

# 1.2

# MEMORY AND STORAGE

**CONCISE NOTES**

**GCSE**

**OCR**

## 1.2.1 PRIMARY STORAGE

There are two main types of primary storage: RAM and ROM.

Random Access Memory (RAM)	Read-only Memory (ROM)
Holds the operating system, running applications, and associated data while the computer is on and in use.	Stores the bootstrap loader/BIOS to start the computer from scratch.
Volatile: Loses data when the power is turned off.	Non-volatile: Retains data even when the power is turned off.
Can be read from and written to by the computer.	Read-only: Cannot be written to by the computer during normal operation.
Temporary: Only while the computer is powered on.	Permanent: Data remains stored even when the computer is powered off.
If insufficient RAM, uses virtual memory by moving data to/from secondary storage temporarily.	N/A

When a computer runs complex programs or multiple applications simultaneously, there may not be enough RAM to store all the necessary data. In such cases, the computer uses a portion of secondary storage as an extension of RAM, known as **virtual memory**. It moves data not currently needed by the CPU from RAM to secondary storage and retrieves it back when required. This process allows the computer to handle more data than the available RAM alone would permit.

- Moving data between RAM and virtual memory is relatively slow – so using virtual memory slows down the performance of the computer.
- Adding more RAM reduces the need for virtual memory. If less data is held in virtual memory, then there are fewer slow data transfers between RAM and virtual memory. Therefore, adding more RAM improves the performance of the computer.

## 1.2.2 SECONDARY STORAGE

Secondary storage is needed to store files and programs. It needs to be: non-volatile, so doesn't lose data when switched off, low cost, high capacity and reliable.

Magnetic storage mostly uses hard disk drives (HDDs).

- They are made of a stack of magnetic disks (or platters) that rotate.
- A moving read/write head moves across the surface of the platters to read and write data.
- Magnetic disks are reliable and cost effective and provide high-capacity storage at low cost
- Not very portable due to having moving parts

Solid-state storage uses flash memory.

- Because they use flash memory, SSDs have no moving parts.
- No moving parts means access to data is faster than for a magnetic hard disk drive.
- No moving parts also means power requirements are low and no noise or heat is generated.
- SSDs are robust, lightweight and compact making them ideal for use in portable devices.
- SSDs have a smaller capacity than magnetic hard disk drives
- The cost per unit of storage is high.
- SSDs are commonly used in tablet computers, mobile phones

Optical storage devices use the properties of light to store data.

- The most common optical storage medium are optical disks – CDs, DVDs and Blu-Ray disks.
- They work by reflecting laser light onto the surface of the rotating disk and reading the reflections as 1s or 0s.
- Easily damaged by mishandling and scratches.

## 1.2.3 UNITS

Computers use switches to store data and these switches can be in one of two states: on or off. Because of this we need to convert all data and instructions into binary, which can represent on or off using the two digits 0 and 1.

4 bits	1 nibble
8 bits	1 byte
1000 bytes	1 kilobyte (KB)
1000KB	1 megabyte (MB)
1000MB	1 gigabyte (GB)
1000GB	1 terabyte (TB)
1000TB	1 petabyte (PB)

sound file size = sample rate (Hz) × duration (s) × bit depth

image file size = colour depth × image height (pixels) × image width (pixels)

text file size = bits per character × number of characters

## 1.2.4 DATA STORAGE

Denary number range 0 – 255

Hexadecimal range 00 – FF

Binary number range 00000000 – 11111111

**Left shift** is the same as multiplying by 2 and **right shift** is the same as dividing by 2. **Overflow error** may happen when adding together two binary numbers, this is when there is a carry bit / left over bit.

The leftmost digit in the number is called the **most significant bit (MSB)** and the rightmost digit the **least significant bit (LSB)**. In an 8-bit number, the MSB value represents 128 in decimal and the LSB value represents 1.

### Characters

Each character is represented by a numeric binary code. The character set of a computer is a list of all the characters available to the computer.

**ASCII** is a 7-bit code able to represent the English alphabet, numbers, some symbols and some control characters. There are  $2^7$  or 128 characters available.

**Extended ASCII** uses the 8th bit in the byte to include extra symbols, mathematical symbols and some non-English characters. There are  $2^8$  or 256 characters available.

**Unicode** originally used a 16-bit code to represent many additional non-English characters and a wide range of symbols. The 16-bit code has 216 or 65536 characters available. Unicode has since been extended to use even more bits to represent billions of characters. The original ASCII and extended ASCII codes are the same in Unicode so ASCII can be considered a subset of Unicode.

## Images

Images are represented on screen as a series of **pixels**. Pixels are stored in a computer as binary codes. The number of bits used for each pixel determines how many colours each pixel can represent. With 1 bit for each pixel we have just two possibilities: 0 or 1. This means a pixel can only be one of two colours.

To store more than two colours we need more bits per pixel: 2 bits to store 4 ( $2^2$ ) colours per pixel. 3 bits to store 8 ( $2^3$ ) colours per pixel. 8 bits to store 256 ( $2^8$ ) colours per pixel.

Image **metadata** contains information that tells the computer how to reproduce the image from the binary data stored and includes:

- **Colour depth** – the number of bits used per pixel.
- **Resolution** – the number of dots (pixels) per unit of distance, for example dots per inch (DPI).
- Geographical data - where the image was taken
- Date created, date modified, file size

Higher colour depth: a larger number of colours can be represented giving a better-quality image. More data is stored making the image file larger.

Higher resolution: more pixels are used to represent the image meaning the quality is better and it can be made larger without losing resolution. More data is needed to represent the pixel, meaning the file needed to store the data is larger.

## Sound

Sounds are a series of vibrations that continuously vary and can take any value – this means they are **analogue**. In order to store this on a computer sound is sampled at regular intervals by a device that converts analogue to digital signals, and the digital values are stored as binary.

**Sample rate** - is the number of samples taken per second, measured in Hz (hertz). 1 Hz means one sample per second.

**Duration** - is the length of time that the sound is sampled for, measured in seconds or minutes.

**Bit depth** - is the number of bits used to store each sample.

Sound file size depends on: sample rate, duration and bit depth.

## 1.2.5 COMPRESSION

When transmitting files, storing very large files or storing a large number of files we need to compress the data to make it smaller.

Lossy compression

- Some of the data is removed to make the file smaller.
- Algorithms remove data that is least likely to be noticed.
- The original file cannot be restored from the compressed version.
- Suitable for images, video ....

Lossless compression

- None of the data is removed.
- Algorithms look for patterns in the data so that repeated data items only need to be stored once, together with information about how to restore them.
- The original file can be restored
- Suitable for text files, audio ....

**If you found this  
useful, drop a follow  
to help me out!**

**THANK YOU!**

**GCST**