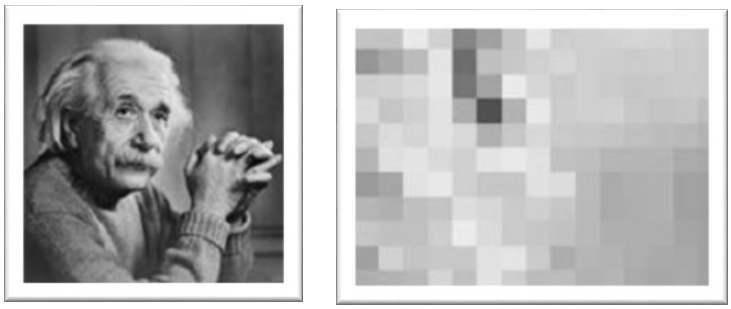
Image Compression

A digital image is a rectangular array of dots, or picture elements, arranged in *m* rows and *n* columns. **The expression *m*×*n* is called the *resolution* of the image**, and the dots are called *pixels* (except in the cases of fax images and video compression, where they are referred to as *pels*). The term "resolution" is sometimes also used to indicate the number of pixels per unit length of the image. Thus, (**dpi**) stands for dots per inch. Or expressed in the number of pixels per inch (**ppi**).

Pixels

Images are all around us. We see them in color and in high resolution. Many objects (especially artificial objects) seem perfectly smooth, with no jagged edges and no graininess. Computer graphics, on the other hand, deals with images that consist of small dots, pixels. The term pixel stands for "picture element".



In the above picture, there may be thousands of pixels that together make up this image. We will zoom that image to the extent that we are able to see some pixels division. The value of the pixel at any point denotes the intensity of image at that location, and that is also known as gray level. Each pixel can have only one value and each value denotes the intensity of light at that point of the image.

We will now look at a very unique value 0. The value 0 means absence of light. It means that 0 denotes dark, and it further means that when ever a pixel has a value of 0, it means at that point, black color would be formed. Have a look at this image matrix

0	0	0
0	0	0
0	0	0

Total no of pixels = total no. of rows X total no. of columns. = 3 X 3= 9. It means that an image would be formed with 9 pixels, and that image would have a dimension of 3 rows and 3 column and most importantly that image would be black.

Image Types

A bi-level (or monochromatic) image: This is an image where the pixels can have one of two values, normally referred to as black and white. Each pixel in such an image is represented by one bit, making this the simplest type of image.

A grayscale image: Grayscale is a range of monochromatic shades from black to white. Example of grayscale image 8-bit gray image
$2^8 = 256\, range\ of\ black\ and\ white\ color.$

A continuous-tone image: This type of image can have many similar colors. A continuous-tone image is normally a natural image and is obtained by taking a photograph with a digital camera

A discrete-tone image

There are compression methods for bi-level images, for continuous-tone images, and for discrete-tone images. There are also methods that try to break an image up into continuous-tone and discrete-tone parts, and compress each separately.

Image format

There are **5 main formats** in which to store images

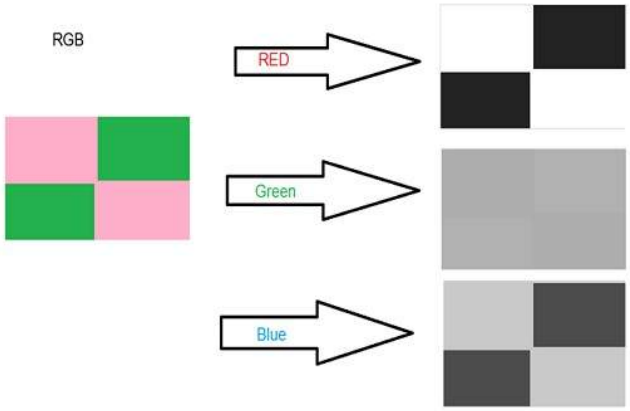
1- **TIFF** stands for Tagged Image File Format. TIFF images create very large file sizes. TIFF images are uncompressed and thus contain a lot of detailed image data
2- **JPEG** stands for Joint Photographic Experts Group. JPEG files are images that have been compressed to store a lot of information in a small-size file.
3- **GIF** stands for Graphic Interchange Format. GIFs also have an extremely limited color range suitable for the web but not for printing.
4- **PNG** stands for Portable Network Graphics. It's used almost exclusively for web images, never for print images. For photographs, PNG is not as good as JPEG, because it creates a larger file.
5- **Raw** image files contain data from a digital camera (usually). The size of a raw file is extremely large. Usually they are converted to TIFF before editing and color-correcting.

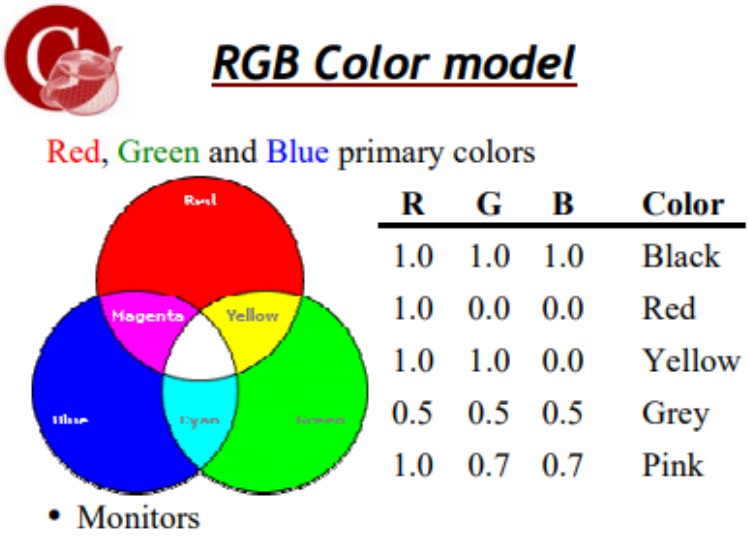
Color spaces

Color spaces are **different types of color modes**, used in image processing and signals and system for various purposes. Some of the common color spaces are:

- RGB
- CMY'K
- Y'UV
- YIQ
- Y'CbCr
- HSV

RGB: The RGB model defines a color by giving the intensity level of red, green and blue light that mix together to create a pixel on the display Each color image is actually formed of three different images. Red image, Blue image, and black image. A normal grayscale image can be defined by only one matrix, but a color image is actually composed of three different matrices. The intensity of each color is from 0 to 255.





CMYK: An alternative model to the RGB model is the CMYK model, which is used for color printing. This model uses the colors cyan (C), magenta (M), yellow (Y) and black (K).

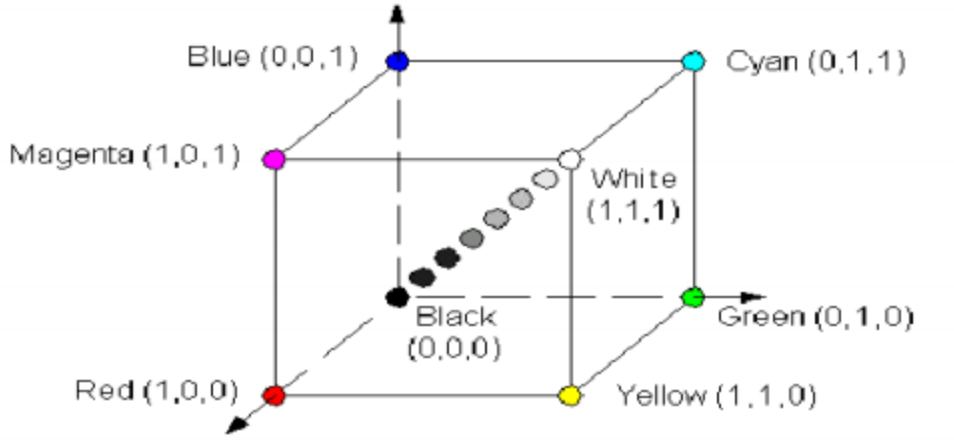
Cyan = Blue+Green. (0,1,1)

Magenta =Blue+Red. (1,0,1)

Yellow =Red+Green (1,1,0)

RGB Color cube

We can represent RGB and CMYK colors as a cube tone.



Complementary colors are easily calculated by subtracting the Color values from 255 or from 1. For example, the color (0, 0,255) is a pure blue tone. Its complimentary color is:

(255-0, 255-0,255-255) = (255,255,0) or (1,1,0) which is yellow.

Adavntage of cymk color model:

- It is used for printers.
- It is used for commercial color printing (book, journals).
- Less color processing and more productivity.
- Most devices that deposit colored pigments on paper, such as color printers and copiers, require CMY data input or perform an RGB to CMY conversion internally. This conversion is performed using the simple operation

$$\begin{pmatrix} C \\ M \\ Y \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} - \begin{pmatrix} R \\ G \\ B \end{pmatrix}$$

Or

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 255 \\ 255 \\ 255 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$