# Lecture 3: Using Images on the World Wide Web

As we have discussed in previous lectures, there are a range of graphic and image types. In this lecture we are going to be specifically discussing image formats for use on the World Wide Web (WWW) and concepts related to their optimal use.

One common theme related to the use of images on the WWW is size. Although the uptake of broadband Internet connectivity has meant that larger file sizes are becoming more common, for the majority of commercial sites the relationship between download times and file sizes is still an important issue.

The larger a file is, the longer it is going to take to download. In order to minimise download times, experienced web designers will carefully select the best format for each graphic or image on their site.

In addition, they are likely to use compression, colour depth reduction, dithering and other techniques to try and reduce the file size of images (and hence how long they will take to download).

Designers must make a trade off between size and quality, as most of the techniques involve some sort of degradation of the original image. With experience, and an understanding of the underlying concepts, it's relatively easy to achieve quality images with greatly reduced file sizes.
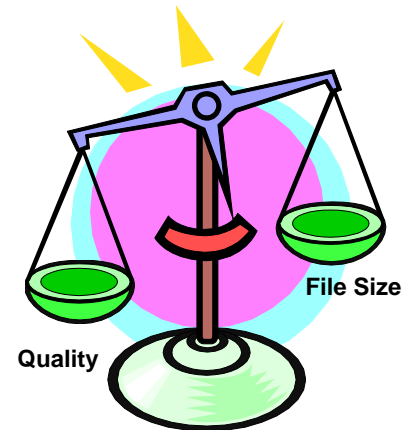
The Major Bitmap WWW File Types

While it is possible to display both bitmap and vector file types on the WWW, in today's lecture we'll be focusing on bitmap images. While modern browsers are capable of displaying quite a range of bitmap file types, in practice there are three major bitmap formats which are used to display images. These are JPG/JPEG, GIF and PNG.
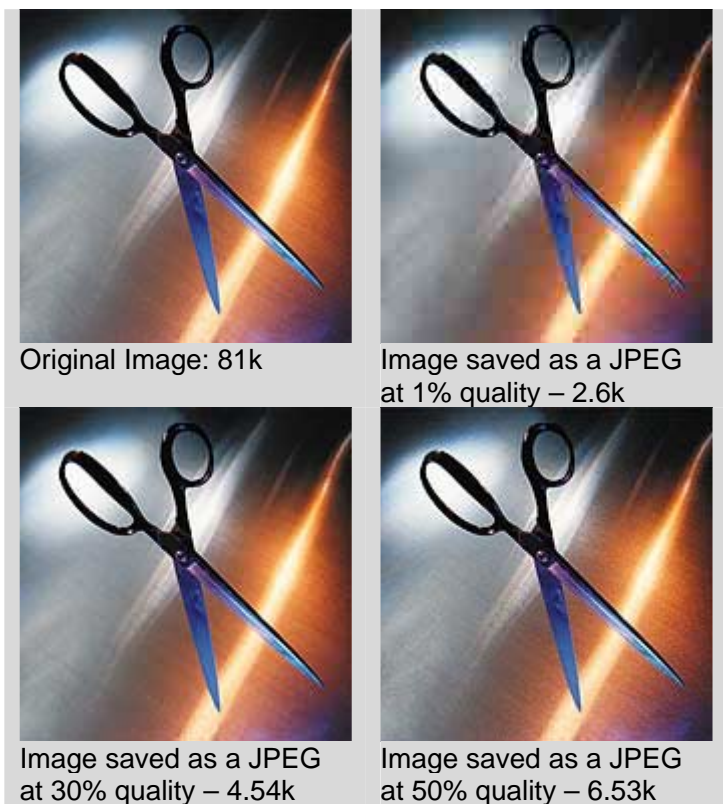
Interestingly, these are also the main 3 formats used in other multimedia products (such as CD-Roms and applications). Although other formats can also be used in these products, because of their availability and compression options they tend to be used more than the alternatives.

JPG/JPEG

The JPEG format (pronounced Jay-Peg) was created by the Joint Photographic Experts Group, and in a relatively short period of time has become the standard for storage and distribution of low-resolution "real world" continuous tone images. Although it is possible to utilise the JPEG format for high-resolution images, this is seldom done because of the 'lossy' nature of JPEG compression.

In fact it is just this reason why JPEG is used extensively on the WWW. Because JPEG offers variable compression levels, it is possible to use the JPEG format to compress image files into *extremely* small file sizes. This, however, comes at a cost. JPEG compression is lossy (meaning that when reversing the compression process, data has been lost between the original file and the decompressed file). In other words, the JPEG compression algorithm 'throws out' or distorts data in order to make the file smaller. When the image is reassembled (or decompressed) the original data is not restored. For this reason, JPEG is not usually used for images where it is important to keep all of the pixel information complete (such as in archive situations or where high-quality output is required).

Although the JPEG format does reduce the quality of the image data within an image, because of the variable compression levels it is still a useful format – it is possible to reduce the quality of an image so there is no discernable difference to the human eye but significant file size savings are still made. As is almost always the case with lossy compression algorithms, the higher the compression, the greater the loss of quality and the smaller the resultant file size.

Original Image: 81k

Image saved as a JPEG at 1% quality – 2.6k

Image saved as a JPEG at 30% quality – 4.54k

Image saved as a JPEG at 50% quality – 6.53k

Because JPEG allows variable compression levels, it is possible to select how much compression is applied to an image when it is being saved.

Compression levels are typically expressed as a percentage, and most imaging programs allow you to see a visual sample of the image in the save process.

While very small file sizes can be achieved, there is an obvious drop in the visual clarity of the image.

In the examples on the left, the image compressed to 1% quality is unacceptably distorted (although does boast a tiny file size).

The 30% quality JPEG is not too bad, but there is still visible degradation of the image.

The 50% quality option is only marginally visually different to the original file, but offers a file size 12 times smaller than the original.

Because image data is lost when a file is saved as a JPEG, it's important to also keep a copy of your uncompressed images (source files). In fact, many professional multimedia professionals keep a copy of all images etc. in a non-compressed or lossless compression format (such as PSD or TIFF format) and create low-resolution screen ready images from these.

GIF
GIF (Graphics Interchange Format) was the first image format used on the WWW. There are two major types; 87a and the later 89a. They both use the .gif file extension, but 89a GIF files support transparency and animation.

GIFs work in a completely different way to JPEG files. For a start, GIFs have a smaller colour palette – GIF files are maximum 8-bit (which works out to be 256 possible colours). These colours are what are referred to as 'indexed'. This means that they are stored in a colour table specific to the image (or you can elect to use a predefined table such as the web-safe colour palette or the windows system colours). There are seven different colour table settings you can choose from (which directs how the colours to make up the colour table will be selected):

Perceptual selects colors for which the human eye has more sensitivity. What this means is that out of the 256 possible colors, these are the ones for which we have the greatest ability to discern the differences.

Selective is the Photoshop and ImageReady default option for Color Tables and produces images with the greatest color integrity. Similar to Perceptual, Selective concentrates on broad areas of color and attempts to use Web Safe colors as much as possible.

Adaptive builds the best palette of colors based upon the selected image. An image with a predominance of red for example, will have more variations of red than any of the other Color Tables.

Web is the Web Safe palette. All colors are composed of one or more of the 216 Web Safe colors. While the image quality is not as good as the other tables when used with photographic images or images with subtle gradients, the resulting image will appear about the same on all computer platforms.

Custom preserves the settings for the selected Color Table and does not change when the image is modified.

Mac OS uses up to 256 colors that are the default system colors on the Macintosh platform. 216 of these colors are Web Safe, the remaining 40 are not. This is good palette to use if you are preparing images that will only be viewed on Macintosh computers, such as on a company Intranet, with a limitation of 256 colors.

Windows is the default 256 system colors for the Windows platform. As with the Mac OS Color Table, this is a good palette to use if you are creating images that will only be viewed on Windows computers but must be limited to 256 colors.

In addition to these Color Tables, you can create your own Color Tables, name and save them, and apply these custom settings to other images.

http://www.webdevelopersjournal.com/articles/color_in_photoshop.html

Just because there are 256 colours available, however, does not mean all GIF files use all 256 colours! One of the ways GIFs make files smaller is by excluding colours from the colour palette (and hence reducing the colour depth of the image). As you may recall from previous lectures, one way of reducing the file size of an image is to reduce the colour depth and hence reduce the number of bits used to describe colour.

Because of the way GIF deals with colour, it is not suitable for all types of images. Colour photographs, for example, do not always look their best in only 256 colours, and as such the GIF format is not the ideal

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format for them. While it is possible to save photographs and other images with tonal graduations in the GIF format, often it is 'cheaper' in terms of file size to use an alternate format (such as JPEG). Another thing to keep in mind when using the GIF format is that it does not cope particularly well with gradients as the number of colours needed to adequately describe a gradient is often large. This can result in 'banding'.
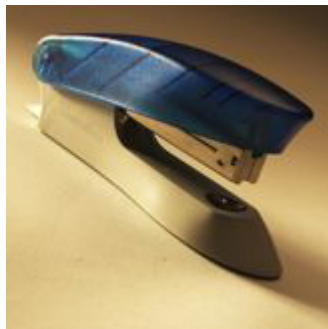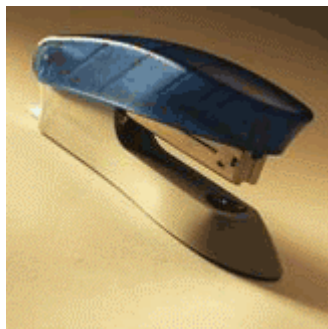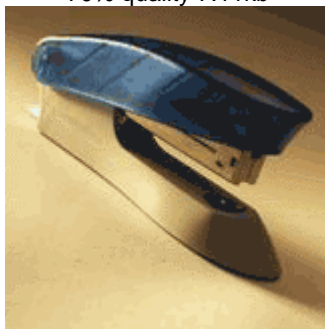

Original file – 76.9kb
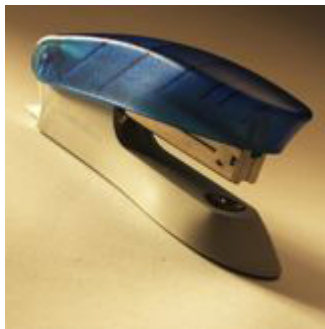
Compressed JPEG file at 70% quality 7.11kb
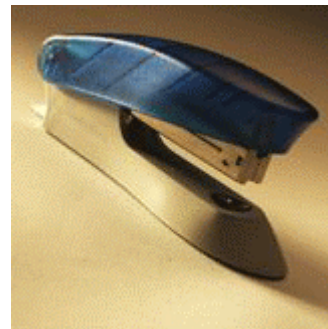
GIF file saved with 256 colour palette – 18kb

GIF file saved with 128 colour palette – 11.6kb

GIF file saved with 64 colour palette – 8.37kb

GIF file saved with 32 colour palette – 6.1kb

One technique used to make GIF images, using a low number of colours in their palette, look better is dithering. You'll remember we discussed that several lectures ago. Essentially dithering is when spots of colour are placed on the image to trick the eye into seeing smoother transitions and to represent colour that may not be contained within the colour palette. Although dithering an image adds slightly to its file size, often it enables the designer to achieve better-looking images whilst still maintaining smaller file sizes.

Image saved as a GIF with a 256 colour palette – 32.1kb

Image saved as a GIF with a 32 colour palette – 14.1kb

Image saved as a GIF file with 32 colour palette and diffusion dither – 17.1kb

There are 3 different types of dithering that can be used: diffusion, pattern and noise. In practice, most of the time the diffusion dither will be the most useful.

Diffusion – spots placed in areas of transition to simulate true graduation

Pattern – spots placed in a grid-like pattern to introduce dithering

Noise – spots introduced in a random pattern to introduce dithering

The GIF format uses LZW (Lempel-Zev-Welch) compression that is based on the repetition of information. Because of this it is efficient at compressing rows of identically coloured pixels. This is why the GIF format is ideal for images where there are few colours, and particularly images like diagrams, where there are few colours and a lot of repetition in same coloured pixels.

For example, in the following diagram, you'll notice the difference in clarity due to the way JPEG and GIF compress their files. In this instance it's a much better option to use GIF rather than JPEG as the file type of choice if clarity and a smaller file size is preferred.
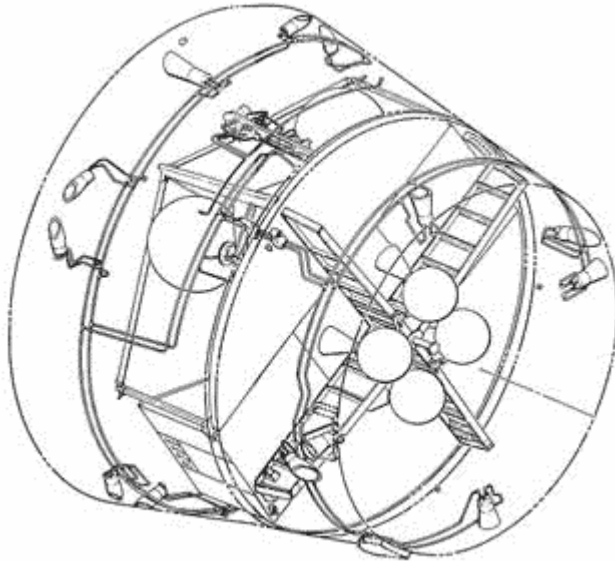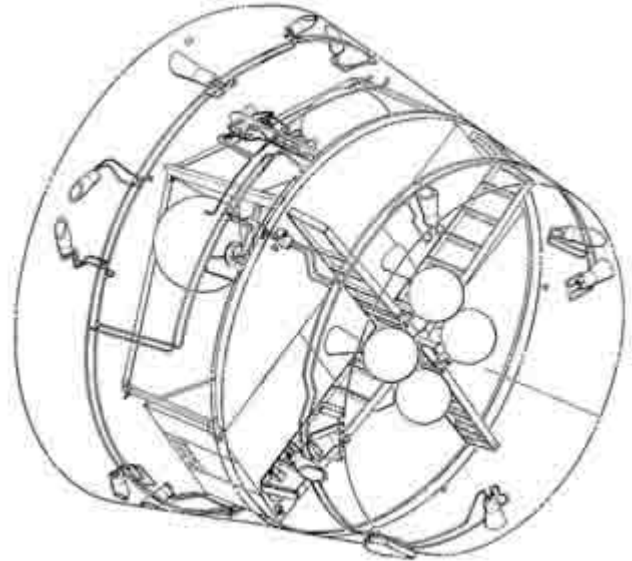
GIF file – 15kb   JPEG file – 18kb

PNG
The PNG (or portable networks graphic) format is the most recent of the standard web formats (introduced in 1995) and shares characteristics of both the JPEG and GIF formats. While, like GIF, PNG is a paletted format, it can support 8-bit, 16-bit and up to 48-bit RGB colour, which makes it a lot more flexible than the GIF format. It also uses a better type of (lossless) compression.

The major difference between GIF and PNG, however, lies in the introduction of alpha transparency. While the GIF format does allow transparency within the image, this has to be 1 single colour that is elected to be transparent. The PNG format can support up to 16-bit transparency, or in other words 65,536 different transparent, or partially transparent, colours.

Although it sounds like PNG is the 'wonder' format of the WWW, in practice it is seldom used. The main reason behind this is browser support. The PNG format was first supported in the 4.04 version of Netscape and 4.0b1 of Internet Explorer for Windows but alpha transparency and another feature gamma correction were not fully supported at that time. Although all modern browsers now support the PNG file type, it is still not commonly used due to the lack of support in legacy systems.

Where PNG is used, it is most often used as a replacement for GIF files. Although the PNG format can do high-quality true colour images (as can JPEG) it is 'cheaper' (in file size) to use the JPEG format for these sorts of images.

Which Format to Use When

Establishing which format to use in each situation is a matter of practice, experience and experimenting with the export/save for web settings. Fortunately, if you're using Photoshop or Fireworks you can compare file size and quality before you even save!
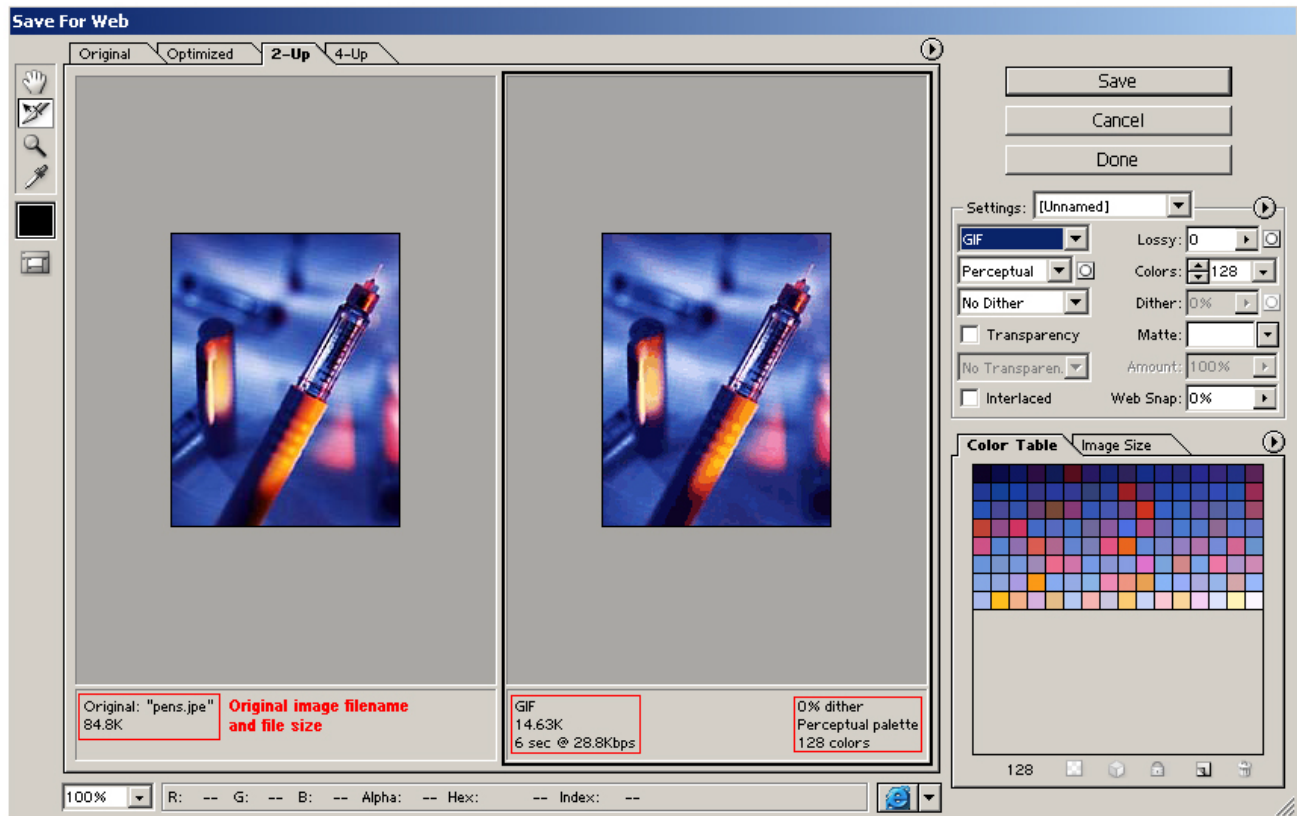
As a general rule however, you can use the following table as a guide.

JPEG File type	GIF File type	PNG File type
Good for: • Photographic images • Images with a wide tonal range • Images with gradients	**Good for:** • Images with a lot of flat colour • Images with fine lines • Very detailed diagrams	**Good for:** • Images with a lot of flat colour Images with fine lines • Very detailed diagrams • Images where alpha transparency is required • Images where a large number of flat colour exist • Images where gamma correction is required
Not recommended for: • Images with fine lines • Images with a lot of flat colour • Very detailed diagrams	**Not recommended for:** • Photographic images • Images with a wide tonal range • Images with gradients	**Not recommended for:** • Photographic images • Images with a wide tonal range • Images with gradients