



Memory and Storage

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Outlines

Introduction to Memory

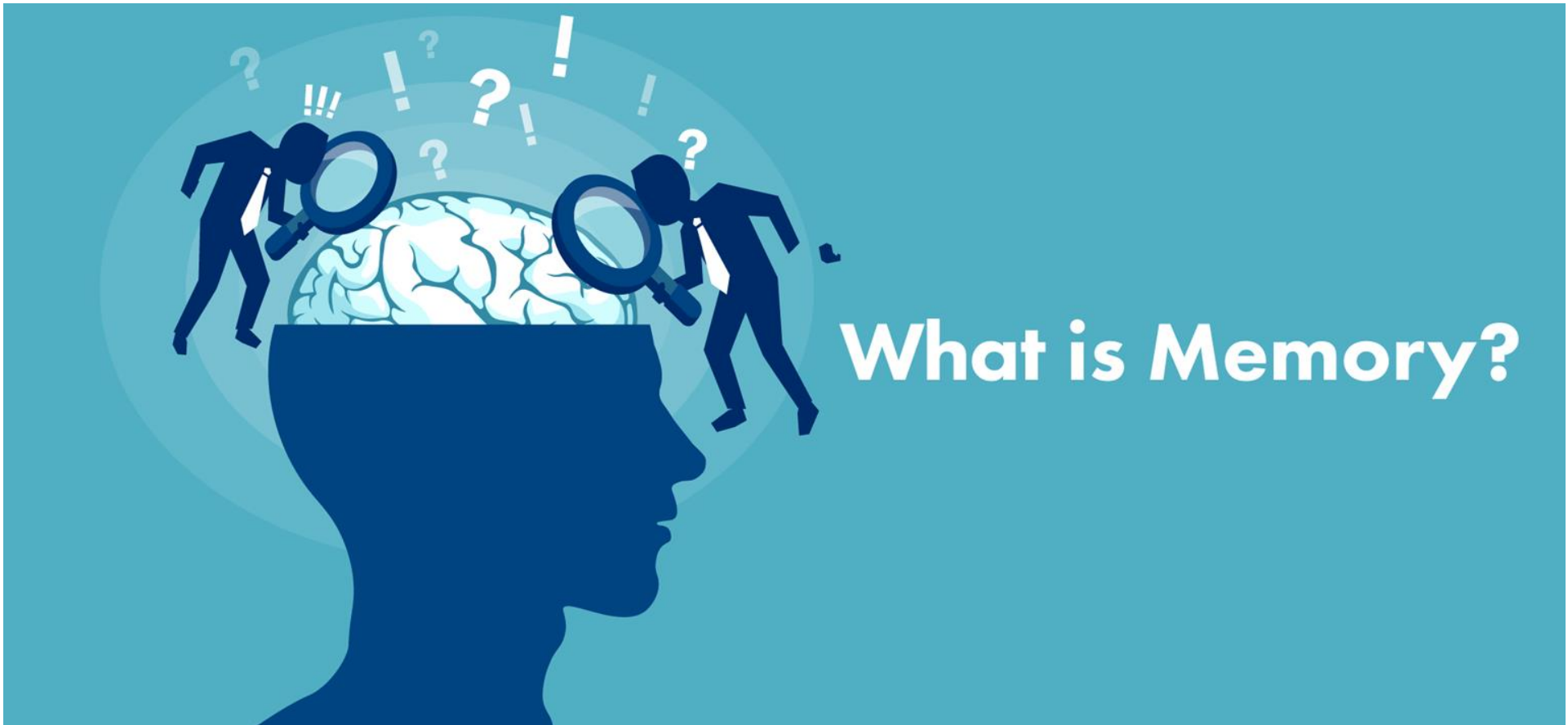
Storage Capacity

Types of Memory

Classification of Memory and Storage

Types of Main Memory

What is a Memory?



What is a Memory?

- ✓ **Computer memory** is just like the human brain. It is used to store data/information and instructions.
- ✓ **Computer memory** is any physical device capable of storing information temporarily, like RAM (random-access memory), or permanently, like ROM (read-only memory).
- ✓ It is a data storage unit or a data storage device where data is to be processed and instructions required for processing are stored.

Units of Memory

Memory units are the amount of data that a memory device can store. Here are some units of memory:

- **Bit:** A bit is the smallest unit of measurement of data. The first memory location in a computer is a bit. Represents binary values 0 and 1.
- **Nibble:** It means the group of 4 bits.
- **Word:** A word is a unit of data in computer architecture that can be moved between a computer's processor and storage. The number of bits in a word is known as the word size, word length, or word width. A word consists 16 bit.
- **Byte:** The fundamental unit used to measure data is the byte. It has 8 bits in it. A byte can therefore represent 2^8 or 256 values.

Units of Memory

Kilobyte (KB): 1024 bytes is equal to one kilobyte. $1\text{KB} = 2^{10} \text{ Byte}$

Megabyte (MB): A megabyte is 1024 kilobytes in size. It contains more info as compared to a kilobyte. $1\text{MB} = 2^{20} \text{ Byte}$

Gigabyte (GB): A megabyte is 1024 kilobytes in size. It contains more info as compared to a kilobyte. $1\text{GB} = 2^{30} \text{ Byte}$

Terabyte (TB): A terabyte is made up of 1024 gigabytes. $1\text{TB} = 2^{40} \text{ Byte}$

Petabyte (PB): A petabyte is made up of 1024 terabytes.



Units of Memory

Exabyte (EB): Equal to 1024 petabytes.

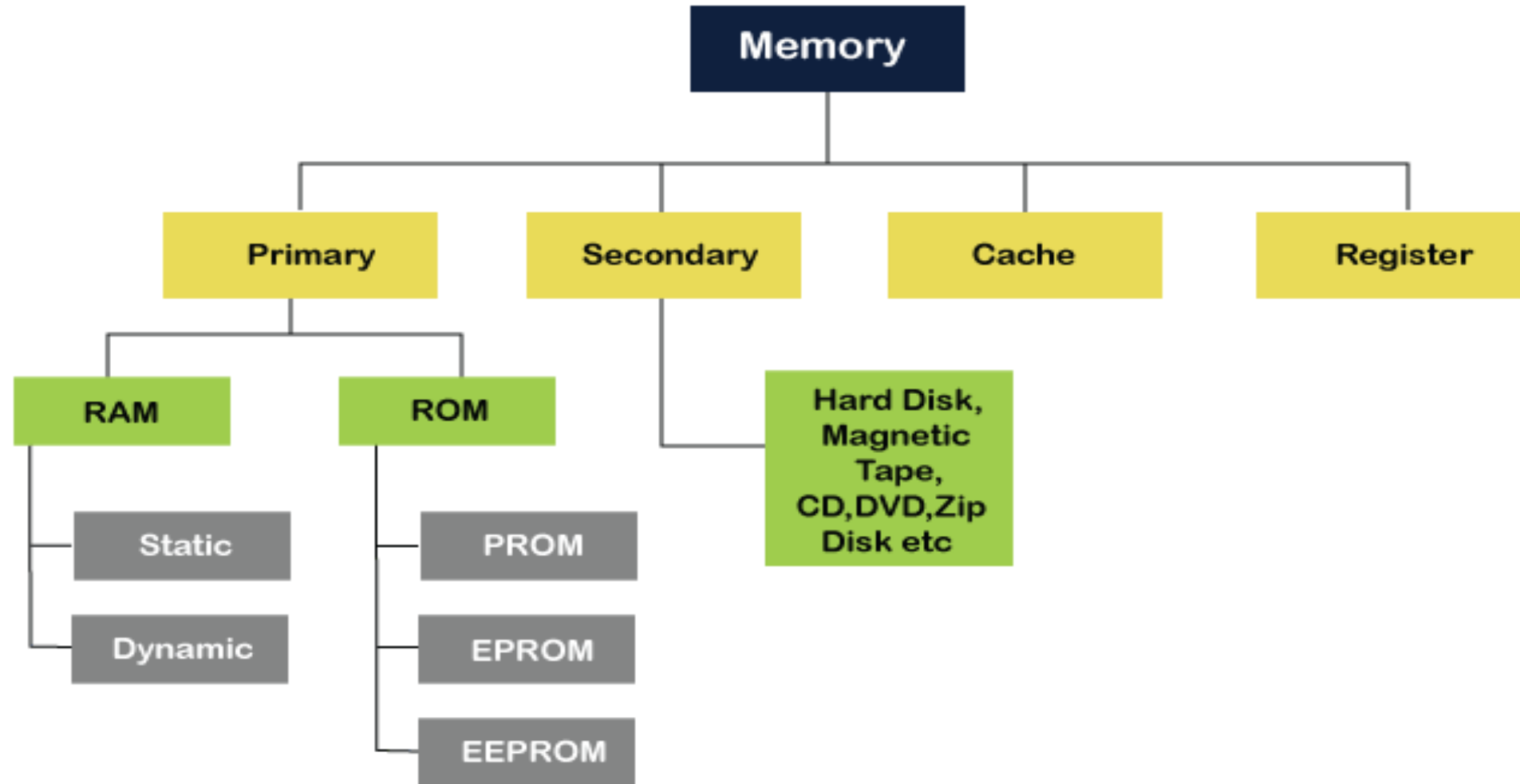
Zettabyte (ZB): Equal to 1024 exabytes.

Yottabyte (YB): Equal to 1024 zettabyte.

Conversion of Units

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	1024 Kilobytes	1, 048, 576
Gigabyte	1024 Megabytes	1, 073, 741, 824
Terabyte	1024 Gigabytes	1, 099, 511, 627, 776
Petabyte	1024 Terabytes	1, 125, 899, 906, 842, 624
Exabyte	1024 Petabytes	1, 152, 921, 504, 606, 846, 976
Zettabyte	1024 Exabytes	1, 180, 591, 620, 717, 411, 303, 424
Yottabyte	1024 Zettabytes	1, 208, 925, 819, 614, 629, 174, <u>706</u> , 176

Types of Memory

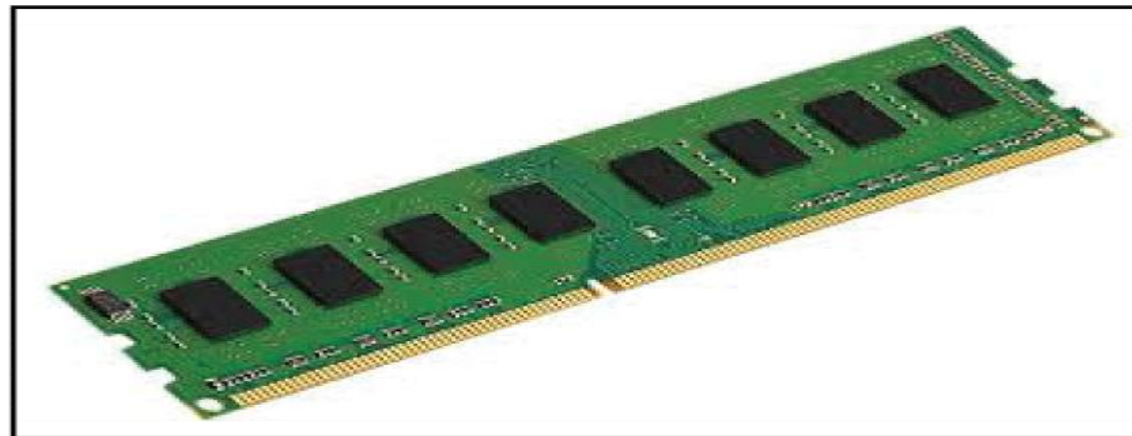


Primary Memory

- **Primary memory** is also known as the computer system's **main memory** that communicates directly within the CPU, Auxiliary memory, and Cache memory.
- **Main memory** is used to keep programs or data when the processor is active to use them.
- When a program or data is activated to execute, the processor first loads instructions or programs from **secondary memory** into **main memory**, and then the processor starts execution.
- The primary memory is further divided into two parts:
 - RAM (Random Access Memory)
 - ROM (Read Only Memory)

Primary Memory: RAM

- **Random Access Memory (RAM)** is one of the faster types of main memory accessed directly by the CPU.
- It is the hardware in a computer device to temporarily store data, programs or program results.
- It is used to read/write data in memory until the machine is working.
- It is **volatile**, which means if a power failure occurs or the computer is turned off, the information stored in RAM will be lost.
- All data stored in computer memory can be read or accessed randomly at any time.



Primary Memory: RAM

There are two types of RAM:

- ✓ **SRAM:** SRMA (Static Random-Access Memory) is a type of RAM used to store static data in the memory. It means that storing 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. The size of the capacitor and the transistor is so small, requiring millions of them to store on a single chip
- ✓ **DRAM:** DRAM (Dynamic Random-Access Memory) is a type of RAM that is used for the dynamic storage of data in RAM. In DRAM, each cell carries one-bit information. The cell is made up of two parts: a capacitor and a transistor.

Primary Memory: ROM

- ❖ **ROM or Read Only Memory** is a memory device or storage medium that is used to permanently store information inside a chip.
- ❖ It is a read-only memory that can only read stored information, data, or programs, but we cannot write or modify anything.
- ❖ **A ROM contains some important instructions or program data that are required to start or boot a computer.**
- ❖ It is a **non-volatile** memory; which means that the stored information cannot be lost even when the power is turned off or the system is shut down.

Primary Memory: ROM

Types of ROM are:

- ❖ MROM (Masked Read Only Memory)
- ❖ PROM (Programmable Read Only Memory)
- ❖ EPROM (Erasable and Programmable Read Only Memory)
- ❖ EEPROM (Electrically Erasable and Programmable Read Only Memory)
- ❖ Flash ROM

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

- ❑ **Secondary memory** is a permanent storage space to hold a **large amount of data**.
- ❑ Secondary memory is also known as **external memory** which represents 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.



Secondary 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 disks and floppy disks, an optical disk such as CDs and CDRoms, and magnetic tapes.

Secondary Memory vs Primary Memory

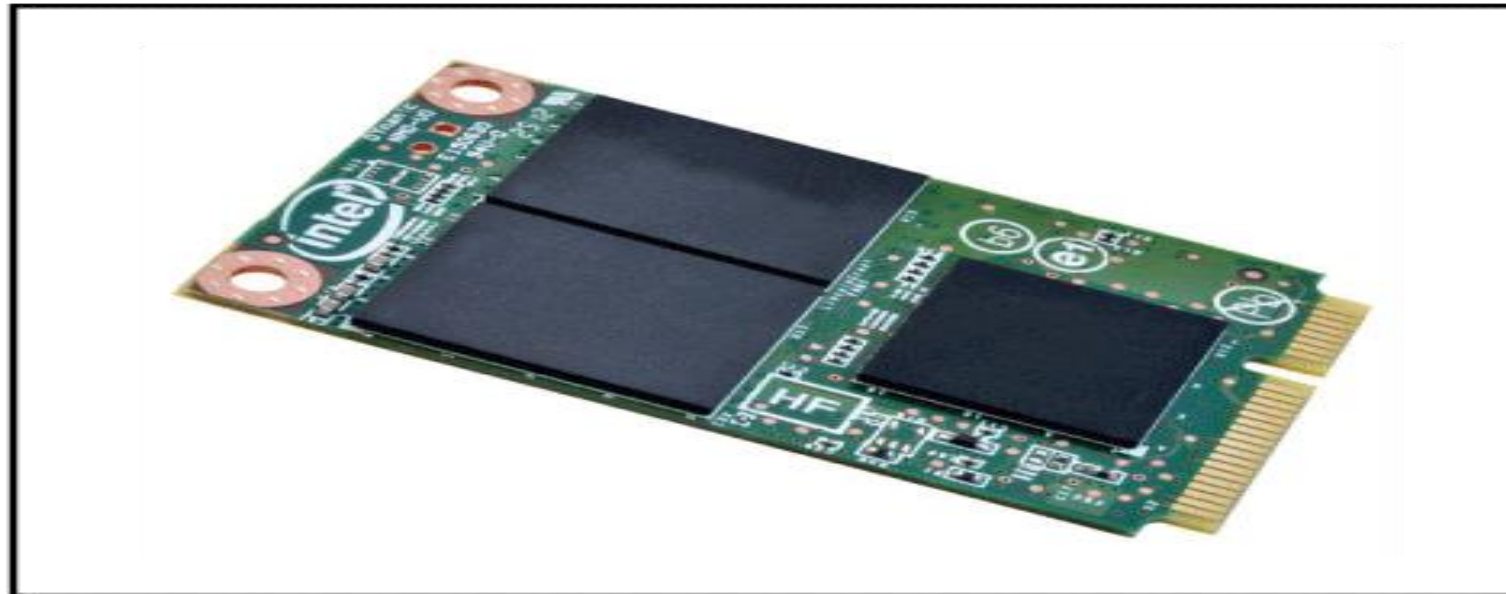
Primary Memory	Secondary Memory
It is also known as temporary memory.	It is also known as a permanent memory.
Data can be access directly by the processor or CPU.	Data cannot be accessed directly by the I/O processor or CPU.
Stored data can be a volatile or non-volatile memory.	The nature of secondary memory is always non-volatile.
It is more costly than secondary memory.	It is less costly than primary memory.
It is a faster memory.	It is a slower memory.
It has limited storage capacity.	It has a large storage capacity.
It required the power to retain the data in primary memory.	It does not require power to retain the data in secondary memory.
Examples of primary memory are RAM, ROM, Registers, EPROM, PROM and cache memory.	Examples of secondary memory are CD, DVD, HDD, magnetic tapes, flash disks, pen drive, etc.

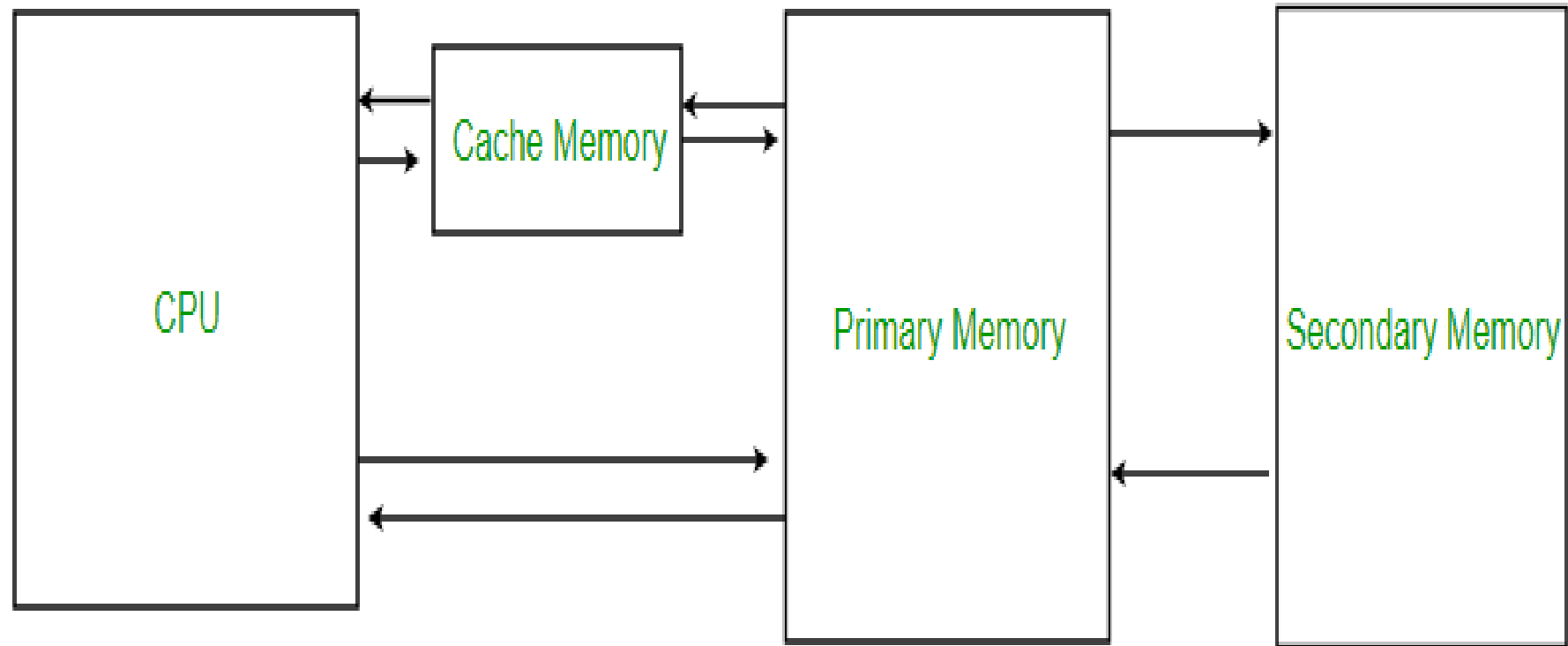
Cache Memory

- ☐ 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

Cache Memory

- ✓ Cache memory is divided into three levels: L1, L2, and L3.
- ✓ L1 cache is the fastest but smallest,
- ✓ L2 cache is slower but bigger, and
- ✓ L3 cache is the slowest but biggest. L3 cache is designed to optimize the performance of L1 and L2 cache and is the largest type of cache memory with a capacity of 1MB to 8MB.





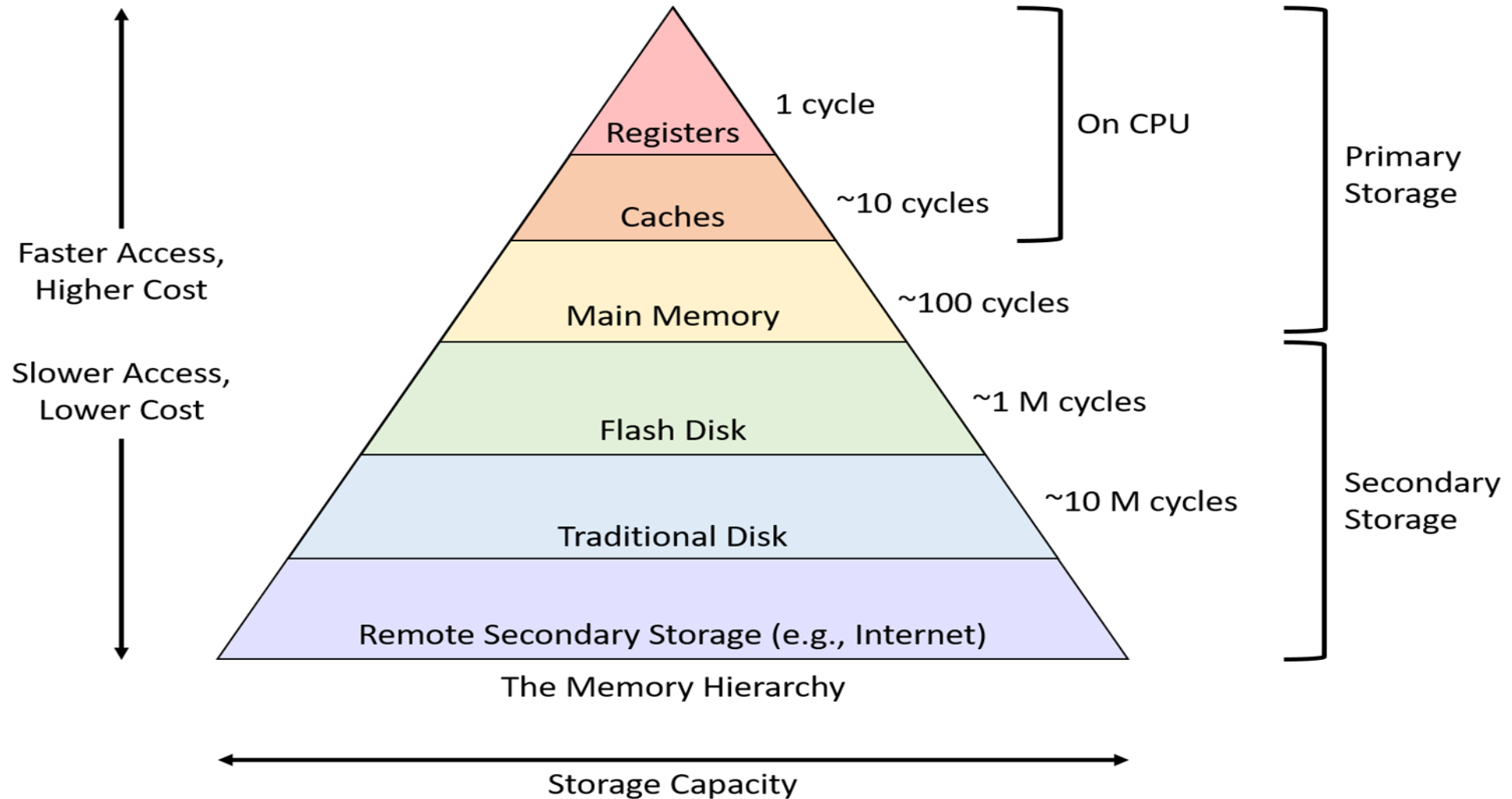
Cache Memory vs Main Memory

Cache Memory	Main Memory
Smaller in size	Larger in size
Located closer to the processor	Located farther from the processor
More expensive but faster	Less expensive but slower
Stores frequently accessed data	Stores less frequently accessed data
Accessed first by the processor	Accessed after the cache memory

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.

Memory Hierarchy





Any Questions?



Thank You