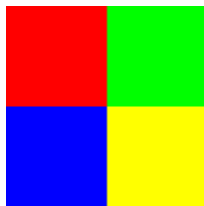# Pixel

Computers can process information essentially only in form of numbers. While internally stored as binary numbers, the quantization in this fashion goes for basically **everything** computers process. This makes it necessary to chose one of two approaches to describe image contents: Either the content is describable by some sort of formula (vector graphics), such as defining on point of the surface as the center of a circle, and the image consists of one circle with a given radius and color around that point. This is a rather sharp definition, that also a computer can work with. Or the image is described in form of fixed defined small areas with their color and opacity information. In any case, any location on the surface of an image must also quantized in order to make it possible to have a concept of a location or an area. Usually this is done in a very similar fashion as is done for the well-known game *sinking ships*, in rows and columns of fixed height and width.

This means, the image is partitioned into areas, that can be addressed uniquely, similar to a mathematical coordination system. Usually that means squares, but the partitioning can also be in form of rectangles. Each sub-area resulting from that partitioning has exactly one color and maybe also one transparency value, all over that particular section. The entirety of these sub-areas with their unique colors and transparency values makes up the image. E.g. a simple square shaped image could be partitioned into four sub-squares, 2 in on direction, and 2 in perpendicular direction (usually referred to as x- and y-direction):

Each of the four squares is one pixel of the image. The size of a pixel (or actual number of pixels used for display here) is a different matter. While your display most certainly will use a whole lot more pixels than four to display the image above, the fact remains: The surface **of the image** could be **defined or described** totally accurately as a 2 x 2 grid of pixels, each with no alpha channel information, so therefore only 24 bit color information. It could then be zoomed just as big as here, with the very same result. The PNG file used here actually has a quantization of 100 x 100, giving the size of 50 x 50 for each sub-square. So one image may be described differently in various so-called resolutions, depending on the case, maybe even with the very same net-result. For vector-graphics (such as EPS or SVG) this never loses actual information for the graphics in any case (even if the result of low-resolution may be lacking any aesthetic value). The information is stored in the formula, that is to be used to derive the actual contents the computer is to **calculate** from it. and they are calculated for a given rasterization/partitioning for display, the so-called resolution. The actual image can be re-rastered and then recalculated any time for any resolution, as the image is described by a formula.

Actual raster graphics (such as a PNG) have a fixed raster information, with color (and opacity) information for each pixel. Re-reastering such an image will never increase the level of detail. At worst it will be a loss of detail, that cannot be recovered from the result later. A lowering of the resolution (rougher partitioning) essentially means, less information available for describing the image. Lessening the information means, the information is lost permanently. So the number of pixels used for describing a raster image is crucial for its quality. Once set, it can never be increased without some sort of »guessing« (e.g. extrapolation, interpolation, AI tools). A further decrease is always

possible.

Note: While a pixel is actually an area of an image (having with and height) the term *pixel* is very often also used for refer to the dimensions of an image. So the above described image has the size of 100 pixels x 100 pixels. This works well of practical reasons. But the reality is, the PNG image used above actually has 10'000 pixels. So it is important to know, what is referred to as *pixel*, the dimensions of the image, or the actual number of pixels making up the image.

The three-dimensional pendant of the pixel is the voxel. The same principles apply, just adding one more dimension to the two.

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