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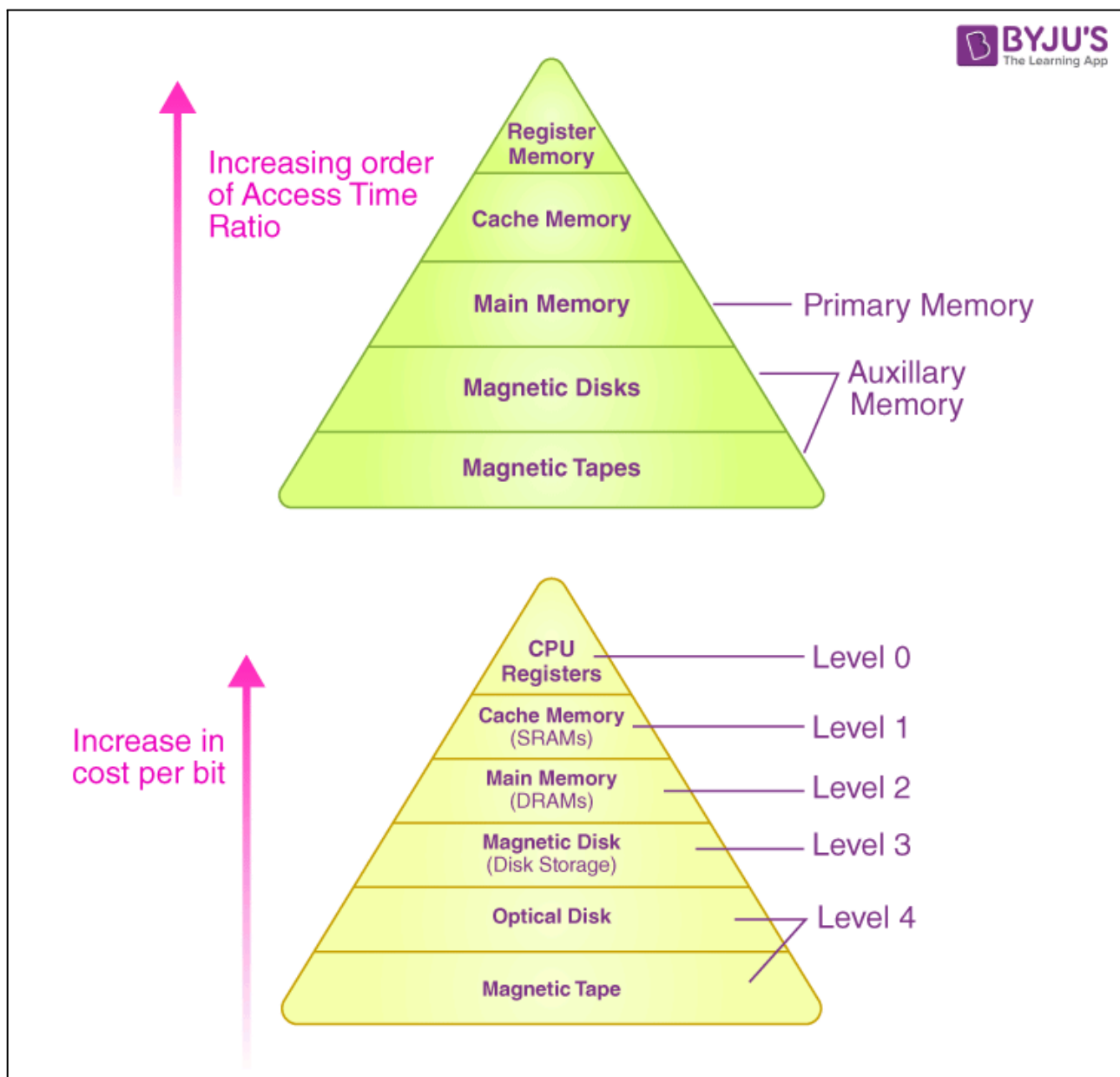
Digital Logic Circuits
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The computer memory can be divided into 5 major hierarchies that are based on use as well as speed. A processor can easily move from any one level to some other on the basis of its requirements. These five hierarchies in a system's memory are register, cache memory, main memory, magnetic disc, and magnetic tape.

What are the Design and Characteristics of Memory Hierarchy?

Memory Hierarchy, in Computer System Design, is an enhancement that helps in organizing the memory so that it can actually minimize the access time. The development of the Memory Hierarchy occurred on a behavior of a program known as locality of references. Here is a figure that demonstrates the various levels of memory hierarchy clearly:



Memory Hierarchy Design

This Hierarchy Design of Memory is divided into two main types. They are:

External or Secondary Memory

It consists of Magnetic Tape, Optical Disk, Magnetic Disk, i.e. it includes peripheral storage devices that are accessible by the system's processor via I/O Module.

Internal Memory or Primary Memory

It consists of CPU registers, Cache Memory, and Main Memory. It is accessible directly by the processor.

Characteristics of Memory Hierarchy

One can infer these characteristics of a Memory Hierarchy Design from the figure given above:

1. Capacity

It refers to the total volume of data that a system's memory can store. The capacity increases moving from the top to the bottom in the Memory Hierarchy.

2. Access Time

It refers to the time interval present between the request for read/write and the data availability. The access time increases as we move from the top to the bottom in the Memory Hierarchy.

3. Performance

When a computer system was designed earlier without the Memory Hierarchy Design, the gap in speed increased between the given CPU registers and the Main Memory due to a large difference in the system's access time. It ultimately resulted in the system's lower performance, and thus, enhancement was required. Such a kind of enhancement was introduced in the form of Memory Hierarchy Design, and because of this, the system's performance increased. One of the primary ways to increase the performance of a system is minimising how much a memory hierarchy has to be done to manipulate data.

4. Cost per bit

The cost per bit increases as one moves from the bottom to the top in the Memory Hierarchy, i.e. External Memory is cheaper than Internal Memory.

Design of Memory Hierarchy

In computers, the memory hierarchy primarily includes the following:

1. Registers

The register is usually an SRAM or static RAM in the computer processor that is used to hold the data word that is typically 64 bits or 128 bits. A majority of the processors make use of a status word register and an accumulator. The accumulator is primarily used to store the data in the form of mathematical operations, and the status word register is primarily used for decision making.

2. Cache Memory

The cache basically holds a chunk of information that is used frequently from the main memory. We can also find cache memory in the processor. In case the processor has a single-core, it will rarely have multiple cache levels. The present multi-core processors would have three 2-levels for every individual core, and one of the levels is shared.

3. Main Memory

In a computer, the main memory is nothing but the CPU's memory unit that communicates directly. It's the primary storage unit of a computer system. The main memory is very fast and a very large memory that is used for storing the information throughout the computer's operations. This type of memory is made up of ROM as well as RAM.

4. Magnetic Disks

In a computer, the magnetic disks are circular plates that's fabricated with plastic or metal with a magnetised material. Two faces of a disk are frequently used, and many disks can be stacked on a single spindle by read/write heads that are obtainable on every plane. The disks in a computer jointly turn at high speed.

5. Magnetic Tape

Magnetic tape refers to a normal magnetic recording designed with a slender magnetizable overlay that covers an extended, thin strip of plastic film. It is used mainly to back up huge chunks of data. When a computer needs to access a strip, it will first mount it to access the information. Once the information is allowed, it will then be unmounted. The actual access time of a computer memory would be slower within a magnetic strip, and it will take a few minutes for us to access a strip.

System Software vs Application Software – Comparative Analysis

As discussed earlier, there are various points of difference between a system and application software. The same has been given in a tabulated manner below for an easy and better understanding of the two.

Difference Between System Software and Application Software	
System Software	Application Software
This acts as an interface between the system and the applications	This is designed directly from the user perspective
It is the platform that allows the various application software to run on the system	These are independent applications which can be download and installed in the system
System Software is generally developed in low-level languages. This is so that the interaction between the software and hardware can be simplified and made more compatible	Each application has a specific purpose and thus is developed with high-level languages so that the purpose can be fulfilled
It is more automated. Once a system is turned on, the system software starts working	User action is required to start application software. These applications can only be work when the user commands the system to do so
These are responsible for the working of the system	They have minimum involvement in the processing and functioning of the computer device
The system software are installed at the time of installing the operating system. A computer device cannot work without its presence	The application software can be installed as and when the user requires them
It is an independent software. Once this is installed the computer will work	This is a dependent software. Applications can only be downloaded when the operating system is installed
Since a device cannot work without a system software, the user has to have it installed in their devices	These are designed to be user interactive, thus the application software can be removed as and when required by the user