

Unit 1 : Introduction to Computers

Computers are electronic device that takes input from user, processes it and produces the output.

Characteristics of Computer

1. **Speed:** The computer can process data very fast, at the rate of *millions of instructions per second*. Some calculations that would have taken hours and days to complete otherwise, can be completed in a few seconds using the computer.
2. **Accuracy:** Computer provides a high degree of accuracy. For example, the computer can accurately give the result of division of any two numbers up to 10 decimal places.
3. **Diligence:** When used for a longer period of time, the *computer does not get tired or fatigued*. It can perform long and complex calculations with the same speed and accuracy from the start till the end.
4. **Storage Capability:** *Large volumes of data and information can be stored* in the computer and also retrieved whenever required.
5. **Versatility:** Computer is versatile in nature. *It can perform different types of tasks with the same ease*. At one moment you can use the computer to prepare a letter document and in the next moment you may play music or print a document.
6. **Resource Sharing:** Computers can be easily connected with each other and *can share resources like printer, memory, etc.*

Computer Hardware

A computer system is divided into two categories:

1. **Hardware**
2. **Software.**

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

Examples of Hardware are the 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.

Software refers to a **set of instructions** which enable the hardware to perform a specific set of tasks.

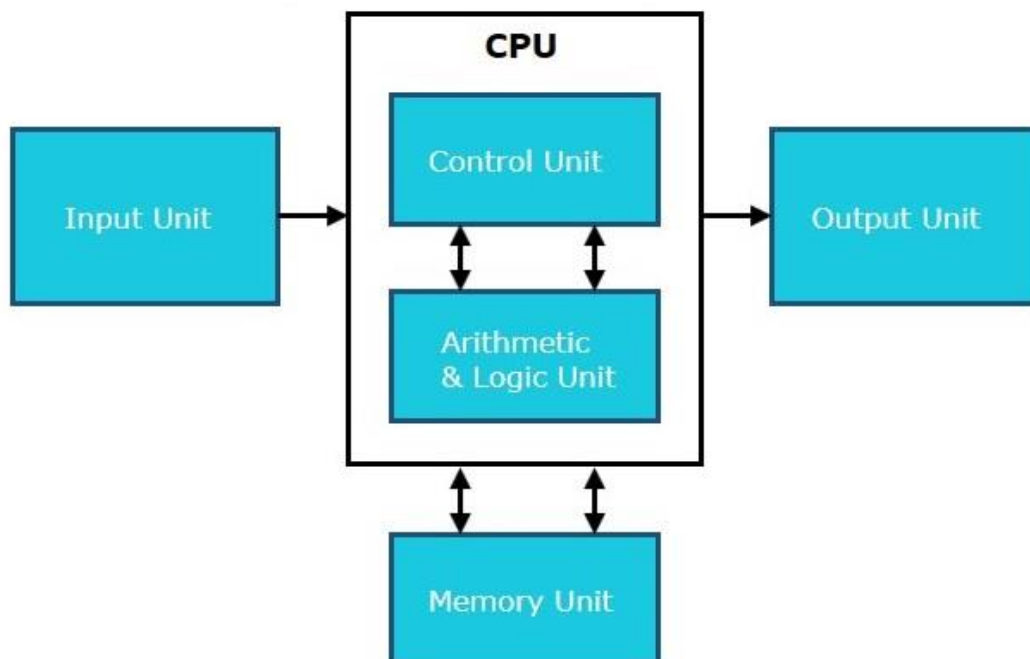
Examples of software are Ms Word, Power Point, Google Chrome, Photoshop etc.

Central Processing Unit (CPU)

CPU is considered as the *brain of the computer*. CPU performs all types of data processing operations. It stores data, intermediate results, and instructions (program). It controls the operation of all parts of the computer.

Three components of CPU are-

- **Memory or Storage Unit**
- **Control Unit**
- **ALU(Arithmetic Logic Unit)**



Input Unit

Input devices are used to enter data into the computer. It translates the information into a form understandable by the computer.

Memory Unit

Memory unit can store instructions, data, and intermediate results. This unit supplies information to other units of the computer when needed.

Primary memory and secondary memory are two types of memories in the computer.

Functions of the memory unit are –

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores the final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through the main memory.

Control Unit

This unit **controls the operations** of all parts of the computer.

Functions of control unit are –

- It is responsible for controlling the transfer of data and instructions among other units of a computer.
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/output devices for transfer of data or results from storage.

ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely,

- **Arithmetic Section**
- **Logic Section**

Arithmetic Section

Function of arithmetic section is to perform arithmetic operations like *addition, subtraction, multiplication, and division.*

Logic Section

Function of logic section is to perform logic operations such as *comparing, selecting, matching, and merging of data.*

Output Unit

The output unit consists of devices with the help of which we get the information from the computer.

Registers

Registers are *fastest memory unit* in computer located inside CPU.

Registers are *used to store data temporarily during the execution of a program.*

Register allow the CPU to quickly fetch and execute instructions from RAM, and also to write data to RAM.

Mostly used Registers are

Accumulator (AC)

Data Register (DR)

Address Register (AR)

program counter (PC)

Memory Data Register (MDR)

Index register

Memory Buffer Register.

Registers Perform:-

- 1) **Fetch:** Fetching or taking instructions given by the user or instructions stored in Main memory.
- 2) **Decode:** The Decode Operation is used for interpreting the Instructions .i.e. determining what Operation to be performed on Instructions.
- 3) **Execute:** The Execute Operation is performed by the CPU. And Results are Stored into the Memory and displayed on the user Screen.

Computer Bus

A bus is a set of wires or communication lines used to transfer data from one component to another. They are used to connect various hardware components that are part of the computer system.

Buses are essential for the functioning of computer.

Computers normally have two types of bus:-

1. **System bus:** A bus which is used to provide communication between the major components of a computer is called a System bus.
2. **I/O bus:** connects various peripheral devices to the CPU.

Types of System Buses

1. Address bus
2. Data bus
3. Control bus

Address bus

Carries memory addresses from the processor to other components. The address bus is unidirectional.

Data bus

- Carries the data between the processor and other components. The data bus is bidirectional.
- The size (width) of bus determines how much data can be transmitted at one time.
- E.g.: A 16-bit bus can transmit 16 bits of data at a time.

Control bus

- Used to carry the control signals and timing signals
- Carries control signals and timing signals from the processor to other components. The control bus is unidirectional.

Functions of system bus

Data sharing: transfer data between components of computer.

Addressing: transfer address of memory locations.

Power: A bus supplies the power to various connected peripherals.

Components inside computer cabinet

Motherboard

A motherboard (also called main board/system board/planar board) is the main **circuit board** inside computer cabinet that connects the different parts of computer together.

It connects the CPU, memory, hard drives, optical drives, video card, sound card, and other ports and expansion cards directly or via cables. It can be considered as the **backbone** of a computer.

Popular manufacturers of the motherboard includes **Intel, ASUS , AOpen.**



BIOS

BIOS stand for **Basic Input/output system**. BIOS are **preinstalled program stored in ROM**.

The CPU initially accesses the BIOS, after which the operating system is loaded.

Functions of BIOS include:

- **Power on Self Test (POST):** when the power is turned on, POST program checks whether all components of computer are working properly.
- **Booting:** Starting up process of a computer is called booting. Once POST is executed successfully, Operating system is loaded in RAM, after which the control is transferred to OS.
- **Setting the system clock**
- **Hardware configuration**
- **Selecting boot drives**

BIOS support several hardware configuration options that can be changed through the setup utility.

CMOS

CMOS stands for **Complementary Metal–Oxide–Semiconductor**. CMOS is small memory on a computer motherboard that stores the BIOS settings.

It includes system time and date, as well as hardware settings.

Ports and interfaces

A port is a point on a computer to connect external or peripheral devices to the computer.

For example, you will need a port to connect a keyboard, mouse, pen-drives, etc.

So, **it acts as an interface** between computer and external devices.

Different types of ports are:

- **Serial Port-** transmits data one bit after another
- **Parallel Port-** transmits all bits in parallel. Thus a parallel port transmits data much faster than a serial port.
- **USB Ports-** USB stands for Universal Serial Bus. It is used to attach keyboard, mouse, printers, and mobile devices to the computer. It is also used for charging portable products.
- **J45 connector** (called LAN or Ethernet port) is used to connect the computer to a network.
- **VGA connector** for connecting a monitor.

- **Audio plugs** (line-in, line-out and microphone), for connecting sound speakers and the microphone.
- **PS/2 port** to connect mouse and keyboard into PC.
- **SCSI port** for connecting the hard disk drives and network connectors.

Expansion Slots

An expansion slot is a port on the motherboard that is used to insert an expansion card (or circuit board), which provides additional features to a computer such as video, sound, advanced graphics, Ethernet or memory. There are several types of slots:

- **ISA** (Industry Standard Architecture) slot- to connect modem and input devices.
- **PCI** (Peripheral Component Interconnect) slot- to connect audio, video and graphics. They are much faster than ISA cards.
- **AGP** (Accelerated Graphic Port) slot - A fast port for a graphics card.
- **PCI Express** (Peripheral Component Interconnect Express) slot- faster bus architecture than AGP and PCI buses.
- **PC Card**- It is used in laptop computers. It includes Wi-Fi card, network card and external modem.

Memory Chips

Memory chips are integrated circuits that are capable of storing information.

Memory chips can hold memory either temporarily through RAM, or permanently through ROM.

Two types of RAM chips-

Single In-line Memory Module (SIMM) and

Dual In-line Memory Module (DIMM) are used in desktop computers.

Processor

CPU or processor is called the *brain of the computer*.

It takes information from the RAM and processes.

The CPU is usually a **two-inch ceramic square** with a **silicon chip** located inside. The chip is usually about the size of a thumbnail. The CPU fits into the motherboard's **CPU socket**, which is covered by the **heat sink**, an object that absorbs heat from the CPU.

A processor's **speed** is measured in **megahertz (MHz)**, or millions of instructions per second; and **gigahertz (GHz)**, or billions of instructions per second. A faster processor can execute instructions more quickly.

Storage Devices

The disk drives are present inside the computer. The common disk drives are hard disk drive, floppy drive and CD drive or DVD drive.

These storage devices can store large amounts of data, permanently.

Computer memory representation

The computer memory stores different kinds of data and instructions.

Binary digit or **bit** is the basic unit of memory. A bit is a single binary digit, i.e., **0 or 1**.

A bit is the smallest unit of representation of data in a computer. A group of 8 bits form a **byte**.

1 bit = 0 or 1

1 Byte (B) = 8 bits

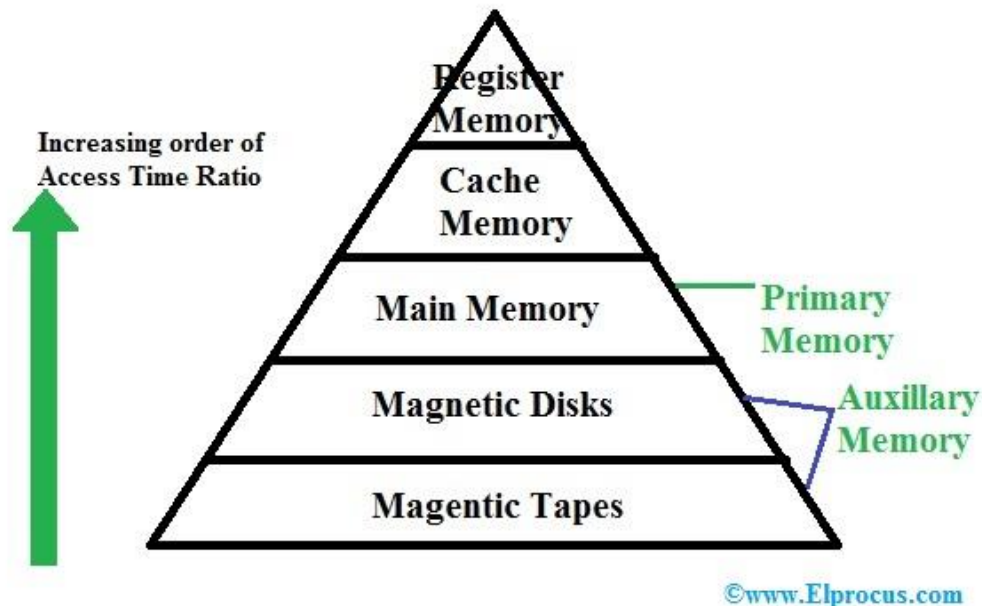
1 Kilobyte (KB) = 1024 bytes

1 Megabyte (MB) = 1024KB

1 Gigabyte (GB) = 1024 MB

1 Terabyte (TB) = 1024 GB

Memory Hierarchy



The memory in a computer can be divided into **five levels / hierarchies** based on the **speed** as well as **use**.

The processor can move from one level to another based on its requirements. The five hierarchies in the memory are registers, cache, main memory, magnetic discs, and magnetic tapes.

The first three hierarchies are **volatile** memories, whereas the last two hierarchies are **non-volatile**.

Memory hierarchy is divided into two types

1. Primary Memory

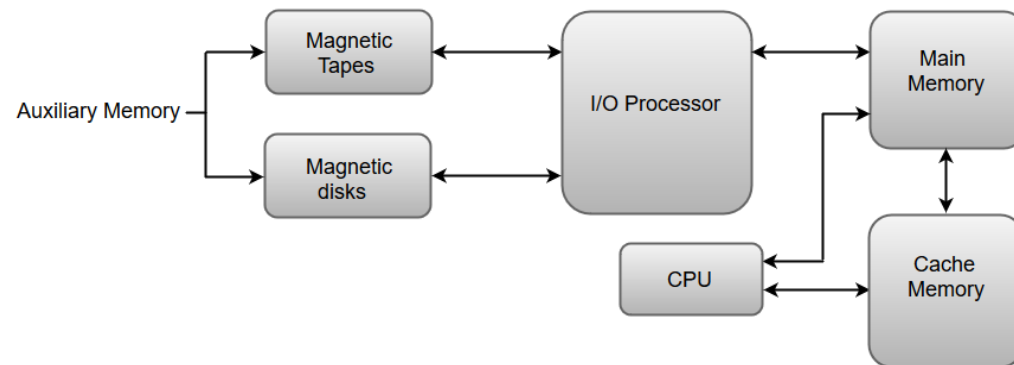
The memory unit that establishes direct communication with the CPU is called **Primary Memory**. This memory includes main, cache, as well as CPU registers.

2. Secondary/ Auxiliary Memory

Auxiliary memory is known as the lowest-cost, highest-capacity and slowest-access storage in a computer system. Auxiliary memory provides storage for programs and data that are kept for long-term storage or when not in immediate

use. The most common examples of auxiliary memories are magnetic tapes and magnetic disks.

Memory Hierarchy in a Computer System:



I/O Processor

The primary function of an I/O Processor is to manage the data transfers between auxiliary memories and the main memory.

Main Memory

The main memory in a computer system is often referred to as **Random Access Memory (RAM)**. This memory unit communicates directly with the CPU and with auxiliary memory devices through an I/O processor.

The programs that are not currently required in the main memory are transferred into auxiliary memory to provide space for currently used programs and data.

Cache Memory

Cache memory is a high-speed memory inside CPU, which is small in size but faster than the main memory (RAM).

Cache memory acts as a buffer between RAM and the CPU. Cache memory is used to reduce the average time to access data from the Main memory.

Whenever the CPU requires data, it first checks the cache. If the data is found, it is read from the cache memory (Finding data or instruction in cache is

called **cache hit**). Otherwise, the CPU moves onto the main memory (**cache miss**).

The cache memory stores the program currently being executed or which may be executed within a short period of time.

Types of Cache

- **Primary Cache (L1 cache) –**

A primary cache is always located on the processor chip. This cache is small and its access time is comparable to that of processor registers.

- **Secondary Cache (L2 cache) –**

Secondary cache is placed between the primary cache and the rest of the memory. It is referred to as the level 2 (L2) cache.

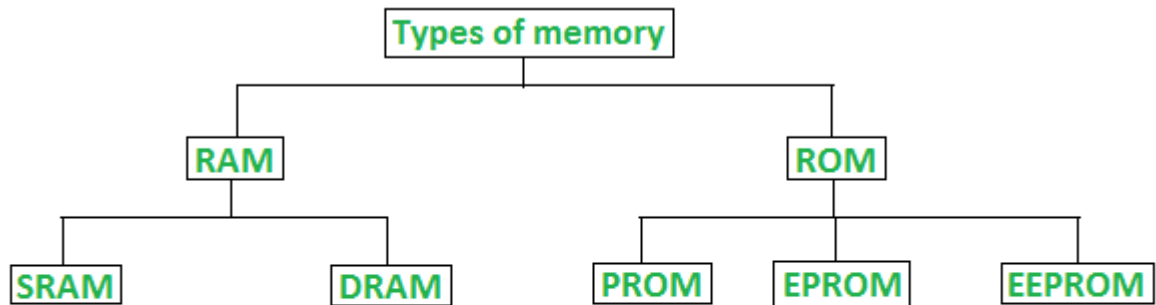
Primary memory

The memory unit that establishes direct communication with the CPU is called **Primary Memory**.

Primary memory stores the intermediate results and final results of the processing before it is stored in the permanent storage. Some of this memory is volatile i.e. contents stored will get erased if power is switched off and some of them are non-volatile i.e. contents cannot be erased.

Primary memory can be broadly classified into two parts:

1. **Read-Only Memory (ROM)**
2. **Random Access Memory (RAM)**



Classification of computer memory

Read-Only Memory (ROM)

ROM is a **permanent memory chip** in motherboard which contains booting programs. They are present in computers and many other types of electronic products.

The programs inside ROM are executed each time we switch ON the computer. Normally the contents are not erased.

Types of ROM:

ROM can be broadly classified into 4 types based on their behaviour:

- **MROM** (*Masked ROM*)

They are pre-programmed ROM. Program once written cannot be changed anyhow.

- **PROM** (*Programmable ROM*)

PROM can be programmed **once** by the user. Once written the content cannot be altered.

- **EPROM** (*Erasable and Programmable ROM*)

Here the content of ROM can be erased by exposing EPROM to Ultra violet radiation.

- **EEPROM** (*Electrically Erasable and Programmable ROM*)

Here the content of ROM can be erased using electric signals.

However, only one byte can be erased at a time. Hence, reprogramming of EEPROM is a slow process.

RAM

RAM stands for **Random Access Memory**. It is also called “*direct access memory*”. Random access means that data can be accessed **directly**.

RAM is **used to store data and instructions temporarily**. A program must be loaded into RAM before execution.

RAM is volatile memory. It means that its contents are lost when the power is turned off. RAM is read/write memory. CPU can read data from RAM and write data to RAM. It is used to store data and instruction while it is being executed. RAM is also called main memory or primary storage.

RAM plays very important role in the processing speed of a computer. A bigger RAM size provides larger amount of space for processing. So *the processing speed is increased*. The amount of data that can be stored in RAM is measured in bytes. Most desktop computers typically have **2 GB to 4 GM of RAM**. It also allows the addition of more memory if needed.

RAM is of two types –

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

Difference between Static RAM and Dynamic RAM

SRAM	DRAM
Transistors are used to store information in SRAM.	Capacitors are used to store data in DRAM.
Capacitors are not used hence no refreshing is required .	To store information for a longer time, contents of the capacitor needs to be refreshed periodically .
SRAM is faster	DRAM is slower as compared to SRAM.
These are expensive .	These are cheaper .
These are <u>used in cache memories</u> .	These are <u>used in main memories</u> .

SRAMs are **low density** devices.

DRAMs are **high density** devices.

Secondary memory

Secondary memory is also known as **External Memory/Auxiliary memory/Backup memory**. It is **used for storing data and instructions both permanently**. It is also used to transfer data from one computer to another.

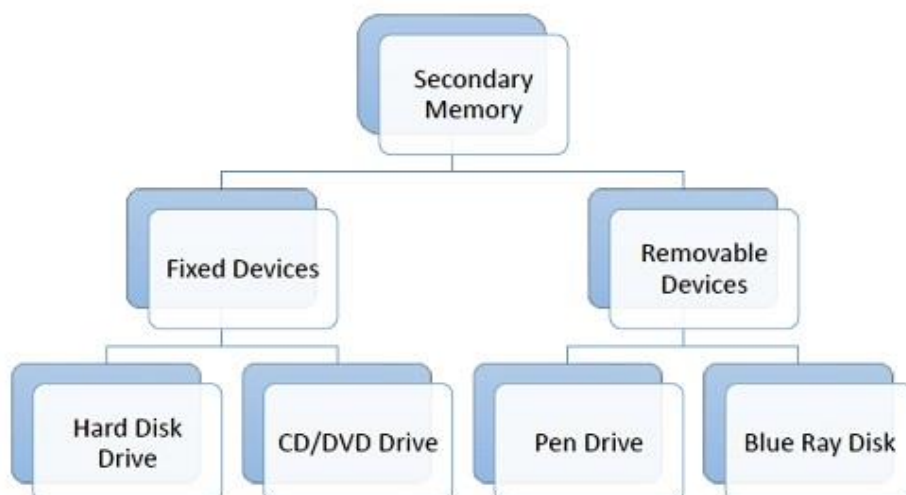
Secondary memory is not directly accessible to the CPU. They are non-volatile in nature and data does not disappear when the computer turned off. Secondary memory is *cheaper than primary memory* and also *slower* in both reading and writing.

Example: Hard disk, CD, DVD, Pen drive, etc.

Uses of secondary memory

- **Permanent storage:** It stores data permanently even if the power supply is off.
- **Large Storage:** It provides large storage
- **Portable:** Some secondary devices are removable. So, we can transfer data from one computer to another.

Types of Secondary memory



Secondary memory is of two types:

1. Fixed devices

Fixed storage is also known as fixed disk drives or **hard drives**. Here data is stored in a built-in fixed storage device.

Types of fixed storage:

- SSD (solid-state disk)
- Hard disk drives (HDD)

2. Removable devices

Removable storage is also known as disks drives or **external drives**.

It is a storage device that can be inserted or removed from the computer according to our requirements. They are portable so that we can easily transfer data from one computer to another. Also, they provide the fast data transfer.

Types of Removable Storage:

- Optical discs (like CDs, DVDs, Blu-ray discs, etc.)
- Memory cards
- Floppy disks
- Magnetic tapes

Secondary memory devices

1. Floppy Disk

A floppy disk consists of a magnetic disc in a square plastic case. It is used to store data and to transfer data from one device to another device. Floppy disks are available in two sizes

(a) Size: 3.5 inches, the Storage capacity of 1.44 MB

(b) Size: 5.25 inches, the Storage capacity of 1.2 MB.

To use a floppy disk, our computer needs to have a floppy disk drive.

This storage device becomes obsolete now and has been replaced by CDs, DVDs, and flash drives.

2. Compact Disc

A Compact Disc (CD) is a commonly used secondary storage device. It contains tracks and sectors on its surface. Its shape is circular and is made up of polycarbonate plastic. The storage capacity of CD is up to 700 MB of data. A CD may also be called a CD-ROM (Compact Disc Read-Only Memory), in these computers can read the data present in a CD-ROM, but cannot write new data onto it.

CD is of two types:

- **CD-R (compact disc recordable):** Once the data has been written onto it cannot be erased, it can only be read.
- **CD-RW (compact disc rewritable):** It is a special type of CD in which data can be erased and rewritten as many times as we want. It is also called an erasable CD.

3. Digital Versatile Disc

A Digital Versatile Disc also known as DVD it is looks just like a CD, but the storage capacity is greater compared to CD, it stores up to 4.7 GB of data. DVD-ROM drive is needed to use DVD on a computer. The video files, like movies or video recordings, etc., are generally stored on DVD and you can run DVD using the DVD player. DVD is of three types:

- **DVD-ROM(Digital Versatile Disc Read only)**
- **DVD-R(Digital Versatile Disc Recordable)**
- **DVD-RW(Digital Versatile Disc Rewritable and Erasable)**

4. Blu-ray Disc

A Blu-ray disc looks just like a CD or a DVD but it can store data or information up to 25 GB data. If you want to use a Blu-ray disc, you need a Blu-ray reader. The name Blu-ray is derived from the technology that is used to read the disc 'Blu' from the blue-violet laser and 'ray' from an optical ray.

5. Hard Disk

A hard disk is a part of a unit called a hard disk drive. It is used to storing a large amount of data. Hard disks or hard disk drives come in different storage capacities.(like 256 GB, 500 GB, 1 TB, and 2 TB, etc.). It is created using the collection of discs known as platters. The platters are placed one below the other. They are coated with magnetic material. Each platter consists of a

number of invisible circles and each circle having the same centre called tracks.

Hard disk is of two types (i) Internal hard disk (ii) External hard disk.