

Department of BES-II

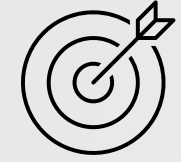
# Digital Design and Computer Architecture 23EC1202

Topic:

## Introduction - Storage Systems

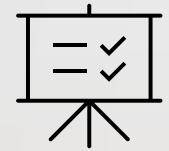
Session No: 31

## AIM OF THE SESSION



To familiarize students with the basic concept of different storage systems

## INSTRUCTIONAL OBJECTIVES



This Session is designed to:

1. Identify and differentiate the various types of primary (e.g., RAM, cache) and secondary storage devices (e.g., HDD, SSD, optical disks, tape storage).
2. Learn which storage types are volatile (data is lost when power is off) versus non-volatile (data is retained without power).
3. Understand the impact of different storage systems on computer performance.

## LEARNING OUTCOMES



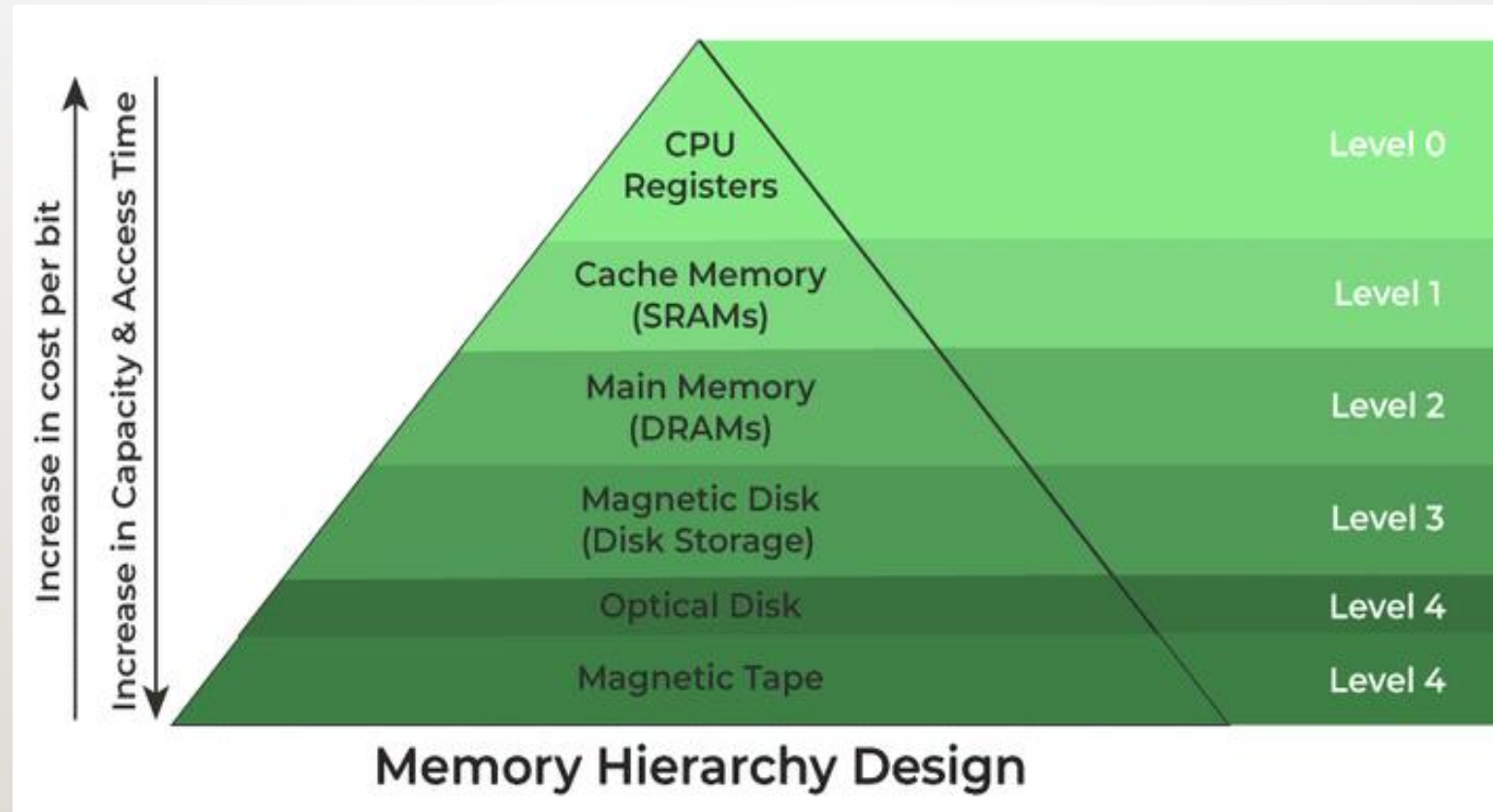
At the end of this session, students should be able to:

1. Gain a comprehensive understanding of how primary and secondary storage systems
2. Acquire the knowledge necessary to make informed decisions regarding the selection and application of appropriate storage
3. Develop skills to optimize data storage, retrieval, and management practices

## SESSION INTRODUCTION

- A storage unit is a part of the computer system which is employed to store the information and instructions to be processed.
- Without a storage device, a computer would not be able to run or even boot up. Or in other words, a storage device is a hardware that is used for storing, porting, or extracting data files.
- It can also store information/data both temporarily and permanently.

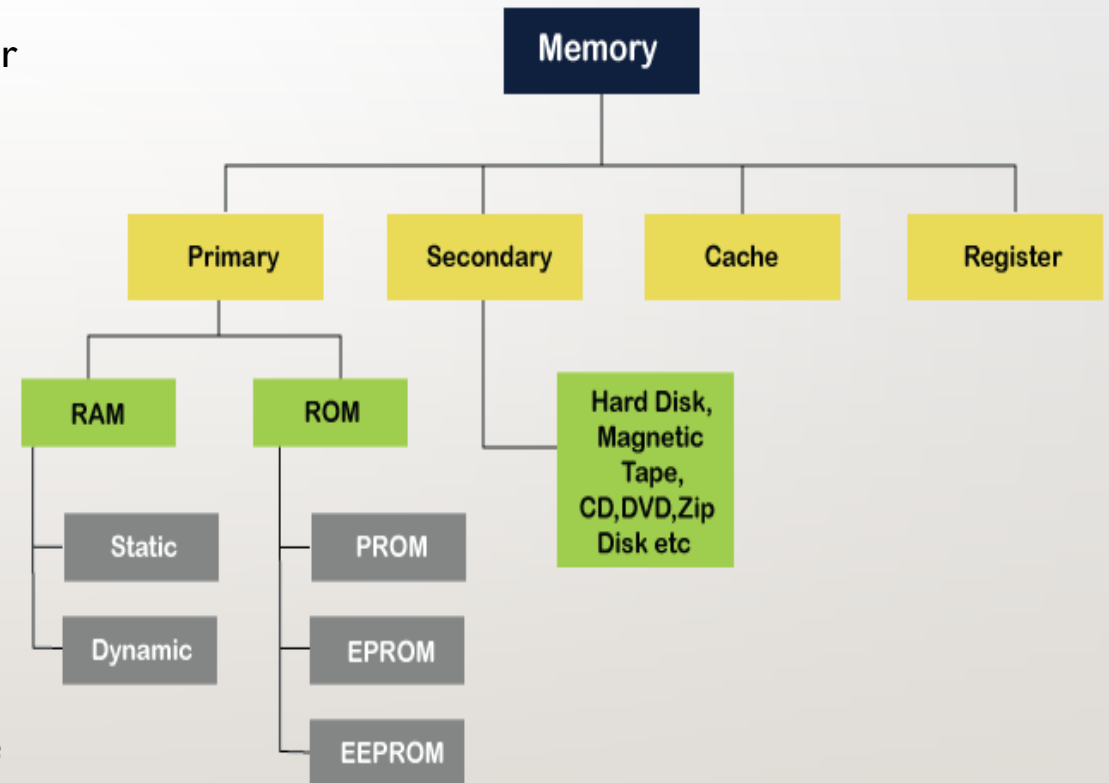
## Storage Hierarchy @ Memory



## Types of Computer Memory

**Primary Memory:** It is also known as internal memory or main memory. This is a section of the CPU that holds program instructions, input data, and intermediate results. It is generally smaller in size. RAM and ROM are examples of primary storage.

**Secondary Memory:** Secondary storage is a memory that is stored external to the computer. It is mainly used for the permanent and long-term storage of programs and data. Hard Disks, CDs, DVDs, Pen/Flash drives, SSD, etc, are examples of secondary storage.



## Primary Memory Devices

### Random Access Memory (RAM):

- Used to store information temporarily
- Data will be lost once the computer turned off  
i.e. volatile memory
- Range from 1 GB to 32/64 GB

### Static RAM (SRAM):

- Retain stored information as long as the power supply is ON
- Lower access time and much faster compared to DRAM
- Costly compared to DRAM

### Dynamic RAM (DRAM):

- Used to store binary data in the form of electrical charge applied to capacitors
- Slower and Cheaper compared to SRAM

## Primary Memory Devices (Cont..)

### **Synchronous DRAM (SDRAM):**

- Widely used in home/office desktops and laptops
- Faster than DRAM
- Upgraded version of double data rate RAM i.e. DDR1, DDR2, DDR3 and DDR4

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

- Data cannot be modified or deleted once the data is stored i.e. Non-volatile memory
- Stores instructions that are used to start a computer
- Stores only few megabytes (MB) of data ranges between 4 and 8 MB per ROM chip

### **Programmable ROM (PROM):**

- These are the ROMs that can be programmed using a special PROM programmer
- Once the chip has been programmed, information on the PROM can't be altered
- PROM is non-volatile i.e. data is not lost when power is switched off

## Primary Memory Devices (Cont..)

### Erasable PROM (EPROM):

- It is possible to erase the information which has been previously stored on an EPROM using ultraviolet light and write new data onto the chip

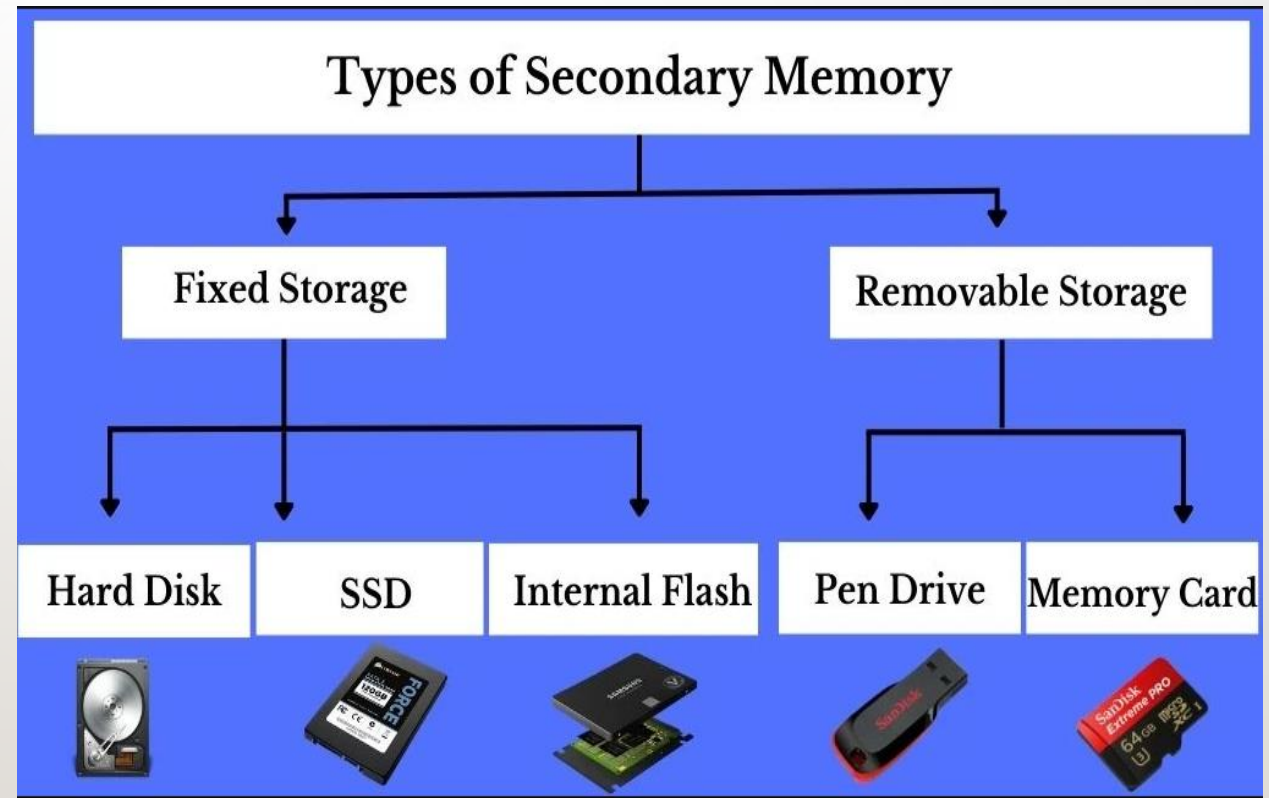
### Electrically EPROM (EEPROM):

- Data can be erased by applying electric field without using ultraviolet light
- Primary memory is volatile and has limited capacity. So, it is important to have another form of memory that has a larger storage capacity and from which data and programs are not lost when the computer is turned off. Such a type of memory is called **secondary memory**.



## Secondary Memory Devices

To store large amount of data or programs permanently, we need a cheaper and permanent memory. Such memory is called **secondary memory**. Depending on whether secondary memory device is part of CPU or not, there are two types of secondary memories – **fixed** and **removable**.



## Types of Fixed Storage

Generally, the data of the computer system is stored in a built-in fixed storage device. Fixed storage does not mean that you can not remove them from the computer system, you can remove the fixed storage device for repairing, for the upgrade, or for maintenance, etc. with the help of an expert or engineer.

- Hard disk drives (HDD)
- SSD (solid-state disk)
- Internal flash memory (rare)



## Types of Removable Storage

- It is a storage device that can be inserted or removed from the computer according to the requirements while the computer system is running.
- Removable storage devices are portable so they can easily transfer data from one computer to another.
- Also, removable storage devices provide the fast data transfer rates associated with storage area networks (SANs).
- USB drives, Memory cards, Optical discs (like CDs, DVDs, Blu-ray discs, etc.), Floppy disks, Magnetic tapes etc.

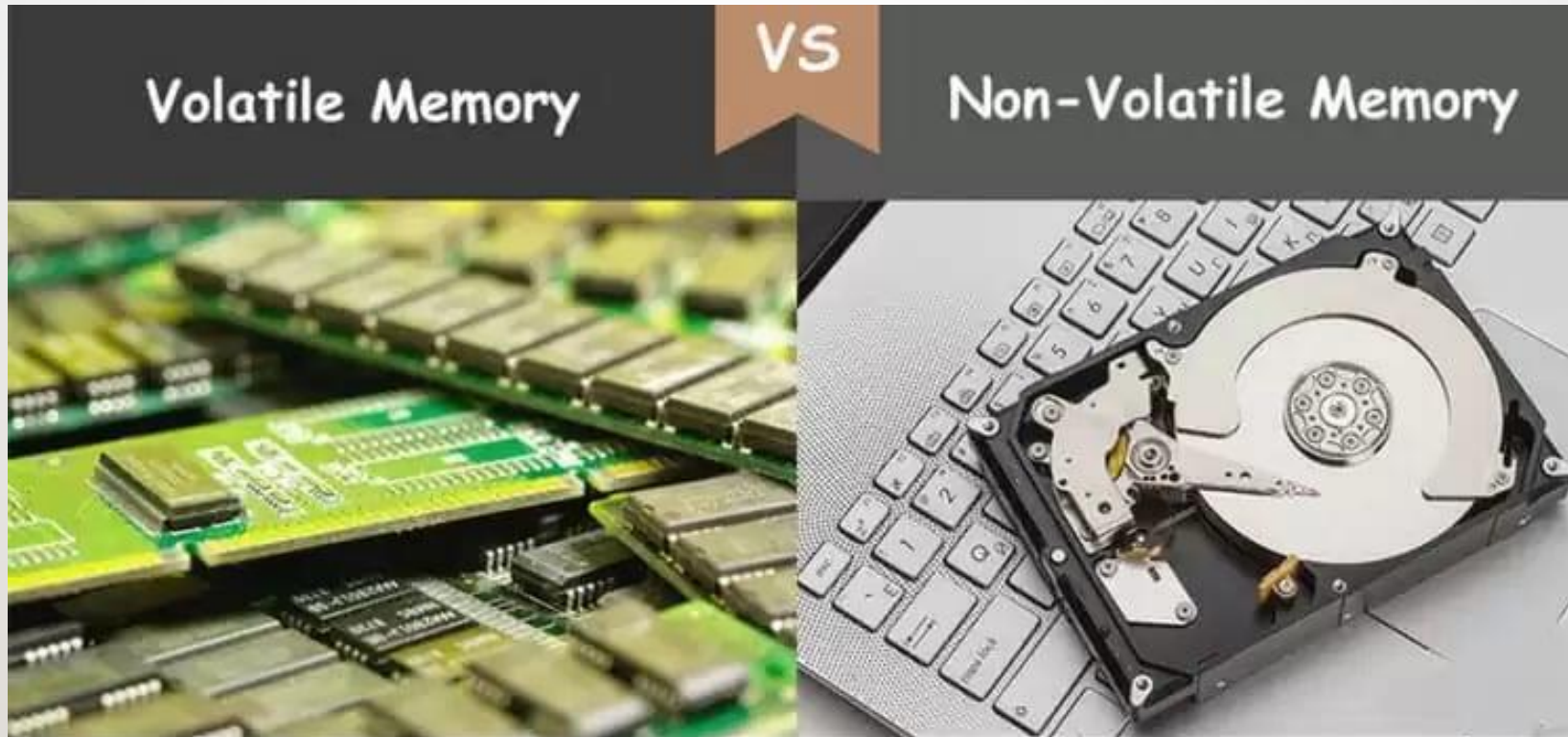


## Volatile Vs Non-Volatile

Volatile Memory	Non-Volatile Memory
It is a type of computer memory that stores the data temporarily.	It is also a type of computer memory that stores the data permanently.
It requires a continuous electric current to maintain its saved data.	It retains the data in the system even when the power is gone.
It has less storage capacity, more expensive and provides easy data transfer.	It has less more capacity, less expensive and data transfer is complex.
Ex: RAM, Cache Memory	Ex: CD, HDD, Pen drive, SD Card



## Volatile Vs Non-Volatile



## SELF-ASSESSMENT QUESTIONS

1. What is the main difference between primary and secondary storage?

- A) Secondary storage is temporary; primary storage is permanent.
- B) Primary storage is used for storing temporary data; secondary storage is for permanent data.
- C) Primary storage is directly accessible by the CPU; secondary storage is not.**
- D) Secondary storage can store more data than primary storage.

2. Which of the following is an example of primary storage?

- A) Hard Disk Drive (HDD)
- B) Solid State Drive (SSD)
- C) Random Access Memory (RAM)**
- D) Optical Disk

## SELF-ASSESSMENT QUESTIONS

3. What is the primary advantage of SSDs over HDDs?

- A) Higher storage capacity
- B) Faster data access speed**
- C) More affordable
- D) Longer lifespan

4. Which of the following is a characteristic of secondary storage?

- A) Volatile memory
- B) Directly accessible by the CPU
- C) Non-volatile storage**
- D) Stores data temporarily

## TERMINAL QUESTIONS

### Short answer questions:

1. Identify and list some of the secondary storage devices.
2. Identify and categorize different types of RAM according to their characteristics.

### Long answer questions:

1. Evaluate the types and functionality of primary memory devices exploring their role in data storage.
2. Investigate the hierarchical organization of memory in computing systems with examples.
3. Evaluate the types and functionality of secondary memory devices exploring their role in data storage.
4. Differentiate between Volatile and Non-volatile memory types.



## REFERENCES FOR FURTHER LEARNING OF THE SESSION

### Reference Books:

1. Computer Organization by Carl Hamacher, Zvonko Vranesic and Saftwat Zaky.
2. Computer System Architecture by M. Morris Mano
3. Computer Organization and Architecture by William Stallings

### Sites and Web links:

1. <https://www.geeksforgeeks.org/what-is-a-storage-device-definition-types-examples/>
2. <https://www.geeksforgeeks.org/difference-between-primary-and-secondary-memory/>

THANK YOU



Team – Digital Design & Computer Architecture