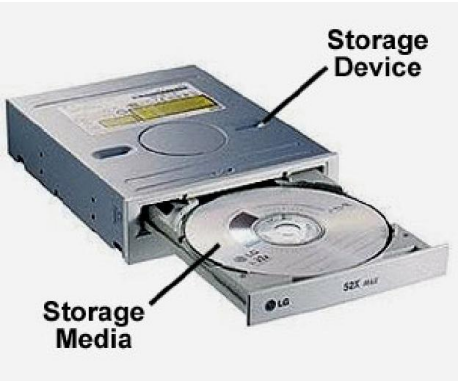
COMPUTER STORAGE DEVICES

A **storage device** records and retrieves items to and from a storage medium.

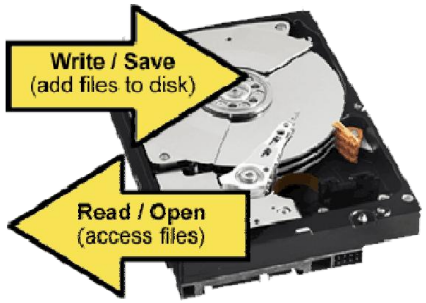
A **storage media** is the actual physical material that holds data and programs.

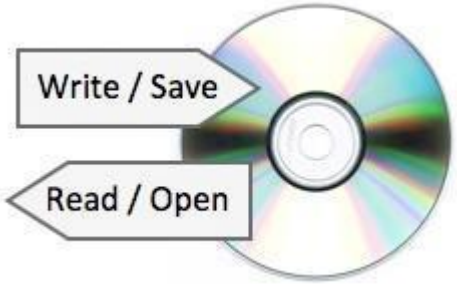


Writing is the process of saving information to storage devices whereas **reading** is the process of accessing information from storage devices.

Writing of data = storing data also known as **saving-**Reading of data = getting our data back also known as **opening.**

To save data, data is moved from memory to secondary storage.





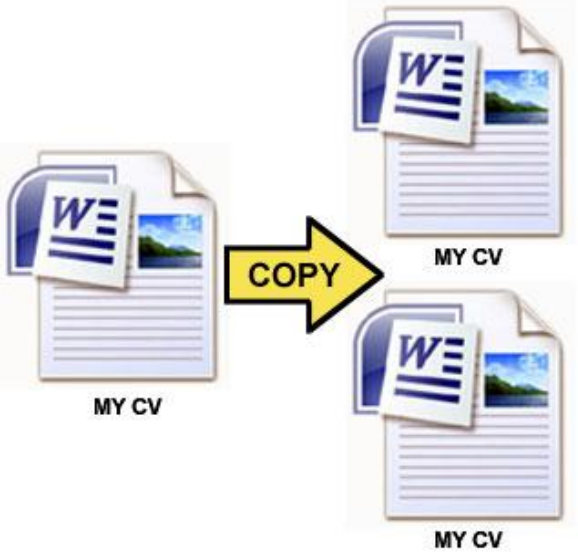
Factors to consider when choosing a storage device

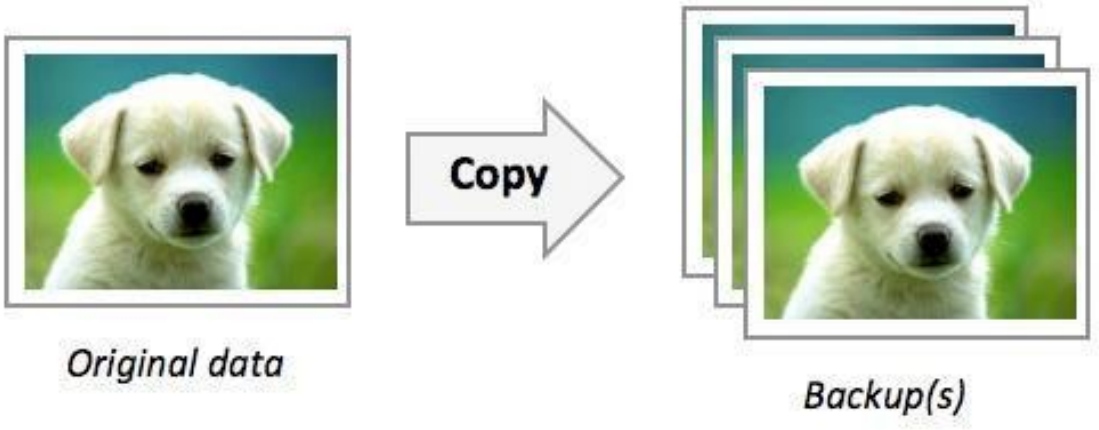
1) Storage capacity
2) Brand/make
3) Portability
4) Durability/readability
5) Price/cost
6) Compatibility with system-IDE, USB, SATA
7) Safety of the media/nature of work to be stored
8) Data access speed

BACKING UP DATA

Process of copying files, programs and data to a different storage device for future use. (making of copies of your files, data and information)

A backup is a copy of your original file or data stored on another storage device.





WHY BACK UP DATA?

1. Original data could be accidentally copied over or deleted.

2. Data could be lost due to damage to the original storage device.

3. You could lose your original storage device.

How Are Backups Created?

1) Burning files to a CD
2) Copying files to an external hard-drive
3) Copying the files to another computer on a network

Forms of computer storage

1) Secondary storage (backing storage or auxiliary storage)

2) Primary storage (memory)

Secondary storage

Secondary storage is a type of storage designed to retain data and instructions in a relatively permanent form.

Secondary storage devices are storage devices designed to retain data and instructions in a relatively permanent form.

Secondary storage devices can be used as both input (***when part of their stored data is sent for processing***) and output devices (***when used to receive processed data***)

Advantages of secondary storage devices

1) Non-volatile meaning that saved data and instructions remain intact when the computer power is turned off
2) Backing storage provides a cheap and almost an unlimited amount of storage
3) Available in various capacities
4) Used for backup and transfer data from one computer to another.

Disadvantages of secondary storage devices

1) Backing storage is slow because of the mechanical components involved
2) Agent of computer viruses
3) Can be affected by magnetic fields, vibrations and high temperatures

Examples of secondary storage devices

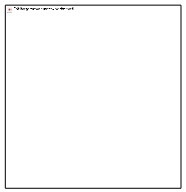
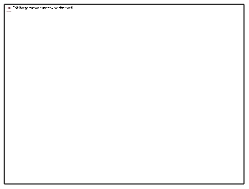
Secondary storage devices are grouped into:

a) Magnetic storage devices

b) Optical storage devices

c) Solid state storage devices

Magnetic storage devices

1) Floppy diskette 
2) Magnetic tape 
3) Zip disk 
4) Jaz disks
5) Hard disk

Optical storage devices

1) Compact disks (CD)

2) Digital video disks (DVD)

Solid state storage devices

1) Memory cards

2) Smart cards

3) Flash disks

a) Magnetics storage devices

Magnetic storage devices hold data magnetically.

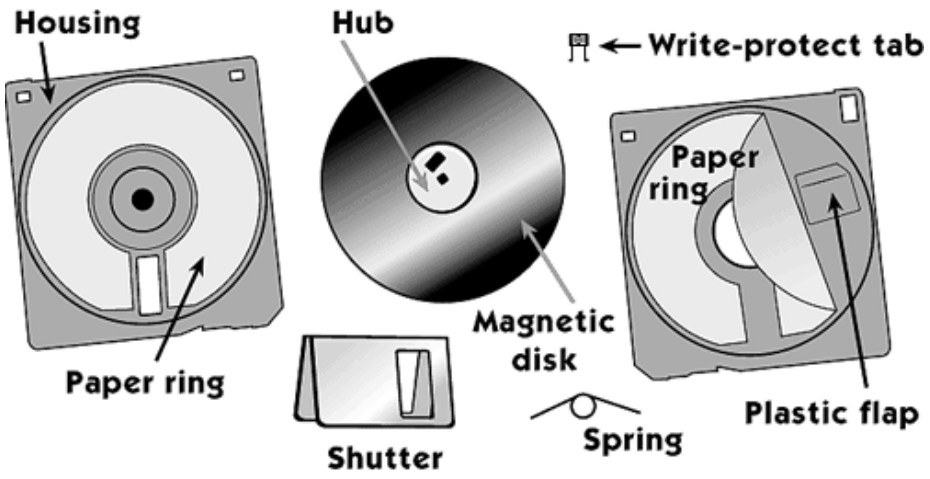
Floppy diskette

Floppy diskettes provide an old method of portable data storage.

Data is held on a thin plastic disk with a magnetic coating covered with a plastic protective case.

The most widely used floppy disk is the 3.5 inch floppy diskette.

Floppy diskettes are used where small files need to be transferred or stored.



Care for floppy diskettes

1) Keep the diskettes in a storage tray or protective case when not in use
2) Do not place heavy objects on the diskettes
3) Keep diskettes away from direct sunshine or excessive heat.
4) Do not use floppy diskettes near magnetic fields since data can be lost.
5) Do not use alcohol to clean the floppy diskette.
6) Do not use rubber bands or paper clips to tie the floppy diskettes together.
7) Diskettes should not be bent or sat on to avoid breaking them
8) The circular disk surface should not be touched since it is easily contaminated which can lead to data loss.

Advantages of using floppy diskettes

1) Can be used to transfer data from one computer to another
2) Are portable and inexpensive
3) Data on a floppy disk can be accessed randomly.
4) Data on a floppy disk can be write-protected from being changed accidentally using the write protection tab.

Disadvantages of floppy diskettes

1) Floppy diskettes are not durable since they can be destroyed by dust and dirt, magnetic fields.
2) Access time of a floppy is slow
3) Storage capacity of a floppy disk is limited

Before anything can be written on a new floppy disk, it must be formatted.

Formatting is the process of preparing a disk for reading and writing by organizing the disk into storage locations.

The write protect facility is useful to prevent accidental overwriting of data.

Magnetic tape

A magnetic tape is a magnetically coated plastic ribbon capable of storing large amounts of data and information at a low cost.

Magnetic tapes are one of the most oldest forms of data storage on computers.

Magnetic tapes are used for applications which require extremely large storage capacity and for backup of files.

Advantages of magnetic tapes

1) Substantially less expensive
2) The storage capacity of a magnetic tape is much higher than that of a floppy diskette.

Disadvantages of magnetic tapes

1) Magnetic tapes are slow when writing and retrieving data
2) Magnetic tapes have a limited shelf life of about two years for reliable results.
3) Need another tape to update data

Zip disks

Another obsolete storage device, Zip disks are high capacity disks that resemble floppy disks however are slightly larger and thicker is size compared to floppy disks. Zip disks were used for data backup and moving large files between computers.

Jaz disks

These are small portable disks with high storage capacity and are used for storing data that requires large storage. Jaz disks were used for data backup and moving large files between computers. Were expensive and very unreliable.

Hard disks

A hard disk usually consists of several inflexible circular magnetic disks called platters on which data, instructions and information are stored electronically.

A hard disk is also known as a hard disk drive (HDD). Hard disks are sealed tightly to keep out contaminants like dust and smoke which can lead to head crashes.

Hard disks are used to:

1) Data and files
2) Application software
3) System software like the operating system

Advantages of hard disks

1) Provide far much larger storage capacity
2) Provide faster and convenient data access time
3) Hard disks are cheaper than floppy diskettes per storage amount.
4) Since some reside inside the computer, they cannot be stolen or misplaced.
5) Data life of hard disks is long once in use
6) Hard disks are reliable and have better protection against dust and dirt.

Disadvantages of hard disks

1) Hard disks are expensive
2) Data becomes less secure if left on the hard disk
3) Virus attacks render data life limited in case of unprotected systems
4) Head crash may occur due to extreme shock or contaminants

Why a hard disk may fail to operate:

1) Aging
2) Violent shaking
3) Power failures
4) Virus attacks
5) Excessive heat and Humid conditions

Types of hard disks

Internal (fixed) disks

These are high speed and high storage capacity hard disks that cannot be removed from the disk drives.

External (removable) hard disks

These are special types of hard disks that may be inserted in the computer when there is need for storage and then removed thereafter.

Uses of external hard disks

1) Can carry data-backups all over the place
2) Transfer information, programs and pictures between computers

Advantages of external hard disks

1) Improved data cargo carrying capacity
2) More portable-small and light

Disadvantages of external hard disks

1) Have to be handled quite carefully
2) More expensive than other forms of removable storage.
3) Easy to be stolen or misplaced

Removable storage media

Removable media is any type of storage device that can be removed from a computer and is not incorporated into the computer itself.

Examples of removable media include CDs, DVDs and Blu-Ray disks, as well as diskettes and USB drives.

Removable media makes it easy for a user to move data from one computer to another and can deliver the fast data backup and recovery times

The main drawback of removable media is that it's more expensive than many other forms of storage.

b) Solid state storage devices

Solid state storage devices are devices with no moving parts.

Data and information are stored and retrieved electronically directly from these devices.

This type of storage is expensive but is more reliable and requires less power and can be written to and updated.

This technology is becoming widely used for specialized removable storage devices.

Memory cards

Memory cards are solid state storage devices widely used on computers.

Memory cards are used:

1) When data has to be read from small electronic devices like phones, PDAs and palmtops
2) When there is a likelihood of making changes to files
3) When there is need to access files on various electronic devices
4) When there is need to transfer files from one device to another
5) When you have a memory card reader

Advantages

1) Easy to transport since they are small in size
2) Robust and not easy to damage
3) Easy to connect to mobile devices through SD slots

Disadvantages

1) More expensive
2) Easy to lose or to have stolen due to their small size

Smart cards

Smart cards are devices that store data on a thin microprocessor embedded (fixed) in the card.

Smart cards are used for:

1) Storing prepaid cash amounts for example prepaid telephone calling card
2) Storing patients records and other health care information
3) Tracking information of customers and employees

Flash disks

Flash disks are small storage devices that can be held on a key ring or necklace. These devices conveniently connect directly to a computer's universal serial bus port to transfer data, files and information.

Flash disks are used:

1) When there is need to access files on various electronic devices with USB ports
2) When files have to be kept for a long time (quickly and easily backup files)
3) When more files have to be added from time to time
4) When there is need create a boot disk

Advantages of flash disks

1) More compact and durable shape, design
2) Hold much more data
3) Operate more reliably due to no moving parts
4) Compatible with almost any computer

Disadvantages of flash disks

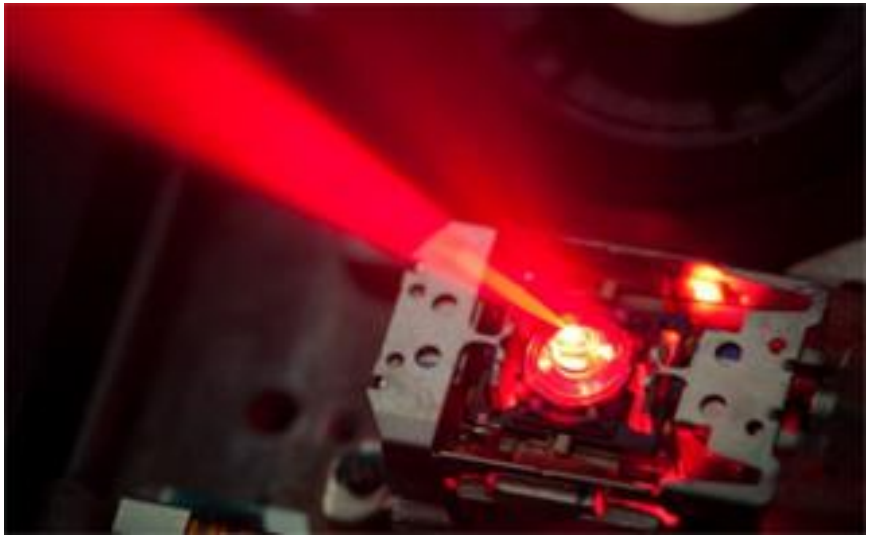
1) No write protection feature so it is possible to accidentally copy over data
2) Small physical size means that they are easy to misplace or lose
3) More expensive per unit of data stored compared to hard disks

c) Optical storage devices

Optical storage devices store data on a disk as a number of data dots that can be read using light.

Data is read by shinning the laser beam onto the surface of the disk.

The beam burns very tiny holes (pits) into a thin shiny surface to record data.



Care for optical disks

1) Do not leave the disks in direct sunlight or in hot, humid conditions.
2) Use a soft lint free cloth to remove spots, dust or finger prints and smears on the disk.
3) Store the disks in protective cases
4) Never stack disks on top of each other
5) Never touch the underside of the compact disk
6) Handle the disks only by the outer edges to prevent finger prints and smears on the disks

Advantages of optical disks

1) Are easy to store and are portable
2) Have high storage capacity of over 700MB
3) Are durable and can be stored for a long period of time.
4) Have high access speed and reduces access time
5) Can store text, graphics, video and sound as well as games.

Disadvantages of optical disks

1) Breakage or a simple scratch may render the whole disk useless.
2) Can be attacked by viruses
3) Some kinds of compact disks are read only so their contents may not be changed like the compact disk read only memory.
4) The average access time of a compact disk is slower than that of a hard disk.

Examples of optical storage devices

1) Compact disks (CD)

2) Digital video disks (DVD)

Compact disks

Compact disks are the most widely used optical disks formats.

Compact disks are flat, round, portable storage medium that store data using light beams.

Compact disks are mostly used to store data and information such as video clips, software and sounds.

CDs have a maximum storage capacity of 700MBs

Digital versatile disks (DVDs)

DVDs are also called digital video disks. With these disks, more data can be packed on the disk.

DVDs are suitable for recording motion pictures such as video because they offer better sound and picture quality.

DVD-ROMs have a storage capacity of 4.7GB

Difference between CDs and DVDs

1) DVDs have higher storage capacity than CDs

2) DVDs are cheaper per unit data storage

3) DVDS guarantee higher quality features (sound and video)

4) CDs are cheaper (cost) than DVDs

5) Reading and writing CDs is faster than on DVDs

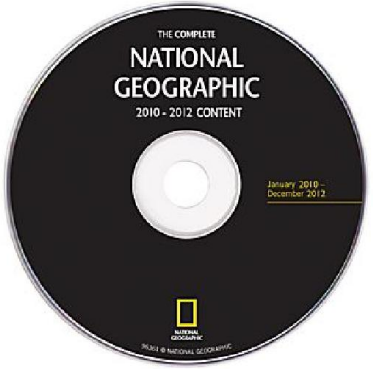
Variations of CDs and DVDs

1) CD-ROM and DVD-ROM
2) CD-R and DVD-R
3) CD-RW and DVD-RW
4) DVD-RAM
5) Photo CD
6) Blu-Ray disks

CD-ROM and DVD-ROM

These disks have data that cannot be written over (added to) but can only be read. These disks are bought with pre-loaded data already on them. Whatever is already loaded onto the disk cannot be removed or changed.

DVD-ROMs hold large amounts of data like movies, modern games, multimedia encyclopedia.



CD-ROMs are used for:

1) Applications that require prevention of deletion of data
2) Distribution of software, data and information by software companies
3) Distribution of music, movies and games
4) Book publishers distribute encyclopedia and reference books

Advantages of CD-ROMs and DVD-ROMs

1) Hold more data than floppy diskettes
2) Less expensive than hard disks
3) You cannot accidentally erase the read only data

Disadvantages of CD-ROMs and DVD-ROMs

1) Hold less data compared to hard disks
2) Slow data transfer and access rates compared to hard disks
3) You cannot add your own data to read only disks

CD-Rs and DVD-Rs

These disks are bought blank and data can be added to the disk (once) but not removed when it is on there.

These disks are ideal for single burning or recording of data.

Uses of CD-Rs and DVD-Rs :

1) CD-Rs are used for recording music play lists
2) DVD-Rs are used for recording video clips
3) Recording data for archival or backup purposes
4) Transfer data from one computer to another.

Advantages of CD-Rs and DVD-Rs

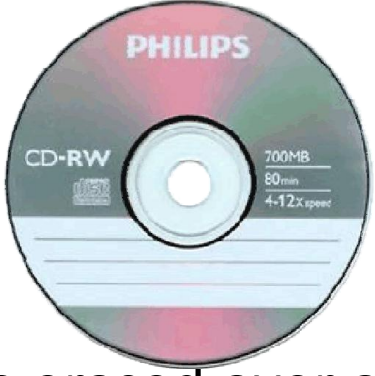
1) Impossible to accidentally delete recorded data
2) Cheaper than CD-RWs and hard disks
3) Easy to transfer information from one computer to another.

Disadvantages of CD-Rs and DV-Rs

1) Only recordable once so updating records may be impossible.
2) Very slow data transfer rate.
3) If an error occurs during burning, the disk is damaged and is wasted.

Both CD-ROMs and CD-Rs are referred to as (WORM) write once read many because they allow the user to record data on them once but read the data as often as necessary.

CD-RWs and DVD-RWs



Data can be added to these disks and also be erased over and over again.

Are also called erasable disks and are ideal for applications that require updating of information and ability to record over old data.

Uses of CD-RWs and DVD-RWs:

1) Both are used for making backups of computer files
2) DVD-RWs are used for recording television programs and can be recorded over many times
3) CD-RWs are used for creating personalised playlists of music and then add/remove songs as you wish.

Advantages of CD-RWs and DVD-RWs

1) Can be re-used many times
2) Stored data can be updated
3) Even if burning of files fails, the disk can still be recorded on later and not wasted.

Disadvantages of CD-RWs and DVD-RWs

1) More expensive than CD-Rs and DVD-Rs
2) Possible to accidentally over write data when updating
3) Data transfer to the disks is very slow

DVD-RAM disks

With DVD-RAM disks, writing and reading of data can happen at the same time.

DVD-RAM disks can be rewritten over many many times.

Uses of DVD-RAM disks

1) Video and data archiving
2) Recording TV programmes

Advantages of DVD-RAM disks

1) Can be re-used many times
2) Stored data can be updated
3) Even if burning of files fails, the disk can still be recorded on later and not wasted.

Disadvantages of DVD-RAM disks

1) More expensive than CD-Rs and DVD-Rs
2) Possible to accidentally over write data when updating
3) Data transfer to the disks is very slow

Photo CDs

Photo CDs use a special format to store digital images.

Photo CDs are multisession meaning that new images can be added at any time.

BLU-RAY DISKS

The laser used to read the data is blue rather than red hence the name Blu-ray disk.

These disks can be rewritten to and have large storage capacities ranging between 25GB, 50GB and 100GB.

Uses of Blu-ray disks

1) Storing high definition video
2) Used in some home video consoles
3) Used to backup data on computers

Advantages of Blu-ray disks

1) Huge storage capacity needed for high definition movies
2) Data can be read/transferred very fast compared to other optical media.

Disadvantages of Blu-ray disks

1) Very expensive compared to other optical media
2) Only work in Blu-ray drives which limits the use of the disks.

Other storage devices

Online storage

Sometimes called an Internet hard drive-is a service on the web that provides storage to computer users for free or for a minimal monthly fee.

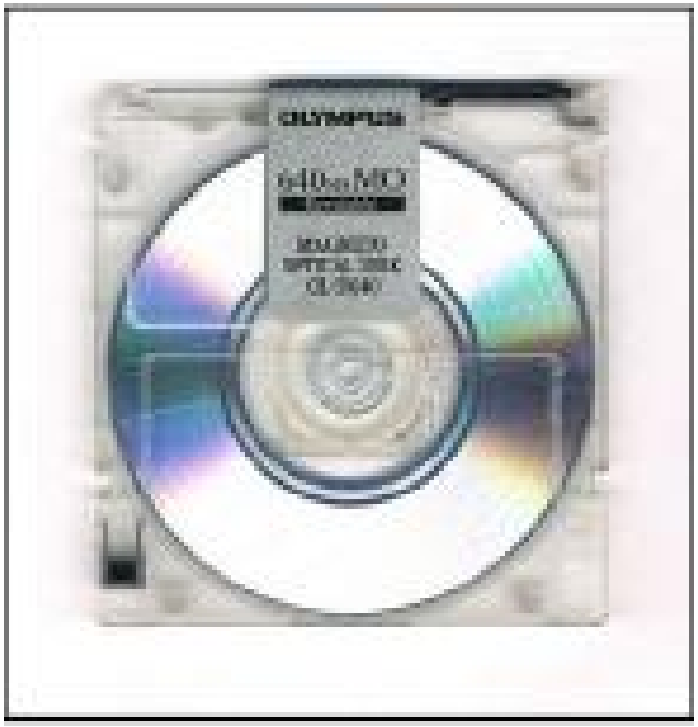
Advantages

1) Files stored on an Internet hard drive can be accessed from any computer or device that has web access
2) Share large audio, video and graphics files with others on the Internet
3) Work as an offsite backups of data

Magneto-optical disk

This combines the best features of magnetic and optical disk technologies.

Has a high storage capacity of an optical disk but can be written over like a magnetic disk.



Characteristics of storage devices

1) Storage capacity

2) Transfer rate

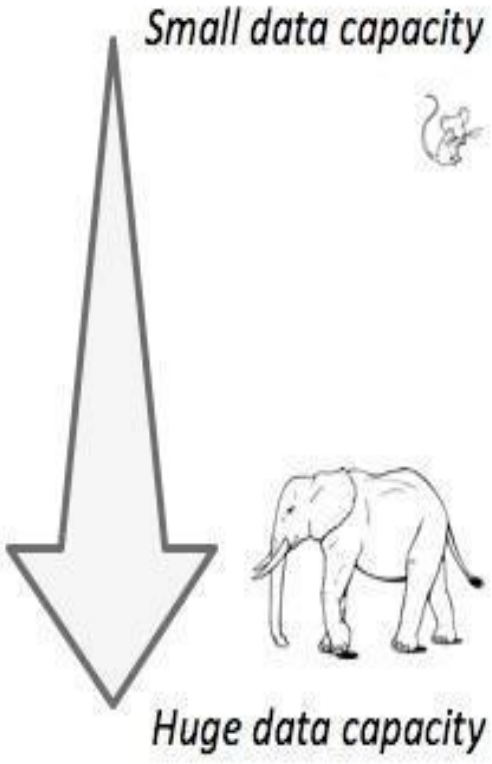
3) Access time

4) Methods of access

Storage capacity

Storage capacity is the amount of data a storage device such as a disk or tape can hold.

Floppy disc	1.44MB
Zip disc	750MB
CD-ROM	800MB
Jaz Drive	2GB = 2,000MB
DVD	4.7GB = 4,700MB
USB memory stick	16GB = 16,000MB
Backup tape	800GB = 800,000MB
Hard drive	1TB = 1,000,000MB



How storage capacity is expressed

A **bit** is the basic unit of information in a computer. (Smallest unit of measurement of information) (Short for binary digit)

A **byte** is eight bits grouped together.

A **kilobyte** (KB) is 2^{10} =1,024 bytes

A **megabyte** (MB) is 2^{20} =1,048,576 bytes

A **gigabyte** (GB) is 2^{30} =1,073,741,824 bytes

A **terabyte** (TB) is 2^{40} = 1,099,511,627,776 bytes

A **Petabyte** (PB) is 2^{50} = 1,125,899,906,842,620 bytes

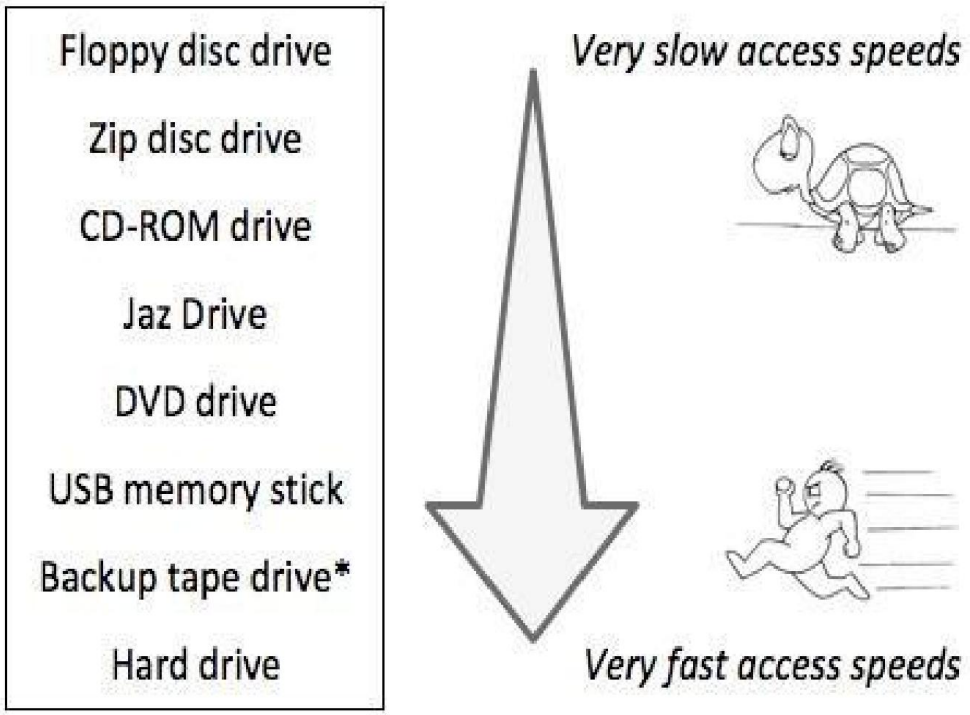
Transfer rate

Transfer rate is the time it takes a drive to transmit data and information from the drive to another device.

Access time

Access time is the amount of time it takes to locate an item on a storage medium.

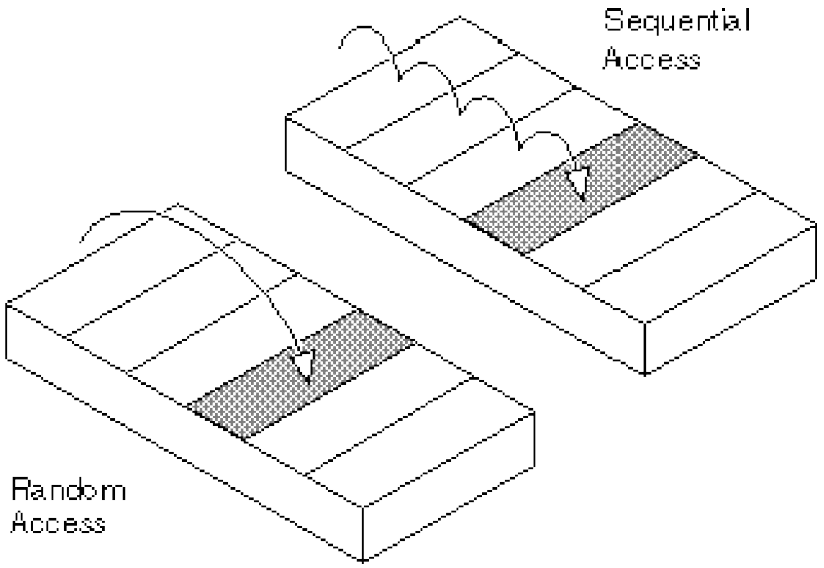
Access time is the amount of time required to retrieve data from a storage device.



METHODS OF ACCESS

There are two methods of data access:

1. Direct access or random access
2. Sequential access or serial access

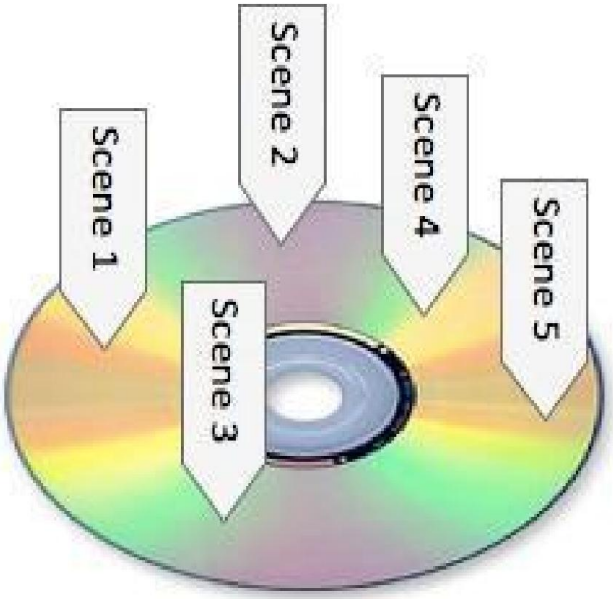


Random access or direct access

A particular data item or file can be located immediately without having to move consecutively through items stored in front of it.

Direct access is used where fast access to data is needed.

Direct access is used in storage media like memory sticks, memory cards, CDs and DVDs as well as hard dis



Sequential access

Under sequenced access, records are accessed one at a time and in the order in which they were recorded.

Serial access is used in old magnetic tapes)video cassettes, music cassettes) and batch processing systems.

Serial access is slow but ideal for a lot of data storage.

Magnetic Tape

Primary storage devices

Primary storage is a form of storage that provides temporary storage for information the computer is currently working on.

Primary storage devices are devices that temporarily store information that the computer is currently working on.

Primary storage devices provide only temporary or volatile storage that is lose all of the contents when the computer power is turned off.

Advantages of primary storage devices

1) High access speed
2) Relatively cheap
3) Always available in all working computers,
4) Not required in large quantity of capacity

Disadvantages of primary storage devices

1) Temporal
2) Expensive
3) Limited storage area
4) Delicate especially to electronic fields.

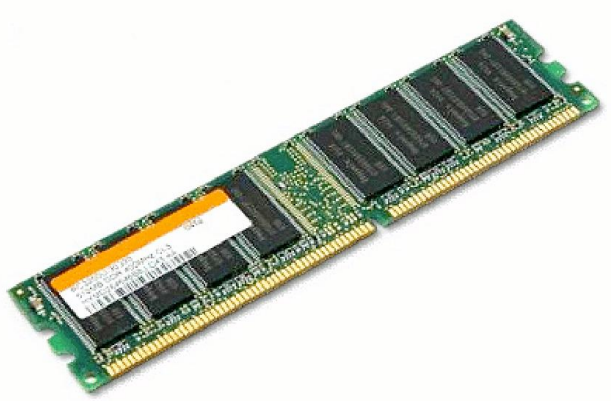
Primary storage Vs secondary storage

Primary storage		Secondary storage	
1	Data can be processed from directly from storage	1	Data cannot be processed directly but must be moved into main memory
2	Located within CPU	2	Located outside the CPU
3	More expensive	3	Less expensive
4	Lower capacity	4	Higher capacity
5	Faster access time	5	Slow access time
6.	Volatile	6.	Non volatile

Examples of primary storage devices

1) Read only memory (ROM)

2) Random access memory (RAM)

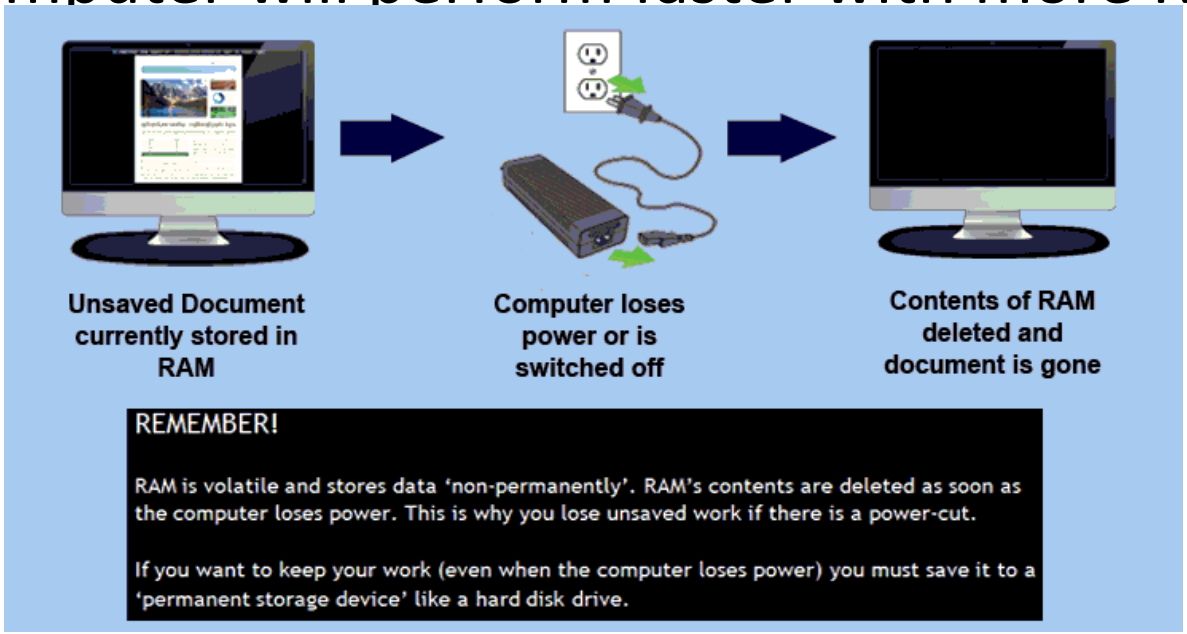


Random access memory

Contents of RAM are lost when the computer is turned off therefore RAM is volatile.

RAM stores data and programs currently in use when the computer is running.

The computer will perform faster with more RAM.



ROM (Read Only Memory)

ROM Stores instructions that tell the computer how to start up.

Contents of ROM are not lost when the computer is turned off therefore ROM is **Non-Volatile** memory.

ROM cannot be written to (altered) but only read.