SCANNING & HALFTONES

Ethics
It is strongly recommend that you observe the rights of the original artist or publisher of the images you scan. If you plan to use a previously published image, contact the artist or publisher for information on obtaining permission.

Scanning an Image
Scanning converts a continuous tone image into a bitmap. Original photographic prints and photographic transparencies (slides) are continuous tone. The scanning process captures picture data as pixels. Think of a pixel as one tile in a mosaic.

Bitmapped images
Three primary pieces of information are relevant to all bitmapped images.
1. Dimensions Example: 2" x 2"
2. Color Mode Example: 256 level grayscale scan
3. Resolution Example: 300 ppi

Basic Steps of Scanning
1. Place image on scanner bed
2. Preview the image
   – click Preview
3. Select area to be scanned
   – drag a selection rectangle
4. Determine scan resolution (dpi or ppi)
5. Determine mode or pixel depth (grayscale, color, line art)
6. Scale selected area to desired dimensions (% of original)
7. Scan

Resolution
Resolution is the amount of something.

<table>
<thead>
<tr>
<th>something</th>
<th>amount</th>
<th>amount over physical distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>fabric</td>
<td>the number of stitches in fabric</td>
<td>the number of stitches per inch in a needlepoint</td>
</tr>
<tr>
<td>film</td>
<td>the amount of grain in film</td>
<td>the number of grains in a micro meter in film</td>
</tr>
<tr>
<td>digital image</td>
<td>the number of pixels</td>
<td>the number of pixels per inch in a digital image</td>
</tr>
</tbody>
</table>

Resolution is a unit of measure:

- **Input Resolution** the number of pixels per inch (ppi) of a scanned image or an image captured with a digital camera
- **On Screen Resolution** the number of pixels per inch displayed on your computer monitor (ppi or dpi)
- **Output Resolution** the number of dots per inch (dpi) printed by the printer (laser printer, ink jet printer, imagesetter)

dpi or ppi refer to square pixels per inch of a bitmap file.
The two terms are often used interchangeably although ppi more accurately describes scanning and image resolution. dpi more accurately describes the resolution of printing devises such as laserprinters or inkjet printers.

<table>
<thead>
<tr>
<th>ppi</th>
<th>pixels per inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>dpi</td>
<td>dots per inch</td>
</tr>
</tbody>
</table>

Pixel Depth

<table>
<thead>
<tr>
<th>Type of Scan</th>
<th>Bit depth</th>
<th>Amount of Color</th>
<th>Common Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>line art</td>
<td>1-bit (2^1)</td>
<td>two values, black &amp; white</td>
<td>to scan pen &amp; ink drawings</td>
</tr>
<tr>
<td>grayscale</td>
<td>8-bit (2^8)</td>
<td>256 levels of gray</td>
<td>to scan black and white photographs</td>
</tr>
<tr>
<td>color</td>
<td>8-bit (2^8)</td>
<td>256 colors</td>
<td>low quality color, web graphics</td>
</tr>
<tr>
<td>color</td>
<td>24 bit (2^24)</td>
<td>16.7 million colors</td>
<td>high quality color</td>
</tr>
</tbody>
</table>
**Desired Resolution**

Your desired resolution must evaluate many variables. Knowing how and where your image will be reproduced is important. “Preflighting” is a term used to describe working closely with other service providers (scanning, film preparation, proofing, printing) to determine what procedures and specifications are necessary to achieve your desired quality level.

Variables Include:
- Will the image be displayed on a computer monitor or used for printed material?
  - Computer Monitor= web graphics, interactive multimedia, kiosks
  - Printed Material= flyers, brochures, newspaper and magazine advertising
- What quality of print reproduction are you seeking?
  - Duplicating= photocopy of a laserprint
  - Low-end print= quick printing (low quality offset lithography)
  - Medium-end print= offset lithography or digital printing
  - High-end print= quality offset lithography
- What type of digital printer will you use for proofing?
- What are the requirements of your commercial printer?
- What type of paper or material will you be printing on?

<table>
<thead>
<tr>
<th>Display or Print Output</th>
<th>Scanning dpi</th>
<th>Halftone lpi</th>
</tr>
</thead>
<tbody>
<tr>
<td>web graphics</td>
<td>72</td>
<td>does not apply</td>
</tr>
<tr>
<td>laserprinter</td>
<td>150</td>
<td>default of laserprinter</td>
</tr>
<tr>
<td>dye sublimation printer</td>
<td>200</td>
<td>does not apply</td>
</tr>
<tr>
<td>ink jet printer</td>
<td>200</td>
<td>does not apply</td>
</tr>
<tr>
<td>imagesetter for newspaper</td>
<td>170</td>
<td>85- 100</td>
</tr>
<tr>
<td>imagesetter for offset press</td>
<td>300</td>
<td>150+</td>
</tr>
<tr>
<td>Direct to Press</td>
<td>300</td>
<td>250+</td>
</tr>
</tbody>
</table>

**Resolution of Printed Images**

Grayscale images (a grayscale scan of a black & white photograph) need to be broken down into halftone dots for output from a laserprinter or for reproduction in a newspaper. Why? Because newspapers only use black ink and laserprinters only use black toner. Grayscale pixel information is automatically converted to halftone dot information when sent to the laserprinter. The dots, called "halftone dots" produce the illusion of gray values found in the original photograph.

- dots per inch = dpi
- Typical measure of the output resolution produced by printers
  - laserprinters= 600 dpi
  - inkjet printers= 1200 dpi
  - imagesetters= 2450 dpi
- lines per inch = lpi
- A measure of frequency of a halftone screen
  - lpi refers to the frequency of the horizontal and vertical lines in a halftone screen.
  - The higher the lpi, the finer the halftone screen.

**Resolution of Computer Monitors**

Macintosh computer monitors are generally 72 or 75 dpi. PC monitors are about 95 dpi.

What happens when you view a 150 dpi image on a 75 dpi monitor?
At 100% viewing size, the monitor will want to show you every pixel in the image, therefore your image will display 4 times larger. (2 times larger in each direction)
Scaling
Determine your desired resolution and scale the image to size when you scan.
Resizing your image at a later time could produce undesired results.

Resizing an Image
Changing an image’s resolution by adding or subtracting pixels from the image is called resampling.
Resampling down (decreasing the resolution) deletes information. Original pixel data is lost.
Resampling up (increasing the resolution) adds pixel information by interpolation. An image often appears out of focus after you resample up.

Vocabulary
Continuous Tone:
An image containing gradient tones from black to white.
Example: A black and white photographic print made from a 35mm negative.
A grayscale scan of a black & white photograph.

Grayscale:
The depiction of gray tones between black and white.
Example: A grayscale scan of a photo.
Scanning as grayscale is the breaking down of a continuous tone image (such as a black and white photograph) into pixels where each pixel has a mathematical gray value. Grayscale images are converted into halftone dots when printed on a laserprinter.

Line Art:
An image void of gray values.
Example: A pen and ink drawing.
A pen and ink drawing scanned as line art (pixel information is either black or white, containing no gray values).

Halftone:
A pattern of dots of different sizes used to simulate a continuous tone photograph.
Example: A photograph reproduced in a newspaper.
A grayscale photograph printed on a laserprinter.
Halftoning is the breaking down of a continuous tone image (such as a black and white photograph) or a grayscale image (a photograph scanned as grayscale) into halftone dots (black cells of various sizes) so the image can be reproduced. By halftoning a grayscale image you create the illusion of continuous tone by printing black cells that vary in size depending on how dark an area is.

Resolution:
A unit of measure.

Scaling:
Changing size without changing ratio of dimensions.

Cropping:
To eliminate certain areas of an image.

Reflective copy:
Art such as a drawing or photograph that must be scanned on a flatbed scanner.

Transparent copy:
Art such as a photographic slide or 4" x 5" transparency that must be scanned using a transparency scanner.

Image Size:
Describes the physical dimensions of an image.

Canvas Size:
The Canvas size command in Photoshop allows you to add work space, or extra canvas area, around an existing image without changing the dimensions of the image.