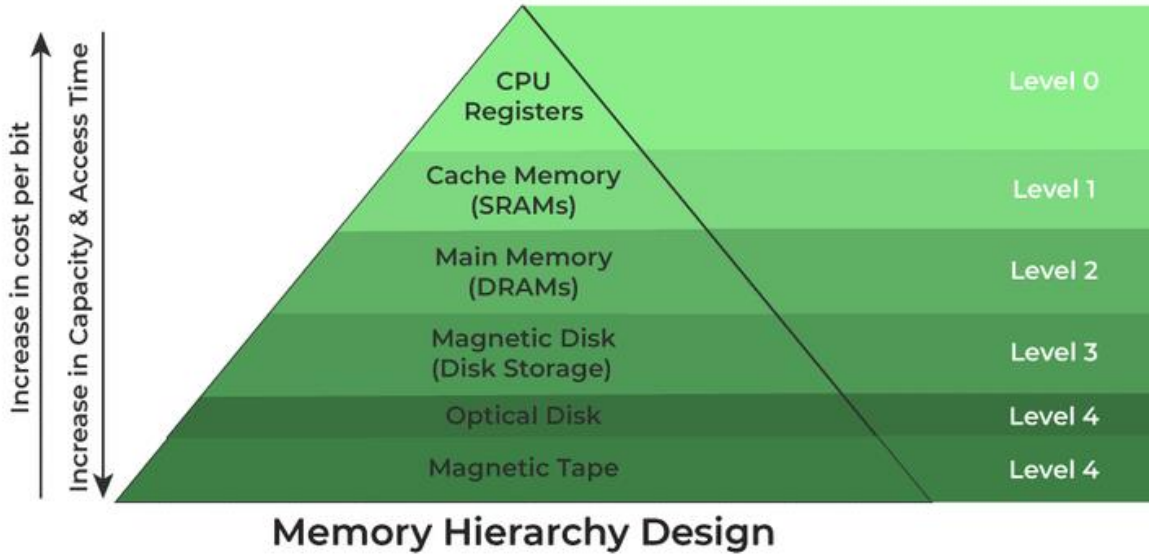
# MEMORY SYSTEM MECHANISMS IN EMBEDDED SYSTEMS

Memory systems play a critical role in the efficient functioning of the device. The mechanisms in the memory system of an embedded system are designed to optimize performance, minimize power consumption, and ensure reliability.

## MEMORY HIERARCHY



**Registers:**

- Small, fast memory within the CPU for temporary data.

**Cache Memory:**

- Stores frequently accessed data to reduce latency.
- Typically divided into levels (L1, L2, L3).

**Main Memory (RAM):**

- Holds data and instructions actively used by the system.
- Volatile, meaning data is lost when power is off.

**Non-Volatile Memory (Flash/EEPROM/ROM):**

- Stores firmware or persistent data.
- Retains data even without power.

## MEMORY ACCESS MECHANISMS

**Direct Memory Access (DMA):**

- Allows peripherals to access memory directly without CPU intervention.
- Improves efficiency and reduces CPU load.

**Memory Controllers:**

- Manage memory access to prevent conflicts.
- Implement features like arbitration and prioritization.

**Bus Systems:**

- Ensure data transfer between memory, CPU, and peripherals.

## TYPES OF MEMORY IN EMBEDDED SYSTEMS

**Volatile Memory:**

- RAM (SRAM, DRAM): Temporary storage for runtime data.

**Non-Volatile Memory:**

- ROM (PROM, EPROM, EEPROM): Stores firmware.
- Flash Memory: Common in modern embedded systems for storing programs and data.

## MEMORY MAPPING

- **Program Memory:** Stores executable code.
- **Data Memory:** Stores runtime data and variables.
- **Memory-Mapped I/O:** Treats peripheral devices as memory addresses for efficient interaction.

# Thank you