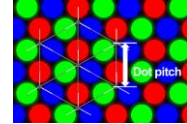# Image File Formats

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Monitor Resolution Measure

- For monitors using red, green, blue subpixels, the DPI (*dots per inch*) should measure the pixel resolution (not the subpixels)
- Less misleading is the term *pixels per inch* (PPI)
- Dot pitch is a measure of the distance between the subpixels
- A lower dot pitch is good, higher PPI is good
- Good LCD monitors display .27mm dot pitch with 94 PPI

Video Card Resolution Measure

- Not the same as monitor resolution
- PPI is influenced by the monitor's display dimension (the diagonal) and the video card display resolution (video standard used)

Video display standard	Video card resolution	Usual monitor size (diagonal)
XGA	1024 x 768	14"-15"
SXGA	1280 x 1024	17", 19"
UXGA	1600 x 1200	20", 21.3"
WSXGA+	1680 x 1050	20"-22"
WUXGA	1920 x 1200	23"-28"
WQXGA	2560 x 1600	27"-30"
WQUXGA	3850 x2400	56"-64"

Print Resolution Measure

- Printers have a much higher resolution than screens
- Printers can manage 300 dpi – 9600 dpi
- People hold paper closer and expect more text information reading paper
- Print 5" x 7" picture, recommend minimum of 575 x 805 pixels
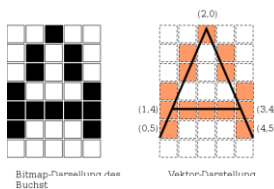- For 8.5" x 11", minimum 775 x 1000 pixels

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Images

- Pictures are stored on computer in either of two ways: bitmap or vector
- Bitmap format stores information about the pixels (dot) in the image
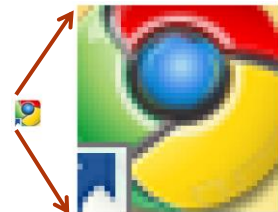- Vector format uses formulas to show the lines and edges within the image

Bitmap-Darstellung des Buchst

Vektor-Darstellung

Bitmap

- Also called raster
- The image is represented as a grid of dots – each dot is one colour
- More dots = bigger image size
- Windows 7 desktop icons are typically 48 pixels x 48 pixels

Bitmap – colour depth

- Each dot in the image can be represented by one of several colours
- The number of different colours in the image determines the size of the image file
- If the image consists of only black and white (two different *colours*), then each dot can be a zero for white and one for black (one bit)
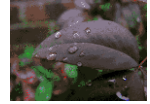
```
1111111
1000001
1000001
1000001
1111111
```

Bitmap – colour depth

- If the image contains 16 unique colours, then each dot can be one of 16 values or some code between 0000 and 1111 (16 combinations) – needing 4 bits per dot
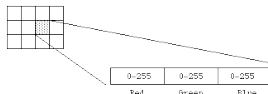- If the image contains 256 unique colours, then 8 bits (1 byte) per dot are needed

Bitmap-colour depth

- Truecolor is the term for photo-realistic images having 24 bits (3 bytes per red/green/blue combination) per dot. (Jpg, or 24-PNG)
- 16.7 million colours possible
  256 levels of red x
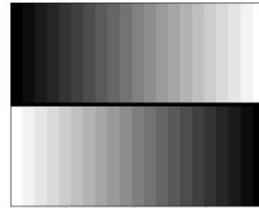 256 levels of green x
  256 levels of blue

0-255	0-255	0-255
Red	Green	Blue

Grayscale

- Grayscale images have not just white and black but many shades of gray in between
- Also called monochromatic

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Dithering

- Where a colour palette is limited, dithering is a technique for creating the illusion of colour depth
- Human eyes tend to combine two colours that are close together
- Reducing the colour depth of a photograph will lose detail
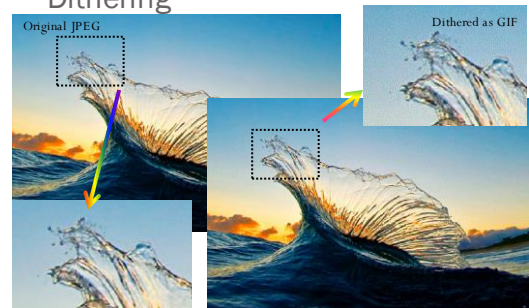- Jpeg images with a small resolution when with this better than Gif images.
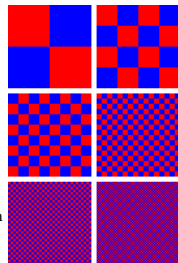
Dithering

http://webstyleguide.com/wsg2/graphics/dither.html

Original JPEG

Dithered as GIF

Bitmap file size

- Photo-realistic images are much larger in digital storage size because of the greater number of bits or bytes needed per dot in the image.
- Downloading large files can be slow and tie up network resources
- Compression technologies reduce the size of the image file in some cases by 90%

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JPEG image size 1.6 Mb   **1400 x 935 pixels 96 dpi**

No compression.

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JPEG image size 378 Kb   **1400 x 935 pixels 72 dpi**

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JPEG image size 252 Kb

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JPEG image size 171 Kb

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JPEG image size 104 Kb

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JPEG image size 61 Kb

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Anti-Aliasing

- Bitmap images, when scaled up in size, may appear to have jagged edges
- Anti-aliasing is the technique of minimizing the effect of these blocky appearances
- Video processor may result in subtle changes in colour around the curve or edge

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Bitmap compression

- Some common bitmap formats:
  - **Bmp** – Windows Bitmap (best quality, large file)
  - **Gif** – CompuServe Graphic Interchange Format (max 256 colour palette, lossless format, small file, animation, proprietary, pronounced "jiff/giff")
  - **Jpeg** – Joint Photographic Experts Group (lossy format, large file, no transparency) – **Jpeg 2000** supports lossless and lossy (commonly known as jpg)
  - **Png** – Portable Network Graphic (open source, true colour, small file, lossless, transparency)
  - **WebP** – Google's image format to supersede JPG (lossy format, open standard, true colour)   https://developers.google.com/speed/webp/
  - **Pcx** – Personal Computer eXchange (uses RLE)
  - **Psd** – Photoshop Document
  - **Tiff** – Tagged Image File Format (printing industry, uses RLE)

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Compression - RLE

- Run length encoding (RLE) is a lossless compression algorithm (indexed images such as GIF, TIFF and PNG use this)
- Rather than store a long sequence of the same colour on a row, ☐ hat colour instead

1111111	becomes 7B
1000001	1B5W1B
1000001	1B5W1B
1000001	1B5W1B
1111111	7B

- E.g.

WWWWWWWWWWWWBWWWWWWWWWWWBWBBBWWWWWWW
WWWWWWWWWWWWWWWWWWBWWWWWWWWWWWWWW
Encoded is: 12W1B12W3B24W1B14W

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Lossless and Lossy

- Jpeg performs compression through interpolation of adjacent pixels' colours (e.g. substitute image subgrids with a single colour block) – JPEG is Lossy!
  - Can create visual artefacts / blurring in images having a long straight edge (e.g. building against sky) – noticeable when zooming or scaling
  - Typically 10:1 compression with little loss in quality

Text Caption

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When to use

- Use Png for images having transparent backgrounds and smooth or blending edges
- Use Gif for small, animated images or images with one transparent layer
- Use Jpeg for large, photo realistic images
- Google's Webp (webby) may supplant Jpeg at some point

GIF89

JPEG   WEBP

1867802 bytes   1234926 (31.74%)

Image URL: http://en.wikipedia.org/wiki/File:12th_street_tunnel.jpg
Image Author: Ser Amantio di Nicolao

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When to use JPG, PNG and Giffs

If your image is…	Use…	Because…
Is graphical, with flat colours	Gif or 8-PNG	GIF and PNG excel ay compressing flat colour.
Is a photograph or contains granulated colour	JPEG	JPEG compression works best on images with blended colour. Because it is lossy, it generally results in small file sizes than 24-PNG.
Is a combination of flat and photographic imagery	GIF or 8-PNG	Indexed colour formates are best at preserving and compressing flat colour areas. The dithering that appears in the photographic areas as a result of reducing to a palette is usually not problematic.
Requires transparency	GIF or PNG	On/off transparency in images.
Requires multiple levels of transparency	PNG	Only format that supports transparency in images.
Requires animation	GIF	Gif is the only format that can contain animation frames.

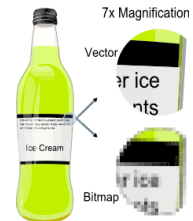Learning Web Design, 4th Edition. Jennifer Niederst Robbins pg. 520

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Bitmap vs Vector

- When scaled, bitmapped images lose clarity while vector images can be scaled without any loss of quality
- It is easier to convert a vector image into a bitmap equivalent – MUCH more difficult to convert a bitmap to a vector image.

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Vector format

- Vector image formats describe the image as geometric lines, curves and formulas
- Significant space saving compared to bitmap especially if the image is large
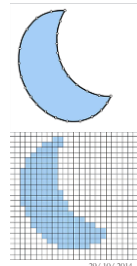- SVG (Scalable Vector Graphics) is an image format that supports both vector and raster

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Vector format

- SVG is an open standard by W3C (1999)
- Images are expressed as XML text
- Other vector type images
  - Adobe Illustrator
  - CorelDRAW
  - Encapsulated PostScript
  - OpenDocument Graphics
  - Portable Document Format (PDF)
  - Shockwave Flash

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Questions?

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References

- http://www.infobyip.com/detectscreenresolution.php
- http://en.wikipedia.org/wiki/Graphic_display_resolutions
- http://www.michaelbach.de/ot/fcs_mosaic/index.html
- http://www.htmlgoodies.com/tutorials/web_graphics/article.php/3479931

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