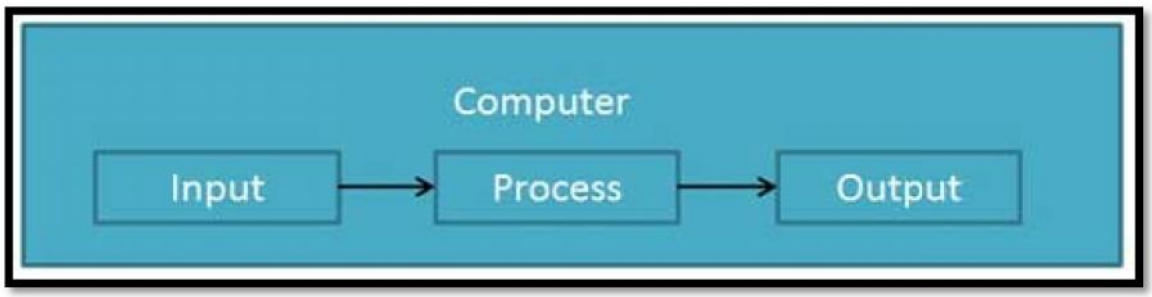
Chapter 1 – Introduction to Computers

Define a Computer System

Computer is an advanced electronic device that takes raw data as input from the user and processes it under the control of set of instructions (called program), gives the result (output), and saves it for the future use.

A system of interconnected computers that share a central storage system and various peripheral devices such as a printers, scanners, or routers. Each computer connected to the system can operate independently, but has the ability to communicate with other external devices and computers.



Functionalities of a computer

- Takes data as input.
- Stores the data/instructions in its memory and use them when required.
- Processes the data and converts it into useful information.
- Generates the output
- Controls all the above four steps.

Advantages:

- High Speed
  - ✓ It is capable of performing calculation of very large amount of data.
  - ✓ The computer has units of speed in microsecond, nanosecond, and even the picosecond.
- Accuracy
  - ✓ In addition to being very fast, computers are very accurate.
  - ✓ Computers perform all jobs with 100% accuracy provided that correct input has been given.
- Storage Capability
  - ✓ It can store large amount of data.
  - ✓ It can store any type of data such as images, videos, text, audio and many others.
- Diligence
  - ✓ Unlike human beings, a computer is free from monotony, tiredness and lack of concentration.
  - ✓ It can work continuously without any error and boredom.
  - ✓ It can do repeated work with same speed and accuracy.
- Versatility
  - ✓ A computer is very flexible in performing the jobs to be done.
  - ✓ At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.

- Reliability
  - ✓ Modern electronic components have long lives.
  - ✓ Computers are designed to make maintenance easy.
- Automation
  - ✓ Automation means ability to perform the given task automatically.
  - ✓ Once a program is given to computer i.e., stored in computer memory, the program and instruction can control the program execution without human interaction.
- Reduction in Paper Work
  - ✓ As data in electronic files can be retrieved as and when required, the problem of maintenance of large number of paper files gets reduced.
- Reduction in Cost
  - ✓ Though the initial investment for installing a computer is high but it substantially reduces the cost of each of its transaction.

Disadvantages:

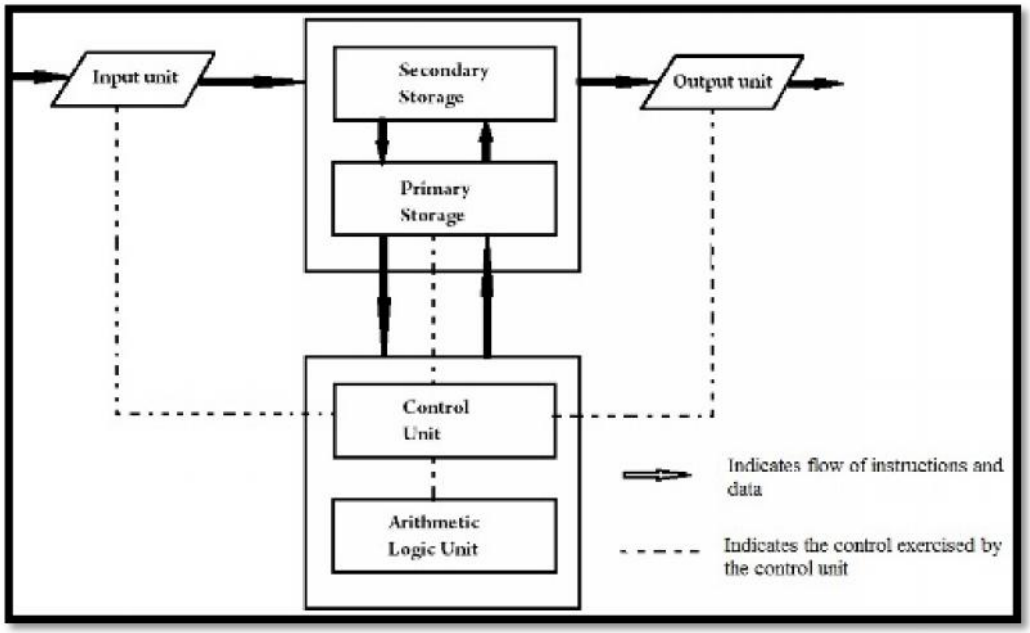
- No I.Q
  - ✓ Each instruction has to be given to computer.
  - ✓ A computer cannot take any decision on its own.
- Dependency
  - ✓ It functions as per a user's instruction, so it is fully dependent on human being
- Environment
  - ✓ The operating environment of computer should be dust free and suitable.
- No Feeling
  - ✓ It cannot make judgement based on feeling, taste, experience, and knowledge unlike a human being.

Block diagram of a Computer System and its working

A computer fast and accurate electronic data processing machine which takes input from the user, stores the data, processes data and generates the output according to the instruction given to it by the user with high speed and accuracy. The computer consists of the following functional units:-

- Input Unit
- Storage Unit
- Central Processing Unit (CPU)
- Output Unit

- **Input Unit:** The Input Unit is used to feed the data as well as instructions into the computer. Data and Instructions enter into input unit in the forms that depend upon the particular device used. The commonly used input devices are Keyboard, Mouse, Scanner, Joystick, Light Pen, Trackball etc. The Input Unit performs the following functions:
  - ✓ Firstly, it accepts the list of instruction and data from the outside world.
  - ✓ Then, it converts these instructions and data in computer acceptable form.
  - ✓ Finally, it supplies the converted instructions and data to the computer system for further processing.



- **Storage Unit**: The Storage Unit is a very important unit of the computer system. The programs, data and instructions entered in the computer system through the input unit need to be stored in the computer system before actual processing starts. Also, the results produced during processing can either be intermediate and final results. The storage unit basically consists of Primary and Secondary Memory. The following functions are performed by the Storage Unit:

  - ✓ It holds the data, instructions, intermediate and final result of processing received from various devices connected to it.
  - ✓ It provides the space for storing the data, results and instructions.
- **Central Processing Unit:** The CPU is the heart of any computer system. It is the fastest unit of the computer system. In a computer system, all major calculations and comparisons are made inside the CPU. CPU is also responsible for activating and controlling the operations of other units. It consists of further two sub-parts:
  - ✓ Control Unit: It works supervisor of the computer. It selects, interprets and directs the execution of the program instructions. It fetches the required instructions from the memory, interprets them and then sends them to ALU for processing. It works as a central nervous system for the computer. It controls the flow of data to and from the main memory.
  - ✓ Arithmetic Logic Unit: The function of ALU is to perform the actual calculations in the computer. It performs arithmetic and logical calculations. Under the of the Control Unit the data and instructions, which are stored in the main memory for processing, are transferred to ALU. ALU performs the calculations and sends intermediate and final results to the main memory.
- **Output Unit:** During data processing, computer processes the data according to the instructions fed into it and produce the required results. The Output Unit is used to provide the result to user. It links the computer with the external environment. The commonly used output devices are Monitor, Printer, and Plotter etc. The following functions are performed by Output Unit:
  - ✓ It accepts the results produced by the computer which are in binary form.
  - ✓ It converts these binary coded results to human acceptable form.
  - ✓ It supplies converted results to the outside world through the output device.

Associated peripherals

Computer peripherals are any computer components that expand system functionality and are not necessary for basic operation. Any devices that you connect to your computer, like a webcam, mouse or flash drive are all considered peripherals. However, the lines between peripheral and necessary are a little blurry within the system itself. A computer can operate with just a CPU, motherboard and power supply, making those three non-peripheral devices. Whether RAM and internal hard drives are peripherals is debatable.

KEYBOARD, MOUSE AND TOUCH PAD DEVICES

- Keyboards, mice, touch pads and other Human Interface Devices are considered peripherals. A HID is a peripheral that lets the computer use input data or interact with the computer. HIDs are always considered peripheral devices because it is possible for a computer to operate and do countless jobs without the need for human interaction. You can disconnect an HID from a computer and replace it with a new one without affecting the core functionality of the system.

DATA STORAGE DEVICES

- Data storage devices are hardware devices capable of holding information and include system RAM, internal hard drives, external hard drives, solid state drives, flash drives, memory cards and cassettes. Any type of storage device that connects outside of the computer, or isn't necessary for the computer to run, is considered a peripheral. For example, you can connect and disconnect external hard drives, flash drives and memory cards without disabling the computer. However, system RAM and internal hard drives straddle the peripheral line. While the motherboard and CPU have small amounts of built-in memory, alone, they are not enough to utilize most of the computer's capabilities.

AUDIO AND VIDEO OUTPUT DEVICES

- Unless a computer operates in a self-contained situation, without any need for human interaction, it's necessary for the computer to convey information to the user. The computer uses peripheral devices like monitors, speakers and screen readers to translate the system's binary data stream into something people can understand and interact with. Peripheral devices encompass all devices that the system uses to output data, including printers. The data output devices aren't essential for the computer to operate; they're just needed to make the system useful.

PERIPHERAL CARDS AND COMPONENTS

- Any type of peripheral card, like a graphics card, sound card, network card or controller card, is considered a peripheral. Most modern non-storage based internal storage devices use the Peripheral Component Internet and PCI Express connection standards. The connection standard name itself implies that whatever hardware uses it is a peripheral device. While peripheral devices are necessary for things like displaying video output and communicating with other computers on a network, the computer can still operate without them.

Memories - RAM, ROM

RAM(Random Access Memory) is the internal memory of the CPU for storing data, program and program result. It is read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time. Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence a backup uninterruptible power system (UPS) is often used with computers. RAM is small, both in terms of its physical size and in the amount of data it can hold.

RAM is of two types

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

RAM (random access memory) is the place in a computing device where the operating system (OS), application programs and data in current use are kept so they can be quickly reached by the device's processor. RAM is much faster to read from and write to than other kinds of storage in a computer, such as a hard disk drive (HDD), solid-state drive (SSD) or optical drive. Data remains in RAM as long as the computer is running. When the computer is turned off, RAM loses its data. When the computer is turned on again, the OS and other files are once again loaded into RAM, usually from an HDD or SSD.

ROM stands for Read Only Memory. The memory from which we can only read but cannot write on it. This type of memory is non-volatile. The information is stored permanently in such memories during manufacture. A ROM, stores such instructions that are required to start a computer. This operation is referred to as bootstrap. ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.

The advantages of ROM are as follows:

- Non-volatile in nature
- These cannot be accidentally changed
- Cheaper than RAMs
- Easy to test
- More reliable than RAMs
- These are static and do not require refreshing
- Its contents are always known and can be verified

Primary Memory (Main Memory)

Primary memory holds only those data and instructions on which computer is currently working. It has limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed reside in main memory. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories
- It is known as main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without primary memory.

Secondary Memory

This type of memory is also known as external memory or non-volatile. It is slower than main memory. These are used for storing data/Information permanently. CPU directly does not access these memories instead they are accessed via input-output routines. Contents of secondary memories are first transferred to main memory, and then CPU can access it. For example : disk, CD-ROM, DVD etc.

Characteristic of Secondary Memory:

- These are magnetic and optical memories
- It is known as backup memory.
- It is non-volatile memory.
- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without secondary memory.
- Slower than primary memories.

Secondary storage devices

Secondary Storage Devices are essential as the size of Primary storage or main memory in every computer is limited. With this, the computer can only accommodate a limited sized program and data. To carry out big jobs like commercial data processing, it becomes essential that data be held in some expansive form of storage. This is achieved through secondary storage Devices. It is also called as external storage, and can hold data either sequentially or at random.

TYPES OF SECONDARY STORAGE DEVICES IN COMPUTERS ARE:

- Magnetic tape
- Magnetic disk and
- Magnetic drum.

MAGNETIC TAPE:

- The process of reading and writing of data is carried out on a device called Tape Drive and the records on magnetic tape are stored in sequential order. For example: if the payroll file is to be stored on a magnetic tape, the records would likely to be stored in the sequence of employee numbers. Hence, magnetic tapes are referred to as *sequential access device*.

MAGNETIC DISK:

- Magnetic disk is another type of secondary storage device known as random (direct) access as it permits direct accessing of data. An individual disk is a circular metal plate coated on both side by ferrous oxide material.

- Data is recorded in the form of magnetized spots on the tracks of the disk, a spot representing the presence by “1” and its absence by “0” enabling representing of data in binary form.
- The surface of the magnetic disk is divided into number of invisible concentric circles called “tracks” and these tracks are further subdivided into “sectors”, “blocks” etc. each its own unique addresses to facilitate the location of data and the Disk moves on a vertical rotating spindle.
- Reading /writing on the disks is accomplished by means of series of read/write heads which are placed close to the surfaces of the disks.

MAGNETIC DRUM:

- It is a metallic cylinder coated with a special magnetic alloy.
- Data is stored in this surface as minute magnetized spoke arranged in binary form in a series of parallel circular tracks.

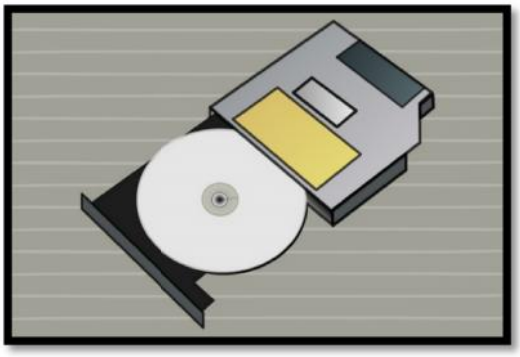
ADVANTAGES

- Very fast access
- Random access capability
- Stored data is not destroyed until new data is written in the same location.

DISADVANTAGES

- Drums cannot be removed from the unit and stored.
- Storage capacity is limited.
- Requires machine interpretation to read the information as it is not humanly readable.

CD-ROM



- CD-ROM (Compact Disc Read Only Memory) is a Compact Disc contains data accessible by a computer. While the Compact Disc format was originally designed for music storage and play back, the format was later adapted to hold any form of binary data.
- The plain and shiny disk surface and the microscopic bits help to represent the binary numbers 0 and 1, as required by the concentric tracks.
- The CD-ROMs are pre-recorded disks used for storing a large amount of data and information. Hence, the CD-ROM drive has become a standard peripheral device used for retrieval of stored data on the CD-ROM.

HARD DISK

- A hard disk drive [HDD], commonly referred to as a hard drive, hard disk or fixed disk drive. It is a non-volatile secondary storage device which stores digitally encoded data on rapidly rotating platters with magnetic surfaced. The hard disk is an electro mechanical device. HDDs record data by magnetizing a ferromagnetic material directionally to represent either a “0” or “1” binary digit.

- The hard disk drive has a set of magnetic heads or read/write heads for both surfaces of each disk, on the spindle.
- The disk drive consists of a motor to rotate the disk pack at a speed of about 3600 revolutions per minute [rpm] about a spindle.
- The information is stored on the magnetic surfaces as bits 0's and 1's on the concentric circles as tracks.
- Each track is divided into sectors of the same density.
- The set of corresponding tracks of all the surfaces of all the disks constitute a cylinder.

FLOPPY DISKS

- These are also called as flexible disks. These are used in the smallest micro computer systems as well as mini computers. Floppy disks have higher storage capacity and offer direct access capability. The floppy disk is permanently sealed in a plastic coated jacket and the whole package is inserted the floppy drive for data recording and retrieval.
- The jacket of the disk has a small slot to permit the read/write head to contact the disk. They are 5.25 inch (or) 3.5 inch in diameter. They come in single and double density and recorded on one or both surface of the diskette. The capacity of a 5.25 inch floppy is 1.2 mega bytes whereas for 3.5 inch floppy it is 1.44 mega bytes.
- It is cheaper than that of any other secondary storage devices and is portable too. The floppy is a low-cost device particularly suitable for personal computer system. Once data has been recorded, a floppy disk reader can be used to enter data into CPU. Again, the disk is loaded and rotated at a constant speed inside its envelope. Tiny magnetic heads in the disk reader access data through the slot in the jacket.

USB flash drives are pocket-sized hard drives used to store and transport files and folders. They also are used to backup or archive important data. These storage devices are connected to computers through USB sockets.

Computer Software and Hardware

Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem.
There are two types of software

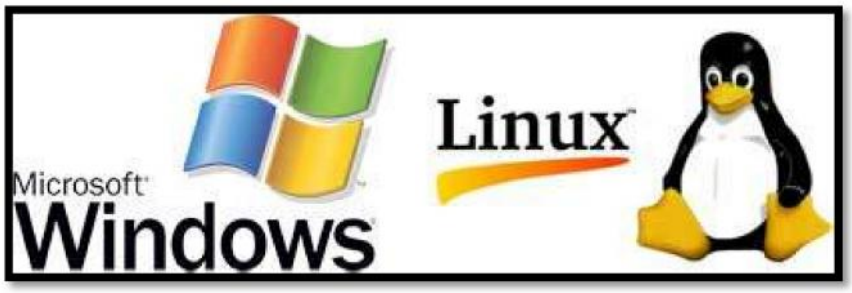
- System Software
- Application Software

System Software

The system software is collection of programs designed to operate, control, and extend the processing capabilities of the computer itself. System software are generally prepared by computer manufactures. These software products comprise of programs written in low-level languages which interact with the

hardware at a very basic level. System software serves as the interface between hardware and the end users.

Some examples of system software are Operating System, Compilers, Interpreter, Assemblers etc.



Features of system software are as follows:

- Close to system
- Fast in speed
- Difficult to design
- Difficult to understand
- Less interactive
- Smaller in size
- Difficult to manipulate
- Generally written in low-level language

Application Software

Application software products are designed to satisfy a particular need of a particular environment. All software applications prepared in the computer lab can come under the category of Application software. Application software may consist of a single program, such as a Microsoft's notepad for writing and editing simple text. It may also consist of a collection of programs, often called a software package, which work together to accomplish a task, such as a spreadsheet package.

Examples of Application software are following:

- Payroll Software
- Student Record Software
- Inventory Management Software
- Income Tax Software
- Railways Reservation Software
- Microsoft Office Suite Software
- Microsoft Word
- Microsoft Excel
- Microsoft Powerpoint

Features of application software are as follows:

- Close to user
- Easy to design
- More interactive
- Slow in speed
- Generally written in high-level language
- Easy to understand
- Easy to manipulate and use
- Bigger in size and requires large storage space

Hardware represents the physical and tangible components of a computer i.e. the components that can be seen and touched.

Examples of Hardware are following:

- **Input devices** -- keyboard, mouse etc.
- **Output devices** -- printer, monitor etc.
- **Secondary storage devices** -- Hard disk, CD, DVD etc.
- **Internal components** -- CPU, motherboard, RAM etc.

Relationship between Hardware and Software

- Hardware and software are mutually dependent on each other. Both of them must work together to make a computer produce a useful output.
- Software cannot be utilized without supporting hardware.
- Hardware without set of programs to operate upon cannot be utilized and is useless.
- To get a particular job done on the computer, relevant software should be loaded into the hardware
- Hardware is a one-time expense.
- Software development is very expensive and is a continuing expense.
- Different software applications can be loaded on hardware to run different jobs.
- Software acts as an interface between the user and the hardware.
- If hardware is the 'heart' of a computer system, then software is its 'soul'. Both are complimentary to each other.