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Computer Memory

Memory is the best essential **element of a computer** because computer can't perform simple tasks. The performance of computer mainly based on **memory and CPU**. Memory is internal storage media of computer that has several names such as majorly categorized into two types,

1.Main memory/ Primary Memory

2. Secondary Memory

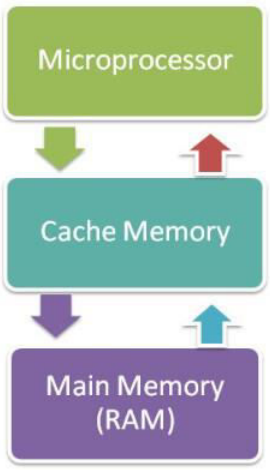
Primary Memory:

Primary memory is computer memory that a **processor or computer accesses first or directly**. It allows a processor to **access running** execution applications and services that are temporarily stored in a specific memory location. Primary memory is also known as primary storage or main memory

1. RAM (Volatile Memory).

2. ROM (Non-Volatile Memory).

Random Access Memory (RAM):



It is a **volatile memory**. It means it does not store data or instructions permanently. It is read/write memory which stores data till the machine is working. When you switch on the computer and perform some task the data and instructions from the hard disk are stored in RAM.

CPU utilizes this data to perform the required tasks. As soon as you shut down the computer the RAM loses all the data.

RAM categorized into following types.

1. DRAM- Dynamic memory must be **constantly refreshed**, or it loses its contents. This type of memory is more economical.

2. SRAM- SRAM is faster and less volatile than DRAM but requires more power and is more expensive. It **does not need to be refreshed** like a DRAM.

3. SDRAM(Synchronous Dynamic Random-Access Memory) - A type of DRAM that can run at much higher clock speeds.

- **Read Only Memory (ROM):**

It is a non-volatile memory. It means it does not lose its data or programs that are written on it at the time of manufacture. So it is a permanent memory that contains all important data and instructions needed to perform important tasks like the boot process.

ROM memory has several models such names are following.

1. PROM: Programmable Read Only Memory (PROM) maintains large storage media but **can't offer the erase** features in ROM. This type of RO maintains PROM chips to write data once and read many. The programs or instructions designed in PROM can't be erased by other programs.

2. EPROM : Erasable Programmable Read Only Memory designed for recover the problems of PROM and ROM. Users can **delete the data of EPROM** thorough pass on **ultraviolet light** and it **erases chip** is reprogrammed.

3. EEPROM: Electrically Erasable Programmable Read Only Memory similar to the EPROM but it uses **electrical beam for erase** the data of ROM.

Some other memories are

- **Register Memory:**

Register memory is the smallest and fastest memory in a computer. It is located in the CPU in the form of registers. A **register temporarily holds frequently used data**, instructions and memory address that can be quickly accessed by the CPU.

❖ **Cache Memory:**

It is small in size but faster than the main memory. The CPU can access it more quickly than the primary memory. It holds the **data and programs frequently used** by the CPU. So if the CPU finds the required data or instructions in cache memory it doesn't need to access the primary memory (RAM). Thus, it speeds up the system performance.

❖ **Semi-volatile memory:**

A third category of memory is "semi-volatile". The term is used to describe a memory which has **some limited non-volatile duration after power** is removed, but then data is ultimately lost. A typical goal when using a semi-volatile memory is to provide high performance/durability/etc. associated with volatile memories, while providing some benefits of a true non-volatile memory.

❖ **Virtual memory:**

Virtual memory is a system where all physical memory is controlled by the operating system. When a program needs memory, it **requests it from the operating system**. The operating system then decides in what **physical location to place the program's** code and data.

❖ **Protected memory:**

Protected memory is a system where **each program is given an area of memory to use** and is not permitted to go outside that range. Use of protected memory greatly enhances both the reliability and security of a computer system.

Secondary Memory:

The storage devices in the computer or connected to the computer are known as secondary memory of the computer. It is **non-volatile in nature so permanently stores** the data even when the computer is turned off. The CPU can't directly access the secondary memory. First the secondary memory data is

transferred to primary memory then CPU can access it. Common secondary storage devices are the hard disk and optical disks. The hard disk has enormous storage capacity compared to main memory.

There are three main types of secondary storage in a computer system:

- **Solid state storage devices**(such as USB memory sticks): Solid state storage is also faster than traditional hard disk drives because the data is stored electrically in silicon chips called cells. Within the cells, the binary data is stored by holding an electrical current in a transistor with an on / off mode.
- **Optical storage devices**(such as CD, DVD and Blue-ray discs): Optical devices use a laser to scan the surface of a spinning disc made from metal and plastic. The disc surface is divided into tracks, with each track containing many flat areas and hollows. The flat areas are known as lands and the hollows as pits.
- **Magnetic storage devices**(such as hard disk drives): Magnetic devices such as hard disk drives use magnetic fields to magnetise tiny individual sections of a metal spinning disk. Each tiny section represents one bit. A magnetised section represents a binary '1' and a demagnetized section represents a binary '0'.

Hard drive: It is a non-removable storage device containing magnetic disks or platters rotating at high speeds. The hard drives store data in **segments of concentric circles.** It may spin at 5,400 to 15,000 RPM.

Optical disk: an electronic data storage medium that can be written to and read using a low-powered laser beam.

- **CD-ROM:** "Read Only" (used for distribution of commercial software, for example) Standard storage capacity is 640MB.
- **CD-R** (or CD-WORM): "Write Once, Read Many" times
- **CD-RW:** rewritable multiple times
- **DVD:** similar to CD, but with significantly larger storage capacity (4.7GB)

- **Write once read many (WORM)** describes a data storage device in which information, once written, cannot be modified

Floppy Disk: Floppy disk is composed of a thin, flexible magnetic disk sealed in a square plastic carrier. Floppy disks were widely used to distribute software, transfer files, and create backup copies of data. To read and write data from a floppy disk, a computer system must have a floppy disk drive (FDD).

Magnetic Tape: Magnetic tape used in recording sound, pictures, or computer data.

Flash memory: a kind of memory that retains data in the **absence of a power supply**.

Primary memory	Secondary memory
The primary memory is categorized as volatile & nonvolatile memories.	The secondary memory is always a non-volatile memory.
These memories are also called internal memory.	Secondary memory is known as a Backup memory or Additional memory or Auxiliary memory.
Data is directly accessed by the processing unit.	Data cannot be accessed directly by the processor. It is first copied from secondary memory to primary memory. Only then CPU can access it.
It holds data or information that is currently being used by the processing unit. Capacity is usually in 16 to 32 GB	It stores a substantial amount of data and information. Capacity is generally from 200GB to terabytes.
Primary memory can be accessed by the data bus.	Secondary memory is accessed by I/O channels.
Primary memory is costlier than secondary memory.	Secondary memory is cheaper than primary memory.

Memory unit

Memory unit is the **amount of data that can be stored in the storage unit**. This storage capacity is expressed in terms of **Bytes**.

Unit	Description
Bit (Binary Digit)	A binary digit is logical 0 and 1 representing a passive or an active state of a component in an electric circuit.
Nibble	A group of 4 bits is called nibble.
Byte	A group of 8 bits is called byte. A byte is the smallest unit, which can represent a data item or a character.
Kilobyte (KB)	1 KB = 1024 Bytes
Megabyte (MB)	1 MB = 1024 KB
GigaByte (GB)	1 GB = 1024 MB
TeraByte (TB)	1 TB = 1024 GB
PetaByte (PB)	1 PB = 1024 TB
Exa Byte	1 EB = 1024 PB

Zetta Byte	1 ZB = 1024 EB
Yotta Byte	1 YB = 1024 ZB