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BCA Sem - 2
Computer Organization and Architecture

Computer Architecture:

The architecture of a computer system can be considered as a catalogue of tools or attributes that are visible to the user such as instruction sets, number of bits used for data, addressing techniques, etc. Computer Architecture refers to those attributes of a system that are visible to a programmer, or in other words, those attributes that have a direct impact on a logical execution of a program. From technical point of view, Computer Architecture deals with ISA.ISA here stands for "Instruction Set Architecture". Instruction Set Architecture is defined as the abstract image of computing system that is seen by a machine language (or assembly language) programmer.

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Computer Organization:

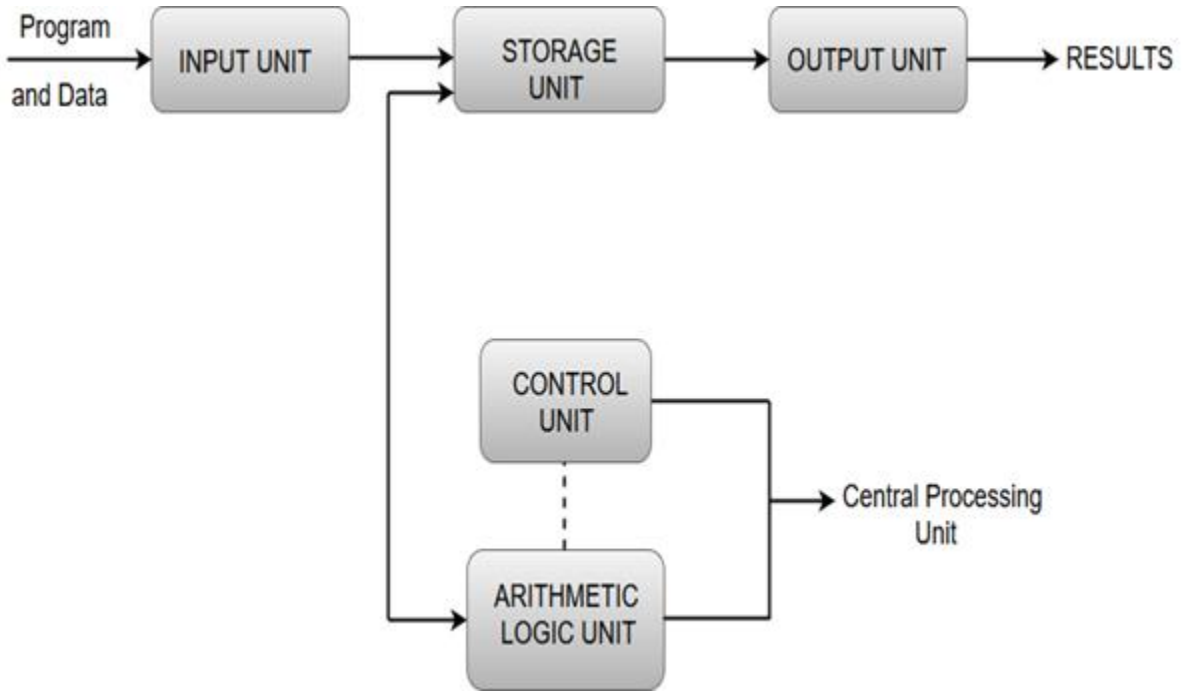
Organization of a computer system defines the way system is structured so that all those catalogued tools can be used. The significant components of Computer organization are ALU, CPU, memory and memory organization. Computer Organization refers to the operational units and their interconnection that realize the architectural specifications. In other words, Computer Organization is concerned with the way the hardware components operate and the way they are connected together to form the computer system. From technical point of view, we can say that, it deals with HSA.HSA here stands for "Hardware System Architecture".

Differences Between Computer Architecture and Computer Organization

Computer Architecture	Computer Organization
Computer Architecture is concerned with the way hardware components are connected together to form a computer system.	Computer Organization is concerned with the structure and behaviour of a computer system as seen by the user.
It acts as the interface between hardware and software.	It deals with the components of a connection in a system.
Computer Architecture helps us to understand the functionalities of a system.	Computer Organization tells us how exactly all the units in the system are arranged and interconnected.
A programmer can view architecture in terms of instructions, addressing modes and registers.	Whereas Organization expresses the realization of architecture.
While designing a computer system architecture is considered first.	An organization is done on the basis of architecture.
Computer Architecture deals with high-level design issues.	Computer Organization deals with low-level design issues.
Architecture involves Logic (Instruction sets, Addressing modes, Data types, Cache optimization)	Organization involves Physical Components (Circuit design, Adders, Signals, Peripherals)

Functional Unit of Computer

- A computer organization describes the functions and design of the various units of a digital system.
- A general-purpose computer system is the best-known example of a digital system. Other examples include telephone switching exchanges, digital voltmeters, digital counters, electronic calculators and digital displays.
- Computer architecture deals with the specification of the instruction set and the hardware units that implement the instructions.
- Computer hardware consists of electronic circuits, displays, magnetic and optic storage media and also the communication facilities.
- Functional units are a part of a CPU that performs the operations and calculations called for by the computer program.
- Functional units of a computer system are parts of the CPU (Central Processing Unit) that performs the operations and calculations called for by the computer program. A computer consists of five main components namely, Input unit, Central Processing Unit, Memory unit Arithmetic & logical unit, Control unit and an Output unit.



Input unit

- Input units are used by the computer to read the data. The most commonly used input devices are keyboards, mouse, joysticks, trackballs, microphones, etc.
- However, the most well-known input device is a keyboard. Whenever a key is pressed, the corresponding letter or digit is automatically translated into its corresponding binary code and transmitted over a cable to either the memory or the processor.

Central processing unit

- Central processing unit commonly known as CPU can be referred as an electronic circuitry within a computer that carries out the instructions given by a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.

Memory unit

- The Memory unit can be referred to as the storage area in which programs are kept which are running, and that contains data needed by the running programs.
- The Memory unit can be categorized in two ways namely, primary memory and secondary memory.
- It enables a processor to access running execution applications and services that are temporarily stored in a specific memory location.
- Primary storage is the fastest memory that operates at electronic speeds. Primary memory contains a large number of semiconductor storage cells, capable of storing a bit of information. The word length of a computer is between 16-64 bits.
- It is also known as the volatile form of memory, means when the computer is shut down, anything contained in RAM is lost.
- Cache memory is also a kind of memory which is used to fetch the data very soon. They are highly coupled with the processor.
- The most common examples of primary memory are RAM and ROM.
- Secondary memory is used when a large amount of data and programs have to be stored for a long-term basis.
- It is also known as the Non-volatile memory form of memory, means the data is stored permanently irrespective of shut down.

- The most common examples of secondary memory are magnetic disks, magnetic tapes, and optical disks.

Arithmetic & logical unit

- Most of all the arithmetic and logical operations of a computer are executed in the ALU (Arithmetic and Logical Unit) of the processor. It performs arithmetic operations like addition, subtraction, multiplication, division and also the logical operations like AND, OR, NOT operations.

Control unit

- The control unit is a component of a computer's central processing unit that coordinates the operation of the processor. It tells the computer's memory, arithmetic/logic unit and input and output devices how to respond to a program's instructions.
- The control unit is also known as the nerve center of a computer system.
- Let's us consider an example of addition of two operands by the instruction given as Add LOCA, RO. This instruction adds the memory location LOCA to the operand in the register RO and places the sum in the register RO. This instruction internally performs several steps.

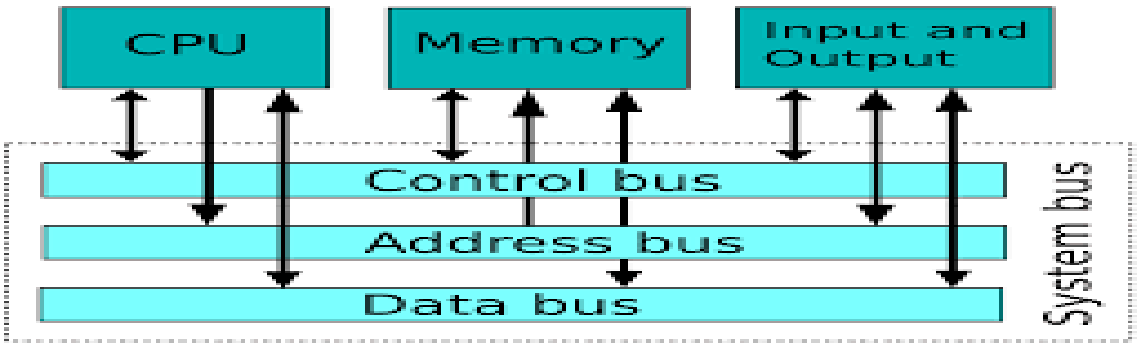
Output Unit

- The primary function of the output unit is to send the processed results to the user. Output devices display information in a way that the user can understand.
- Output devices are pieces of equipment that are used to generate information or any other response processed by the computer. These devices display information that has been held or generated within a computer.
- The most common example of an output device is a monitor.

Bus InterConnection

We know that computer consists of a CPU, Main Memory and I/O Unit. For data to flow between these components we need some kind of interconnections, which is another very important component of overall computer architecture.

These components are interconnected by using a set of parallel lines (**Conducted Wires**). Each of these lines can be used to transfer a sequence of bits from one component of the computer to the other component. This is a set of parallel lines is called **BUS.**



Generally a computer has more than one bus interconnection. The bus used to connect the main components of a computer is called the **System Bus.** General-purpose computers have a 70-100 line system bus. The system bus is divided into three main categories.

Control Bus: These lines are use to transmit different commands from one component to the other. For example, if the CPU wants to read data from the main memory; it will send the **memory read** command to the main memory of the computer. The control bus is also used to transmit other control signals like **ACKS (A**cknowledgement **S**ignals).For example when CPU give a command to the main memory for writing data, the memory sends a acknowledgement signal to the CPU after writing the data successfully so that the CPU can move forward and perform some more actions.

Data Bus: On the system bus 32 or 64 lines are reserved to transfer data from one component to the other. These lines are commonly known as the data bus. A 64-line data bus can transfer 64 bits of data simultaneously so it is not difficult to see that the width of the data bus has a direct impact on the performance of the computer.

Address Bus: As we know that many components are connected to one another through the system bus so it is important to assign a unique ID to each component. This ID is called the address of that component. When a computer component wants to communicate with another, it uses a few of the system bus lines to specify the destination component by using its address. These lines are commonly known as the address bus.

I/O Buses: (I/O is an acronym for input/output), connecting various peripheral devices to the CPU. These devices connect to the system bus via a 'bridge' implemented in the processors' chipset. Other names for the I/O bus include "expansion bus", "external bus" or "host bus".

Peripheral Component Interconnect (PCI) : is one of the latest developments in bus architecture and is the current standard for PC expansion cards. Intel developed and launched it as the expansion bus for the Pentium processor in 1993. It is a local bus like VESA, that is, it connects the CPU, memory, and peripherals to a wider, faster data pathway.

PCI was used in developing Plug and Play (PnP) and all PCI cards support PnP. This means a user can plug a new card into the computer, power it on and it will "self-identify" and "self-specify" and start working without manual configuration using jumpers.

Universal Serial Bus (USB)

This is an external bus standard that supports data transfer rates of 12 Mbps. A single USB port connects up to **127 peripheral devices**, such as mice, modems, and keyboards. The USB also supports hot plugging or insertion (ability to connect a device without turning the PC off) and plug and play (You connect a device and start using it without configuration).

We have two versions of USB:-

USB 1x

First released in 1996, the original USB 1.0 standard offered data rates of 1.5 Mbps. The USB 1.1 standard followed with two data rates: 12 Mbps for devices such as disk drives that need high-speed throughput and 1.5 Mbps for devices such as joysticks that need much less bandwidth.

USB 2x

In 2002 a newer specification USB 2.0, also called Hi-Speed USB 2.0, was introduced. It increased the data transfer rate for PC to a USB device to 480 Mbps, which is 40 times faster than the USB 1.1 specification. With the increased bandwidth, high throughput peripherals such as digital cameras, CD burners, and video equipment could now be connected with USB.