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COMPUTER MEMORY

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Computer Memory

The computer memory is one of the most important elements in a computer system. It stores data and instructions required during the processing of data and output results.

Storage may be required for a limited period of time, instantly or for an extended period of time.

It also relates to many devices that are responsible for storing data on a temporary or a permanent basis.

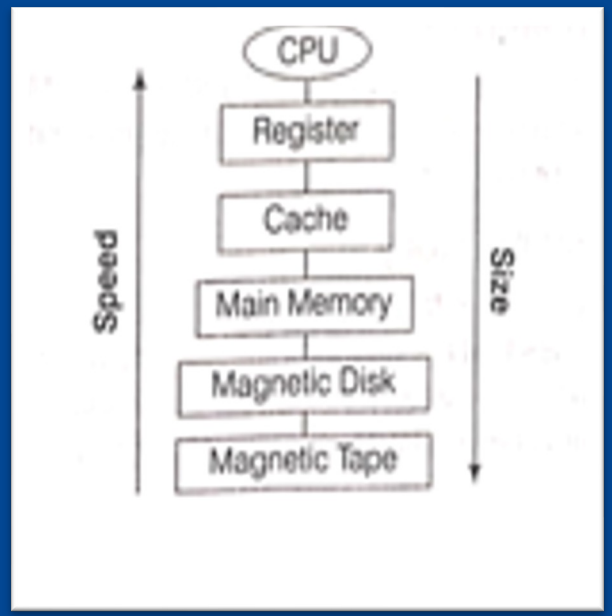
Computer Memory Size

Name	Equal To	Size (In Bytes)
Bit	1 Bit	1/8
Nibble	4 Bits	1/2 (rare)
Byte	8 Bits	1
Kilobyte	1024 Bytes	1024
Megabyte	1, 024 Kilobytes	1, 048, 576
Gigabyte	1, 024 Megabytes	1, 073, 741, 824
Terabyte	1, 024 Gigabytes	1, 099, 511, 627, 776
Petabyte	1, 024 Terabytes	1, 125, 899, 906, 842, 624
Exabyte	1, 024 Petabytes	1, 152, 921, 504, 606, 846, 976
Zettabyte	1, 024 Exabytes	1, 180, 591, 620, 717, 411, 303, 424
Yottabyte	1, 024 Zettabytes	1, 208, 925, 819, 614, 629, 174, 706, 176

Computer Memory Size

Memory Hierarchy

The hierarchical arrangement of storage in current computer architectures is called the memory hierarchy. The computer uses a hierarchy of memory that is organised in a manner to enable the fastest speed and largest capacity of memory as shown in figure. The memory is characterised on the basis of two key factors; capacity and access time.



Parameters of Memory

Some related parameters of memory are as follows

1. **Storage Capacity** It is representative of the size of memory. The capacity of internal memory or main memory can be expressed in terms of number of words or bytes.
2. **Access Modes** A memory is comprised of various memory locations. The information from these memory locations can be accessed randomly, sequentially and directly.
3. **Access Time** The access time is the time required between the desired modes for a read or write operation till the data is made available or written at the desired location.

4. **Physical Characteristics** In this respect, the devices can be categorized into four main categories as electronic, magnetic, mechanical and optical.

5. **Permanence of Storage** Its permanence is high for future use in magnetic materials.

Types of Memory

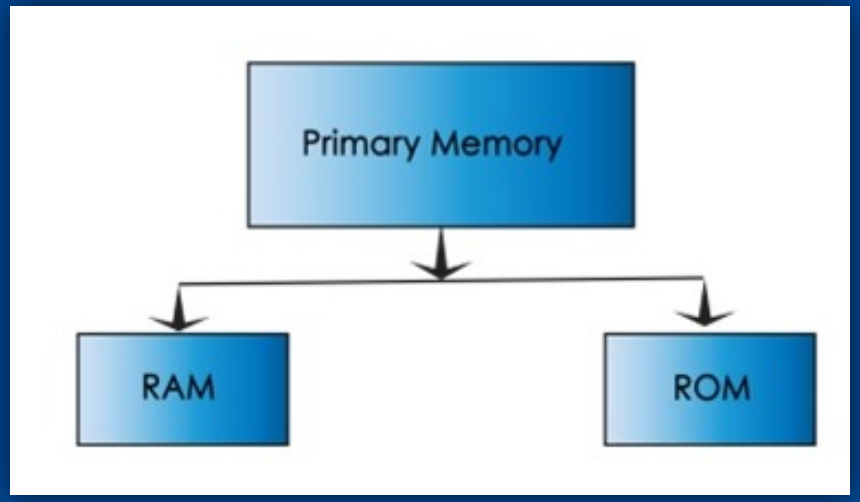
In general, the memory is classified into two categories as follows

1. **Primary memory or Main memory**
2. **Secondary memory or Auxiliary memory**

Primary memory or Main memory

The memory unit that communicates directly with the CPU is called main memory or internal memory or primary memory. The primary memory allows the computer to store data for immediate manipulation and to keep track of what is currently being processed. It has limited storage capacity.

Primary memory is of two types as shown in the image below.



Random Access Memory (RAM)

It is also known as read/write memory, that allows CPU to read as well as write data and instructions into it. RAM is used for the temporary storage of input data, output data and intermediate results.

There are two categories of RAM as follows

(i) **Dynamic RAM (DRAM)** It is made up of memory cells where each cell is composed of one capacitor and one transistor. DRAM must be refreshed continually to store information. DRAM is slower, less- expensive and occupies less space on the computer's motherboard.

(ii) **Static RAM (SRAM)** It retains the data as long as power is provided to the memory chip. SRAM needs not be refreshed periodically. It uses multiple transistors for each memory cell. It does not use capacitor. SRAM is often used cache memory due to its high speed. SRAM is more expensive and faster than DRAM.

Read Only Memory (ROM)

Read Only Memory (ROM) It is also known as non-volatile memory or permanent storage. It does not lose its contents when the power is switched OFF.

ROM can have data and instructions written to it only one time. Once a ROM chip is programmed at the time of manufacturing, it cannot be reprogrammed or rewritten. So, it has only read capability, not write.

There are three categories of ROM as follows :

1. Programmable ROM (PROM)
2. Erasable Programmable ROM (EPROM)
3. Electrically Erasable Programmable ROM (EEPROM)

Programmable ROM (PROM)

It is also non-volatile in nature. Once a PROM has been programmed, its contents can never be changed. It is one-time programmable device. These types of memories are found in video game consoles, mobile phones, implantable medical devices and high definition multimedia interfaces.

Erasable Programmable ROM (EPROM) :

It is similar to PROM, but it can be erased by exposure to strong ultraviolet light, then rewritten. So, it is also known as Ultraviolet Erasable Programmable ROM (UVEPROM).

Electrically Erasable Programmable ROM (EEPROM)

It is similar to EPROM, but it can be erased electrically, then rewritten electrically. It is the most flexible type of ROM, and is now (commonly used for holding BIOS)

(Apart from above memory, there is also some other memory that helps to primary memory which are as follows)

Cache Memory:

It is a storage buffer that stores the data which more often, temporarily and makes, them available to CPU at a fast rate. Cache memory is a very high speed. memory placed in between RAM and CPU. It increases the speed of processing. Cache memory is very expensive, so it is smaller in size. Generally, computers have cache memory of sizes 256 KB to 2 MB.

Flash Memory :

It is a kind of semiconductor based non-volatile rewritable memory, used in digital camera, mobile phone, printer, etc.

Virtual Memory

It is a technique that allows the execution of processes that are not completely in main memory. One major advantage of this scheme is that programs can be larger than main memory.

Secondary Memory/Storage

- This memory stores much larger amounts of data and information for extended periods of time
- Data in secondary memory cannot be processed directly by the CPU, it must first be copied into primary memory, i.e. RAM
- It is the slower and cheaper form of memory
- Secondary storage is used to store data and programs when they are not being processed. It is also non-volatile in vis nature. Due to this, the data remain in the secondary storage as long as it is not overwritten or deleted by the user
- It is a permanent storage

Secondary memory devices include as follows:

1. Magnetic Storage
2. Optical Storage
3. Solid State Storage

Magnetic Storage

Magnetic storage is the manipulation of magnetic fields on a medium in order to record audio, video or other data. It includes hard disk drive, floppy disk and magnetic tape..

Optical Storage

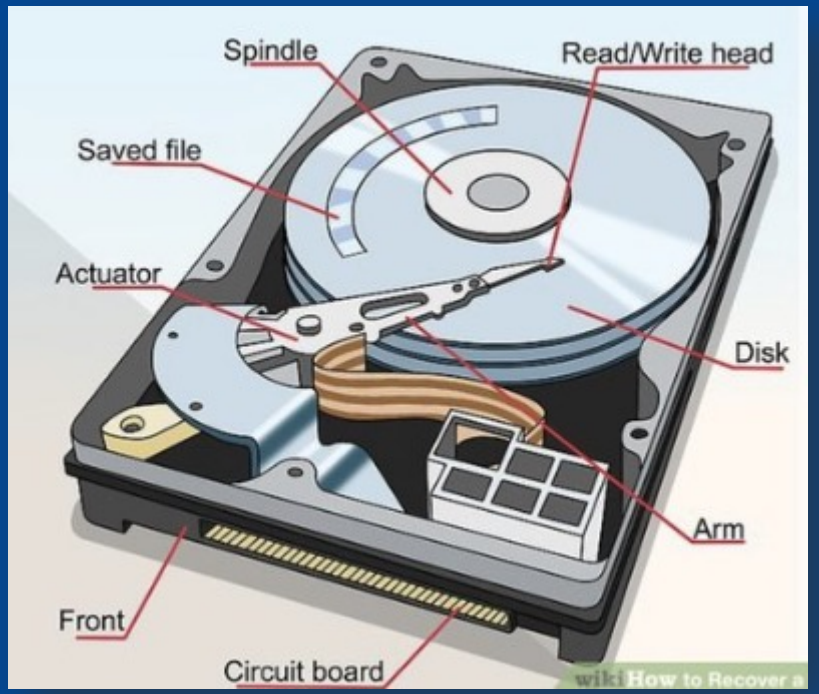
Optical storage is any storage type in which data is written and read with a laser. It includes CD, DVD and Blu-ray disc.

Solid State Storage

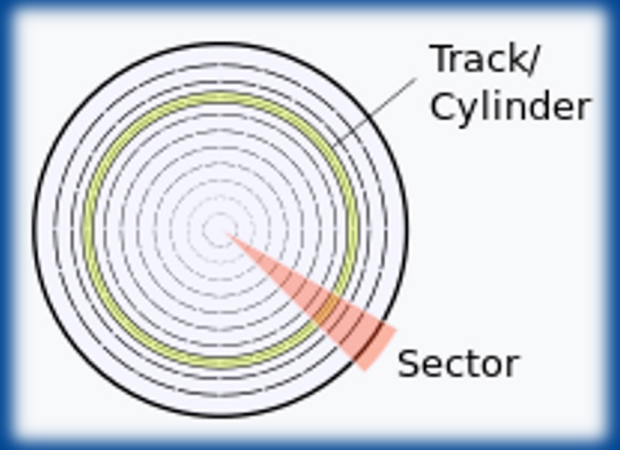
Solid state storage is a type of storage technique that employs storage devices built using silicon microchip based storage architecture. It includes pen/flash drive, memory card.

Hard Disk Drive (HDD)

- It is a non-volatile and random access digital data storage device. HDD is a data storage device used for storing and retrieving digital information using rotating disks (platters) coated with magnetic material.
- All programs of a computer are installed in hard disk.
- It is a fixed disk i.e. cannot be removed from the drive.



It consists of a spindle that holds non-magnetic flat circular disks, called platters, which hold the recorded data. Each platter requires two read/write heads, that are used to write and read information from a platter. All the read/write heads are attached to a single access arm so that they cannot move independently.



The information is recorded in bands; each band of information is called a track. Each platter has the same number of tracks and a track location that cuts across all platters is called a cylinder.

The tracks are divided into pie-shaped sections known as sectors.

Floppy Disk (Diskette)

It is used to store data but it can store small amount of data and it is slower to access than hard disks. Floppy disk rounds in shape and a thin plastic disk coated with iron oxide. Data is retrieved or recorded on the surface of the disk through a slot on the envelope. Floppy disk is removable from the drive.

Floppy disk is available in three sizes;

8 inch , $5\frac{1}{4}$ inch , $3\frac{1}{2}$ inch

Magnetic Tape

- These tapes are made of a plastic film-type material coated with magnetic materials to store data permanently.
- Data can be read as well as recorded.
- It is usually 12.5 mm to 25 mm wide and 500 m to 1200 m long.
- Magnetic tapes hold the maximum data, which can be accessed sequentially.
- They are generally used to store backup data or that type of data, which is not frequently used or to transfer data from one system to another.

Compact Disc (CD)

It is the most popular and the least expensive type of optical disc. A CD is capable of being used as a data storage device along with storing of digital audio. The files are stored on this particular contiguous sectors.

CDs are Categorized into three main types as follows

(i) CD-ROM.(Compact Disc-Read Only Memory)

(ii) CD-R (Compact Disc- Recordable)

(iii) CD-RW (Compact Disc- Rewritable)

Digital Video Disc (DVD)

DVD is also known as Super Density Disc (SDD) or Digital Versatile Disc (DVD).It is an optical disc storage media. DVDs offer higher storage capacity than CDs while having the same dimensions. Depending upon the disc type, DVD can store several Gigabytes of data (4.7 GB-17.08 GB). DVDs are primarily used to store music or 6 movies and can be played back on your television or computer too. They are not rewritable media.

DVDs come in three varieties as follows

1. DVD-ROM(Digital Video Disc-Read Only Memory)
2. DVD-R (DVD-Recordable)
3. DVD-RW (DVD-Rewritable)

Blu-ray Disc

It is an optical disc storage medium designed to re-capture the data normally in DVD format. Blu-ray disc (BD) contains 25 GB (23.31 GB) per layer space. The name Blu-ray disc refers to the blue laser used to read the disc, which allows information to be stored at a greater density than the longer- wavelength red laser used in DVDs.

Blu-ray can hold almost 5 times more data than a single layer DVD.

The variations in the formats are as follows

(i) BD-ROM (Read only)

(ii) BD-R (Recordable)

(iii) BD-RW (Rewritable)

(iv) BD-RE (Rewritable)

Pen/Thumb Drive

Pen drive is also known as flash drive. A flash drive is a data storage device that consists of flash memory (key memory) with a portable USB (Universal Serial Bus) interface. USB flash drive are typically removable, rewritable and much smaller than a floppy disk.

Memory Cards

These are the data storage devices in a chip shaped which can store the data in it. They are commonly used in many electronic devices, including digital cameras, mobile phones, laptop computers. They are small, re-recordable, easily portable and very light weighted.

Secondary Memory Devices and their storage method and capacity are follows :

Secondary Memory Devices	Storage Method	Capacity
Floppy Disk (5.25 inch)	Magnetic	1.2 MB
Floppy Disk (3.5 inch)	Magnetic	1.44 MB
Floppy Disk (8 inch)	Magnetic	80 KB to 242 KB
CD-ROM	Optical	640 MB to 680 MB
DVD-ROM	Optical	4.7 GB to 17 GB
Pen Drive	Solid State	1 GB to 512 GB
Magnetic Tape	Magnetic	upto 1 TB

1. Which is representative of the size of the memory?

A. Storage capacity
B. Access mode
C. Access time
D. Permanence storage

2. Where is data saved permanently ?

A. RAM
B. Storage
C. CPU
D. Printer

3. Where are programs and data to be used by the computer available?

A. Processing unit
B. Output
C. Storage
D. Input

4. How many types of memory does a computer have?

A. Four
B. Eight
C. One
D. Two

5. Primary storage is ..... as compared to secondary storage.

A. Slow and inexpensive
B. Fast and inexpensive
C. Fast and expensive
D. Slow and expensive

6. The key feature(s) of internal memory is/are

A. limited storage capacity
B. temporary storage
C. fast access and high cost.
D. All of the above

7. Internal storage is also called main _____

A. Memory
B. Area
C. Screen
D. Unit

8. The two kinds of main memory are

A. ROM and RAM
B. Primary and Secondary
C. Floppy disk and hard disk
D. Direct and Sequential

9. Which memory is used as temporary memory?

A. Non-volatile memory
B. Volatile memory
C. Hard disk memory
D. Read only memory

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10. Which of the following is a correct definition of volatile memory?

A. It does retain its contents at high temperatures
B. It is to be kept in air-tight boxes
C. It loses its contents on failure of power supply
D. It does not lose its contents on failure of power supply

11. Cache and main memory will not be able to hold their contents when the power is OFF. They are

A. Dynamic
B. Static
C. Volatile
D. Non-volatile

12. Which of the following is not an access mode ?

A. Random
B. Sequential
C. Continuous
D. Direct

13_____memory in a computer is where information is temporarily stored while it is being accessed or worked on by the processor.

A. Logical
B. Secondary
C. ROM
D. RAM

14. Why RAM is so called ?

A. Because it is read and write memory
B. Because it is a volatile memory
C. Because it can be selected directly for storing and retrieving data and instructions of any location of chip
D. Because it is a non-volatile memory

15. Which of the following is not true about RAM ?

A. RAM is the same as hard disk storage
B. RAM is a temporary storage area
C. RAM is volatile
D. RAM is a primary memory

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