Computer Hard ware

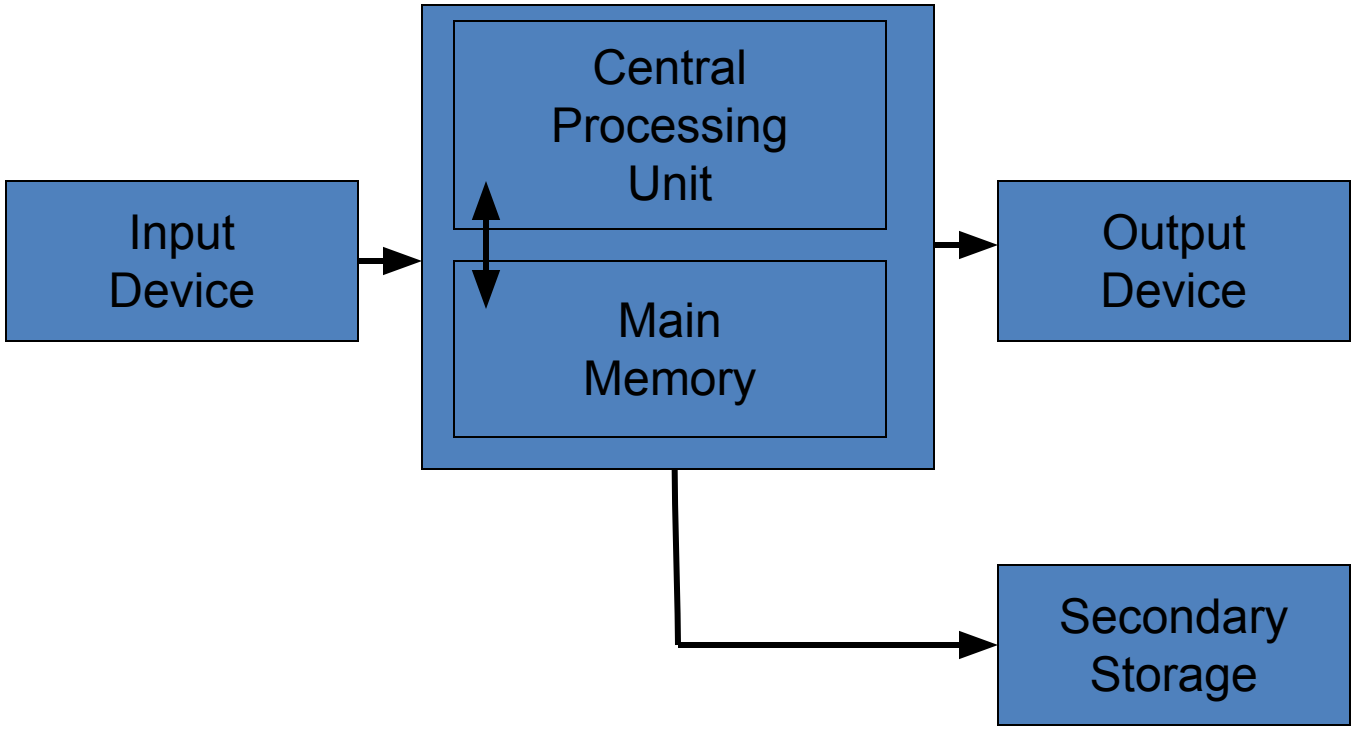
- **A computer performs basically five major operations :**

1. **it accepts data or instructions by any way of input,**
2. **it stores data,**
3. **it can process data as required by the user,**
4. **it gives results in the form of output, and**
5. **it controls all operations inside a computer**

Computer Hardware

- Refers to the physical components
- Not one device but a system of many devices
- Major types of components include:
  - Central Processing Unit
  - Main memory
  - Secondary storage devices
  - Input devices
  - Output devices

Organization of a Computer System



The CPU

- Fetches instructions from main memory
- Carries out the operations commanded by the instructions
- Each instruction produces some outcome
- A *program* is an entire sequence of instructions
- Instructions are stored as *binary numbers*
- *Binary number* - a sequence of 1's and 0's

Main Memory

- Commonly known as random access memory, or just RAM
- Holds instructions and data needed for programs that are currently running
- RAM is usually a *volatile* type of memory
- Contents of RAM are lost when power is turned off

Secondary Storage

- A *nonvolatile* storage medium
- Contents retained while power is off
- Hard disk drives are most common
  - Records data magnetically on a circular disk
  - Provides fast access to large amounts of data
- Optical devices store data on CD's as pits
- USB flash memory devices
  - High capacity device plugs into USB port
  - Portable, reliable, and fits easily in a pocket

Input Devices

- Any type of device that provides data to a computer from the outside world
- For example:
  - Keyboard
  - Mouse
  - Scanner

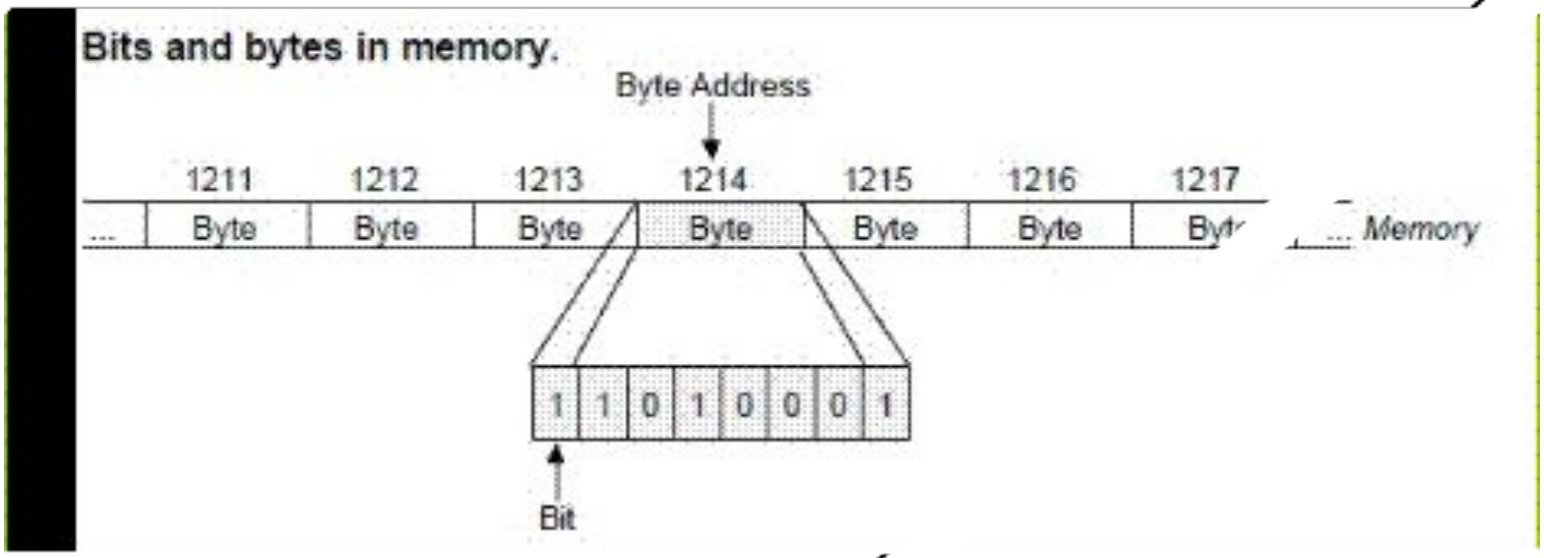
Output Devices

- Any type of device that provides data from a computer to the outside world
- Examples of output data:
  - A printed report
  - An image such as a picture
  - A sound
- Common output devices include:
  - Monitor (display screen)
  - Printer

Memory Organization

Memory Representation

- The memory is organized in the form of a cell, each cell is able to be identified with a unique number called address.
- Each cell is able to recognize control signals such as “read” and “write”, generated by CPU when it wants to read or write address.
- Whenever CPU executes the program there is a need to transfer the instruction from the memory to CPU because the program is available in memory.
- The smallest unit in the memory is known as bit. And the total memory is organized in to byte.
- Each byte divided into 8 bit.

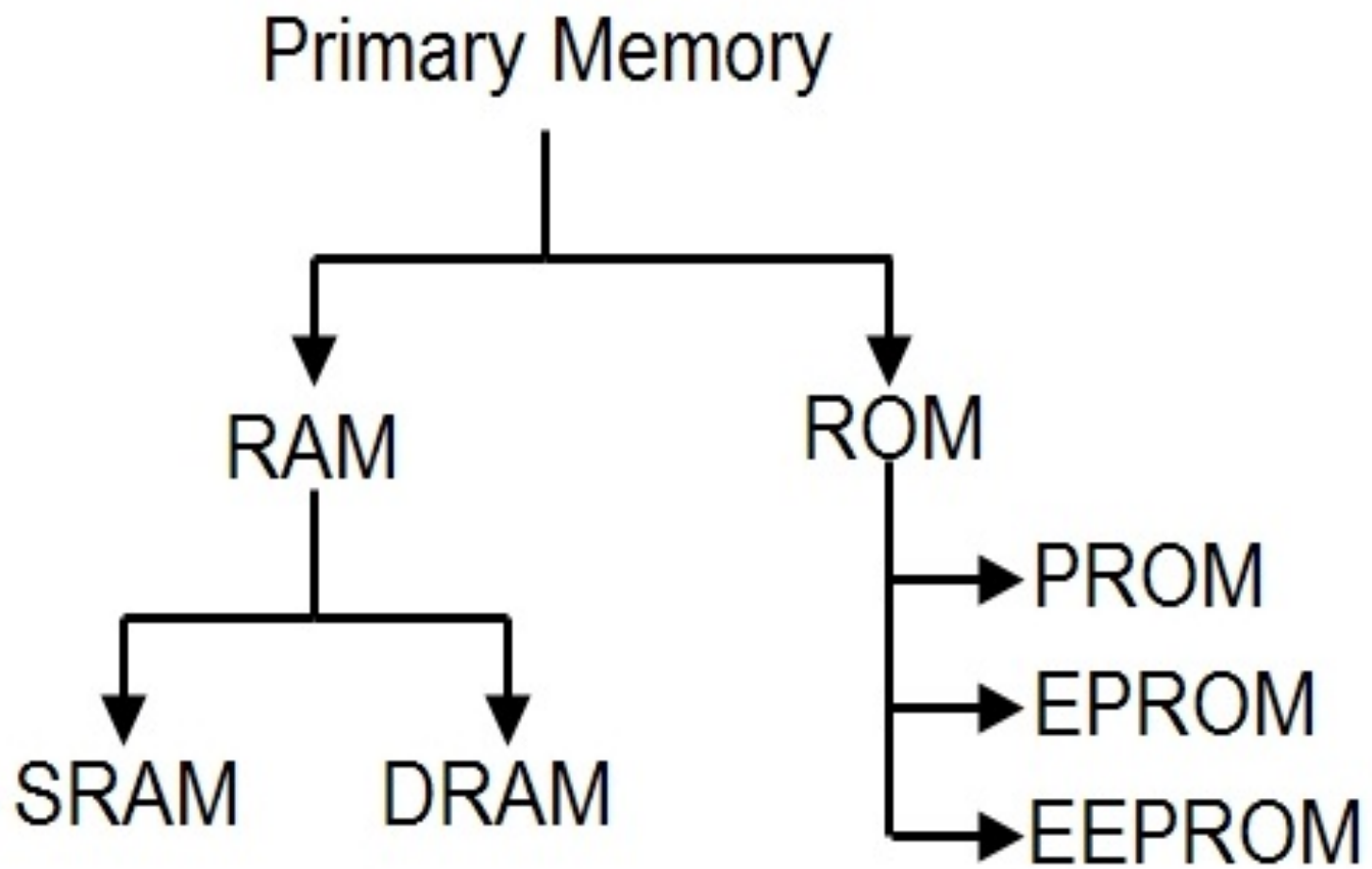

Bits and bytes in memory.
Byte Address
1211
1212
1213
1214
1215
1216
1217
...
Byte
Byte
Byte
Byte
Byte
Byte
Byt
... Memory
1 1 0 1 0 0 0 1
Bit

Types of Memory

- Memory is the most essential element of a computing system because without it computer can’t perform simple tasks.
- Computer memory is of two basic type –
  - ✔ Primary memory(RAM and ROM)
  - ✔ Secondary memory(hard drive,CD,etc.).

Primary Memory

- **Random Access Memory (RAM) –**
- It is also called as *read write memory* or the *main memory* or the *primary memory*.
- The programs and data that the CPU requires during execution of a program are stored in this memory.
- It is a volatile memory as the data loses when the power is turned off.
- RAM is further classified into two types- *SRAM (Static Random Access Memory)* and *DRAM (Dynamic Random Access Memory)*.


Primary Memory
RAM
ROM
SRAM
DRAM
PROM
EPROM
EEPROM

- **DRAM**: DRAM stands for Dynamic RAM.

  The oldest type is known as single data rate (SDR) DRAM, but newer computers use faster dual data rate (DDR) DRAM. DDR comes in several versions including DDR2 , DDR3, and DDR4, which offer better performance and are more energy efficient than DDR. DRAM consists of a transistor and a capacitor in each cell.

- **SRAM**: SRAM stands for Static RAM.

  It is a particular type of RAM which is faster than DRAM, but more expensive and bulker, having six transistors in each cell. For those reasons SRAM is generally only used as a data cache within a CPU itself or as RAM in very high-end server systems. A small SRAM cache of the most imminently-needed data can result in significant speed improvements in a system

DRAM	SRAM
1. Constructed of tiny capacitors that leak electricity.	1.Constructed of circuits similar to D flip-flops.
2.Requires a recharge every few milliseconds to maintain its data.	2.Holds its contents as long as power is available.
3.Inexpensive.	3.Expensive.
4. Slower than SRAM.	4. Faster than DRAM.
5. Can store many bits per chip.	5. Can not store many bits per chip.
6. Uses less power.	6.Uses more power.
7.Generates less heat.	7.Generates more heat.
8. Used for main memory.	8. Used for cache.

Difference between SRAM and DRAM

Read Only Memory (ROM)

- Stores crucial information essential to operate the system, like the program essential to boot the computer.
- It is not volatile.
- Always retains its data.
- Used in embedded systems or where the programming needs no change.
- Used in calculators and peripheral devices.
- ROM is further classified into 4 types- *ROM*, *PROM*, *EPROM*, and *EEPROM*.

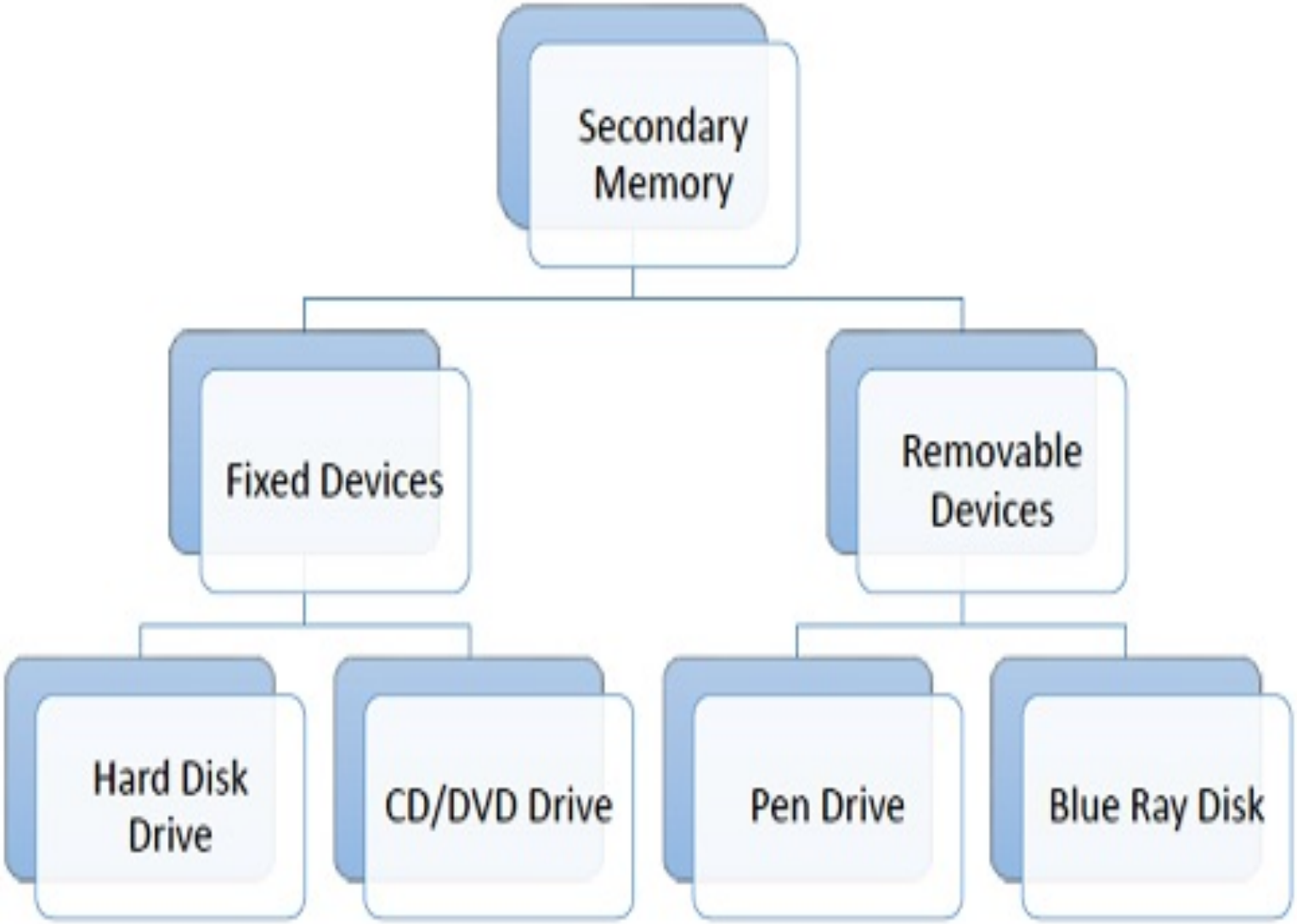
- **Types of Read Only Memory (ROM) –**
- **PROM (Programmable read-only memory)** – It can be programmed by user. Once programmed, the data and instructions in it cannot be changed.
- **EPROM (Erasable Programmable read only memory)** – It can be reprogrammed. To erase data from it, expose it to ultra violet light. To reprogram it, erase all the previous data.
- **EEPROM (Electrically erasable programmable read only memory)** – The data can be erased by applying electric field, no need of ultra violet light. We can erase only portions of the chip.

RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4.Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.

Difference between RAM and ROM

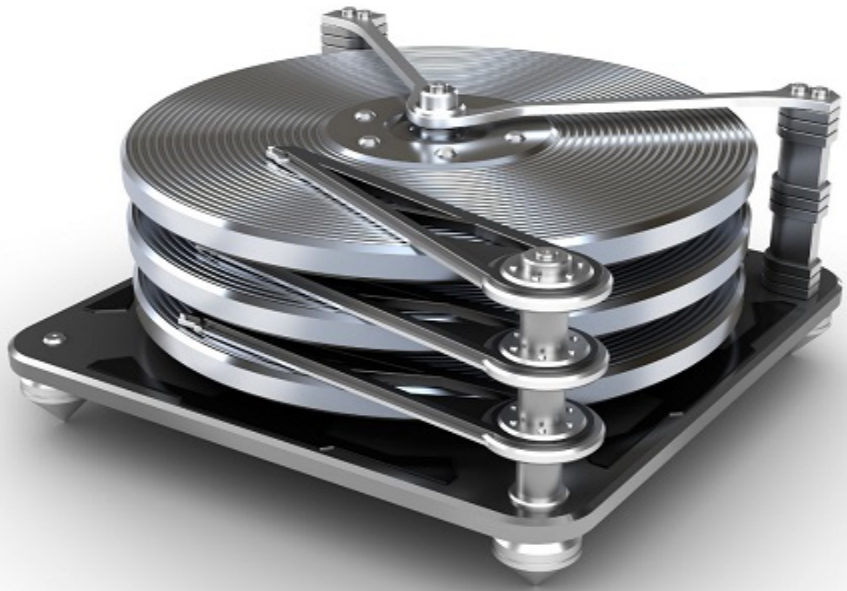
Secondary Memory

- **Secondary storage** is **non-volatile**, long-term storage. Without secondary storage all programs and data would be lost the moment the computer is switched off.
- It is large capacities to the tune of terabytes
- It is cheaper as compared to primary memory
- Depending on whether secondary memory device is part of CPU or not, there are two types of secondary memory – fixed and removable.

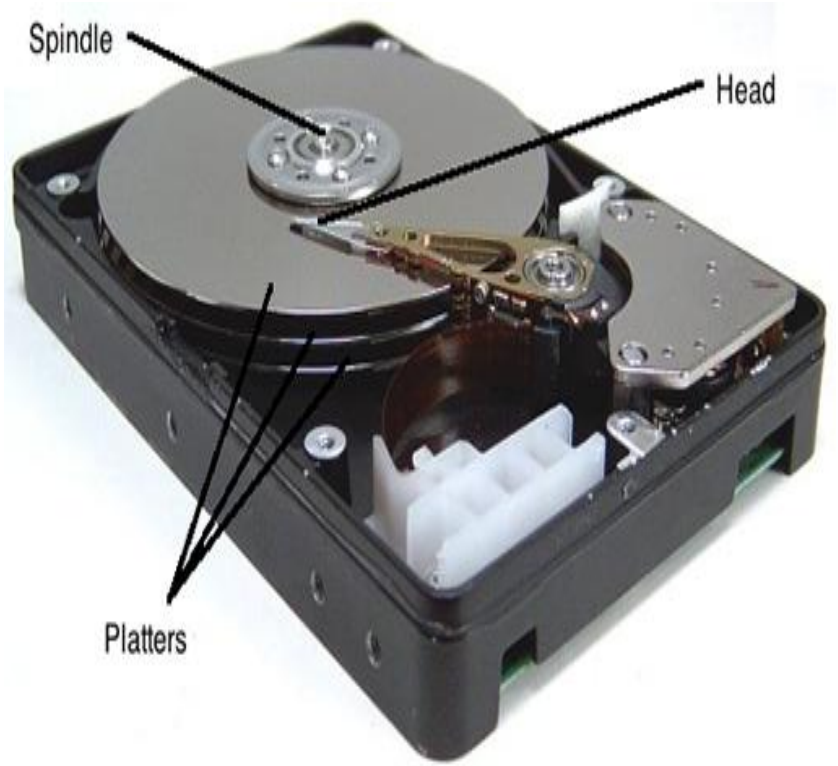

Secondary Memory
Fixed Devices
Removable Devices
Hard Disk Drive
CD/DVD Drive
Pen Drive
Blue Ray Disk

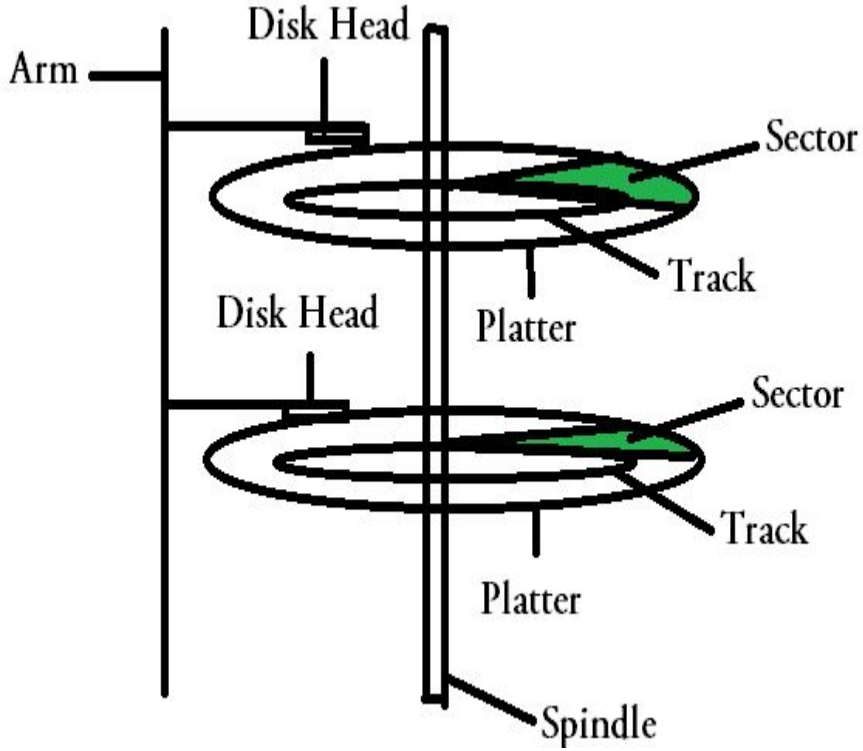
Hard Disk Drive

- Hard disk drive is made up of a series of circular disks called **platters** arranged one over the other almost ½ inches apart around a **spindle**. Disks are made of non-magnetic material like aluminum alloy and coated with 10-20 nm of magnetic material.



Exploded View of Hard Disk





CD Drive

- CD stands for **Compact Disk**. CDs are circular disks that use optical rays, usually lasers, to read and write data.
- They are very cheap as you can get 700 MB of storage space for less than a dollar. CDs are inserted in CD drives built into CPU cabinet. There are three types of CDs −
- **CD-ROM (Compact Disk – Read Only Memory)** − The data on these CDs are recorded by the manufacturer. Proprietary Software, audio or video are released on CD-ROMs.
- **CD-R (Compact Disk – Recordable)** − Data can be written by the user once on the CD-R. It cannot be deleted or modified later.
- **CD-RW (Compact Disk – Rewritable)** − Data can be written and deleted on these optical disks again and again.

DVD Drive

- DVD stands for **Digital Video Display**. DVD are optical devices that can store 15 times the data held by CDs. They are usually used to store rich multimedia files that need high storage capacity. DVDs also come in three varieties – read only, recordable and rewritable.

Pen Drive

- Pen drive is a portable memory device that uses solid state memory rather than magnetic fields or lasers to record data. It uses a technology similar to RAM, except that it is non-volatile. It is also called USB drive, key drive or flash memory.

Blu Ray Disk

- Blu Ray Disk (BD) is an optical storage media used to store high definition (HD) video and other multimedia filed. BD uses shorter wavelength laser as compared to CD/DVD. This enables writing arm to focus more tightly on the disk and hence pack in more data. BDs can store up to 128 GB data.

Cache Memory

- The speed of CPU is extremely high compared to the access time of main memory.
- Therefore the performance of CPU decreases due to the slow speed of main memory.
- **Cache Memory is** a small memory chip is attached between CPU and Main memory whose access time is very close to the processing speed of CPU.
- CACHE memories are accessed much faster than conventional RAM. It is used to store programs or data currently being executed or temporary data

Registers:

- The CPU processes data and instructions with high speed, there is also movement of data between various units of computer.
- It is necessary to transfer the processed data with high speed.
- So the computer uses a number of special memory units called *registers*.
- They are not part of the main memory but they store data or information temporarily and pass it on as directed by the control unit.