N5 Computing Science
Data Representation
Summary Notes

Units of storage

The following units are used when referring to file sizes or storage capacity.

- Bit – a single binary digit, 1 or 0.
- Byte – 8 bits, e.g. 10010001
- Kilobyte (KB) – 1024 bytes
- Megabyte (MB) – 1024 KB
- Gigabyte (GB) – 1024 MB
- Terabyte (TB) – 1024 GB
- Petabyte (PB) – 1024 TB

Storage of program instructions

Instructions are stored using the processor's own language called **machine code**. Different processors (or families of processors) use different machine code.

Positive integer storage

Every type of data in a computer system is stored using the binary number system, where 1 is represented by ON and 0 is represented by OFF.

Positive integers (whole numbers) can be represented as shown below.

Examples (8 bit)

128	64	32	16	8	4	2	1		
0	1	0	1	1	0	1	1	=	91
1	1	1	1	1	1	1	1	=	255
1	0	0	0	0	0	1	0	=	130

- The **range of numbers** that can be stored depends on the number of bits available in memory to store it.
- The highest number that can be stored in n bits is $\mathbf{2^n - 1}$
  (e.g. 8 bits can store values from 0 up to 2^8-1 = 256-1 = 255)

Real number storage

Real numbers (numbers with a fractional part) are stored using the **floating point** system, which stores the **mantissa** and the **exponent**.

Example

In the number $0.10100001 \times 2^{1011}$, the mantissa is 0.10100001 and the exponent is 1011.

Character storage

Text is converted into binary using a code, where each character is represented by a binary number.

- **ASCII** code converts each character into an 8 bit binary number.
  This allows for 256 different characters (2^8=256).

Graphic storage – bitmapped

A bitmap image is stored as an array of pixels, each number representing the colour of a pixel.

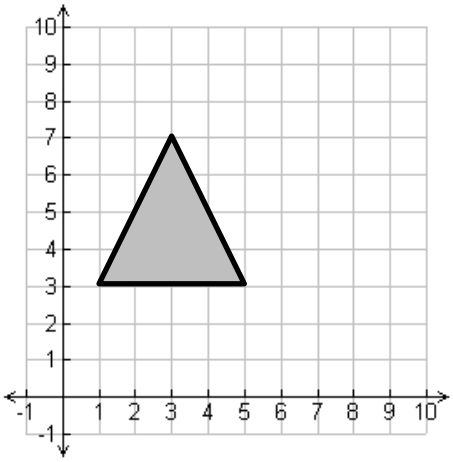
- If 2 bits are used then the graphic is a black and white image – 1 represents black and 0 represents white
- The number of bits used to store the colour of each pixel is known as the **bit depth**.
- RGB (red, green and blue) colour codes are created by using 8 bits for each of the three primary colours (red, green and blue)
- **True colour** uses 24 bits per pixel (16 777 216 colours)

Graphics storage – vector

Vector graphics are stored as a list of objects & attributes

Example

- polygon(x1, y1, x2, y2, x3, y3, fill colour, line colour)
- polygon(1, 3, 3, 7, 5, 3, grey, black) would draw the shape below



Bitmapped	Vector
Manipulate at pixel level.	Manipulate at object level.
Typically a larger file size.	Typically a small` file size
File size is affected by resolution of image.	File size increases as more objects are stored
File sizes are fixed regardless of detail in graphic.	
Becomes pixelated (blocky) when enlarged.	Can be enlarged without affecting quality (it is resolution independent).
Ideal for photos and realistic images.	Ideal for simple logos on websites, etc.

Factors that affect file size

- Resolution
- Colour/bit depth (number of colours used)

Standard File Formats

Standard file formats for graphics files are

File Format	Compression	Animation	Transparency	Colour Depth
JPEG	lossy	✗	✗	24 = 16777216 colours
GIF	lossless	✓	✓	8 = 256 colours
PNG	lossless	✗	✓	24 = 16777216 colours

Audio storage

Sound is stored digitally by sampling the original analogue sound.

- **Sampling** means taking measurements of the signal. This process of digitising sound means that quality will be lost.
- **Sample frequency** is the number of times each second that the sound is sampled. Sample frequency is measured in Hertz (Hz). A frequency of 1Hz means one sample per second. The greater the sampling frequency, the better quality the sound but the larger the file size.

Factors that affect file size & quality

- Sample rate – increasing the sample rate will increase the quality but this will also increase the file size

Standard File Formats

Standard file formats for audio files are

File Format	Compression	Quality	File Size
MP3	lossy	High	Small
WAV	lossless	High	Large