Open-Source Solutions for Photography and Cameras in the Digital Age

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Course Outline

What We'll Cover

- **This tutorial is intended to be a brief and basic introduction and orientation to photography in the digital age.**
- **It's for anyone with a digital camera or three, plus anyone who'd like to move from analogue to digital but still mistrusts the latter.**
- **The first half of the tutorial covers essential elements of photography itself, placing emphasis on whether, when, and how digital changes any of that.**
- **The second half covers specific issues and solutions for managing and manipulating your digital photos without having to resort to paid-for software.**

Brief history of photography

- **The camera oscura: perspective**
- **19th - 20th analogue photography**
  - **Large, medium, small format photography**
  - **The role of the photo lab: now outsourced to you!**
- **Early digitals: your tax-dollars at work via NASA**

Biological digression

- **The human eye: what — and *how* — we "see", and what we don't**
- **Cones and rods, cone distribution, focusing**
- **Primary colors based on biology, not physics**
- **Vision as a synthesized mind-function, not (just) biology**
- **CIE color model, the luminance formula**

Current state of digital tech

- **Sensors: Photons become elektrons**
- **Bayer-pattern CFA: Replicating the eye?**
- **CFAs: CCD or CMOS?**
- **The Foveon Sensor: pros and cons (stacked cones)**
- **The Fuji CCD: Bayer for cones + "negative" rods for luminance**
- **Other Possibilities**

Signal and noise

- **Why "megapixels" tells you *less* than nothing**
- **Size Matters: bigger really is better**
- **Pixel Pitch**
- **Bit Depth (6,8,12,14,16 bits *per* color channel)**

Different strokes for different folks

- **Why one size camera doesn't fit all occasions, nor ever has**
- **Keeping a photo diary**
- **Pros and cons on each of**
  - **Cell-phone Cameras**
  - **Pocket(able) Cameras**
  - **Interchangeable-lens cameras**

Cameras with Interchangeable Lenses

- **Small (half- and full-frame) format**
- **Medium formats**
- **Scanning backs for large-format work**

Why do digital and analogue SEEM different?

- **As it was in the Beginning, is Now, and Ever shall be:**

```
EXPOSURE == APERTURE
          * SHUTTER SPEED
          * SENSITIVITY
```

- **Old Myths about Instamatics vs "Wedding-Cameras"**
- **What's possible with digital that wasn't with analogue? Answer: Lots and lots**
- **What's possible with analogue that (still) isn't with digital? Answer: Not too much, but still some**
- **Why can it seem so hard to do as well in digital?**
  - **Too many automatic settings**
  - **Too little understanding of basic photographic principles**
  - **Too much expectation of in hard shooting situations**
  - **Too much tinkering at your local print shop**
  - **Too little tinkering at your home print shop**

Optics and Focusing Systems

- It's all about the lens
- Different lenses for different scenarios
- Your anti-alias filter vs your lens: sharpening
- Trade-off between types of optical distortions
- Post-correction in software

Focusing Systems

- **Phase-shift autofocus systems**
- **Contrast-detection autofocus systems**
- **Manually focusing: watch that shutter button!**
- **What about a split-collar focus prism as of old?**

Importance of in-camera vs post-camera processing

- **The print vs the negative**
- **Getting exposure right**
- **What "white-balance" is, and isn't:**
  - **Color temperature (1 axis black-body radiation in K)**
  - **White balance (2 axis L*a*b* model of blue-yellow, green-magenta)**
- **Spectral interpretation: A violet by any other name shall never a purple make**
- **The raw file as latent image = unprocessed negative/positive film**
- **Noise (grain), sharpening, shadow/highlight recovery**
- **New tricks on the block**

Software for Digital Photography

- **You must decide how much work in photo editing, arranging, backing up, and such you want to do on your own, how much you want to delegate, and how much you want to pay for all this.**
- **Photohosting services are often the easiest route, but may not be what you're looking for.**
- **Running software on your own computer has its pros and cons. It's faster and likely more flexible, but is probably limited to very few platforms.**

Advantages of Photo Software Services

- **For many, especially non-programming types, companies providing web-based photo hosting and sharing (and sometimes editing) services are the easiest approach.**
- **A few such are Flickr, Fokti, Fotopic, PBase, Picasaweb, Smugmug, and Zenfolio.**
- **Services may include grouping, external linking, password protection, statistics, making prints, selling your photos, various sorts of searching, limited editing, and slideshows with elaborate backgrounds and fancy transitions.**
- **Most of these are free; some aren't. Some permit professional/commercial use; some prohibit it.**
- **Now you have an off-site backup.**

Disadvantages of Photo Software Services

- **Some impose modest limits on how much data you store there for free.**
- **The more professional sites are going to charge you.**
- **Most impose content restrictions (!porn, but more), or copyright and indemnification paperwork you won't want to sign.**
- **Although in theory, they take care of backups and redundancy for you, in practice, if they go out of business, your data is probably history.**
- **Editing software will never be as quick running on your own computer, and it eventually may not be sophistated enough for you.**
- **You might not get any EXIF tags at all, or just a few.**
- **You'll likely be forced to use the sRGB color space, despite any ICC profiles to the contrary.**
- **Raw files may not be supported.**

Types of Photo Software

- **For those of us who like to tinker more than these provide, a vast wealth of software is out there — somewhere.**
- **Some software really is open source, so you can get the source code if you want it and it's licence is compliant with the official Open Source Definition (http://www.opensource.org/docs/osd).**
- **Some software is freely available in frozen pre-compiled form, but its original source code itself is not. This may include manufacturer software that came with your digital camera. It is probably only available for Microsoft systems and just maybe, for Apple.**
- **Some software you can't get without buying it. Often a trial period is allowed before you must buy the key.**

Open-Source Photo-Transfer Software

- **To transfer files from your camera, you might use a simple copy command or a fancy transfer agent.**
- **Of open-source programs, the CLI *gphoto2* progrma seems to be the most popular and powerful.**
- **It can even handle limited remote-control camture and configure operations, although this depends on your camera model.**
- **Sometimes transfers terminate prematurely, so you have to wade in there by hand to find out which file it died on, then remove the offending file.**

Raw-Conversion Software

- **If your camera can produce raw files, then it probably came with software to convert these to JFIF or TIFF files. But it will be for Microsoft's systems only, plus sometimes Apple's.**
- **Commercial alternatives are many, but they're platform limited and not always all they're cracked up to be. *Bibble* is available for Linux.**
- **In general, the faster they are, the worse job you can expect them to do. Doing a good job takes work. *RML* is one of the better such programs.**
- **The CLI program *dcraw* is cross-platform open-source. It's not always as good as the manufacturer's converters. Then again, neither is Adobe's ACR, and that you pay for.**
- **Graphical front-ends to *dcraw* are available, including *ufraw* and plug-ins for the *gimp*.**
- **A very good, free but not open-source, program for raw file conversion is *rpp*, but it's only available for Macs.**

Commercial Photo-Editing Software

- **Many people are content to use commercial software for their photo editing needs.**
- **Most of these provide more whistle and bells and shiny chrome than the free options available.**
- **They may also provide a more integrate workflow.**
- **Very few of these are available for Unix-like systems, unless you have a Mac.**
- **Market leaders are Adobe's *Photoshop* and its *Lightroom* suite and Apple's *Aperture*.**
- **I often use Nikon's *Capture NX*, because it came free with my camera, does some things much more easily than Photoshop, and runs on my Mac. It's also a better raw-converter for Nikon raw files than nearly anything else.**

The exiftool Program and `Image::ExifTool` Perl Module

- **Possibly the most impressively useful piece of open-source software that exists for handling image files, especially their metadata, is the *exiftool* program and its underlying `Image::ExifTool` Perl module, both by Phil Harvey.**
  `http://www.sno.phy.queensu.ca/~phil/exiftool/`

- **It's a more impressive piece of work even than *dcraw* is. Current production version is `v7.82` as of this writing.**

- **If you regularly install Perl modules from CPAN, the easiest download is**
  `$ perl -MCPAN -e 'install Image::Exiftool'`

- **That installs module, the CLI program, and their respective documentation.**

- **You *can* also install stand-alone versions of the program Microsoft executable, or as an Apple OS X package.**

Metametadata Discussion

- **Metadata is data about data. Where it lives varies, and this can be a problem. When a dataset and its associated metadata part ways, important information is lost.**
- **Some metadata are so important that your operating system reveals them only through carefully mediated syscalls, squirrelling away such metadata in secret places only it can access.**
- **This is a reasonably robust way to maintain metadata.**
- **But it's not user-extensible.**
- **Mistakes do happen; see *fsck*.**

O/S Metadata

Examples of OS-maintained metadata include:

- **a file's name — or names**
- **type of that "file" (plain, directory, device, link, pipe, socket, &c)**
- **its record structure (eg: MVS, VMS)**
- **a list of its data blocks**
- **its owner — or owners**
- **its size, in blocks or bytes**
- **link info**
- **modification and other times**
- **executability**
- **journaling info**
- **access control lists and/or file permissions**
- **file versioning (eg: VMS)**

The Worst Place to Keep Metadata

- **Some metadata elements may be encoded in other metadata, with the file's name most often used for this. It's a *terribly bad idea*:**
  - **It's fragile: names may change.**
  - **Files may have several names .**
  - **It leaves annoying lacunae in the namespace that's user available.**
  - **Execute permissions may lurk there, as in DOS's silly `.exe` file-associations.**
  - **File type may even be indicated in the filename, as in CP/M and all its dirty children's nautinesses with files name *aux*, *con*, *nul*, or *prn*. These also make poor hostnames.**

Other Dubious Places to Keep Metadata

- **Metadata may be stored in external databases or one sort or another. These have their uses, like rapid queries, but they're fragile due to things moving around.**
- **Next to residing within the filename itself, metadata's most annoying when placed hidden or semi-hidden *but necessary* files that go along with main data.**
- **This is bad because now they're in user-space, and easy to forget.**
- **Examples include Apple's storied resource forks and Adobe's dreaded sidecar XMP files.**
- **It's all a big pain, or can be. And unnecessary.**

One File to Hold Them All

- **The best place to store metadata that's clearly in the domain of user space not kernel space is to embed those metadata in same file that holds the data proper.**
- **The *file* command uses the file's *magic number* plus other information contained within the file to determine the file's type:**

```
% file /usr/local/bin/perl1
/usr/local/bin/perl1: OpenBSD/i386 demand paged dynamically linked
    executable not stripped
% file /usr/local/bin/perl5.10.0
/usr/local/bin/perl5.10.0: ELF 32-bit LSB executable, Intel 80386,
    version 1, for OpenBSD, dynamically linked (uses shared libs),
    not stripped
```

- **An executable's magic number says what sort of executable it is, such as dynamically vs statically linked, demand paged, the chip/machine language, and more.**

Our Favorite Magic Number

- **A cool magic number is `020443` in little-endian, `021441` in big-endian. (That's an unsigned 16-bit integer in octal notation.)**
- **It indicates an indirect executable.**

```
% perl -le 'print unpack("A2", pack("v", 020443))'
#!
% perl -le 'print unpack("A2", pack("n", 021441))'
#!
% perl -le 'print unpack("A2", pack("n", 020443))'
!#
```

- **Current */etc/magic* files are really rather clever:**

```
% file ~/scripts/exiftool /usr/local/bin/exiftool
/home/tchrist/scripts/exiftool: a perl script text executable
/usr/local/bin/exiftool:        perl script text
% head -1 ~/scripts/exiftool /usr/local/bin/exiftool
==> /home/tchrist/scripts/exiftool <==
#!/usr/bin/env perl
==> /usr/local/bin/exiftool <==
#!/usr/local/bin/perl -w
```

Extensible Metadata Tags

Many file formats have *some* mechanism for storing tagged metadata within the file itself.

- **<meta> elements embedded in HTML or XHTML**
- **ID3 tags in MP3 files**
- **comments in Ogg Vorbis files**
- **Microsoft&IBM's RIFF tags [Resource Interchange Format] in some A/V files**
- **IPT tags in JFIF files**
- **TIFF tags [Tagged Image File Format]**
- **Adobe's XML in PDF and photo files [Extensible Metadata Platform]**
- **EXIF tags in some A/V files.**

TLA & FLA Confusions

- **BMP is a rasterized bitmap file; magic number `046502` ("BM").**
- **GIF is Graphics Interchange Format; has LZW-compressed (losslessly) bitmaps; just 8 bits of color per point, not 3*8, so only 256 colors; patented.**
- **PNG is the Portable Network Graphics standard created to avoid patent problems. PNG's Not GIF.**
- **JPEG derives from the name of the body that came up with it, the Joint Photographic Experts Group (formed in 1986, produced in 1992, approved as ISO 10918-1 in 1994). Includes metatags and lossy compression [usually] for its data.**
- **JIF is the JPEG Interchange Format; little used.**
- **JFIF is the JPEG File Interchange Format; usually what people mean by "JPEG".**
- **EXIF adds specific metadata tags to JFIF, TIFF, &c files.**

EXIF: Exchangeable Image File Format

- **EXIF is a way to include bits of metadata (AKA tag data or metatags) within image files created by digital cameras — and in practice, also those created by image software and scanners.**
- **The EXIF spec was created in Japan by a non-profit body, with version 2.1 published in 1998-06-12 and version 2.2 in 2002-04.**
- **EXIF proper covers only TIFF and JFIF image files and WAV and AIFF audio files. The first two already had limited metatag functionality.**

The exiftool Program

- **This CLI interface to the Perl `Image::ExifTool` module grants easy access from the command line, in shell scripts, Makefiles, etc.**
- **Despite its name, it isn't *just* about EXIF data. Rather, it's for *all* metadata for many, many file formats.**
- **It knows about thousands of tags.**

```
% exiftool -list | grep '^ ' | wc -w
    6222
```

- **The next slide lists supported formats per its manpage.**

File Types Supported by ExifTool

File Types						Meta Information	
3FR	r	HTML	r	PNG	r/w	EXIF	r/w/c
ACR	r	ICC	r/w/c	PPM	r/w	GPS	r/w/c
AI	r	IND	r/w	PPT	r	IPTC	r/w/c
AIFF	r	ITC	r	PS	r/w	XMP	r/w/c
APE	r	JNG	r/w	PSD	r/w	MakerNotes	r/w/c
ARW	r	JP2	r/w	QTIF	r	Photoshop IRB	r/w/c
ASF	r	JPEG	r/w	RA	r	ICC Profile	r/w/c
AVI	r	K25	r	RAF	r/w	MIE	r/w/c
BMP	r	KDC	r	RAM	r	JFIF	r/w/c
BTF	r	M4A	r	RAW	r/w	Ducky APP12	r/w/c
CR2	r/w	MEF	r/w	RIFF	r	PDF	r/w/c
CRW	r/w	MIE	r/w/c	RW2	r/w	CIFF	r/w
CS1	r/w	MIFF	r	RWL	r/w	AFCP	r/w
DCM	r	MNG	r/w	RWZ	r	JPEG 2000	r
DCP	r/w	MOS	r/w	RM	r	DICOM	r
DCR	r	MOV	r	SO	r	Flash	r
DIVX	r	MP3	r	SR2	r	FlashPix	r
DJVU	r	MP4	r	SRF	r	QuickTime	r
DLL	r	MPC	r	SVG	r	GeoTIFF	r
DNG	r/w	MPG	r	SWF	r	PrintIM	r
DOC	r	MPO	r/w	THM	r/w	ID3	r
DYLIB	r	MRW	r/w	TIFF	r/w	Kodak Meta	r
EPS	r/w	NEF	r/w	VRD	r/w/c	Ricoh RMETA	r
ERF	r/w	NRW	r/w	WAV	r	Picture Info	r
EXE	r	OGG	r	WDP	r/w	Adobe APP14	r
EXIF	r/w/c	ORF	r/w	WMA	r	MPF	r
FLAC	r	PBM	r/w	WMV	r	APE	r
FLV	r	PDF	r/w	X3F	r	Vorbis	r
FPX	r	PEF	r/w	XLS	r	SPIFF	r
GIF	r/w	PGM	r/w	XMP	r/w/c	DjVu	r
HDP	r/w	PICT	r	ZIP	r	(and more)	

png files

```
% exiftool illguts/op1.png
ExifTool Version Number         : 7.82
File Name                       : op1.png
Directory                       : illguts
File Size                       : 15 kB
File Modification Date/Time     : 2009:06:14 11:48:12-06:00
File Type                       : PNG
MIME Type                       : image/png
Image Width                     : 576
Image Height                    : 408
Bit Depth                       : 8
Color Type                      : Palette
Compression                     : Deflate/Inflate
Filter                          : Adaptive
Interlace                       : Noninterlaced
Palette                         : (Binary data 96 bytes, ...
Image Size                      : 576x408
```

wav files

```
% exiftool Singles/bleck-moonlight.wav
ExifTool Version Number          : 7.82
File Name                        : bleck-moonlight.wav
Directory                        : Singles
File Size                        : 52 MB
File Modification Date/Time      : 2003:03:06 19:19:32-07:00
File Type                        : WAV
MIME Type                        : audio/x-wav
Encoding                         : Microsoft PCM
Num Channels                     : 2
Sample Rate                      : 44100
Avg Bytes Per Sec                : 176400
Bits Per Sample                  : 16
```

OGG files

```
% exiftool "$cwd"/Ken*.ogg

ExifTool Version Number         : 7.51
File Name                       : Kenneth Gilbert-Prelude and Fugue no.8
                                  (a 3 voci) in E-flat minor and D-sharp minor, BWV 853.ogg
Directory                       : Johan Sebastian Bach/Keyboard/Well-Tempered-Clavier/BWV/
                                  BWV853-WTC1-08 in E-flat and D-sharp minors
File Size                       : 20 MB
File Modification Date/Time     : 2007:07:11 22:15:00-06:00
File Type                       : OGG
MIME Type                       : audio/x-ogg
Vorbis Version                  : 0
Audio Channels                  : 2
Sample Rate                     : 44100
Nominal Bitrate                 : 320018
Vendor                          : Xiph.Org libVorbis I 20020717
Artist                          : Johan Sebastian Bach
Album                           : The Well Tempered Clavier, part I,
                                  cd 1 kenneth gilbert harpsichord
Title                           : Praeludium es-moll & Fuga (a 3 voci) dis-moll BWV 853
Track Number                    : 8
Genre                           : Baroque Keyboard
Performer                       : Kenneth Gilbert
Organization                    : Archiv Produktion (Deutsches Grammophon)
Date                            : 1984
```

GIF Files

```
% exiftool cards.gif
ExifTool Version Number         : 7.82
File Name                       : cards.gif
Directory                       : .
File Size                       : 4.8 kB
File Modification Date/Time     : 2009:03:02 09:21:44-07:00
File Type                       : GIF
MIME Type                       : image/gif
GIF Version                     : 89a
Image Width                     : 310
Image Height                    : 51
Image Size                      : 310x51
```

Raw Image Files

```
% exiftool -common 2009-02-13_17-38-57_TSC_0341.NEF
File Name                       : 2009-02-13_17-38-57_TSC_0341.NEF
File Size                       : 12 MB
Camera Model Name               : NIKON D700
Date/Time Original              : 2009:02:13 17:38:57
Image Size                      : 4288x2844
Quality                         : Raw
Focal Length                    : 50.0 mm
Shutter Speed                   : 1/125
Aperture                        : 1.4
ISO                             : 4000
White Balance                   : Incandescent
Flash                           : No Flash
```

Photoshop Files

```
% exiftool 2004-09-01_10-36-56_TSC#2861.psd | wc -l
     123
% exiftool -G0  -common -Photoshop:all 2004-09-01_10-36-56_TSC#2861.psd

[File]          File Name                       : 2004-09-01_10-36-56_TSC#2861.psd
[File]          File Size                       : 16 MB
[EXIF]          Camera Model Name               : NIKON D70
[EXIF]          Date/Time Original              : 2004:09:01 11:36:56
[Composite]     Image Size                      : 3008x2000
[EXIF]          Focal Length                    : 50.0 mm
[Composite]     Shutter Speed                   : 1/500
[Composite]     Aperture                        : 11.0
[EXIF]          White Balance                   : Auto
[EXIF]          Flash                           : No Flash
[Photoshop]     Num Channels                    : 3
[Photoshop]     Image Height                    : 2000
[Photoshop]     Image Width                     : 3008
[Photoshop]     Bit Depth                       : 8
[Photoshop]     Color Mode                      : RGB
[Photoshop]     IPTC Digest                     : 00000000000000000000000000000000
[Photoshop]     X Resolution                    : 300
[Photoshop]     Displayed Units X               : inches
[Photoshop]     Y Resolution                    : 300
[Photoshop]     Displayed Units Y               : inches
[Photoshop]     Global Angle                    : 30
[Photoshop]     Global Altitude                 : 30
[Photoshop]     Copyright Flag                  : False
[Photoshop]     Photoshop Thumbnail             : (Binary data 13576 bytes, ...
```

JPEG files

```
% exiftool Large/2004-10-13_08-03-58DSC_4880.jpeg
ExifTool Version Number         : 7.82
File Name                       : 2004-10-13_08-03-58DSC_4880.jpeg
Directory                       : Large
File Size                       : 582 kB
File Modification Date/Time     : 2004:10:13 23:28:29-06:00
File Type                       : JPEG
MIME Type                       : image/jpeg
JFIF Version                    : 1.01
Resolution Unit                 : None
X Resolution                    : 1
Y Resolution                    : 1
Image Width                     : 1064
Image Height                    : 1600
Encoding Process                : Progressive DCT, Huffman coding
Bits Per Sample                 : 8
Color Components                : 3
Y Cb Cr Sub Sampling            : YCbCr4:2:0 (2 2)
Image Size                      : 1064x1600
```

More JPEG files

```
% exiftool 2008-12-20_21-41-42__TSC4711-alt.jpg | wc -l
     198

% exiftool -nikon 2008-12-20_21-41-42__TSC4711-alt.jpg
Camera Model Name                : NIKON D300
Date/Time Original               : 2008:12:20 21:41:42.56
Shutter Count                    : 35242
Lens                             : 50mm f/1.4 D
Focal Length                     : 50.0 mm
Image Size                       : 4288x2848
Shutter Speed                    : 1/250
Aperture                         : 1.4
ISO                              : 2000
Noise Reduction                  : Off
Exposure Program                 : Aperture-priority AE
Exposure Compensation            : -1/3
White Balance                    : Incandescent
White Balance Fine Tune          : 2 0
Shooting Mode                    : Continuous
Quality                          : Raw
Metering Mode                    : Center-weighted average
Focus Mode                       : AF-C
Color Space                      : sRGB
Hue Adjustment                   : -1
Saturation                       : Normal
Sharpness                        : Hard
Flash                            : No Flash
Flash Mode                       : Did Not Fire
```

Tricks with exiftool

- *exiftool* recognizes different types of tag, which is calls families.
- The **-listgN** switch lists the tags in family number *N*.

```
% exiftool -listg0
Groups in family 0:
 AFCP AIFF APE APP12 APP13 APP14 APP15 APP5 APP6 APP8 ASF BMP CanonVRD
 Composite DICOM DNG DjVu Ducky EXE EXIF ExifTool FLAC File Flash
 FlashPix FotoStation GeoTiff HTML ICC_Profile ID3 IPTC ITC JFIF JPEG
 Jpeg2000 Leaf MIE MIFF MNG MPC MPEG MPF MakerNotes Meta PDF PICT PNG
 PhotoMechanic Photoshop PostScript PrintIM QuickTime RAF RIFF Rawzor
 Real SVG SigmaRaw Stim Vorbis XMP ZIP
```

Grouping by Family

Add -gN to group by family:

```
% exiftool -g0 -common 2008-12-20_21-41-42__TSC4711-alt.jpg
---- File ----
File Name                       : 2008-12-20_21-41-42__TSC4711-alt.jpg
File Size                       : 6.6 MB
---- EXIF ----
Camera Model Name               : NIKON D300
ISO                             : 2000
Date/Time Original              : 2008:12:20 21:41:42
Flash                           : No Flash
Focal Length                    : 50.0 mm
---- MakerNotes ----
Quality                         : Raw
White Balance                   : Incandescent
---- Composite ----
Aperture                        : 1.4
Image Size                      : 4288x2848
Shutter Speed                   : 1/250
```

Prefacing with Family

Add `-GN` to preface each tag by its family:

```
% exiftool -common -G0 2008-12-20_21-41-42__TSC4711-alt.jpg
[File]          File Name                       : 2008-12-20...
[File]          File Size                       : 6.6 MB
[EXIF]          Camera Model Name               : NIKON D300
[EXIF]          Date/Time Original              : 2008:12:20 21:41:42
[Composite]     Image Size                      : 4288x2848
[MakerNotes]    Quality                         : Raw
[EXIF]          Focal Length                    : 50.0 mm
[Composite]     Shutter Speed                   : 1/250
[Composite]     Aperture                        : 1.4
[EXIF]          ISO                             : 2000
[MakerNotes]    White Balance                   : Incandescent
[EXIF]          Flash                           : No Flash
```

Full Family Listings

Multiple families are allowed.

```
% exiftool -common -G0:1:2 2008-12-20_21-41-42__TSC4711-alt.jpg
[File:Image]               File Name              : 2008-12-20...
[File:Image]               File Size              : 6.6 MB
[EXIF:IFD0:Camera]         Camera Model Name      : NIKON D300
[EXIF:ExifIFD:Time]        Date/Time Original     : 2008:12:20 21:41:42
[Composite:Image]          Image Size             : 4288x2848
[MakerNotes:Nikon:Camera] Quality                 : Raw
[EXIF:ExifIFD:Camera]      Focal Length           : 50.0 mm
[Composite:Image]          Shutter Speed          : 1/250
[Composite:Image]          Aperture               : 1.4
[EXIF:ExifIFD:Image]       ISO                    : 2000
[MakerNotes:Nikon:Camera] White Balance           : Incandescent
[EXIF:ExifIFD:Camera]      Flash                  : No Flash
```

Short Listings

The `-S` switch (or `-s -s`) will squeeze things smaller:

```
% exiftool -S -common 2008-12-20_21-41-42__TSC4711-alt.jpg
FileName: 2008-12-20_21-41-42__TSC4711-alt.jpg
FileSize: 6.6 MB
Model: NIKON D300
DateTimeOriginal: 2008:12:20 21:41:42
ImageSize: 4288x2848
Quality: Raw
FocalLength: 50.0 mm
ShutterSpeed: 1/250
Aperture: 1.4
ISO: 2000
WhiteBalance: Incandescent
Flash: No Flash
```

Displaying Specific Tags

```
% exiftool -lensid -shutterspeed -aperture -iso .
======== ./2009-07-04_11-42-59__TSC0233-adj.JPG
Lens ID                         : AF-S DX Zoom-Nikkor 17-55mm f/2.8G IF-ED
Shutter Speed                   : 1/1600
Aperture                        : 5.0
ISO                             : 200
======== ./2009-07-04_11-44-42__TSC0245-adj.JPG
Lens ID                         : AF-S DX Zoom-Nikkor 17-55mm f/2.8G IF-ED
Shutter Speed                   : 1/250
Aperture                        : 5.0
ISO                             : 200
======== ./2009-07-04_12-03-27__TSC0285.JPG
Lens ID                         : AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED
Shutter Speed                   : 1/400
Aperture                        : 9.0
ISO                             : 159
======== ./2009-07-04_12-50-17__TSC0370.JPG
Lens ID                         : AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED
Shutter Speed                   : 1/320
Aperture                        : 8.0
ISO                             : 200

1 directories scanned
4 image files read
```

Conditional Actions

Add `-if` with a Perl expression for conditional control:

```
% exiftool -if '$aperture > 8'                    \
    -lensid -shutterspeed -aperture -iso          \
    -focusdistance -DOF -FOV -hyperfocaldistance .

======== ./2009-07-04_12-03-27__TSC0285.JPG
Lens ID                     : AF-S VR Micro-Nikkor 105mm f/2.8G IF-ED
Shutter Speed               : 1/400
Aperture                    : 9.0
ISO                         : 159
Focus Distance              : 3.76 m
Depth Of Field              : 0.45 m (3.55 - 4.00)
Field Of View               : 12.7 deg (0.84 m)
Hyperfocal Distance         : 60.96 m
    1 directories scanned
   51 files failed condition
    1 image files read
```

More Great exiftool Tricks

- **Extract preview image from jpeg file, write to new one.**

```
% exiftool -b -PreviewImage thispic.jpeg > thispic-preview.jpg
```

- **Why store raw and jpeg in your camera? The raw has the jpeg in it! This recursively extracts that embedded jpeg image from all NEF files in the current directory, adding "_JFR.jpg" for the name of the output jpeg files.**

```
% exiftool -b -JpgFromRaw -w _JFR.jpg -ext NEF -r .
```

Accessing Image Times

- **Print formatted date/time for a given file:**

```
% exiftool -d '%r %a, %B %e, %Y' -DateTimeOriginal -S -s Collin.jpg
   06:35:47 PM Sat, January 21, 2006
```

- **Prints all image files prefixed by their original shooting time, and sorts them:**

```
% exiftool -p '$dateTimeOriginal $filename' -q -f . | sort
2001:07:25 14:43:54 oscon-tom-and-geneva.jpg
2001:07:25 14:49:02 oscon-tom-doublekeboarding.jpg
2004:02:01 08:52:30 DSC00500.JPG
2004:05:20 17:13:35 23brow.583.jpg
2004:06:18 14:01:50 columbine2d.jpg
2004:08:28 18:57:21 pescado.jpg
2004:08:28 18:57:21 pez.jpg
2004:08:28 18:57:21 repescado.jpg
2005:01:15 16:43:48 2005-01-15_16-43-48DSC_9094-adjusted-and-shopped.jpg
2006:01:21 18:35:47 Collin.jpg
2006:04:02 15:22:09 3.jpg
2006:12:02 17:35:35 Demes_shots_0030.jpg
2007:02:01 18:59:15 stemmed-tomato.jpg
2007:06:25 22:14:57 scan0001.jpg
2008:03:29 13:23:58 20080329_132358_IMG_0498-smaller.jpg
2008:05:11 17:50:07 2008-05-11_17-50-07__TSC7938-alt-small.JPG
2008:05:30 13:25:24 Tom_Madden--Tubing2.jpg
```

Setting Values

- **Your camera had the wrong time. Drat! So fix it:**

```
% exiftool -AllDates+=1:30 *.jpg
```

- **Delete all Photoshop info (NB: Photoshop information includes IPTC):**

```
% exiftool -Photoshop:All="" edited-version.jpg
```

- **Delete all meta info — *except* JFIF group — from an image:**

```
% exiftool -all="" --jfif:all hush.jpg
```

- **Geotag *a.jpg*) from position information in a GPS track-log file named *track.log*. `DateTimeOriginal` is used for geotagging. Local system time is assumed unless `DateTimeOriginal` contains a timezone.**

```
% exiftool -geotag track.log a.jpg
```

Moving and Renaming Files

- **Rename all files in *somedir* by adding the focal length to filename.**

```
% exiftool '-filename<%f_${FocalLength}.%e' somedir
```

- **Set filename of all jpeg images in cwd from `Create Date` and `File Number` tags, in form "`20060507_118-1861.jpg`".**

```
% exiftool '-FileName<${CreateDate}_$filenumber.jpg' -d %Y%m%d *.jpg
```

- **Move all files in "dir" into a directory hierarchy based on year, month and day of `DateTimeOriginal`. ie) This command would move the file *dir/image.jpg* with a `DateTimeOriginal` of `2005:10:12 16:05:56` to *2005/10/12/image.jpg*.**

```
% exiftool '-Directory<DateTimeOriginal' -d %Y/%m/%d dir
```

Netpbm Software

- **I use the free *netpbm* software to batch-manipulate images. (!= Network Play-by-Mail). It's a toolkit for converting images between different formats.**
- **Others use *ImageMagick* for the same purposes.**
- ***Netpbm* overs:**
  - **PBM - portable bitmap format (monochrome)**
  - **PGM - portable graymap format (greyscale)**
  - **PPM - portable pixmap format (RGB)**
  - **PNM - portable anymap format (whatever)**
- **Its ~300 utils include:**

```
asciitopgm bmptoppm giftopnm jpeg2ktopam jpegtopnm jpegtopnm
pamenlarge pamflip pamgauss pamscale pamstack pamtojpeg2k
pbmtoascii pbmtoicon pbmtopgm pnmcolormap pnmenlarge pnmgamma
pnminvert pnmrotate pnmscale pnmtojpeg pnmtotiff ppmcolors
ppmdither ppmtobmp ppmtojpeg ppmtopgm ppmtoppm tifftopnm xwdtopnm
```

Netpbm Shell Script Example

```
jpegtopnm < $jpeg > $fname.pnm

pnmscale -xysize   80   80 < $fname.pnm \
    | pnmtojpeg --progressive --smooth 10 --quality 90 > Thumb/$jpeg

exiftool -tagsfromfile $jpeg -all:all Thumb/$jpeg

pnmscale -xysize  300  300 < $fname.pnm \
    | pnmtojpeg --progressive --smooth 10 --quality 95 > Small/$jpeg

exiftool -tagsfromfile $jpeg -all:all Small/$jpeg

pnmscale -xysize  750  750 < $fname.pnm \
    | pnmtojpeg --progressive --smooth 10 --quality 95 > Medium/$jpeg

exiftool -tagsfromfile $jpeg -all:all Medium/$jpeg

pnmscale -xysize 1600 1600 < $fname.pnm \
    | pnmtojpeg --progressive --smooth 10 --quality 95 > Large/$jpeg

exiftool -tagsfromfile $jpeg -all:all Large/$jpeg

exiftool $TAGNAMES -h $jpeg >$fname.html \
    && mv $fname.html Info

mv -f $jpeg Orig && rm $fname.pnm && \
    (find . -name '*_original' -print0 | xargs -0 rm)
```