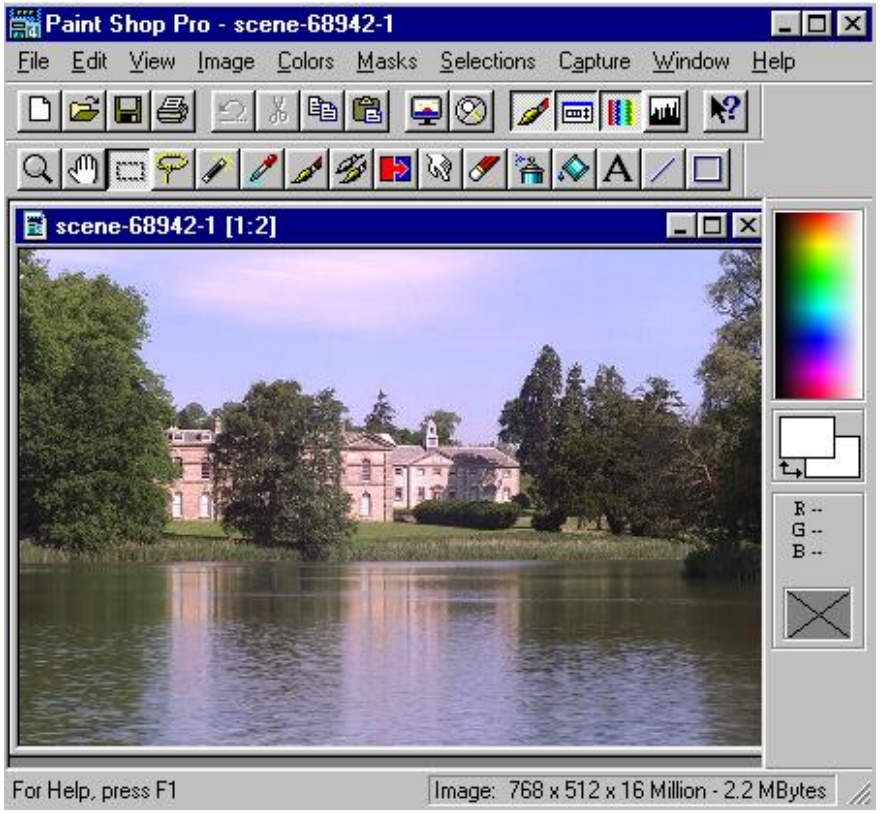
Digital Images on the Web

Overview of Learning Expectations:

- Compare and Contrast Images for Web & Print
- Optimisation of Images for the Web
- Related HTML Issues
- Editing & Enhancing Images for the Web

Digital Image Editing

- Many Editing Software Options
  - Paint Shop Pro
  - MS Image Composer
  - MS Paint
  - GIMP
  - Pixlr
  - Adobe Photoshop
- Functionality
  - Basic text, drawing and painting tools, plus image manipulation functions.
  - Picture touch-up, enlargement, reduction, colour manipulation, distorting etc…



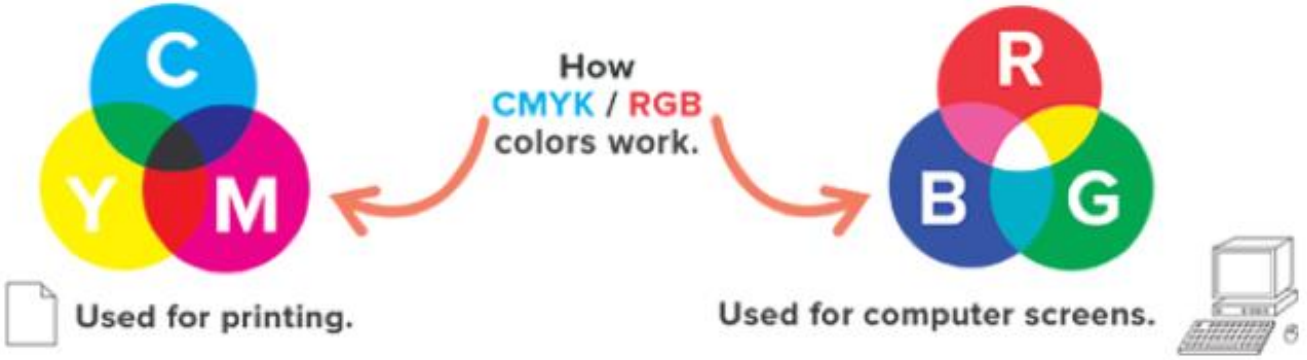
Web vs Printable Images

- Although the basic characteristics of web images and printable images are the same, six main factors distinguish them:
  - Colour
  - Format
  - Size/Resolution
  - Speed
  - Transparency
  - Animation

COLOUR

Colour

- **CMYK vs RGB Colour Models**
  - Color displays very differently printed on a piece of paper versus viewed on screen, because it involves different color spaces: CMYK for print and RGB for web.



  - CMYK stands for the four ink colors used by all printers: cyan, magenta, yellow, and black.

Colour

People have come to expect colour, and colour can add a great deal to an image, if it is used effectively.

Sometimes, colour is vital to the purpose for which an image is being used.

- E.g., the colours in an online clothing catalogue will influence people's buying decisions, and must be accurate to avoid disappointment and complaints.

Digital Colour Representations

- Monitors display pictures as a rectangular array of pixels.
  - i.e. small usually square dots of colour, which merge optically when viewed at a suitable distance to produce the impression of continuous tones.
- To display an image on the monitor each pixel is assigned a particular colour. The pattern of pixels on the screen produces the desired image.
- Full photographic colour resolution must account for millions of individual colours. While this is possible on any modern colour monitor, for economic (memory) reasons many systems are limited to display a much smaller range.

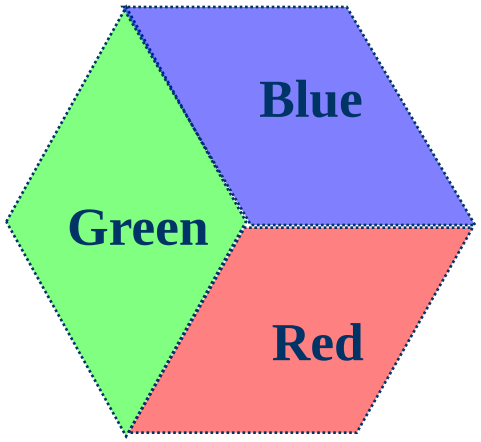
Digital Colour Representations

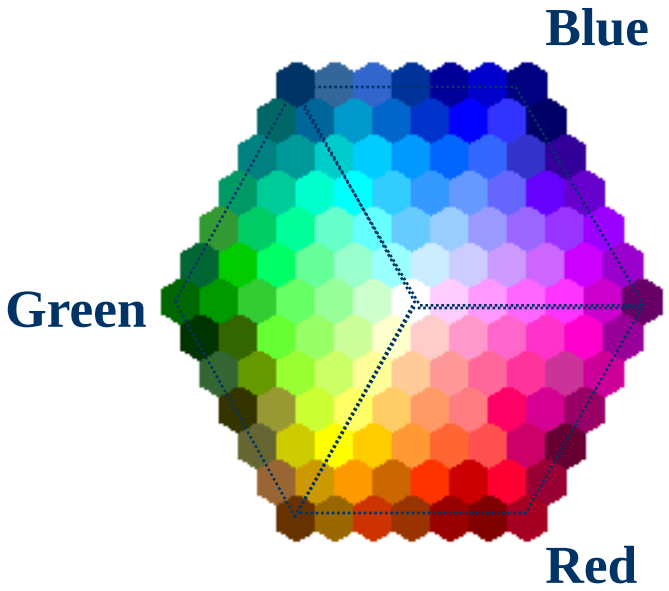
- ColorDepth
  - The current trend is that most computers use 24 or 32 bits hardware to display 16,777,216 different colours.

Date	16,777,216	65,536	256
January 2016	99%	0.5%	0.5%
January 2015	99%	0.5%	0.5%
January 2014	98.5%	1%	0.5%
January 2013	98%	1.5%	0.5%
January 2012	98%	2%	0%
January 2011	97%	3%	0%
January 2010	97%	3%	0%
January 2009	95%	4%	1%
January 2008	90%	8%	2%
January 2007	86%	11%	2%
January 2006	81%	16%	3%
January 2005	72%	25%	3%
January 2004	65%	31%	4%
January 2003	51%	44%	5%
January 2002	43%	50%	7%
January 2001	37%	55%	8%
January 2000	34%	54%	12%

The RGB Colour Cube

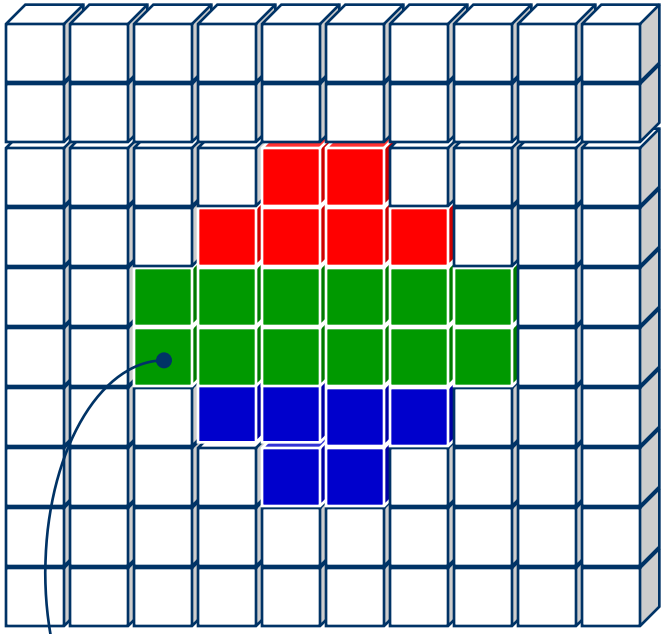
- Additive Colour Model
  - Current colour monitors use a so called *additive* colour model with three primary colours, red, green, and blue.
  - Combinations of these primaries produce intermediate colours, and equal quantities of all three *add* to produce white.





8-Bit Colour

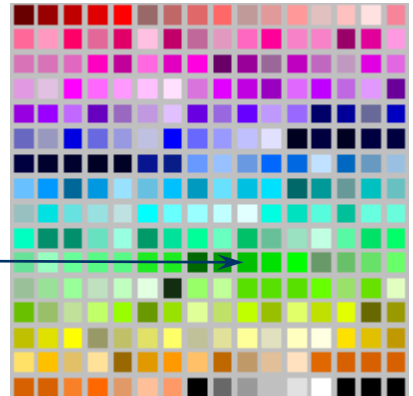
Screen Pixels



Each pixel is encoded as an 8-bit binary number which serves as the address of a colour in an 8-bit colour palette (or look-up table)

A given palette is then a subset of possible colours that could be displayed.

8-bit (256 Colour) Palette



10100110

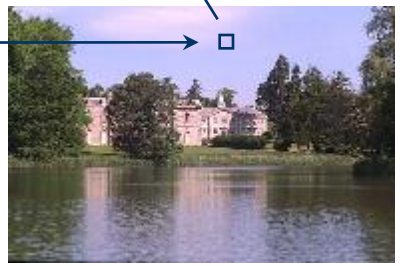
24-Bit Colour (“True Colour”)

00110101

10100110

11100010

00110101101001101110001 0



True photographic quality colour requires 24 bits of information per pixels, 8 bits for each of the primary colours (Red, Green, and Blue)

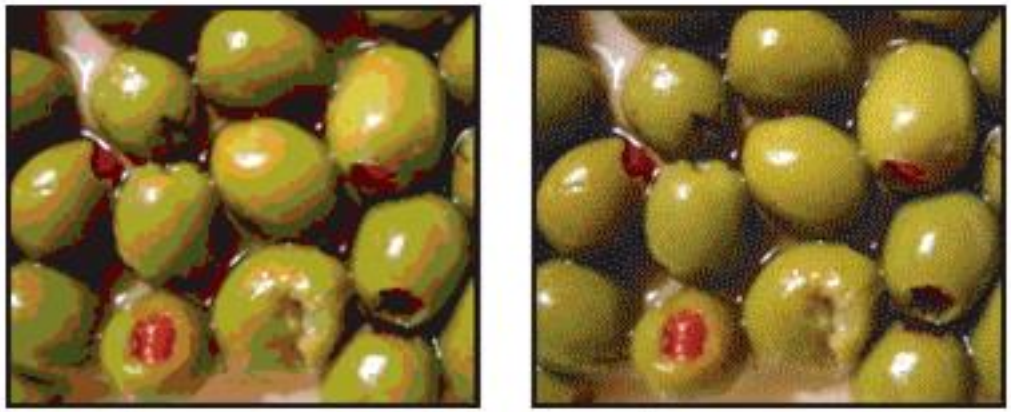
Displaying Colour

- If a browser is called upon to show a colour that is out of its range, it has two options:
  - It can mix two colours to produce the missing one. A process called ***dithering***.
  - It can ***shift*** the missing colour to one in the current set. Sometimes you hardly notice this, but othertimes it can be a disaster!

NOTE: In the past when there was less browser support for colour options. If you didn't want colours to dither or shift on an 8-bit monitor you have to use one of the colours in the browsers particular set. However, since browsers reserve a bunch of colours for the browser window itself, and because the sets for Windows and Mac are slightly different there are actually only **216** colours that won't dither on 8-bit monitors on either of these platforms. These are called **Web-Safe** or **browser-safe** colours.

An Example

- Dithering refers to the method of simulating colours not available in the colour display system of your computer.
- A higher dithering percentage creates the appearance of more colours and more detail in an image, but can also increase the file size.



GIF image with 0% dither (left), and with 100% dither (right)

- For optimal compression, use the lowest percentage of dither that provides the colour detail you require.
- Images with primarily solid colours may work well with no dither.
- Images with continuous-tone colour (especially colour gradients) may require dithering to prevent colour banding.

Colour Loss

70,000 colours approx. (24 bits)

256 colours (8 bits)

16 colours (4 bits)

2 colours (1 bit)

FORMAT

Format

- People who create images that will be printed on paper do not have to worry about what their readers will use to view the images.

- The Web Slant…
  - Millions of users gaining access using Macs, Windows-based PCs, Unix machines etc. The graphics you use in a web page should be in a format that each of these operating systems can recognise.

Graphics Formats

- Wide Range of Formats
  - BMP, GIF, JPEG, PICT, TIFF, IFF, PNG, SVG, WebP(Google) …
- Most Commonly Used Web Image Formats:
  - Graphics Interchange Format (GIF)
  - Joint Photographic Experts Group (JPEG)
  - Portable Network Graphic (PNG)

NOTE: Current versions of Internet Explorer, Mozilla Firefox, Google Chrome & Safari can view all of these image formats.

GIFs

- **General Points**
  - Graphics Interchange Format
  - Developed by CompuServe
  - 8-bit palette – limited to 256 colours
  - Fine for traditional *computer-style* graphics (bar-charts, icons, …)
  - Problems associated with photographic images which require many more colours.
- **Lossless Compression Technique**
- **Supports Transparency**
  - If the GIF image is displayed against a coloured background or another image, the background will show through. This, in effect, allows you to produce images that are not rectangular.
- **Suitability**
  - Ideal for diagrammatic images and icons. Less successful with scanned and photographical images, which may have wide colour ranges and tonal variations.

JPEGs

- **General Points**
  - Joint Photographics Experts Group
  - Poor adjustable compression technique
    - Although compressed images may be stored in several different formats.
  - The name ‘JPEG file’ is used to refer to what are correctly called ***JFIF***.
    - Stands for JPEG File Interchange Format.
- **24-bit, True-Colour Images**
  - JPEGs are instrinsically 24-bit images capable of reproducing the fine textures and tonal variety needed for photographs.
- **No Transparency**
- **Suitability**
  - Photographs

PNGs

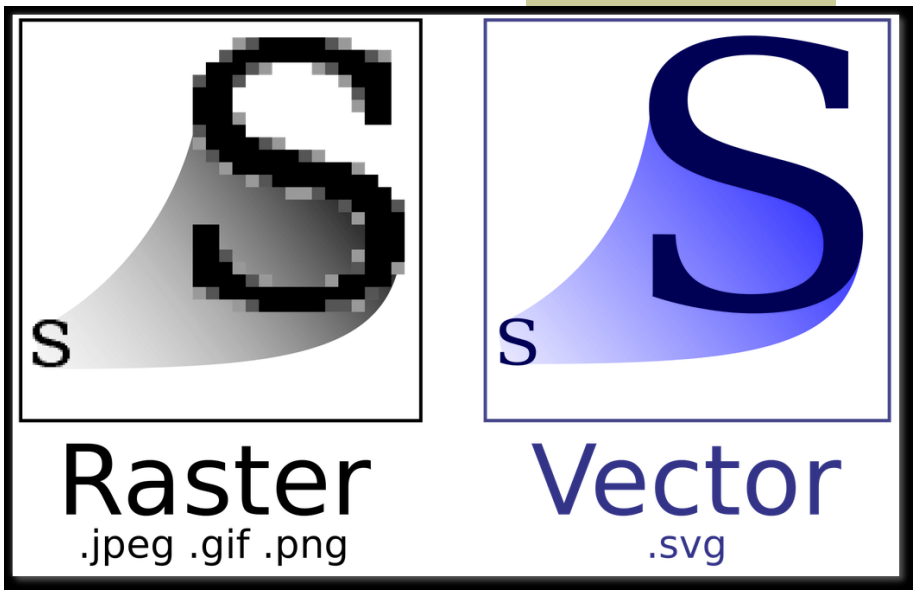
- **General Points**
  - Portable Network Graphic (pronounced '*ping*')
  - Devised to supersede GIFs.
    - The trouble with GIF was that the compression algorithm it employs is covered by a patent owned by Unisys, who required a license fee to be paid for by any program that implemented GIF compression.
  - PNG-8, PNG-24
- **Patent-Free Lossless Compression.**
- **Not restricted to 256 colours**
  - Palette-based, Greyscale and True-Color support.
- **Sophisticated Transparency & Interlacing**
- **Open file format maintained by the W3C**

Which Format to Use?

- **GIFs**
  - Good for diagrammatic images (good compression).
  - Poor photographic reproduction.
  - Interlacing & transparency may be an important factor.
- **JEPGs**
  - Best for photographic reproductions.
  - Poor for diagrammatic images (compression artefacts).
- **PNGs**
  - Good for both computer generated and natural-colour images.
  - Often better than GIF but not as good as JPEG for photographic images.
  - Unlike JPEG, de-compressed images can be fully restored.

SVG

- **Not a traditional format**
  - You can't take a photograph and just save/export it as an svg.
  - Series of coordinates, written in XML
  - Code representing image goes right into the markup: no external file required
  - Can be resized dynamically without any loss in quality
  - Incredibly powerful, but difficult to manipulate
  - Particularly useful for diagrammatic images



https://upload.wikimedia.org/wikipedia/commons/0/07/Wikipedia_logo_%28svg%29.svg

SIZE / RESOLUTION

Size/Resolution

- PPI vs DPI
  - Many people mistakenly use these interchangably.
  - DPI (“Dots Per Inch”) - refers to the density of the dots of ink printed on an inch of printing surface.
  - PPI (“Pixels Per Inch”) - refers to the number of pixels (the square building blocks of a digital image) displayed in an inch of screen space.
  - Equipment that is set to print at a higher DPI will produce a higher quality image reproduction. But, unlike PPI, DPI has nothing to do with the size of a print.

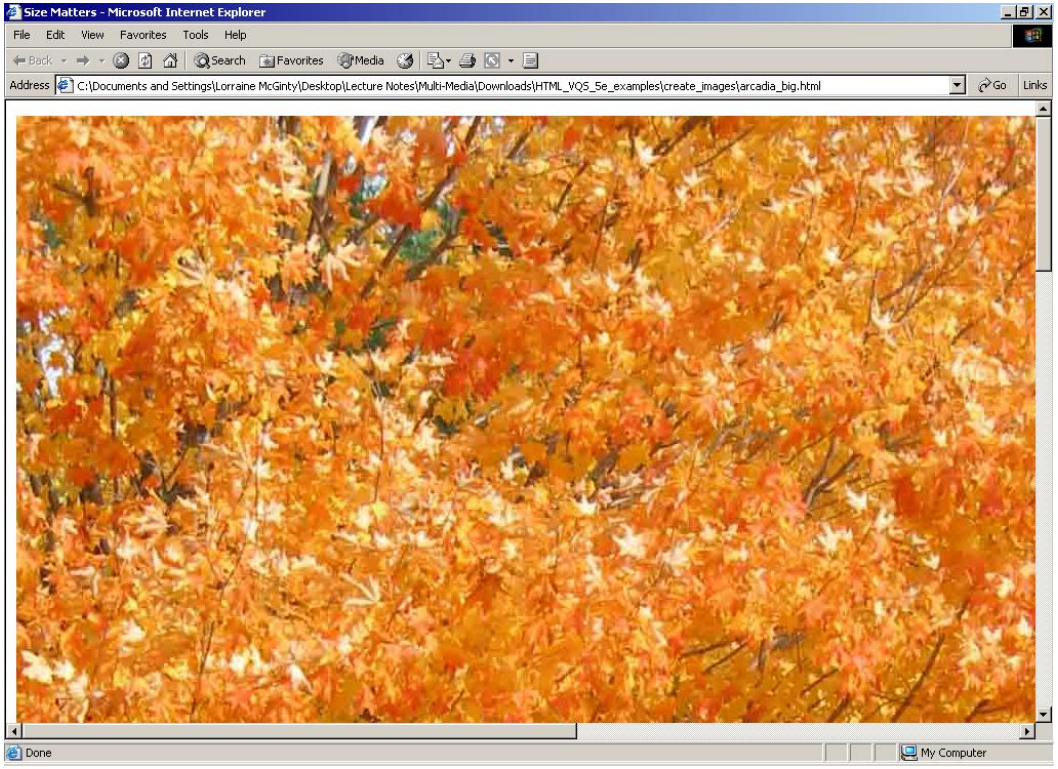
Size/Resolution

- Remember digital images are measured in *pixels*.

- An Example…
  - A digital camera may take pictures that are 640 pixels wide by 480 pixels high, but how big is that? Well, it depends…
    - If you are printing the image to a printer at 200ppi (pixels per inch), that image will measure a rather petite 3.2 X 2.4 inches.
    - Of you are displaying that image on the Web, the image will depend on your visitors monitor's resolution, which is more likely to be between 72 and 100ppi. So, if its 86ppi your image will display ay a larger 7.5 X 5.5 inches!

Example

- This image is 1704 pixels wide and in PhotoShop has an output resolution of 284ppi and measures 6 X 8 inches.



- Here in Explorer, however, it's output resolution is determined by the visitor's monitor – about 86ppi – which means the picture is about 20 inches wide!

Size/Resolution

- Screen Resolution

~97% of visitors are using a screen resolution of 1024x768 pixels or higher.

Date	Other high	1920x1080	1366x768	1280x1024	1280x800	1024x768	800x600	Lower
January 2016	30.7%	18%	35%	6%	4%	3%	0.3%	3%
January 2015	32.7%	16%	33%	7%	5%	4%	0.3%	2%
January 2014	34%	13%	31%	8%	7%	6%	0.5%	0.5%
January 2013	36%	11%	25%	10%	8%	9%	0.5%	0.5%
January 2012	35%	8%	19%	12%	11%	13%	1%	1%
January 2011	50%	6%		15%	14%	14%	0%	1%
January 2010	39%	2%		18%	17%	20%	1%	3%
January 2009	57%					36%	4%	3%
January 2008	38%					48%	8%	6%
January 2007	26%					54%	14%	6%
January 2006	17%					57%	20%	6%
January 2005	12%					53%	30%	5%
January 2004	10%					47%	37%	6%
January 2003	6%					40%	47%	7%
January 2002	6%					34%	52%	8%
January 2001	5%					29%	55%	11%
January 2000	4%					25%	56%	15%

Size/Resolution

- So resolution can mean one of two distinct concepts:
  - The actual number of pixels on a monitor or an image…say 640x480, or
  - The number of pixels in an inch of that monitor or image…say 86ppi.

- Regardless, **the higher the resolution, the greater the pixels**!
  - On paper, pixels can add detail or size.
  - On screen, more pixels ***always*** translates to a bigger size image that requires more memory.

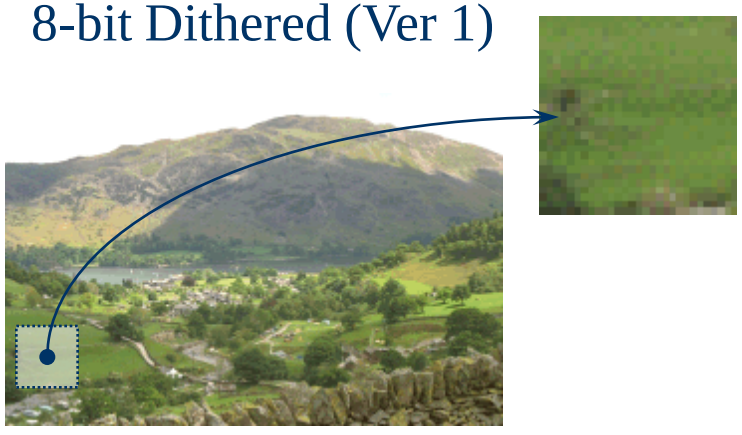
Resolution Problems

- Remember… JPEGs use 24-bit Colour
  - Thus they are capable of reproducing the fine textures and tonal variety needed for photographs.
- JPEG Colour Resolution Problems
  - As always care should be taken to consider the possible viewing conditions.
  - A 24-bit JPEG viewed on a 16-bit or 8-bit system will undergo *dithering* to take care of missing colours. This may seriously degrade the quality of the image.

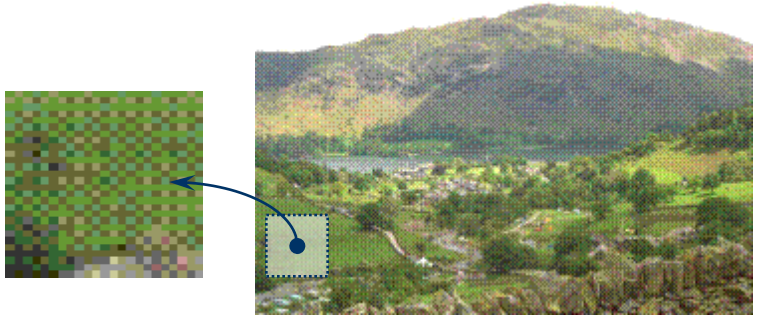
JPEG Colour II

24-bit Original

8-bit Dithered (Ver 1)



8-bit Shifted (Ver 2)



SPEED / BANDWIDTH ISSUES

Speed / Bandwidth Issues

- Another principal difference between Web images and printed images is that your visitors have to wait for web images to download.
  - Imagine waiting for images to appear in your daily newspaper!

A Lerner Communications Newspaper

North Center • Lincoln Belmont • Lake View

Booster

Wednesday, June 5, 1996

2 Sections

Crane of hope

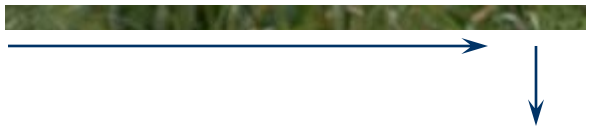
LVCC den
new appro
parking lo

Landmark

Interlacing

- **Image Loading Problems**
  - Top-to-bottom loading bias.
  - Difficult to detect image content until most of the image has been loaded.
- **Interlacing**
  - You can save an image in such a way that a browser can show it at gradually increasing resolutions.
  - Allows readers to preview progressively more detailed views of an image during download.
  - Although the initial image is blurry, the visitor immediately gets an idea of what the image will (eventually) look like.
  - Remember: Interlaced images are not faster to download!

Non-Interlaced Loading



Interlaced Loading

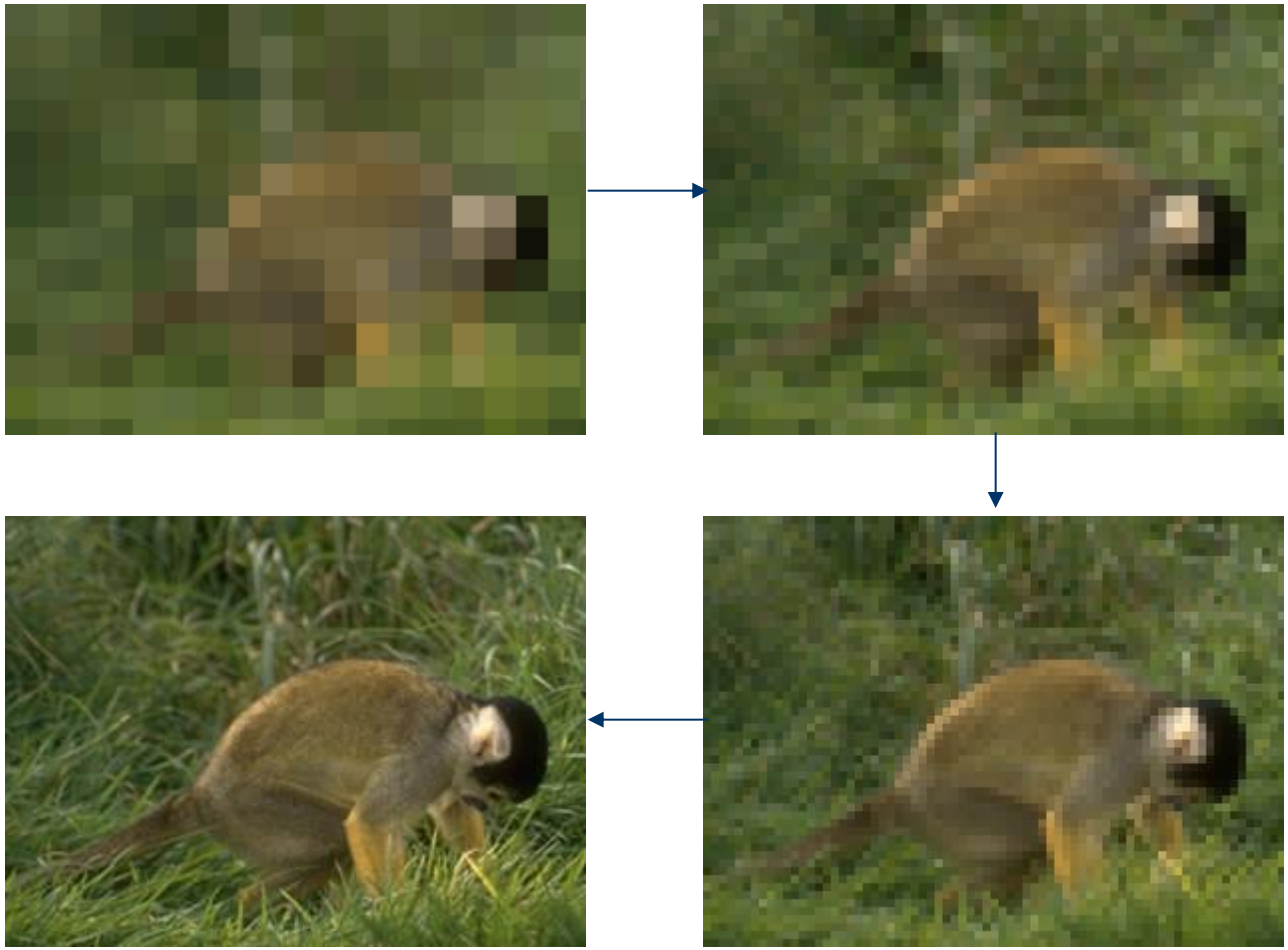


Image Layout Cues

- **Specifying Image Dimensions**
  - `<img src="pic.gif" height="200" width="300" />`
- **Advantages**
  - Specifying image dimensions allows the browser to start to layout out the web page before trying to download individual images.
  - There is no speed increase, but there is a perceptual advantage because the user can assess page structure quickly.
  - Always specify image dimensions!

Text Associations

- The **`alt`** Attribute
  - `<img src="me.gif" alt="My Picture" ...>`

  The specified text is displayed in place of the image until the download commences, or permanently if the download fails or the user has chosen not to download images.

- Advantages
  - Only really necessary when considering images that are important for understanding the contents of the page; and also from the view of bots/SEO

Speed / Bandwidth Issues

- Keeping Download Time to a Minimum:

  - Try to use **small** images as much as possible.

  - Always **compress** larger images.

- ***Image Optimisation*** refers to the process of creating an image with the lowest file size that still renders a good-quality image.

Compression: Lossless vs Lossy

- Lossy Compression
  - The compression algorithm being used results in some loss in data.
  - This means you will not get the exact same image as the original if you try to decompress it.
  - The data loss, in most instances, is not very noticeable.

- Lossless Compression
  - Involves compression algorithms that when decompressed, will get you exactly the same image as the original.
  - Example of lossless compression is the process of zipping up a document using the ZIP format.

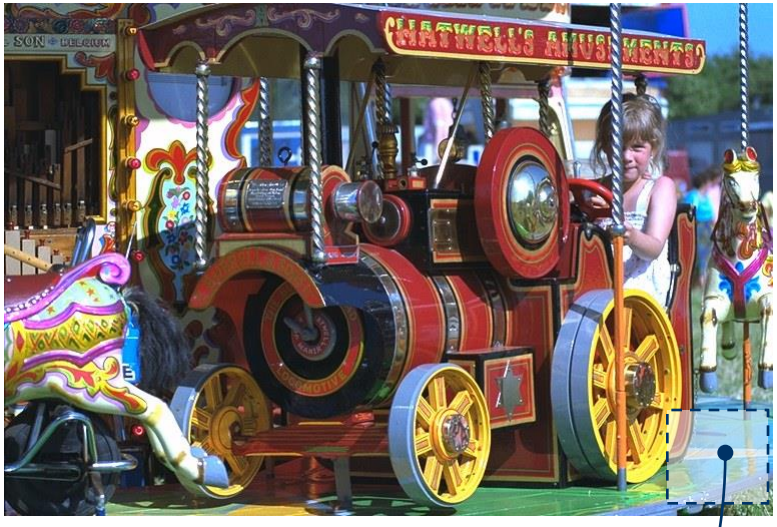
GIF Compression

- LZW (Lempel Zev Welch) **Lossless** Compression
  - No information is lost during compression (discounting potential colour loss) .
  - Run-length encoding => Looks for ‘runs’ of the same colour in an image and converts these into compressed ‘run’ descriptions.
  - Other techniques further improve compression rates.

- Pros & Cons
  - Images with large regions of homogeneous colour compress well.
  - Poor compression rates for highly textured images (E.g., photos)

GIF Colour Loss *vs* Compression

Original, 24-bit, 1,153Kb



GIF, 8-bit, 288Kb

JPEG Compression

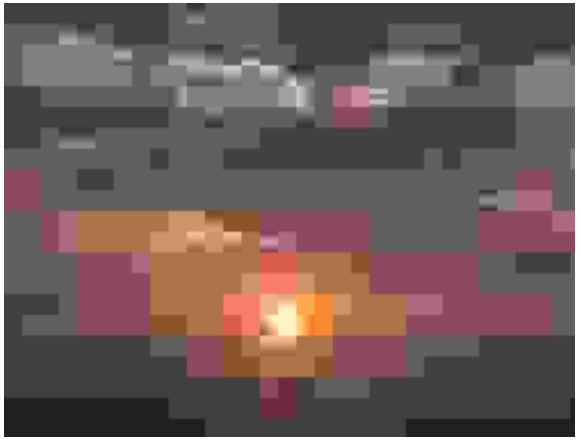
- "**Lossy**" Compression
  - Discrete Cosine Transformation - This technique removes "unnecessary" information permanently but with hopefully limited impact on image quality.
  - Uncompressing the image will not restore these eliminated details.
  - Graded compression levels offering a sliding scale of image quality - high, medium, and poor quality.
  - Compression ratios up to 100:1
  - High compression rates can seriously distort an image and introduce noise -- image artefacts.
  - Not worth it for very small images.

JPEG Compression

High Quality, 25Kb

Medium Quality, 3Kb

Low Quality, 1Kb



PNG Compression

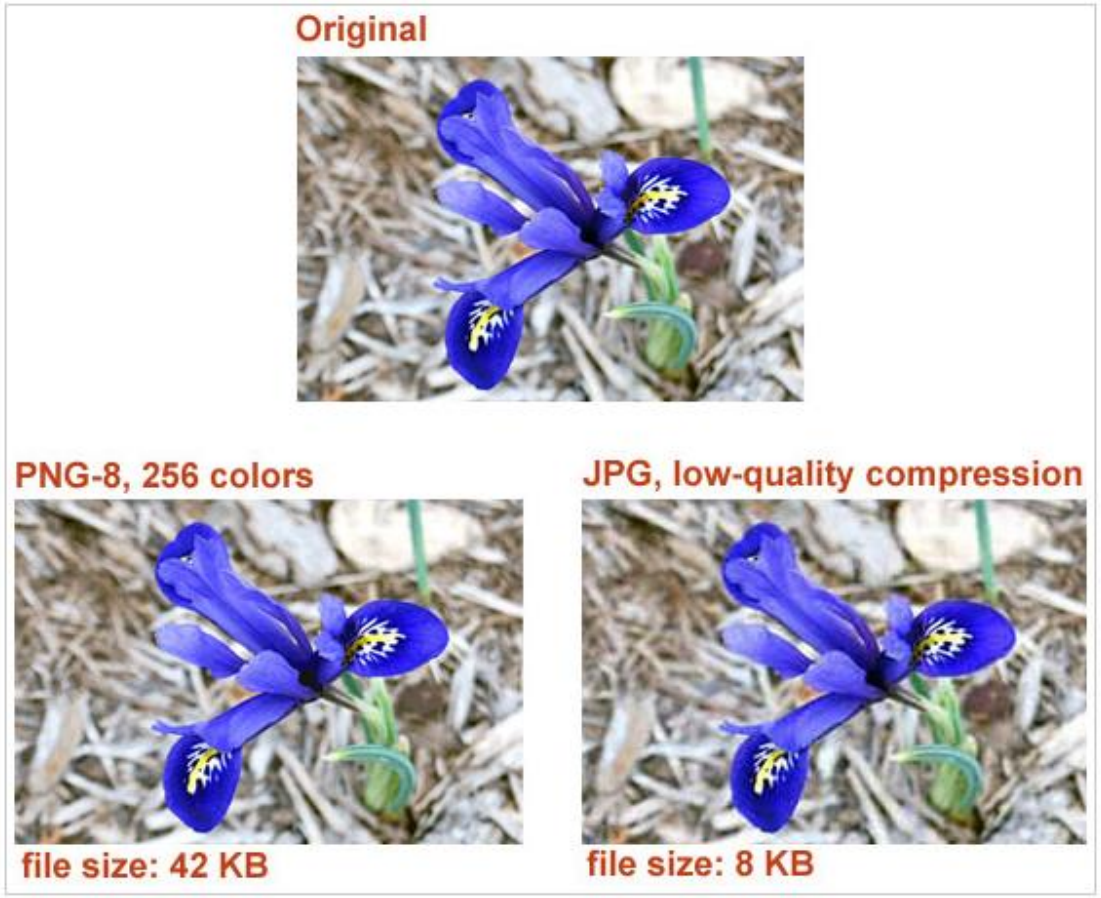
- Like GIF, PNG uses **lossless** compression. But PNG's compression is based on a scheme called LZ77, which is not patented (Note: LZW is). This was one of the main reasons for creation of PNG format. LZW patent expired in 2003/2004.

- PNG's compression is usually about 25% better than GIF's without losing information like JPEG.

- PNG not supported on ancient browsers (Internet Explorer 9 was first major browser to not have issues with the format)

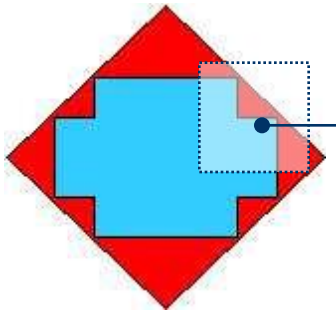
Comparisons

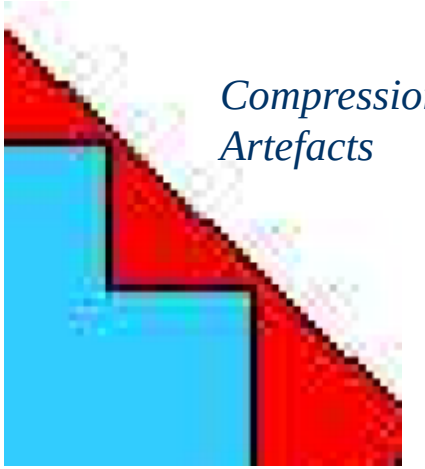
- Lossy vs lossless



Comparisons

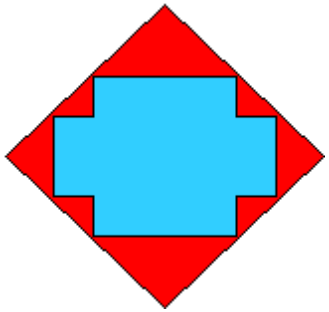
JPEG, 3800bytes



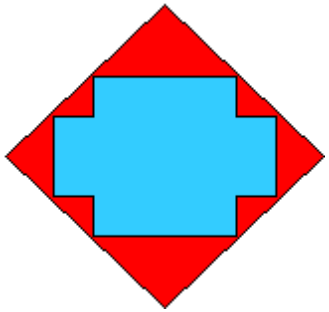


Compression Artefacts

GIF, 1000 bytes



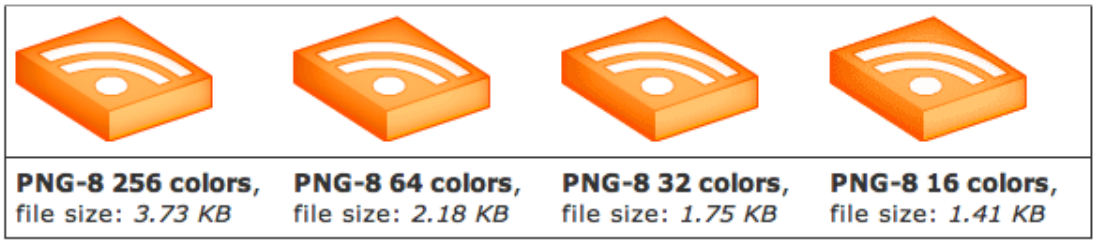
PNG, 854 bytes



PNG Optimisation

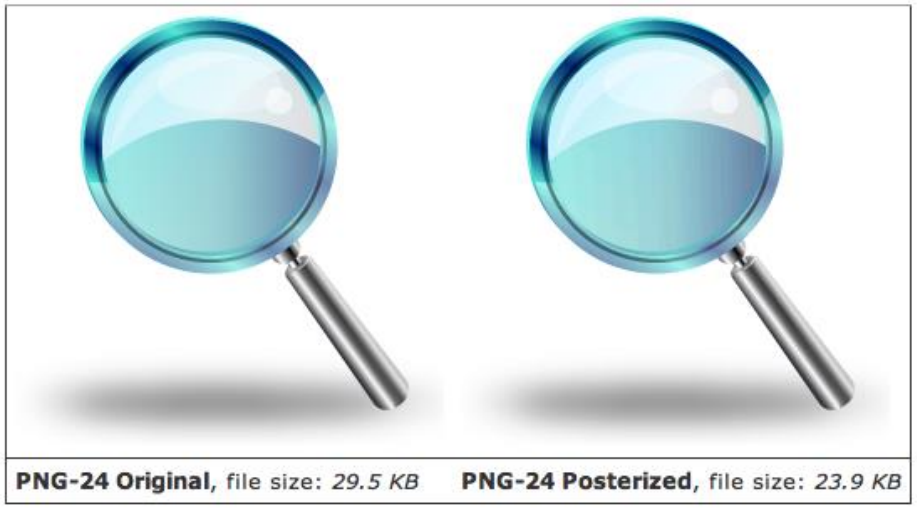
- **PNG-8 Colour Reduction Optimisation**

  - decreases the number of colours in the image.



PNG-8 256 colors, file size: *3.73 KB*	PNG-8 64 colors, file size: *2.18 KB*	PNG-8 32 colors, file size: *1.75 KB*	PNG-8 16 colors, file size: *1.41 KB*

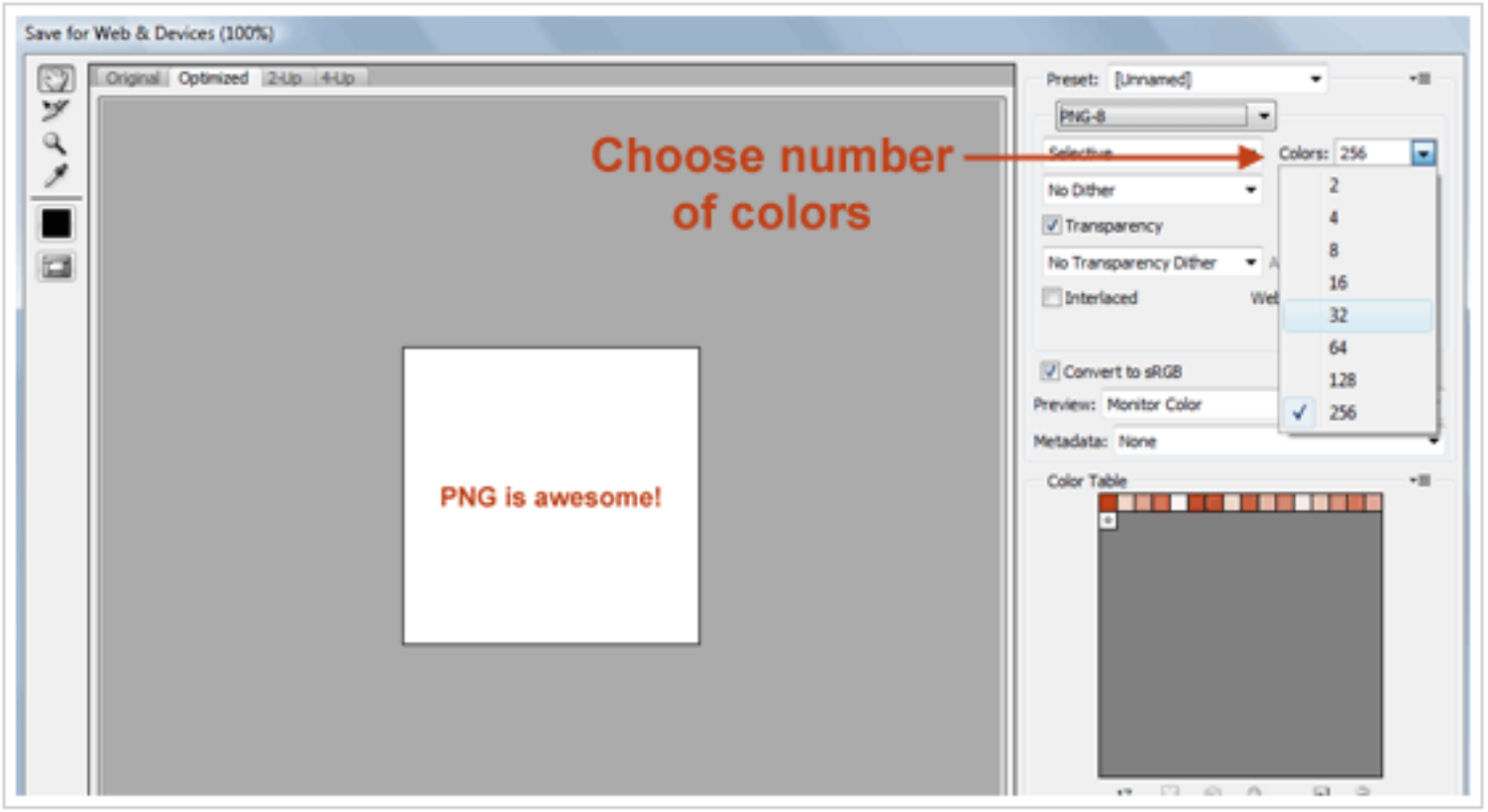
- **PNG-24 Posterisation Optimisation**
  - Reduces the amount of colours by combining similar colours.



PNG-24 Original, file size: *29.5 KB* **PNG-24 Posterized**, file size: *23.9 KB*

PNG-8 Colour Reduction Optimisation

Photoshop : File > Save for Web Devices.



PNG-24 Posterisation Optimisation

Photoshop :

Step 1: Open the image

Step 2: Image > Adjustments > Posterize

Step 3: Decrease levels until it results in visible quality loss.

Step 4: Save the image in PNG-24 format using the “Save for the Web & Devices” feature.

Comparisons

PNG-8, file size: *3.73 KB*

PNG-24, file size: *5.68 KB*

GIF, file size: *4.20 KB*

- **Optimisation Tip**
  - There are lots of tools you can use to optimise your images.
  - “pngcrush” for PNG images, “smushit” for GIF used below.
  - No apparent loss in quality, and PNG-8 still wins over GIF.

PNG-8, file size: *3.69 KB*

PNG-24, file size: *5.41 KB*

GIF, file size: *3.71 KB*

Comparisons

PNG-24, file size: *66.6 KB*

JPEG, file size: *14.41 KB*

Further optimization with pngcrush and Smush.it:

PNG-24, file size: *64 KB*

JPEG, file size: *14.2 KB*

TRANSPARENCY

Transparency

- Both GIF and PNG allow transparency; JPEG does not.
  - You can create an image with transparent area(s) by selecting only one colour to be the designated transparent colour. Every pixel (i.e., every single point of programmable colour) in the image that has that colour will be invisible.

Transparency

- Transparency is important for two reasons:
  - You can create complex layouts by making one image move behind another.
  - You can take advantage of transparency to give an image a non-rectangular outline, adding visual interest to your pages.

Graphic Overlays & Transparency

- Background Colour Clashes
  - Clashes between the background colour of an image and the background of a web page can produce unattractive, unprofessional looking presentations.

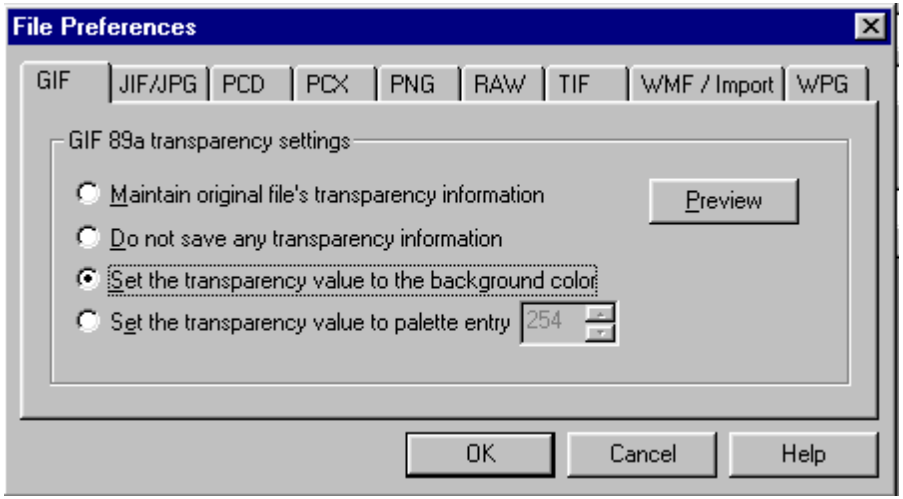
Here, the GIF is standing out against the red background of a Web page.

We'd like the GIF's pink background to be transparent so that the GIF looks like it is part of the Web page.

GIF Transparency

Pink is set to be the transparent colour

PaintShop Pro
"Save Options" Dialog.



Transparency Problems

- Global Colour Replacement
  - Transparent colour selections may occur throughout an image.
  - Watch out for anti-aliasing halos!

No Transparency

Halos and Transparency Artefacts

Anti-Aliasing

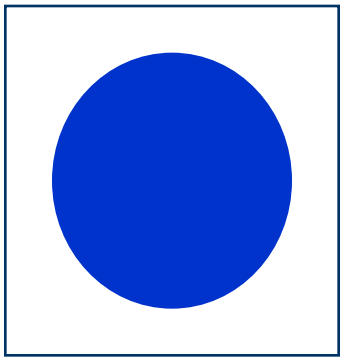
- What is it?
  - A technique used to make diagonal or curved edges appear smoother by setting pixels near the edge to intermediate colours according to where the edge crosses the underlying colour.

- Since pixels are square points an image that is not anti-aliased will often have **jagged edges**.

- Anti-aliasing is carried out by, blending the edges with pixels that get lighter and lighter until the edge is transparent.

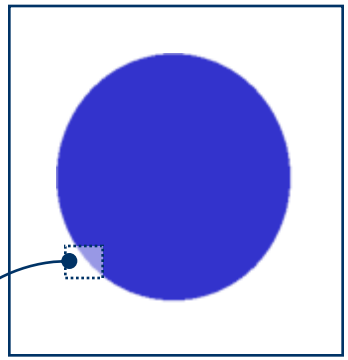
Anti-Aliasing

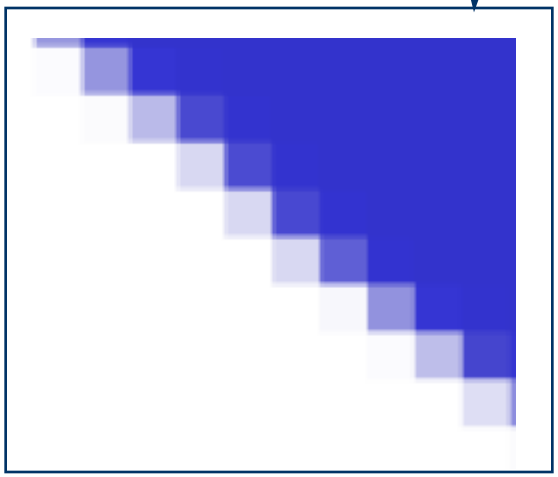
Jagged edges...



Anti-aliasing

Smooths edges!



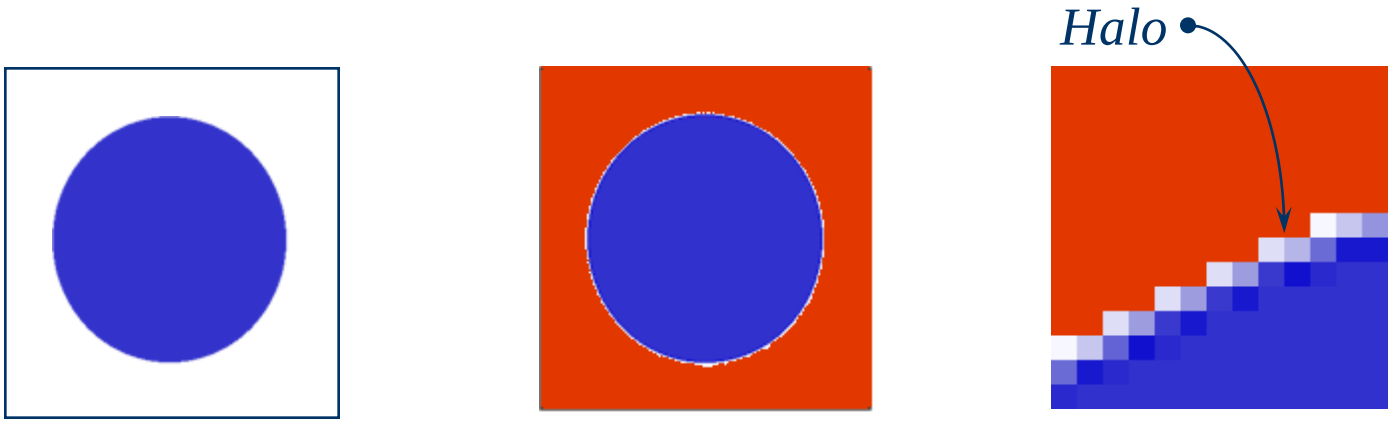


Intermediate shades of blue soften the hard edges

Halo Problems

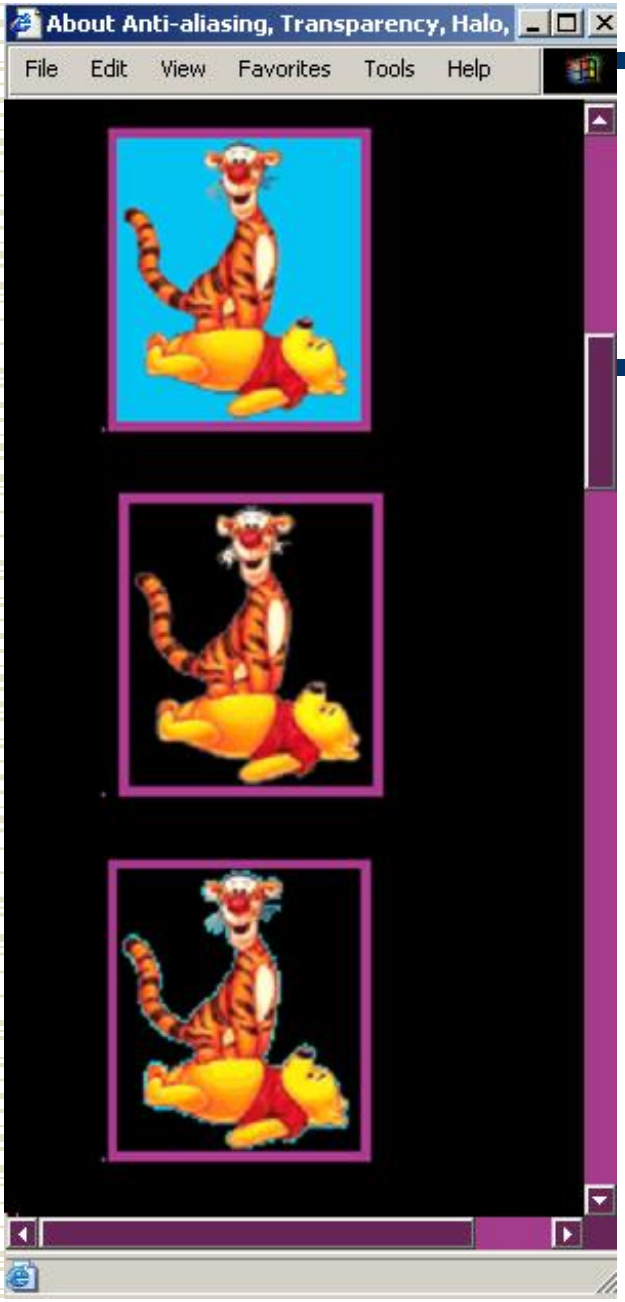
- Halo Problems
  - So anti-aliasing works by interpolating between the foreground and the the background colour (e.g., grays between black and white).
  - Remember that transparency works by designating one colour as transparent. So, problems can occur because the choice of intermediate colour depends on the background colour of the graphic in question.
  - Displaying an anti-aliased graphic on a different background colour will produce an ugly halo effect.
  - The ‘halo’ is located directly between the image’s edge and the background colour.

Halo Effects



The blue circle was originally anti-aliased against a white background, resulting in the addition of intermediate blue-white shades.

Of course these shades stand out against the new red background. The image needs to be re-touched or anti-aliased again against the new background.



More Examples

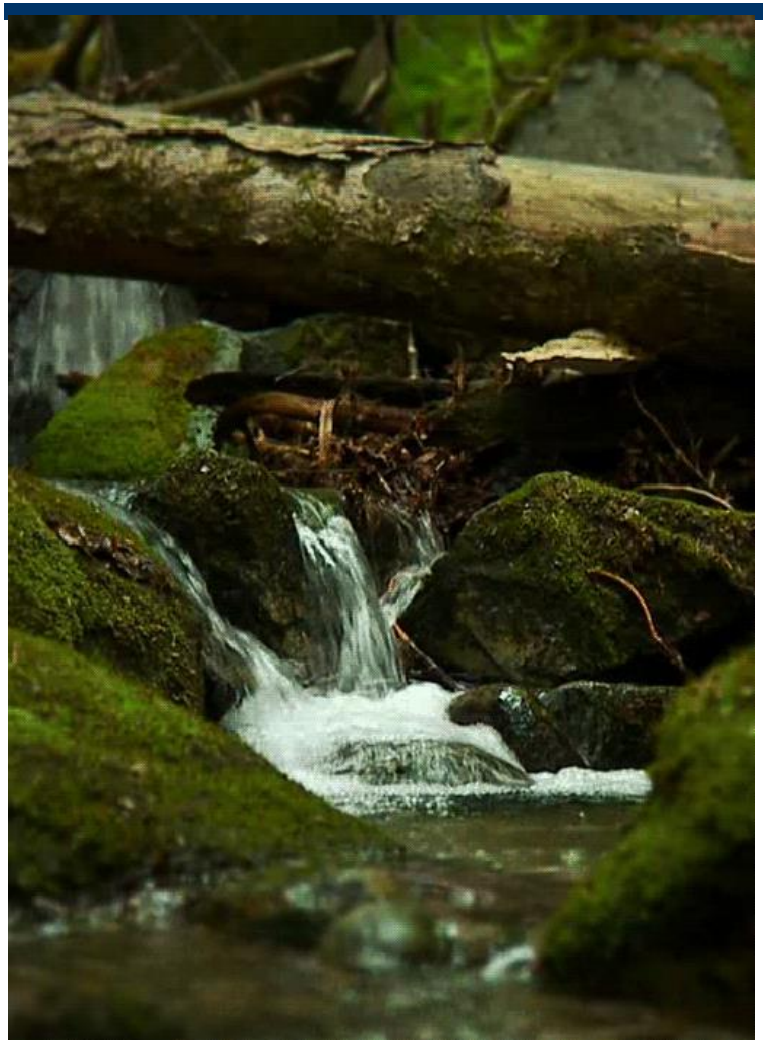
- The first image has **not** been saved with a transparent background, thus the blue background is visible.
- The second image above **has** been saved with a transparent background, blended with a black colour, so the blue background is not visible, thus no halos appear.
- The third image **has** been saved with a transparent background, blended with a original blue background colour that does not match this pages black background, so the blue background is not visible, but halos are visible.

ANIMATION

Animation

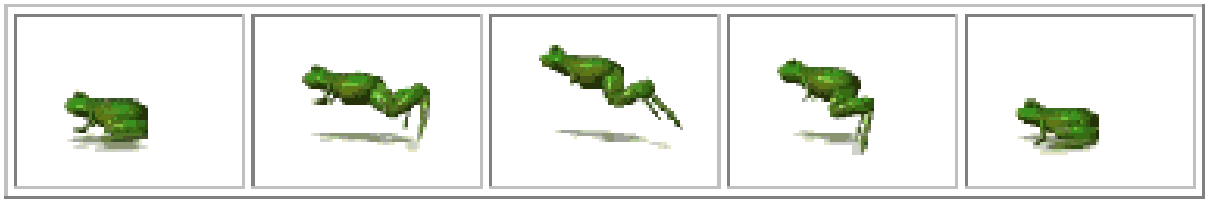
- One thing you won't be seeing on paper for some time is moving images!
- Animated images can be created in GIF format, but not in JPG format.
- Paint Shop Pro's ***Animation Shop***, is an animation facility that can save animated GIF files for use on the Web.
- Animation typically is provided in one of four ways: Images, Flash, HTML5 video or CSS.
- You insert animated GIFs/APNGs on a web page like any other image.

- Although tricky, gifs can be made to a very high quality (despite 256 colour palette)
- APNG not restricted to 256 palette, but unsupported by IE/Edge



Animation

- An animated GIF is a simple file that contains a collection of images that are shown, one after the other.



- Important Settings
  - File-naming,
  - Ordering,
  - Time-delay
  - Recurrent Loops.

HTML MARKUP POINTS

Remember…

- Embedding images on a page:

- Type **<img src="image.url"** where image.url indicates the location of the image file on the server.
- Offer alternate text use the **alt** attribute.
- Optionally you can offer tooltips using the **title** attribute.
- Type a space and then the final **/>**.

- Catering for different devices?

- Nest the <img /> element in a <picture></picture> element.
- Picture elements allow you to specify different sources based upon either the type of media (i.e type of screen) viewing the web page, or based on MIME type (i.e what type of image compatibility the user's browser supports)

Linking Thumbnails to Images

- Don’t expect your visitors to wait more than **5 seconds** to load and view your entire page.
  - One approach is to create miniatures of large images and let visitors *choose* to view larger images.
  - The most typical way to do this is to have miniature versions of the images (thumbnails) that have been reduced in size (both in terms of dimensions and bytes) through use of image editing software (not through HTML/CSS!)
  - Using JavaScript, the full-size image can be fetched when the thumbnail is clicked on.

Specifying Size for Speedier Viewing

- When a browser gets to the (X)HTML code for an image, it must load the image to see how big it is and how much space must be reserved for it.

- If you specify the images dimensions, the browser can fill in the text around the image as the image loads, so that your visitors have something to read while waiting for the images.
  - **`E.g., width="x" height="y"`** (x & y reflect the dimensions in pixels)

- NOTES:
  - The height and width attributes of <img> should only be used to specify the actual height and width of an image (in pixels)
  - If you wish to add styling to an image you can always use CSS to this effect.

Scaling an Image

- You can change the size of an image just by specifying a new height and width in pixels.
- This is an easy way to change the dimension of an image.

BUT

- Sloppy solution
  - Warping pictures tends to make them grainy and ugly!
  - Reduced images take longer to view than images that are really that size.