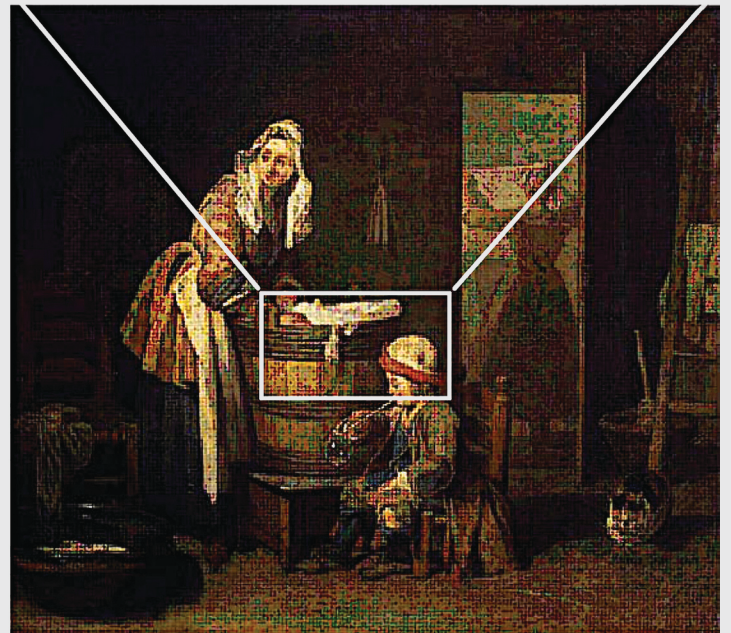
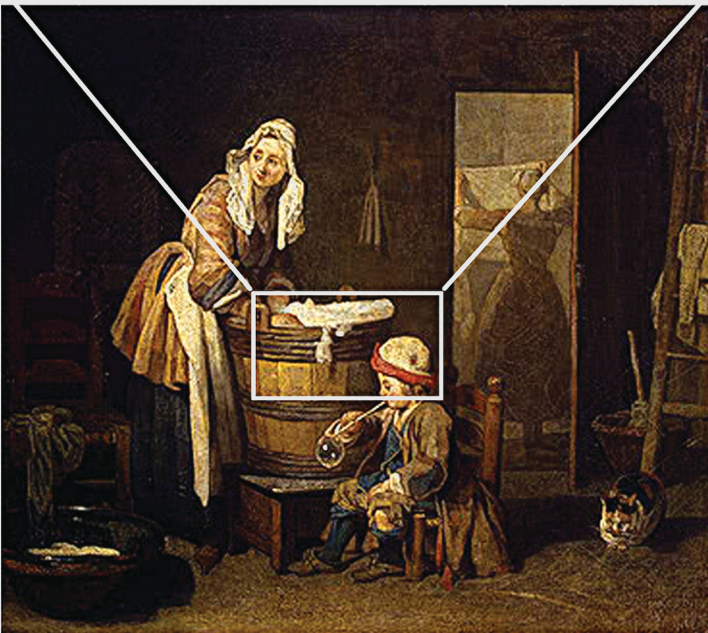


Resolution



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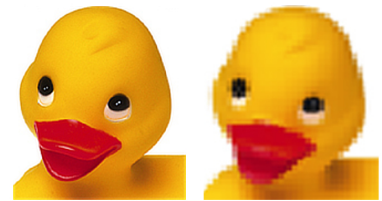
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Resolution

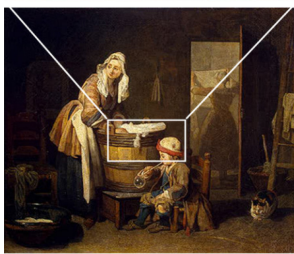
Resolution is the degree to which an image or device can record or reproduce detail. It is commonly stated as dpi, dots per inch, although more correctly, pixels per inch, ppi. High resolution images have more detail and are used for printing. Low resolution images have less detail and are common on the Internet.

Printing uses the pixels we see in the image. Obviously, if printed at this size, 72 dpi is inferior to 300 dpi.

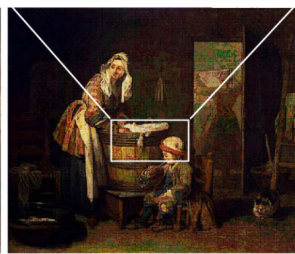


300 dpi
Hi res

72 dpi
Low res



Screen Capture



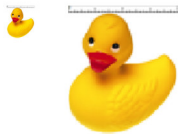
Print of Downloaded File

Most people look at an image on their monitors and do not see this problem because our video cards are incredibly powerful. On the left is an image as seen on the monitor, then I saved the image and printed it.

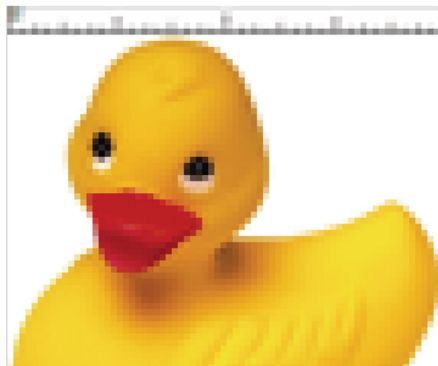
The printed image, left, and the low res duck, above, both show why resolution is important for printing.

Images can be referred to as being high resolution, 300 dpi and above, or low resolution, 72–96 dpi. I am not sure, in between, when low becomes high.

Absent the various methods of interpolation, called sampling, if you increase the resolution of an image, the size of the images goes down; if you decrease the size of an image the resolution goes up. This is what happens in Word or LibreOffice, InDesign or Affinity Publisher.



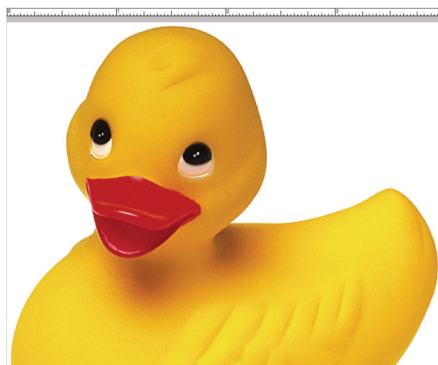
Resized
with no
sampling



All three images have the same file size: 37.9 KB. At 0.25" wide, the image is 300 dpi. At 1" wide it is 72 dpi, and at 4" wide it is 18 dpi.



Resized
with
sampling



All three images are 300 dpi, at the same dimensions as above. However the file sizes are vary: 37.9 KB, 309 KB, and 4.62 MB.

If you resize your images inside a word processor or page layout program, the resolution will change. So you should size your images in a graphics program to fit your work before inserting them. A little tweaking is usually okay. In most graphics programs you can resize your images, controlling the dimensions and the resolution if you enable sampling (sometimes called resampling or interpolation). Sometimes you will be given choices as to the sampling method:

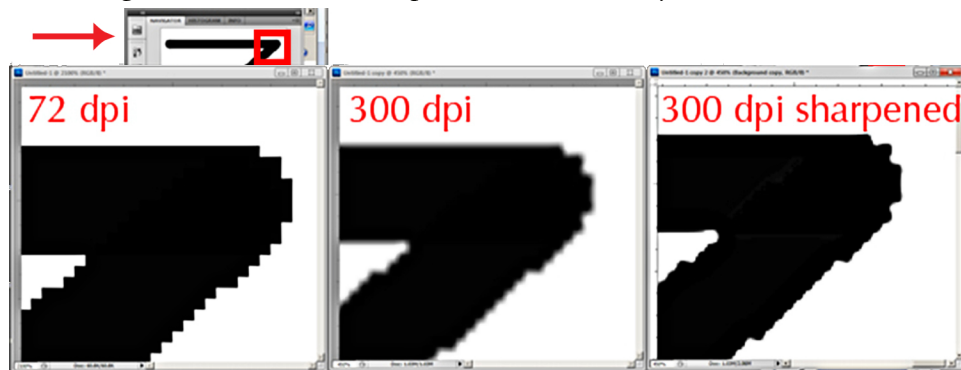
Nearest neighbor: is the simplest and fastest sampling method. Every pixel in the enlargement corresponds to one of the source image's. In effect, enlarging is similar to pixelization, in that it produces **jaggies** (the jagged edges on the low res duck on the previous page are called jaggies; see below). Reducing an image will result in some pixels being skipped, and their color may not appear in the reductions. However, because it is very sharp, there are images where nearest neighbor is ideal, e.g., I use it often for screenshots of applications with text.

Bilinear: best for downsampling images (reducing).

Bicubic: best for upsampling images (enlarging). Slightly smoother than bilinear.

Lanczos: slightly sharper and smoother results. Of these, it is the slowest method.

When an image is enlarged (with sampling), the edges often soften. Some programs add a little sharpening when images are enlarged. Sometimes it isn't a problem. Sometimes you have to do a little sharpening:

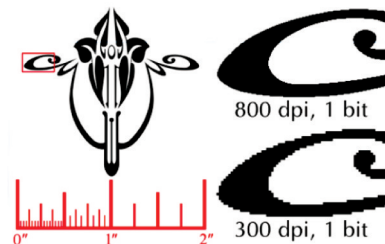


Would this softening be a problem? I don't know. But it could be, so you need to be aware of it.

One solution to jaggies is antialiasing. Aliasing is the term for some distortion or artifact when a signal is processed. In digital graphics, a common form of aliasing is jaggies: the stair-step edge of a diagonal or curved edge. Antialiasing is the name for a technique of adding intermediate tones to create the illusion of smoother lines. When making selections, most graphics programs offer selecting Antialiasing.



The first example, on page 3, the duck, was continuous tone (aka con-tone), that is, an image with gradients such as photographs or paintings. Line art is a different kind of artwork. As the name says, it is art made up of lines. While text isn't called line art, it is a perfect example. On the right, 300 dpi is insufficient to remove jaggies and smooth the edges. Most printers suggest 600 dpi, but in tests, I found that 800 dpi is a tad smoother. Over 800 and the irregularities in the edges is due to the paper fibers.



What you can see in these examples is that increasing (upsizing) the resolution of line art or art with line art, for example, text over a continuous tone image, benefits from being between 600 dpi–800 dpi.

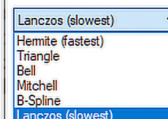
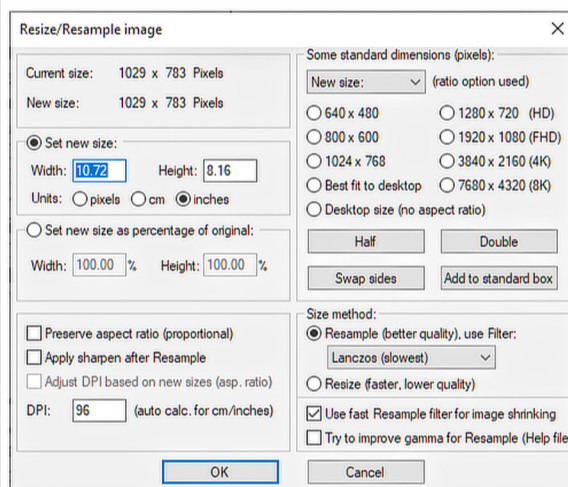
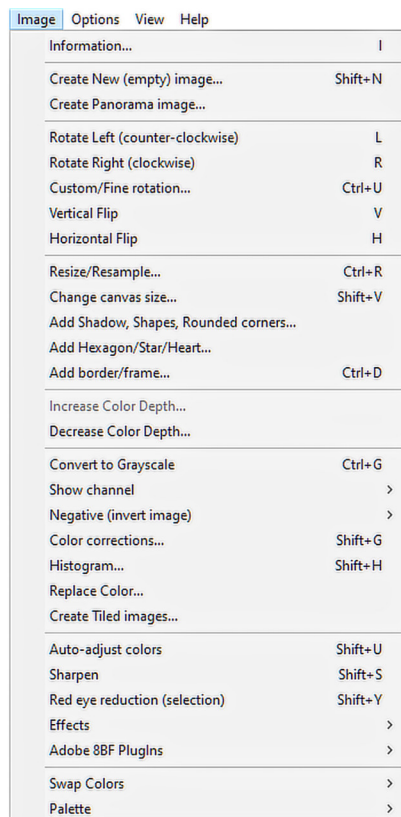
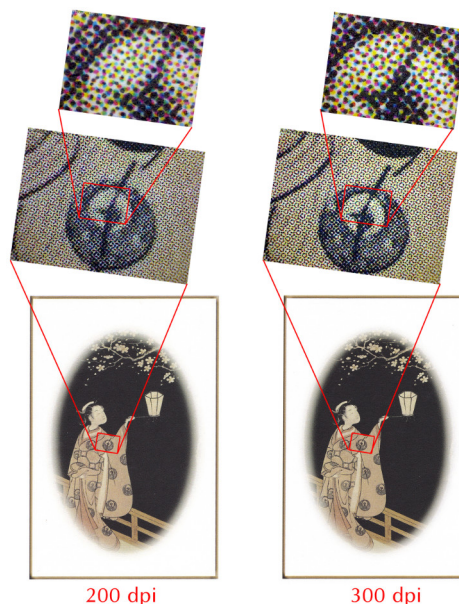
In other words, although there is a distinction between continuous tone images and line art, in terms of

resolution, the distinctions are very much unique to the images themselves. Inasmuch as there is no penalty for file size, unless you approach the minimums (650 MB for KDP, 1.5 GB IngramSpark), I recommend erring on the side of too high a resolution rather than too low. There are no consequences of too much resolution—what cannot be printed cannot be printed, halftone screening is the great limiter.

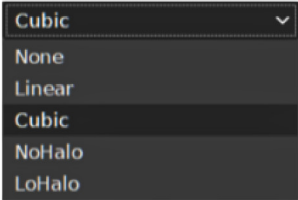
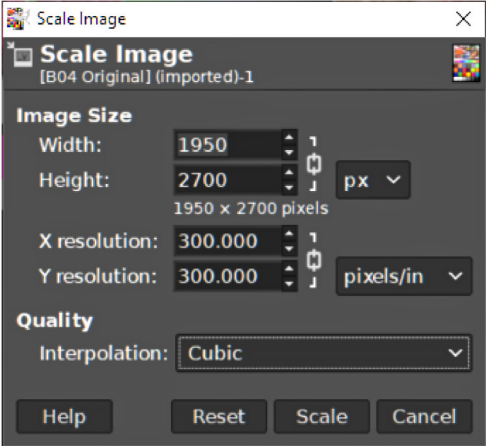
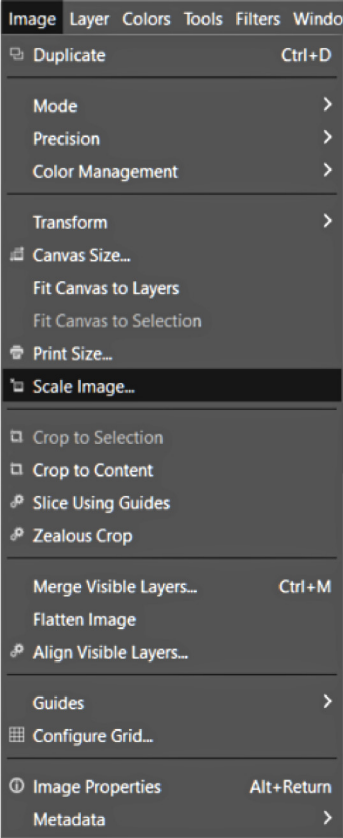
Having said that continuous tone images should be 300 dpi, line art should be 600-800 dpi, and images with text, should probably be 600-800 dpi too . . . There is often flexibility. Here are scans of the same image printed at 200 dpi and 300 dpi. In the original printed pieces, the 200 dpi version looks a tad better. But do not assume, therefore, that you have carte blanche to do whatever you want. You should adhere to the recommendations because, on the whole, they work best.

There are many more things that can be done to improve print quality. However, the thing to understand from the beginning is that resolution is important, and merely taking a picture with your cellphone, downloading an image from the Internet, or making a scan does not mean it has the right resolution.

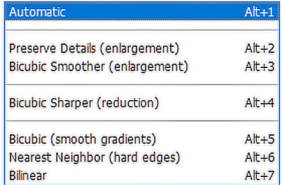
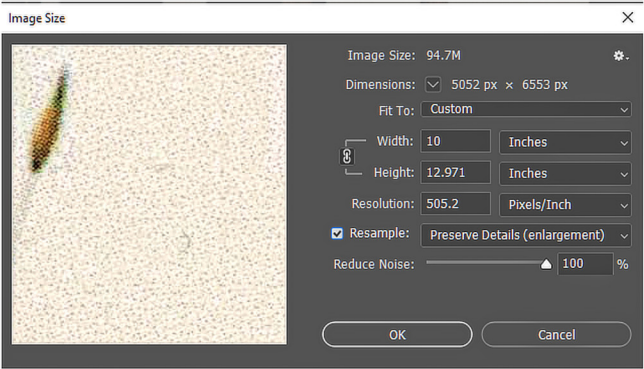
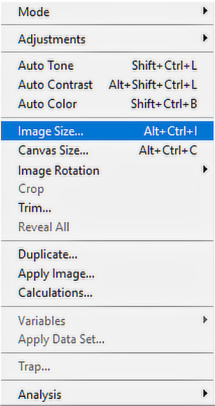
Open your images in a graphics program. If you are only checking the resolution or adjusting it and the dimension, you can use a free, small program like XnView or IrfanView. Both programs do more than just resized images, but a lot less than programs like Affinity Photo, GIMP, or Photoshop.



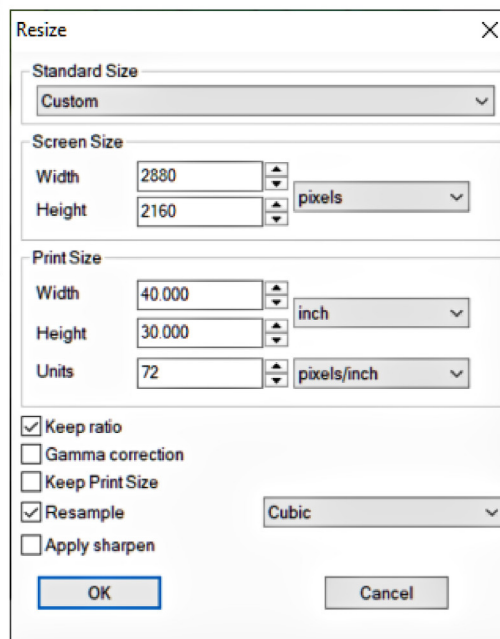
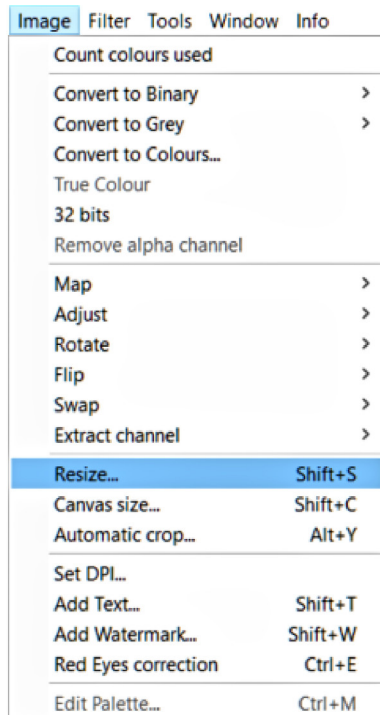
IrfanView



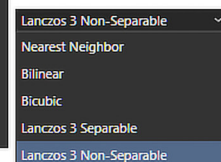
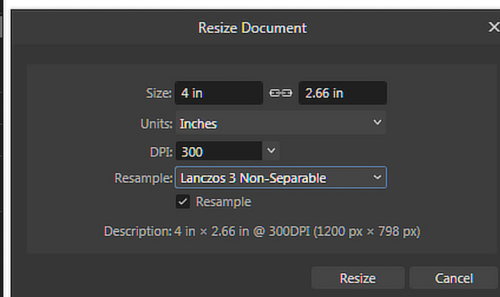
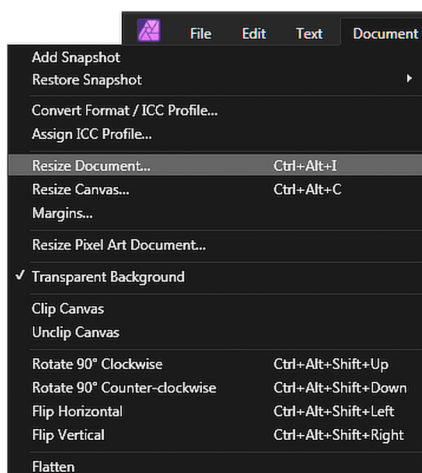
GIMP



Photoshop (with detail of an image)



XnView



Affinity Photo

When you see the chain link between the width and height, that means the width and the height will change proportionally. This is the most common setting. You can click on the link to break it. Then you adjust the width and the height separately.

Set the unit of measurement to the most comfortable, usually inches/mm or pixels.

The sampling methods tend to go from fastest to slowest. Nearest Neighbor, the fastest, will enlarge the jaggies. The slowest generally produces the most realistic enlargement. Sometimes the advantages are unclear, so test things and compare different settings.

Odds and Ends

Every image is different. What works best for one might not work for another. Most advice about image preparation has to be general.

Images “never” get better when commercially printed. Some image preparation is generally necessary. High resolution doesn’t guarantee your images will print perfectly, but it’s a good place to start.

Just because your images look good on your monitor doesn’t mean they will print well: resolution and sharpness are important.

If you are using Photoshop or Affinity Photo, you can use adjustment layers, or, for filters in Photoshop, Convert for Smart Filters will give you the same ability to set and reset the filter(s). These permit making and remaking changes. When the image looks the way you want, export it to JPG, highest quality, lowest compression.

Sometimes adding a Levels or Curves adjustment assists in enhancing the images when you are enlarging and sharpening.

Do not over sharpen. Over sharpening causes halos, white fringing around objects. The following example is perhaps more extreme than normal over sharpening, but the halos would be there nonetheless.



There are a few sharpening methods worth knowing about.

Unsharp Mask: this is the most common method. Generally, you select a small Radius 1 px–3 px, usually use 1; and the Amount is between 150%–300%. Keep threshold to 0%.

Hiraloam: this uses unsharp mask, but the settings are Radius 10 px–12 px; Amount 40%–60% (high radius low amount). It is hard to over sharpen in this range. It tends to be my first choice.

HighPass: this requires using blending modes (overlay, soft light, hard light, etc.).

Sharpening can be done selectively, with selections. It can also be adjusted by using the opacity slider. I will often use several methods on one image, including selections, opacity changes, etc. A lot depends on the image.

For print books, always order a printed proof. KDP offers printed proofs. At the time of this writing, IngramSpark (IS) does not. However: IS recommends ordering a printed copy as soon as the book is available. KDP and IS offer digital proofs.

While none of this is difficult, it is surprising how many people do not think their images need to be 300 dpi, and then complain about the quality of printing.