Storing Pictures

Pictures in computers need to be stored as ones and zeroes.

One way to convert an image so that it is made up of ones and zeroes is to split the image up into small squares. These squares are known as Pixels (short for Picture Elements). In the black and white image of the letter J below every black square is coded with a 1 and every white square as a 0. Each colour (black or white) requires one digit (1 or 0) to represent it. It is said to have a colour depth of 1.

All of the rows can then be written as one long line (see below)

000000000110011000000001100000010000100001111000000000000

and then stored in the computer. In order to display a picture stored like this correctly the computer needs to know that the picture has 8 rows and 8 columns and it can then use the information to split the data back up into rows and display a grid on the screen where the pixels labelled one are coloured black and the ones labelled 0 are coloured white.

Have a go at decoding the following 8x8 pixel picture

00000000011001100000000110000001000010000111100000000000

The number above has already been split into rows for you.

Create your own

Make up your own picture below and convert it to a line of ones and zeroes. Give this code to someone else and see if they can recreate your picture.

http://www.oxfordsparks.ox.ac.uk/content/what-machine-learning
Compressing Pictures
When storing pictures it is often useful to make them take up less space. There are a variety of different ways to do this.

One way to save space is to look for patterns and repeats in the data. For instance the code 00000000 could be represented as 8w for 8 lots of white or 80 (8 lots of zero). So this code

000000001111100001100000110000011000010110000111111111000000000

Could be written

9061402160214011102160214041110

This means 9 zeroes, then six ones, then 4 zeroes, then 2 ones etc

This method of shortening the stored digits is known as run length encoding or RLE. Note that none of the data has been lost, it can easily be turned back into a long list of ones and zeroes. This is known as a lossless data compression technique.

Shorten the number below using RLE.

00000000111110000110000011000011000010110000111111111000000000

Other methods of compressing pictures involve simplifying the pictures by reducing the level of detail or the number of colours. This is lossy data compression as the picture cannot be returned to the previous level of detail.

This may seem like a bad idea but our eyes might not be able to tell any difference between an image before and after compression. So a picture with thousands of almost identical shades of blue might be replaced with only hundreds of them.

Coloured Pictures
In order to store or transmit coloured pictures a similar process is followed, but rather than each pixel being recorded as a one or zero each colour is given a different binary code.

E.g. the picture below has been created using 4 colours where

00 = white 11=black 01=yellow and 10=red

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Each colour requires two digits (each a combination of 1 and 0). This means that a picture with 4 different colours is said to have a colour depth of 2.

How many colours could you use with a colour depth of 3?

Meta data
Meta data means data about data and is often needed by the computer to know how to display pictures correctly. For instance, an example of meta data for the picture above is that it is 8 pixels high, 8 pixels wide and has a colour depth of 2.

Additional meta data stored might include information about when and where the picture was taken as well as camera settings etc.