

# Section 2: Hardware

## 1) Central Processing Unit

*Understand some of the functions of the CPU in terms of calculations, logic control, immediate access memory. Know that the speed of the CPU is measured in megahertz (MHz) or gigahertz (GHz).*

### 1.1 Parts of the CPU

There are three main components to the CPU: the arithmetic-logic unit (ALU), control unit and on-board cache memory.

**Control unit:** The control unit is responsible for loading and interpreting the individual instructions that comprise the computer program. These instructions are in a language called **machine code**. Machine code is a pattern of ones and zeros. The control unit also has the task of getting the data needed by the instructions and returning the results of the processing after the instruction has been executed.

**Arithmetic-logic unit:** The ALU is responsible for carrying out arithmetic operations such as addition and subtraction as well as logical decisions such as whether one number is bigger than another. All programs consist of complex sets of arithmetic and logical operations. Another way of thinking of a logical operation is as a decision making operation.

**On-board cache memory:** Because the CPU can perform its operations much faster than data can be transferred from RAM, many CPUs have on-board cache memory. This is memory that the control unit can access very quickly and use for intermediate storage. Further, data and instructions can be loaded into cache before they are actually needed. When they are needed, the transfer is much faster than it would have been if RAM had been used.

**Speed of the CPU:** The CPU operates as a result of electronic pulses sent to it by another device on the motherboard called the clock. The speed of a CPU is measured by the maximum number of pulses it is able to handle. This is measured in MHz (megahertz) or millions of pulses per second or GHz (gigahertz) thousands of millions of pulses per second. A good personal computer will use a CPU with a clock speed of over 2 GHz. This means it receives 2 000 000 000 million pulses every second from the CPU.

Previously CPUs could only do one operation per pulse. With improvements in technology, they have been able to improve on this. For example, they can do one operation at the start of the pulse and one at the end of the pulse.

## 2) Memory

*Understand different types of computer memory such as: RAM (random-access memory), ROM (read-only memory) and distinguish between them.*

As mentioned in the first chapter RAM is used to store the current data and programs whereas ROM is used to store the routines that enable a computer to boot up.

The following table compares RAM and ROM.

	<b>RAM</b>	<b>ROM</b>
<b>Function</b>	Store the currently active programs and their data.	Stores certain fixed routines such as the boot-up routines.
<b>Volatility</b>	RAM is volatile: When the computer is switched off, the contents are lost.	ROM is non-volatile: When the computer is switched off, the contents are not lost.
<b>Changeable</b>	The contents of RAM can be changed or deleted.	The contents of ROM cannot be changed or deleted.

*Know how computer memory is measured: bit, byte, KB, MB, GB, TB. Relate computer memory measurements to characters, files and directories/folders.*

### 2.1 Bits

In all the components of a computer, data and instructions are stored as patterns of ones and zeros. These individual ones and zeros are called bits.

In electronic components the one is stored by switching an electronic switch on and a zero by switching it off. On a magnetic material, such as the surface of a hard disk, the one may be stored with a clockwise magnetic field and a zero with a counter-clockwise field.

The reason for the use of only ones and zeros stems directly from the fact that modern circuitry makes use of electronic switches and these can only be on or off. The term for circuitry based on switches is **digital**. Arithmetic based on the use of only ones and zeros is called **binary arithmetic**.

### 2.2 Bytes

Bits are grouped together into sets of eight. A set of eight bits is called a **byte**.

**ASCII** or **American Standard Code for Information Interchange** was a system of representing all the characters of the western alphabet and certain

special characters in a single byte. You can think of the byte as the amount of memory required to store a single character.

As there are only 256 possible variations within eight bits, this is not sufficient to represent other alphabets. As a result a new system, called **uni-code**, has been developed to represent all the alphabets of the world. This makes use of two bytes or sixteen bits. With two bytes, 65536 different characters and symbols can be represented.

### 2.3 Units of memory

Because we use very large numbers of bytes for storage, abbreviations are used for large numbers. These are based on powers of two and are set out in the following table.

kB	kilobyte	$2^{10} = 1\,024$ bytes	approx. 1 000 bytes
Mb	Megabyte	$2^{20} = 1\,048\,576$ bytes	approx. 1 000 000 bytes
Gb	Gigabyte	$2^{30}$ bytes	approx. 1000 000 000 bytes
Tb	Terabyte	$2^{40}$ bytes	approx. 1000 000 000 000 bytes

The capacity of hard drives is measured in bytes. A modern hard drive has a capacity of 500Gb or more.

When files are stored on disk, the amount of space they occupy is measured in bytes. The following screen shows a partial listing of files in a directory. Notice the fourth column which contains the size of the file in bytes. (Don't be concerned with the detail of this screen – it is shown purely for illustrative purposes.)

```
[david@Linux1 david]$ ls -l
total 636
drwxrwxr-x   3 david  david    4096 Jan 20 18:32 Desktop/
drwxr-xr-x   2 david  david    4096 Jan 11 15:34 Documents/
-rw-r--r--   1 root   root    42853 Jan  6 12:49 MyFirstDocument.sxw
-rw-rw-r--   1 david  david   60088 Jan 11 13:42 snapshot10.png
-rw-rw-r--   1 david  david   13241 Jan 11 15:36 snapshot11.png
-rw-rw-r--   1 david  david   56729 Jan 21 17:35 snapshot1.png
-rw-rw-r--   1 david  david   25389 Jan 20 16:30 snapshot2.png
-rw-rw-r--   1 david  david  104870 Jan 20 15:19 snapshot3.png
-rw-rw-r--   1 david  david   89470 Jan 20 15:20 snapshot4.png
-rw-rw-r--   1 david  david   29193 Jan 20 15:21 snapshot5.png
```

When we work with files and directories, we often need to know how large the files are or how much space a directory and its files occupies.

- One **byte** is one character which is a number, letter or symbol. It consists of eight bits (binary digits) and is the smallest unit of information a computer can process.

- One **kilobyte** is 1,024 characters and is approximately equal to one page of text in doublespacing.
- One **megabyte** is 1,048,576 characters and is approximately equal to one book.
- One **gigabyte** is 1,073,741,824 characters and is approximately equal to 1000 books.
- One **terabyte** is 1,099,511,627,776 characters and is approximately equal to a whole library.