



COMPUTER MEMORY

Unit – II

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CONTENTS

- ◉ What is Computer Memory?
- ◉ Why is memory important or needed for a computer?
- ◉ Types of Computer Memory
 - ◉ Primary Memory
 - ◉ Secondary Memory
 - ◉ Primary Vs Secondary Memory

WHAT IS A COMPUTER MEMORY

Computer Memory is like any physical device, used to store data, information or instruction temporarily or permanently.

It is the collection of storage units that stores binary information in the form of bits. The memory block is split into a small number of components, called cells.

Each cell has a unique address to store the data in memory

For example, if the size of computer memory is 64k words.

The memory units have $64 * 1024 = 65536$ locations or cells.

The address of the memory's cells varies from 0 to 65535.

WHY DO WE NEED A COMPUTER MEMORY

In the computer system, we need computer memory to store various types of data like text, images, video, audio, documents, etc.

We can retrieve it when the data is required. For example, when we write and execute any computer program, it is initially stored in primary memory.

If the processor does not need particular items for a longer time, the program or data is automatically saved into the permanent or secondary memory. Then the data is called from secondary memory to main memory and performs the execution of codes.

FEATURES OF MEMORY

1.Location: It represents the internal or external location of the memory in a computer. The internal memory is inbuilt in computer memory. It is also known as **primary memory**.

The example of primary memory are registers, cache and main memory. Whereas, external memory is the separate storage device from the computer, such as disk, tape, USB pen drive.

2.Capacity: It is the most important feature of computer memory. Storage capacity can vary in external and internal memory.

External devices' storage capacity is measured in terms of bytes, whereas the internal memory is measured with bytes or words. The storage word length can vary in bits, such as 8, 16 or 32 bits.

FEATURES OF MEMORY

3.Access Methods: Memory can be accessed through four modes of memory.

- **DMA:** As the name specifies, Direct Memory Address (DMA) is a method that allows input/output (I/O) devices to access or retrieve data directly or from the main memory.
- **Sequential Access Method:** The sequential access method is used in a data storage device to read stored data sequentially from the computer memory.
- **Random Access Method:** It is a method used to randomly access data from memory. This method is the opposite of SAM. For example, to go from A to Z in random access, we can directly jump to any specified location.
In the Sequential method, we have to follow all intervening from A to Z to reach at the particular memory location.

Associative Access Method: It is a special type of memory that optimizes search performance through defined data to directly access the stored information based on a memory address.

FEATURES OF MEMORY

4.Unit of transfer: As the name suggests, a unit of transfer measures the transfer rate of bits that can be **read or write, in or out** of the memory devices. The transfer rate of data can be different in external and internal memory.

- **Internal memory:** The transfer rate of bits is mostly equal to the word size.
- **External memory:** The transfer rate of bit or unit is not equal to the word length. It is always greater than a word or may be referred to as **blocks**.

FEATURES OF MEMORY

5.Performance: The performance of memory is majorly divided into three parts.

- **Access Time:** In random access memory, it represents the total time taken by memory devices to perform a read or write operation that an address is sent to memory.
- **Memory Cycle Time:** Total time required to access memory block and additional required time before starting second access.
- **Transfer rate:** It describes the transfer rate of data used to transmit memory to or from an external or internal memory device. Bit transfer can be different for different external and internal devices.

FEATURES OF MEMORY

6.Physical types: It defines the physical type of memory used in a computer such as magnetic, semiconductor, magneto-optical and optical.

7.Organization: It defines the physical structure of the bits used in memory.

8.Physical characteristics: It specifies the physical behavior of the memory like volatile, non-volatile or non-erasable memory.

Volatile memory is known as RAM, which requires power to retain stored information, and if any power loss has occurred, stored data will be lost.

Non-volatile memory is a permanent storage memory that is used to obtain any stored information, even when the power is off.

Non-erasable memory is a type of memory that cannot be erased after the manufactured like ROM because at the time of manufactured ROM are programmed.

MEMORY

As the word implies “memory” means the place where we have to store any thing, this is very essential part of human being just like this memory is also very important for computer system because in computer system we have to store some data or information and for storing these items we need some memory or space.

So that’s why we can say that memory is very important part of computer system.

MEMORY

- Memory is one of the most important components of a computer system as it stores data and instructions.
- Every memory chip contains thousands of memory locations. In the computer, the data is stored in the form of bits and bytes.
- A bit is the smallest storage unit of memory. A nibble is a collection of 4 bits. Eight bits combined together to form a single byte, which in turn represents a single character

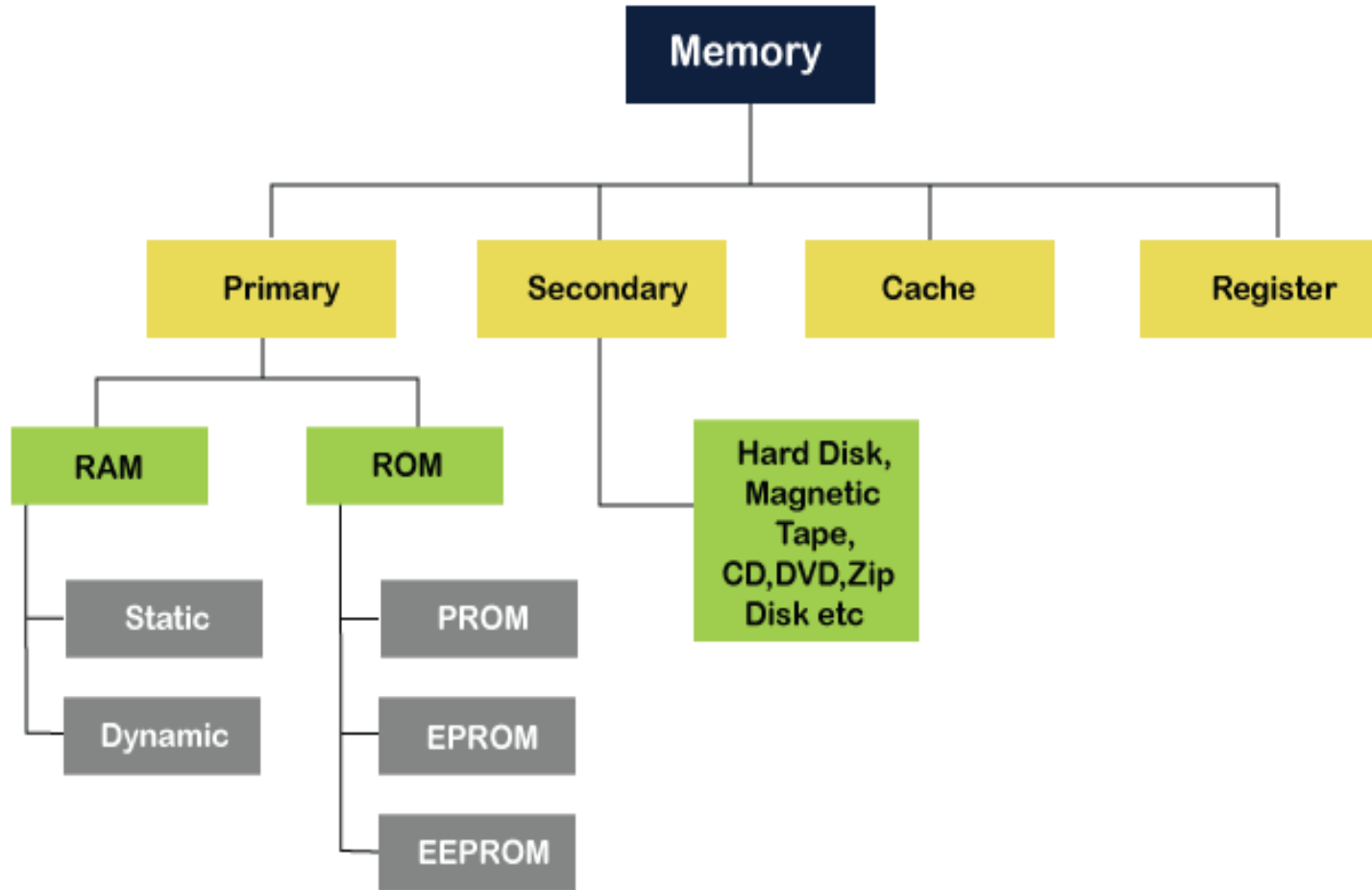
MEMORY UNITS

Memory unit	Relationship with earlier memory unit	In equivalent Bytes
Kilo Byte (KB)	1 Kilo Byte = 1024 Bytes(or 2^{10} Bytes)	1024
Mega Byte (MB)	1 Mega Byte = 1024 Kilo Byte(or 2^{10} KB)	1024×1024
Giga Byte (GB)	1 Giga Byte = 1024 Mega Byte(or 2^{10} MB)	$1024 \times 1024 \times 1024$
Tera Byte (TB)	1 Tera Byte = 1024 Giga Byte(or 2^{10} GB)	$1024 \times 1024 \times 1024 \times 1024$
Peta Byte (PB)	1 Peta Byte = 1024 Tera Byte(or 2^{10} TB)	$1024 \times 1024 \times 1024 \times 1024 \times 1024$
Exa Byte(EB)	1 Exa Byte = 1024 Peta Byte(or 2^{10} PB)	$1024 \times 1024 \times 1024 \times 1024 \times 1024 \times 1024$

TYPES OF MEMORY

The computer memories can be divided into following categories:

- Primary Memory
- Secondary memory
- Cache Memory
- Register Memory



TYPES OF MEMORY

- **Primary Memory :-**

Primary memory also known as “main memory” or “internal memory” which is located in the mother board of system or as we say which is directly connected to the CPU. It is the place where only little bit of data are stored either by manufacturer or by user.

This is further divided into two types ;

- ☐ RAM

- ☐ ROM

RAM

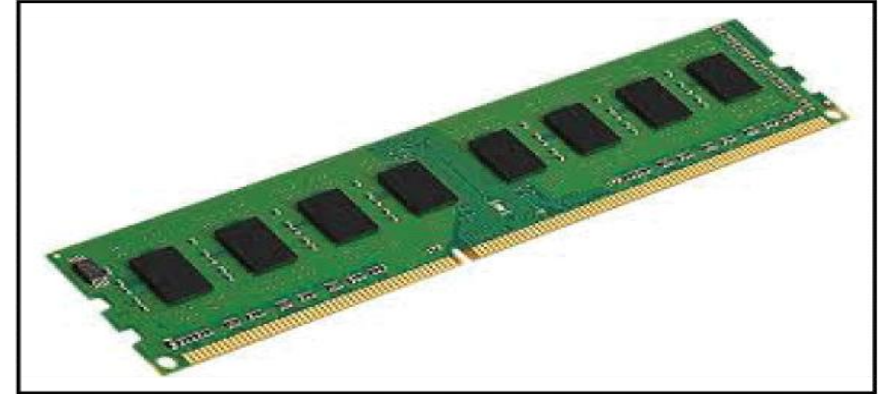
RAM also known as “**random access memory**” it stores the data which the user currently uses or as we say it stores the data temporary in it.

RAM needs power or electricity to work when the computer power is turned off then all the data in it will be erased automatically.

This is a circuit which have its separate space or slot in motherboard. This allows the computer to run the software faster.

RAM

- It is a volatile memory and loses its contents when the power is switched off or interrupted.
- Nowadays RAMs are available in gigabytes. The normal memory access time of a RAM is 20-80 ns.



RAM is further classified into two parts

☐ SRAM

☐ DRAM

DRAM

- Known as **Dynamic RAM**. It also contains data only when electricity is available.
- DRAM needs to be refreshed periodically due to this, this RAM works slower than SRAM.
- Mainly general PC uses this RAM because it is much cheaper than SRAM and requires less space

CHARACTERISTICS OF DRAM

- It requires continuously refreshed to retain the data.
- It is slower than SRAM
- It holds a large amount of data
- It is the combination of capacitor and transistor
- It is less expensive as compared to SRAM
- Less power consumption

SRAM

SRAM (**Static Random-Access Memory**)

Is a type of RAM used to store static data in the memory. It means to store data in SRAM remains active as long as the computer system has a power supply. However, data is lost in SRAM when power failures have occurred.

SRAM Known as **Static RAM**. The word “static” refers that the memory retains its contents as long as the power is supplied so that’s why we can say this is volatile in nature. SRAM does not need to be refreshed periodically . SRAM is faster but more expensive than DRAM

CHARACTERISTICS OF SRAM

- It does not require to refresh.
- It is faster than DRAM
- It is expensive.
- High power consumption
- Longer life
- Large size
- Uses as a cache memory

SRAM Vs. DRAM

SRAM	DRAM
Stores data till the power is supplied	Stores data only for few milliseconds even when power is supplied
Uses an array of 6 transistors for each memory cell	Uses a single transistor and capacitor for each memory cell
Does not refresh the memory cell	Needs to refresh the memory cell after each reading of the capacitor
Data access is faster	Data access is slower
Consume more power	Consume less power
Low density/less memory per chip	High density/more memory per chip
Cost per bit is high	Cost per bit is low

ADVANTAGES OF RAM

- It is a faster type of memory in a computer.
- It requires less power to operate.
- Program loads much faster
- More RAM increases the performance of a system and can multitask.
- Perform read and write operations.
- The processor can read information faster than a hard disc, floppy, USB, etc.

DISADVANTAGES OF RAM

- Less RAM reduces the speed and performance of a computer.
- Due to volatile, it requires electricity to preserve the data.
- It is expensive than ROM
- It is unreliable as compared to ROM
- The Size of RAM is limited.

ROM

- Known as “**Read Only Memory**” as the word refers
- mainly it can only read the data which is stored in it.
- This memory is mainly used by our computer when we just turn on our computer.
- This is non-volatile in nature.

Mainly there are three types of ROM :-

- PROM
- EPROM
- EEPROM



1. PROM

- Known as “**programmable Read Only memory**”.
- In this when the data is stored then we have no right to change or alter any data to it.
- In this the data is written by Manufacturer company, even you can also purchase blank PROM chip but it can be programmed by special tool such as PROM programmers.
- In general PC's mainly PROM is used because we don't have to alter any data to it.

2.EPROM

- Known as “**Erasable PROM**” as the word refers “erasable” means we can change or erase the data. So in EPROM we have right to change the data.
- In this we can change the data.
- EPROM is much expensive than PROM

3.EEPROM

- Known as “**Electrically Erasable PROM**” the type of ROM which can be erased by electrical charges.
- EEPROM can be erased one byte at anytime rather than erasing the entire chip.

FLASH MEMORY

- Its an electrically erasable & programmable permanent type memory.
- It uses one transistor memory all resulting in high packing density, low power consumption, lower cost & higher reliability.
- Its used in all power, digital cameras, MP3 players etc.

ADVANTAGES OF ROM

- It is a non-volatile memory in which stored information can be lost even power is turned off.
- It is static, so it does not require refreshing the content every time.
- Data can be stored permanently.
- It is easy to test and store large data as compared to RAM.
- These cannot be changed accidentally
- It is cheaper than RAM.
- It is simple and reliable as compared to RAM.
- It helps to start the computer and loads the OS.

DISADVANTAGES OF ROM

- Store data cannot be updated or modify except to read the existing data.
- It is a slower memory than RAM to access the stored data.
- It takes around 40 minutes to destroy the existing data using the high charge of ultraviolet light.

RAM vs ROM

RAM	ROM
It is a Random-Access Memory.	It is a Read Only Memory.
Read and write operations can be performed.	Only Read operation can be performed.
Data can be lost in volatile memory when the power supply is turned off.	Data cannot be lost in non-volatile memory when the power supply is turned off.
It is a faster and expensive memory.	It is a slower and less expensive memory.
Storage data requires to be refreshed in RAM.	Storage data does not need to be refreshed in ROM.
The size of the chip is bigger than the ROM chip to store the data.	The size of the chip is smaller than the RAM chip to store the same amount of data.
Types of RAM: DRAM and SRAM	Types of ROM: MROM, PROM, EPROM, EEPROM

SECONDARY MEMORY

- The major limitation of primary memory is that it has limited storage capacity and is volatile.
- To overcome this limitation we have secondary memory storage devices. This type of memory is also called external memory.
- For example Floppy disk, hard disk, USB drives, CD/DVDs.

SECONDARY MEMORY

Is a **permanent storage** space to hold a large amount of data. Secondary memory is also known as external memory that representing the various storage media (hard drives, USB, CDs, flash drives and DVDs) on which the computer data and program can be saved on a long term basis.

However, it is cheaper and slower than the main memory. Unlike primary memory, secondary memory cannot be accessed directly by the CPU. Instead of that, secondary memory data is first loaded into the RAM (Random Access Memory) and then sent to the processor to read and update the data.

Secondary memory devices also include magnetic disks like hard disk and floppy disks, an optical disk such as CDs and CDRoms, and magnetic tapes.

FEATURES OF SECONDARY MEMORY

- Its speed is slower than the primary/ main memory.
- Store data cannot be lost due to non-volatile nature.
- It can store large collections of different types, such as audio, video, pictures, text, software, etc.
- All the stored data in a secondary memory cannot be lost because it is a permanent storage area; even the power is turned off.
- It has various optical and magnetic memories to store data.

1.MAGNETIC DISK

Magnetic disks are made of rigid metals or synthetic plastic material. The disk platter is coated on both the surfaces with magnetic material and both the surfaces can be used for storage. The magnetic disk furnishes direct access and is for both small and large computer systems.

HARD DISK

A hard disk is a computer's permanent storage device. It is a non-volatile disk that permanently stores data, programs, and files, and cannot lose store data when the computer's power source is switched off.

Typically, it is located internally on computer's motherboard that stores and retrieves data using one or more rigid fast rotating disk platters inside an air-sealed casing.

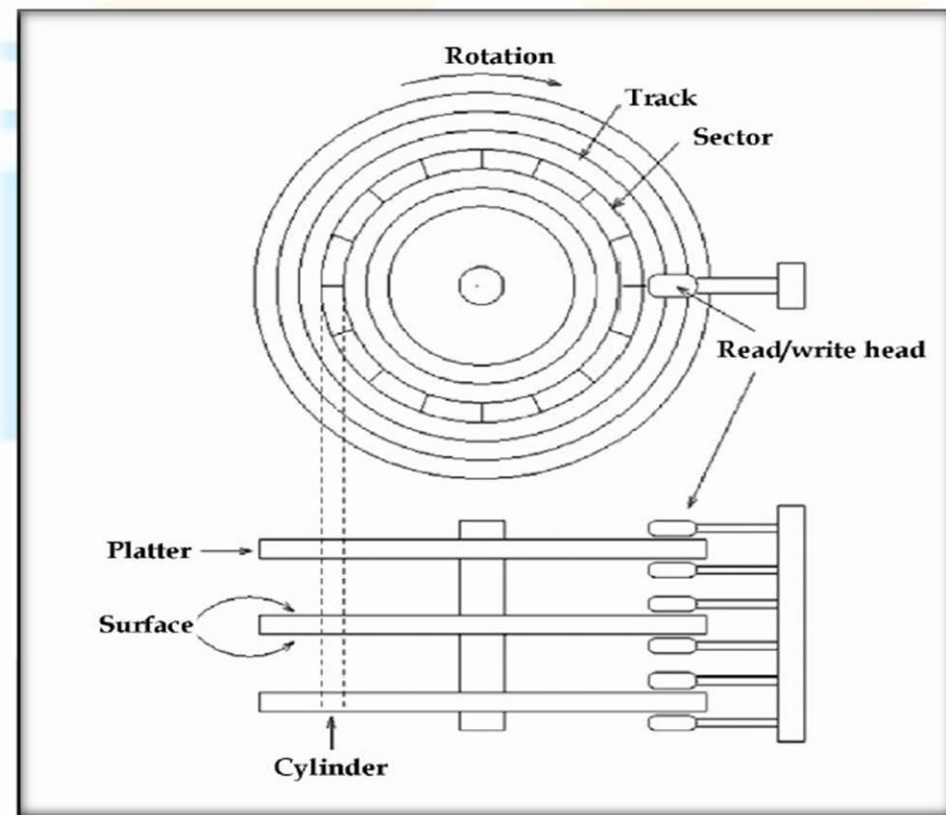
It is a large storage device, found on every computer or laptop for permanently storing installed software, music, text documentation, videos, operating system, and data until the user did not delete.



ROTATING ARM OF HARD DISK

Information is recorded on each of these disks in the form of concentric circles called tracks which are further divided into sectors. Hard drives however, are not very portable and are primarily used internally in a computer system.

But external hard disks are also available as a substitute for portable storage. Today the hard disks have the storage capacity of several gigabytes to terabytes.



2.MAGNETIC TAPE

Magnetic tape is serial access storage medium and it can store a large volume of data at low costs. The conventional magnetic tape is in reels of up to 3600 feet made of Mylar plastic tape.

The tape is one-half inch in width and is coated with magnetic material on one side. The reel of tape is loaded on a magnetic tape drive unit.

During any read/write operation, the tape is moved from one spool to another in the same way as in the audiocassette tape recorder.

The magnetic tape is densely packed with magnetic spots in frames across its width.

3.OPTICAL DRIVES

Optical drives are a storage medium from which data is read and to which it is written by lasers. Optical disks can store much more data up to 6GB.

Optical store devices are the most widely used and reliable storage devices. The most widely used type of optical storage devices are explained below.

CD(COMPACT DISK)

A CD is an optical disk storage device, stands for Compact Disc. It is a storage device used to store various data types like audio, videos, files, OS, Back-Up file, and any other information useful to a computer.

The CD has a width of 1.2 mm and 12 cm in height, which can store approximately 783 MB of data size.

It uses laser light to read and write data from the CDs.



TYPES OF CD's

- CD-ROM (Compact Disc Read Only Memory): It is mainly used for bulk size mass like audio CDs, software and computer games at the time of manufacture. Users can only read data, text, music, videos from the disc, but they cannot modify or burnt it.
- CD-R (Compact Disc Recordable): The type of Compact Disc used to write once by the user; after that, it cannot be modified or erased.
- CD-RW (Compact Disc Rewritable): It is a rewritable CD disc, often used to write or delete the stored data.

DVD Drive/Disc

DVD is an optical disc storage device, stands for **Digital Video Display or Digital Versatile Disc**. It has the same size as a CD but can store a larger amount of data than a compact disc. It was developed in **1995** by Sony, Panasonic, Toshiba and Philips four electronics companies.

DVD drives are divided into three types, such as DVD ROM (Read Only Memory), **DVD R** (Recordable) and **DVD RW** (Rewritable or Erasable).

It can store multiple data formats like audio, videos, images, software, operating system, etc.

The storing capacity of data in DVD is 4.7 GB to 17 GB.



PEN DRIVE

A pen drive is a portable device used to permanently store data and is also known as a USB flash drive. It is commonly used to store and transfer the data connected to a computer using a USB port.

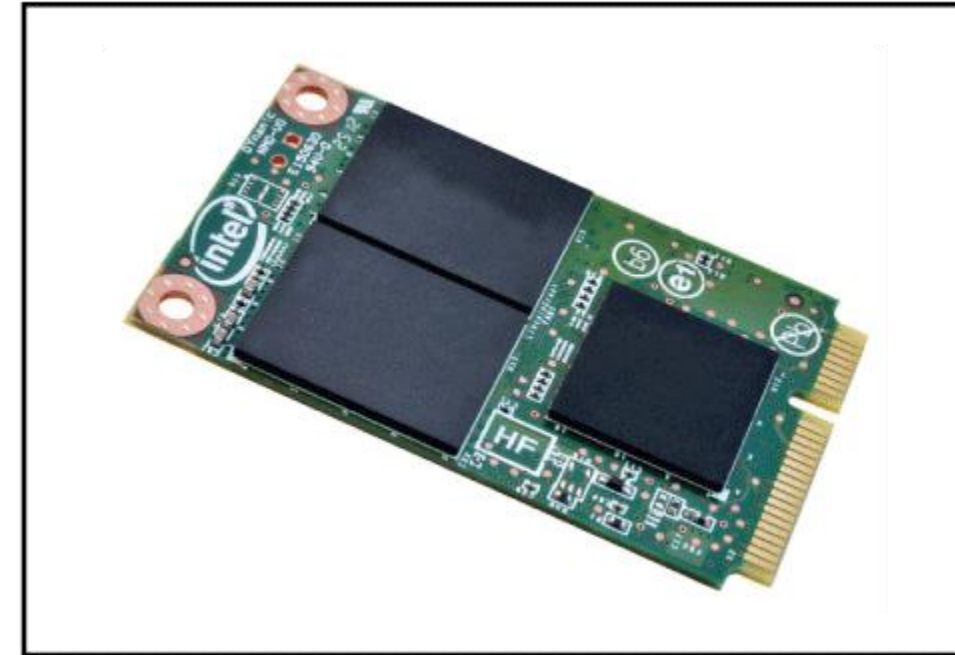
It does not have any moveable part to store the data; it uses an integrated circuit chip that stores the data. It allows the users to store and transfer data like audio, videos, images, etc. from one computer to any USB pen drive.

The storing capacity of pen drives from 64 MB to 128 GB or more.



CACHE MEMORY

- It is a small-sized chip-based computer memory that lies between the CPU and the main memory.
- It is a faster, high performance and temporary memory to enhance the performance of the CPU.
- It stores all the data and instructions that are often used by computer CPUs.
- It also reduces the access time of data from the main memory. It is faster than the main memory, and sometimes, it is also called CPU memory because it is very close to the CPU chip.



LEVELS OF CACHE MEMORY

- **L1 Cache:** The L1 cache is also known as the onboard, internal, or primary cache. It is built with the help of the CPU. Its speed is very high, and the size of the L1 cache varies from 8 KB to 128 KB.
- **L2 Cache:** It is also known as external or secondary cache, which requires fast access time to store temporary data. It is built into a separate chip in a motherboard, not built into the CPU like the L1 level. The size of the L2 cache may be 128 KB to 1 MB.
- **L3 Cache:** L3 cache levels are generally used with high performance and capacity of the computer. It is built into a motherboard. Its speed is very slow, and the maximum size up to 8 MB.

ADVANTAGES OF CACHE MEMORY

- Cache memory is the faster memory as compared to the main memory.
- It stores all data and instructions that are repeatedly used by the CPU for improving the performance of a computer.
- The access time of data is less than the main memory.

DISADVANTAGES OF CACHE MEMORY

- It is very costly as compared to the Main memory and the Secondary memory.
- It has limited storage capacity.

REGISTER MEMORY

The register memory is a temporary storage area for storing and transferring the data and the instructions to a computer. It is the smallest and fastest memory of a computer.

It is a part of computer memory located in the CPU as the form of registers. The register memory is 16, 32 and 64 bits in size.

It temporarily stores data instructions and the address of the memory that is repeatedly used to provide faster response to the CPU.

PRIMARY Vs SECONDARY MEMORY

Parameter	Primary memory	Secondary memory
Nature	The primary memory is categorized as volatile & nonvolatile memories.	The secondary memory is always a non-volatile memory.
Alias	These memories are also called internal memory.	Secondary memory is known as a Backup memory or Additional memory or Auxiliary memory.
Access	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.
Formation	It's a volatile memory meaning data cannot be retained in case of power failure.	It's a non-volatile memory so that that data can be retained even after power failure.



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HOW COMPUTER MEMORY WORKS

<https://www.youtube.com/watch?v=p3q5zWCw8J4>

Q & A





THANK YOU