# Computer Architecture

# Lecture 4
# Microprocessor Basics

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# Microprocessor Basics

- At present there are many types and sizes of computers available. These computers are designed and constructed based on digital and Integrated Circuit (IC) fabrication technology.

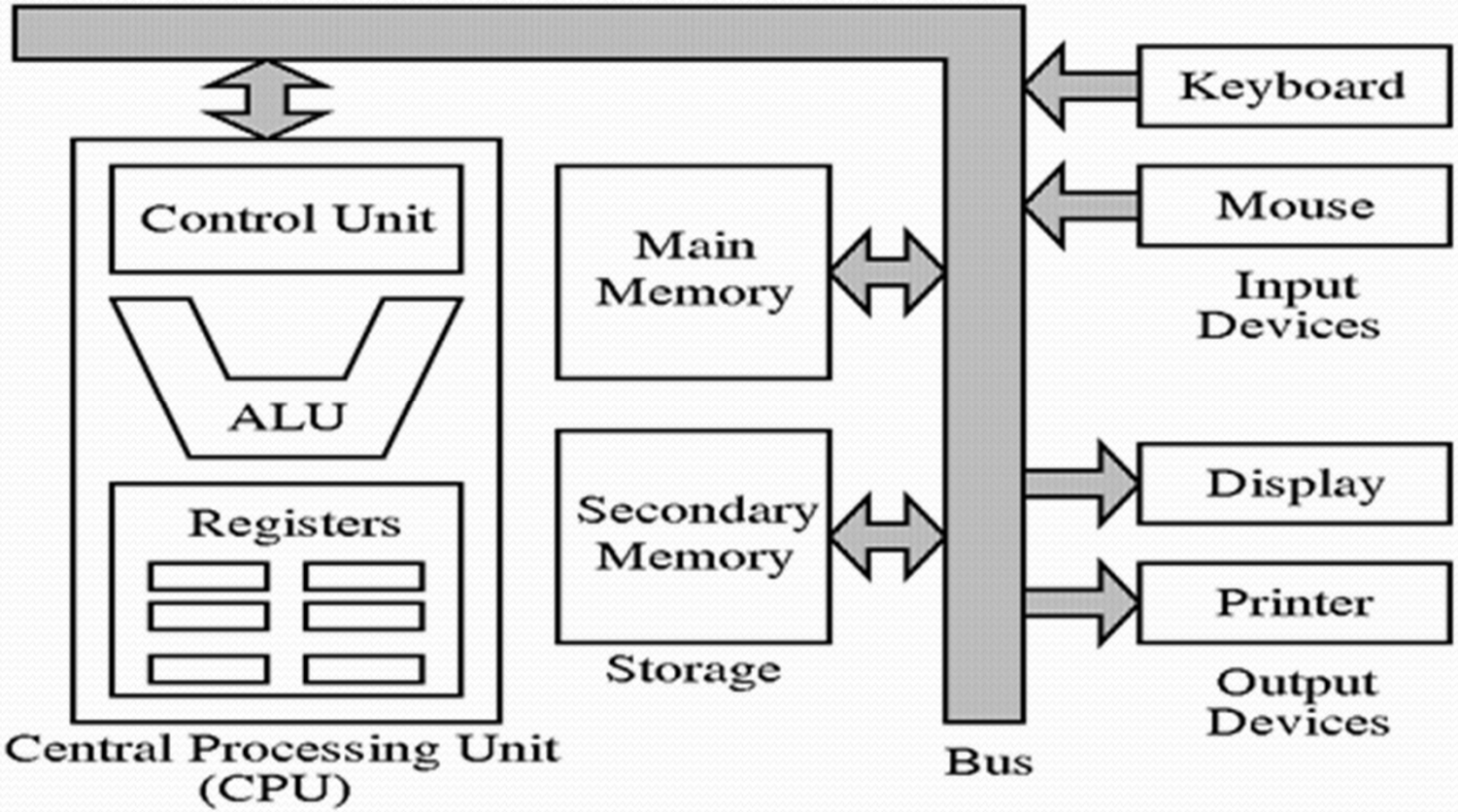
- A digital computer is a machine that can be used to solve problems for people by carrying out the task by following the instructions given to it. A sequence of instructions describing how to perform a certain task or job is called a program.

# Microprocessor Basics

- A personal computer (PC) uses its memory to store the instructions, typically memory size is more than 32Mb of RAM. PCs were used for word processing, spreadsheets, and numerous highly interactive applications.

# Microprocessor Basics

- Following figure show the structure of PC.



# Microprocessor Basics

**Structure of a PC:**

- All types of computers, regardless of their size, type and use, consist of at least the following devices:-

1. Microprocessor or Central Processing Unit (CPU)
2. Storage device (Memory)
3. Input/Output devices (I/O)
4. Instructions or programs

# Microprocessor Basics

- When these devices are connected and make to work together as a system, it is called a microcomputer system.

- The CPU, memory and I/O are called hardware since they are physical devices, whereas the instructions or programs (non-physical component) is called software.

# Microprocessor Basics

**Microprocessor or Central Processing Unit (CPU):**

- **A microprocessor is a multipurpose, programmable logic device (IC)** that reads binary instructions from a storage device **called memory**, accepts binary data as input and **processes data according to those instructions**, and provide results as output.

- A multipurpose device means it can be used to perform various sophisticated computing tasks or functions, as well as simple tasks.

# Microprocessor Basics

- **A programmable device** means that it can be instructed to perform given tasks within its capability. Today's microprocessor is designed to understand and execute many binary instructions.

- Microprocessor is also called Central Processing Unit (CPU) since it is the functional center of the computer system and it is used to process data.

# Microprocessor Basics

- The CPU is the functional center of the microcomputer system. Its internal construction can be broadly divided into three sections : **Control section**, **Arithmetic and Logic Unit** and **Register section.**

**1.Control Section:**

- The control section/unit is the part of the microcomputer that controls its basic operations. It is made up of the control signal generating circuitry (clock) and the command (instruction) decoder.

# Microprocessor Basics

- The control section fetches pre-programmed instructions from memory (op-code fetch cycle) as needed and temporarily stores them in the command register (also known as Instruction Register IR).

- These instructions are then decoded by the operation decoder (decode cycle), which sends control signals to the relevant parts of the microcomputer system (via the system busses) to cause them to carry out the required operation (execute cycle).

# Microprocessor Basics

- The timing with which these control signals are generated is determined by the clock. The number of T-states tells the time taken for the CPU to execute that particular instruction.

- The major types of operations controlled by the control signals are:-

1. Sending of data from one part of the microcomputer to another (read or write cycle).

# Microprocessor Basics

2. Inputting and outputting of data to/from the microcomputer (I/O read or write cycle).

2. Arithmetic and Logic calculations.

2. Halting of computer instructions.

3. Jumping to another instruction during running (execution) of a program.

# Microprocessor Basics

## 2. Arithmetic and Logic Unit (ALU):

- This section, under the control of control section carries out the actual processing of data, normally describe as data manipulation.

- This consists largely of arithmetic operations (ADDition, SUBtraction, INCrementing, DECrementing etc) and logical operations (ANDing, ORing, XORing, NOTing etc).

# Microprocessor Basics

**The ALU carries out these operations in the following manner :-**

1. Stores data fetched from memory or I/O in the registers
2. Fetches this data as needed from the registers and/or from relevant accumulators.
3. Send this data either to its arithmetic circuitry or logical circuitry, where necessary, where the necessary arithmetic or logical operations are carried out.
4. Send results of its arithmetic or logical operation to relevant accumulator, to the memory, or to the I/O interfaces.

# Microprocessor Basics

## 3. Register Section:

- The register section/array consists completely of circuitry used to temporarily store data or program codes until they are sent to the ALU or to the control section or to memory.

- The number of registers are different for any particular CPU, and the more register a CPU have will result in easier programming tasks.

# Microprocessor Basics

**System Bus:**

- The three components of the microcomputer system is connected by three buses, also known as system bus. These busses are used to transfer information (data) internally and externally to the microprocessor.

# Microprocessor Basics

## 1. Address Bus:

- The address bus is 'unidirectional', over which the microprocessor sends an address code to the memory or input/output. The size (width) of the address bus is specified by the number of bits it can handle.

- The more bits there are in the address bus, the more memory locations a microprocessor can access. A 16 bit address bus is capable of addressing 65,536 (64K) addresses.

# Microprocessor Basics

## 2. Data Bus:

- The data bus is two ways 'bi-directional', on which data or instruction codes are transferred into the microprocessor or on which the result of an operation or computation is sent out from the microprocessor to the memory or input/output. Depending on the particular microprocessor, the data bus can handle 8 bit or 16 bit data.

# Microprocessor Basics

### 3. Control Bus:

- The control bus is used by the microprocessor to send out or receive timing and control signals in order to coordinate and regulate its operation and to communicate with other devices, i.e. memory or input/output.

# Microprocessor Basics

## Memory

- Memory is the term used to the various storage devices in which are used to store the programs and data for the microprocessor. These storage devices are made of semiconductor devices, and also known as Primary Storage Devices

- The semiconductor memory is of 2 types that is Read Only Memory (ROM) and Read Write Memory (RWM). RWM is popularly known as Random Access Memory (RAM).

# Microprocessor Basics

**Input/Output:**

- The input/output unit allows the microprocessor to communicate with the outside world, either to receive or to send data.

- Most of the time, the input/output unit will also act as an interface for the microprocessor, that is to convert the data into a suitable format for the microprocessor.

- Data can be in the form of parallel (8 bit) or serial format (single line).

# Microprocessor Basics

- Input devices are devices that input data or send data to the computer. Input devices are such as **keyboard**, **punched card readers**, **sensors**, **switches**, **Mouse**, etc.

- Output devices are devices that output data or perform various operations under the control of the CPU. Output devices are LEDs, speaker, printer, etc


The End