## Bitmap Graphics

Bitmap images are made up from tiny dots called **pixels** (picture elements). Each pixel has a colour associated with it. An image can then be constructed from many of pixels which will have different colours arranged in rows and columns.

File Dimensions

Total number of pixels = height x width
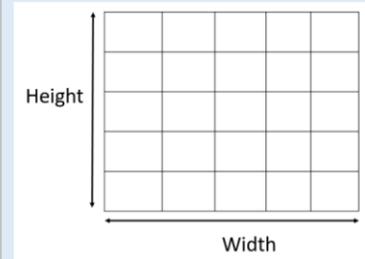
Colour depth is the number of bits used to represent each pixel in an image. A black and white image has two colours. Each pixel can be represented by a single bit where 0 is black and 1 is white.

To represent more colours we can use more bits. For instance if we have 2-bits we can represent 4 colours because we know have 4 binary code combinations (00, 01, 10, 11) where each code represents a different colour.

If we want to have 8 greyscale colours between black and white we will need 3 bits per pixel i.e. 2^3.

With 8 bits we can represent 256 ($256=2^8$) colours (or different shades of grey)

Image resolution is the number of pixels per area of image and is often given in dots per inch (DPI). The more pixels the better the quality of the image. Lower resolution images may be pixelated.

Low resolution image, pixilation is clearly evident	*High resolution image, quality is much better*

Pixilation occurs when the image is overstretched. In these situations, the image has a blocky and blurred appearance. This arises when the image is presented at too large a size and there are not enough pixels to reproduce the details in the image at this larger size.

2-bit image with corresponding values	00 black 10 light grey 01 dark grey 11 white 01 11 00 00 11 01 11 00 00 11 11 10 11 01 11 11 10 11 01 11 00 00 00 01 11
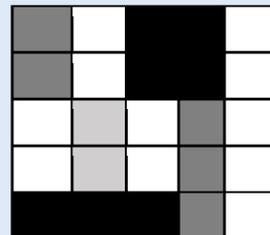
Metadata is information about the images and is stored within the image itself. Metadata includes information on the:
- dimensions such as width and height
- colour depth in bits
- Resolution

The size of a bitmap image as stored on a file is calculated by multiplying the length, width and colour depth of the image.

File size in bits = width x height x colour depth (number bits per pixel)

File size in bytes = (width x height x colour depth) / 8

Worked Example
If the width of a bitmap image is 1000 pixels, the height is 2000 pixels and the colour depth is 8 bits, estimate the size of the image in Mbytes.

Total number of pixels: 1000 X 2000 = 2,000,000
Colour depth is 8 bits = 1 byte.
The size of the file is: 1 X 2,000,000 bytes
To convert to Mb we divide by 1,000,000
The file size in Mb is: **2Mb**

Vector Graphics

Vector graphics are made up of primitive shapes such as point, lines and polygons. Complex shapes can be constructed by combining basic primitive shapes.

Vector graphics are scalable meaning whatever size the images are represented at they do not lose their quality like bitmap graphics.

Vector graphics are made up of lists of primitive shapes that have various properties.

Note how the graphic below is made up of different shapes.
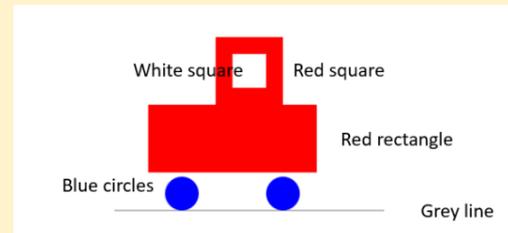
The properties of the shapes are stored in a list.
```
rect width="80" height="80" x="150" y="70" fill="red"
rect width="40" height="40" x="170" y="90" fill="white"
rect width="200" height="80" x="70" y="150" fill="red"
line x1="30" y1="275" x2="350" y2="275" stroke="grey"
circle cx="110" cy="255" r="20" fill="blue"
circle cx="230" cy="255" r="20" fill="blue"
```

The properties include the size, position and colour of the object.

Properties for a rectangle		*Properties for a circle*	
`width="80"`	dimension	`radius="50"`	dimension
`height="80"`	dimension	`x="150"`	position
`x="150"`	position	`y="70"`	position
`y="70"`	position	`fill="red"`	fill colour
`fill="red"`	fill colour		

Properties for a point		*Properties for a line*	
`x="150"`	position	`x1="150"`	position
`y="70"`	position	`y1="70"`	position
`color="red"`	fcolour	`x2="100"`	position
		`y2="30"`	position
		`colour="red"`	colour
		`width="red"`	line width

Vector Versus Bitmap Graphics

	Bitmap graphics	Vector graphics
	Fundamentally made of pixels.	Made up of primitive shapes such as point, lines and polygons.
Advantages	Suitable for representing photographs of complex scenes with a multitude of colours, such as photograph of landscapes	Suitable for simple graphics with a limited range of colours such as logos and cartoons. Much smaller in size than bitmap graphics Vector graphics are scalable meaning that they retain their quality regardless of the scale at which they are viewed. Much better for editing. Can modify individual objects easily and supports layering in graphics packages.
Disadvantages	Pixilation occurs when the image becomes overstretched. The quality of bitmap image degrades as you zoom in.	Poor at representing images with lots of colours