2004 2836
B2	1418 2004
B3	1002 1418
B4	709 1002
B5	501 709
C0	2600 3677
C1	1837 2600
C2	1298 1837
C3	918 1298
C4	649 918
C5	459 649
C6	323 459
Flsa	612 936
Flse	612 936
HalfLetter	396 612

You can specify the page size by media (e.g., A4, Ledger, etc.). Otherwise, `-page` behaves much like `-geometry` (e.g., `-page letter+43+43>`).

- To position a GIF image, use

```
-page {+-}<x offset>{+-}<y offset>
```

for example,

```
-page +100+200
```

For a PostScript page, the image is sized as in `-geometry` and positioned relative to the lower-left hand corner of the page by `{+-}<x offset>{+-}<y offset>`. The default page dimension for a TEXT image is 612x792.

- To position a TEXT page, use

```
-page 612x792>
```

to center the image within the page.

Tip! If the image size exceeds the PostScript page, it's reduced to fit the page.

-pointsize *value*

Lets you specify the point size of a PostScript font.

-quality *value*

Lets you specify one of the following compression levels:

- JPEG with a *value* from 0–100 (i.e., worst to best); the default is 75
- MIFF with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)
- PNG with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)

The following are valid filter types:

- 0 for none; used for all scanlines
- 1 for sub; used for all scanlines
- 2 for up; used for all scanlines
- 3 for average; used for all scanlines
- 4 for Paeth; used for all scanlines
- 5 for adaptive filter; used when quality is greater than 50 and the image doesn't have a colormap; otherwise no filtering is used
- 6 or higher for adaptive filtering; used with minimum-sum-of-absolute-values

Note: The default is quality is 75—nearly the best compression with adaptive filtering.

For more information, see the PNG specification (RFC 2083) at <http://www.w3.org/pub/WWW/TR>.

-rotate *degrees*{<}{>}

Applies Paeth image rotation to the image.

Use > to rotate the image only if its width exceeds the height. If the image width is less than its height, < rotates the image.

For example, if you have an image size of 480x640 and you specify

-90>

the image is not rotated by the specified angle. However, if the image is 640x480, it's rotated by -90 degrees.

Note: Empty triangles left over from rotating the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-scene *value*

Lets you specify the image scene number.

-screen

Lets you indicate that the `GetImage` request used to obtain an image should be done on the root window, rather than directly on the specified window. In this way, you can obtain pieces of other windows that overlap the specified window and more importantly, you can capture menus or other popups that are independent windows, which appear over the specified window.

-silent

Lets you operate silently, i.e., without any bells.

-transparency *color*

Lets you make a specified color in an image transparent.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for `treedepth` to take effect.

-verbose

Lets you print the following detailed information about an image:

- image name
- image size

- image depth
- image format
- image comment
- image scene number
- image class (DirectClass or PseudoClass)
- total unique colors
- number of seconds to read and transform the image
- whether a matte is associated with the image
- the number of runlength packets

-window *ID*

Lets you set the background pixmap of this window to the image.

ID can be a window ID or name. Specify `root` to select X's root window as the target window. By default the image is tiled onto the background of the target window. If `-backdrop` or `-geometry` is specified, the image is surrounded by the background color. See [Appendix B, X Resources](#) for details.

Note: The image will not display on the root window if the image has more unique colors than the target window colormap allows.

Use `-colors` to reduce the number of colors. You can also specify the following standard X resources as command line options:

- `-background`
- `-bordercolor`
- `-borderwidth`
- `-font`
- `-foreground`
- `-iconGeometry`
- `-iconic`
- `-mattecolor`
- `-name`
- `-title`

Chapter 6

Animate

Overview

Animate displays a sequence of images on any workstation running an X server. *Animate* first determines the hardware capabilities of the workstation. If the number of unique colors in an image is fewer than or equal to the number the workstation can support, the image is displayed in an X window. Otherwise the number of colors in the image is first reduced to match the color resolution of the workstation.

For example, a continuous-tone 24 bits/pixel image can display on an 8-bit pseudo-color device or a monochrome device. In most cases the reduced color image closely resembles the original. Alternatively, a monochrome or pseudo-color image sequence can display on a continuous-tone 24 bits/pixels device.

To prevent color flashing on X server visuals that have colormaps, *animate* creates a single colormap from the image sequence, which can be time consuming. You can speed up this operation by reducing the colors in the image *before* you animate them.

- Use *mogrify* to color reduce the images to a single colormap. See [Chapter 9, *Mogrify*](#) for details.
- Alternatively, you can use a standard colormap, or a static, direct, or true color visual. You can define a standard colormap with *xstdcmap*. See *xstdcmap*, an X11 client program that's available with an X11 distribution.

This method is recommended for colormapped X server because it eliminates the need to compute a global colormap.

Syntax

```
animate [options ...] file [ [options ...] file ...]
```

Examples

- To animate a set of images of a cockatoo, use

```
animate cockatoo.*
```

- To animate a cockatoo image sequence using the Standard Colormap best, use

```
xstdcmap -best  
animate -map best cockatoo.*
```

- To animate an image of a cockatoo without a border centered on a backdrop, use

```
animate +borderwidth -backdrop cockatoo.*
```

Animate Options

-backdrop

Lets you center an image on a backdrop.

This backdrop covers the entire workstation screen and is useful for hiding other X window activity while viewing the image. The color of the backdrop is specified as the background color. See [Appendix B, X Resources](#) for details.

-colormap *type*

Lets you specify a type of colormap:

- Shared
- Private

This option applies only when the default X server visual is PseudoColor or GrayScale. See [-visual](#) for more details.

By default, a *Shared* colormap is allocated. The image shares colors with other X clients. Some image colors may be approximated and your image may not look the way you intended.

Choose *Private* and the image colors appear exactly as they are defined. However, other clients may go technicolor when the image colormap is installed.

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

- GRAY
- OHTA
- RGB
- Transparent
- XYZ
- YCbCr
- YIQ

- YPbPr
- YUV
- CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-crop *<width>x<height>{+-}<x offset>{+-}<y offset>{%}*

Lets you specify the size and location of a cropped image. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

To specify the width or height as a percentage, append %. For example to crop an image by 10% on all sides, use

```
-crop 10%
```

Use cropping to apply image processing options to, or display, a particular area of an image. Omit the *x offset* and *y offset* to generate one or more subimages of a uniform size.

Use cropping to crop an area of an image. Use

`-crop 0x0`

to trim edges that are the background color. Add an *x offset* and *y offset* to leave a portion of the trimmed edges with the image. The equivalent X resource for this option is *cropGeometry* (class *CropGeometry*). See [Appendix B, X Resources](#) for details.

-delay *<1/100ths of a second>x<seconds>*

Displays the next image after pausing.

This option is useful for regulating the display of the sequence of GIF images in Netscape. 1/100ths of a second must pass before the image sequence can be displayed again.

The default is no delay between each showing of the image sequence. The maximum delay is 65535.

The *seconds* value is optional. It lets you specify the number of seconds to pause before repeating the animation sequence.

-density *<width>x<height>*

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-gamma *value*

Lets you specify the level of gamma correction for an image.

The same color image displayed on different workstations may look different because of differences in the display monitor. Use gamma correction to adjust for this color difference. Reasonable values range from 0.8–2.3.

You can apply separate gamma values to the red, green, and blue channels of an image with a gamma value list delineated with slashes, for example,

`1.7/2.3/1.2`

Use `+gamma` to set the image gamma level without actually adjusting the image pixels. This option is useful if the image has a known gamma that isn't set as an image attribute, such as PNG images.

-geometry *<width>x<height>[!]{<}>[%]*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append `%`. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use `>` to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, `<` resizes the image. For example, if you specify

```
640x480>
```

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

-map *type*

Lets you display an image using one of the following standard colormap types:

- best
- default
- gray
- red
- green
- blue

The X server must support the colormap you choose, otherwise an error occurs. For *type* specify `list` and `display` searches the list of colormap types in top-to-bottom order until one is located. For one way of creating standard colormaps see *xstdcmap*, an X11 client program that's available with an X11 distribution.

-monochrome

Lets you transform an image to black and white.

-remote *string*

Lets you execute a command in a remote display process.

Note: The only command recognized at this time is the name of an image file to load.

-rotate *degrees{<}{>}*

Applies Paeth image rotation to the image.

Use > to rotate the image only if its width exceeds the height. If the image width is less than its height, < rotates the image.

For example, if you have an image size of 480x640 and you specify

-90>

the image is not rotated by the specified angle. However, if the image is 640x480, it's rotated by -90 degrees.

Note: Empty triangles left over from rotating the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-scene *value*

Lets you specify the image scene number.

-size *<width>x<height>{+offset}{!}{%}*

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-title *string*

Lets you assign a title to the displayed image. The title is typically displayed in the window title bar.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for treedepth to take effect.

-verbose

Lets you print the following detailed information about an image:

- image name
- image size
- image depth
- image format
- image comment
- image scene number
- image class (DirectClass or PseudoClass)
- total unique colors
- number of seconds to read and transform the image
- whether a matte is associated with the image
- the number of runlength packets

-visual *type*

Lets you display an image using one of the following visual types:

- StaticGray
- GrayScale
- StaticColor
- PseudoColor
- TrueColor
- DirectColor
- default
- visual ID

Note: The X server *must* support the visual you choose, otherwise an error occurs. If you don't specify a visual, the visual class that can display the most simultaneous colors on the default X server screen is used.

-window *ID*

Lets you set the background pixmap of this window to the image.

ID can be a window ID or name. Specify `root` to select X's root window as the target window. By default the image is tiled onto the background of the target window. If `-backdrop` or `-geometry` is specified, the image is surrounded by the background color. See [Appendix B, X Resources](#) for details.

Note: The image will not display on the root window if the image has more unique colors than the target window colormap allows.

Use `-colors` to reduce the number of colors. You can also specify the following standard X resources as command line options:

- `-background`
- `-bordercolor`
- `-borderwidth`
- `-font`
- `-foreground`
- `-iconGeometry`
- `-iconic`
- `-mattecolor`
- `-name`

- -title

X Resources for Animate

Animate options can appear on the command line or in your X resource file. Options on the command line supersede values specified in your X resource file. See the X Windows system manual at <http://www.x.org> for details about the specification.

All animate options have a corresponding X resource. In addition, the animate program uses the following X resources:

- borderColor (class BorderColor)
- borderWidth (class BorderWidth)
- font (class Font or FontList)
- foreground (class Foreground)
- geometry (class geometry)
- iconGeometry (class IconGeometry)
- iconic (class Iconic)
- matteColor (class MatteColor)

- name (class Name)
- sharedMemory (class SharedMemory)
- text_font (class textFont)
- title (class Title)

For detailed information about these X Resources, see [Appendix B, X Resources](#).

Chapter 7

Montage

Overview

Montage creates a composite by combining several separate images. The images are tiled on the composite image. The name of each image can be displayed below its tile.

The composite image is constructed in the following manner. First, each image specified on the command line, except for the last, is scaled to fit the maximum tile size. The maximum tile size by default is 120x120. It can be modified with the `-geometry` command line argument or X resource. See Options for more information on command line arguments. See X(1) for more information on X resources. Note that the maximum tile size need not be a square. To respect the aspect ratio of each image append `~` to the geometry specification.

Next the composite image is initialized with the color specified by the `-background` command line argument or X resource. The width and height of the composite image is determined by the title specified, the maximum tile size, the number of tiles per row, the tile border width and height, the image border width, and the label height. The number of tiles per row specifies how many images are to appear in each row of the composite image. The default is to have 5 tiles in each row and 4 tiles in each column of the composite. A specific value is specified with `-tile`. The tile border width and height, and the image border width defaults to the value of the X resource `-borderwidth`. It can be changed with the `-borderwidth` or `-geometry` command line argument or X resource. The label height is determined by the font you specify with the `-font` command line argument or X

resource. If you do not specify a font, a font is chosen that allows the name of the image to fit the maximum width of a tiled area. The label colors is determined by the `-background` and `-pen` command line argument or `X` resource. Note, that if the background and pen colors are the same, labels will not appear.

Initially, the composite image title is placed at the top if one is specified (refer to `-pen`). Next, each image is set onto the composite image, surrounded by its border color, with its name centered just below it. The individual images are left-justified within the width of the tiled area. The order of the images is the same as they appear on the command line unless the images have a scene keyword. If a scene number is specified in each image, then the images are tiled onto the composite in the order of their scene number. Finally, the last argument on the command line is the name assigned to the composite image. By default, the image is written in the MIFF format and can be viewed or printed with display.

Note, that if the number of tiles exceeds the default number of 20 (5 per row, 4 per column), more than one composite image is created. To ensure a single image is produced, use `-tile` to increase the number of tiles to meet or exceed the number of input images.

Finally, to create one or more empty spaces in the sequence of tiles, use the `NULL` image format.

Syntax

```
montage [ options ...] file [ [ options ...] file ...] output_file
```

Examples

- To create a montage of a cockatoo, a parrot, and a hummingbird and write it to a file called birds, use

```
montage cockatoo.miff parrot.miff hummingbird.miff birds.miff
```

- To tile several bird images so that they are at most 256 pixels in width and 192 pixels in height, surrounded by a red border, and separated by 10 pixels of background color, use

```
montage -geometry 256x192+10+10 -bordercolor red birds.*montage.miff
```

- To create an unlabeled parrot image, 640 by 480 pixels, and surrounded by a border of black, use

```
montage -geometry 640x480 -bordercolor black -label "" parrot.miff bird.miff
```

- To create an image of an eagle with a textured background, use

```
montage -texture bumps.jpg eagle.jpg eagle.png
```

- To join several GIF images together without any extraneous graphics (e.g. no label, no shadowing, no surrounding tile frame), use

```
montage +frame +shadow +label -tile 5x1 -geometry 50x50+0+0 *.gif joined.gif
```

Montage Options

-adjoin

Lets you join images into a single multi-image file.

Note: By default, all images in an image sequence are stored in the same file. However, some formats, such as JPEG, do not support more than one image and are saved to separate files. Use `+adjoin` to force this behavior.

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

■ GRAY

- OHTA
- RGB
- Transparent
- XYZ
- YCbCr
- YIQ
- YPbPr
- YUV
- CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-comment *string*

Lets you annotate an image with a comment.

By default, each image is commented with its file name. Use this option to assign a specific comment to the image.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes

Special Character (Cont.)	Value
%o	output filename
%p	page number
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-comment "%m:%f %wx%h"
```

produces for an image—titled bird.miff whose width is 512 and height is 480—the comment

```
MIFF:bird.miff 512x480
```

Note: If the first character of *string* is @, the image comment is read from a file titled by the remaining characters in the string.

-compose *operator*

Lets you specify the type of image composition.

By default, each of the composite image pixels are replaced by the corresponding image tile pixel. You can choose an alternate composite operation. Each operator's behavior is described below.

This operator...	Results in...
over	the union of the two image shapes, with the <i>composite image</i> obscuring the <i>image</i> in the region of overlap
in	<i>composite image</i> cut by the shape of the <i>image</i> ; none of the image data of image will be in the result
out	<i>composite image</i> with the shape of the <i>image</i> cut out
atop	the same shape as image <i>image</i> , with <i>composite image</i> obscuring <i>image</i> where the image shapes overlap; (Note: This differs from <i>over</i> because the portion of <i>composite image</i> outside <i>image's</i> shape does not appear in the result.)

This operator... (Cont.)	Results in...
xor	the image data from both <i>composite image</i> and <i>image</i> that is outside the overlap region; the overlap region will be blank
plus	just the sum of the image data; output values are cropped to 255 (no overflow); this operation is independent of the matte channels
minus	<i>composite image</i> minus <i>image</i> , with underflow cropped to 0; the matte channel is ignored (set to 255, full coverage)
add	<i>composite image</i> plus <i>image</i> , with overflow wrapping around (mod 256)
subtract	<i>composite image</i> minus <i>image</i> , with underflow wrapping around (mod 256); the add and subtract operators can be used to perform reversible transformations
difference	The result of abs (<i>composite image</i> minus <i>image</i>); this is useful for comparing two very similar images
bumpmap	<i>image</i> shaded by <i>composite image</i>
replace	<i>image</i> replaced with <i>composite image</i> ; here the matte information is ignored

The image compositor requires a matte or alpha channel in the image for some operations. This extra channel usually defines a mask that represents a sort of a cookie-cutter for the image.

This is the case when *matte* is 255 (full coverage) for pixels inside the shape, 0 outside, and between 0 and 255 on the boundary. For certain operations, if *image* does not have a *matte* channel, it's initialized with 0 for any pixel matching in color to pixel location (0,0). Otherwise it's 255.

Note: To work properly, *borderwidth* must be 0.

-compress *type*

Lets you specify one of the following types of image compression:

- None
- Bip
- Fax
- JPEG
- LZW
- RunlengthEncoded
- Zip

Specify

`+compress`

to store the binary image in an uncompressed format. The default is the compression type of the specified image file.

-crop *<width>x<height>{+-}<x offset>{+-}<y offset>{%}*

Lets you specify the size and location of a cropped image. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

To specify the width or height as a percentage, append %. For example to crop an image by 10% on all sides, use

```
-crop 10%
```

Use cropping to apply image processing options to, or display, a particular area of an image. Omit the *x offset* and *y offset* to generate one or more subimages of a uniform size.

Use cropping to crop an area of an image. Use

```
-crop 0x0
```

to trim edges that are the background color. Add an *x offset* and *y offset* to leave a portion of the trimmed edges with the image. The equivalent X resource for this option is *cropGeometry* (class *CropGeometry*). See [Appendix B, X Resources](#) for details.

-density *<width>x<height>*

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-dispose

Lets you specify one of the following GIF disposal methods:

This method...	Specifies...
0	no disposal specified
1	do not dispose
2	restore to background color
3	restore to previous

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-draw *string*

Lets you annotate an image with one or more of the following graphic primitives:

This...	Requires...
point	a single coordinate
line	a single coordinate, start and end coordinates,
rectangle	upper-left and lower-right coordinates
fillRectangle	upper-left and lower-right coordinates
circle	center and an outer edge coordinates
fillCircle	center and an outer edge coordinates
polygon	three or more coordinates to define its boundaries
fillPolygon	three or more coordinates to define its boundaries
color	a single coordinate
matte	a single coordinate
text	a single coordinate
image	a single coordinate

Coordinates are integers separated by an optional comma. For example, to define a circle centered at 100,100 that extends to 150,150 use

```
-draw 'circle 100,100 150,150'
```

Consider the target pixel as that specified by your coordinate. Use *color* to change the color of a pixel. Follow the pixel coordinate with one of the following methods:

- *point* recolors the target pixel
- *replace* recolors any pixel that matches the color of the target pixel
- *floodfill* recolors any pixel that matches the color of the target pixel and its neighbor pixel
- *reset* recolors all pixels

Use *matte* to change the pixel matte value to transparent. Follow the pixel coordinate with one of the following methods:

- *point* changes the matte value of the target pixel
- *replace* changes the matte value of any pixel that matches the color of the target pixel
- *floodfill* changes the matte value of any pixel that matches the color of the target pixel and its neighbor.
- *reset* changes the matte value of all pixels

Use *text* to annotate an image with text. Follow the text coordinates with a string.

Tip! If the string has embedded spaces, enclose it in double quotes.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number

Special Character (Cont.)	Value
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-draw 'text 100,100 "%m:%f %wx%h"'
```

annotates an image—titled `bird.miff` whose width is 512 and height is 480—with

```
MIFF:bird.miff 512x480
```

To generate a Unicode character (TrueType fonts only), embed the code as an escaped hex string, for example,

`\\0x30a3`

Use `-image` to composite an image with another image. Follow the image coordinates with the filename of an image. If the first character of the string is `@`, the text is read from a file titled by the remaining characters in the string.

You can set the primitive color, font color, and font bounding box color with `-pen`, `-font`, and `-box`, respectively. Options are processed in command-line order so be sure to use `-pen` *before* the `-draw` option.

-font *name*

Font lets you specify the font to use when annotating an image with text.

If the font is a fully-qualified X server font name, the font is obtained from an X server, for example,

`-*-helvetica-medium-r-*-12-*-*-*-iso8859-*`

To use a TrueType font, precede the TrueType filename with `@`, for example,

`@times.ttf`

Otherwise, specify a PostScript font, for example,

`helvetica`

-frame *<width>x<height>+<outer bevel width>+<inner bevel width>*

Lets you surround an image with an ornamental border. See the X Windows system manual at <http://www.x.org> for details about the specification.

Note: The color of the border is specified with the `-mattecolor` command line option.

-gamma *value*

Lets you specify the level of gamma correction for an image.

The same color image displayed on different workstations may look different because of differences in the display monitor. Use gamma correction to adjust for this color difference. Reasonable values range from 0.8–2.3.

You can apply separate gamma values to the red, green, and blue channels of an image with a gamma value list delineated with slashes, for example,

`1.7/2.3/1.2`

Use `+gamma` to set the image gamma level without actually adjusting the image pixels. This option is useful if the image has a known gamma that isn't set as an image attribute, such as PNG images.

-geometry *<width>x<height>[!]{<|>}{%}*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append %. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use > to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, < resizes the image. For example, if you specify

```
640x480>
```

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

-gravity *direction*

Lets you specify the direction an image gravitates within a tile. See the X Windows system manual at <http://www.x.org> for details about the gravity specification.

A tile of a composite image is a fixed width and height. However, the image within the tile may not fill it completely (see [-geometry](#)).

The *direction* you choose specifies where to position the image within the tile. For example, `center` gravity forces the image to be centered within the tile. By default, the image gravity is center.

-interlace *type*

Lets you specify one of the following interlacing schemes:

- none (default)
- line
- plane
- partition

Interlace also lets you specify the *type* of interlacing scheme for raw image formats such as RGB or YUV.

Scheme	Description
none	does not interlace (e.g., RGBRGBRGBRGBRGB...)
line	uses scanline interlacing (e.g., RRR...GGG...BBB...RRR...GGG...BBB...)
plane	uses plane interlacing (e.g., RRRRRR...GGGGGG...BBBBBB...)
partition	similar to plane except that different planes are saved to individual files (e.g., image.R, image.G, and image.B)

Tip! Use `line`, or `plane` to create an interlaced GIF or progressive JPEG image.

-label *name*

Lets you assign a label to an image.

-matte

Lets you store the matte channel (i.e., the transparent channel) if an image has one.

-mode *type*

Lets you specify one of the following the montage types:

- `frame`
- `unframe` (default)
- `concatenate`

This option is for convenience. You can obtain the same results by setting individual options. For example, *unframe* is equivalent to

```
+frame +shadow +borderwidth
```

-monochrome

Lets you transform an image to black and white.

-page *<width>x<height>{+-}<x offset>{+-}<y offset>{!}{<}>{ }{ %}*

Lets you set the size and location of an image canvas. Use this option to specify the dimensions of a

- PostScript page in dots per inch (dpi) or a
- TEXT page in pixels

This option is used in concert with `-density`.

The choices for a PostScript page are

Media	Size (pixel width by pixel height)
11x17	792 1224
Ledger	1224 792
Legal	612 1008
Letter	612 792
LetterSmall	612 792
ArchE	2592 3456
ArchD	1728 2592
ArchC	1296 1728
ArchB	864 1296
ArchA	648 864
A0	2380 3368
A1	1684 2380
A2	1190 1684
A3	842 1190

Media (Cont.)	Size (pixel width by pixel height)
A4	595 842
A4Small	595 842
A5	421 595
A6	297 421
A7	210 297
A8	148 210
A9	105 148
A10	74 105
B0	2836 4008
B1	2004 2836
B2	1418 2004
B3	1002 1418
B4	709 1002
B5	501 709
C0	2600 3677

Media (Cont.)	Size (pixel width by pixel height)
C1	1837 2600
C2	1298 1837
C3	918 1298
C4	649 918
C5	459 649
C6	323 459
Flsa	612 936
Flse	612 936
HalfLetter	396 612

You can specify the page size by media (e.g., A4, Ledger, etc.). Otherwise, `-page` behaves much like `-geometry` (e.g., `-page letter+43+43>`).

■ To position a GIF image, use

```
-page {+-}<x offset>{+-}<y offset>
```

for example,

```
-page +100+200
```


For a PostScript page, the image is sized as in `-geometry` and positioned relative to the lower-left hand corner of the page by `{+}<x offset>{+}<y offset>`. The default page dimension for a TEXT image is 612x792.

- To position a TEXT page, use

```
-page 612x792>
```

to center the image within the page.

Tip! If the image size exceeds the PostScript page, it's reduced to fit the page.

-pen *color*

Lets you set the color of the font or opaque color. See [-draw](#) for details. See the X Windows system manual at <http://www.x.org> for details about the *color* specification.

-pointsize *value*

Lets you specify the point size of a PostScript font.

-quality *value*

Lets you specify one of the following compression levels:

- JPEG with a *value* from 0–100 (i.e., worst to best); the default is 75

- MIFF with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)
- PNG with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)

The following are valid filter types:

- 0 for none; used for all scanlines
- 1 for sub; used for all scanlines
- 2 for up; used for all scanlines
- 3 for average; used for all scanlines
- 4 for Paeth; used for all scanlines
- 5 for adaptive filter; used when quality is greater than 50 and the image doesn't have a colormap; otherwise no filtering is used
- 6 or higher for adaptive filtering; used with minimum-sum-of-absolute-values

Note: The default is quality is 75—nearly the best compression with adaptive filtering.

For more information, see the PNG specification (RFC 2083) at <http://www.w3.org/pub/WWW/TR>.

-rotate *degrees*{<}{>}

Applies Paeth image rotation to the image.

Use > to rotate the image only if its width exceeds the height. If the image width is less than its height, < rotates the image.

For example, if you have an image size of 480x640 and you specify

`-90>`

the image is not rotated by the specified angle. However, if the image is 640x480, it's rotated by -90 degrees.

Note: Empty triangles left over from rotating the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-scene *value*

Lets you specify the image scene number.

-shadow

Lets you add a shadow to a tile to simulate depth.

-size <width>x<height>{+offset}{!}%}

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-texture *filename*

Lets you specify a file, which contains a texture, to tile onto an image's background.

-tile <width>x<height>

Lets you specify the number of tiles to appear in each row and column of a composite image.

Specify the numbr of tiles per row with *width* and the number of tiles per column with *height*. For example, if you want one tile in each row and up to 10 tiles in the composite image, use

```
-tile 1x10
```

The default is five tiles in each row and four tiles in each column of the composite.

-transparency *color*

Lets you make a specified color in an image transparent.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for `treedepth` to take effect.

-verbose

Lets you print the following detailed information about an image:

- image name
- image size
- image depth
- image format
- image comment
- image scene number
- image class (DirectClass or PseudoClass)

- total unique colors
- number of seconds to read and transform the image
- whether a matte is associated with the image
- the number of runlength packets

Additional Montage Options

In addition to the options listed, you can specify these standard X resources as command line options:

- -background
- -bordercolor
- -borderwidth
- -font
- -foreground
- -mattecolor
- -title

See [Appendix B, X Resources](#) for details.

Chapter 8

Convert

Overview

Convert changes an input file of one image format to an output file of a different image format. In addition, various types of image processing can be performed on the converted image during the conversion process.

For a comprehensive list of the formats *Convert* recognizes, see [Appendix A, Supported Image Formats](#). Support for some of these formats require additional programs or libraries; this information is also provided in the appendix. See the Readme file for information about where to find the additional software.

Note: A format delineated with + means that if more than one image is specified, they are combined into a single multi-image file. Use `+adjoin` if you want to produce a single image for each frame.

Raw images are expected to have one byte per pixel unless ImageMagick is compiled in 16-bit mode. Here, the raw data is expected to be stored two bytes per pixel in most-significant-byte-first order.

Syntax

```
convert [ options ... ] file [file ...] file
```

Examples

- To convert a MIFF image of a cockatoo to a SUN raster image, use

```
convert cockatoo.miff sun:cockatoo.ras
```

- To convert a multi-page PostScript document to individual FAX pages, use

```
convert -monochrome document.ps fax:page
```

- To convert a TIFF image to a PostScript A4 page with the image in the lower left-hand corner, use

```
convert -page A4+0+0 image.tiff document.ps
```

- To convert a raw Gray image with a 128 byte header to a portable graymap, use

```
convert -size 768x512+128 gray:raw image.pgm
```

- To convert a Photo CD image to a TIFF image, use

```
convert -size 1536x1024 img0009.pcd image.tiff convert img0009.pcd[4] image.tiff
```

- To create a visual image directory of all your JPEG images, use

```
convert 'vid:*.jpg' directory.miff
```

- To annotate an image with blue text using font 12x24 at position (100,100), use

```
convert -font helvetica -pen blue -draw "text 100,100 Cockatoo" bird.jpg bird.miff
```


- To tile a 640x480 image with a JPEG texture with bumps use

```
convert -size 640x480 tile:bumps.jpg tiled.png
```

- To surround an icon with an ornamental border to use with Mosaic(1), use

```
convert -mattecolor #697B8F -frame 6x6 bird.jpg icon.png
```

- To create a GIF animation from a DNA molecule sequence, use

```
convert -delay 20 dna.* dna.gif
```

Convert Options

-adjoin

Lets you join images into a single multi-image file.

Note: By default, all images in an image sequence are stored in the same file. However, some formats, such as JPEG, do not support more than one image and are saved to separate files. Use `+adjoin` to force this behavior.

-align type

Lets you specify how to align text.

- Left (default)

■ Center

■ Right

See [-draw](#) for details.

-average

Lets you average a set of images.

-blur *factor*

Lets you blur an image. Specify *factor* as a percentage of enhancement from 0.0–99.9%.

-border *<width>x<height>*

Lets you surround an image with a colored border.

The color of the border is obtained from the X server and is defined as *borderColor* (class *BorderColor*). See the X Windows system manual at <http://www.x.org> for details about the specification.

-box *color*

Lets you set the color of an annotation bounding box. See [-draw](#) for details.

-charcoal *factor*

Lets you simulate a charcoal drawing. See the X Windows system manual at <http://www.x.org> for details about the specification.

-colorize *value*

Lets you colorize an image with a pen color.

Specify the *value* of colorization as a percentage. You can apply separate colorization values to the red, green, and blue channels of the image with a colorization value list delineated with slashes, for example,

0/0/50

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

- GRAY
- OHTA
- RGB
- Transparent
- XYZ
- YCbCr
- YIQ
- YPbPr
- YUV
- CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-comment *string*

Lets you annotate an image with a comment.

By default, each image is commented with its file name. Use this option to assign a specific comment to the image.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename

Special Character (Cont.)	Value
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution

Special Character (Cont.)	Value
\n	newline
\r	carriage return

For example,

```
-comment "%m:%f %wx%h"
```

produces for an image—titled `bird.miff` whose width is 512 and height is 480—the comment

```
MIFF:bird.miff 512x480
```

Note: If the first character of *string* is @, the image comment is read from a file titled by the remaining characters in the string.

-compress *type*

Lets you specify one of the following types of image compression:

- None
- Bip
- Fax

- JPEG
- LZW
- RunlengthEncoded
- Zip

Specify

`+compress`

to store the binary image in an uncompressed format. The default is the compression type of the specified image file.

-contrast

Lets you enhance or reduce the intensity differences between the lighter and darker elements of an image.

Use

`-contrast`

to enhance the image or

`+contrast`

to reduce the image contrast.

-cycle *amount*

Lets you displace an image colormap by a specified amount.

Amount defines the number of positions each colormap entry is shifted.

-delay *<1/100ths of a second>x<seconds>*

Displays the next image after pausing.

This option is useful for regulating the display of the sequence of GIF images in Netscape. 1/100ths of a second must pass before the image sequence can be displayed again.

The default is no delay between each showing of the image sequence. The maximum delay is 65535.

The *seconds* value is optional. It lets you specify the number of seconds to pause before repeating the animation sequence.

-density *<width>x<height>*

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-despeckle

Lets you reduce the speckles in an image.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-dispose

Lets you specify one of the following GIF disposal methods:

This method...	Specifies...
0	no disposal specified
1	do not dispose
2	restore to background color
3	restore to previous

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-draw *string*

Lets you annotate an image with one or more of the following graphic primitives:

This...	Requires...
point	a single coordinate
line	a single coordinate, start and end coordinates,
rectangle	upper-left and lower-right coordinates
fillRectangle	upper-left and lower-right coordinates
circle	center and an outer edge coordinates
fillCircle	center and an outer edge coordinates
polygon	three or more coordinates to define its boundaries
fillPolygon	three or more coordinates to define its boundaries

This... (Cont.)	Requires...
color	a single coordinate
matte	a single coordinate
text	a single coordinate
image	a single coordinate

Coordinates are integers separated by an optional comma. For example, to define a circle centered at 100,100 that extends to 150,150 use

```
-draw 'circle 100,100 150,150'
```

Consider the target pixel as that specified by your coordinate. Use *color* to change the color of a pixel. Follow the pixel coordinate with one of the following methods:

- *point* recolors the target pixel
- *replace* recolors any pixel that matches the color of the target pixel
- *floodfill* recolors any pixel that matches the color of the target pixel and its neighbor pixel
- *reset* recolors all pixels

Use *matte* to the change the pixel matte value to transparent. Follow the pixel coordinate with one of the following methods:

- *point* changes the matte value of the target pixel
- *replace* changes the matte value of any pixel that matches the color of the target pixel
- *floodfill* changes the matte value of any pixel that matches the color of the target pixel and its neighbor.
- *reset* changes the matte value of all pixels

Use *text* to annotate an image with text. Follow the text coordinates with a string.

Tip! If the string has embedded spaces, enclose it in double quotes.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename

Special Character (Cont.)	Value
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-draw 'text 100,100 "%m:%f %wx%h"'
```

annotates an image—titled `bird.miff` whose width is 512 and height is 480—with

```
MIFF:bird.miff 512x480
```

To generate a Unicode character (TrueType fonts only), embed the code as an escaped hex string, for example,

```
\\0x30a3
```

Use `-image` to composite an image with another image. Follow the image coordinates with the filename of an image. If the first character of the string is `@`, the text is read from a file titled by the remaining characters in the string.

You can set the primitive color, font color, and font bounding box color with `-pen`, `-font`, and `-box`, respectively. Options are processed in command-line order so be sure to use `-pen` *before* the `-draw` option.

-edge *factor*

Lets you detect edges within an image. Specify *factor* as a percentage of the enhancement from 0.0–99.9%.

-enhance

Lets you apply a digital filter to enhance a noisy image.

-equalize

Lets you perform histogram equalization on an image.

-filter *type*

Lets you specify one of the following filters to use when you resize an image:

- Point
- Box
- Triangle
- Hermite
- Hanning
- Hamming
- Blackman
- Gaussian
- Quadratic
- Cubic

- Catrom
- Mitchell (default)
- Lanczos
- Bessel
- Sinc

See [-geometry](#).

-flip

Lets you create a mirror image by reflecting the scanlines in the vertical direction.

-flop

Lets you create a mirror image by reflecting the image scanlines in the horizontal direction.

-font *name*

Font lets you specify the font to use when annotating an image with text.

If the font is a fully-qualified X server font name, the font is obtained from an X server, for example,

```
-*-helvetica-medium-r-*-*12-*-*-*-*iso8859-*
```

To use a TrueType font, precede the TrueType filename with @, for example,

```
@times.ttf
```

Otherwise, specify a PostScript font, for example,

```
helvetica
```

-frame *<width>x<height>+<outer bevel width>+<inner bevel width>*

Lets you surround an image with an ornamental border. See the X Windows system manual at <http://www.x.org> for details about the specification.

Note: The color of the border is specified with the `-mattecolor` command line option.

-gamma *value*

Lets you specify the level of gamma correction for an image.

The same color image displayed on different workstations may look different because of differences in the display monitor. Use gamma correction to adjust for this color difference. Reasonable values range from 0.8–2.3.

You can apply separate gamma values to the red, green, and blue channels of an image with a gamma value list delineated with slashes, for example,

```
1.7/2.3/1.2
```

Use `+gamma` to set the image gamma level without actually adjusting the image pixels. This option is useful if the image has a known gamma that isn't set as an image attribute, such as PNG images.

-geometry *<width>x<height>[!]{<}>[%]*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append `%`. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use `>` to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, `<` resizes the image. For example, if you specify

```
640x480>
```

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

-implode *amount*

Lets you implode image pixels around the image's center. Specify *amount* as a percentage of implosion from 0–99.9% or explosion from -99.9–0%.

-interlace *type*

Lets you specify one of the following interlacing schemes:

- none (default)
- line
- plane
- partition

Interlace also lets you specify the *type* of interlacing scheme for raw image formats such as RGB or YUV.

Scheme	Description
none	does not interlace (e.g., RGBRGBRGBRGBRGB...)
line	uses scanline interlacing (e.g., RRR...GGG...BBB...RRR...GGG...BBB...)
plane	uses plane interlacing (e.g., RRRRRR...GGGGGG...BBBBBB...)
partition	similar to plane except that different planes are saved to individual files (e.g., image.R, image.G, and image.B)

Tip! Use `line`, or `plane` to create an interlaced GIF or progressive JPEG image.

-label *name*

Lets you assign a label to an image.

-layer *type*

Lets you specify the type of layer to extract from an image:

- red
- green

- blue
- matte

Matte for example, is useful for extracting the opacity values from an image.

-linewidth *value*

Lets you set the width of a line. See [-draw](#) for details.

-loop *iterations*

Lets you add a Netscape loop extension to your GIF animation.

A value other than zero forces the animation to repeat itself up to the number of times you specify for *iterations*.

-map *type*

Lets you display an image using one of the following standard colormap types:

- best
- default
- gray

- red
- green
- blue

The X server must support the colormap you choose, otherwise an error occurs. For *type* specify `list` and `display` searches the list of colormap types in top-to-bottom order until one is located. For one way of creating standard colormaps see *xstdcmap*, an X11 client program that's available with an X11 distribution.

-matte

Lets you store the matte channel (i.e., the transparent channel) if an image has one.

-modulate *value*

Lets you vary the brightness, saturation, and hue of an image.

Specify the percentage of change in brightness, the color saturation, and the hue separated by commas. For example, to increase the color brightness by 20%, decrease the color saturation by 10%, and leave the hue unchanged, use

```
-modulate 20/-10
```

-monochrome

Lets you transform an image to black and white.

-negate

Lets you apply color inversion to an image.

The red, green, and blue intensities of an image are negated. Use `+negate` to negate only the grayscale pixels of the image.

-noise

Lets you add noise to or reduce noise in an image.

The principal function of the noise peak elimination filter is to smooth the objects within an image without losing edge information and without creating undesired structures.

The algorithm replaces a pixel with its next neighbor in value within a 3 x 3 window, if this pixel is noise. A pixel is defined as noise if and only if the pixel is a maximum or minimum within the 3 x 3 window.

Use `+noise` followed by a noise type to add noise to an image. Choose from the following noise types:

- Uniform
- Gaussian

- Multiplicative
- Impulse
- Laplacian
- Poisson

-normalize

Lets you transform an image to span the full range of color values using this contrast enhancement technique.

-opaque *color*

Lets you change the color you specify to the pen color in the image. See [-pen](#) for details.

-page *<width>x<height>{+-}<x offset>{+-}<y offset>{!}{<}{>}{%}*

Lets you set the size and location of an image canvas. Use this option to specify the dimensions of a

- PostScript page in dots per inch (dpi) or a
- TEXT page in pixels

This option is used in concert with `-density`.

The choices for a PostScript page are

Media	Size (pixel width by pixel height)
11x17	792 1224
Ledger	1224 792
Legal	612 1008
Letter	612 792
LetterSmall	612 792
ArchE	2592 3456
ArchD	1728 2592
ArchC	1296 1728
ArchB	864 1296
ArchA	648 864
A0	2380 3368
A1	1684 2380
A2	1190 1684
A3	842 1190

Media (Cont.)	Size (pixel width by pixel height)
A4	595 842
A4Small	595 842
A5	421 595
A6	297 421
A7	210 297
A8	148 210
A9	105 148
A10	74 105
B0	2836 4008
B1	2004 2836
B2	1418 2004
B3	1002 1418
B4	709 1002
B5	501 709
C0	2600 3677

Media (Cont.)	Size (pixel width by pixel height)
C1	1837 2600
C2	1298 1837
C3	918 1298
C4	649 918
C5	459 649
C6	323 459
Flsa	612 936
Flse	612 936
HalfLetter	396 612

You can specify the page size by media (e.g., A4, Ledger, etc.). Otherwise, `-page` behaves much like `-geometry` (e.g., `-page letter+43+43>`).

- To position a GIF image, use

```
-page {+-}<x offset>{+-}<y offset>
```

for example,

```
-page +100+200
```

For a PostScript page, the image is sized as in `-geometry` and positioned relative to the lower-left hand corner of the page by `{+}<x offset>{+}<y offset>`. The default page dimension for a TEXT image is 612x792.

- To position a TEXT page, use

`-page 612x792>`

to center the image within the page.

Tip! If the image size exceeds the PostScript page, it's reduced to fit the page.

-paint *radius*

Lets you simulate an oil painting.

Each pixel is replaced by the most frequently used color in a circular neighborhood whose *radius* you specify.

-pen *color*

Lets you set the color of the font or opaque color. See [-draw](#) for details. See the X Windows system manual at <http://www.x.org> for details about the *color* specification.

-pointsize *value*

Lets you specify the point size of a PostScript font.

-quality *value*

Lets you specify one of the following compression levels:

- JPEG with a *value* from 0–100 (i.e., worst to best); the default is 75
- MIFF with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)
- PNG with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)

The following are valid filter types:

- 0 for none; used for all scanlines
- 1 for sub; used for all scanlines
- 2 for up; used for all scanlines
- 3 for average; used for all scanlines
- 4 for Paeth; used for all scanlines
- 5 for adaptive filter; used when quality is greater than 50 and the image doesn't have a colormap; otherwise no filtering is used

- 6 or higher for adaptive filtering; used with minimum-sum-of-absolute-values

Note: The default is quality is 75—nearly the best compression with adaptive filtering.

For more information, see the PNG specification (RFC 2083) at <http://www.w3.org/pub/WWW/TR>.

-raise <width>x<height>

Lets you lighten or darken image edges to create a 3-D effect. See the X Windows system manual at <http://www.x.org> for details about the *geometry* specification.

Use `-raise` to create a raised effect; otherwise use `+raise`.

-region <width>x<height>{+}<x offset>{+}<y offset>

Lets you apply options to a portion of an image.

By default, command line options you specify are applied to an entire image. Use `-region` to restrict operations to a particular area of the image.

-roll {+}<x offset>{+}<y offset>

Lets you roll an image vertically or horizontally. See the X Windows system manual at <http://www.x.org> for details about the *geometry* specification.

A negative x offset rolls the image left to right. A negative y offset rolls the image top to bottom.

-rotate *degrees*{<|>}

Applies Paeth image rotation to the image.

Use > to rotate the image only if its width exceeds the height. If the image width is less than its height, < rotates the image.

For example, if you have an image size of 480x640 and you specify

`-90>`

the image is not rotated by the specified angle. However, if the image is 640x480, it's rotated by -90 degrees.

Note: Empty triangles left over from rotating the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-sample *geometry*

Lets you scale an image with pixel sampling. See [-geometry](#) for details about the geometry specification.

-scene *value*

Lets you specify the image scene number.

-seed *value*

Lets you generate a seed value using a pseudo-random number generator.

-segment *value*

Lets you eliminate insignificant clusters.

The number of pixels in each cluster must exceed the cluster threshold to be considered valid.

-shade *<azimuth>x<elevation>*

Lets you shade an image using a distant light source.

Specify *azimuth* and *elevation* as the position of the light source. Use `+shade` to return the shading results as a grayscale image.

-sharpen *factor*

Lets you sharpen an image. Specify *factor* as a percentage of enhancement from 0.0–99.9%.

-size *<width>x<height>{+offset}{!}{%}*

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-solarize *factor*

Lets you negate all pixels above a threshold level. Specify *factor* as a percentage of the intensity threshold from 0 - 99.9%.

Note: This option produces a solarization effect seen when exposing a photographic film to light during the development process.

-spread *amount*

Lets you displace image pixels by a random amount.

Amount defines the size of the neighborhood around each pixel from which to choose a candidate pixel to swap.

-swirl *degrees*

Lets you swirl image pixels about the center of an image.

Degrees defines the tightness of the swirl.

-transparency *color*

Lets you make a specified color in an image transparent.

-texture *filename*

Lets you specify a file, which contains a texture, to tile onto an image's background.

-threshold *value*

Threshold lets you create a bi-level image such that any pixel intensity that is equal to or exceeds the threshold *value* you specify is reassigned the maximum intensity. Otherwise, it's reassigned the the minimum intensity.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for treedepth to take effect.

-undercolor <undercolor factor>x<black-generation factor>

Lets you control undercolor removal and black generation on CMYK images (i.e., images to be printed on a four-color printing system).

You can control the amount of cyan, magenta, and yellow to remove from your image and the amount of black to add to it. The standard undercolor removal is 1.0x1.0. You'll frequently get better results though if the percentage of black you add to your image is slightly higher than the percentage of C, M, and Y you remove from it. For example, you might try 0.5x0.7.

-verbose

Lets you print the following detailed information about an image:

- image name
- image size
- image depth
- image format
- image comment
- image scene number
- image class (DirectClass or PseudoClass)

- total unique colors
- number of seconds to read and transform the image
- whether a matte is associated with the image
- the number of runlength packets

-view *string*

Lets you specify FlashPix viewing parameters.

-wave *<amplitude>x<wavelength>*

Lets you alter an image along a sine wave.

Specify *amplitude* and *wavelength* to affect the characteristics of the wave.

Segmenting Images

Use `-segment` to segment an image by analyzing the histograms of the color components and identifying units that are homogeneous with the fuzzy c-means technique. The scale-space filter analyzes the histograms of the three color components of the image and identifies a set of classes. The extents of each class are used to coarsely segment

the image with thresholding. The color associated with each class is determined by the mean color of all pixels within the extents of a particular class. Finally, any unclassified pixels are assigned to the closest class with the fuzzy c-means technique.

The fuzzy c-Means algorithm can be summarized as follows:

- Build a histogram, one for each color component of the image.
- For each histogram, successively apply the scale-space filter and build an interval tree of 0 crossings in the second derivative at each scale. Analyze this scale-space “fingerprint” to determine which peaks or valleys in the histogram are most predominant.
- The fingerprint defines intervals on the axis of the histogram. Each interval contains either a minima or a maxima in the original signal. If each color component lies within the maxima interval, that pixel is considered “classified” and is assigned an unique class number.
- Any pixel that fails to be classified in the above thresholding pass is classified using the fuzzy c-Means technique. It is assigned to one of the classes discovered in the histogram analysis phase.

The fuzzy c-Means technique attempts to cluster a pixel by finding the local minima of the generalized within group sum of squared error objective function. A pixel is assigned to the closest class of which the fuzzy membership has a maximum value.

For additional information see Young Won Lim, Sang Uk Lee. “On the Color Image Segmentation Algorithm Based on the Thresholding and the Fuzzy c-Means Techniques,” *Pattern Recognition, Volume 23, Number 9*, pages 935–952, 1990.

Chapter 9

Mogrify

Overview

Mogrify transforms an image or a sequence of images. These transformations include image scaling, image rotation, color reduction, and others. The transformed image overwrites the original image.

Syntax

```
mogrify [ options ...] file [ [ options ...] file ...]
```

Examples

- To convert all the TIFF files in a particular directory to JPEG, use

```
mogrify -format jpeg *.tiff
```

- To scale an image of a cockatoo to exactly 640 pixels in width and 480 pixels in height, use

```
mogrify -geometry 640x480! cockatoo.miff
```

Mogrify Options

-align *type*

Lets you specify how to align text.

- Left (default)
- Center
- Right

See **-draw** for details.

-blur *factor*

Lets you blur an image. Specify *factor* as a percentage of enhancement from 0.0–99.9%.

-border *<width>x<height>*

Lets you surround an image with a colored border.

The color of the border is obtained from the X server and is defined as *borderColor* (class *BorderColor*). See the X Windows system manual at <http://www.x.org> for details about the specification.

-box *color*

Lets you set the color of an annotation bounding box. See [-draw](#) for details.

-charcoal *factor*

Lets you simulate a charcoal drawing. See the X Windows system manual at <http://www.x.org> for details about the specification.

-colorize *value*

Lets you colorize an image with a pen color.

Specify the *value* of colorization as a percentage. You can apply separate colorization values to the red, green, and blue channels of the image with a colorization value list delineated with slashes, for example,

0 / 0 / 50

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

- GRAY
- OHTA
- RGB
- Transparent
- XYZ
- YCbCr
- YIQ
- YPbPr
- YUV

■ CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-comment *string*

Lets you annotate an image with a comment.

By default, each image is commented with its file name. Use this option to assign a specific comment to the image.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention

Special Character (Cont.)	Value
%f	filename
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution

Special Character (Cont.)	Value
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-comment "%m:%f %wx%h"
```

produces for an image—titled `bird.miff` whose width is 512 and height is 480—the comment

```
MIFF:bird.miff 512x480
```

Note: If the first character of *string* is `@`, the image comment is read from a file titled by the remaining characters in the string.

-compress *type*

Lets you specify one of the following types of image compression:

- None
- Bip

- Fax
- JPEG
- LZW
- RunlengthEncoded
- Zip

Specify

```
+compress
```

to store the binary image in an uncompressed format. The default is the compression type of the specified image file.

-contrast

Lets you enhance or reduce the intensity differences between the lighter and darker elements of an image.

Use

```
-contrast
```

to enhance the image or

```
+contrast
```

to reduce the image contrast.

-crop *<width>x<height>{+-}<x offset>{+-}<y offset>{%}*

Lets you specify the size and location of a cropped image. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

To specify the width or height as a percentage, append %. For example to crop an image by 10% on all sides, use

```
-crop 10%
```

Use cropping to apply image processing options to, or display, a particular area of an image. Omit the *x offset* and *y offset* to generate one or more subimages of a uniform size.

Use cropping to crop an area of an image. Use

```
-crop 0x0
```

to trim edges that are the background color. Add an *x offset* and *y offset* to leave a portion of the trimmed edges with the image. The equivalent X resource for this option is *cropGeometry* (class *CropGeometry*). See [Appendix B, X Resources](#) for details.

-cycle *amount*

Lets you displace an image colormap by a specified amount.

Amount defines the number of positions each colormap entry is shifted.

-delay <1/100ths of a second>x<seconds>

Displays the next image after pausing.

This option is useful for regulating the display of the sequence of GIF images in Netscape. 1/100ths of a second must pass before the image sequence can be displayed again.

The default is no delay between each showing of the image sequence. The maximum delay is 65535.

The *seconds* value is optional. It lets you specify the number of seconds to pause before repeating the animation sequence.

-density <width>x<height>

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-despeckle

Lets you reduce the speckles in an image.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-dispose

Lets you specify one of the following GIF disposal methods:

This method...	Specifies...
0	no disposal specified
1	do not dispose
2	restore to background color
3	restore to previous

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-draw *string*

Lets you annotate an image with one or more of the following graphic primitives:

This...	Requires...
point	a single coordinate
line	a single coordinate, start and end coordinates,
rectangle	upper-left and lower-right coordinates
fillRectangle	upper-left and lower-right coordinates
circle	center and an outer edge coordinates
fillCircle	center and an outer edge coordinates
polygon	three or more coordinates to define its boundaries
fillPolygon	three or more coordinates to define its boundaries
color	a single coordinate
matte	a single coordinate
text	a single coordinate

This... (Cont.)	Requires...
image	a single coordinate

Coordinates are integers separated by an optional comma. For example, to define a circle centered at 100,100 that extends to 150,150 use

```
-draw 'circle 100,100 150,150'
```

Consider the target pixel as that specified by your coordinate. Use *color* to change the color of a pixel. Follow the pixel coordinate with one of the following methods:

- *point* recolors the target pixel
- *replace* recolors any pixel that matches the color of the target pixel
- *floodfill* recolors any pixel that matches the color of the target pixel and its neighbor pixel
- *reset* recolors all pixels

Use *matte* to change the pixel matte value to transparent. Follow the pixel coordinate with one of the following methods:

- *point* changes the matte value of the target pixel
- *replace* changes the matte value of any pixel that matches the color of the target pixel

- *floodfill* changes the matte value of any pixel that matches the color of the target pixel and its neighbor.
- *reset* changes the matte value of all pixels

Use *text* to annotate an image with text. Follow the text coordinates with a string.

Tip! If the string has embedded spaces, enclose it in double quotes.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename
%l	label
%m	magick

Special Character (Cont.)	Value
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

For example,

```
-draw 'text 100,100 "%m:%f %wx%h"'
```

annotates an image—titled `bird.miff` whose width is 512 and height is 480—with

```
MIFF:bird.miff 512x480
```

To generate a Unicode character (TrueType fonts only), embed the code as an escaped hex string, for example,

```
\\0x30a3
```

Use `-image` to composite an image with another image. Follow the image coordinates with the filename of an image. If the first character of the string is `@`, the text is read from a file titled by the remaining characters in the string.

You can set the primitive color, font color, and font bounding box color with `-pen`, `-font`, and `-box`, respectively. Options are processed in command-line order so be sure to use `-pen` *before* the `-draw` option.

-edge *factor*

Lets you detect edges within an image. Specify *factor* as a percentage of the enhancement from 0.0–99.9%.

-emboss

Lets you emboss an image.

-enhance

Lets you apply a digital filter to enhance a noisy image.

-equalize

Lets you perform histogram equalization on an image.

-filter *type*

Lets you specify one of the following filters to use when you resize an image:

- Point
- Box
- Triangle
- Hermite
- Hanning
- Hamming
- Blackman
- Gaussian
- Quadratic
- Cubic

- Catrom
- Mitchell (default)
- Lanczos
- Bessel
- Sinc

See [-geometry](#).

-flip

Lets you create a mirror image by reflecting the scanlines in the vertical direction.

-flop

Lets you create a mirror image by reflecting the image scanlines in the horizontal direction.

-format *type*

Lets you convert an image to a format you specify.

By default, the image is written to its original name. However, if the filename extension matches a supported format, the extension is replaced with the image format *type* you specify. For example, if you specify tiff as the format type and the input image filename is

```
image.gif
```

the output image filename becomes

```
image.tiff
```

See [Appendix A, Supported Image Formats](#) for the format types ImageMagick supports.

-font *name*

Font lets you specify the font to use when annotating an image with text.

If the font is a fully-qualified X server font name, the font is obtained from an X server, for example,

```
--helvetica-medium-r--*-12--*-iso8859--*
```

To use a TrueType font, precede the TrueType filename with @, for example,

```
@times.ttf
```

Otherwise, specify a PostScript font, for example,

```
helvetica
```

-frame *<width>x<height>+<outer bevel width>+<inner bevel width>*

Lets you surround an image with an ornamental border. See the X Windows system manual at <http://www.x.org> for details about the specification.

Note: The color of the border is specified with the `-mattecolor` command line option.

-gamma *value*

Lets you specify the level of gamma correction for an image.

The same color image displayed on different workstations may look different because of differences in the display monitor. Use gamma correction to adjust for this color difference. Reasonable values range from 0.8–2.3.

You can apply separate gamma values to the red, green, and blue channels of an image with a gamma value list delineated with slashes, for example,

`1.7/2.3/1.2`

Use `+gamma` to set the image gamma level without actually adjusting the image pixels. This option is useful if the image has a known gamma that isn't set as an image attribute, such as PNG images.

-geometry *<width>x<height>[!]{<|>}{%}*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append %. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use > to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, < resizes the image. For example, if you specify

```
640x480>
```

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

-implode *amount*

Lets you implode image pixels around the image's center. Specify *amount* as a percentage of implosion from 0–99.9% or explosion from -99.9–0%.

-interlace *type*

Lets you specify one of the following interlacing schemes:

- none (default)
- line
- plane
- partition

Interlace also lets you specify the *type* of interlacing scheme for raw image formats such as RGB or YUV.

Scheme	Description
none	does not interlace (e.g., RGBRGBRGBRGBRGB...)
line	uses scanline interlacing (e.g., RRR...GGG...BBB...RRR...GGG...BBB...)

Scheme (Cont.)	Description
plane	uses plane interlacing (e.g., RRRRRR...GGGGGG...BBBBBB...)
partition	similar to plane except that different planes are saved to individual files (e.g., image.R, image.G, and image.B)

Tip! Use `line`, or `plane` to create an interlaced GIF or progressive JPEG image.

-label *name*

Lets you assign a label to an image.

-layer *type*

Lets you specify the type of layer to extract from an image:

- red
- green
- blue
- matte

Matte for example, is useful for extracting the opacity values from an image.

-linewidth *value*

Lets you set the width of a line. See [-draw](#) for details.

-loop *iterations*

Lets you add a Netscape loop extension to your GIF animation.

A value other than zero forces the animation to repeat itself up to the number of times you specify for *iterations*.

-map *type*

Lets you display an image using one of the following standard colormap types:

- best
- default
- gray
- red
- green
- blue

The X server must support the colormap you choose, otherwise an error occurs. For *type* specify `list` and `display` searches the list of colormap types in top-to-bottom order until one is located. For one way of creating standard colormaps see *xstdcmap*, an X11 client program that's available with an X11 distribution.

-matte

Lets you store the matte channel (i.e., the transparent channel) if an image has one.

-modulate *value*

Lets you vary the brightness, saturation, and hue of an image.

Specify the percentage of change in brightness, the color saturation, and the hue separated by commas. For example, to increase the color brightness by 20%, decrease the color saturation by 10%, and leave the hue unchanged, use

```
-modulate 20/-10
```

-monochrome

Lets you transform an image to black and white.

-negate

Lets you apply color inversion to an image.

The red, green, and blue intensities of an image are negated. Use `+negate` to negate only the grayscale pixels of the image.

-noise

Lets you add noise to or reduce noise in an image.

The principal function of the noise peak elimination filter is to smooth the objects within an image without losing edge information and without creating undesired structures.

The algorithm replaces a pixel with its next neighbor in value within a 3 x 3 window, if this pixel is noise. A pixel is defined as noise if and only if the pixel is a maximum or minimum within the 3 x 3 window.

Use `+noise` followed by a noise type to add noise to an image. Choose from the following noise types:

- Uniform
- Gaussian
- Multiplicative
- Impulse
- Laplacian
- Poisson

-normalize

Lets you transform an image to span the full range of color values using this contrast enhancement technique.

-opaque *color*

Lets you change the color you specify to the pen color in the image. See [-pen](#) for details.

-page *<width>x<height>{+-}<x offset>{+-}<y offset>{!}{<}{>}{%}*

Lets you set the size and location of an image canvas. Use this option to specify the dimensions of a

- PostScript page in dots per inch (dpi) or a
- TEXT page in pixels

This option is used in concert with `-density`.

The choices for a PostScript page are

Media	Size (pixel width by pixel height)
11x17	792 1224
Ledger	1224 792

Media (Cont.)	Size (pixel width by pixel height)
Legal	612 1008
Letter	612 792
LetterSmall	612 792
ArchE	2592 3456
ArchD	1728 2592
ArchC	1296 1728
ArchB	864 1296
ArchA	648 864
A0	2380 3368
A1	1684 2380
A2	1190 1684
A3	842 1190
A4	595 842
A4Small	595 842
A5	421 595

Media (Cont.)	Size (pixel width by pixel height)
A6	297 421
A7	210 297
A8	148 210
A9	105 148
A10	74 105
B0	2836 4008
B1	2004 2836
B2	1418 2004
B3	1002 1418
B4	709 1002
B5	501 709
C0	2600 3677
C1	1837 2600
C2	1298 1837
C3	918 1298

Media (Cont.)	Size (pixel width by pixel height)
C4	649 918
C5	459 649
C6	323 459
Flsa	612 936
Flse	612 936
HalfLetter	396 612

You can specify the page size by media (e.g., A4, Ledger, etc.). Otherwise, `-page` behaves much like `-geometry` (e.g., `-page letter+43+43>`).

- To position a GIF image, use

```
-page {+-}<x offset>{+-}<y offset>
```

for example,

```
-page +100+200
```

For a PostScript page, the image is sized as in `-geometry` and positioned relative to the lower-left hand corner of the page by `{+-}<x offset>{+-}<y offset>`. The default page dimension for a TEXT image is 612x792.

- To position a TEXT page, use

`-page 612x792>`

to center the image within the page.

Tip! If the image size exceeds the PostScript page, it's reduced to fit the page.

-paint *radius*

Lets you simulate an oil painting.

Each pixel is replaced by the most frequently used color in a circular neighborhood whose *radius* you specify.

-pen *color*

Lets you set the color of the font or opaque color. See [-draw](#) for details. See the X Windows system manual at <http://www.x.org> for details about the *color* specification.

-pointsize *value*

Lets you specify the point size of a PostScript font.

-quality *value*

Lets you specify one of the following compression levels:

- JPEG with a *value* from 0–100 (i.e., worst to best); the default is 75

- MIFF with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)
- PNG with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)

The following are valid filter types:

- 0 for none; used for all scanlines
- 1 for sub; used for all scanlines
- 2 for up; used for all scanlines
- 3 for average; used for all scanlines
- 4 for Paeth; used for all scanlines
- 5 for adaptive filter; used when quality is greater than 50 and the image doesn't have a colormap; otherwise no filtering is used
- 6 or higher for adaptive filtering; used with minimum-sum-of-absolute-values

Note: The default is quality is 75—nearly the best compression with adaptive filtering.

For more information, see the PNG specification (RFC 2083) at <http://www.w3.org/pub/WWW/TR>.

-region *<width>x<height>{+-}<x offset>{+-}<y offset>*

Lets you apply options to a portion of an image.

By default, command line options you specify are applied to an entire image. Use `-region` to restrict operations to a particular area of the image.

-rotate *degrees{<}{>}*

Applies Paeth image rotation to the image.

Use `>` to rotate the image only if its width exceeds the height. If the image width is less than its height, `<` rotates the image.

For example, if you have an image size of 480x640 and you specify

`-90>`

the image is not rotated by the specified angle. However, if the image is 640x480, it's rotated by -90 degrees.

Note: Empty triangles left over from rotating the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-roll {+-}<x offset>{+-}<y offset>

Lets you roll an image vertically or horizontally. See the X Windows system manual at <http://www.x.org> for details about the geometry specification.

A negative x offset rolls the image left to right. A negative y offset rolls the image top to bottom.

-sample *geometry*

Lets you scale an image with pixel sampling. See [-geometry](#) for details about the geometry specification.

-scene *value*

Lets you specify the image scene number.

-seed *value*

Lets you generate a seed value using a pseudo-random number generator.

-segment *value*

Lets you eliminate insignificant clusters.

The number of pixels in each cluster must exceed the cluster threshold to be considered valid.

-shade <*azimuth*>*x*<*elevation*>

Lets you shade an image using a distant light source.

Specify *azimuth* and *elevation* as the position of the light source. Use `+shade` to return the shading results as a grayscale image.

-sharpen *factor*

Lets you sharpen an image. Specify *factor* as a percentage of enhancement from 0.0–99.9%.

-shear <*x degrees*>*x*<*y degrees*>

Lets you create a parallelogram by shearing (i.e., sliding) an image along its x or y axis by a positive or negative shear angle.

An x-direction shear slides an edge along the x axis, while a y-direction shear slides an edge along the yaxis. The amount of the shear is controlled by the shear angle. For x-direction shears, *x degrees* is measured relative to the yaxis. For y-direction shears, *y degrees* is measured relative to the x axis.

Empty triangles left over from shearing the image are filled with the color defined as `bordercolor` (class `BorderColor`). See the X Windows system manual at <http://www.x.org> for details.

-size *<width>x<height>{+offset}{!}{%}*

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-solarize *factor*

Lets you negate all pixels above a threshold level. Specify *factor* as a percentage of the intensity threshold from 0 - 99.9%.

Note: This option produces a solarization effect seen when exposing a photographic film to light during the development process.

-spread *amount*

Lets you displace image pixels by a random amount.

Amount defines the size of the neighborhood around each pixel from which to choose a candidate pixel to swap.

-swirl *degrees*

Lets you swirl image pixels about the center of an image.

Degrees defines the tightness of the swirl.

-transparency *color*

Lets you make a specified color in an image transparent.

-texture *filename*

Lets you specify a file, which contains a texture, to tile onto an image's background.

-threshold *value*

Lets you create a bi-level image such that any pixel whose intensity is equal to or greater than the threshold *value* you specify is reassigned the maximum intensity. Otherwise, it's reassigned the the minimum intensity.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for `treedepth` to take effect.

-undercolor <undercolor factor>x<black-generation factor>

Lets you control undercolor removal and black generation on CMYK images (i.e., images to be printed on a four-color printing system).

You can control the amount of cyan, magenta, and yellow to remove from your image and the amount of black to add to it. The standard undercolor removal is 1.0x1.0. You'll frequently get better results though if the percentage of black you add to your image is slightly higher than the percentage of C, M, and Y you remove from it. For example, you might try 0.5x0.7.

-verbose

Lets you print the following detailed information about an image:

- image name
- image size
- image depth
- image format
- image comment
- image scene number
- image class (DirectClass or PseudoClass)

- total unique colors
- number of seconds to read and transform the image
- whether a matte is associated with the image
- the number of runlength packets

-view *string*

Lets you specify FlashPix viewing parameters.

-wave *<amplitude>x<wavelength>*

Lets you alter an image along a sine wave.

Specify *amplitude* and *wavelength* to affect the characteristics of the wave.

Segmenting Images

Use `-segment` to segment an image by analyzing the histograms of the color components and identifying units that are homogeneous with the fuzzy c-means technique. The scale-space filter analyzes the histograms of the three color components of the image and identifies a set of classes. The extents of each class is used to coarsely segment

the image with thresholding. The color associated with each class is determined by the mean color of all pixels within the extents of a particular class. Finally, any unclassified pixels are assigned to the closest class with the fuzzy c-means technique.

The fuzzy c-Means algorithm can be summarized as follows:

- Build a histogram, one for each color component of the image.
- For each histogram, successively apply the scale- space filter and build an interval tree of zero crossings in the second derivative at each scale. Analyze this scale-space ``fingerprint" to determine which peaks or valleys in the histogram are most predominant.
- The fingerprint defines intervals on the axis of the histogram. Each interval contains either a minima or a maxima in the original signal. If each color component lies within the maxima interval, that pixel is considered ``classified" and is assigned an unique class number.
- Any pixel that fails to be classified in the above thresholding pass is classified using the fuzzy c-Means technique. It is assigned to one of the classes discovered in the histogram analysis phase. The fuzzy c-Means technique attempts to cluster a pixel by finding the local minima of the generalized within group sum of squared error objective function. A pixel is assigned to the closest class of which the fuzzy membership has a maximum value.

For additional information see Young Won Lim, Sang Uk Lee, "On the Color Image Segmentation Algorithm Based on the Thresholding and the Fuzzy c-Means Techniques", *Pattern Recognition*, Volume 23, Number 9, pages 935–952, 1990.

Chapter 10

Identify

Overview

Identify describes the format and characteristics of one or more image files. It will also report whether an image is incomplete or corrupt. The information displayed for an image includes the following:

- the scene number
- file name
- image width and height
- whether the image is colormapped
- the number of colors in the image
- the number of bytes in the image
- the image format (JPEG, PNM, etc.)
- the number of seconds it took to read and process the image

The following is a sample line output from *identify*.

```
images/aquarium.miff 640x480 PseudoClass 256c 308135b MIFF 1s
```

If `-verbose` is set, expect additional output including any image comment, such as,

```
Image: images/aquarium.miff
class: PseudoClass
colors: 256
signature: eb5dca81dd93ae7e6ffae99a5275a53e
matte: False
geometry: 640x480
depth: 8
bytes: 308135
format: MIFF
comments:
Imported from MTV raster image:  aquarium.mtv
```

Syntax

```
identify file [ file ... ]
```

Identify Options

-ping

Lets you determine image characteristics efficiently.

This is a less memory-intensive way to query whether an image exists and what its size is.

Note: Only the size of the first image in a multiframe image file is returned.

-size *<width>x<height>[+offset][!]{%}*

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-verbose

Lets you print the following detailed information about an image:

- image name
- image size
- image depth
- image format
- image comment

- image scene number
- image class (DirectClass or PseudoClass)
- total unique colors
- number of seconds to read and transform the image
- whether a matte is associated with the image
- the number of runlength packets

Chapter 11

Combine

Overview

Combine lets you combine two or more images into a new image.

Syntax

```
combine [ options... ] image composite [ mask ] combined
```

Examples

- To combine a image of a cockatoo with a perch, use

```
combine cockatoo.miff perch.ras composite.miff
```

- To compute the difference between images in a series, use

```
combine -compose difference series.1 series.2  
↳difference.miff
```

- To combine a image of a cockatoo with a perch starting at location (100,150), use

```
combine -geometry +100+150 cockatoo.miff perch.ras  
↳composite.miff
```

- To tile a logo across your image of a cockatoo, use

```
convert +shade 30x60 cockatoo.miff mask.miff  
combine -compose bumpmap -tile logo.gif cockatoo.miff mask.miff composite.miff
```

- To combine a red, green, and blue color plane into a single composite image, try

```
combine -compose ReplaceGreen red.png green.png red-green.png  
combine -compose ReplaceBlue red-green.png blue.png composite.png
```

Combine Options

-blend *value*

Blend lets you blend two images a given percentage.

-colors *value*

Lets you specify the preferred number of colors in an image.

The actual number of colors in the image may be fewer than you specify, but will never be more.

Note: This is a color reduction option. Duplicate and unused colors will be removed if an image has fewer unique colors than you specify. See [Appendix D, Quantize](#) for more details. The options `-dither`, `-colorspace`, and `-treedepth` affect the color reduction algorithm.

-colorspace *value*

Lets you specify the type of colorspace.

- GRAY
- OHTA
- RGB
- Transparent
- XYZ
- YCbCr
- YIQ
- YPbPr
- YUV
- CMYK

Color reduction by default, takes place in the RGB color space. Empirical evidence suggests that distances in color spaces such as YUV or YIQ correspond to perceptual color differences more closely than distances in RGB space. These color spaces may give better results when color reducing an image. See [Appendix D, Quantize](#) for details.

Note: The transparent colorspace is unique. It preserves the matte channel of the image if it exists.

Tip! The `-colors` or `-monochrome` option is required for the transparent option to take effect.

-comment *string*

Lets you annotate an image with a comment.

By default, each image is commented with its file name. Use this option to assign a specific comment to the image.

Optionally you can include the image filename, type, width, height, or scene number in the label by embedding special format characters. The following table shows these characters and their values.

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename

Special Character (Cont.)	Value
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution

Special Character (Cont.)	Value
\n	newline
\r	carriage return

For example,

```
-comment "%m:%f %wx%h"
```

produces for an image—titled `bird.miff` whose width is 512 and height is 480—the comment

```
MIFF:bird.miff 512x480
```

Note: If the first character of *string* is `@`, the image comment is read from a file titled by the remaining characters in the string.

-compose *operator*

Lets you specify the type of image composition.

By default, each of the composite image pixels are replaced by the corresponding image tile pixel. You can choose an alternate composite operation. Each operator's behavior is described below.

This operator...	Results in...
over	the union of the two image shapes, with the <i>composite image</i> obscuring the <i>image</i> in the region of overlap
in	<i>composite image</i> cut by the shape of the <i>image</i> ; none of the image data of <i>image</i> will be in the result
out	<i>composite image</i> with the shape of the <i>image</i> cut out
atop	the same shape as <i>image image</i> , with <i>composite image</i> obscuring <i>image</i> where the image shapes overlap; (Note: This differs from <i>over</i> because the portion of <i>composite image</i> outside <i>image's</i> shape does not appear in the result.)
xor	the image data from both <i>composite image</i> and <i>image</i> that is outside the overlap region; the overlap region will be blank
plus	just the sum of the image data; output values are cropped to 255 (no overflow); this operation is independent of the matte channels
minus	<i>composite image</i> minus <i>image</i> , with underflow cropped to 0; the matte channel is ignored (set to 255, full coverage)
add	<i>composite image</i> plus <i>image</i> , with overflow wrapping around (mod 256)

This operator... (Cont.)	Results in...
subtract	<i>composite image</i> minus <i>image</i> , with underflow wrapping around (mod 256); the add and subtract operators can be used to perform reversible transformations
difference	The result of abs (<i>composite image</i> minus <i>image</i>); this is useful for comparing two very similar images
bumpmap	<i>image</i> shaded by <i>composite image</i>
replace	<i>image</i> replaced with <i>composite image</i> ; here the matte information is ignored

The image compositor requires a matte or alpha channel in the image for some operations. This extra channel usually defines a mask that represents a sort of a cookie-cutter for the image.

This is the case when matte is 255 (full coverage) for pixels inside the shape, 0 outside, and between 0 and 255 on the boundary. For certain operations, if *image* does not have a matte channel, it's initialized with 0 for any pixel matching in color to pixel location (0,0). Otherwise it's 255.

Note: To work properly, *borderwidth* must be 0.

-compress type

Lets you specify one of the following types of image compression:

- None

- Bip
- Fax
- JPEG
- LZW
- RunlengthEncoded
- Zip

Specify

`+compress`

to store the binary image in an uncompressed format. The default is the compression type of the specified image file.

-density *<width>x<height>*

Lets you specify in pixels the vertical and horizontal resolution of an image.

This option lets you specify an image density when decoding a PostScript or Portable Document page. The default is 72 pixels per inch in the horizontal and vertical direction.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-displace *<horizontal scale>x<vertical scale>*

Lets you shift image pixels as defined by a displacement map. With this option, a composite image is used as a displacement map.

In the displacement map

- black is a maximum positive displacement
- white is a maximum negative displacement
- middle gray is neutral

The displacement is scaled to determine the pixel shift. By default, the displacement applies to both the horizontal and vertical directions. However, if you specify `mask`, the composite image is the horizontal X displacement and `mask` is the vertical Y displacement.

-display *host:display[.screen]*

Specifies the X server to contact. See the X Windows system manual at <http://www.x.org> for details about the specification.

-dispose

Lets you specify one of the following GIF disposal methods:

This method...	Specifies...
0	no disposal specified
1	do not dispose
2	restore to background color
3	restore to previous

-dither

Lets you apply Floyd/Steinberg error diffusion to an image.

Dithering trades intensity resolution for spatial resolution by averaging the intensities of several neighboring pixels. You can use this option to improve images that suffer from severe contouring when reducing colors.

Note: The `-colors` or `-monochrome` option is required for dithering to take effect.

Tip! Use `+dither` to render PostScript without text or graphic aliasing.

-font *name*

Font lets you specify the font to use when annotating an image with text.

If the font is a fully-qualified X server font name, the font is obtained from an X server, for example,

```
-*-helvetica-medium-r-*-12-*-*-*-*iso8859-*
```

To use a TrueType font, precede the TrueType filename with @, for example,

```
@times.ttf
```

Otherwise, specify a PostScript font, for example,

```
helvetica
```

-geometry *<width>x<height>[!]{<}>[%}*

Lets you specify the size and location of an image window. See the X Windows system manual at <http://www.x.org> for details about the geometry specification. By default, the window size is the image size. You specify its location when you map it.

The width and height, by default, are maximum values. That is, the image is expanded or contracted to fit the width and height value while maintaining the aspect ratio of the image.

Append an exclamation mark to the geometry to force the image size to exactly the size you specify. For example,

```
640x480!
```

sets the image width to 640 pixels and height to 480. If you specify one factor only, both the width and height assume that value.

To specify a percentage width or height instead, append %. The image size is multiplied by the width and height percentages to obtain the final image dimensions. To increase the size of an image, use a value greater than 100 (e.g., 125%). To decrease an image's size, use a percentage less than 100.

Use > to change the dimensions of the image only if its size exceeds the geometry specification. If the image dimension is smaller than the geometry you specify, < resizes the image. For example, if you specify

```
640x480>
```

and the image size is 512x512, the image size does not change. However, if the image is 1024x1024, it's resized to 640x480.

Tip! There are 72 pixels per inch in PostScript coordinates.

-gravity *direction*

Lets you specify the direction an image gravitates within a tile. See the X Windows system manual at <http://www.x.org> for details about the gravity specification.

A tile of a composite image is a fixed width and height. However, the image within the tile may not fill it completely (see [-geometry](#)).

The *direction* you choose specifies where to position the image within the tile. For example, `center` gravity forces the image to be centered within the tile. By default, the image gravity is `center`.

-interlace *type*

Lets you specify one of the following interlacing schemes:

- none (default)
- line
- plane
- partition

Interlace also lets you specify the *type* of interlacing scheme for raw image formats such as RGB or YUV.

Scheme	Description
none	does not interlace (e.g., RGBRGBRGBRGBRGB...)
line	uses scanline interlacing (e.g., RRR...GGG...BBB...RRR...GGG...BBB...)
plane	uses plane interlacing (e.g., RRRRRR...GGGGGG...BBBBBB...)
partition	similar to plane except that different planes are saved to individual files (e.g., image.R, image.G, and image.B)

Tip! Use `line`, or `plane` to create an interlaced GIF or progressive JPEG image.

-matte

Lets you store the matte channel (i.e., the transparent channel) if an image has one.

-monochrome

Lets you transform an image to black and white.

-negate

Lets you apply color inversion to an image.

The red, green, and blue intensities of an image are negated. Use `+negate` to negate only the grayscale pixels of the image.

-page `<width>x<height>{+-}<x offset>{+-}<y offset>{!|}{<}>{ }{ %}`

Lets you set the size and location of an image canvas. Use this option to specify the dimensions of a

- PostScript page in dots per inch (dpi) or a
- TEXT page in pixels

This option is used in concert with `-density`.

The choices for a PostScript page are

Media	Size (pixel width by pixel height)
11x17	792 1224
Ledger	1224 792
Legal	612 1008
Letter	612 792
LetterSmall	612 792
ArchE	2592 3456
ArchD	1728 2592
ArchC	1296 1728
ArchB	864 1296
ArchA	648 864
A0	2380 3368
A1	1684 2380
A2	1190 1684
A3	842 1190

Media (Cont.)	Size (pixel width by pixel height)
A4	595 842
A4Small	595 842
A5	421 595
A6	297 421
A7	210 297
A8	148 210
A9	105 148
A10	74 105
B0	2836 4008
B1	2004 2836
B2	1418 2004
B3	1002 1418
B4	709 1002
B5	501 709
C0	2600 3677

Media (Cont.)	Size (pixel width by pixel height)
C1	1837 2600
C2	1298 1837
C3	918 1298
C4	649 918
C5	459 649
C6	323 459
Flsa	612 936
Flse	612 936
HalfLetter	396 612

You can specify the page size by media (e.g., A4, Ledger, etc.). Otherwise, `-page` behaves much like `-geometry` (e.g., `-page letter+43+43>`).

- To position a GIF image, use

```
-page {+-}<x offset>{+-}<y offset>
```

for example,

```
-page +100+200
```

For a PostScript page, the image is sized as in `-geometry` and positioned relative to the lower-left hand corner of the page by `{+}<x offset>{+}<y offset>`. The default page dimension for a TEXT image is 612x792.

- To position a TEXT page, use

`-page 612x792>`

to center the image within the page.

Tip! If the image size exceeds the PostScript page, it's reduced to fit the page.

-quality *value*

Lets you specify one of the following compression levels:

- JPEG with a *value* from 0–100 (i.e., worst to best); the default is 75
- MIFF with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)
- PNG with a *value* from 0–100 (i.e., worst to best); sets the amount of image compression (quality/10) and filter-type (quality % 10)

The following are valid filter types:

- 0 for none; used for all scanlines
- 1 for sub; used for all scanlines

- 2 for up; used for all scanlines
- 3 for average; used for all scanlines
- 4 for Paeth; used for all scanlines
- 5 for adaptive filter; used when quality is greater than 50 and the image doesn't have a colormap; otherwise no filtering is used
- 6 or higher for adaptive filtering; used with minimum-sum-of-absolute-values

Note: The default is quality is 75—nearly the best compression with adaptive filtering.

For more information, see the PNG specification (RFC 2083) at <http://www.w3.org/pub/WWW/TR>.

-scene *value*

Lets you specify the image scene number.

-size *<width>x<height>[+offset][!]{%}*

Lets you specify the width and height of a raw image whose dimensions are unknown, such as GRAY, RGB, or CMYK.

In addition to *width* and *height*, use `-size` to skip any header information in the image or tell the number of colors in a MAP image file, for example,

```
-size 640x512+256
```

-stereo

Lets you combine two images to create a stereo anaglyph.

The left side of the stereo pair is saved as the red channel of the output image. The right side is saved as the green channel.

Note: You need red-blue stereo glasses to properly view the stereo image.

-tile *<width>x<height>*

Lets you specify the number of tiles to appear in each row and column of a composite image.

Specify the numbr of tiles per row with *width* and the number of tiles per column with *height*. For example, if you want one tile in each row and up to 10 tiles in the composite image, use

```
-tile 1x10
```

The default is five tiles in each row and four tiles in each column of the composite.

-treedepth *value*

Lets you choose an optimal tree depth for the color reduction algorithm. Normally, *value* is 0 or 1.

An optimal depth generally provides the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. To assure the best representation try values between 2 and 8. See [Appendix D, Quantize](#) for details.

Note: The `-colors` or `-monochrome` option is required for `treedepth` to take effect.

Using Mask

The optional mask can be used to provide matte information for composite when it has none or if you want a different mask. a mask image is typically grayscale and the same size as composite. if the image is not grayscale, it is converted to grayscale and the resulting intensities are used as matte information.

If combined already exists, you will be prompted to overwrite it.

Chapter 12

PerlMagick

Overview

PerlMagick is an objected-oriented Perl interface to ImageMagick. You can use it to read, manipulate, or write an image or image sequence from within a Perl script. This makes it very suitable for web CGI scripts.

For either Perl script or CGI scripts to work, you must have the following installed on your system:

- ImageMagick 4.1.5 or later
- Perl 5.002 or later

Note: Perl version 5.005_02 or later is required for PerlMagick to work on an NT system.

There are a number of useful scripts available to show you the value of PerlMagick. You can do web-based image manipulation and conversion with MogrifyMagick, or use L-systems to create images of plants using mathematical constructs. Finally, you can navigate through collections of thumbnail images and select an image to view with the WebMagick Image Navigator.

An object-oriented Python interface to ImageMagick is also available, see PythonMagick at <http://starship.skyport.net/crew/zack/pymagick/>.

Installing PerlMagick

Instructions for installing PerlMagick are organized by platform in the following sections.

Installing for Unix

ImageMagick must already be installed on your system.

Note: For Unix, you typically need to be root to install the software. There are ways around this. Consult the Perl manual pages for more information.

- 1 Download the PerlMagick distribution from ???.
- 2 Unpack the distribution by typing the following at the system prompt:

```
gunzip -c PerlMagick-1.54.tar.gz | tar -xvf - cd PerlMagick
```

- 3 Edit Makefile.PL and change LIBS and INC to include the appropriate path information to the required libMagick library.

Note: You will also need paths to the JPEG, PNG, TIFF, etc. delegates if they were included with your installed version of ImageMagick.

- 4 Type the following to build and install PerlMagick:

```
perl Makefile.PL make make install
```

Installing for Windows NT/95/98

ImageMagick must already be installed on your system. The ImageMagick source distribution for Windows NT is also required and you must have the **nmake** from the Visual C++ or J++ development environment.

- 1 Copy `\bin\IMagick.dll` and `\bin\X11.dll` to a directory in your dynamic load path, such as `c:\perl\site\5.00502`.
- 2 Type

```
cd PerlMagick
copy Makefile.nt Makefile.PL
perl Makefile.PL
nmake
nmake install
```

Running the Regression Tests

- 1 To verify a correct installation, type

```
make test
```

Use `nmake test` under Windows. A few demonstration scripts are available to exercise many of the functions PerlMagick can perform.

- 2 Type

```
cd demo
make
```

You are now ready to use the PerlMagick methods from within your Perl scripts.

Using PerlMagick within PerlScripts

Any script that uses PerlMagick methods must first define the methods within its namespace and instantiate an image object. Do this with:

```
use Image::Magick;
$image=Image::Magick->new;
```

The new method takes the same parameters as *SetAttribute*. For example,

```
$image=Image::Magick->new(size=>'384x256');
```

Next you'll want to

- read an image or image sequence,
- manipulate it, then
- display or write it.

The remainder of this chapter is divided into the following sections:

- [Reading and Writing an Image](#) defines the input and output methods for PerlMagick.
- [Setting an Image Attribute](#) identifies methods that affect the way an image is read or written.
- [Manipulating an Image](#) provides a list of methods you can use to transform an image.
- [Getting an Image Attribute](#) describes how to retrieve an attribute for an image.
- [Creating an Image Montage](#) provides details about tiling your images as thumbnails on a background.
- [Miscellaneous Methods](#) describes methods that don't neatly fit into any of the above categories.

Destroying PerlMagick Objects

Once you're finished with a PerlMagick object you should consider destroying it. Each image in an image sequence is stored in virtual memory. This can potentially add up to mega-bytes of memory. After you destroy a PerlMagick object, memory is returned for use by other Perl methods. The recommended way to destroy an object is with `undef`.

```
undef $image
```

To delete all the images but retain the `Image::Magick` object use

```
undef @$image
```

To delete a single image from a multi-image sequence, use

```
undef $image->[x];
```

The next section illustrates how to use various PerlMagick methods to manipulate an image sequence.

Some of the PerlMagick methods require external programs such as Ghostscript. This may require an explicit path in your PATH environment variable to work properly. For example,

```
$ENV{PATH}='/bin:/usr/bin:/usr/local/bin';
```

Examples

The following are an examples of scripts to get you started.

- The following script reads three images, crops them, and writes a single image as a GIF animation sequence.

```
#!/usr/local/bin/perl
use Image::Magick;

my($image, $x);

$image = Image::Magick->new;
$x = $image->Read('girl.gif', 'logo.gif', 'rose.gif'); warn "$x" if "$x";

$x = $image->Crop(geometry=>'100x100+100+100');
warn "$x" if "$x";

$x = $image->Write('x.gif');
warn "$x" if "$x";
```

- In many cases you may want to access individual images of a sequence. The next example illustrates how this is done:

```
#!/usr/local/bin/perl
use Image::Magick;

my($image, $p, $q);

$image = new Image::Magick;
$image->Read('x1.gif');
$image->Read('j*.jpg');
$image->Read('k.miff[1, 5, 3]');
$image->Contrast;
for ($x = 0; $image->[x]; $x++)
{
    $image->[x]->Frame('100x200') if $image->[x]->Get('magick') eq 'GIF';
    undef $image->[x] if $image->[x]->Get('columns') < 100;
}
$p = $image->[1];
$p->Draw(pen=>'red', primitive=>'rectangle', points=>20, 20 100, 100);
$q = $p->Montage();
undef $image;
$q->Write('x.miff');
```

- Suppose you want to start out with a 100 x100 pixel black canvas with a red pixel in the center. Try

```
$image = Image::Magick->new;
$image->Set(size=>'100x100');
$image->ReadImage('xc:white');
$image->Set('pixel[49, 49]'=>'red');
```

- Perhaps you want to convert your color image to grayscale. Try

```
$image->Quantize(colorspace=>'gray');
```

■ Other clever things you can do with PerlMagick objects include

```
$i = $$p+1;      # return the number of images associated with object p
push(@$q, @$p);  # push the images from object p onto object q
undef @$p;       # delete the images but not the object p
```

Reading and Writing an Image

Use the methods listed below to read, write, or display an image or image sequence.

Read/Write Methods/Description	Parameters	Return Value
<i>Read</i> reads an image or image sequence.	one or more filenames	the number of images read
<i>Write</i> writes an image or image sequence.	filename	the number of images written
<i>Display</i> displays an image or image sequence to an X server.	server name	the number of images displayed
<i>Animate</i> animates an image sequence to an X server.	server name	the number of images animated

For convenience, the *Write*, *Display*, and *Animate* methods can take any parameter *SetAttribute* recognizes. For example,

```
$image->Write(filename=>'image.png', compress=>'None');
```

Use `-` as the filename to method *Read* to read from standard in or to method *Write* to write to standard out, for example,

```
binmode STDOUT; $image->Write('gif:-');
```

Examples

- To read an image in the GIF format from a PERL filehandle, use

```
$image = Image::Magick->new(magick=>'GIF');  
open(DATA, 'image.gif');  
$image->Read(file=>DATA);  
close(DATA);
```

- To write an image in the PNG format to a PERL filehandle, use

```
$filename = "image.png";  
open(DATA, ">$filename");  
$image->Write(file=>DATA, filename=>$filename);  
close(DATA);
```

- You can optionally add *Image* to any method name. For example, *ReadImage* is an alias for method *Read*.

Manipulating an Image

Once you create an image with method `ReadImage`, for example, you may want to operate on it. The following is an example of a call to an image manipulation method:

```
$image->Crop(geometry=>'100x100+10+20');  
$image->[x]->Frame("100x200");
```

The following table shows additional image manipulation methods you can call.

Image Manipulation Method/Description	Parameters
<i>AddNoise</i> adds noise to an image.	noise=>{Uniform, Gaussian, Multiplicative, Impulse, Laplacian, Poisson}
<i>Annotate</i> annotates an image with text.	text=> <i>string</i> , font=> <i>string</i> , pointsize=> <i>integer</i> , density=> <i>geometry</i> , box=> <i>colorname</i> , pen=> <i>colorname</i> , geometry=> <i>geometry</i> , server=>{ <i>string</i> , @ <i>filename</i> }, gravity=>{NorthWest, North, NorthEast, West, Center, East, SouthWest, South, SouthEast}, x=> <i>integer</i> , y=> <i>integer</i>
<i>Blur</i> blurs an image.	factor=> <i>percentage</i>
<i>Border</i> surrounds an image with a colored border.	geometry=> <i>geometry</i> , width=> <i>integer</i> , height=> <i>integer</i> , x=> <i>integer</i> , y=> <i>integer</i>
<i>Charcoal</i> simulates a charcoal drawing.	factor=> <i>percentage</i>
<i>Chop</i> chops an image.	geometry=> <i>geometry</i> , width=> <i>integer</i> , height=> <i>integer</i> , x=> <i>integer</i> , y=> <i>integer</i>
<i>Clone</i> makes a copy of an image.	n/a
<i>Coalesce</i> merges a sequence of images.	n/a

Image Manipulation Method/Description (Cont.)	Parameters
<i>ColorFloodfill</i> changes the color value of any neighboring pixel that matches the color of the target pixel. If you specify a border color, the color value is changed for any neighboring pixel that isn't that color.	<i>geometry=>geometry</i> , <i>x=>integer</i> , <i>y=>integer</i> , <i>pen=>colorname</i> , <i>bordercolor=>colorname</i>
<i>Colorize</i> colorizes an image with the pen's color.	<i>color=>colorname</i> , <i>pen=>colorname</i>
<i>Comment</i> adds a comment to an image.	string
<i>Composite</i> composites one image onto another.	<i>compose=>{Over, In, Out, Atop, Xor, Plus, Minus, Add, Subtract, Difference, Bumpmap, Replace, ReplaceRed, ReplaceGreen, ReplaceBlue, ReplaceMatte, Blend, Displace}</i> , <i>image=>image-handle</i> , <i>geometry=>geometry</i> , <i>x=>integer</i> , <i>y=>integer</i> , <i>gravity=>{NorthWest, North, NorthEast, West, Center, East, SouthWest, South, SouthEast}</i>
<i>Condense</i> compresses an image to take up the least amount of memory.	n/a
<i>Contrast</i> enhances or reduces the image contrast.	<i>sharpen=>{True, False}</i>

Image Manipulation Method/Description (Cont.)	Parameters
<i>Crop</i> crops an image.	<code>geometry=>geometry, width=>integer, height=>integer, x=>integer, y=>integer</code>
<i>Despeckle</i> displaces the image colormap by an amount.	<code>amount=>integer</code>
<i>Draw</i> annotates an image with one or more graphic primitives.	<code>primitive=>{point, Line, Rectangle, FillRectangle, Circle, FillCircle, Ellipse, FillEllipse, Polygon, FillPolygon, Color, Matte, Text, Image, @filename}, points=>string, method=>{Point, Replace, Floodfill, FillToBorder, Reset}, pen=>colorname, bordercolor=>colorname, linewidth=>integer, server=>string</code>
<i>Edge</i> detects edges in an image.	<code>factor=>percentage</code>
<i>Emboss</i> embosses an image.	n/a
<i>Enhance</i> applies a digital filter to enhance a noisy image.	n/a
<i>Equalize</i> performs a histogram equalization to an image.	n/a
<i>Flip</i> creates a mirror image by reflecting the image scanlines vertically.	n/a

Image Manipulation Method/Description (Cont.)	Parameters
<i>Flop</i> creates a mirror image by reflecting the image scanlines horizontally.	n/a
<i>Frame</i> surrounds an image with an ornamental border.	geometry=> <i>geometry</i> , width=> <i>integer</i> , height=> <i>integer</i> , inner=> <i>integer</i> , outer=> <i>integer</i> , color=> <i>colorname</i>
<i>Gamma</i> gamma corrects an image.	gamma=> <i>double</i> , red=> <i>double</i> , green=> <i>double</i> , blue=> <i>double</i>
<i>Implode</i> implodes image pixels about the image center.	factor=> <i>percentage</i>
<i>Label</i> assigns a label to an image.	string
<i>Layer</i> extracts a layer from an image.	layer={Red, Green, Blue, Matte}
<i>Magnify</i> doubles the size of an image.	n/a
<i>Map</i> chooses a particular set of colors from an image.	image=> <i>image-handle</i> , dither={True, False}

Image Manipulation Method/Description (Cont.)	Parameters
<i>MatteFloodfill</i> changes the matte value of any pixel that matches the color of the target pixel and is a neighbor. If you specify a border color, the matte value is changed for any neighbor pixel that's not that color.	<i>geometry=>geometry</i> , <i>width=>integer</i> , <i>height=>integer</i> , <i>matte=>integer</i> , <i>border=>colorname</i>
<i>Minify</i> reduces the size of an image by half.	n/a
<i>Modulate</i> varies the brightness, saturation, and hue of an image.	<i>brightness=>double</i> , <i>saturation=>double</i> , <i>hue=>double</i>
<i>Negate</i> applies color inversion to an image.	<i>gray=>{True, False}</i>
<i>Normalize</i> transforms an image to span the full range of color values.	n/a
<i>OilPaint</i> simulates an oil painting.	<i>color=>colorname</i> , <i>pen=>colorname</i>
<i>Opaque</i> changes the color to the pen color in the image.	<i>color=>colorname</i> , <i>pen=>colorname</i>

Image Manipulation Method/Description (Cont.)	Parameters
<i>Quantize</i> is the preferred number of colors in an image.	<code>colors=>integer</code> , <code>colorspace=>{RGB, Gray, Transparent, OHTA, XYZ, YCbCr, YIQ, YPbPr, YUV, CMYK}</code> , <code>treedepth=>integer</code> , <code>dither=>{True, False}</code> , <code>measure_error=>{True, False}</code> , <code>global_colormap=>{True, False}</code>
<i>Raise</i> lightens or darkens image edges to create a 3D effect.	<code>geometry=>geometry</code> , <code>width=>integer</code> , <code>height=>integer</code> , <code>x=>integer</code> , <code>y=>integer</code> , <code>raise=>{True, False}</code>
<i>ReduceNoise</i> adds or reduces the noise in an image.	n/a
<i>Roll</i> rolls an image vertically or horizontally.	<code>geometry=>geometry</code> , <code>x=>integer</code> , <code>y=>integer</code>
<i>Rotate</i> rolls an image vertically or horizontally.	<code>degrees=>double</code> , <code>crop=>{True, False}</code> , <code>sharpen=>{True, False}</code>
<i>Sample</i> scales an image with pixel sampling.	<code>geometry=>geometry</code> , <code>width=>integer</code> , <code>height=>integer</code>
<i>Scale</i> scales an image to a specified size.	<code>geometry=>geometry</code> , <code>width=>integer</code> , <code>height=>integer</code>

Image Manipulation Method/Description (Cont.)	Parameters
<i>Segment</i> segments an image by analyzing the histograms of color components and identifying units that are homogeneous.	<code>colors=>integer</code> , <code>colorspace=>{RGB, Gray, Transparent, OHTA, XYZ, YCbCr, YIQ, YPbPr, YUV, CMYK}</code> , <code>verbose=>{True, False}</code> , <code>cluster=>double</code> , <code>smooth=>double</code>
<i>Shade</i> shades an image using a distant light source.	<code>geometry=>geometry</code> , <code>azimuth=>double</code> , <code>elevation=>double</code> , <code>color=>{True, False}</code>
<i>Sharpen</i> sharpens an image.	<code>factor=>percentage</code>
<i>Shear</i> shears an image along the X or Y axis by a positive or negative shear angle.	<code>geometry=geometry</code> , <code>x=>double</code> , <code>y=>double</code> , <code>crop=>{True, False}</code>
<i>Signature</i> generates an MD5 signature for an image.	n/a
<i>Solarize</i> negates all pixels above a threshold level.	<code>factor=>percentage</code>
<i>Spread</i> displaces image pixels by a random amount.	<code>amount=>integer</code>

Image Manipulation Method/Description (Cont.)	Parameters
<i>Stereo</i> combines two images and produces a single image that's the composite of a left and right image of a stereo pair.	<code>image=>image-handle</code>
<i>Stegano</i> hides a digital watermark in an image.	<code>image=>image-handle, offset=>integer</code>
<i>Swirl</i> swirls image pixels about the center.	<code>degrees=>double</code>
<i>Texture</i> specifies name of a texture to tile onto an image background.	<code>filename=>string</code>
<i>Threshold</i> thresholds an image.	<code>threshold=>integer</code>
<i>Transform</i> crops or resizes an image with a fully-qualified geometry specification.	<code>crop=>geometry, geometry=>geometry, filter->{Point, Box, Triangle, Hermite, Hanning, Hamming, Blackman, Gaussian, Quadratic, Cubic, Catrom, Mitchell, Lanczos, Bessel, Sinc}</code>
<i>Transparent</i> makes the specified color transparent in an image.	<code>color=>colorname</code>
<i>Trim</i> removes from an image edges that are the background color.	n/a

Image Manipulation Method/Description (Cont.)	Parameters
<i>Wave</i> alters an image along a sine wave.	<code>geometry=>geometry</code> , <code>amplitude=>double</code> , <code>wavelength=>double</code>
<i>Zoom</i> scales an image to a specified size.	<code>geometry=>geometry</code> , <code>width=>integer</code> , <code>height=>integer</code> , <code>filter=>{Point, Box, Triangle, Hermite, Hanning, Hamming, Blackman, Gaussian, Quadratic, Cubic, Catrom, Mitchell, Lanczos, Bessel, Sinc}</code>

Note: A `geometry` parameter is a short cut for the width and height parameters, for example,

```
geometry=>'106x80'
```

is equivalent to `width=>106, height=>80`).

You can specify `@filename` in both `Annotate` and `Draw`. This reads the text or graphic primitive instructions from a file on disk. For example,

```
$image->Draw(pen=>'red', primitive=>'rectangle', points=>'20, 20 100, 100 40, 40 200,  
↳200 60, 60 300, 300');
```

is equivalent to

```
$image->Draw(pen=>'red', primitive=>'@draw.txt');
```

where `draw.txt` is a file on disk that contains

```
rectangle 20, 20 100, 100
rectangle 40, 40 200, 200
rectangle 60, 60 300, 300
```

The text parameter for methods *Annotate*, *Comment*, *Draw*, and *Label* can include the image filename, type, width, height, or other image attribute by embedding the following special format characters:

Special Character	Value
%b	file size
%d	directory
%e	filename extention
%f	filename
%h	height
%i	input filename
%l	label
%m	magick
%n	number of scenes
%o	output filename
%p	page number

Special Character (Cont.)	Value
%q	quantum depth
%s	scene number
%t	top of filename
%u	unique temporary filename
%w	width
%x	x resolution
%y	y resolution
\n	newline
\r	carriage return

Optionally you can add `Image` to any method name. For example, *TrimImage* is an alias for method *Trim*.

Most of the attributes listed above have an analog in `convert`. See [Chapter 8, Convert](#) for a detailed description of these attributes.

Setting an Image Attribute

Use method `Set` to set an image attribute. For example,

```
$image->Set(dither=>'True');  
$image->[$x]->Set(delay=>3);
```

The following are image attributes you can set.

Attribute/Description	Values
<code>adjoin</code> joins images into a single mult-image file	True, False
<code>background</code> is the image's background color	<i>string</i>
<code>blue_primary</code> is the chromaticity of the blue primary point (e.g., 0.15, 0.06)	<i>x-value, y-value</i>
<code>bordercolor</code> sets the images border color	<i>string</i>
<code>colormap[i]</code> is the color name (e.g., red) or hex value (e.g., #ccc) at position <i>i</i>	<i>string</i>
<code>colors</code> is the preferred number of colors in an image	<i>integer</i>
<code>colorspace</code> is the type of colorspace	RGB, gray, transparent, OHTA, XYZ, YCbCr, YCC, YIQ, YPbPr, YUV, CMYK
<code>compress</code> is the type of image compression	none, BZip, Fax, JPEG, LZW, Runlength, Zip
<code>delay</code> is the number of 1/100ths of a second that must expire before displaying thenext image in a sequence	<i>integer</i>
<code>density</code> is te vertical and horizontal resolution of an image in pixels	<i>geometry</i>

Attribute/Description (Cont.)	Values
depth is the image depth	<i>integer</i>
dispose is the GIF disposal method	<i>1, 2, 3, 4</i>
dither applies the Floyd/Steinberg error diffusion to an image	<i>True, False</i>
display specifies an X server to contact	<i>string</i>
file sets the image filehandle	<i>filehandle</i>
filename sets the image file name	<i>string</i>
filter is used to resize an image	<i>Point, Box, Triangle, Hermite, Hanning, Hamming, Blackman, Gaussian, Quadratic, Cubic, Catrom, Mitchell, Lanczos, Bessel, Sinc</i>
font is used when annotating an image with text	<i>string</i>
fuzz specifies the distance within which colors are considered equal	<i>integer</i>
green_primary is the chromaticity of the green primary point (e.g., 0.3, 0.6)	<i>x-value, y-value</i>
interlace is the type of interlacing scheme	<i>None, Line, Plan, Partition</i>

Attribute/Description (Cont.)	Values
<code>iterations</code> adds a Netscape loop to a GIF animation	<i>integer</i>
<code>loop</code> adds a Netscape loop to a GIF animation	<i>integer</i>
<code>magick</code> sets the image format	<i>string</i>
<code>mattecolor</code> sets the image matte color	<i>string</i>
<code>monochrome</code> transforms an image to black and white	<i>string</i>
<code>page</code> is the preferred size and location of an image <code>canvas</code>	Letter, Tabloid, Ledger, Legal, Statement, Executive, A32, A4, A5, B4, B5, Folio, Quarto, 10x14, or geometry
<code>pen</code> is the color name (e.g., red) or hex value (e.g., #ccc) for annotating or changing an opaque color	<i>color</i>
<code>pixel[x,y]</code> is the color name (e.g., red) or hex value (e.g., #ccc) at position (x,y)	<i>string</i>
<code>pointsize</code> is the size of the PostScript or TrueType font	<i>integer</i>

Attribute/Description (Cont.)	Values
<code>preview</code> is the type of preview for the Preview image format	Rotate, Shear, Roll, Hue, Saturation, Brightness, Gamma, Spiff, Dull, Grayscale, Quantize, Despeckle, ReduceNoise, AddNoise, Sharpen, Blue, Threshold, EdgeDetect, Spread, Solarize, Shade, Raise, Segment, Swirl, Implode, Wave, OilPaint, CharcoalDrawing, JPEG
<code>quality</code> is the JPEG/MIFF/PNG compression level	<i>integer</i>
<code>red_primary</code> is the chromaticity of the red primary point (e.g., 0.64, 0.33)	<i>x-value, y-value</i>
<code>rendering_intent</code> is the type of rendering intent	Undefined, Saturation, Percetual, Absolute, Relative
<code>scene</code> is the image scene number	<i>integer</i>
<code>subimage</code> is part of an image sequence	<i>integer</i>
<code>subrange</code> is the number of images relative to the base image	<i>integer</i>
<code>server</code> specifies an X server to contact	<i>string</i>

Attribute/Description (Cont.)	Values
<code>size</code> is the width and height of a raw image	<i>string</i>
<code>tile</code> is the tile name of an image	<i>string</i>
<code>texture</code> is the name of the texture to tile onto an image background	<i>string</i>
<code>treedepth</code> is the depth of the color classification tree	<i>0, 1, 2, 3, 4, 5, 6, 7, 8</i>
<code>undercolor</code> controls undercolor removal and black generation on CMYK images	<i>undercolor factor x black-generation factor</i>
<code>verbose</code> prints detailed information about an image	True, False
<code>white_primary</code> is the chromaticity of the white primary point (e.g., 0.3127, 0.329)	<i>x-value, y-value</i>

Note: The geometry parameter is a short cut for the width and height parameters, for example,

```
geometry=>'106x80'
```

is equivalent to

```
width=>106, height=>80).
```

`SetAttribute` is an alias for method `Set`.

Most of the attributes listed in the table above have an analog in `convert`. See [Chapter 8, Convert](#) for a detailed description of these attributes.

Getting an Image Attribute

Use method `Get` to get an image attribute. For example,

```
($a, $b, $c) = $image->Get('colorspace', 'magick', 'adjoin');  
$width = $image->[3]->Get('columns');
```

In addition to all the attributes listed in [Setting an Image Attribute](#), you can get these additional attributes:

Attribute/Description	Values
<code>base_columns</code> is the base image width (before transformations)	integer
<code>base_filename</code> is the base image file name (before transformations)	string
<code>base_rows</code> is the base image height (before transformations)	integer
<code>class</code> is the image class	Direct, Pseudo
<code>comment</code> is the image comment	string

Attribute/Description (Cont.)	Values
columns is the image width	integer
directory is the tile names from within an image montage	string
filesize is the number of bytes of an image on disk	integer
format gets the descriptive image format	string
gamma is the gamma level of an image	double
geometry is the image geometry	string
height is the number of row or heith of an image	integer
label is the image label	string
matte is the image transparency (true means an image has tranparency)	True, False
mean is the mean error per pixel computed whn animage is color reduced	double
montage is the tile size and offset within an image montagw	geometry
normalized_max is the nomralized max error per pixel computed when an image is color reduced	double

Attribute/Description (Cont.)	Values
<code>normalized_mean</code> is the normalized mean error per pixel computed when an image is color reduced	double
<code>packet_size</code> is the number of bytes in each pixel packet	integer
<code>packets</code> is the number of runlength-encoded packets in an image	integer
<code>rows</code> is the number of rows or height of an image	integer
<code>signature</code> is the MD5 signature associated with an image	string
<code>text</code> is any text associated with an image	string
<code>total_colors</code> is the number of colors in an image	integer
<code>type</code> is the image type	bilevel, greyscale, palette, true color, true color with transparency, color separation
<code>units</code> is the units of resolution	string
<code>view</code> is the FlashPix viewing parameters	string
<code>width</code> is the number of columns or width of an image	integer
<code>x-resolution</code> is the x resolution of an image	integer
<code>y-resolution</code> is the y resolution of an image	integer

GetAttribute is an alias for method *Get*.

Most of the attributes listed above have an analog in *convert*. See [Chapter 8, Convert](#) for a detailed description of these attributes.

Creating an Image Montage

Use method *Montage* to create a composite image by combining several separate images. The images are tiled on the composite image with the name of the image optionally appearing just below the individual tile. For example,

```
$image->Montage(geometry=>'160x160', tile=>'2x2', texture=>'granite:');
```

Montage parameters you can set are:

Parameter/Description	Values
<code>background</code> is the X11 color name	color
<code>borderwidth</code> is the image border width	integer
<code>compose</code> is the composite operator	Over, In, Out, Atop, Xor, Plus, Minus, Add, Subtract, Difference, Bumpmap, Replace, MatteReplace, Mask, Blend, Displace
<code>filename</code> is the name of a montage image	string
<code>font</code> is the X11 font name	string
<code>frame</code> surrounds an image with an ornamental border	geometry
<code>geometry</code> is the preferred tile and border size of each tile of a composite image	geometry
<code>gravity</code> is the direction an image gravitates within a tile	NorthWest, North, NorthEast, West, Center, East, SouthWest, South, SouthEast

Parameter/Description (Cont.)	Values
<code>label</code> assigns a label to an image	string
<code>mode</code> specifies thumbnail framing options	Frame, Unframe, Concatenate
<code>pen</code> is the color for annotation text	string
<code>pointsize</code> is the size of a PostScript or TrueType font	integer
<code>shadow</code> adds a shadow beneath a tile to simulate depth	True, False
<code>texture</code> is the name of a texture to tile onto an image background	string
<code>tile</code> is the number of tiles per row and column	geometry
<code>title</code> assigns a title to an image montage	string
<code>transparent</code> specifies the color to make transparent within an image	string

Note: The geometry parameter is a short cut for the width and height parameters, for example,

```
geometry=>'106x80'
```

is equivalent to

```
width=>106, height=>80)
```

MontageImage is an alias for method *Montage*.

Most of the attributes listed in the table above have an analog in montage. See [Chapter 7, Montage](#) for a detailed description of these attributes.

Miscellaneous Methods

Append

The *Append* method appends a set of images. For example,

```
$x = $image->Append(stack=>{true,false});
```

appends all the images associated with object `$image`. All the specified images must have the same width or height. Same-width images are stacked top to bottom. Same-height images are stacked left to right. Rectangular images are stacked left to right when the `stack` parameter is `False`. When the parameter is `True`, rectangular images are stacked top to bottom.

Average

The *Average* method averages a set of images. For example,

```
$x = $image->Average();
```

averages all the images associated with object `$image`.

Morph

The *Morph* method morphs a set of images. Both the image pixels and size are linearly interpolated to give the appearance of a metamorphosis from one image to the next, for example,

```
$x = $image->Morph(frames=>integer);
```

where `frames` is the number of intermediate images to generate. The default is 1.

Mogrify

The *Mogrify* method is a single entry point for the image manipulation methods (see [Manipulating an Image](#)). The parameters are the name of a method followed by any parameters the method may require. For example, these calls are equivalent:

```
$image->Crop('340x256+0+0');  
$image->Mogrify('crop', '340x256+0+0');
```

MogrifyRegion

The *MogrifyRegion* method applies a transformation to a region of an image. It's similar to *Mogrify* but it begins with a region's geometry. For example, suppose you want to brighten a 100x100 region of an image at location (40, 50):

```
$image->MogrifyRegion('100x100+40+50', 'modulate', brightness=>50);
```

Clone

The *Clone* method copies a set of images. For example,

```
$p = $image->Clone();
```

copies all the images from object `$q` to `$p`.

Use this method for multi-image sequences. PerlMagick transparently creates a linked list from an image array. If two locations in the array point to the same object, the linked list goes into an infinite loop and your script will run continuously until it's interrupted. Instead of

```
push(@$images, $image);  
push(@$images, $image); # warning duplicate object
```

use cloning to prevent an infinite loop, such as,

```
push(@$images, $image);  
$clone=$image->Clone();  
push(@$images, $clone); # same image but different object
```

Ping

Ping accepts one or more image file names and returns their respective width, height, size in bytes, and format (e.g. GIF, JPEG, etc.). For example,

```
($width, $height, $size, $format) = split(',', $image->Ping('logo.gif'));
```

This is a more efficient and less memory-intensive way to query whether an image exists and what its characteristics are.

Note: Information about the first image only in a multi-frame image file is returned.

You can optionally add *Image* to any method name above. For example, *PingImage* is an alias for method *Ping*.

RemoteCommand

Use *RemoteCommand* to send a command to an already running *Display* or *Animate* application. The only parameter required is the name of the image file you want to display or animate.

QueryColor

The *QueryColor* method accepts one or more color names or hex values and returns their respective red, green, and blue color values:

```
($red, $green, $blue) = split(' ', $image->QueryColor('cyan'));  
($red, $green, $blue) = split(' ', $image->QueryColor('#716bae'));
```

Troubleshooting

All successful PerlMagick methods return an undefined string context. If a problem occurs, an error is returned as a string with an embedded numeric status code.

- A status code of less than 400 is a warning. This means that the operation did not complete but was recoverable to some degree.
- A numeric code equal to or greater than 400 is an error and indicates the operation failed completely.

Errors are returned for the different methods as follows:

- Methods that return a number (e.g., *Read*, *Write*)

```
$x = $image->Read(...);
warn "$x" if "$x"; # print the error message
$x =~ /(\d+)/;
print $1; # print the error number
print 0+$x; # print the number of images read
```

- Methods that operate on an image (e.g., *Zoom*, *Crop*)

```
$x = $image->Crop(...);
warn "$x" if "$x"; # print the error message
$x =~ /(\d+)/;
print $1; # print the error number
```

- Methods that return images (e.g., *Average*, *Montage*, *Clone*) should be checked for errors this way:

```
$x = $image->Montage(...);  
warn "$x" if !ref($x); # print the error message  
$x =~ /(\d+)/;  
print $1; # print the error number
```

Error messages look similar to

```
Error 400: Memory allocation failed
```

The following is a table of of errors and warning codes:

Code	Mnemonic	Description
0	Success	method completed without error or warning
300	ResourceLimitWarning	a program resource is exhausted (e.g., not enough memory)
305	XSwerverWarning	an X resource is unavailable
310	OptionWarning	a command-line option was malformed
315	DelegateWarning	an ImageMagick <i>delegate</i> returned a warning
320	MissingDelegateWarning	the image type can't be read or written because the appropriate <i>delegate</i> is missing
325	CorruptImageWarning	the image file nay be corrupt
330	FileOpenWarning	the image file could not be opened

Code (Cont.)	Mnemonic	Description
400	ResourceLimitError	a program resource is exhausted (e.g., not enough memory)
405	XServerError	an X resource is unavailable
410	OptionError	a command-line option was malformed
415	DelegateError	an ImageMagick <i>delegate</i> returned an error
420	MissingDelegateError	the image type can't be read or written because the appropriate <i>delegate</i> is missing
425	CorruptImageError	the image file may be corrupt
430	FileOpenError	the image file could not be opened

You can use a numeric status code as follows:

```
$x = $image->Read('rose.gif');
$x =~ /(\d+)/;
die "unable to continue" if ($1 == ResourceLimitError);
```


Appendix A

Supported Image Formats

Overview

ImageMagick™ supports over fifty image formats. Some of the image formats require additional programs or libraries. See the ImageMagick ReadMe file for information about where to find the related materials.

Format	Description	Notes
AVS	AVS X image file	
BMP	Microsoft Windows bitmap image file	
BMP24	Microsoft Windows 24-bit bitmap image file	
CGM	Computer graphics metafile	requires ralcgm; read only
CMYK	raw cyan, magenta, yellow, and black bytes	user -size command line option to specify width and height
DCX	ZSoft IBM PC multipage Paintbrush file	
DIB	Microsoft Windows bitmap image file	
EPDF	Encapsulated Portable Document Format file	

Format (Cont.)	Description	Notes
EPS	Adobe Encapsulated PostScript file	requires Ghostscript
EPS2	Adobe Level II Encapsulated PostScript file	requires Ghostscript
EPSF	Adobe Encapsulated PostScript Interchange format	requires Ghostscript
EPSI	Adobe Encapsulated PostScript Interchange format	requires Ghostscript
FAX	Group 3	
FIG	TransFig image format	requires TransFig
FITS	Flexible Image Transport System	
FPX	FlashPix format	use -DHasFPX to compile; requires FlashPIX SDK
GIF	CompuServer graphics interchange format	8-bit color
GIF87	CompuServer graphics interchange format	8-bit color (version 87a)

Format (Cont.)	Description	Notes
GRADATION	gradual passing from one shade to another	specify the desired shading as the filename (e.g., gradation: red-blue)
GRANITE	granite texture	
GRAY	raw gray bytes	use -size command line option to specify width and height
HDF	Hierarchical Data Format	use -DHasHDF to compile
HISTOGRAM	histogram of an image	
HTML	Hypertext Markup Language with a client-side image map	requires HTML2PS to read this format
JBIG	Joint Bi-level Image Experts Group file interchange format	use -DHasJBIG to compile
JPEG	Joint Photographic Experts Group JFIF format	use -DHasJPEG to compile
ICO	Microsoft icon	read only

Format (Cont.)	Description	Notes
LABEL	text image format	specify label text as the filename (e.g., label:This is a label)
MAP	colormap intensities and indices	
MIFF	Magick Image File Format	
MNG	Multiple Image Network Graphics	
MPEG	Motion Picture Experts Group file interchange format	use -DHasMPEG to compile
MTV	MTV Raytracing image format	
NETSCAPE	Netscape 216 color cube	
NULL	null image	useful for creating blank tiles with montage
PBM	portable bitmap format (black and white)	
PCD	Photo CD	maximum resolution written is 512 x 768 pixels

Format (Cont.)	Description	Notes
PCDS	Photo CD	decode with the sRGB color tables
PCL	Page Control Language	write only
PCX	ZSoft IBM PC Paintbrush file	
PDF	Portable Document Format	requires Ghostscript
PGM	portable graymap format (grayscale)	
PICT	Apple Macintosh QuickDraw/PICT file	
PIX	Alias/Wavefront RLE image format	read only
PLASMA	plasma fractal image	specify the base color as the filename (e.g., plasma:blue-yellow); use fractal to initialize random value (e.g., plasma:fractal)
PNG	Portable Network Graphics	
PNM	portable anymap	use +compress to produce ASCII renditions

Format (Cont.)	Description	Notes
PPM	portable pixmap format (color)	
P7	Xv's visual schnauzer format	
PS	Adobe PostScript file	requires Ghostscript
PS2	Adobe Level II PostScript file	requires Ghostscript
PSD	Adobe Photoshop bitmap file	
RAD	Radiance image file	
RGB	raw red, green, and blue bytes	use -size command line option to specify width and height
RGBA	raw red, green, blue, and matte bytes	use -size command line option to specify width and height
RLA	Alias/Wavefront image file	read only
RLE	Utah run length encoded image file	read only

Format (Cont.)	Description	Notes
SCAN	Import image from a scanner device	requires SANE; specify device name and path as the filename (e.g., scan:mustek:/dev/sca nner)
SGI	Irix RGB image file	
SHTML	Hypertext Markup Language with a client-side image map	write only
SUN	SUN rasterfile	
TEXT	raw text file	read only
TGA	Truevision Targa image file	
TIFF	Tagged Image File Format	use -DHasTIFF to compile
TIFF24	24-bit Tagged Image File Format	use -DHasTIFF to compile
TILE	tile image with a texture	read only
TIM	PSX TIM file	read only

Format (Cont.)	Description	Notes
TTF	TrueType font file	read only
UIL	X-Motif UIL table	
UYVY	16-bit/pixel interleaved YUV	use -size command line option to specify width and height
VICAR		read only
VID	Visual Image Directory	
VIFF	Khoros Visualization Image File Format	
WIN	select image from or display image to your computer screen	
X	select image from or display image to your X server screen	
XC	constant image of X server color	use -size command line option to specify width and height
XBM	X Windows system bitmap (black and white only)	
XPM	X Windows system pixmap file (color)	

Format (Cont.)	Description	Notes
XWD	X Windows system window dump file (color)	
YUV	CCIR 601 4:1:1 file	use -size command option to specify width and height

On some platforms, ImageMagick processes the following extensions automatically:

- .gz for Zip compression
- .Z for Unix compression
- .bz2 for block compression
- .pgp for PGP encryption

For example, a PNM image called image.pnm.gz is decompressed and read with the gzip program automatically.

Appendix B

X Resources

Overview

Several of the ImageMagick features use X resources.

These resources are identified in the table in alphabetical order.

X Resource	Function
background (class Background) <i>Used by animate, display, montage</i>	Specifies the preferred color to use for the Image window background. The default is #ccc .
borderColor (class BorderColor) <i>Used by animate, display, montage</i>	Specifies the preferred color to use for the Image window border. The default is #ccc .
borderWidth (class BorderWidth) <i>Used by animate, display, montage</i>	Specifies the width in pixels of the Image window border. The default is 2 .
browseCommand (class browseCommand) <i>Used by display</i>	Specifies the name of the preferred browser when displaying ImageMagick documentation. The default is netscape %s .

X Resource (Cont.)	Function
confirmExit (class ConfirmExit) <i>Used by display</i>	Prompts the user to confirm exiting the program when exiting ImageMagick. Set this resource to <code>False</code> to exit without a confirmation.
displayGamma (class DisplayGamma) <i>Used by display</i>	Specifies the gamma of your X server. You can apply separate gamma values to the red, green, and blue channels of an image with a gamma value list delineated with slashes—1.7/2.3/1.2.
displayWarnings (class DisplayWarnings) <i>Used by display</i>	Displays a warning message when appropriate. Set this resource to <code>False</code> to ignore warning messages.
editorCommand (class editorCommand) <i>Used by display</i>	Specifies the name of the preferred editor when editing image comments. The default is xterm -title "Edit Image Comment" -e vi %s .
font (class Font or FontList) <i>Used by animate, display, montage</i>	Specifies the name of the preferred font to use in normal formatted text. The default is 14 point Helvetica .

X Resource (Cont.)	Function
font[1–9] (class Font[1–9]) <i>Used by display</i>	Specifies the name of the preferred font to use when annotating an image window with text. The default fonts are fixed , variable , 5x8 , 6x10 , 7x13bold , 8x13bold , 9x15bold , 10x20 , and 12x24 . See Image Annotation for details.
foreground (class Foreground) <i>Used by animate, display, montage</i>	Specifies the preferred color to use for text within the Image window. The default is black .
gammaCorrect (class gammaCorrect) <i>Used by display</i>	This resource, if true, will lighten or darken an image of known gamma to match the gamma of the display. See the resource <i>displayGamma</i> . The default is True .
geometry (class geometry) <i>Used by animate, display</i>	Specifies the preferred size and position of the image window. It is not necessarily obeyed by all window managers.
iconGeometry (class IconGeometry) <i>Used by animate, display, montage</i>	Specifies the preferred size and position of the application when iconified. It is not necessarily obeyed by all window managers.

X Resource (Cont.)	Function
iconic (class Iconic) <i>Used by animate, display, montage</i>	Specifies you would prefer an application's windows not be visible initially, as if the windows had been immediately iconified by you. Window managers may choose not to honor the application's request.
magnify (class Magnify) <i>Used by display</i>	Specifies an integral factor by which an image should be enlarged. The default is 3 .
matteColor (class MatteColor) <i>Used by animate, display, montage</i>	The color of windows. It's used for the backgrounds of windows, menus, and notices. A 3D effect is achieved by using highlight and shadow colors derived from this color. The default is #ddd .
name (class Name) <i>Used by animate, display, montage</i>	The name under which resources for the application should be found. This resource is useful in shell aliases to distinguish between invocations of an application without resorting to creating links to alter the executable file name. The default is the application name.

X Resource (Cont.)	Function
pen[1–9] (class Pen[1–9]) <i>Used by display</i>	Specifies the color of the preferred font to use when annotating an image window with text. The default colors are black , blue , green , cyan , gray , red , magenta , yellow , and white . See Image Annotation for details.
printCommand (class PrintCommand) <i>Used by display</i>	This command is executed when ever Print is issued. See Buttons. In general, it's the command to print PostScript to your printer. The default value is lpr -r %s .
sharedMemory (class SharedMemory) <i>Used by animate, display, montage</i>	Whether animate should attempt to use shared memory for pixmaps. ImageMagick must be compiled with shared memory support, and the display must support the MIT-SHM extension. Otherwise, this resource is ignored. The default is True .
textfont (class textFont) <i>Used by animate, display, montage</i>	The name of the preferred font to use in fixed (typewriter style) formatted text. The default is 14 point Courier .

X Resource (Cont.)	Function
title (class Title) <i>Used by animate, display, montage</i>	The title to use for the Image window. This information is sometimes used by a window manager to provide some sort of header to identify the window. The default is the image file name.
undoCache (class UndoCache) <i>Used by display</i>	Specifies, in megabytes (Mb), the amount of memory in the undo edit cache. Each time you modify the image, it's saved in the undo edit cache as long as memory is available. You can subsequently undo one or more of these transformations. The default is 16Mb .

X Resource (Cont.)	Function
usePixmap (class UsePixmap) <i>Used by display</i>	Images are maintained as an ximage by default. Set this resource to <code>True</code> to use a server pixmap instead. This is useful if your image exceeds the dimensions of your server screen and you intend to pan the image. Panning is much faster with pixmaps than with ximages. Pixmaps are considered a precious resource; use them with discretion. To set the geometry of the <i>Magnify</i> or <i>Pan</i> window, use the geometry resource. For example, to set the pan window geometry to 256x256, use <code>display.pan.geometry: 256x256</code> .

Appendix C

Magick Image File Format

Overview

Magick Image File Format (MIFF) is a platform-independent format for storing bitmap images. MIFF is a part of the ImageMagick toolkit of image manipulation utilities for the X Window System. ImageMagick is capable of converting many different image file formats to and from MIFF (e.g., JPEG, XPM, TIFF, etc.).

A MIFF image file consist of two sections.

- a header composed of keywords describing the image in text form
- the binary image data

The header is separated from the image data by a colon (:) character immediately followed by a newline (\n).

The MIFF header is composed entirely of LATIN-1 characters. The fields in the header are a keyword and value combination in the *keyword=value* format. Each keyword and value is separated by an equal sign (=). Each keyword=value combination is delimited by at least one control or whitespace character.

Comments may appear in the header section and are always delimited by braces. The MIFF header always ends with a colon (:) character, followed by a newline character (\n). It's also common for a formfeed and a newline character to appear before the colon. You can then list the image keywords with *more*, without printing the binary image that follows the colon separator.

The following is a list of keyword=value combinations that may be found in a MIFF file:

Keyword=value	Definition
<i>background-color=x,y border-color=x,y matte-color=x,y</i>	These optional keywords reflect the image background, border, and matte colors, respectively.
<i>class=DirectClass , class=PseudoClass</i>	The type of binary image data stored in the MIFF file. If this keyword is not present, <i>DirectClass</i> image data is assumed.
<i>colors=value</i>	The number of colors in a <i>DirectClass</i> image. For a <i>PseudoClass</i> image, this keyword specifies the size of the colormap. If this keyword is not specified in the header, and the image is <i>PseudoClass</i> , a linear 256 color grayscale colormap is used with the image data.
<i>columns=value</i>	The width of the image in pixels. This is a required keyword and has no default.
<i>color-profile=value</i>	The number of bytes in the International Color Consortium color profile. The profile is defined by the ICC profile specification.
<i>compression=RunlengthEncoded, compression=Zip, compression=BZip</i>	The type of algorithm used to compress the image data. If this keyword is not present, the image data is assumed to be uncompressed.
<i>delay <1/100ths of a second></i>	The interframe delay in an image sequence. The maximum delay is 65535.
<i>depth=8, depth=16</i>	The depth of a single color value representing values from 0 to 255 (depth 8) or 65535 (depth 16). If this keyword is absent, a depth of 8 is assumed.

Keyword=value (Cont.)	Definition
<i>dispose=value</i>	GIF disposal method. The valid methods are: 0, No disposal specified; 1, Do not dispose; 2, Restore to background color; 3, Restore to previous.
<i>gamma=value</i>	Gamma of the image. If it is not specified, a gamma of 1.0 (linear brightness response) is assumed,
<i>id=ImageMagick</i>	Identifies the file as a MIFF-format image file. This keyword is required and has no default. Although this keyword can appear anywhere in the header, it should start as the first keyword of the header in column 1. This will allow programs like file(1) to easily identify the file as MIFF.
<i>iterations=value</i>	The number of times an image sequence loops before stopping.
<i>label="value"</i>	This optional keyword defines a short title or caption for the image. If any whitespace appears in the label, it must be enclosed within double quotes.
<i>matte=True, matte=False</i>	Specifies whether a <i>DirectClass</i> image has matte data. Matte data is generally useful for image compositing. This keyword has no meaning for pseudocolor images.

Keyword=value (Cont.)	Definition
<i>montage</i> =<width>x <height>{+-}<x offset> {+-}<y offset>	<p>Size and location of the individual tiles of a composite image. See X(1) for details about the geometry specification.</p> <p>Use this keyword when the image is a composite of a number of different tiles. A tile consists of an image and optionally a border and a label. <width> is the size in pixels of each individual tile in the horizontal direction and <height> is the size in the vertical direction. Each tile must have an equal number of pixels in width and equal in height. However, the width can differ from the height. <x offset> is the offset in number of pixels from the vertical edge of the composite image where the first tile of a row begins and <y offset> is the offset from the horizontal edge where the first tile of a column begins.</p> <p>If this keyword is specified, a directory of tile names must follow the image header. The format of the directory is explained below.</p>
<i>packets</i> =value	The number of compressed color packets in the image data section. This keyword is optional for RunlengthEncoded images, mandatory for Zip or BZip compressed images, and not used for uncompressed image.
<i>page</i> =value	Preferred size and location of an image canvas.
<i>red-primary</i> =x,y, <i>green-primary</i> =x,,y <i>blue-primary</i> =x,,y <i>white-point</i> =x,y	This optional keyword reflects the chromaticity primaries and white point.

Keyword=value (Cont.)	Definition
<i>rendering-intent=saturation, rendering-intent=perceptual, rendering-intent=absolute, rendering-intent=relative</i>	Rendering intent is the CSS-1 property that has been defined by the International Color Consortium.
<i>resolution=<x-resolution>x<y-resolution></i>	Vertical and horizontal resolution of the image. See units for the specific resolution units (e.g., pixels per inch).
<i>rows=value</i>	The height of the image in pixels. This is a required keyword and has no default.
<i>scene=value</i>	The sequence number for this MIFF image file. This optional keyword is used when a MIFF image file is one in a sequence of files used in an animation.
<i>signature=value</i>	This optional keyword contains a string that uniquely identifies the image pixel contents. RSA's Data Security MD5 Digest Algorithm is recommended.
<i>units=pixels-per-inch, units=pixels-per-centimeter</i>	Image resolution units.

The following is a sample MIFF header. In this example, <FF> is a formfeed character:

```
id=ImageMagick class=PseudoClass colors=256
compression=RunlengthEncoded
```

```
packets=27601 columns=1280 rows=1024
scene=1
signature=d79e1c308aa5bbcddea8ed63df412da9
{
  Rendered via Dore by Sandi Tennyson.
}
<FF>
:
```

Note that *keyword=value* combinations may be separated by newlines or spaces and may occur in any order within the header. Comments (within braces) may appear anywhere before the colon.

If you specify the montage keyword in the header, follow the header with a directory of image tiles. This directory consists of a name for each tile of the composite image separated by a newline character. The list is terminated with a NULL character.

If you specify the color-profile keyword in the header, follow the header (or montage directory if the montage keyword is in the header) with the binary color profile.

Next comes the binary image data itself. How the image data is formatted depends upon the class of the image as specified (or not specified) by the value of the class keyword in the header.

DirectClass images (*class=DirectClass*) are continuous-tone, RGB images stored as intensity values in red-green-blue order. Each color value is one byte in size for an image depth of 8 and there are three bytes per pixel (four with an optional matte value). If the depth is 16, each color value is two bytes with the most significant byte being first. The total number of pixels in a DirectClass image is calculated by multiplying the rows value by the column value in the header.

PseudoClass images (*class=PseudoClass*) are colormapped RGB images. The colormap is stored as a series of red-green-blue pixel values, each value being a byte in size. If the image depth is 16, each colormap entry is two bytes with the most significant byte being first. The number of colormap entries is indicated by the *colors* keyword in the header, with a maximum of 65,535 total entries allowed. The colormap data occurs immediately following the header (or image directory if the *montage* keyword is in the header).

PseudoClass image data is an array of index values into the color map. If these are 256 or fewer colors in the image, each byte of image data contains an index value. If the image contains more than 256 colors or the depth is 16, the index value is stored as two contiguous bytes with the most significant byte being first. The total number of pixels in a *PseudoClass* image is calculated by multiplying the *rows* value by the *columns* value in the header.

The image data in a MIFF file may be uncompressed or may be compressed using one of two algorithms. The compression keyword in the header indicates how the image data is compressed. The run-length encoding (RLE) algorithm may be used to encode image data into packets of compressed data. For *DirectClass* images, runs of identical pixels values (not *BYTE* values) are encoded into a series of four-byte packets (five bytes if a *matte* value is included). The first three bytes of the packet contain the red, green, and blue values of the pixel in the run. The fourth byte contains the number of pixels in the run. This value is in the range of 0 to 255 and is one less than the actual number of pixels in the run. For example, a value of 127 indicates that there are 128 pixels in the run.

For *PseudoClass* images, the same RLE algorithm is used. Runs of identical index values are encoded into packets. Each packet contains the colormap index value followed by the number of index values in the run. The number of bytes in a *PseudoClass* RLE packet will be either two or three, depending upon the size of the index values. The number of RLE packets stored in the file is specified by the *packets* keyword in the header, but is not required.

Use *Zip* or *BZip* compression to achieve a greater compression ratio than run-length encoding. The number of compressed packets stored in the file is specified by the *packets* keyword in the header.

MIFF files may contain more than one image. Simply concatenate each individual image (composed of a header and image data) into one file.

Appendix D

Quantize

Overview

This document describes how ImageMagick performs color reduction on an image. To fully understand this chapter, you should have a knowledge of basic imaging techniques and the tree data structure and terminology.

For purposes of color allocation, an *image* is a set of n pixels, where each pixel is a point in *RGB space*. RGB space is a 3-dimensional vector space, and each pixel, p_i , is defined by an ordered triple of red, green, and blue coordinates, (r_i, g_i, b_i) .

Each primary color component (red, green, or blue) represents an intensity that varies linearly from 0 to a maximum value, C_{\max} , which corresponds to full saturation of that color. Color allocation is defined over a domain consisting of the cube in RGB space with opposite vertices at $(0,0,0)$ and $(C_{\max}, C_{\max}, C_{\max})$. ImageMagick requires $C_{\max} = 255$.

The algorithm maps this domain onto a tree in which each node represents a cube within that domain. In the following discussion, these cubes are defined by the coordinate of two opposite vertices—the vertex nearest the origin in RGB space and the vertex farthest from the origin.

The tree's root node represents the the entire domain, $(0,0,0)$ through $(C_{\max}, C_{\max}, C_{\max})$. Each lower level in the tree is generated by subdividing one node's cube into eight smaller cubes of equal size. This corresponds to bisecting the parent cube with planes passing through the midpoints of each edge.

The basic algorithm operates in three phases:

- Classification, which builds a color description tree for the image
- Reduction, which collapses the tree until the number it represents, at most, is the number of colors desired in the output image
- Assignment, which defines the output image's color map and sets each pixel's color by reclassification in the reduced tree

Our goal is to minimize the numerical discrepancies between the original colors and quantized colors. To learn more about quantization error, see [Measuring Color Reduction Error](#).

Classification

Classification begins by initializing a color description tree of sufficient depth to represent each possible input color in a leaf. However, it's impractical to generate a fully-formed color description tree in the classification phase for realistic values of C_{\max} . If color components in the input image are quantized to k -bit precision, so that $C_{\max} = 2^k - 1$, the tree would need k levels below the root node to allow representing each possible input color in a leaf. This becomes prohibitive because the tree's total number of nodes = $1 + \text{Sum}(8^i), i=1, k$

For $k=8$, Number of nodes = $1 + (8^1 + 8^2 + \dots + 8^8) = 8^8 - 1 = 1 + 8,000,000 - 1 = 19,173,961$

Therefore, to avoid building a fully populated tree, ImageMagick does the following:

- Initializes data structures for nodes only as they are needed
- Chooses a maximum depth for the tree as a function of the desired number of colors in the output image (currently based-two logarithm of C_{\max}).

For $C_{\max}=255$,

Maximum tree depth = $\log_2(255) = \log(255) / \log(2) \approx 7.99 \approx 8$

A tree of this depth generally allows the best representation of the source image with the fastest computational speed and the least amount of memory. However, the default depth is inappropriate for some images. Therefore, the caller can request a specific tree depth.

For each pixel in the input image, classification scans downward from the root of the color description tree. At each level of the tree, it identifies the single node which represents a cube in RGB space containing the pixel's color. It updates the following data for each such node:

Node	Data
n_1	Number of pixels whose color is contained in the RGB cube which this node represents
n_2	Number of pixels whose color is not represented in a node at lower depth in the tree; initially, $n_2=0$ for all nodes except leaves of the tree.
$S_r S_g S_b$	Sums of the red, green, and blue component values for all pixels not classified at a lower depth. The combination of these sums and n_2 will ultimately characterize the mean color of a set of pixels represented by this node.

Node (Cont.) Data

E	The distance squared in RGB space between each pixel contained within a node and the nodes' center. This represents the quantization error for a node.
---	--

Reduction

Reduction repeatedly prunes the tree until the number of nodes with $n_2 > 0$ is less than or equal to the maximum number of colors allowed in the output image. On any given iteration over the tree, it selects those nodes whose E value is minimal for pruning and merges their color statistics upward. It uses a pruning threshold, E_p , to govern node selection as follows:

```
Ep = 0
while number of nodes with (n2 > 0) > required maximum number of colors
  prune all nodes such that E ≤ Ep
  Set Ep to minimum E in remaining nodes
```

This has the effect of minimizing any quantization error when merging two nodes together.

When a node to be pruned has offspring, the pruning procedure invokes itself recursively in order to prune the tree from the leaves upward. The values of n_2 , S_r , S_g , and S_b in a node being pruned are always added to the corresponding data in that node's parent. This retains the pruned node's color characteristics for later averaging.

For each node, n_2 pixels exist for which that node represents the smallest volume in RGB space containing those pixel's colors. When $n_2 > 0$ the node will uniquely define a color in the output image. At the beginning of reduction, $n_2 = 0$ for all nodes except the leaves of the tree which represent colors present in the input image.

The other pixel count, n_1 , indicates the total number of colors within the cubic volume which the node represents. This includes $n_1 - n_2$ pixels whose colors should be defined by nodes at a lower level in the tree.

Assignment

Assignment generates the output image from the pruned tree. The output image consists of two parts.

- A color map, which is an array of color descriptions (RGB triples) for each color present in the output image.
- A pixel array, which represents each pixel as an index into the color map array.

First, the assignment phase makes one pass over the pruned color description tree to establish the image's color map. For each node with $n_2 > 0$, it divides S_r , S_g , and S_b by n_2 . This produces the mean color of all pixels that classify no lower than this node. Each of these colors becomes an entry in the color map.

Finally, the assignment phase reclassifies each pixel in the pruned tree to identify the deepest node containing the pixel's color. The pixel's value in the pixel array becomes the index of this node's mean color in the color map.

Empirical evidence suggests that the distances in color spaces such as YUV, or YIQ correspond to perceptual color differences more closely than do distances in RGB space. These color spaces may give better results when color reducing an image. Here the algorithm is as described except each pixel is a point in the alternate color space. For convenience, the color components are normalized to the range 0 to a maximum value, C_{max} . The color reduction can then proceed as described.

Measuring Color Reduction Error

Depending on the image, the color reduction error may be obvious or invisible. Images with high spatial frequencies (such as hair or grass) will show error much less than pictures with large smoothly shaded areas (such as faces). This is because the high-frequency contour edges introduced by the color reduction process are masked by the high frequencies in the image.

To measure the difference between the original and color reduced images (the total color reduction error), ImageMagick sums over all pixels in an image the distance squared in RGB space between each original pixel value and its color reduced value. ImageMagick prints several error measurements including the mean error per pixel, the normalized mean error, and the normalized maximum error.

The normalized error measurement can be used to compare images. In general, the closer the mean error is to zero the more the quantized image resembles the source image. Ideally, the error should be perceptually-based, since the human eye is the final judge of quantization quality.

These errors are measured and printed when `-verbose` and `-colors` are specified on the command line:

- *mean error per pixel* is the mean error for any single pixel in the image

- *normalized mean square error* is the normalized mean square quantization error for any single pixel in the image

This distance measure is normalized to a range between 0 and 1. It's independent of the range of red, green, and blue values in the image.

- *normalized maximum square error* is the largest normalized square quantization error for any single pixel in the image.

This distance measure is normalized to a range between and blue values in the image.

Appendix E

XTP

Overview

XTP is a utility for retrieving, listing, or printing files from a remote network site, or sending files to a remote network site. XTP performs most of the same functions as the FTP program, but it doesn't require any interactive commands. You simply specify the file transfer task on the command line and XTP performs the task automatically.

Syntax

```
xtp [ -options ... ] <uniform resource locator>
```

Examples

- To retrieve the file `bird.jpg` in directory `images` from host `wizard.mystic.es.dupont.com`, use

```
xtp ftp://wizard.mystic.es.dupont.com/images/bird.jpg
```

- To retrieve all the files from directory `images` from host `wizard.mystic.es.dupont.com`, use

```
xtp -retrieve ftp://wizard.mystic.es.dupont.com/images/
```


You will be prompted for a password.

- To retrieve all the files from directory images as user cristy and password magick from host wizard.mystic.es.dupont.com, use

```
xtp -retrieve ftp://cristy:magick@wizard.mystic.es.dupont.com/images/
```

XTP Options

-account *password*

Supplies a supplemental password required by a remote system for access to resources.

-binary

Retrieves files as binary. This is the default. Use `+binary` to retrieve files as text.

-directory

Lists the names of files (and their attributes) that match the filename component of the Uniform Resource Locator (URL). The filename component is processed as a regular expression.

-exclude *expression*

Excludes files that match the regular expression. This option applies to the `-directory`, `-print`, or `-retrieve` options.

-file name

Stores the file with this name. Refer to the `-get` and `-put` options for details.

-get

Gets files that match the filename component of the URL. The filename component is expanded by passing it to `csh(1)`.

This option is equivalent to using the `ftp get` command. However, if the filename contains globbing characters this option is equivalent to the `ftp mget` command. Without globbing characters, you can store the file locally with a different name using the `-file` option.

-ident *password*

Supplies a password required by a remote system. This defaults to your username and hostname.

-port *number*

If no port number is specified, xtp attempts to contact an FTP server at the default port. Otherwise, the specified port number is used.

-proxy *hostname*

Accesses the remote host via a proxy ftpd client running on this host.

The default value of this option can be set with the environment variable `xtp_proxy`. See [Environment](#) for details. Use `+proxy` to prevent proxy connections.

-print

Prints files that match the filename component of the URL. The filename component is processed as a regular expression.

-prune

Processes files in the remote directory specified by the directory component of the URL.

Note: This option does not recursively search for files.

-put

Puts files that match the filename component of the URL. The filename component is expanded by passing it to `csh(1)`.

This option is equivalent to using the `ftp put` command. However, if the filename contains globbing characters, this option is equivalent to the `ftp mput` command. Without globbing characters, you can store the file remotely with a different name by using the `-file` option.

-retrieve

Retrieves files that match the filename component of the URL. The filename component is processed as a regular expression.

Retrieved files are stored on your local host directory as the full name of the retrieved file. For example, if the retrieved file is named `documents/xtp.man` on the remote FTP server, it will appear in your remote directory as `documents/xtp.man`.

-timeout *seconds*

Specifies the maximum number of seconds to complete your remote FTP server request. If this time expires, the program terminates. The program also terminates if one tenth of this value is exceeded while logging onto the remote FTP server.

-type *name*

Identifies the remote system type: Unix, VMS, or other.

The system type is determined automatically, however, you can override the system type with this option.

-verbose

Shows all responses from the remote server.

Using XTP Options

If only the program name is specified on the command line, the program command syntax and options are listed. If `-directory`, `-print`, `-put`, or `-retrieve` are specified on the command line, the file or files specified by the URL are retrieved from the remote network host (as if `-get` was specified).

This option has the format

```
protocol://host/[directory/[filename]]
```

where *protocol* is ftp and *host* is [user[:password]]@hostname.

User defaults to anonymous and *password* defaults to host.domain. Note that *directory/[filename]* is interpreted relative to the home directory for user, thus an absolute pathname must be specified with the leading /;

```
ftp://host//tmp/anyfile
```

As an extension, the filename part of the locator is expanded by the shell for options `-get` or `-put`, otherwise it's processed as a regular expression. For convenience, the protocol component of the URL (`ftp://`) may be omitted.

Xtp retrieves files from the remote directory for `-get` and puts files in the remote directory for `-put`. Otherwise, xtp looks for a file of the form `ls-ls-l([Rt])+([Rt])*` and assumes it contains a recursive directory listing. If none is found, xtp recursively descends the directory hierarchy from the remote directory. Some remote hosts may have thousands of files causing a significant delay satisfying your request. This can be wasteful if the files you're interested in reside in a known directory. You can reduce the searching required by specifying a remote directory on the command line. This limits the filename search to the specified directory and any of its subdirectories. Alternatively, `-prune` restricts the search to the remote directory only.

Regular Expressions

A *regular expression* is zero or more branches, separated by `|`. It matches anything that matches one of the branches. A *branch* is zero or more pieces, concatenated. It matches a match for the first, followed by a match for the second, etc.

A *piece* is an atom possibly followed by `*`, `+`, or `?`. An atom followed by `*` matches a sequence of 0 or more matches of the atom. An atom followed by `+` matches a sequence of 1 or more matches of the atom. An atom followed by `?` matches a match of the atom, or the null pattern.

An atom is a regular expression in parentheses (matching a match for the regular expression), a range (see below), . (matching any single character), ^ (matching the null pattern at the beginning of the input pattern), \$ (matching the null pattern at the end of the input pattern), a ' followed by a single character (matching that character), or a single character with no other significance (matching that character).

A range is a sequence of characters enclosed in []. It normally matches any single character from the sequence. If the sequence begins with ^, it matches any single character not from the rest of the sequence. If two characters in the sequence are separated by -, this is shorthand for the full list of ASCII characters between them (e.g., [0-9] matches any decimal digit). To include a literal] in the sequence, make it the first character (following a possible ^). To include a literal -, make it the first or last character.

Files

`~/.netrc`

Environment

xtp_proxy

Specifies that the remote site should be contacted by proxy. See [-proxy hostname](#).

Appendix F

Acknowledgments

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Rebecca Richardson, technical writer, gathered the web resources, edited them, and formatted them into this guide.

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