Data representation

All data is represented as binary digits, whether it is numbers, text, images or sound. Calculations are also done in binary.

Units

In a computer, all data is stored in binary form. A binary digit has two possible states, 1 and 0.

A binary digit is known as a bit. A bit is the smallest unit of data a computer can use. The binary unit system is used to describe bigger numbers too.

Eight bits are known as a byte.

The binary unit system is as follows:

Size	Unit
8 bits	1 byte (B)
1,000 bytes (1,000 B)	1 kilobyte (KB)
1,000 kilobytes (1,000 KB)	1 megabyte (MB)
1,000 megabytes (1,000 MB)	1 gigabyte (GB)
1,000 gigabytes (1,000 GB)	1 terabyte (TB)
1,000 terabytes (1,000 TB)	1 petabyte (PB)

Four bits or half a byte is known as a nibble.

Analogue data and digital data

Analogue data is a real-life signal that can vary greatly in value. Examples include:

- sound waves
- pressure
- temperature

Digital data is binary data which represents analogue data. Computers work with digital data. Analogue data must be converted to digital before a computer can use it. A device known as an analogue-to-digital convertor (ADC) is used to generate digital data from analogue signals. In the same way, a digital signal can be converted back to an analogue signal using a digital-to-analogue convertor (DAC).

Binary and denary

Humans tend to use the denary number system. However, computers work in binary. Denary numbers must be converted into their binary equivalent before a computer can use them.

The denary system has ten digits (0, 1, 2, 3, 4, 5, 6, 7, 8 and 9). Each denary place value is calculated by multiplying the previous place value by ten.

How do digital images work?

A digital image is a picture that is stored on a computer. It has been digitised, which means it has been changed into a sequence of numbers that computers can understand.
There are a few ways you can make a digital image. You could create one in a piece of design software (like Paint or Photoshop), take one on a digital camera or scan one in using a scanner.

What is a pixel?

A 'pixel' (short for ‘picture element') is a tiny square of colour. Lots of these pixels together can form a digital image.
Each pixel has a specific number and this number tells the computer what colour the pixel should be. The process of digitisation takes an image and turns it into a set of pixels.

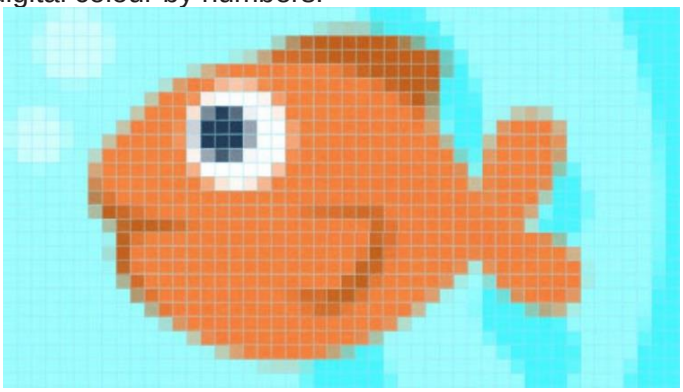
Seeing the big picture

Imagine a picture of a fish.

Lay a square grid over it.

Every one of the squares is a pixel. To store the picture, the computer simply records a number to represent the colour of each square. The more squares in the grid, the better the images will look.

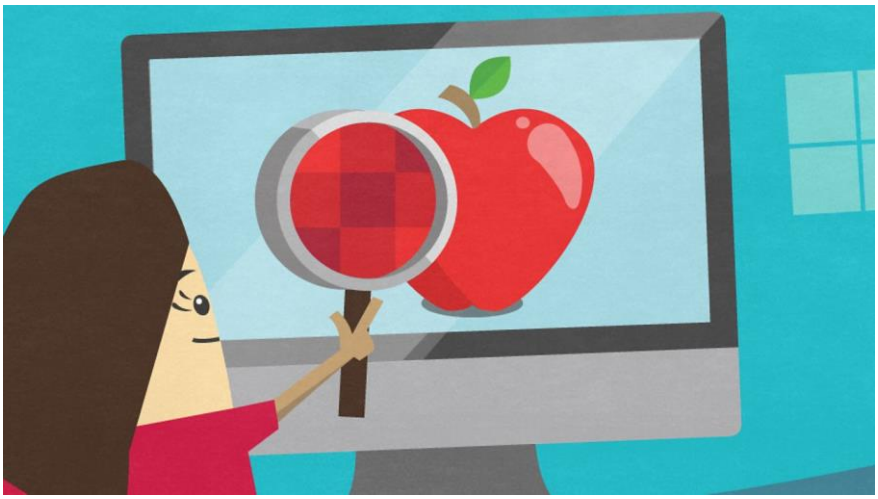
It works a bit like a digital colour by numbers.



How do pixels make up a display?

If you look closely at your computer monitor you will see that the screen is made up of millions of tiny squares.
Each one of those squares is a pixel and each pixel can be one of millions of different colours.

To display an image, the computer tells the monitor to show a particular colour for each of the pixels.



What is a bitmap?

A bitmap is a method for storing images using pixels. It is called a bitmap because it is a 'map' of where the 'bits' of information are stored.
This information is stored as a sequence of numbers defining the colour of each pixel.

In a simple black and white image, a bitmap just needs to know if a pixel is ‘on’ or ‘off’, which can be stored as 1 or 0. In a colour image we need lots of 'bits' (typically 24) to store the colour values of each pixel.

Bitmap is also the name for a common file format for saving images.
Find out how pictures can be represented in the form of binary digits.

Different types of image

Pixel images

Images can be saved in a number of formats, such as JPEG, TIFF, PNG and GIF. These formats all use pixels in some way to store the picture.

Vector graphics

Not all images use pixels. 'Vector' graphics are made up of lines, curves and shapes instead of pixels. Each part of a vector graphic is editable and they can be resized very easily.

Vector graphics are great for making diagrams or graphics. They can't normally be used to store photographic images.

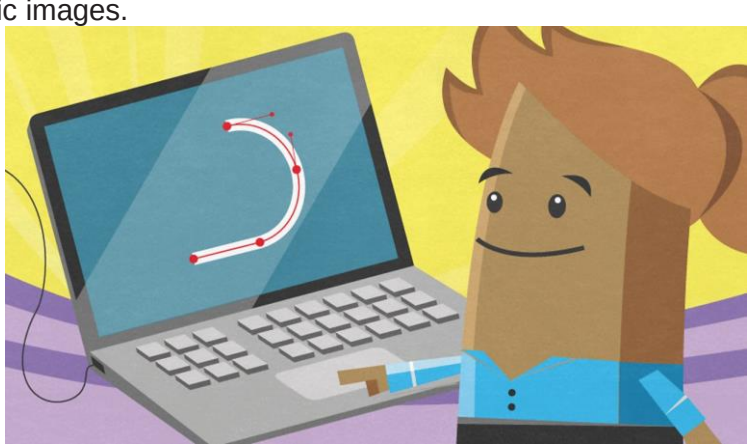


Image compression

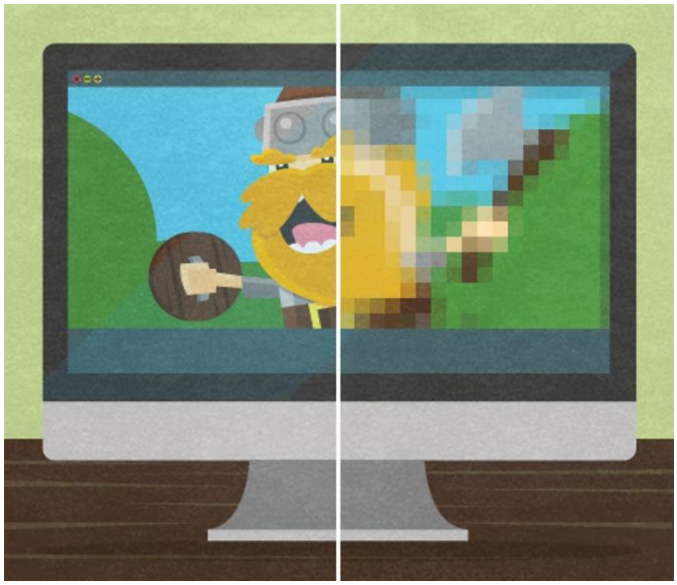
It is possible to 'compress' (squeeze) an image to reduce its file size. If an image has a smaller file size it will take up less room on your computer.
There are two types of compression, 'lossy' and 'lossless'.

Lossless compression

Lossless compression works by rewriting the data so it is stored more efficiently. The quality of the file will stay the same.

Lossy compression

Lossy compression works by removing some of the data. The quality of the file will be reduced.



Lossy compression means that the quality of your file will be reduced. The right side of this image has been saved using lossy compression and doesn't look as good as the left.