Covered Topics Under UNIT-1 of "PPS-PROGRAMMING FOR PROBLEM SOLVING (BCS101 / BCS201)"

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Class Notes

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PPS: UNIT-1

Introduction to Components of a Computer System

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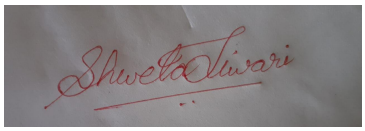

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TOPIC On : UNIT-1: THE CENTRAL PROCESSING UNIT (CPU)

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Under On: Introduction to Components of a Computer System

PREPARED FOR
Engineering Students
All Engineering College

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TOPIC On : UNIT-1: THE CENTRAL PROCESSING UNIT (CPU)

THE CENTRAL PROCESSING UNIT (CPU)

THE CENTRAL PROCESSING UNIT

The brain of any computer system is the CPU. It controls the functioning of the other units and process the data. The CPU is sometimes called the **processo**r, or in the personal computer field called "**microprocessor**". It is a single integrated circuit that contains all the electronics needed to execute a program. The processor **calculates** (add, multiplies and so on), **performs logical operations** (compares numbers and make decisions), and **controls the transfer of data among devices**.

The processor acts as the controller of all actions or services provided by the system. Processor actions are synchronized to its clock input. A **clock signal** consists of *clock cycles*. The time to complete a clock cycle is called the ***clock period***. Normally, we use the clock frequency, which is the inverse of the clock period, to specify the clock. The clock frequency is measured in Hertz, which represents one cycle/second. Hertz is abbreviated as Hz.

Usually, we use mega Hertz (MHz) and Giga Hertz (GHz) as in 1.8 GHz Pentium.

The processor can be thought of as executing the following:

1. Fetch an instruction from the memory,
2. Decode the instruction (i.e., determine the instruction type),
3. Execute the instruction (i.e., perform the action specified by the instruction).

Execution of an instruction involves fetching any required operands, performing the specified operation, and writing the results back. This process is often referred to as the *fetch-execute* cycle, or simply the *execution* cycle. The execution cycle is repeated as long as there are more instructions to execute. This raises several questions. Who provides the instructions to the processor? Who places these instructions in the main memory? How does the processor know where in memory these instructions are located?

When we write programs—whether in a high-level language or in an assembly language— we provide a sequence of instructions to perform a particular task (i.e., solve a problem). A compiler or assembler will eventually translate these instructions to an equivalent sequence of machine language instructions that the processor understands. The operating system, which provides instructions to the processor whenever a user program is not executing, loads the user program into the main memory. The operating system then indicates the location of the user program to the processor and instructs it to execute the program.

The actions of the CPU during an execution cycle are defined by micro-orders issued by the control unit. These micro-orders are individual control signals sent over dedicated control lines. For example, let us assume that we want to execute an instruction that moves the contents of register **X** to register **Y**. Let us also assume that both registers are connected to the data bus, **D**. The control unit will issue a control signal to tell register **X** to place its contents on the data bus **D**. After some delay, another control signal will be sent to tell register **Y** to read from data bus **D**.

THE COMPONENTS OF CPU

A typical CPU has three major components:

1. **Register Set**.
2. **Arithmetic Logic Unit (ALU)**.
3. **Control Unit (CU)**.

Figure 1 shows lock diagram of the main components of the CPU and its interactions with the memory system and the input/output devices.

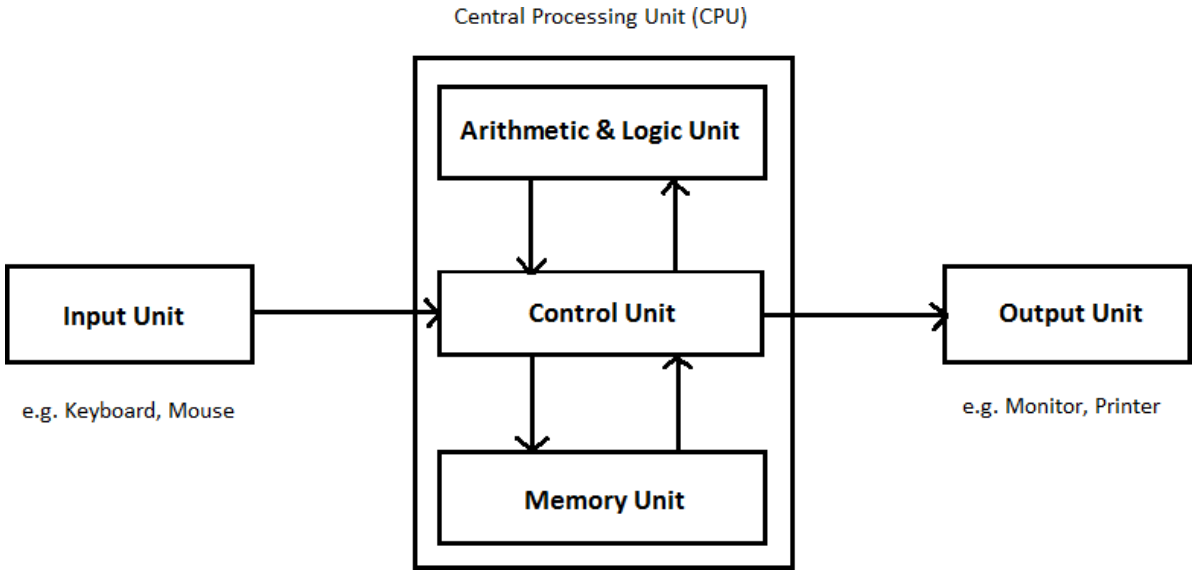

Figure 1: Block Diagram of CPU Components of CPU and their functions:

1. **The Register Set** differs from one computer architecture to another. CPU registers perform a variety of functions, a primary one of which is to offer temporary storage for the CPU to access information stored on the hard drive. Every CPU register has a distinct function and the registers are essential components of CPU commonly recognized for memory allocation purposes.

   Examples of registers:

   Examples of CPU registers include:

   - The Memory Address Register (MAR).
   - The Memory Buffer Register (MBR).
   - I/O Address Register (I/O AR).
   - The Program Counter (PC).

   These CPU registers perform specific functions in the CPU. For example, the MAR stores the address where the memory for the CPU reads and writes data. The MBR stores the contents of the data the CPU reads from in the memory.

2. Arithmetic and logic unit (ALU)

ALU can also be subdivided into two sections namely, **arithmetic unit** and **logic unit**. It is a complex digital circuit which consists of registers and which performs arithmetic and logical operations. Arithmetic sections perform arithmetic operations like addition, subtraction, multiplication, division etc. All other Complex operations can also be performed by repetition of these above basic operations.

The logic unit is responsible for performing logical operations such as comparing, selecting, matching and merging of different data or information.

So basically ALU is the major part of the computer system which handles different calculations. Depending on the design of ALU it makes the CPU more powerful and efficient.

3. Control unit:

It is the unit which controls all the operations of the different units but does not carry out any actual data processing operation. **Control unit** transfers data or instruction among different units of a computer system. It receives the instructions from the memory, interprets them and sends the operation to various units as instructed.

Control unit is also responsible for communicating with all input and output devices for transferring or receiving the instruction from the storage units. So, the control unit is the main coordinator since it sends signals and find the sequence of instructions to be executed.