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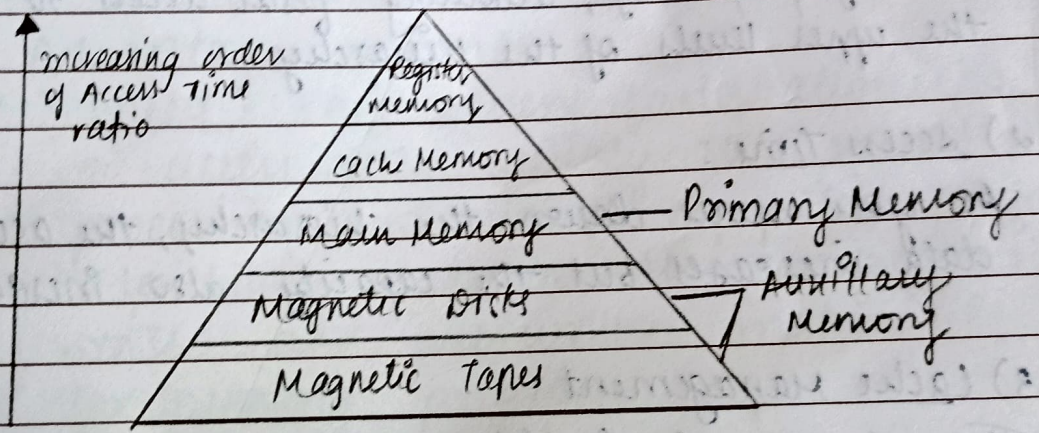
B-43.

Good 1 2

COA Assignment 2

Q1] Describe the concept of memory hierarchy with neat and clean diagram.

→ A "memory hierarchy" in computer systems refers to a structured arrangement of different memory types, organized based on their access speed, where faster, smaller memory levels (like CPU registers) sit at the top, and slower, larger memory levels (like hard disks) reside at the bottom, allowing for a balance between quick access to frequently used data and large storage capacity at a lower cost; essentially creating a pyramid-like structure with increasing capacity as you move down the hierarchy



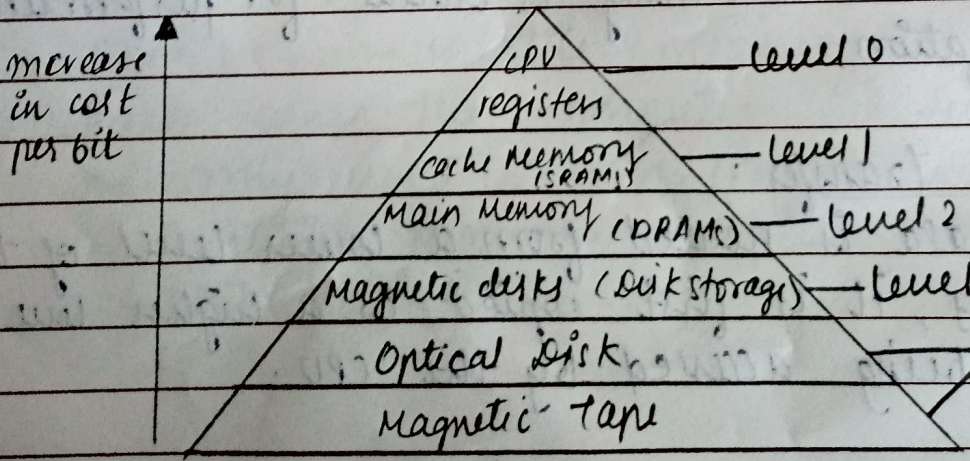


Diagram:

Level 0 (Top) → CPU registers - Fastest access, smallest capacity
Level 1 (L1 cache) → cache Memory - very fast access, small capacity
Level 2 (L2 cache) → cache memory - slightly slower than L1, larger capacity
Level 3 (Main Memory): RAM - Relatively fast access, larger capacity
Level 4 (Bottom): secondary storage (Hard Disk) - slowest access, largest capacity

Key Points:

1) Locality of References:
The concept of memory hierarchy is based on the principle of "locality of reference" which states that programs tend to access data in localized areas of memory frequently, allowing faster access to data stored in the upper levels of the hierarchy.

2) Access Time:
As you move down the hierarchy, the access time to data increases but the capacity also increases.

3) Cache Management:
The process of deciding which data to store in each level of the hierarchy is crucial for performance optimization.

4) Data Transfer:
When data is needed from a lower level of the hierarchy, it is first copied to a higher level before being accessed by the CPU.

Q2] What are the basic types of main memory? Explain its advantages.

→ The two basic types of main memory are Random Access Memory (RAM) and Read-only Memory (ROM)

1) Random Access Memory (RAM)

RAM is the most common type of main memory. It is volatile, meaning it loses its data when the computer is turned off. RAM allows for both reading and writing data, making it essential for active processing.

- RAM has ~~by~~ two types:
  - i) Dynamic RAM (DRAM)
  - ii) Static RAM (SRAM)
- Advantages of RAM:
  - i) Speed: RAM is very fast, allowing the CPU to access data quickly. This speeds up processing and overall computer performance.
  - ii) Flexibility: Data in RAM can be easily written and overwritten, making it ideal for running programs and multitasking.

2) Read-only Memory (ROM)

ROM is non-volatile, meaning it retains data even when the computer is turned off. It's primarily used to store firmware or essential instructions that the computer needs to start up (like the BIOS).

- Types of ROM:
  i) Programmable ROM (PROM)
  ii) Erasable Programmable ROM (EPROM)
  iii) Electrically Erasable Programmable ROM (EEPROM).
- Advantages of ROM:
  i) Data Retention: ROM's non-volatility ensures that critical startup instructions are always available.
  ii) Security: The data in ROM is usually protected from accidental changes.

Q3] Write the difference between RAM and ROM.

→

RAM	ROM
i) RAM stands for random access memory.	i) ROM stands for read-only memory.
ii) It is temporary memory	ii) It is pumanent memory
iii) The data in RAM can be changed or deleted.	iii) The instructions writtch in ROM cannot be deleted or changed.
iv) It is volatile memory.	iv) It is non-volatile memory
v) Instructions are writtch at time of execution.	v) Instructions are writtch at manufacturing time.
vi) Instrictions in RAM change continuously as different programs are executed and new data is processed.	vi) It is not possible to write new information or instruction in ROM.

Q4] Write a short note on
(i) SRAM (ii) DRAM

(i) → SRAM

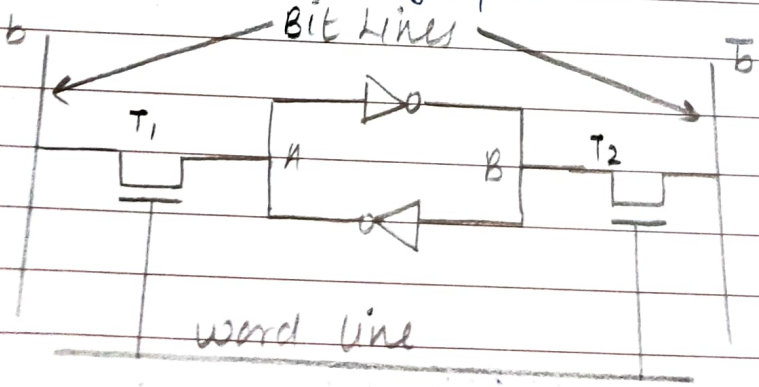
I) It stands for Static Random Access Memory.

II) It is a type of RAM that stores data using transistors. It is called static because it doesn't need to be refreshed constantly like DRAM.

III) It uses a flip-flop circuit to hold each bit of data. This makes it very fast, but also more complex and expensive than DRAM.

IV) Key features:

- Speed = SRAM is extremely fast, making it ideal for situations where quick access to data is crucial.
- No refresh needed = SRAM doesn't require constant refreshing, simplifying its design and operation.
- Cost = SRAM is significantly more expensive than DRAM due to its complex structure.
- Density = SRAM has a lower density compared to DRAM, meaning it can store less data in the same amount of space.



SRAM Memory Cell.

(ii) → DRAM

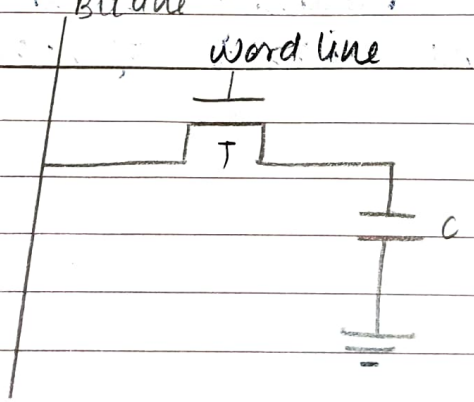
i) It is stands for Dynamic Random Access Memory

ii) It is the most common type of RAM used in computers. It stores data as electrical charges within capacitors.

(iii) DRAM uses capacitors to store bits of data. However, these charges leak over time, so DRAM needs to be refreshed periodically to maintain the data.

iv) Key features:

- Cost: It is much cheaper than SRAM, making it more suitable for large amounts of memory.
- Density: DRAM has a high density, allowing for more data to be stored in a smaller space.
- Refresh required: DRAM needs to be refreshed constantly, which adds some complexity and overhead.
- Speed: DRAM is slower than SRAM but still fast enough for most applications.



DRAM Memory Cell

Q5] What is cache memory? Explain the levels of cache memory.

→ Cache memory is a small, fast type of memory that sits between the CPU and main memory (RAM). Its job is to hold the data and instructions that the CPU is most likely to need next, so that the CPU can access them quickly without having to wait for the slower main memory.

- Importance:
  1) Speed: Cache memory is much faster than main memory. The CPU can retrieve data from cache much more quickly, which speeds up processing.
  11) Efficiency: By storing frequently used data, cache memory reduces the number of times the CPU has to access main memory, which is a slower process. This improves the overall efficiency of the computer.

Levels of cache memory:

- Level 1 or Register
  ↳ It is a type of memory in which data is stored & accepted that are immediately stored in ~~ECU~~ CPU. Most commonly used register is accumulator, Program counter, address register etc.
- Level 2 or Cache memory
  ↳ It is the fastest memory which has faster access time where data is temporarily stored for faster access.
- Level 3 or Main memory
  ↳ It is memory on which computer works currently. It is small in size and once power is off data no longer stays in the memory

- Level 4 or secondary memory
  - It is external memory which is not as fast as main memory but data stays permanently in the memory.
- Cache performance
  - When the processor needs to read or write a location in main memory, it first checks for a corresponding entry in the cache.

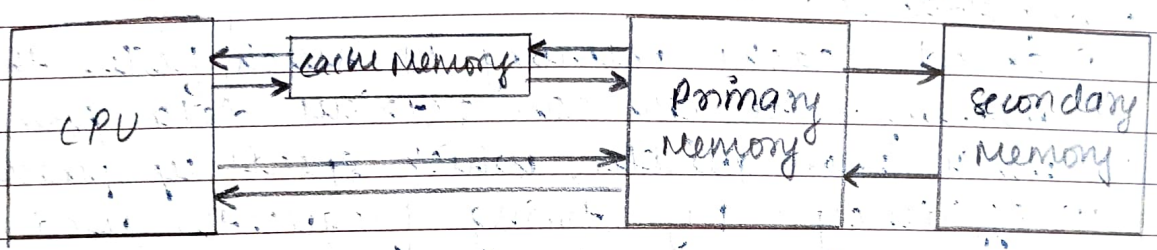


Fig: Cache Memory

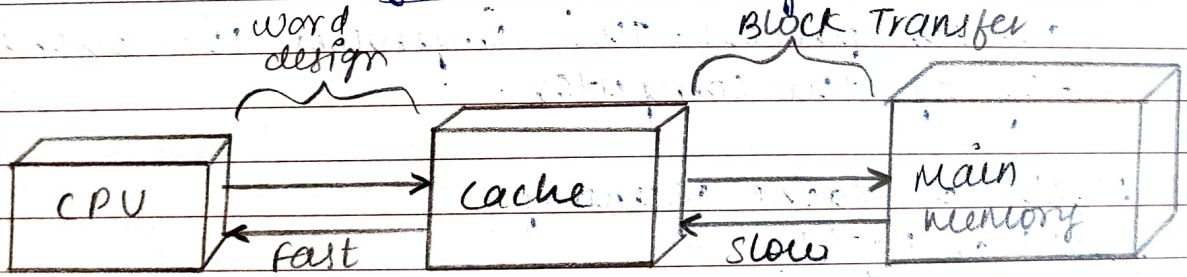


Fig: Single cache

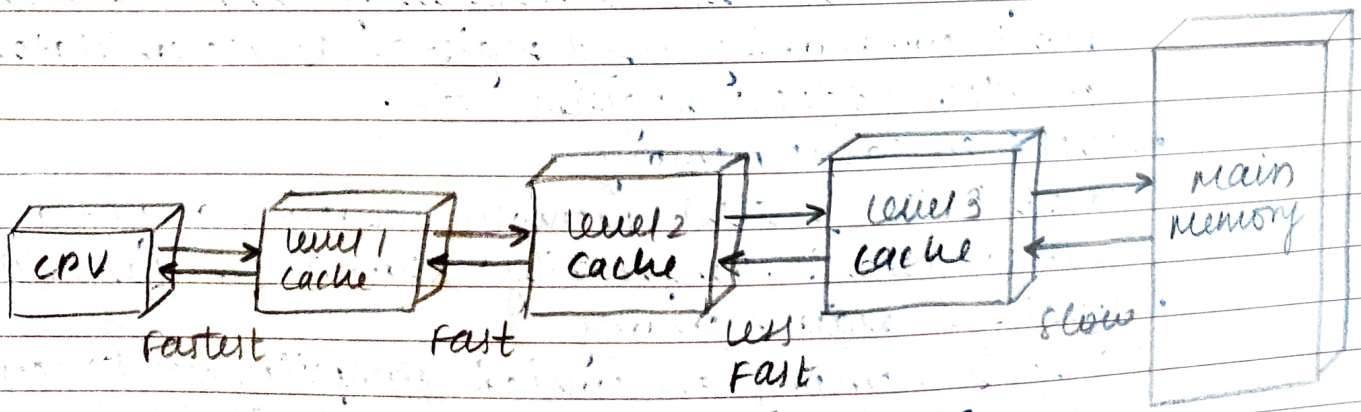


Fig: Three-Level cache organization

Explain ROM chip with neat diagram

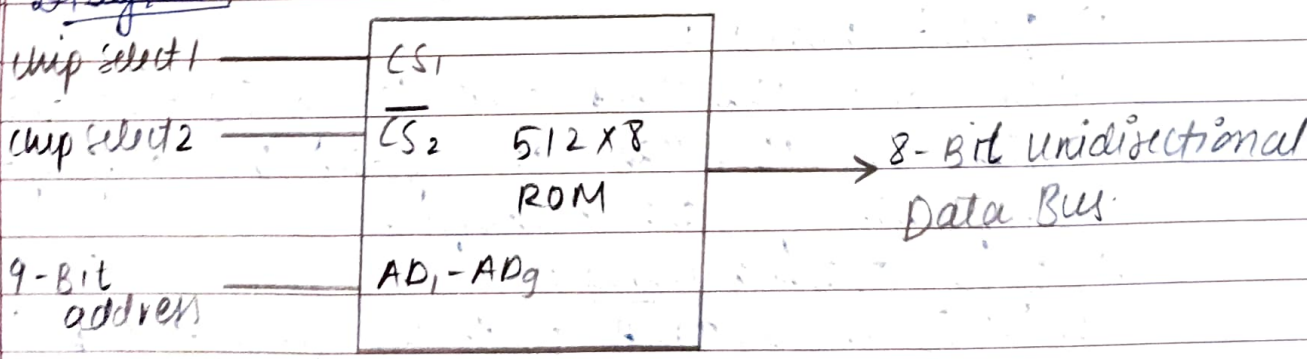
A ROM (Read-only Memory) chip is a non-volatile memory chip that permanently stores data and instructions needed by a computer or an electronic device. Unlike RAM (Random Access Memory), ROM retains its data even when the power is turned off.

Working of a ROM chip:

- The ROM chip is designed with a fixed set of data and instructions.
- It is mainly used to stor firmware, BIOS and embedded system ~~int~~ instructions.
- The CPU reads from ROM when booting up the system.

For the same size chip, it is possible to have more bits of ROM than of RAM, because the internal binary cells in ROM occupy less space than in RAM.
For the same reason, the diagram specifies a 512 byte ROM, while the RAM has only 128 bytes.
The nine address lines in the ROM chip specify any one of the 512 bytes stored in it.

Diagram:



Q7] With a neat schematic diagram, explain about DMA controller and its mode of data transfer.

→ A Direct Memory Access (DMA) controller is a dedicated hardware component that allows data to be transferred directly between memory and I/O devices without continuous intervention from the CPU. This improves system efficiency by reducing CPU workload, allowing it to focus on other tasks while data transfer occur in the background.

Working of DMA controller:

1) The CPU initializes the DMA controller by providing details such as address, destination address, and the size of the data to be transferred.
2) The DMA controller takes control of the system bus.
3) It directly transfers data between I/O devices and memory without CPU involvement.
4) Once the transfer is complete, the DMA controller notifies the CPU via an interrupt.

~~Block Diagram~~

The DMA controller transfers the data in three modes:

1) Burst mode:
Here, once the DMA controller gains the charge of the system bus, it releases the system bus only after completion of data transfer.

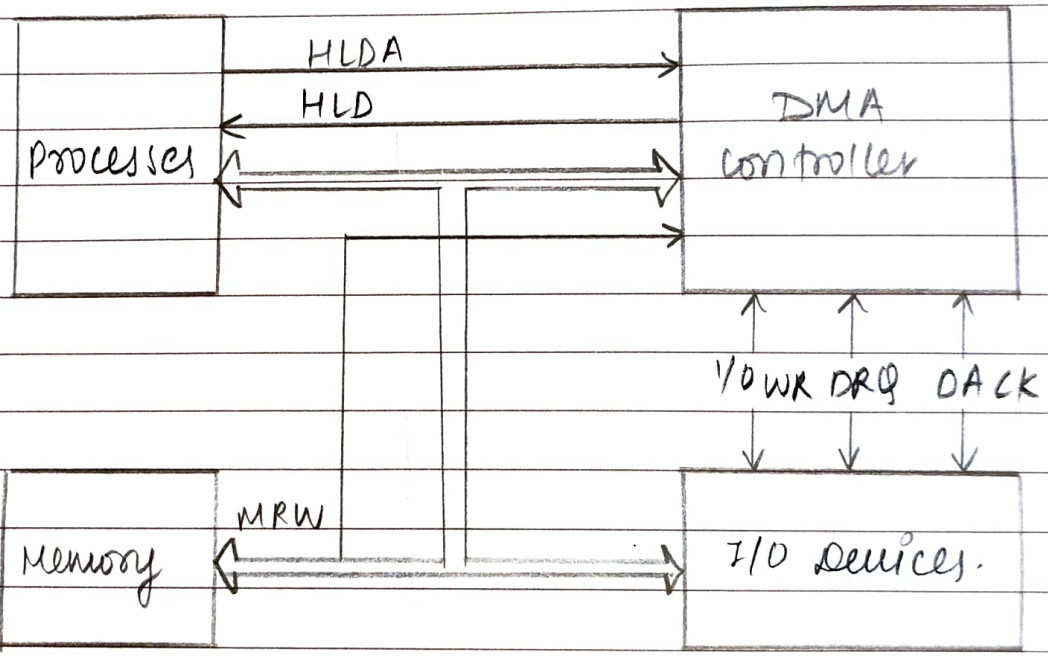
2) Cycle stealing Mode:
In this mode, DMA controller forces the ~~period~~ CPU to stop its operations and relinquish the control over

the bus for short term to DMA controller. After transfer of every byte, it releases the bus.

3) Transparent mode:

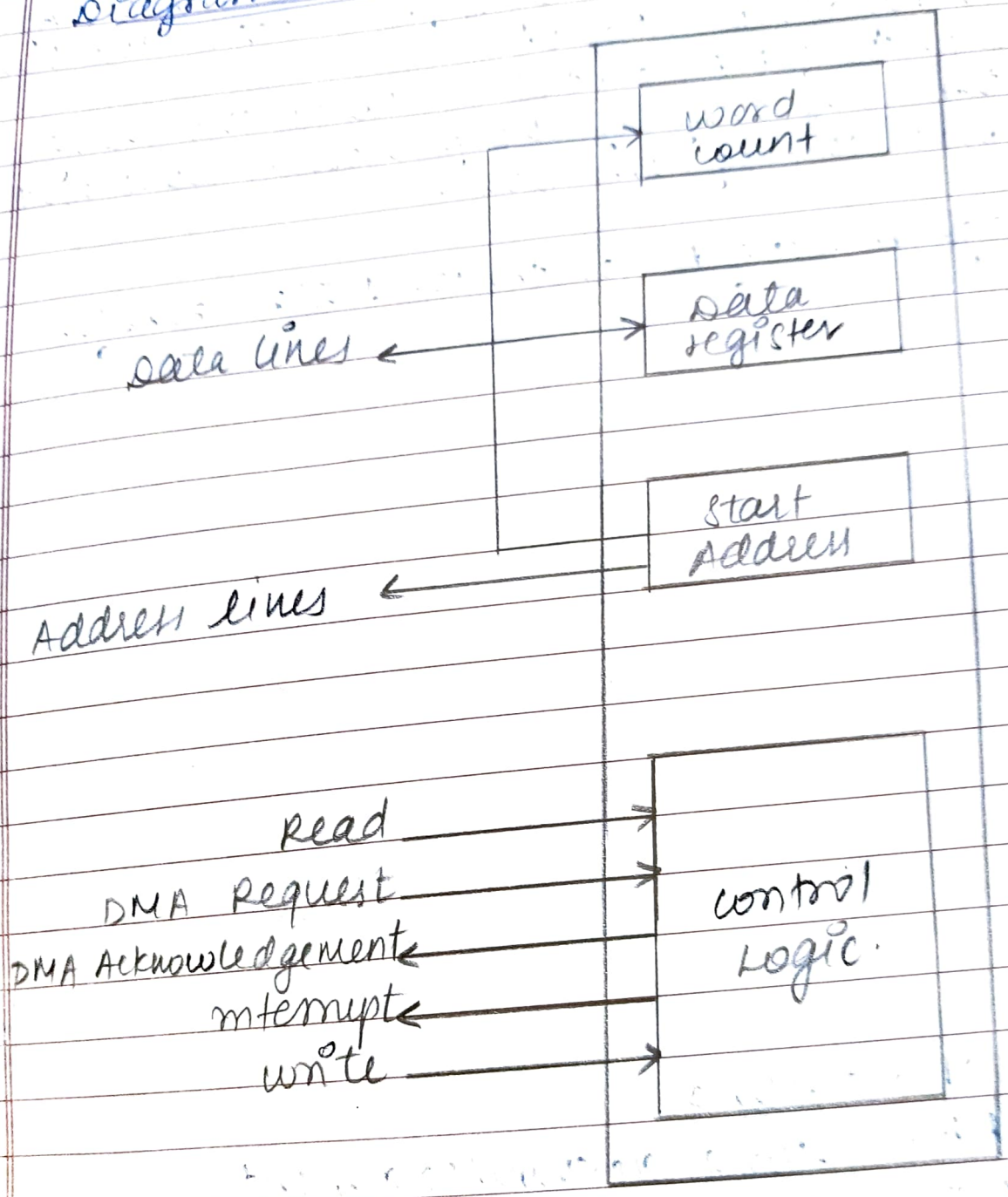
Here, the DMA controller takes the charge of system bus only if the processor does not require the system bus.

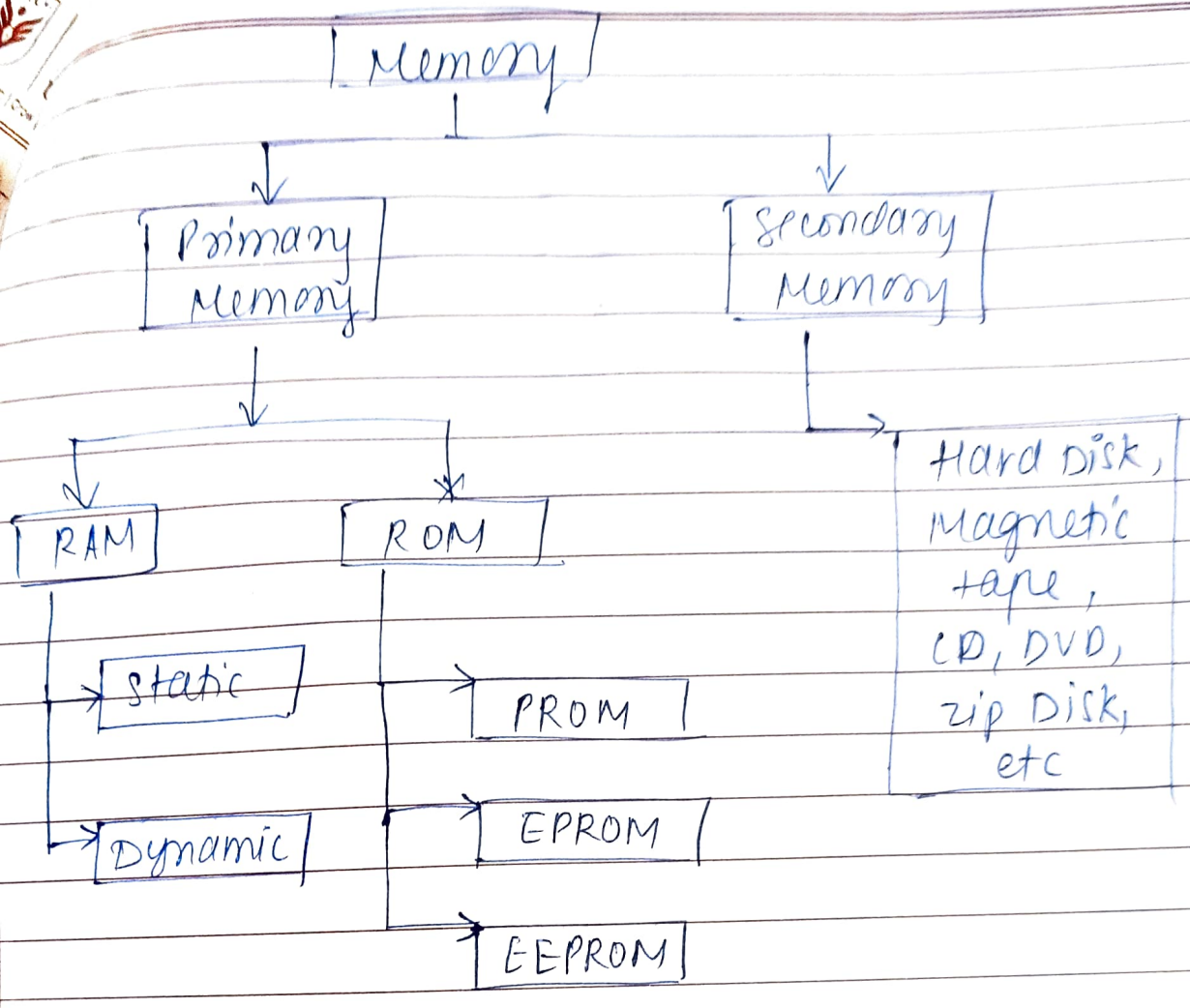
Diagram: DMA controller Data Transfer



HOD → Hold
HLDA → Hold acknowledgement
DRQ → DMA request
DACK → DMA controller acknowledge.

Diagram: DMA Block Diagram




Memory
Primary Memory
Secondary Memory
RAM
ROM
Hard Disk, Magnetic tape, CD, DVD, zip Disk, etc
Static
Dynamic
PROM
EPROM
EEPROM

7/10.
good