

# 1

## Computer System

### Outline

#### 1.1 Introduction

Computers are the machines that have revolutionised the world around us. The way we used to live around 25-30 years ago is very different from how we live today. A modern age student cannot even imagine life without email, Internet, print outs, playing music on computers or smartphones, photos just a click away in the form of smartphones and so on. In short, in every aspect of life around us, we see computers play a role directly or indirectly.

Computers deliver so much, diligently and efficiently, all thanks to the wonderful combination of their **hardware** and **software**.

- ⇒ **Hardware.** The physical electronic components of a computer are called hardware, *e.g.*, keyboard, CPU, monitor, printer etc.
- ⇒ **Software.** These are the recorded instructions and programs that govern the working of a computer. Recall that a *program is a set of instructions to carry out a specific task or achieve a special work goal.*

In this chapter, we shall discuss computer's functioning in broad sense by discussing computer system organization and how various types of software aid in computer's overall performance.

- 1.1 Introduction
- 1.2 Computer System
- 1.3 Computer Systems and Data
- 1.4 Software

## 1.2 Computer System

A computer system comprises of *five* basic components (see Fig. 1.1) :

- (i) **Input Unit.** It is responsible for taking input for the computer. The **input devices** attached to the computer system make the input unit.
- (ii) **Output Unit.** It is responsible for taking input for the computer. The **output devices** attached to the computer system make the output unit.
- (iii) **Central Processing Unit (CPU).** It is responsible for processing the data and instructions. It comprises of *two* parts :
  - (a) **Arithmetic and Logic Unit (ALU).** It is responsible for carrying out the arithmetic instructions (*add, subtract, multiply, divide*) and making logic decisions (*greater than, less than, equal to*).
  - (b) **Control Unit.** It is responsible for controlling and supervising the processing.
- (iv) **Primary Memory.** It is the internal volatile memory where data and instructions are stored during processing.
- (v) **Secondary Storage Unit.** It refers to the external storage devices which provide permanent memory to the computer system.

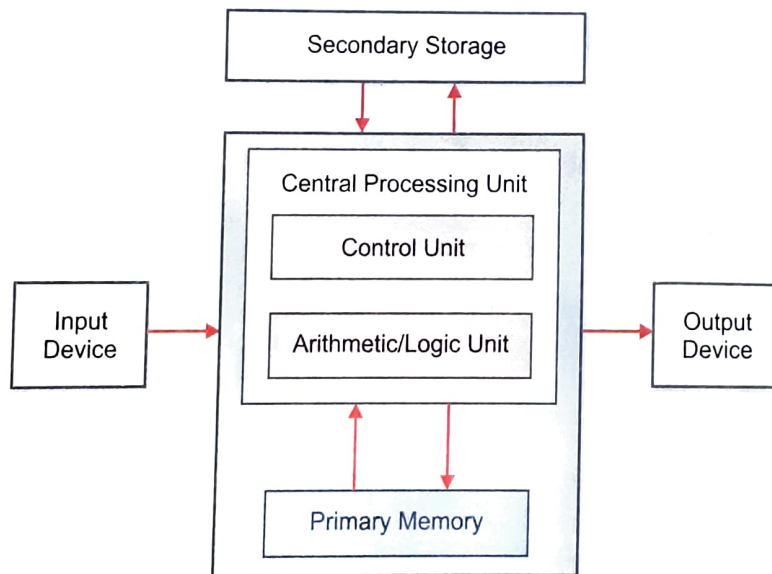


Figure 1.1 Components of a computer system.

The components of a computer system make the physical structure of a computer whereas the logical structure of a computer system is defined as **Computer Organisation**.

### 1.2.1 Computer Organisation

Computer organization refers to the logical structure of a computer describing how its components are connected to one another ; how they affect one another's functioning, and contribute to overall performance of the computer.

Computers, as you must be knowing, follow the 'IPO' principle *i.e.*, Input → Process → Output (a certain input is processed to generate specific output).

Thus basic computer organization is as shown in Fig. 1.2. To see the interconnections and basic working of computer (Computer Organization), scan this QR Code with SIPO app.

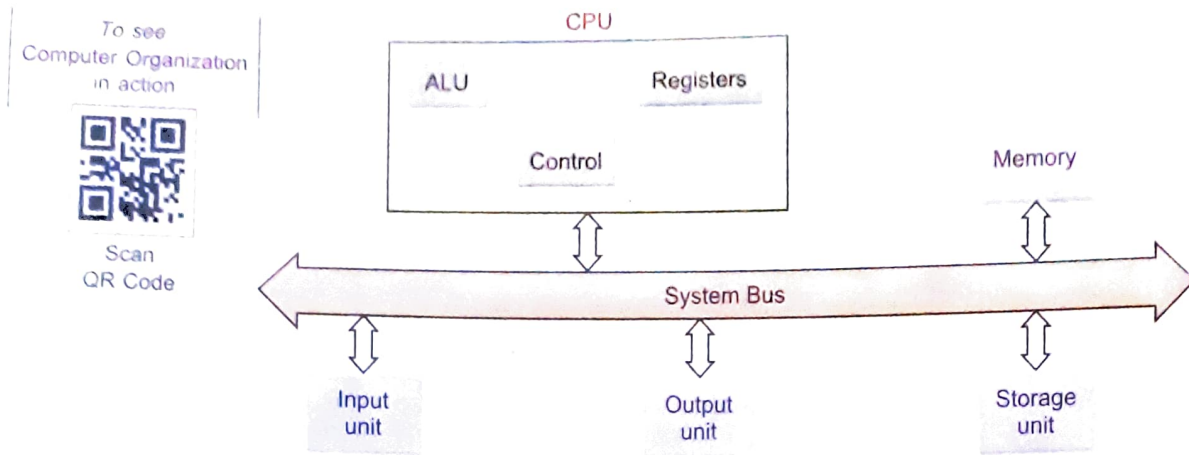


Figure 1.2 Basic Computer Organization.

Let us talk about these functional components of a computer, one by one.

### 1.2.2 Input Unit (Input Devices)

The input unit is formed by the input devices attached to the computer. *Examples* of input devices and media are : keyboard, mouse, magnetic ink character reader (MICR), optical mark reader (OMR), optical character reader (OCR), joystick etc.

The input unit is responsible for taking input and converting it into computer understandable form (the binary code).

All the *inputs* consisted of *data* (on which the action was to be performed) *as well as the instruction* (the action to be taken).

The input unit is comprised of different input devices that take the input in different forms and pass them in digital form to CPU for processing. Some common input devices are :

- (i) **Keyboard.** Keyboard is a typewriter like device which is used to type in the letters, digits and commands. For visually challenged people, *Braille keyboards* are also available these days.
- (ii) **Mouse.** Mouse is pointing device with either a roller on its base or some laser mechanism. Mouse controls movement of *pointer* (also called *mouse pointer*) on screen.
- (iii) **Microphone (Mic).** We can send sound input to computer through a special input device called **microphone** or **mic** in short. A **mic** converts the sound received into computer's format, which is called *digitized sound* or *digital audio*.

A **mic** can work if your computer has a special hardware known as **sound card**.

- (iv) **Scanner.** A scanner is a device similar to a photocopier. A scanner creates an electronic form of the printed image, which can later be manipulated, changed and modified according to the requirements.

- (v) **Barcode Reader.** A barcode reader is used to read barcodes which can be found on products in shops. The barcode uses lasers to identify the position and thickness of the bars.

- (vi) **Light Pen.** A light-sensitive input device shaped like a pen, used to draw on the computer screen or to make menu selections.



#### NOTE

System Bus connects various components of a computer system, through which they communicate and work in tandem.

#### NOTE

An input unit takes the input and converts it into digital binary form so that it can be understood by the computer.

### 1.2.3 Output Unit (Output Devices)

The output unit is formed by the output devices attached to the computer. The output coming from the CPU is in the form of electronic binary signals which needs conversion in some form which can be easily understood by human beings *i.e.*, characters, graphical or audio visual form. This function of conversion is performed by output unit.

Output Unit converts the output in binary form to human readable form.

Some popular output devices are :

- (i) **Monitors. Monitor** (or "screen") is the most common form of output from a computer. It displays information in a similar way to that shown on a television screen. The picture on a monitor is made up of thousands of tiny coloured dots called **pixels**.



For visually challenged people, Braille monitors are also available these days.

- (ii) **Printers.** Printers are the devices that deliver information by means of printed characters on paper. Printers come in variety of forms, *e.g.*, inkjet, laserjet, dotmatrix printers etc. Unlike old style printers, which printed on a paper, these days 3D printers are also available which can print/create 3D models.



Laser Printer

- (iii) **Speakers.** Speakers receive the sound in form of electric current from the sound card and then convert it to sound format audible to user.



### 1.2.4 The CPU (Central Processing Unit)

The CPU or the *Central Processing Unit* is the main control centre and processing unit. It is also called brain of the computer as it guides, directs, controls and governs the performance of a computer. The CPU has some sub-components that help in carrying out the processing of a task. These are :

- (i) Arithmetic Logic Unit (ALU)      (ii) Control Unit (CU)      (iii) Registers

#### (i) Arithmetic Logic Unit (ALU)

The ALU performs all the four arithmetic (+, -, \*, /) and some logical (<, >, =, <=, >=, !=) operations. When two numbers are required to be added, these numbers are sent from memory to ALU where addition takes place and the result is put back in the memory. In the same way, other arithmetic operations are performed (through ALU only).

For logical operations also, the numbers to be compared are sent from memory to ALU where the comparison takes place and the result is returned to the memory. The result of a logical operation is either TRUE or FALSE. These operations provide the capability of decision-making to the computer.

ALU performs arithmetic (+, -, \*, /) and logic operations.

#### (ii) Control Unit (CU)

The CU **controls and guides** the interpretation, flow and manipulation of all data and information. The CU sends control signals until the required operations are done properly by ALU and memory.

CU acts as a supervisor by controlling and guiding the operation taking place.

- ❖ CU controls instruction execution
- ❖ guides dataflow

Another important function of CU is the **program execution** i.e., carrying out all the instructions stored in the program. The CU gets program instructions from memory and executes them one after the other.

The control unit even controls the flow of data from input devices to memory and from memory to output devices.

(iii) Registers

Registers or processor registers are small units of data holding places. The CPU uses registers to temporarily hold some important processing-information during the time the processing is taking place. CPU may store some part data or some memory address or some instruction in its processor registers.

1.2.5 The Memory [Main Memory/Primary Memory]

The memory of a computer is more like a predefined working place, where it temporarily keeps information and data to facilitate its performance. Each memory location has a unique memory address. When the task is performed, it clears its memory and memory space is then available for the next task to be performed. When the power is switched off, everything stored in the memory gets erased and cannot be recalled, i.e., primary memory is **volatile** in nature.

The memory of a computer can be thought of as 'cells'. Each of these cells is further broken down into smaller parts known as *bits* (see Fig. 1.3). A bit means a *binary digit* i.e., either 0 or 1. A number of bits together are used to store data instructions by their combination.

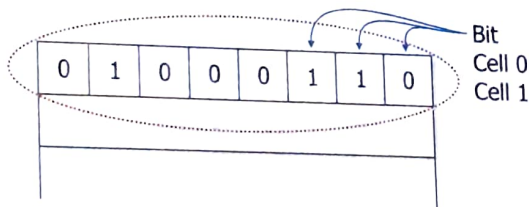


Figure 1.3 Memory cells.

A **bit** is an elementary unit of the memory. Eight bits together form a **byte**.

One byte is the smallest unit which can represent a data item or a character. Other units of memory are KB, MB, GB, TB etc.

Every higher memory unit is equal to  $2^{10}$  of its lower unit.

Following Table 1.1 lists various memory units used.

Table 1.1 Units of Computer Memory Measurements

Unit	Short Name	Full Name	Unit	Short Name	Full Name
1 Bit	Bit	Binary Digit	$2^{10}$ i.e., 1024 GB	1 TB	Terra Byte
8 Bits	1 Byte	Byte	$2^{10}$ i.e., 1024 TB	1 PB	Peta Byte
$2^{10}$ i.e., 1024 Bytes	1 KB	Kilo Byte	$2^{10}$ i.e., 1024 PB	1 EB	Exa Byte
$2^{10}$ i.e., 1024 KB	1 MB	Mega Byte	$2^{10}$ i.e., 1024 EB	1 ZB	Zetta Byte
$2^{10}$ i.e., 1024 MB	1 GB	Giga Byte	$2^{10}$ i.e., 1024 ZB	1 YB	Yotta Byte

NOTE

Modern days' smart machines (e.g., washing machines, microwave oven etc.) also come with embedded CPUs. In fact, these embedded CPUs are more than the CPU as these also contain little ROM, RAM and other required circuitry containing some embedded instructions. These embedded CPUs with accompanying memory and embedded instructions are called **microcontrollers**.

NOTE

The memory of computer is often called main memory or primary memory or internal memory.

BYTE OR NIBBLE

“ A group of 8 bits is called a *byte* and a group of 4 bits is called a *nibble*. ”

Since computer's main memory (primary memory) is temporary (volatile), secondary memory space is needed to store data and information permanently for later use. Some most common secondary storage media are the hard disk, CD-RWs, flash drive etc. The secondary memory devices are also known as **storage devices**.

### 1.2.5A Parts of Main Memory/Primary Memory

In the random-access memory (RAM), the memory cells can be accessed for information transfer from any desired random location. That is, the process of locating a word in memory is the same and requires an equal amount of memory, thus the name "random access". You can read as well as write in RAM.

The main drawback of RAM memory is that it is a volatile memory. That is, when the power goes off, the contents of RAM get erased.

#### Read Only Memory (ROM)

As the name implies, a read-only memory (ROM) is a memory unit that performs the read operation only; it does not have a write capability. This implies that the binary information stored in a ROM is made permanent during the hardware production of the unit and cannot be altered by writing different words into it (hence non-volatile). Whereas a RAM is a general-purpose device whose contents can be altered during the computational process, a ROM is restricted to reading words that are permanently stored within the unit. ROMs are used for applications in which it is known that the information never needs to be altered, for example, a monitor program controlling a machine. These, however, are slower than RAM.

### 1.2.6 Cache Memory

Pronounced as *cash*, the *cache memory* is a special high-speed storage mechanism. It can be either a reserved section of main memory or an independent high-speed storage device or even on CPU chip. Whenever some data is required, the CPU first looks in the cache, if it is there or not. If the data is found in cache, CPU does not access main memory and hence the process becomes very fast. If the required data is not found in *cache*, CPU reads it from main memory and loads it in *cache*.

When data is found in the cache, it is called a cache hit, and the effectiveness of a cache is judged by its hit rate. 95% of the time the processor is working, it is accessing information from cache.

#### CACHE MEMORY

“ The *Cache Memory* is a high speed memory available inside CPU in order to speed up access to data and instructions stored in RAM memory. ”

### 1.2.7 The Storage Unit (Secondary Memory)

Computers need to store and retrieve data for processing. Since primary memory has a limited storage capacity and is not permanent, secondary storage devices are used to store large amount of data permanently. There are various types of secondary devices available these days.

Let us now talk about some most common storage devices.

#### 1. Hard Disks

The hard disk memories store information on one or more circular platters (or disks) which are continually spinning. These rotating disks are coated with a magnetic material and stacked with space between them. Information is recorded on the surface of rotating disks by magnetic heads as tiny magnetic spots.

The hard disks of today have storage capacity measured in giga bytes and terra bytes.

## 2. Compact Disks (CDs) and DVDs

The compact disks or CDs are optical media, which use lasers to store information. The CDs are relatively cheap and have a storage capacity of upto 700 Mb.

DVD is an optical storage device that looks the same as a compact disc but is able to hold about 15 times as much information and transfer it to the computer about 20 times as fast as a **CD-ROM**. A DVD, also called a **Super Density disk (SD)**, can hold upto 17 **gigabytes** of data or four hours of movies on a side.

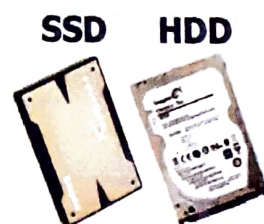
## 3. Portable Flash Memory

Portable flash memories are also popularly known as **pen drives**. A flash drive is a small, ultra-portable storage device with a 'solid state' memory *i.e.*, it has no moving parts unlike magnetic storage devices, nor does it make use of lasers — unlike optical drives. Instead, it works in a similar way to RAM. The key difference is that data is retained in Flash memory even when the power is switched off. They are now fairly inexpensive, costing from ₹ 250/- upwards. Typical sizes range from 4 GB up to 128 GB and beyond.



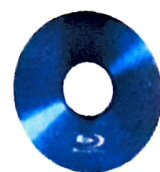
## 4. Solid-State Drive (SSD)

A solid-state drive is a new generation of storage device used nowadays in place of hard-disks. Unlike mechanical hard disks, SSDs use flash-based memory, which is significantly faster than older hard-disk storage technologies and have RAM like working mechanism. Thus, use of SSDs makes computers significantly faster.



## 5. Blu Ray Disk

**Blu-ray Disc** (also known as **Blu-ray** or **BD**) is an optical disc storage media format. Its main uses are high-definition video and data storage. The disc has the same dimensions as a standard DVD or CD. While current optical disc technologies such as DVD, DVD ± R, DVD ± RW, and DVD-RAM rely on a red laser to read and write data, the new format uses a **blue-violet laser** instead, hence the name **Blu-ray**. The benefit of using a *blue-violet laser* (405 nm) is that it has a shorter wavelength than a *red laser* (650 nm), which makes it possible to focus the laser spot with even greater precision. This allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as a CD/DVD. Blu Ray disks of today are capable of storing upto 128 GB of data.



### Check Point

#### 1.1

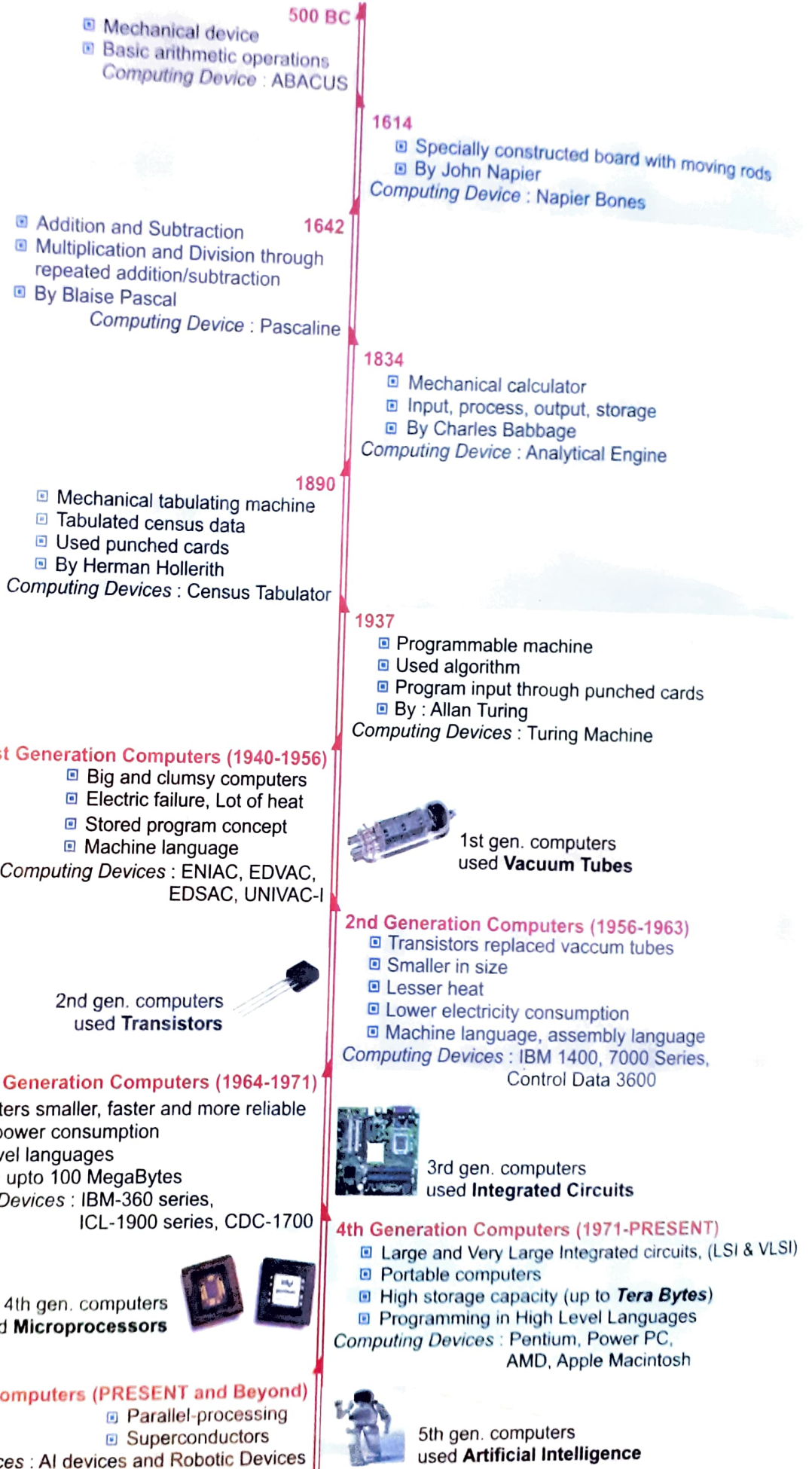
- (i) Storage of 1 KB means the \_\_\_\_\_ number of bytes :  
(ii) One Megabyte is equivalent to \_\_\_\_\_ bytes.
- What are the functional components of a digital computer ?
- What are the components of CPU ? What is its role ? What is the function of control unit of CPU ?
- What role does the input unit play in a computer ?
- What is the function of ALU ?
- What role does the output unit play in a computer ?
- What is the function of main memory ? What are the measuring units of memory ?
- What are different types of ROM ?
- Name some fast storage devices.
- Which storage device is considered a portable device ?

### NOTE

The storage devices are also called the *secondary memory*, the *auxiliary memory*, or the *external memory*.

# Evolution of Computers

**NOTE** A punched card or punch card is a piece of stiff paper that can be used to contain digital data represented by the presence or absence of holes in predefined positions.





### 1.2.8 The System Bus

The system bus (or the bus) is an electronic pathway composed of connecting cables and that connects the major components of a computer system. Through system bus, data and instructions are passed among the computer system components.

- ❖ The data carrying part of system bus is called **data bus**.
- ❖ The control instruction carrying part of system bus is called **control bus**.
- ❖ The memory address carrying part of system bus is called **Address bus**.
- ❖ A separate type of bus called **I/O Bus** connects the Input, Output and other external devices to the system.

## Microprocessor Evolution

An integrated circuit (IC) is a small electronic circuit made out of a semiconductor material, it is a circuit on a single chip. IC got created as engineers were able to stuff a number of transistors and logic gates on single chip. Chips started with SSI (small scale integration) where about 10 transistors were stuffed on a single chip to create circuits and with time, they have evolved to be so dense that now modern day chips are able to stuff about a million transistors on a single chip (Ultra Large Scale Integration – ULSI), as you can see yourself in the following table. And this is one major contributing reason toward the reducing size of computers with increased computing power.

Name	Significance	Year	Transistors number
SSI	small-scale integration	1964	1 to 10
MSI	medium-scale integration	1968	10 to 500
LSI	large-scale integration	1971	500 to 20,000
VLSI	very large-scale integration	1980	20,000 to 1,000,000
ULSI	ultra-large-scale integration	1984	1,000,000 and more

### 1.3 Computer Systems and Data

Computer Systems may also be termed as data processors as they receive the input data, process it and then produce desired results. Let us learn how raw data, input data and processed data is captured, stored and retrieved.

#### (a) Data Capturing

**Data capturing** means inputting data to convert it into digital form so that it is usable to computer. The task of data capturing is performed by the Input unit, *i.e.*, the input devices. For example, *keyboard* captures textual data, *mouse* captures pointer position, barcode readers capture the data stored in bar codes, sensors also capture data by sensing the changes in temperatures, movements, disturbances in normal flow etc.

As types of data vary, so do data capturing devices.

#### DATA CAPTURING

“ **Data Capturing** means inputting data to convert it into digital form so that it is usable to computer. ”

### (b) Data Storage

The captured data may be processed immediately or may be stored for processing at a later time. For this purpose, *i.e.*, to store the captured data, digital storage devices are used, which you have already read about in the storage devices section.

Two issues are related to data storage :

- (i) data is generated at very high rates
- (ii) data keeps on increasing with time and after sometime, you need more storage space to handle this.

To solve these issues ;

- ⇒ high speed digital storage devices are used these days.
- ⇒ storage devices are upgraded periodically, both storage capacity wise as well as technology wise.

For these reasons, large organisations<sup>1</sup> these days employ data servers, which are computers with larger and faster, dedicated storage.

While upgrading to newer technology or higher capacities, you may sometimes decide to discard your old system or old storage devices. That is, these may become *e-waste*. You will then need to be careful while discarding them.

#### Important Concern of Discarding Old Storage Devices

While discarding *e-waste*, you should be careful about the data stored in discarded storage devices. It is very important that you delete everything stored in them manually, permanently, be it your computer systems' hard disc, laptop's disk, smartphone's memory disks, digital camera's storage and so forth. Just deleting the digital data is not enough, someone can still undelete it. So, take care to format it or delete it using proper tools that shred the data in a form which can never be undeleted or unformatted later.

#### NOTE

Use proper tools to delete or shred data before disposing off any old or faulty storage device.

### (c) Data Retrieval

**Data Retrieval** refers to the process of obtaining stored data from a storage device and making it available to the CPU.

In data retrieval, the access times are dependent on the storage devices. Faster the storage device, lesser are the access times. The **access time** refers to the time taken to retrieve data from a storage device.

Faster access times mean the faster is the data processing. Modern day SSDs (Solid State Drives) have faster access times than hard disks.

#### DATA RETRIEVAL

“ **Data Retrieval** refers to the process of obtaining stored data from a storage device and making it available to the CPU. ”

#### ACCESS TIME

“ The **Access Time** refers to the time taken to retrieve data from a storage device. ”

1. These cost really high and thus are used by mainly large organisations.

## 1.4 Software

A computer system consists of hardware and software for its proper functioning.

*Hardware* represents the physical and tangible components of the computer *i.e.*, the components that can be seen and touched. *Input devices, output devices, CPU, hard disk, printer* etc. are examples of computer hardware.

*Software* represents the set of programs that govern the operation of a computer system and make the hardware run. Software can be classified broadly into *two* categories.

1. System Software
2. Application Software

### 1.4.1 System Software

The software that controls internal computer operations (*viz.* reading data from input devices, transmitting processed information to the output devices, checking system components, converting data/instructions to computer understandable form etc.) is known as **system software**.

The system software is further classified into following subcategories :

- |                        |                          |
|------------------------|--------------------------|
| (i) Operating System   | (ii) Language Processors |
| (iii) System Utilities | (iv) Device Drivers      |

Let us talk about these one by one.

#### 1.4.1A Operating System

The primary goal of an operating system is to make the computer system convenient to use and secondary goal is to use computer hardware in an efficient manner. An operating system is an important component of a computer system which controls all other components of the computer system.

Major components of a computer system are :

1. The Hardware
2. The Operating System
3. The Application program routines (compiler, language processors, device drivers, utility programs)
4. The Humanware (users)

where *hardware* provides the basic computing resources, *the application program routines* define the ways in which these resources are used to solve the computing problems of the users and the *Operating System* controls and coordinates the use of the hardware among the various application programs for the various users.

An operating system's major role is to execute a program.

There are different types of operating systems available today to cater to varied type of requirements. These are : *Single user OS, Multiuser OS, Time sharing OS, Real time OS, Multiprocessing OS, Distributed OS* etc.

**Examples of Operating Systems are :** *Microsoft, Windows, Linux, MacOS, Android OS* etc.

### NOTE

**Role or importance of software** lies with the fact that a software plays a key role of a mediator between the user and the computer hardware. In the absence of software, a user essentially can't perform any task on a computer. In short, software makes the hardware usable.

### SYSTEM SOFTWARE

“ The software that controls internal computer operations is called *System Software*. ”

### OPERATING SYSTEM

“ An *Operating System* is a program which acts as an interface between a user and the hardware (*i.e.*, all computer resources). ”

### 1.4.1B Language Processors

A language processor is a special type of a computer software that can translate the source code into an object code or machine code. Here you should know the meaning of the terms *source code* or *object code*.

- ❖ A **source code** refers to the program-code written by a programmer in a high level programming language (HLL) such as in C, Java, C++ etc.
- ❖ An **object code** refers to a code usually in machine language or binary code, a language that computer can understand easily and run on hardware.

So, you can safely say that language processors are software that convert source codes into object codes. There are *three* types of language processors : *assembler, compiler* and *interpreter*.

- (i) *Assembler*. This language processor converts the program written in assembly language into machine language.
- (ii) *Interpreter*. An interpreter is a type of system software that translates and executes instructions written in a computer program line-by-line, unit by unit etc.
- (iii) *Compiler*. A Compiler is another type of system software that translates and executes instructions written in a computer program in one go.

The translated *machine code* runs fast (**faster execution time**) as now computer does not require any type of conversion to run it ; unlike *source code* which requires conversion into object/machine code before it can be executed.

### 1.4.1C System Utilities

Utility software are those helpful programs that ensure the smooth functioning of the computer. Utilities are meant to assist your computer. Some utilities help you back-up data, some help remove outdated files or recover data that has been accidentally erased. Some make it easier to find and arrange the information you need. And some help you avoid virus attacks or clean viruses, if any. In other words, the utility programs perform housekeeping functions.

It is an established truth that everything comes with certain pros and cons. Softwares also are not an exception to it. Utilities bridge the gaps by helping to solve the problems and maximize your computer's potential.

Some commonly used utility software are :

- ❖ **Antivirus Software**. These software protect a computer system from computer-virus attack. Some popular anti-virus software are *Norton Antivirus, Quick Heal Antivirus, Kaspersky Antivirus, McAfee Antivirus* etc.
- ❖ **File Management Tools**. These software help you in tasks like *browse, search, arrange, find information, quick preview* etc. One such tool is by default available to you in Windows operating system, known as **Windows Explorer**. Some other such popular file management tools are *Total Commander, Directory Opus, Google Desktop* etc.
- ❖ **Compression Tools**. This utility program facilitates compression of files. Large files can be compressed so that they take less storage area. When needed, these compressed files can be exploded back to their original form. Some popular file compression tools are : *WinRAR, 7-Zip, PeaZip* etc.

#### UTILITIES

“ Utilities are those application programs that assist the computer by performing housekeeping functions like backing up disk or scanning / cleaning viruses or arranging information etc. ”

- ⇒ **Disk Management Tools.** As the name suggests, these tools are used for efficiently managing data on disks so as to have increased performance. Most of these tools are nowadays inbuilt in operating systems.

Common disk management tools are briefly being discussed below :

- (i) *Disk Cleanup Tool.* The Disk Cleanup utility allows you to free your computer from temporary and unnecessary files.
- (ii) *Disk Defragmenter.* This utilities program attempts to minimise the fragmentation on your disk.
- (iii) *Backup Utility.* This utility program facilitates the backing-up of disk. Back-up means duplicating the disk information (file/folders/drives) so that in case of any damage or data-loss, this backed up data may be used. The backed up data may be restored when needed *i.e.*, if your original files are damaged or lost.

#### 1.4.1D Device Drivers

**Device drivers** or simply **Drivers** are programs or files that contain sets of instructions for the operating system detailing how best to operate or drive a certain hardware device. Each device on your system has its own specific driver. Your audio device, video device, scanner, camera, modem etc. are some of the hardware components that require drivers.

When you add a new device to your computer, the operating system may not know what to do with it. However, when you install the *device driver* software, the operating system knows exactly what it is and, more importantly, it understands how to use it.

#### DEVICE DRIVERS

“ **Device Drivers** are the programs that store instructions to drive and use different hardware devices. ”

#### 1.4.2 Application Software

This type of software pertains to one specific application. For instance, a software that can perform railway reservation functions cannot prepare result for a school.

These are the programs written by programmers to enable computer to perform a specific task such as processing words, inventory control, handling calculations and figures, medical accounting, financial accounting, result preparation, railway reservation, billing etc.

#### APPLICATION SOFTWARE

“ An *Application Software* is the set of programs necessary to carry out operations for a specified application. ”

Application software can further be divided into following *two* sub-categories :

- (a) General purpose software
- (b) Customised software

#### 1.4.2A General Purpose Software

Only system software does not suffice for efficient use of computers because the system software exists mostly for the benefit of the computer. Other programs *i.e.*, the application software are required to make the computer useful for people. Application software has been written to do almost every task imaginable, from word processing to selecting a college to attend.

As applications may be numerous (*from thousands to millions of them*), it is not feasible to design software for each one of them. Rather some general software are designed that may be used by individual users in the manner it suits their needs and requirements. Such general-application software are known as *packages*.

Some major and most common categories of general application software (packages) are :

- (i) Word Processing Software, e.g., MS-Word, Open Office Writer etc.
- (ii) Spreadsheets, e.g., MS-Excel, OpenOffice Calc etc.
- (iii) Database Management Systems, e.g., MS-Access, MySQL etc.
- (iv) Desktop Publishing Software, e.g., Adobe InDesign, QuarkExpress etc.
- (v) Graphics, multimedia, and presentation applications, e.g., CorelDraw, Photoshop, PowerPoint etc.
- (vi) Web browsers, e.g., Google Chrome, Mozilla Firefox, Safari etc.

Using these general purpose software, you can store your data either in softcopy form or in hardcopy form.

#### NOTE

A **hard copy** refers to a printed or physical copy of a document, while a **soft copy** is electronically stored copy of the document on a storage device.

### 1.4.2B Customised Software

Customised Software refers to specially developed software, which is created by software programmers for an individual or business for the tasks specific to their needs. For example, if a boutique owner gets written a software to keep track of orders, deliveries and payments, then it will be a customised software.

Although there are standard business software available in market, yet some companies prefer getting **customized (tailor-made) software** as per their specific requirements. However, such softwares cannot be directly installed at any other user's workplace as the requirements of the other users may differ from the original user and the software may not fit in the requirements of the new user.

#### CUSTOMISED SOFTWARE

“ Customised Software refers to specially developed software, which is created by software programmers for the tasks specific to the needs of a specific business or application. ”

### 1.4.3 Proprietary and Free and Open Source Software

You should also know the categories of software based on their licensing and freedom to use. You should know what proprietary software, free software, freeware, open source software (OSS) and free and open source software (FOSS/FLOSS) mean.

#### 1. OSS and FLOSS

OSS refers to *open source software*, which refers to software whose source code is available to customers and it can be modified and redistributed without any limitation. An OSS may come free of cost or with a payment of nominal charges that its developers may charge in the name of development, support of software.

FLOSS refers to *Free Libre and Open Source Software* or to *Free Livre and Open Source Software*. The term FLOSS is used to refer to a software which is both **free software** as well as **open source software**. Here the words **libre** (a Spanish word) and **livre** (a Portuguese word) mean **freedom**.

*Examples of FLOSS are :* Linux OS, BOSS Linux, MySQL, OpenOffice.org software and many more.

#### 2. Proprietary Software

**Proprietary software** is the software that is *neither open nor freely available*. Its use is regulated through a license and further distribution and modification is either forbidden or requires special permission by the supplier or vendor. Source code of proprietary software is normally not available.

*Examples of proprietary software are :* Microsoft Windows OS, Adobe Premier Pro, other Adobe software, Quick Heal Antivirus and Many more.

### 3. Freeware

The term *freeware* is generally used for software, which is available free of cost and which allows copying and further distribution, but **not modification** and whose source code is not available. Freeware should not be mistaken for *open software* or for *free software*.

Freeware is distributed in binary form (ready to run) without any licensing fee. In some instances, the right to use the software is limited to certain types of users, for instance, for private and non-commercial purposes. Freeware is often used in marketing situations in order to sell additional products and to gain market advantages. One example is *Microsoft Internet Explorer*, which is made available as freeware.

#### NOTE

Freeware and *Free Software* are two different things. Freeware are the software, which permit redistribution but not modification (and their source code is not available). These packages are not free software ; so don't use the word "freeware" to refer to free software.

### 4. Free Software

*Free Software* means the software is freely accessible and can be freely used, changed, improved, copied and distributed by all who wish to do so. And no payments are needed to be made for **free software**.

## LET US REVISE

- ❖ Computers can deliver performance because of an efficient combination of hardware and software.
- ❖ While **hardware** refers to physical electronic components of a computer, **software** represent the recorded instructions/software that govern its operation.
- ❖ Computer organization refers to logical structure of a computer describing their interconnections and work dependency.
- ❖ The functional components of a computer include : **input unit, CPU, Memory, Storage Unit, Output Unit.**
- ❖ The Input unit is responsible for obtaining input from user and converting it to digital form.
- ❖ The CPU (Central Processing Unit) processes the received input as per a set of instructions and produces output.
- ❖ The CPU has these sub-components : ALU, Control Unit and Registers.

- ❖ The ALU (Arithmetic of Logic Unit) is responsible for carrying out arithmetic operations and logic operations (e.g., comparing two values).
- ❖ The Control Unit controls or supervises the processing taking place.
- ❖ Registers are small data holding areas within CPU that hold data, instructions and memory address during the processing.
- ❖ The main memory or memory holds the data and programs for the processing.
- ❖ Main memory can either be ROM or RAM.
- ❖ ROM is read only memory that stores some prewritten instructions.
- ❖ RAM is Random access memory that can be read and written and is used for manipulating data during processing.

#### Check Point

### 1.2

1. How can computer software be classified ?
2. What are the categories of system software ?
3. What is an operating system ? What is its role ?
4. What is application software ? What are the categories of application software ?
5. What is utility software ?
6. What are customized software ?

- ❖ The primary memory (RAM) is volatile in nature as all contents are erased as soon as power goes off.
- ❖ The cache memory is a special high speed memory storing the most recently accessed data.
- ❖ The storage unit stores the contents permanently.
- ❖ Major storage devices are hard disks, CD, DVD, flash drive, SSD and Blue-Ray discs.
- ❖ A mobile system handles complex types of operations including input, output and processing.
- ❖ The software that controls internal computer operations is called system software.
- ❖ An operating system is a program which acts as an interface between the user and the hardware.
- ❖ A language processor converts a program written in high level language to machine language.
- ❖ Application software is a set of programs necessary to carry out operations for a specified application.
- ❖ Utility programs assist the computer in maintaining its performance. Some of the utilities are : text editors, backup utilities, compression utilities, disk defragmentors, and antivirus software.
- ❖ Customised software is tailor made software according to user's requirements.
- ❖ Open source software is the one whose source code is available.

## Objective Type Questions

## OTQs

1. Which of the following components is the main memory of computer ?  
(a) CD (b) DVD  
(c) Internal hard drive  
(d) RAM
2. Which component of a computer connects the processor to the other hardware ?  
(a) System Bus (b) CPU  
(c) Memory (d) Input Unit
3. Which of the following is referred to as the brain of computer ?  
(a) Processor (b) RAM  
(c) ROM (d) Hard drive
4. What is the name of programs that control the computer system ?  
(a) Hardware (b) Keyboard  
(c) Software (d) Mouse
5. The physical components of a computer are called \_\_\_\_\_.  
(a) Software (b) Hardware  
(c) ALU (d) CPU
6. Which of the following is the common measurement of unit of computer memory ?  
(a) IQ (b) Byte  
(c) Terabyte (d) Gigabyte
7. What is the name of the component that used to both read and writes data ?  
(a) ROM (b) RAM  
(c) Hard Drive (d) Cache Memory
8. The CPU is also known as :  
(a) The Brain (b) The Processor  
(c) The Central Processing Unit  
(d) All of these
9. Which smaller unit of the CPU directs and coordinates all activities within it and determines the sequence in which instructions are executed, sending instructions sequence to other smaller unit.  
(a) CU (b) ALU  
(c) PROCESSOR (d) All of these
10. Which smaller unit of the CPU performs all arithmetic and logic functions in a computer ?  
(a) CU (b) ALU  
(c) PROCESSOR (d) All of these
11. Component of CPU which is responsible for comparing the contents of two pieces of data is  
(a) ALU (b) CU (c) memory (d) register
12. In a computer, CU stands for  
(a) control unit (b) cache unit  
(c) calculating unit  
(d) communication unit



13. Arithmetic and logic unit alongwith control unit of a computer, combined into a single unit, is known as
- central processing unit
  - memory unit
  - I/O unit
  - operating unit
14. Word Processor and Desktop Publishing program are the examples of
- Hardware
  - software
  - CPU
  - none of these
15. Operating System is an example of
- Application Software
  - System software
  - Utility program
  - none of these
16. A disk fragmentor is an example of
- Application Software
  - System software
  - Utility program
  - none of these
17. Flash memory and Blu Ray disk are the examples of
- Hardware
  - software
  - cpu
  - none of these
18. Flash memory is a type of \_\_\_\_\_ memory.
- Primary
  - RAM
  - secondary
  - all of these
19. Which of the following memory types will store the data or information permanently?
- RAM
  - cache
  - Flash Memory
  - Hard disk
20. Which of the following memory types cannot store the data or information permanently ?
- RAM
  - cache
  - Flash Memory
  - Hard disk
21. Which of the following is available without any payment ?
- Freeware
  - Free software
  - OSS
  - FLOSS
22. Which of the following makes available its source code ?
- Freeware
  - Free software
  - OSS
  - FLOSS

### Fill in the Blanks

- \_\_\_\_\_ refers to the logical structure of a computer describing their interconnections and dependency.
- RAM and ROM are the types of \_\_\_\_\_ memory.
- The \_\_\_\_\_ is responsible for carrying out arithmetic and logic operations.
- The \_\_\_\_\_ of the CPU controls or supervises the processing taking places.
- The small memory providing units inside the CPU are called the \_\_\_\_\_.
- The \_\_\_\_\_ memory is a special high speed memory storing the most recently accessed data.
- The set of programs necessary to carry out operations/tasks pertaining to a specific application, are called \_\_\_\_\_.
- Software that controls and manages internal computer operations is called \_\_\_\_\_.
- Utility programs are a type of \_\_\_\_\_.
- Antivirus software is a type of \_\_\_\_\_.
- Windows OS is a type of \_\_\_\_\_.
- \_\_\_\_\_ software gives freedom to use it.

### True/False Questions

- A computer system consists of both hardware and software.
- Hardware is a set of instructions called programs that the computer uses to carry out tasks while Software are all the parts of the computer you can see and touch, also known as peripherals.
- The two smaller units of the Processor are CU and ALU.
- Main Memory holds data and instructions being processed by the computer and is directly accessible by the CPU.
- A cache memory is a type of RAM.
- Language processors are a type of application software.
- Customised software is a type of system software.
- Freeware and Free Software are the same.
- No payments are to be made for freeware.
- The source code is also available with Open Source Software.

**NOTE :** Answers for OTQs are given at the end of the book.

## Solved Problems

1. State the basic units of the computer. Name the subunits that make up the CPU, and give the function of each of the units.

**SOLUTION.** The basic units of a computer are :

1. Input unit
2. Central Processing Unit (CPU)
3. Output Unit
4. Memory.

The CPU has *two* subunits : the control unit (CU) and the arithmetic logic unit (ALU).

The control unit controls the entire operation being carried out.

The ALU performs the arithmetic and logical operations.

2. What is the function of memory ? What are its measuring units ?

**SOLUTION.** The memory temporarily holds the data and information during processing.

The smallest unit of memory is a byte (8 bits). A byte can store one character in binary form. Other measuring units are kilobyte (KB) equal to 1024 ( $2^{10}$ ) bytes, Megabyte (MB) equal to 1024 KB, Gigabyte (GB) equal to 1024 MB and Terabyte (TB) equal to 1024 GB.

3. Give examples for each of system software and application software. Explain the function of each type.

**SOLUTION.** Examples of system software are :

- (i) Operating system      (ii) Language Processor      (iii) Application Software

Examples of Operation System are : Windows 10, Ubuntu Linux, MacOS etc.

Operating system governs functions of a computer system and acts as interface between the hardware and the user.

The examples of language processors are : (i) Interpreter      (ii) Compiler      (iii) Assembler

An *interpreter* converts and executes an HLL program into object program line by line whereas a *compiler* converts an HLL program into object program in one go and once the program is error free, it can be executed later. An *assembler* converts an assembly language program into object program.

Examples of application software are : (i) Customised Software      (ii) General software.

The customised software pertains to the requirements of a specific user for whom the software has been developed. General software is developed keeping in mind general specifications of a problem.

4. What is the difference between RAM and ROM ?

**SOLUTION.** RAM refers to random access memory where both read and write operations can take place. But the RAM is a volatile memory ; its contents are lost when power is turned off.

ROM refers to read only memory where only read operation can take place. The ROM is a non-volatile memory.

Both RAM and ROM are parts of the primary memory.

5. What is Cache memory? Why is it considered crucial for a microprocessor's performance?

**SOLUTION.** Cache memory is a special high-speed memory that stores the most recently used data in order to speed up the process of instruction execution. A cache can speed up data retrieval because recently used data is likely to be used again by the computer.

6. What is access time of a storage device ? Name a storage device with faster access times.

**SOLUTION.** The time taken to read data from a storage device and bring it to memory is called *access time*. The flash memories or Solid State Drives (SSDs) have faster access times.

7. What is Data capturing ?

SOLUTION. Obtaining data and converting it into digital form is called data capturing. It is done by the input devices.

8. What is data retrieval ? Which aspect of data retrieval affects the system performance ?

SOLUTION. Obtaining captured data from storage device is called data retrieval. Access time of the storage device affects the performance of a computer system, in data retrieval.

9. What are various categories of software ?

SOLUTION. There are broadly *two* categories of software :

**1. System Software.** This type of software controls internal computer operations. The system software can further be classified in *these* categories :

- (i) *Operating System* an interface between a user and the hardware.
- (ii) *Language Processor* responsible for converting an HLL code into machine code.
- (iii) *System Utilities* carry out housekeeping functions for a computer.
- (iv) *Device Drivers* store instructions to drive and use different hardware devices.

**2. Application Software.** An application software is the set of programs necessary to carry out operations for a specified application.

10. What is the difference between an interpreter and a compiler ?

SOLUTION. An interpreter converts an HLL program into machine language line by line and simultaneously executes the converted line. If an error occurs in a line, the line is displayed and interpreter does not proceed unless the error is rectified.

A compiler converts an HLL program in machine language in one go. If there are errors in the program, it gives the error list along with the line numbers. Once the errors are removed, error-free object code is made available and after this compiler is no more needed in the memory.

11. What is application software ? Why is it required ?

SOLUTION. Application software is a software that pertains to one application.

Application software is required because system software cannot carry out the routine jobs performed by the user which application software can easily do.

To perform various kinds of activities, the application software comes in various categories :

- (i) General purpose software
- (ii) Customised Software

12. Five statements about interpreters and compilers are given below. Study each statement and determine which of them hold true for a compiler or for an interpreter.

- (i) takes one statement at a time and executes it.
- (ii) generates an error report at the end of translation of the whole program.
- (iii) stops the translation process as soon as the first error is encountered.
- (iv) slows speed of execution of program loops.
- (v) translates the entire program in one go.

SOLUTION. **Interpreter :** (i), (iii), (iv) ; **Compiler :** (ii), (v).

13. Describe the terms free software and open source software.

SOLUTION. *Free software* is the software free of cost, which can be copied, modified and redistributed as well but whose source code is not available. *Open source software*, on the otherhand, is the software, whose source code is available and which can be copied, modified and redistributed as well. There may or may not be charges payable for open source software.

14. Write one advantage & one disadvantage of Open Source software over Proprietary software.

**SOLUTION.** **Advantage** of open source software over proprietary software is that open source software can be modified according to one's needs as source code is available.

**Disadvantage** of open source software over proprietary software is that proprietary software provide good customer support as well user friendly interface which is a major drawback of open software.

15. Write examples of one Proprietary and one Open Source Software.

**SOLUTION.** Open source software : Linux ; Proprietary software : Microsoft Windows 10.

16. Name one open source Indian operating system.

**SOLUTION.** BOSS Linux.

## Guidelines to NCERT Questions [NCERT Chapter 1]

1. Name the software required to make a computer functional. Write down its two primary services.

**Ans.** Operating System. Two of its primary services are : *managing CPU* and *managing primary memory*.

2. What is the need of RAM ? How does it differ from ROM ?

**Ans.** The RAM is needed for the smooth running of a computer's operations as it provides memory for reading as well writing ; its contents can be modified as and when required. ROM, on the other hand, stores some instructions which are permanent. ROM cannot be written onto. One can only read instructions from ROM.

Thus RAM along with ROM, is required for the smooth functioning of a computer system.

3. What is the need for secondary memory ?

**Ans.** The primary memory holds the data and instructions only during processing and after that, it gets erased. One cannot store data and instructions permanently on RAM.

To permanently store data and instructions, the secondary memory is required.

4. Draw the block diagram of a computer system. Briefly write about the functionality of each component.

**Ans.** Refer to section 1.2 on page 2.

5. Differentiate between proprietary software and freeware software. Name two software of each type.

**Ans. Proprietary software** is software that is owned by an individual or a company. It comes with a license for its use, and its source code is almost always kept secret.

**Freeware** is software, most often proprietary, that is distributed at no monetary cost to the end user. However, its source code is not available and it comes with a license too.

6. Mention any browsers used for browsing the Internet.

**Ans.** Chrome, Safari, Firefox.

7. Name the input/output device used to do the following :

- (a) To output audio      (b) To enter textual data      (c) To make hard copy of a text file  
 (d) To display the data/information      (e) To enter audio-based command  
 (f) To build 3D models      (g) To assist a visually-impaired individual in entering data

**Ans.** (a) speaker      (b) keyboard      (c) printer      (d) monitor      (e) MIC

(f) 3D printer      (g) Braille Keyboard

8. Identify the category (system, application, programming tool) of the following software :

- (a) Compiler      (b) Assembler      (c) Ubuntu      (d) Text editor

Ans. (a) system software   (b) system software   (c) system software   (d) programming tool

9. Convert the following into bytes :

- (a) 2 MB      (b) 3.7 GB      (c) 1.2 TB

Ans. (a) 2 MB =  $2 \times 1024$  Bytes      (b) 3.7 GB =  $3.7 \times 1024 \times 1024$  Bytes

(c) 1.2 TB =  $1.2 \times 1024 \times 1024 \times 1024$  Bytes

10. What is the security threats involved when we throw away electronic gadgets that are non-functional ?

Ans. While discarding electronic gadgets, if we have not taken care of deleting the stored data permanently by proper tools, then such data may be undeleted and misused.

11. Write down the type of memory needed to do the following :

- (a) To store data permanently      (b) To execute the program

- (c) To store the instructions which cannot be overwritten.

Ans. (a) secondary memory (storage devices)

(b) RAM

(c) ROM

## GLOSSARY

<b>Bit</b>	A binary digit.
<b>Byte</b>	A group of eight bits.
<b>ALU</b>	Arithmetic Logic Unit that carries out arithmetic and logical operations.
<b>Application Software</b>	Software pertaining to the operations of a specified application.
<b>Compiler</b>	Program that converts HLL program into machine language in one go and reports all the errors along with their line numbers.
<b>Operating System</b>	Program which acts as an interface between a user and the hardware.
<b>CPU</b>	Central Processing Unit that carries out the given process and supervises the entire operation.
<b>Memory</b>	An organized collection of cells used to store data and programs in a computer.
<b>RAM</b>	Random-access memory. It is also called a read-write memory because you can read the contents of a memory location or write new contents into it.
<b>ROM</b>	Read-only memory. (ROM Rymes with Mom) This device provides non-volatile storage of programs and data. You can access any memory location by supplying its address.
<b>Software</b>	Set of programs that govern the operation of a computer system.
<b>Language Processor</b>	Software that converts a high level language code into machine understandable form.
<b>System Software</b>	Software that controls internal computer operations.
<b>Utility Software</b>	A software that assists the computer by performing housekeeping functions.
<b>FLOSS</b>	Free Libre (or Livre) Open Source Software. Software that are free as well as open.
<b>Freeware</b>	Software that are available at no cost but cannot be modified.
<b>Proprietary Software</b>	Software for which a license is required to use it and whose source code is not available.
<b>Free Software</b>	Software available free of cost and also can be copied and redistributed but no source code is available.
<b>OSS (Open Source Software)</b>	Software whose source code is available and which can be modified, copied and redistributed.

## Assignments

1. Briefly explain the basic organisation of a computer.
2. What do you understand by input unit ? What is its significance ? What does computer input consist of ?
3. What is the function of CPU in a computer system ? What are its subunits ?
4. What functions are performed by the control unit ? Can we call it the control centre of computer system ? Why ?
5. What functions are performed by the ALU ? Is it an independent unit ? If not, which unit does ALU work in coordination with ?
6. Distinguish between CPU and ALU.
7. What is the function of output unit in a computer system ? Give examples of some output devices.
8. What role does memory play in the functioning of computer system ?
9. Define each of the following :  
(a) byte (b) kilobyte (c) megabyte (d) gigabyte (e) terabyte.
10. What is the meaning of the term volatile primary memory ? What can be done to overcome the problems of volatility ?
11. Distinguish between internal and external memory.
12. What is the role of memory in a computer functioning ? What types of memory does the computer work with ?
13. What are RAM and ROM ? How are they alike ? How are they different ? What are EEROM, PROM and EPROM ?
14. What is cache memory ? How is it useful ?
15. What are major functional components of a mobile system ?
16. Draw a block diagram depicting organization of a mobile system.
17. What does the communication processor do ?
18. What is the role of application processing unit in a mobile system ?
19. How does display subsystem of a mobile system work ?
20. What are different categories of software ? Give examples.
21. What is system software ? What role does it play in the functioning of the computer ?
22. Discuss the role of utility software in the context of computer performance.
23. What is the importance of an OS ?
24. How is system software different from application software ?
25. What is the utility of these software ?  
(i) disk fragmentor (ii) backup software.
26. To run your computer system, what types of software are necessary ? What role does each type play in computer's functioning ?
27. What is OSS ?
28. Define Freeware and Free Software.
29. What are open source based software ?
30. Compare and Contrast  
(i) Free software and Open source software (ii) OSS and FLOSS  
(iii) Proprietary software and Free software (iv) Freeware and Free software.