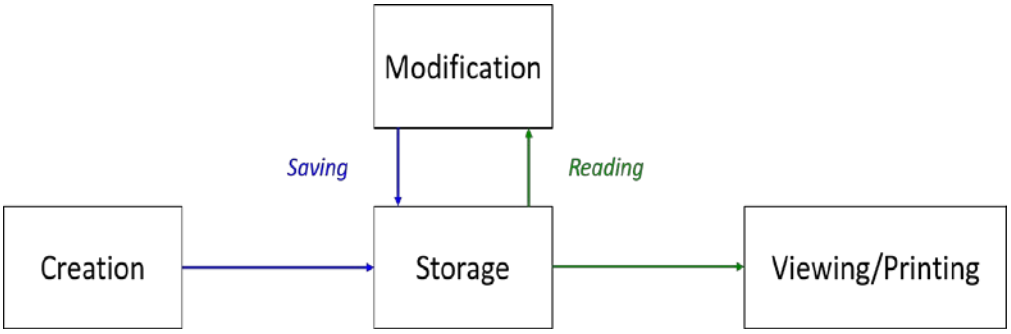


Digital Image Process

Digital images can be created using a digital camera or a scanner

The fundamental element of a digital image is the **Picture Element** or **Pixel**

- The **Resolution** of a digital image is measured in Pixels per Inch
- This can be varied on the digitizing device
    - Camera: File or Image Size (Small, Medium, Large)
    - Scanner: Resolution can be varied from 50 to 12,800 Pixels per inch
- Not enough resolution will result in a fuzzy, pixelated image
- Too much resolution may just be a waste of storage

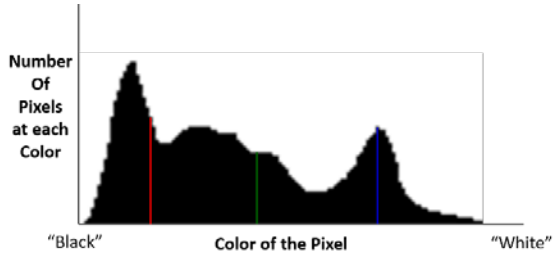
Aspect Ratio: Ratio of the height of an image to its width

- Inches or Pixels

Three **Image Types** can be created:

- **Black and White**
    - **Threshold** – determines the line between Black and White
    - Creates small files
    - OK for lines and text: Not so good for images
- **Color**
    - Most commonly used Image Type
    - Colors stored as Red, Green and Blue components
    - 24-bit color depth
    - 48-bit color depth – Not used much by hobbyists
- **Gray Scale**
    - Equal amounts of Red, Green and Blue
    - Better image quality than Black and White, smaller than Color
    - 8-bit color depth
    - 16-bit color depth – Not used much by hobbyists

Histogram – a count of the number of Pixels at each color



Consider the Source: Not all images are created equal

- **Negatives**, **Slides** and *photographic* **Prints**
  - They have a LOT of resolution
  - They can be:
    - Scanned at high resolutions and
    - Used to create relatively large images.

- Pictures from **newspapers**, **magazines** or printed on **modern printers**
  - They do NOT provide much resolution
  - Scanning at high resolutions creates large, accurate images of poor quality pictures
  - They can NOT be enlarged much

File Formats

- Lossy
- Lossless

TIFF: Tagged **I**mage **F**ile **F**ormat

- Lossless
- Has been format of choice for digital archivists and preservationist for many years
- Disadvantages:
  - Creates large files
  - Many browsers cannot display TIFF formatted images

JPEG: Joint **P**hotographic **E**xperts **G**roup

- Lossy
- Widely used: Supported by every browser I am aware of
- The compression algorithm saves information about groups of pixels
- The degree of compression can be varied
- The compression is performed every time the file is saved
  - Causes additional loss every time the file is saved
- Does NOT support *transparent images*

PNG: **P**ortable **N**etwork **G**raphics

- Supports *transparent images*
- Performs lossless compression (make its files smaller)
- Supported by every browser I am aware of

File Size Comparison

	TIF	PNG	JPG
600 dpi, 24-bit color depth	70 MB	30 MB	10 MB
Savings compared to TIF:		-57%	-85%

	TIF (MB)
300 dpi, 24-bit color depth	18
600 dpi, 24-bit color depth	70
2400 dpi, 24-bit color depth	1125

Digital Cameras

- Most create JPG image files
- Higher end cameras will also create a **Raw** format
  - This is essentially a TIF format
- You can use software compatible with your camera to read and convert RAW to JPG, TIF and other file formats

Metadata

- Information about the image
- Embedded in the file with the digital image data

Image Type Conversion

- Best to go from lossless to lossy
- You can save a TIF (or PNG) image as a JPG
  - The JPG file will be a lower quality image
- You can also save a JPG as a TIF or PNG
  - The TIF (or PNG) will have the same (lower) quality as the JPG

Recommendations

- Use TIF of PNG when digitizing important/significant images
  - Make JPG copies and use them on social media
- If JPG is all you have:
  - Make a master copy
  - NEVER edit/save it
- Work with a copy of the master if you need to edit it

Monitors

- They display colors accurately
  - Each pixel has red, green and blue sub-pixels
- Resolution (pixels per inch)
  - Typical: 90 – 185 pixels per inch

Printers

- Black and white printers actually print in one color: black
  - The "White" is actually the color of the paper
- They print shades of gray in patterns (called halftones).
  - More dots => darker
  - Fewer dots => lighter
- For a 1200 dpi Printer
  - A 4 x 4 group can be used to create 16 shades of gray
    - White (no black dots)
    - Black (16 black dots)
    - The Effective Resolution: **300 Pixels per inch** (1200 / 4 = 300)
  - A 6 x 6 group can be used to create 36 shades of gray
    - White (no black dots)
    - Black (36 black dots)
    - More Shades
    - The Effective Resolution: **200 Pixels per inch** (1200 / 6 = 200)
- Color printers create colors by printing primary colors
  - Red, Blue and Yellow
  - Black is also used
  - The human eye 'averages' them together allowing us to see the intended color
  - This also lowers the effective resolution since the printer must print several different dots to create the desired color

Printing Recommendation

- 300 pixels per inch is a good target to use when printing images
- Remember: This is the number of **pixels for each inch** of the image when it is printed.
  - You need to take this into account when you scan the image

Example Problem

- Scan a 0.8" x 1.3" Photographic Slide and create an 8" x 10" picture
- Want 300 pixels for each inch on the enlarged image

- Solution
  - 300 Pixels x 8 inches = 2400 pixels required (Minimum)
  - 0.8 inches / 2400 Pixels per inch = at least 3000 Pixels per inch scanner setting
    - Will use 3200 Pixels per inch setting
  - Will need to crop the sides of the image to make it fit into the frame due to the different aspect ratios:
    - Slide Aspect ratio: 1.5:1
    - 8 x 10 Aspect ratio: 1.25:1

References/Resources

- **A few scanning tips** – A website created by Wayne Fulton. This in an excellent resource for basic information about digital images. Recently the emphasis has expanded to digital photography.

  http://www.scantips.com

- **Wikipedia** – Comparison of graphic file formats

  https://en.wikipedia.org/wiki/Comparison_of_graphics_file_formats

- **Epson Technical Brief** - Discusses image quality, performance and flexibility of Epson scanners. This is a good overview of technical aspects of scanner design and operation.

  https://files.support.epson.com/pdf/exp16_/exp16_ts.pdf

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