

Digital Image Processing

Concepts behind “dpi”, sizing, and image file formats for “call to artist” submissions

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Text is a summary of information from various Web sources, standards, and general knowledge. It is not intended as full tutorial on the complex topic of digital image processing. Readers are encouraged to do additional supporting research on this topic for a more comprehensive understanding.

Digital Images – Concepts

- **pixels = dots**
- **DPI = Dots per Inch**
- **RGB = Red / Green / Blue – a single color is made up of 3 color values (triplets).**
- **Image file formats use variations of RGB triplets.**
 - **JPG uses RGB, 24-bit color**
 - 16,277,215 possible colors
 - used for photo realistic images
 - **GIF uses an “index” to a color palette**
 - maximum 256 colors
 - used for simple color, graphical images, logos, web

Digital Images – Concepts

- **Image file formats are used as a means of organizing and storing images. Some formats are standardized into a commonly recognized format used by devices and editors.**
- **Image formats can be lossy or lossless.**
- **Lossy format**
 - **does not guarantee that every pixel in the image will be exactly as it was in the original image when it is redisplayed.**
 - **produce smaller images because their compression techniques can be more aggressive.**
- **Lossless format**
 - **every pixel in the image displayed exactly as it was in the original image.**
 - **Compression can be done with lossless formats, but generally not as aggressively as with lossy compression.**

Digital Image Formats

- **TIF**

- best used for archive or original when it is critical to retain all the information in the original image
- usually lossless or near lossless
- generally requires more storage than a similar image stored in JPG format.
- RGB, can be 24-bit color, although there are many RGB options

- **JPG**

- best used for compressed images where some loss of information is acceptable
- repeated editing / generations of an image may result in cumulative loss of detail – best practice is to create a new version of the image from the original, not a previously edited version of the image
- always lossy

- **GIF**

- best used for compressed images where the color palette is simple, graphical images, logos, and Web animation
- 256 colors

Digital Image Formats

- RAW – raw image file
 - A camera **raw image file** contains minimally processed data.
 - Uses lossless or nearly lossless compression, producing file sizes much smaller than the .TIF formats of full size processed images from the same camera.
- RAW file format standard is not fully adopted.
 - ISO 12234-2, TIFF/EP standard exists, but not all RAW images use this standard.
 - There are dozens if not hundreds of raw image formats in use by different models of digital equipment (like cameras or film scanners).
 - Lack of standardization means a RAW file produced by one device may not be readable by another device or by different photo editing software.
 - Lack of standardization may mean some RAW file formats will become obsolete, or not supported by future versions of devices and software.
- See Wikipedia for more information:
http://en.wikipedia.org/wiki/Raw_image_format

Digital Image Resolution

- **DPI refers to the resolution of the image on the OUTPUT device it is displayed on.**
- **Computer monitors typically display 72 to 96 dots per inch**
- **Laser printers can be set up to print typically from 150 to 600 DPI**
- **Some photo printers may have even higher resolution**

Digital Image Sizing

- **Determine the height and width (in inches) that you want your image to display or print**
- **Determine the resolution of the output device.**
- **Multiply the number of inches per dimension by the resolution of the target device.**
- **This gives the number of pixels per dimension of the image for that output device / size combination.**
 - **Example: 5"W x 7"H image, printed at 300 DPI**
 - **5" x 300 = 1500 pixels wide**
 - **7" x 300 = 2100 pixels high**

Digital Image Sizing

- **If a submission calls for a 'maximum' number of pixels on a side for the image file, you do not need to worry about the dimensions or resolution.**
- **When sizing an image, don't forget the impact of changing the aspect ratio – it is probably important not to “stretch” or “squish” an image by changing the aspect ratio.**
- **Photo editing software usually gives you the option to maintain the aspect ratio when resizing an image.**
- **When saving the image, your software may also give you the option to do further compression. This makes the image file (not the image) smaller, and in a format like .JPG, little visual detail will be lost with a modest compression percentage.**

Common Specification Mistakes

- **Some “Calls to Artists” may ask for low or high resolution image file. This is meaningless. An image file is not associated with a resolution. Only a displayed or printed image can have a resolution associated with it.**
- **Specifying “DPI” without the dimensions required for the image when it is displayed or printed does not allow for the calculation of pixels per dimension and so the specification is meaningless.**
- **Some “Calls to Artists” may combine specifications that do not belong together and are confusing:**
 - specifying “max pixels on a side”
 - And DPI

Common Specification Mistakes

- **RGB is not a meaningful specification by itself.**
- **RGB is a “triplet”, and there are many variations on how that “triplet” is defined**
 - **4-bit, 8-bit, 12-bit, 16-bit, 24-bit, etc.**
- **Many image file formats can utilize any number of RGB variations. Specifying the photo is to be “color” and the image file format (.JPG, .TIF, .GIF) is more specific and meaningful.**

Suggestions for Image Specifications

- **Always specify the number of pixels for each dimension, or a maximum number of pixels for any dimension. This leaves no ambiguity in what the “Call to Artists” requirements are for the image file.**
- **You may want to specify image file format, if a specific format is required. .TIF, .JPG, or .GIF are common formats used for image files.**
- **Do not include specifications that are either contradictory or vague.**

Digital Image File Format Notes

- **Per Wikipedia:** http://en.wikipedia.org/wiki/Image_file_formats
- **JPEG/JFIF**
 - **JPEG** (Joint Photographic Experts Group) is a compression method; JPEG-compressed images are usually stored in the **JFIF** (JPEG File Interchange Format) file format. JPEG compression is (in most cases) **lossy compression**. The JPEG/JFIF **filename extension** in **DOS** is **JPG** (other **operating systems** may use **JPEG**). Nearly every digital camera can save images in the JPEG/JFIF format, which supports 8 bits per color (red, green, blue) for a 24-bit total, producing relatively small files. When not too great, the compression does not noticeably detract from the image's quality, but JPEG files suffer generational degradation when repeatedly edited and saved. Photographic images may be better stored in a lossless non-JPEG format if they will be re-edited, or if small "artifacts" (blemishes caused by the JPEG's compression algorithm) are unacceptable. The JPEG/JFIF format also is used as the image compression algorithm in many **Adobe PDF** files.
- **TIFF**
 - The **TIFF (Tagged Image File Format)** format is a flexible format that normally saves 8 bits or 16 bits per color (red, green, blue) for 24-bit and 48-bit totals, respectively, usually using either the **TIFF** or **TIF** filename extension. TIFF's flexibility is both blessing and curse, because no single reader reads every type of TIFF file. TIFFs are lossy and lossless; some offer relatively good lossless compression for **bi-level (black&white) images**. Some digital cameras can save in TIFF format, using the **LZW** compression algorithm for lossless storage. TIFF image format is not widely supported by web browsers. TIFF remains widely accepted as a photograph file standard in the printing business. TIFF can handle device-specific color spaces, such as the **CMYK** defined by a particular set of printing press inks. **OCR** (Optical Character Recognition) software packages commonly generate some (often **monochromatic**) form of TIFF image for scanned text pages.
- **GIF**
 - **GIF (Graphics Interchange Format)** is limited to an 8-bit palette, or 256 colors. This makes the GIF format suitable for storing graphics with relatively few colors such as simple diagrams, shapes, logos and cartoon style images. The GIF format supports animation and is still widely used to provide image animation effects. It also uses a lossless compression that is more effective when large areas have a single color, and ineffective for detailed images or **dithered** images.
- **RAW**
 - **RAW** refers to a family of **raw image formats** that are options available on some digital cameras. These formats usually use a lossless or nearly-lossless compression, and produce file sizes much smaller than the TIFF formats of full-size processed images from the same cameras. Although there is a standard raw image format, (ISO 12234-2, **TIFF/EP**), the raw formats used by most cameras are not standardized or documented, and differ among camera manufacturers. Many graphic programs and image editors may not accept some or all of them, and some older ones have been effectively orphaned already. Adobe's **Digital Negative (DNG)** specification is an attempt at standardizing a raw image format to be used by cameras, or for archival storage of image data converted from undocumented raw image formats, and **is used by several niche and minority camera manufacturers** including **Pentax, Leica, and Samsung**. The raw image formats of more than 230 camera models, including those from manufacturers with the largest market shares such as **Canon, Nikon, Sony, and Olympus**, can be **converted to DNG**.^[5] DNG was based on ISO 12234-2, TIFF/EP, and ISO's **revision of TIFF/EP** is reported to be adding Adobe's modifications and developments made for DNG into profile 2 of the new version of the standard.