

## Introduction to Microprocessors

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### Introduction to Microprocessors

- The microprocessor is one of the most important components of a digital computer.
- It acts as the brain of the computer system.
- As technology has progressed, microprocessors have become faster, smaller and capable of doing more work per clock cycle.
- Sometimes, microprocessor is written as  $\mu P$ .  
 ( $\mu$  is pronounced as **Mu**)

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### Introduction to Microprocessors

- **Definition:**

Microprocessor is the controlling unit or CPU of a micro-computer, fabricated on a very small chip capable of performing ALU operations and communicating with the external devices connected to it.

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### A Computer

- **A computer:**

- Accepts the data from the user.
- Stores the data and the set of instructions supplied by the user in memory.
- Processes the data according to the instructions in the processing unit.
- Communicates the result to the user or stores it for further reference.

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### A Computer

- A computer has the following units:

- Input Unit
- Output Unit
- Memory Unit
- Central Processing Unit

```

    graph LR
        Input[Input Unit] --> CPU
        subgraph CPU
            TCU[Timing & Control Unit]
            ALU[ALU]
            Registers[Registers]
        end
        CPU <--> Memory[Memory]
        CPU --> Output[Output Unit]
    
```

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### A Computer

- **INPUT UNIT**

- The input unit consists of the devices which accept the data and instructions from the user and communicates it to the CPU.
- The various input devices are: keyboard, mouse, joystick, trackball etc.

- **OUTPUT UNIT**

- It provides the result of the various operations performed by the CPU to the user.
- The various output devices are: printers, monitors, loudspeakers etc.

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## A Computer

- **CENTRAL PROCESSING UNIT (CPU)**
  - The CPU is the heart and nerve centre of the computer.
  - It fetches the instruction and data from the peripheral devices and performs all the arithmetic operations, takes logical decision and control the operation of all other units.
  - Various sub-blocks of the central processing unit are:
    - Arithmetic and Logic Unit (ALU)
    - Timing & Control Unit
    - Registers

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## A Computer

- **ARITHMETIC AND LOGIC UNIT (ALU)**
  - This unit perform all the logical and arithmetic operations.
  - Various arithmetic operations are: addition, subtraction, increment and decrement etc.
  - Various logical operations are: AND, OR, NOT, XOR, etc.
- **TIMING AND CONTROL UNIT**
  - This unit controls the entire operations being performed by the system.
  - It controls the operations of ALU, input/output devices and memory unit.
  - This unit interprets the instructions and generates various timing and control signals.
- **REGISTERS**
  - A register is a very small amount of very fast memory that is built into the CPU in order to store the current data and instructions which are being executed by the CPU.

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## A Computer

- **MEMORY UNIT**
  - It stores the program statement and the data i.e. the information supplied from the input unit.
  - It also stores the final output.
  - This is connected to the CPU by means of a bidirectional bus.
  - The CPU processes the information as taken from the memory and performs the operations in the ALU section.
  - The results are either transferred to the output unit or stored in the memory for later use by the CPU.

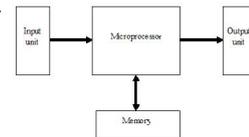
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## A Micro-Computer

- As the name implies, microcomputers are small computers.
- The block diagram of the microcomputer is similar to the computer except that the central processing unit of the microcomputer is contained in a single IC called the microprocessor.



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## A Micro-Computer

- A microprocessor is a LSI (Large Scale Integration) IC that does almost all the functions of the CPU.
- It is also defined as a CPU contained in a single chip.
- The basic function of the microprocessor is:
  - to fetch the instructions stored in the main memory
  - identify the operations and the devices involved in it
  - and accordingly generate control signals to determine when a given action is to take place.
- We can say that a computer with a microprocessor as its CPU, is known as **Microcomputer**.

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## Some Definitions

- **Microprocessor:**
  - The central processing unit built on a single IC is called Microprocessor.
  - A microprocessor (sometimes abbreviated as  $\mu P$ ) is a digital electronic component with miniaturized transistors on a single semiconductor integrated circuit (IC).
  - One or more microprocessors typically serve as a central processing unit (CPU) in a computer system or handheld device.

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### Some Definitions

- **Microcomputer:**
  - A digital computer, in which one microprocessor has been provided to act as a CPU, is called Microcomputer.
  - A desktop computer, laptop, notebook, palmtop, etc. contain one microprocessor to act as a CPU and hence they come under the category of microcomputer.
  - The term microcomputer is generally synonymous with personal computer.

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### Some Definitions

- **Multiprocessor System:**
  - The CPU of a large powerful digital computer contains more than one microprocessor.
  - High-end powerful servers, mainframe computers, supercomputers, etc. contain more than one microprocessor to act as CPU.
  - A computer whose CPU contains more than one microprocessor is called Multiprocessor System.

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### Some Definitions

- **Microcontroller:**
  - A highly integrated chip that contains all the components such as CPU, RAM, some form of ROM, I/O ports, and timers is called Microcontroller.
  - Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task to control a particular system.

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### Microprocessor Characteristics

- **Instruction Set:**
  - The set of instructions that a microprocessor can understand.
- **Bandwidth:**
  - The number of bits processed in a single instruction.
- **Capability:**
  - It depends upon the number of instructions and capability of each instruction.

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### Microprocessor Characteristics

- **Clock Speed:**
  - The clock speed determines how many operations per second the processor can perform.
  - It is also called **Clock Rate**.
  - Every computer contains an internal clock that regulates the rate at which instructions are executed and synchronizes the various computer components.
  - The faster the clock, the more instructions the CPU can execute per second.
  - Clock speeds are expressed in megahertz (MHz) or gigahertz (GHz).
  - The microprocessors of personal computers have clock speeds of anywhere from 300 MHz to over 3.8 GHz.

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### Microprocessor Characteristics

- **Word Length:**
  - It depends upon the width of internal data bus, registers, ALU etc.
  - An 8-bit microprocessor can process 8 bit data at a time.
  - A processor with longer word length is more powerful and can process data at a faster speed as compared to processor with shorter word length.
  - The word length ranges from 4 bits for small microprocessor, to 64 bits for high-end microcomputers.

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## Microprocessor Characteristics

- **Width of Data Bus:**
  - This is the size of the data bus. It defines the number of bits that can be transferred through data bus.
- **Width of Address Bus:**
  - This parameter decides the memory addressing capability of the microprocessor. The maximum size of the memory unit is decided by this parameter.
- **Input/Output Addressing Capability:**
  - The maximum number of the input/output ports accessed by the microprocessor depends upon the width of the input/output address provided in the input/output instruction.

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## Microprocessor Characteristics

- **Data Types:**
  - The microprocessor handles various types of data formats like binary, BCD, ASCII, signed and unsigned numbers.
- **Interrupt Capability:**
  - Interrupts are used to handle unpredictable and random events in the microcomputer.
  - It is used to interrupt the microprocessor.
  - Interrupt driven input/output improves the throughput of a system.

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## Features of Microprocessor

- **Cost:**
  - The most important feature of a microcomputer is its low cost.
  - Because of the widespread use of microprocessors, the volume of production is very high.
  - That is why, microprocessor chips are available at fairly low prices.
- **Size:**
  - The second important feature of a microprocessor is its small size.
  - As a result of improvement in fabrication technology, VLSI, electronic circuitry has become so dense that a minute silicon chip can contain hundred and thousands of transistors.

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## Features of Microprocessor

- **Power Consumption:**
  - Another important feature is its low power consumption.
  - Microprocessors are normally manufactured by Metal-Oxide semiconductor technology, which has the feature of low power consumption.
- **Versatility:**
  - The microprocessors are versatile.
  - Keeping the same basic hardware, a microprocessor-based system can be configured for a number of applications by simply altering the software program.
- **Reliability:**
  - Another important property of microprocessors is its extreme reliability.
  - It has been established that the failure rate of an IC is fairly uniform at the package level, regardless of its complexity.

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## Micron

- A unit of length equal to one millionth of a meter.
- It is denoted by  $\mu$  (Mu).
- For Example:
  - If we pluck a hair from the head, it is very thin.
  - But a hair is more than 2000 times wider than a transistor on a microprocessor.
  - Wires between transistors are even thinner.
  - They're more than 4000 times thinner than a hair.
  - A hair is about 100 microns in diameter.
  - That means, a transistor is just 0.045 microns wide.

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Have a Nice Day

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