Types of Magnetic Storage Devices:

Computer systems need to store data in digital format. One of the most widely used types of digital data storage is **magnetic storage**. This refers to any type of data storage using a magnetized medium. Digital data consists of **binary information**, which is data in the form of zero and ones. There are two types of magnetic polarities, each one used to represent either zero or one.

Magnetic storage is a form of **non-volatile storage**. This means that the data is not lost when the storage device is not powered.

Magnetic storage is widely used because it is relatively cheap in comparison with other storage technologies. Magnetic storage is read-write, which makes it possible to re-use the storage capacity over and over again by deleting older data. The storage capacity is also very large, making it attractive for storing very large amounts of data. The major limitation of magnetic storage is that accessing the data can be quite slow.

Types Include:

1. Floppy disk
2. Hard disk
3. Magnetic tape
4. Magnetic disks

1. Floppy Disk :

A **floppy disk** is a type of disk storage composed of a thin and flexible disk of a magnetic storage medium in a square or nearly square plastic enclosure lined with

a fabric that removes dust particles from the spinning disk. Floppy disks are read from and written to by a **floppy disk drive** (**FDD**).

The first floppy disks, invented and made by IBM, had a disk diameter of 8 inches (203 mm)

Subsequently **5 $\frac{1}{4}$-inch** (133 mm) and then **3 $\frac{1}{2}$ inch** (90 mm)

Floppy disks were so common in late 20th-century culture that many electronic and software programs continue to use save icons that look like floppy disks well into the 21st century. While floppy disk drives still have some limited uses

2. <u>Hard Disk :</u>

A **hard disk drive** (**HDD**), **hard disk**, **hard drive**, or **fixed disk** is an electro-mechanical data storage device that uses magnetic storage to store and retrieve digital data using one or more rigid rapidly rotating platters coated with magnetic material. Introduced by IBM in 1956, HDDs were the dominant secondary storage device for general-purpose computers beginning in the early 1960s. HDDs maintained this position into the modern era of servers and personal computers, though personal computing devices produced in large volume, like cell phones and tablets, rely on flash products.

Though production is growing slowly, sales revenues and unit shipments are declining because solid-state drives (SSDs) have higher data-transfer rates, higher areal storage density, better reliability, and much lower latency and access times.

The primary characteristics of an HDD are its capacity and performance. Capacity is specified in unit prefixes corresponding to powers of 1000: a 1-terabyte (TB) drive has a capacity of 1,000 gigabytes (GB; where 1 gigabyte = 1 billion bytes).

The two most common form factors for modern HDDs are 3.5-inch, for desktop computers, and 2.5-inch,

primarily for laptops. HDDs are connected to systems by standard interface cables such as PATA (Parallel ATA), SATA (Serial ATA), USB or SAS (Serial Attached SCSI) cables. ATA stands for Advanced Technology Attachment.

There are two general types of hard drives: **hard disk drives (HDD)**, which use one or more rotating discs and rely on magnetic storage, and **solid-state drives (SSD)**, which have no moving mechanical parts, but use flash memory like the kind found in USB flash drives. If you have a regular desktop computer, you most likely have a hard disk drive. Solid-state drives are more typical for high-end, expensive laptops.

3. Magnetic Tape :

Magnetic tape is a medium for magnetic recording, made of a thin, magnetizable coating

on a long, narrow strip of plastic film. It was developed in Germany in 1928, based on magnetic wire recording. Devices that record and playback audio and video using magnetic tape are tape recorders and video tape recorders respectively. A device that stores computer data on magnetic tape is known as a tape drive.

Magnetic tape revolutionized sound recording and reproduction and broadcasting

Magnetic tape is usually recorded on only one side. The opposite side is a *substrate* to give the tape strength and flexibility. The magnetic side of most tapes (typically of an oxide material, and hence called the *oxide side*) is magnetically manipulated by a tape head to store the information. The magnetic material used was initially iron oxide, though chromium and other

materials have been used in some tapes


4. Magnetic Disks :

A magnetic disk is a storage device that uses a magnetization process to write, rewrite and access data. It is covered with a magnetic coating and stores data in the form of tracks, spots and sectors. Hard disks, zip disks and floppy disks are common examples of magnetic disks.

A magnetic disk primarily consists of a rotating magnetic surface (called platter) and a mechanical arm that moves over it. Together, they form a "comb". The mechanical arm is used to read from and write to the disk. The data on a magnetic disk is read and written using a magnetization process.

Data is 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 floating heads require very precise control to read/write data due to the proximity of the tracks.

Magnetic disks have traditionally been used as secondary storage devices in computers

Anatomy of a Magnetic Disk
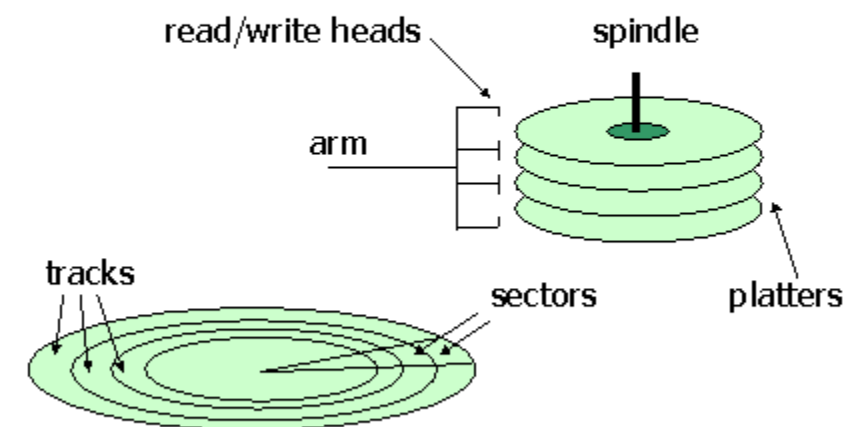
cylinder: all tracks at the same radius, two per platter

Storage Mechanism of Magnetic Storage Devices :

1. Tracks
2. Sectors
3. Clusters

4. Cylinders

---->> Tracks : A **disk drive track** is a circular path on the surface of a disk or diskette on which information is magnetically recorded and from which recorded information is read.

A **track** is a physical division of data in a disk drive

Tracks are subdivided into blocks (or sectors, pages)

---->> Sectors : In computer disk storage, a **sector** is a subdivision of a track on a magnetic disk or optical disc

Each sector stores a fixed amount of user-accessible data.The sector is the minimum storage unit of a hard drive

Most disk partitioning schemes are designed to have files occupy an integral number of sectors regardless of the file's actual size.

---->> Cluster : In computer file systems, a **cluster** or **allocation unit** is a unit of disk space allocation for files and directories. To reduce the overhead of managing on-disk data structures, the file system does not allocate individual disk sectors by default, but contiguous groups of sectors, called clusters.

A cluster is the smallest logical amount of disk space that can be allocated to hold a file

Storing small files on a file system with large clusters will therefore waste disk space; such wasted disk space is called slack space

A cluster need not be physically contiguous on the disk; it may span more than one track or, if sector interleaving is used, may even be discontiguous within a track.
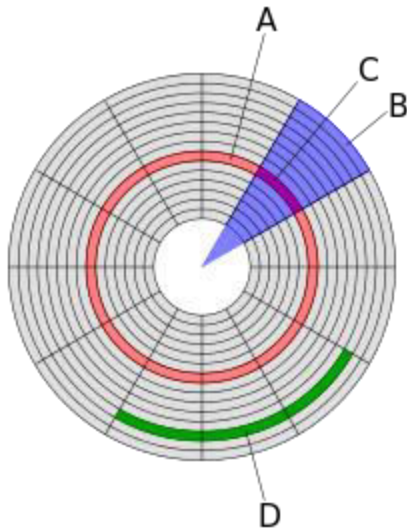
1. Track
2. Geometrical sector
3. Sector
4. Cluster

---->> Cylinder :

A *cylinder* is any set of all of tracks of equal diameter in a hard disk drive (HDD). It can be visualized as a single, imaginary, circle that cuts through all of the platters (and both sides of each platter) in the drive.

Other storage devices :

1. USB – Pen Drives
2. CD
3. DVD
4. Blu-Ray Disk

USB Pen Drives :

A USB flash drive is a data storage device that includes flash memory with an integrated USB interface

It is removable, rewritable and much smaller than optical disc

Since first appearing on the market in 2000, as with virtually all other computer memory devices, storage capacities have risen while prices have dropped

USB flash drives are often used for storage, data backup and transferring of computer files

Compared with floppy disk or CDs, they are smaller, faster, have more capacity and are more durable.

They are unharmed by surface scratches (unlike CD)

Most desktop and laptop computer have USB ports nowadays.

A flash drive consist of a small printed circuit board carrying the circuit elements and a USB connector, insulted electrically and protected inside a plastic, metal or rubberized case, which can be carried in a pocket or on a key chain.

Some devices combine the functionality of a portable media player with USB flash storage, they require a battery only when used to play music.

CD (Compact Disc) :

Compact Disc is a digital optical disc data storage format that was co-developed by Phillips and Sony and released in 1982.

That was originally developed to store and play only digital audio recording (CD-DA) but was later adapted for storage of data (CD-ROM).

Several other formats were further derived from these, including write-once audio and data storage (CD-R), rewritable media (CD-RW), video CD (VCD), super video CD (SVCD), photo CD, picture CD etc

It has capacity upto 700 MB.

Standard CD have a diameter of 4.7 inch. The mini CD has various diameters range from 2.4 to 3.1 inch.

At the time of the technology's introduction, a CD could store much more data than a personal computer hard drive. That could hold 10 MB data.

A polycarbonate disc layer has the data encoded by using bumps.

A shiny layer reflects the laser

A laser beam reads the CD and is reflected to a sensor, which converts it into electronic data.

DVD (Digital Video Disc) :

DVD is an optical disc technology with a 4.7 GB storage capacity on single sided, one layered disc, which is enough for a 133 minutes movie.

A double sided two layered DVD will hold upto 17 GB of video, audio, or other information

This compares 65 GB of storage for a CD-ROM disc.

DVD uses MPEG-2 file and compression standard.

It has following formats :

DVD video: designed for full length movie

DVD-ROM : used for computers. DVD drive will play regular CD-ROM and DVD-video disk

DVD-RAM : it is rewritable version

DVD-Audio : it is CD replacement version

DVD was originally said to stand for digital video disc, and later, digital versatile disc.

Blu- Ray Disc :

The technology for storing data continues to bring us ever-increasing capacity. First, there were CD-ROM discs, next the DVD-discs, which increased capacity and data transfer speed. Now we have blu-ray discs that provide 100 GB of storage. They are used in optical jukeboxes or libraries for archiving computer data

Blu-ray Discs (BD) was introduced by Sony in October 2000. Even though this new technology was developed for the consumer market, it also was capable of handling computer data.

The name Blu-ray Disc is derived from the blue-violet laser used to read and write this type of disc. Because of its shorter wavelength (405 nm), substantially more data can be stored on a Blu-ray Disc than on the DVD format

Blu-ray discs not only have more storage capacity than traditional DVDs, but they also offer a new level of interactivity. Using the latest consumer Blu-ray systems, users will be able to connect to the Internet and instantly download subtitles and other interactive movie features.

With Blu-ray, you can:

- record high-definition television (HDTV) without any quality loss

- instantly skip to any spot on the disc
- record one program while watching another on the disc
- create playlists
- edit or reorder programs recorded on the disc
- automatically search for an empty space on the disc to avoid recording over a program
- access the Web to download subtitles and other extra features

Unlike DVDs and CDs, which started with read-only formats and only later added recordable and re-writable formats, Blu-ray is initially designed in several different formats:

- BD-ROM (read-only) – for pre-recorded content
- BD-R (recordable) – for PC data storage
- BD-RW (rewritable) – for PC data storage
- BD-RE (rewritable) – for HDTV recording

Flash Memory :

Flash memory is a non-volatile memory chip used for storage and for transferring data between a personal computer (PC) and digital devices. It has the ability to be electronically reprogrammed and erased. It is often found in USB flash drives, MP3 players, digital cameras and solid-state drives.

Flash memory is a type of electronically erasable programmable read only memory (EEPROM), but may also be a standalone memory storage device such as a USB drive. EEPROM is a type of data memory device using an electronic device to erase or write digital data. Flash memory is a distinct type of EEPROM, which is programmed and erased in large blocks.

A flash memory chip is composed of NOR or NAND gates.

Flash memory has many features. It is a lot less expensive than EEPROM and does not require batteries for solid-state storage such as static RAM (SRAM). It is non-volatile, has a very fast access time and has a higher resistance to shock compared to a hard disc drive. Flash memory is extremely durable.

It can be used for a wide array of applications such as digital cameras, mobile phones, laptop computers, PDAs (personal digital assistants), digital audio players and solid-state drives (SSDs).

Cloud Storage :

Cloud storage is a service model in which data is transmitted and stored on remote storage systems, where it is maintained, managed, backed up 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, cloud storage providers have added operating expenses that can make the technology considerably more expensive to use. The security of cloud storage services continues to be a concern among users. Service providers have tried to allay those fears by enhancing their security capabilities by incorporating data encryption, multi-factor authentication and improved physical security into their services.

Types of cloud storage

There are three main cloud-based storage access models: public, private and hybrid.

Public cloud storage services provide a Multi-tenant storage environment that is most suited for unstructured data on a subscription basis. Data is stored in the service providers' data centers with storage data spread across multiple regions or continents. Customers generally pay on a per-use basis similar to the utility payment model; in many cases, there are also transaction charges based on frequency and the volume of data being accessed. This market sector is dominated by Amazon Simple Storage Service (S3), Amazon Glacier for cold or deep archival storage, Google Cloud Storage, Google Cloud Storage for cold data and Microsoft Azure.

Private cloud storage service is provided by in-house storage resources deployed as a dedicated environment protected behind an organization's firewall.

Hybrid cloud is a mix of private cloud storage and third-party public cloud storage services

Google Drive

One Drive

Google Drive :

Google Drive is a file storage and synchronization service developed by Google.

Google Drive allows users to store files on their servers, synchronize files across devices, and share files.

In addition to a website, Google Drive offers apps with offline capabilities for Windows and macOS computers, and Android and iOS smartphones and tablets. Google Drive encompasses Google Docs, Google Sheets, and Google Slides. That permits collaborative editing of documents, spreadsheets, presentations, drawings, forms, and more. Files created and edited through the office suite are saved in Google Drive. Google Drive offers users 15 gigabytes of free storage. Google One also offers 100 gigabytes, 200 gigabytes, 2 terabytes, 10 terabytes, 20 terabytes, and 30 terabytes offered through optional paid plans.

Files uploaded can be up to 5 terabytes in size. Users can change privacy settings for individual files and folders, including enabling sharing with other users or making content public.

OneDrive :

OneDrive is an Internet-based storage platform with a significant chunk of space offered for free by Microsoft to anyone with a Microsoft account.

Think of it as a hard drive in the cloud, which you can share, with a few extra benefits thrown in.

As of this writing, OneDrive gives everyone with a Microsoft account 5GB of free storage

Some OneDrive users have all their web-based files and folders stored on their computers, and OneDrive syncs the folders quite quickly — what you see in File Explorer is what's stored in the cloud, and vice versa.

OneDrive does what all the other cloud storage services do — it gives you a place to put your files on the Internet. You need to log in to OneDrive with your Microsoft account

Reading/Writing data to and from storage devices : (HW)

Seek time / Rotational delay / latency / Access :

Seek Time : Seek time is the time required to move the disk arm to the required track

Rotational delay :
Rotational deay or latency is the time it takes for the beginning of the required sector to reach the head.

Access Time :
The sum of seek time (if any) and latency is the Access time. Time taken to actually transfer data is transfer time.