

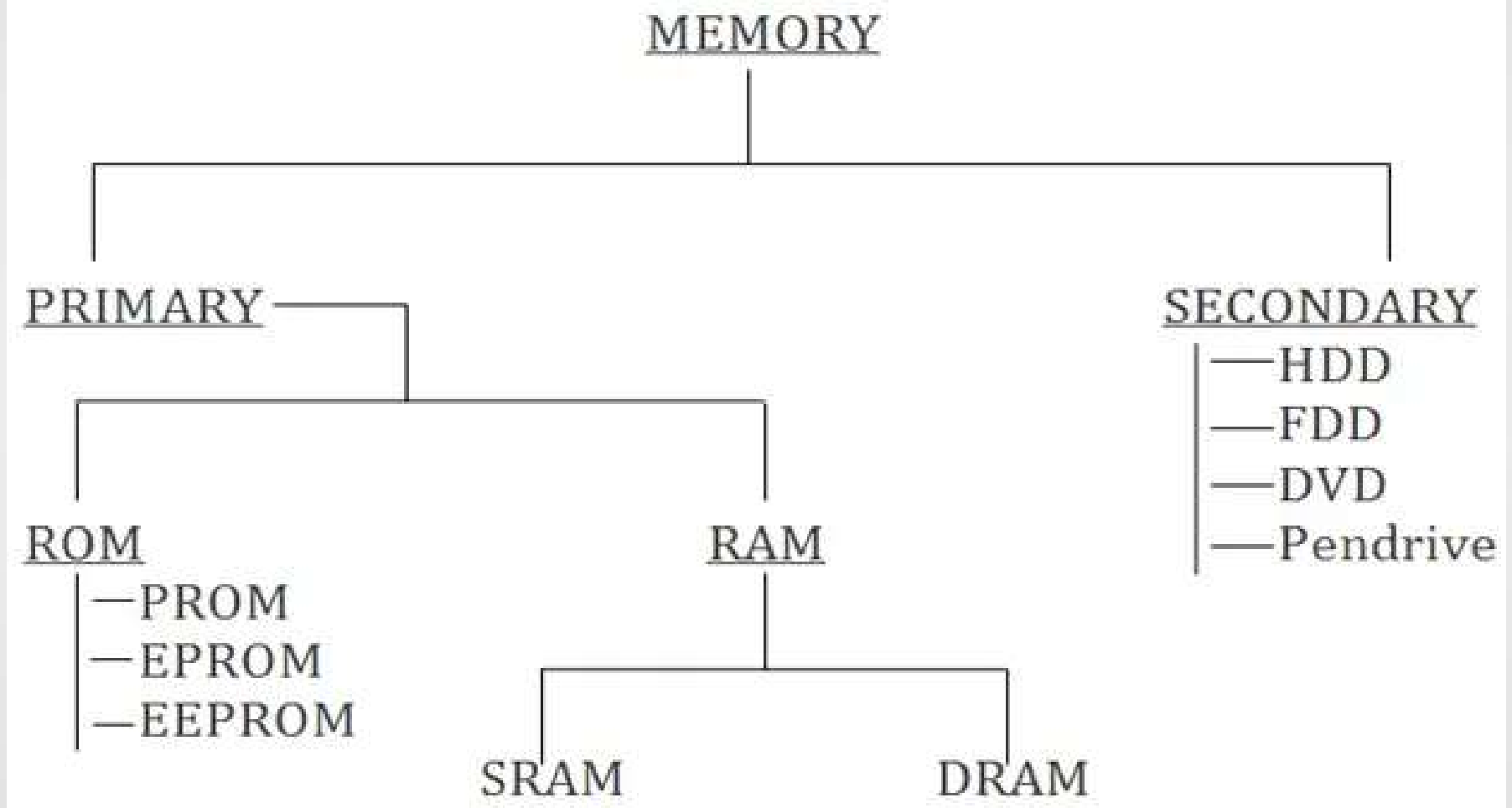
**GLS UNIVERSITY**

**COMPUTER FUNDAMENTALS &  
INFORMATION TECHNOLOGY.  
UNIT- III**

# Memory

- Memory is storage part in computer. It is store the data, information, programs during processing in computer.
- It stores data either temporarily or permanent basis. Memory used to important role in saving and retrieving data.

# Types of Memory



# Types of Memory

- Primary Memory / Volatile Memory.
- Secondary Memory / Non Volatile Memory.
- Cache Memory
- Virtual Memory

# Primary Memory / Volatile Memory

- Primary memory is internal memory of the computer. It is also known as main memory and Temporary memory .Primary Memory holds the data and instruction on which computer is currently working. Primary Memory is nature volatile. It means when power is switched off it lost all data.
- Types of Primary Memory :
  - RAM
  - ROM

# Primary Memory / Volatile Memory

1. **RAM (Random Access Memory)** – It stands for Random Access Memory. RAM is known as read /writes memory. It generally refereed as main memory of the computer system. It is a temporary memory. The information stored in this memory is lost as the power supply to the computer is switched off. That's why RAM is also called “Volatile Memory”

Types of RAM– RAM is also of two types:

- a) **Static RAM-** Static RAM also known as SRAM ,retain stored information as long as the power supply is ON. SRAM are of higher coast and consume more power .They have higher speed than Dynamic RAM

# Primary Memory / Volatile Memory

b)**Dynamic RAM**– Dynamic RAM also known as DRAM, its stored information in a very short time (a few milliseconds) even though the power supply is ON. The Dynamic RAM are cheaper and moderate speed and also they consume less power.

# Primary Memory / Volatile Memory

2. **ROM (Read Only Memory)** – It stands for Read Only Memory. ROM is a Permanent Type memory. Its content are not lost when power supply is switched off. Content of ROM is decided by the computer manufacturer and permanently stored at the time of manufacturing. ROM cannot be overwritten by the computer. It is also called “Non-Volatile Memory”.

Type of ROM: ROM memory is three types names are following-

- a) **PROM(Programmable Read Only Memory)**- PROM chip is programmable ROM. It is PROM chips to write data once and read many. Once chip has been programmed, the recorded information cannot be changed. PROM is also nonvolatile memory.



# Primary Memory / Volatile Memory

- b) **EPROM (Erasable Programmable Read Only Memory)**- EPROM chip can be programmed time and again by erasing the information stored earlier in it. Information stored in EPROM exposing the chip for some time ultraviolet light .
- c) **EEPROM (Electrically Erasable Programmable Read Only Memory)**-The EEPROM is programmed and erased by special electrical waves in millisecond. A single byte of a data or the entire contents of device can be erased.

# Secondary Memory / Non Volatile Memory

- Secondary Memory is external memory of the computer. It is also known as Auxiliary memory and permanent memory. It is used to store the different programs and the information permanently. Secondary Memory is nature non volatile. It means data is stored permanently even if power is switched off.

The secondary storage devices are:

- Floppy Disks
- Magnetic (Hard) Disk
- Magnetic Tapes
- Pen Drive
- Winchester Disk
- Optical Disk(CD,DVD)

Primary storage	Secondary storage
Also known as Main memory or Internal memory.	Also known as External memory or Auxiliary memory.
Data is directly accessed by the processing unit.	Data is first transferred to main memory and then routed to processing unit.
Semi conductor chips are used to store information in primary memory.	Magnetic disk, optical disks are used to store information in secondary memory.
Information stored is temporary and it can be lost when there is a sudden power cut.	Information stored is permanent unless one deletes it intentionally.
Data operated and stored in uniform manner.	Data stored is not uniform in secondary memory.
Primary memory devices are more expensive than secondary storage devices.	Secondary memory devices are less expensive when compare to primary memory devices.
Nature of Parts of Primary memory varies. RAM- volatile in nature. ROM- Non-volatile	It is little slow in interacting with micro processor.
Primary memory has limited storage capacity.	Whereas secondary memory can store bulk amounts of data in a single unit.
Examples: RAM, ROM, Cache memory, PROM, EPROM, Registers etc	Examples: Magnetic Tapes, Optical Disc, Floppy Disks, Flash memory [USB drives], Paper Tape, Punched cards etc.

# Virtual Memory

- Virtual memory is a feature of an operating system that enables a computer to be able to compensate shortages of physical memory by transferring pages of data from random access memory to disk storage.
- A computer can address more memory than the amount physically installed on the system. This extra memory is actually called virtual memory and it is a section of a hard disk that's set up to emulate the computer's RAM.
- It is a concept used to construct large programs though the physical memory has limited space.
- OS keeps the large program in the secondary memory and brings only a part of the program in main memory.

# Virtual Memory

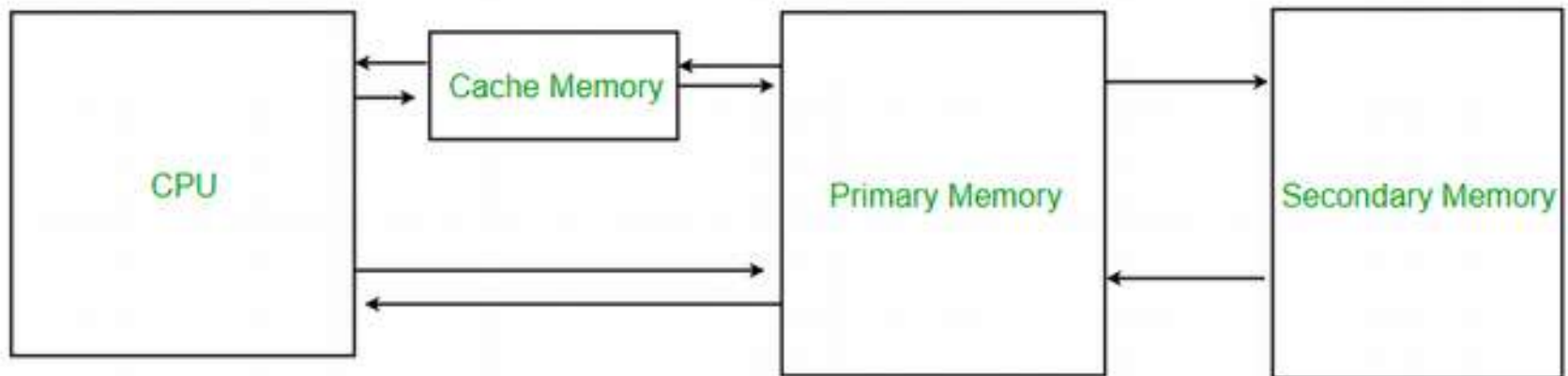
- The address generated by CPU is known as virtual address. Each virtual address is mapped to physical address in main memory.
- The mapping or translation is handled by the operating system and the CPU hardware.
- The user is given an illusion of a large memory for his use, even though the system has small main memory.
- The main visible advantage of this scheme is that programs can be larger than physical memory.
- Virtual memory serves two purposes. First, it allows us to extend the use of physical memory by using disk.
- Second, it allows us to have memory protection, because each virtual address is translated to a physical address.



# Cache Memory

- Cache Memory is a special very high-speed memory. It is used to speed up and synchronizing with high-speed CPU.
- Cache memory is costlier than main memory or disk memory but economical than CPU registers. Cache memory is an extremely fast memory type that acts as a buffer between RAM and the CPU.
- It holds frequently requested data and instructions so that they are immediately available to the CPU when needed.
- Cache memory is used to reduce the average time to access data from the Main memory.
- The cache is a smaller and faster memory which stores copies of the data from frequently used main memory locations. There are various different independent caches in a CPU, which store instructions and data.

# Cache Memory



# Cache Memory

- The fundamental idea of cache memory is to keep frequently used data and instructions in the cache, thus reducing the access time.

## Cache hit and Cache Miss:

- When the CPU access the main memory the cache controller checks to see whether the data is inside the cache or not.
- If data is in cache it is termed as “Cache hit”
- If the data is not present in the cache it is termed as “Cache Miss”

## Hit Ratio:

- Performance of the cache is measured in terms of Hit ratio.
- It is the ratio of the number of hits divided by the total number of references to the memory.

**Hit Ratio= Number of hits/ Total number of memory references**



# Storage Devices

- **Hard Disk**
- **Solid State Devices**
- **Magnetic Tape**
- **Magnetic Disks**
- **CD**
- **DVD**
- **Blu-Ray**
- **USB Drives**

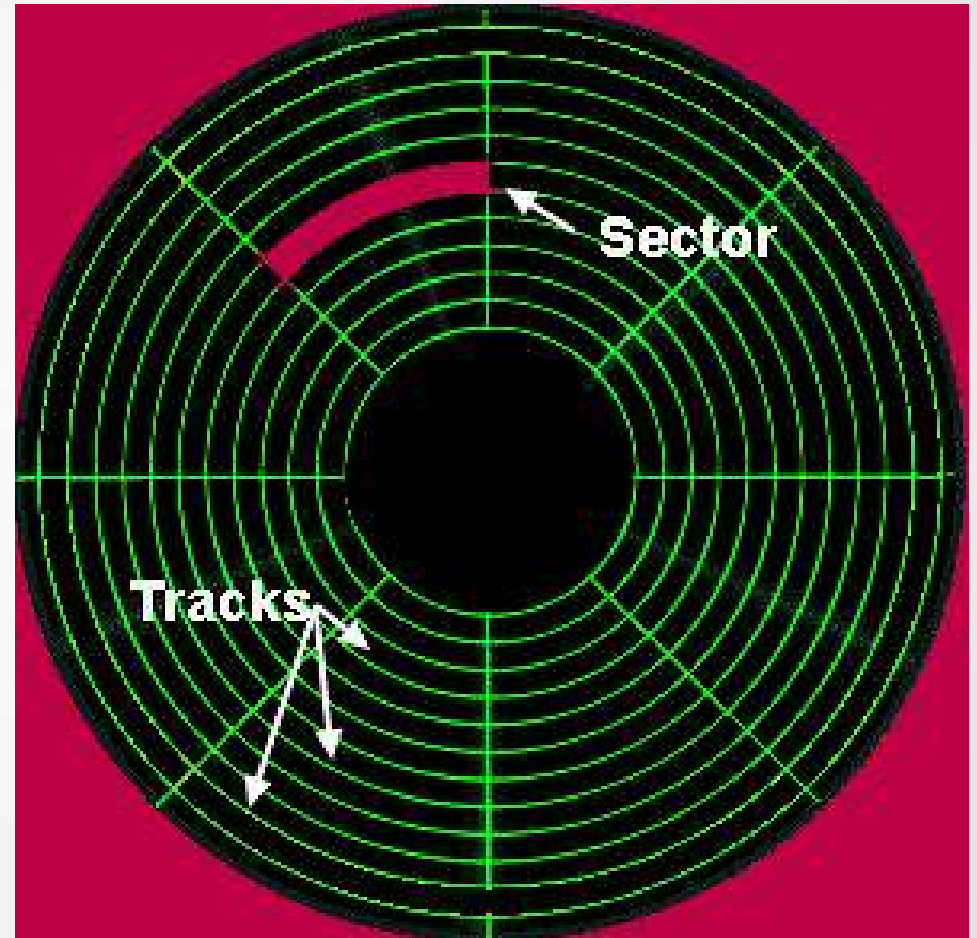
# Storage Devices

- **Definition :-**
- A Storage device is the computer hardware that records and/or retrieves items to and from storage media.
- A storage device is a kind of hardware, which is also known as storage, storage medium, digital storage, or storage media that has the ability to store information either temporarily or permanently.
- **Writing** is the process of transferring data, instructions, and information from memory to a storage medium.
- **Reading** is the process of transferring these items from a storage medium into memory.

# Floppy Disk/ Diskette

- It is a portable, inexpensive storage medium that consists of a thin, circular, flexible plastic Mylar film with a magnetic coating enclosed in a square-shaped plastic shell.
- A floppy disk drive (FDD) offers users the benefit of saving data to removable diskettes. FDDs have been replaced with other storage devices like network file transfer and USB.
- A standard floppy disk has storage capacities up to 1.44 MB.
- The first floppy disks, developed in the late 1960s, are 8 inches in diameter.
- Data is generally written to floppy disks in sectors (angular blocks) and tracks

# Floppy Disk



# Hard Disks/Hard disk drive/Hard drive

- A hard disk drive (HDD) is used to store data permanently as it is a non-volatile computer storage device, and directly connected to the disk controller of the computer's motherboard. Usually, it is installed internally in a computer, known as secondary storage device.
- It is a storage device that contains one or more inflexible, circular platters that magnetically store data, instructions and information. Most desktop contains at least one hard disk.
- The entire device is enclosed in an airtight, sealed case to protect it from contamination.
- A hard disk that is mounted inside the system unit sometimes is called a fixed disk because it is not portable.



# Characteristics of Hard Disk

- ✓ Capacity
- ✓ Platters
- ✓ Read/Write heads
- ✓ Cylinders
- ✓ Sectors & Tracks
- ✓ Revolutions per minute
- ✓ Transfer rate
- ✓ Access time

# Hard Disks/Hard disk drive/Hard drive

- ✓ The **capacity** of a hard disk is determined from the number of platters it contains.
- ✓ A **platter** is made of aluminum, glass, or ceramic and is coated with an alloy material that allows items to be recorded magnetically on its surface.



# Hard Disks/Hard disk drive/Hard drive

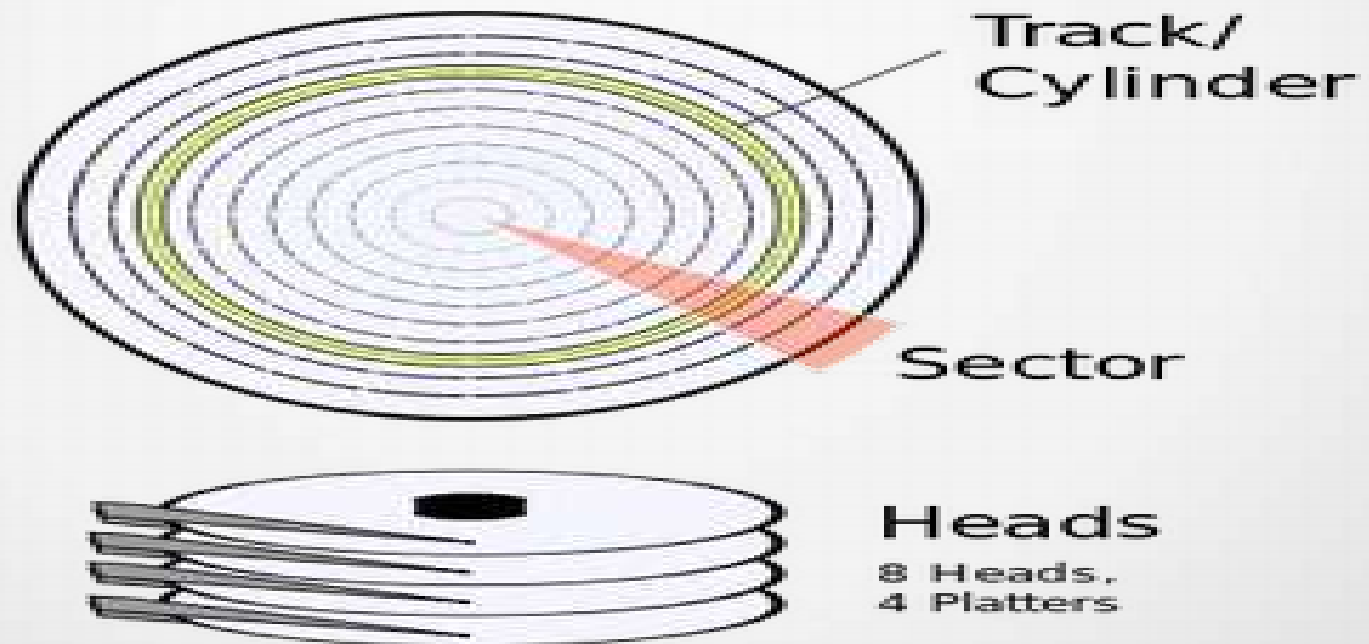
- ✓ A **read/write head** is the mechanism that reads items and writes items in the drive s it barely touches the disk's recording surface.
- ✓ A **cylinder** is the vertical section of a track that passes through all platters.





# Hard Disks/Hard disk drive/Hard drive

- ✓ All information stored on a hard disk is recorded in **tracks**.
- ✓ Each track is broken into smaller units called **sectors**.



# Hard Disks/Hard disk drive/Hard drive

- **RPM** is a measurement of how many revolutions a computer's hard drive makes in a single minute.
- The disk **transfer rate** (sometimes called media rate) is the speed at which data is transferred to and from the disk media (actual disk platter) and is a function of the recording frequency.
- **Access time** is the time from the start of one storage device access to the time when the next access can be started.

# Solid State Devices

- Solid-state storage (SSS) is a type of non-volatile computer storage that stores and retrieves digital information using only electronic circuits, without any involvement of moving mechanical parts.
- Solid-state storage devices typically store data using electrically-programmable non-volatile flash memory, however some devices use battery-backed volatile random-access memory (RAM).
- Having no moving mechanical parts, solid-state storage is much faster than traditional electro-mechanical storage; as a downside, solid-state storage is significantly more expensive and suffers from the write amplification phenomenon.
- It don't have moving parts or spinning disks. They use interconnected pools of flash memory that are managed by an SSD controller to deliver speeds far beyond what an HDD can offer.

# Solid State Devices

Inside of an SSD



Inside of an HDD



# Magnetic Tape

- ✓ Originally, magnetic tape was designed to record sound. In computing, it holds binary data. In recent years, magnetic tape devices have become more scarce with the emergence of digital imaging and audiovisual media storage.
- ✓ Magnetic tape consists of magnetic materials that store data permanently.
- ✓ In magnetic tape only one side of the ribbon is used for storing data. It is sequential memory which contains thin plastic ribbon to store data and coated by magnetic oxide.
- ✓ Data read/write speed is slower because of sequential access. It is highly reliable which requires magnetic tape drive writing and reading data.

# Magnetic Tape

- ✓It can be 12.5mm to 25mm wide plastic film-type and 500m to 1200m long which is coated with the magnetic material.
- ✓it has storage capacity 100 MB to 200 GB.
- ✓It is same to the cassette tape recorder.
- ✓Magnetic tapes are used for large computers like mainframe computers where large volume of data is stored for a longer time.

# Magnetic Tape



# Magnetic Disks

- ✓ A magnetic disk is a storage device that uses a magnetization process to write, rewrite and access data.
- ✓ Magnetic Disk contains circular disk made of metal or plastic. Both side of disk is usually used for storing data. The disk is coated by magnetic oxide. The disk is divided into multiple concentric circles known as track and tracks are divided into sectors in which data are stored.
- ✓ Magnetic disks use magnetic particles to store items such as data, instruction.
- ✓ A magnetic disk primarily consists of a rotating magnetic surface and a mechanical arm that circulates over it. The mechanical arm is used to read from and write data to the disk.

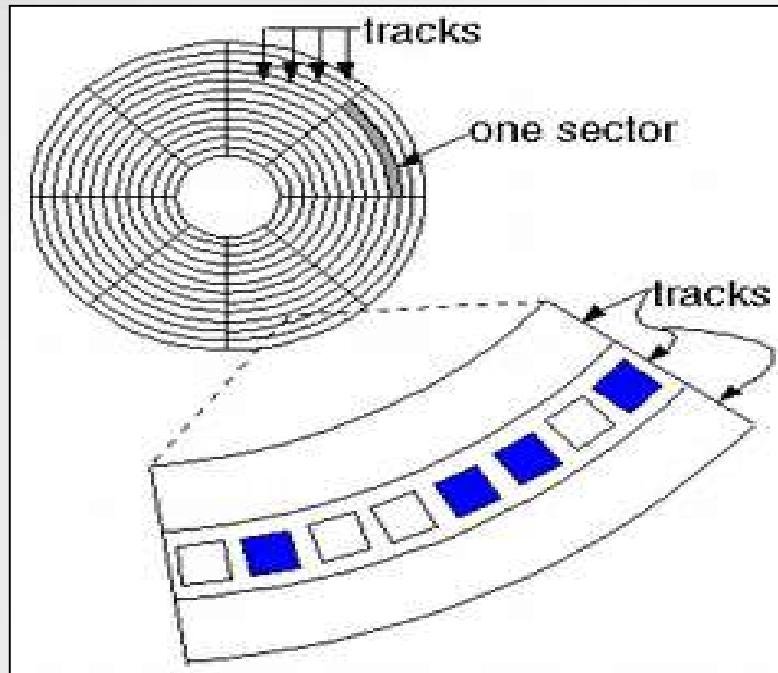


# Magnetic Disks

✓Data are organized on the disk in the form of tracks and sectors, where tracks are the circular divisions of the disk. Tracks are further divided into sectors that contain blocks of data. All read and write operations on the magnetic disk are performed on the sectors.

✓The information is accessed using one or more read/write heads  
Example: Hard disks, floppy disks

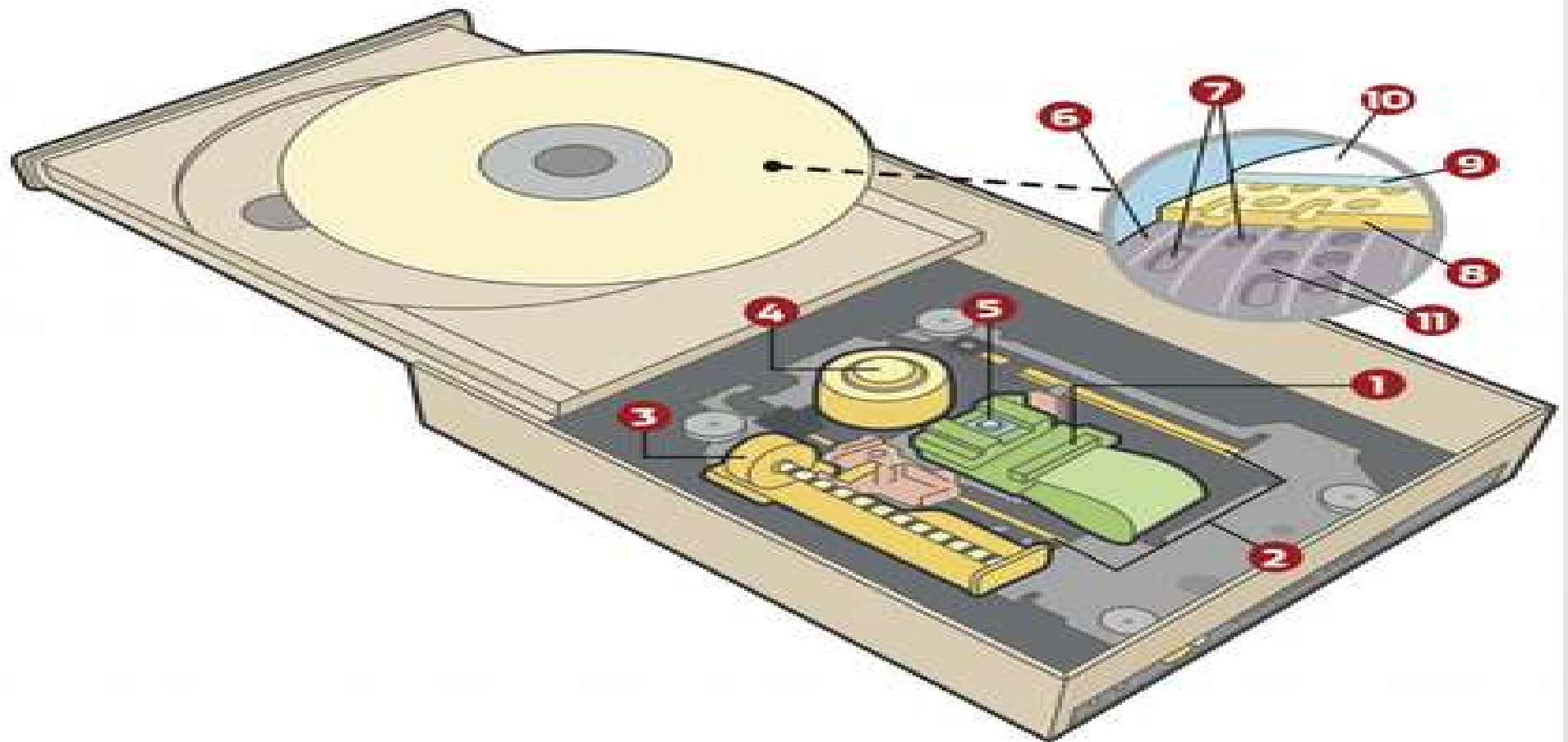
# Magnetic Disks



# CD-ROM

- A **CD-ROM** or compact disc read-only memory, is a type of optical disc that users can read but not write or erase- hence the name read-only.
- It cannot be deleted or changed. It was more popular for distributing games and software for several consoles.
- Computers can read—but not write or erase—CD-ROMs, i.e. it is a type of read-only memory.
- It is already pre recorded and the data on it cannot be altered.
- It usually has a storage capacity of 700 MB.

# CD-ROM



# CD-Rs & CD-RWs

- ✓ **CD-R(Compact Disc - Recordable)** is that you can only write to them once.
- ✓ It is a multi session optical disc on which users can write at once, but not erase, their own items such as text, graphics, and audio.
- ✓ A **CD-RW(Compact Disc - Rewritable)** is an erasable multi session disc you can write on multiple times.
- ✓ CD-ReWritable disk, a type of CD disk that enables you to write onto it in multiple sessions.
- ✓ With CD-RW drives and disks, you can treat the optical disk just like a floppy or hard disk, writing data onto it multiple times.

# Definitions:

✓ The process of writing on an optical disc is called **burning**.

✓ **Ripping** is the process of copying audio or video content to a hard disk, typically from removable media such as compact disc (CD) or DVD, although the word refers to all forms of media.

# **DVD: Digital Video Disc or Digital Versatile Disc**

- DVD stands for Digital Versatile Disc.
- It is commonly known as Digital Video Disc.
- It is a digital optical disc storage format used to store high capacity data like high quality videos and movies.
- It is also used to store operating system.
- It is invented and developed by 4 companies named Philips, Sony, Toshiba and Panasonic in 1995.
- DVDs provide higher storage capacity than CDs( compact disc) and can be played in multiple types of players like DVD players.

# DVD

## Types

On the basis of applications, a DVD can be categorized in different ways as described below:

**DVD-ROM:** It can only be used for reading and cannot be written.

**DVD-R:** It can be used to record any type of data.

**DVD-RW:** It can be read, written, erased and rewritten.

## Advantages

- Large storage capacity, e.g. 4.7 to 9 Gb
- Excellent sound and picture quality, so best option to store videos and audios
- Relatively cheap as they are mass-produced
- Information can be stored on both sides of DVD unlike CD.



# Blu-ray Disc

- ✓The Blu-ray Disc (BD), often known simply as Blu-ray, is a digital optical disc storage format.
- ✓It is designed to supersede the DVD format, and capable of storing several hours of high-definition video
- ✓A **Blu-ray Disc** has storage capacities of 100 GB, with expectations of exceeding 200 GB in the future.
- ✓Designed to hold 5 times more information than DVDs
- ✓It is an optical disc format designed to display high definition video and store large amounts of data.
- ✓A blu-ray disc is a optical storable device that stores high-definition video
- ✓ Blu-ray, also known as Blu-ray Disc (BD) is the name of a next-generation optical disc format.

# USB DRIVES

- ✓ A USB flash drive is a device used for data storage that includes a flash memory and an integrated Universal Serial Bus (USB) interface.
- ✓ Most USB flash drives are removable and rewritable.
- ✓ Physically, they are small, durable and reliable.
- ✓ The larger their storage space, the faster they tend to operate.
- ✓ USB flash drives are mechanically very robust because there are no moving parts.
- ✓ They derive the power to operate from the device to which they are connected (typically a computer) via the USB port.
- ✓ A USB flash drive may also be known as a flash drive or USB drive.

# USB DRIVES

- ✓USB drives are used for auxiliary storage, backup, data transfer between computers
- ✓They can also hold an operating system and be used to boot the computer (bootable disk).

**The main components of the USB flash drive are:**

- ✓**Standard USB plug.** This provides connects the flash drive to a device.
- ✓**USB mass storage controller.** This is a microcontroller for the USB. It has a small amount of RAM and ROM.
- ✓**NAND flash memory chip.** The data is stored in the this component
- ✓**Crystal oscillator.** The data output is controlled by this component.

# USB DRIVES

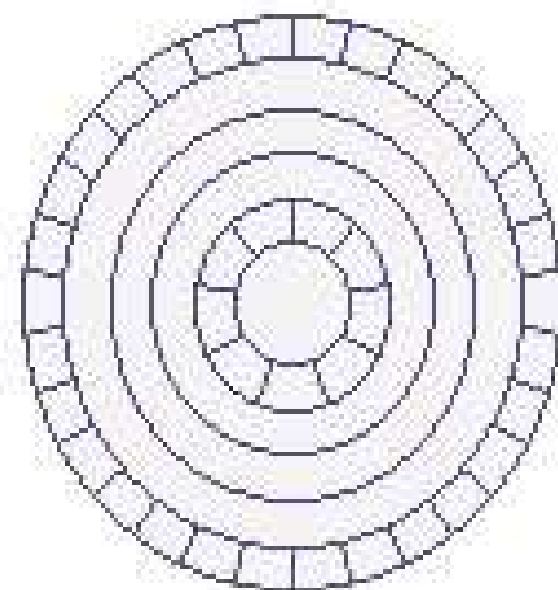
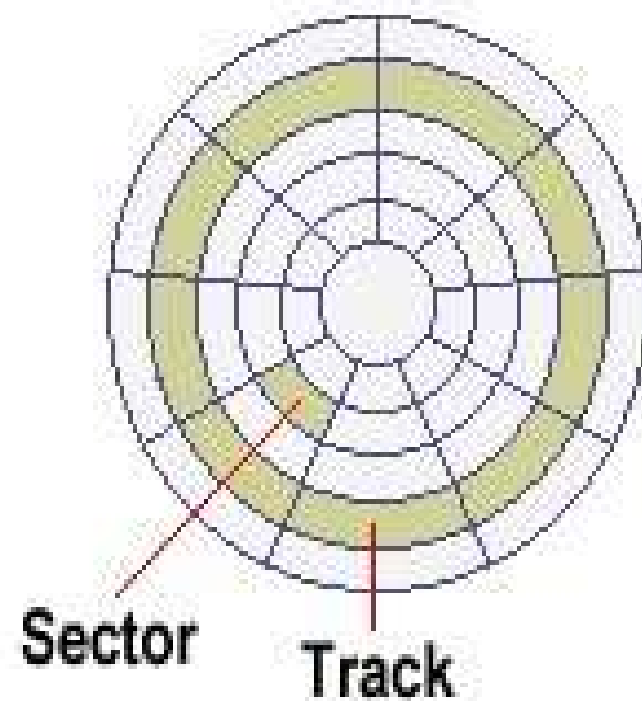
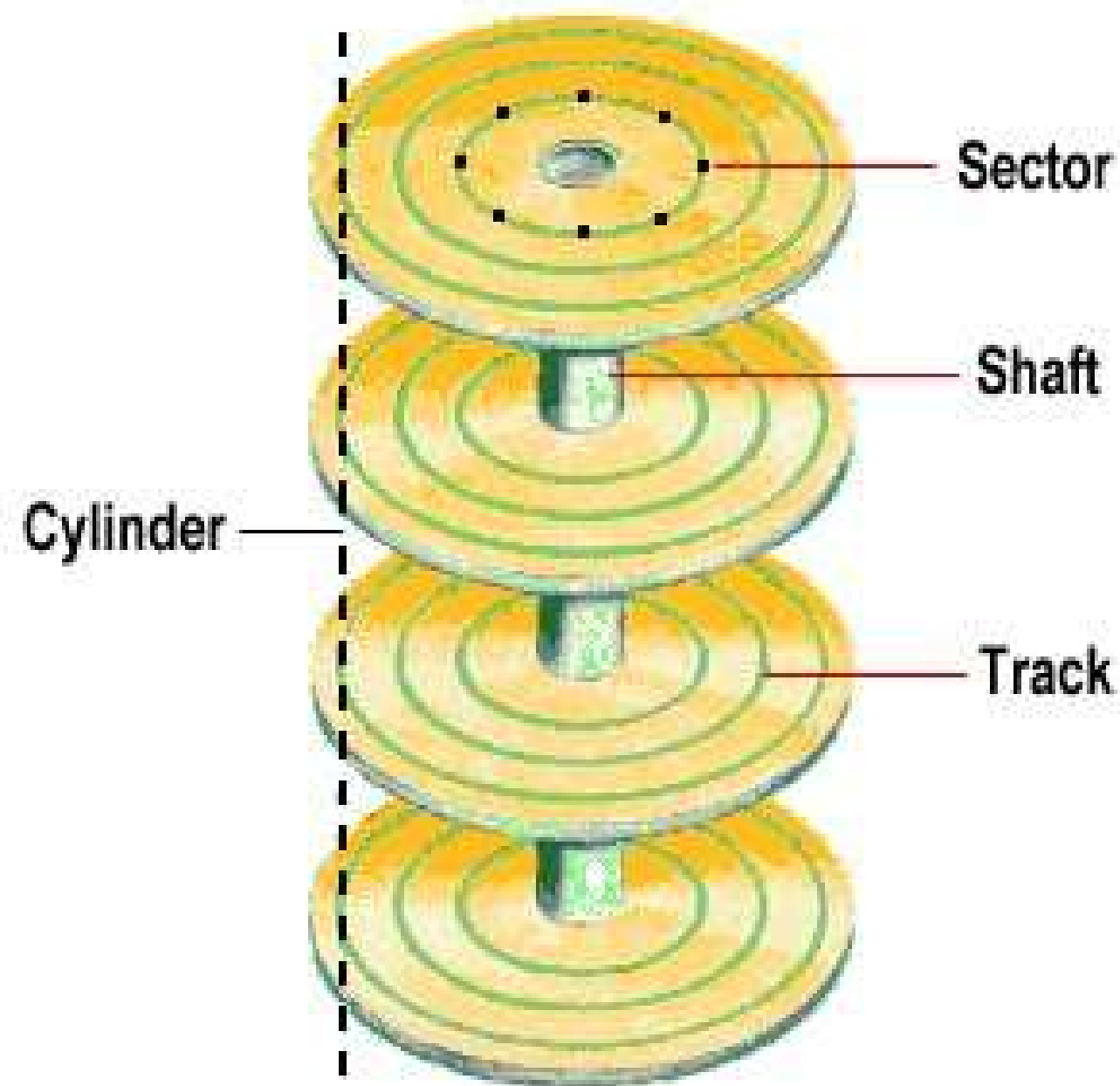


# Storage Mechanism

- ✓Tracks
- ✓Sectors
- ✓Clusters
- ✓Cylinders

# Tracks

- ✓ **A track is a narrow recording band that form a full circle on the surface of the disk.**
- ✓ It is a physical division of data in a disk drive.
- ✓ On a hard disk, data is stored in thin, concentric bands.
- ✓ A drive head, while in one position can read or write a circular ring, or band called a track.
- ✓ There can be more than a thousand tracks on a 3.5-inch hard disk.
- ✓ **Sections within each track are called sectors.**
- ✓ A sector is the smallest physical storage unit on a disk, and is almost always 512 bytes (0.5 kB) in size.



**Zoned-bit recording**

# Sectors

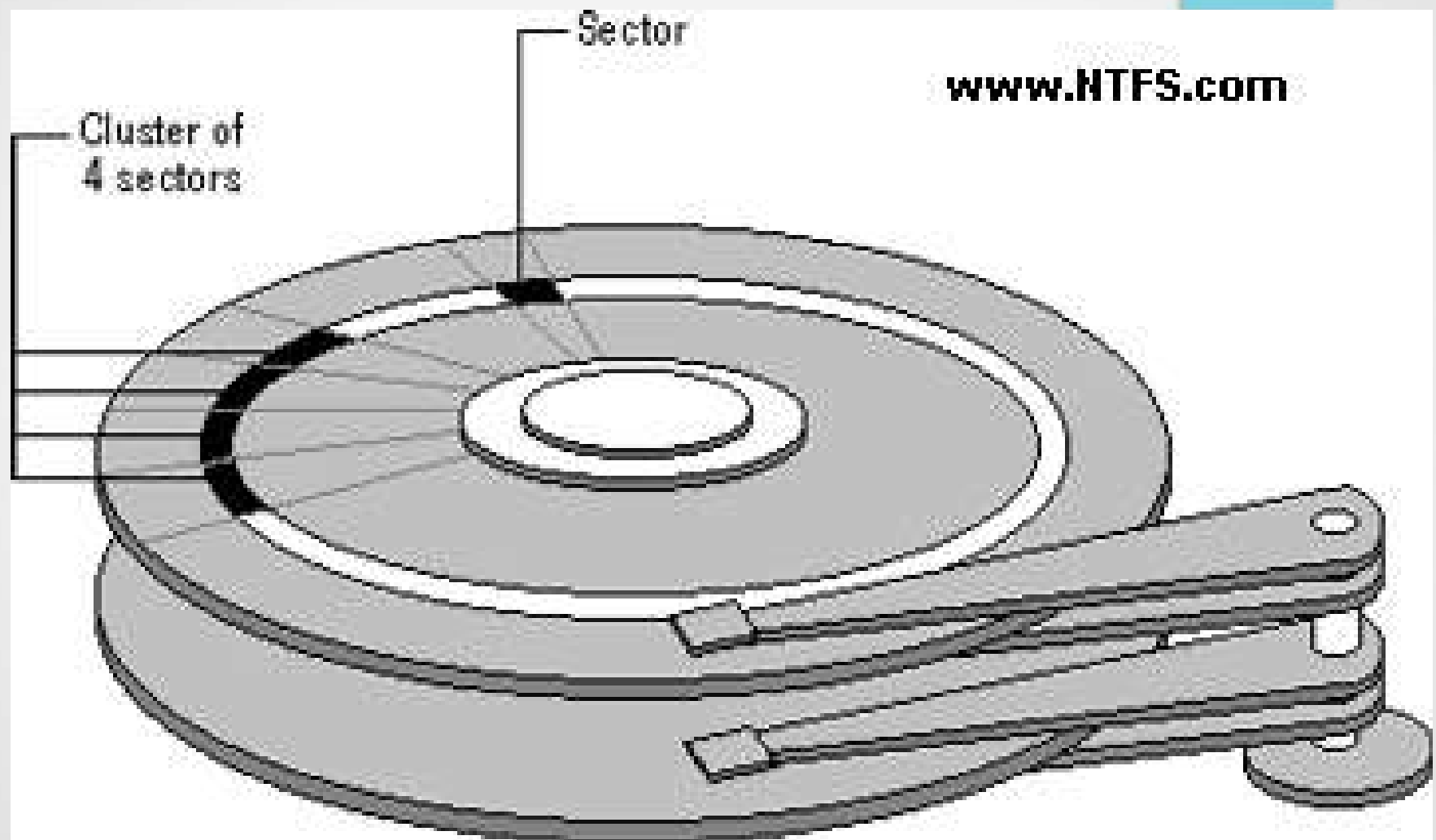
- ✓The disk storage locations consists of pie-shaped sections, which break the tracks into small arcs called sectors.
- ✓It is a subdivision of a track on a magnetic disk or optical disc
- ✓A sector is the smallest physical storage unit on the disk
- ✓Each sector stores a fixed amount of user-accessible data, traditionally 512 bytes for hard disk drives because 512 is a power of 2 (2 to the power of 9) and 2048 bytes for CD-ROMs and DVD-ROMs



# Clusters

- ✓ For reading and writing purpose sectors are grouped into clusters.
- ✓ A cluster is smallest unit of disk space that stores data and information.
- ✓ Each cluster also called an allocation unit, consists of two to eight sectors.
- ✓ A cluster can consist of one or more consecutive sectors.
- ✓ They are called clusters because the space is reserved for the data contents.
- ✓ Even if file consists of only a few bytes it uses an entire cluster.
- ✓ Each cluster holds data from only one file. One file however can span many clusters.

# Clusters



# Cylinders

A cylinder is basically the set of all tracks that all the heads are currently located at. The aggregate of all tracks that reside in the same location on every disk surface.

- ✓ It is the vertical section of a track that passes through all platters.
- ✓ A single movement of the read/write head arms accesses all the platters in a cylinder.

On multiple-platter disks, the cylinder is the sum total of every track with the same track number on every surface. On a floppy disk, a cylinder comprises the top and corresponding bottom track.

# Cylinders

- ✓ If a hard disk has two platters (4 sides) each with 1000 tracks, then it will have 1000 cylinders with each cylinder consisting of 4 tracks.
- ✓ So if a disk had four platters, it would (normally) have eight heads, and cylinder number 720 (for example) would be made up of the set of eight tracks, one per platter surface, at track number 720.

# Data Access Time

1. Seek Time
2. Latency Time
3. Access Time
4. Response Time

# Data Access Time

- ✓ **Seek Time** is measured defines the amount of time it takes a hard drive's read/write head to find the physical location of a piece of data on the disk
- ✓ **Latency** is the average time for the sector being accessed to rotate into position under a head, after a completed seek.
- ✓ **Access time** is the total time it takes the computer to read data from a storage device such as computer memory, hard drive, CD-ROM or other mechanism
- ✓ Computer access time is commonly measured in nanoseconds or milliseconds

# Data Access Time

- ✓ **Response time** is the total amount of time it takes to respond to a request for service.
- ✓ That service can be anything from a memory fetch, to a disk IO, to a complex database query, or loading a full web page.
- ✓ Ignoring transmission time for a moment, the response time is the sum of the service time and wait time.

# Portable Storage Device

- ✓ A portable storage device (PSD) is a small hard drive designed to hold any kind of digital data.
- ✓ This is slightly different from a portable media player, which stores and plays music and movies.(Ex.DVD Player)
- ✓ When travelling, a portable storage device may be a useful alternative to backing up or purging memory cards if a computer is unavailable for downloading.
- ✓ A portable device is any device that can easily be carried. It is a small form factor of a computing device that is designed to be held and used in the hands.
- ✓ Portable devices are becoming an increasingly important part of personal computing as the capabilities of devices like laptops, tablets and smartphones continue to improve.
- ✓ A portable device may also be called a handheld device or mobile device.



# Mobile Storage

- Smartphones are getting better and better in terms of technology these days. We often witness with our devices that we do not get that memory storage that has been advertised to us in terms of internal storage and the companies just say that the remaining is reserved for operating system.
- Users often get confused with different memory storage options.
- Smart phones have built-in slots or ports to read from and write on mobile storage media.
- For mobile devices without built-in slots, users insert the media in separate peripherals such as a card reader/writer, which typically plugs into a USB port.

# Mobile Storage

- There are two types of memory capacities in our smartphones these days:
  1. **Built-in (Internal & Phone) and**
  2. **External (Flash Cards/Memory Cards/MM Cards etc).**
- There are many storage media, two of them are :
  - Flash Memory Cards
  - USB Flash Drives

# Mobile Storage



# Mobile Storage

- **Built-In Storage - Phone Storage:**
- This is the storage that is available to you. This is the storage that you get from the total internal storage capacity of the device.
- Your games and applications are installed in this one and it is the default memory for storing your pictures, movies, songs and so on. You can access it when you connect your device to the computer.

# Mobile Storage



# Flash Memory Cards

- It is the storage which can be removed easily by you (your memory card) and can be used for storing pictures, music, videos and the likes. You may or may not be able to install applications on it. This is because some manufacturers allow for it while some don't. To an extent, even your cloud storage can be categorized as external storage
- Types of Flash Memory Cards : CompactFlash(CF) , Secure Digital (SD),xD Picture Card , Memory Stick.
- Transfer rates can be from about 1 Mbps to 10MBps.
- It is quite expensive.
- If your computer does not have built-in slot,you can purchase a card reader/writer,which is a device that reads and writes the data and stored on the flash memory card.

# Flash Memory Card



# Flash Memory Drives

- A USB flash drive, sometimes called a pen drive or thumb drive, is a flash memory storage device that plugs in a USB port on a computer.
- It is small and lightweight enough to be transported on a pocket.
- With a USB flash drive, users easily transfer documents, pictures, music and videos from one computer to another.
- Transfer rates can be 12MBps.
- Storage capacity ranging from 32 MB to 64GB.
- With latter being extremely expensive.



# Flash Memory Drive



# Cloud & Network Storage

## Cloud Storage :

- ✂ Does anyone have a lot of files on their computer but doesn't have the space to store them?
- ✂ Do you worry about losing files?
- ✂ Do you want your files to be secure and easily accessible?
- ✂ Online file storage centers or cloud storage providers allow you to safely upload your files to the Internet.
- ✂ Cloud storage is a service model in which data is maintained, managed, backed up remotely and made available to users over a network (typically the Internet). Users generally pay for their cloud data storage on a per-consumption, monthly rate. Although the per-gigabyte cost has been radically driven down

# What is Cloud Storage? How doe it work?

1. Cloud storage is a remote platform that uses a highly virtualized, multi-tenant infrastructure to provide enterprises with scalable storage resources that can be provisioned dynamically as required by the organization. This service is offered by a wide array of cloud storage providers.
2. Cloud storage involves at least one data server that a user connects to via the internet. The user sends files manually or in an automated fashion over the Internet to the data server which forwards the information to multiple servers. The stored data is then accessible through a web-based interface.
3. Examples of Cloud Storage are Google Docs, Xdrive, MediaMax and Strongspace.

# Network Storage

## **Network Storage:**

✂ A network storage system maintains copies of digital data across high speed local area network (LAN) connections. It is designed to back up files, databases and other data to a central location that can easily accessed via standard network protocols and tools.

✂ **SAN and NAS:** Two standard types of network storage are called Storage Area Network (SAN) and Network Attached Storage (NAS).

- ▢ SAN is typically used on business networks. It utilizes high-end servers, high capacity disk arrays and Fibre Channel interconnection technology.
- ▢ Home networks typically use NAS, which involves installing hardware called NAS devices onto the LAN via TCP/IP.

## NAS

Often used in homes and small to medium sized businesses.

Less expensive.

Easier to manage.

Data accessed as if it were a network-attached drive.

Speed dependent on local TCP/IP Ethernet network, typically 1GbE to 10GbE, and

## SAN

Often used in professional and enterprise environments.

More expensive.

Requires more administration.

Servers access data as if it were a local hard drive.

High speed using Fibre Channel, most commonly available in 16 Gb/s to 32 Gb/s.