Memory Hierarchy and Different Memory Accessing Techniques

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What is Memory Hierarchy?

The Computer memory hierarchy looks like a pyramid structure which is used to describe the differences among memory types. It separates the computer storage based on hierarchy.

This **Memory Hierarchy Design is divided into 2 main types:**

➔ **External Memory or Secondary Memory** –
Comprising of Magnetic Disk, Optical Disk, Magnetic Tape i.e. peripheral storage devices which are accessible by the processor via I/O Module.

➔ **Internal Memory or Primary Memory** –
Comprising of Main Memory, Cache Memory & CPU registers. This is directly accessible by the processor.

Characteristics of Memory Hierarchy

Performance

Previously, the designing of a computer system was done without memory hierarchy, and the speed gap among the main memory as well as the CPU registers enhances because of the huge disparity in access time, which will cause the lower performance of the system. So, the enhancement was mandatory. The enhancement of this was designed in the memory hierarchy model due to the system's performance increase.

Ability

The ability of the memory hierarchy is the total amount of data the memory can store. Because whenever we shift from top to bottom inside the memory hierarchy, then the capacity will increase.

Access Time

The access time in the memory hierarchy is the interval of the time among the data availability as well as request to read or write. Because whenever we shift from top to bottom inside the memory hierarchy, then the access time will increase.

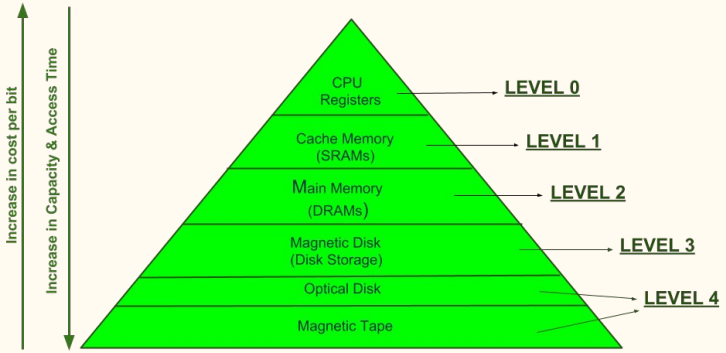
Cost per bit

When we shift from bottom to top inside the memory hierarchy, then the cost for each bit will increase which means an internal Memory is expensive compared with external memory.

Memory Hierarchy Design

Level-0 — Registers

The registers are present inside the CPU. As they are present inside the CPU, they have least access time. *Registers are most expensive and smallest in size* generally in kilobytes. They are implemented by using Flip-Flops.



MEMORY HIERARCHY DESIGN

Level-1 — Cache

Cache memory is used to store the segments of a program that are frequently accessed by the processor. It is expensive and smaller in size generally in Megabytes and is *implemented by using static RAM*.

Level-2 — Primary or Main Memory

It directly communicates with the CPU and with auxiliary memory devices through an I/O processor. Main memory is less expensive than cache memory and larger in size generally in Gigabytes. This memory is implemented by using dynamic RAM.

Level-3 — Secondary storage

Secondary storage devices like Magnetic Disk are present at level 3. They are used as backup storage. They are cheaper than main memory and larger in size generally in a few TB.

Level-4 — Tertiary storage

Tertiary storage devices like magnetic tape are present at level 4. They are used to store removable files and are the cheapest and largest in size (1-20 TB).

Memory Access Methods

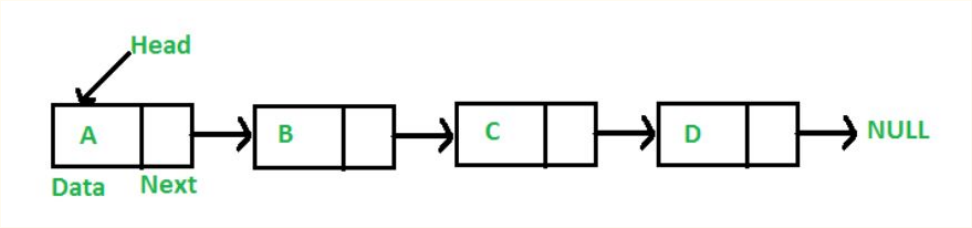
There are 4 types of memory access methods:

- Sequential Access
- Random Access
- Direct Access
- Associate Access

Sequential Access

In this method, the memory is accessed in a specific linear sequential manner, like accessing in a single Linked List. The access time depends on the location of the data.

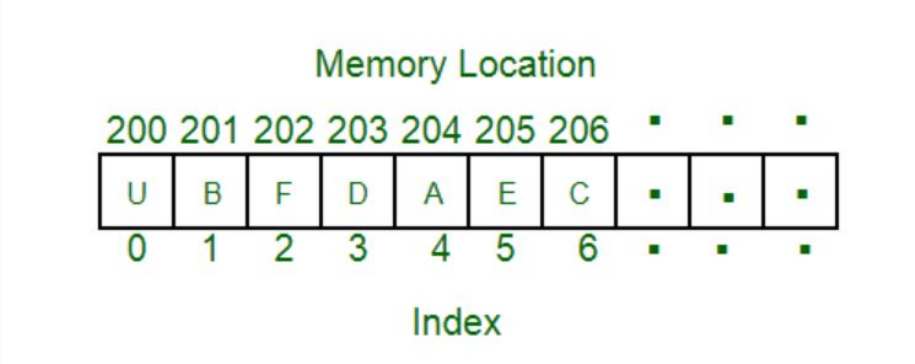
Applications of this sequential memory access are magnetic tapes, magnetic disk and optical memories.



Random Access

In this method, any location of the memory can be accessed randomly like accessing in Array. Physical locations are independent in this access method.

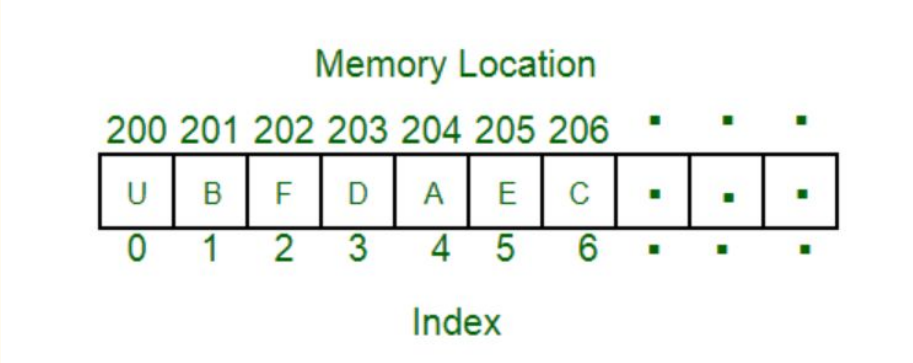
Applications of this random memory access are RAM and ROM.



Direct Access

In this method, individual blocks or records have a unique address based on physical location. access is accomplished by direct access to reach a general vicinity plus sequential searching, counting or waiting to reach the final destination. This method is a combination of above two access methods. The access time depends on both the memory organization and characteristics of storage technology. The access is semi-random or direct.

Application of thus direct memory access is magnetic hard disk, read/write header.



Associative Access

In this memory, a word is accessed rather than its address. This access method is a special type of random access method.

Application of thus direct memory access is Cache memory.

THANK YOU