



# **University of Technology**

**Biomedical Engineering Department**

**First year**

**2<sup>nd</sup> lecture**

**Of**

## **Principles of computer engineering and Programming methodology**

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# Computer Fundamentals

Computer fundamental chapter gives a quick introduction about computer hardware and software system, starting from generations of computers, types, characteristics, architecture, CPU, motherboard, RAM, ROM and numbering system.

Before getting started you should know some of the following definitions:

## **Definitions:**

**Computer:** An electronic device which takes input from the user, which processes it and gives you the required result in the form of display or print.

**Hardware:** Hardware is the physical parts of the system, which can be seen and touched by the user.

**Software:** It is an application program, which performs some operations and gives you desired results.

**Network:** It is group of interconnected computers or devices to have communication within them.

**Programming Language:** It is instruction use to create application and system software.

**Operating System:** is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.

## Types of Computers

Types of computers are based upon the purpose, functioning and size of the computer. Accordingly they are classified into four types:

- Super computers
- Mainframe computers
- Mini computers
- Micro computers

# Characteristics of Computer

Computers are the electronic device which takes input from the user, processes the data and gives the exact output to the user. Computer performs three basic operations

- Taking the input in the form of instruction and data.
- Processing the instruction and data and store the results.
- Display the stored results or output it into the print format.

## Characteristics of Computer

- **Speed:** In general, no human being can compete to solving the complex computation, faster than computer.
- **Accuracy:** Since Computer is programmed, so whatever input we give it gives result with accurately.
- **Storage:** Computer can store mass storage of data with appropriate format (binary data). The storage capacity of a computer is measured in Mega Byte, Gega Byte, Tera Byte.
- **Reliability:** Computer can work for hours without any break and creating error. Computers never make mistakes of their own accord.
- **Power of remembering:** It can remember data for us.

## Limitations

- **NO Intelligence:** Computer does not work without instructions. they need to be programmed to do their task
- **NO FEELING:** Computer does not have emotions, knowledge and feeling
- They cannot learn from their experience.

# Component of computer

The computer system components consist of both *hardware* and information stored on hardware. Information stored on computer hardware is often called *software*.

## 1. Hardware components

Computer hardware system consists of different types of devices. Each device is connected directly or indirectly to the motherboard. These are classified into three basic categories:

1. Input/Output devices
  - Input devices (keyboard, mouse etc.)
  - Output devices (monitor, speakers etc.)

## 2. System Unit

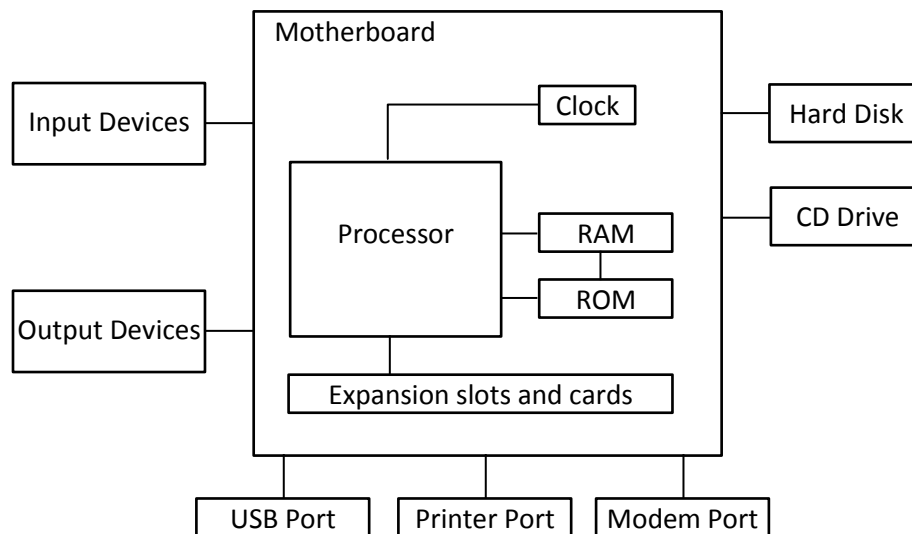
- Processor (e.g. CPU)

## 3. Storage Unit

- Main memory (e.g. RAM).
- Secondary memory (e.g. hard disk drive, CD/DVD drive etc.).

### 1.1. Block diagram of Computer

Functional block diagram consists of three basic units (Input/Output devices, System Unit and Storage Unit).



For typical desktop computers, the processor, main memory, secondary memory, power supply, and supporting hardware are housed in a metal case. Many of the components are connected to the main circuit board of the computer, called the **motherboard**. The power supply supplies power for most of the components. Various **input** devices (such as the keyboard) and **output** devices (such as the monitor) are attached through connectors and ports at the rear of the case.

The terms *input* and *output* say if data flow into or out of the computer. The picture shows the major hardware components of a computer system. The arrows show the direction of data flow.

- A **bus** is a group of wires on the main circuit board of the computer. It is a pathway for data flowing between components.

- **Processor**

The processor is an electronic device about a one inch square, covered in plastic. Inside the square is an even smaller square of silicon containing millions of tiny electrical parts. A modern processor may contain billions of transistors. It does the fundamental computing within the system, and directly or indirectly controls all the other components.

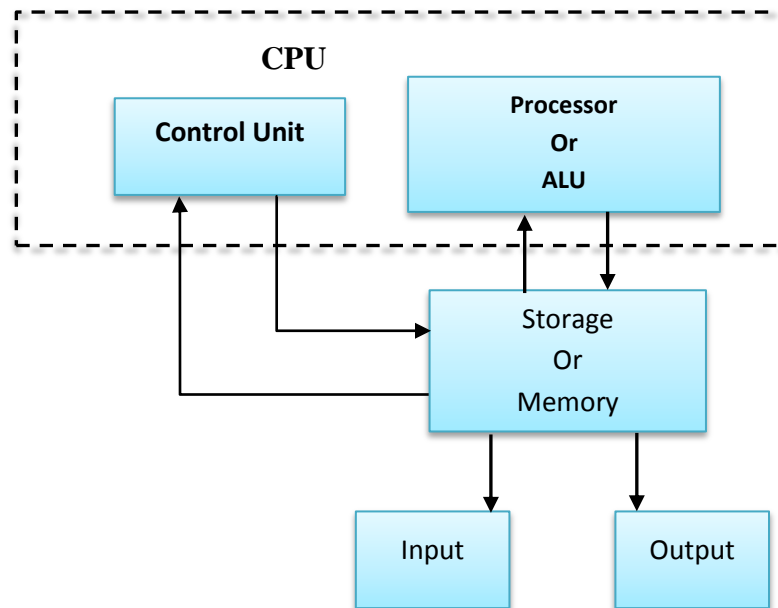


Figure of CPU

Where

CPU is the Central Processing Unit.

CU is the Control Unit.

ALU is the Arithmetic Logic Unit.

- The processor when combined with the control unit form a component referred to as CPU.
- Storage unit stores programs as well as input, output and intermediate data.
- The processor or ALU performs arithmetic and other data processing tasks as specified by the program.
- The control unit supervised the flow of information between various units.
- The program and data prepared by the user are transformed into the memory unit by means of input devices such as: keyboard, scanner ...etc.
- The output unit presents the results of the computation to the user in a form that the user understands it such as: printer, monitor ...etc.

- **Main memory and secondary memory**

The programs and data sets are held in memory external to the processor. This memory is of two fundamental types: main memory, and secondary memory.

- a) Main Memory can be further classified as **RAM** and **ROM**.

**RAM (random access memory)** is type of computer memory that can be accessed randomly. The operating system, application programs and the data in current use are kept temporarily so that they can be accessed by the computer's processor. Main memory is sometimes called volatile because its data remains in RAM as long as the computer is running. When the computer is switched off, RAM loses its data. When the computer is switched on again, the OS and other files are once again loaded into RAM, usually from an HDD (**Hard Disk Driver**).

**ROM or Read Only Memory** is a special type of memory which can only be read and contents of which are not lost even when the computer is switched off. It typically contains manufacturer's instructions. Among other things, ROM also stores an initial program called the 'bootstrap loader' whose function is to start the operation of computer system once the power is switched on.

- b) Secondary memory is usually nonvolatile because it retains its information when power is removed (e.g. **HDD** stands for **Hard Disk Driver**).

## **2. Software components**

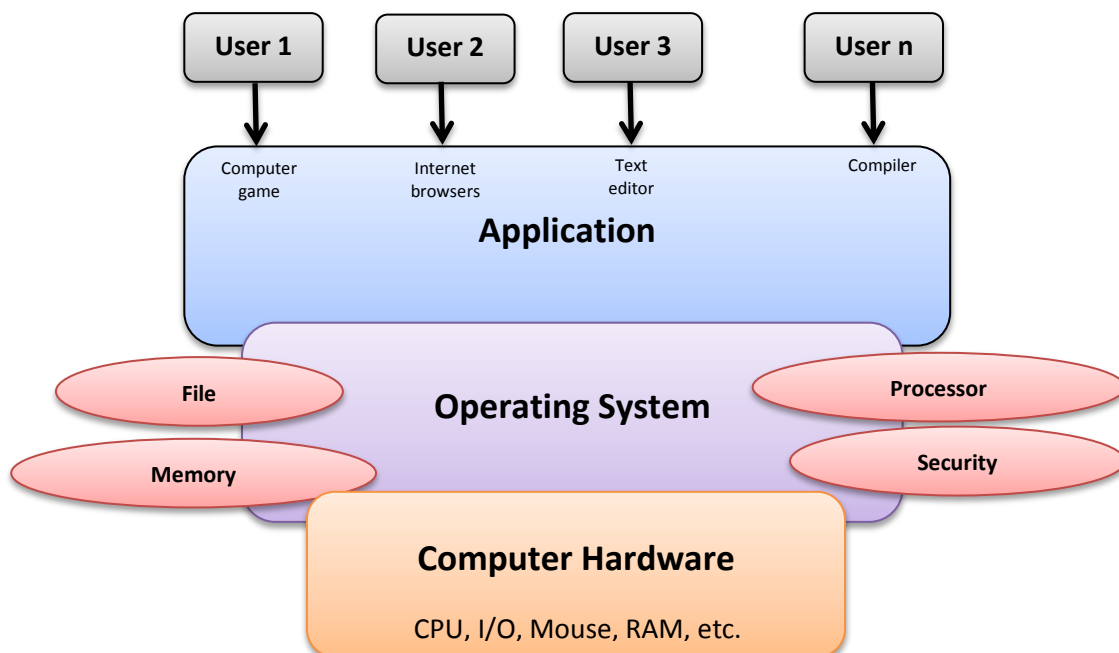
Computer software consists of both *programs* and *data*. **Programs** consist of instructions for the processor. **Data** can be any information that a program needs: character data, numerical data, image data, audio data, and other types. There are two types of programs.

- **Systems programs** keep the hardware and software running together smoothly (e.g. Operating System).
- **Application programs** (usually called just "applications"): are programs that people use to get their work done. Computers exist because people want to run these programs (e.g. Microsoft Offices, internet browser).

## 2.1.System programs (Operating system)

An operating system (OS) is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.

In another word, an operating system (OS) is a collection of software that manages computer hardware resources and provides common services for computer programs. Most the modern OS use graphical environment which is called *Graphical User Interface* (GUI). GUI is a program interface that takes advantage of the computer's graphics capabilities to make the program easier to use like icons, menus and so on. Examples of popular modern operating systems are *Microsoft windows, Linux, Mac* etc.



Following are some of important functions of an operating System.

- Memory management
- File management
- Processor management
- Security

### 2.1.1. Memory Management

Memory management refers to management of Main Memory. Operating System does the following activities for memory management.

- Keeps tracks of primary memory i.e. what part of it are in use by whom, what part are not in use.
- Allocates the memory when the process requests it to do so.
- De-allocates the memory when the process no longer needs it or has been terminated.

### 2.1.2. File Management

A file system is normally organized into directories for easy navigation and usage. These directories contain the file name and its location of that file in memory. Operating System does the following activities for file management.

- Manage file operations: Create, Delete, Open, Close, Read and Write.
- Manage file attribute: file name, file size, and file extension “i.e. .txt, .doc, .dll etc. ...”
- Manage the directories.

### 2.1.3. Processor Management

In multiprogramming environment, Operating System decides which **process** gets the processor (CPU) when and how much time. This function is called *processor scheduling*. Operating System also does the following activities for processor management.

- Keeps tracks of process state (New, Ready, Running, Waiting, Terminate).
- Allocates the processor to a process.
- De-allocates processor when processor is no longer required.

### What is process?

A process is basically a **program** in execution. The execution of a process must progress in a sequential fashion.

### What is program?

A program is a piece of code which may be a single line or millions of lines. A computer program is usually written by a computer programmer in a programming language. For example, here is a simple program written in C++ programming language:-

```
#include <iostream.h>
main()
{
    cout<<"Hello";
}
```

### 2.1.4. Security

Prevents unauthorized access to programs and data by means of passwords and similar other techniques.



## 2.2. Application program

*Application program* is software program that allow user to execute specific task. The media player, word processor and internet browser is an example of application.

- *Media players*: If you want to listen to MP3s or watch movies you've downloaded, you'll need to use a media player. Windows Media Player and iTunes are popular media players.
- *Word processors*: A word processor allows you to write a letter, design a flyer, and create many other types of documents. The most well-known word processor is Microsoft Word.
- *Web browsers*: A web browser is the tool you use to access the Internet. Most computers come with a web browser pre-installed, but you can also download a different one if you prefer. Examples of browsers include Internet Explorer, Firefox, Google Chrome, and Safari.
- *Microsoft Excel*: Software developed and manufactured by Microsoft Corporation that allow users to organize, format and calculate data with formulas and charts using a spreadsheet system broken up by rows and columns.

## 2.3. Numbering Systems

The computer work with numbers only, letters and symbols also the numbers transfer to specific numbers input to computer and process then output the results which transfer from machine language to language understand by humans, display on different output devices. The most numbering systems used are:

1. Decimal System
2. Binary System
3. Octal System
4. Hexadecimal System

Following the properties of (Decimal and Binary) Numbering Systems:

### Decimal System

The properties of decimal system as follows:

1. Base is 10
2. Set of used symbols are: (0,1,2,3,4,5,6,7,8,9)

Example: The number in decimal system  $(29029.98)_{10}$  is compute as follows:

$$2 * 10^4 + 9 * 10^3 + 0 * 10^2 + 2 * 10^1 + 9 * 10^0 + 9 * 10^{-1} + 8 * 10^{-2} = 29029.98$$

## **Binary system**

The properties of Binary system as follows:

1. Base is 2
2. Set of used symbols are: (0,1)

Example: convert the number  $(10101.01)_2$  from binary system to decimal system

$$1 * 2^4 + 0 * 2^3 + 1 * 2^2 + 0 * 2^1 + 1 * 2^0 + 0 * 2^{-1} + 1 * 2^{-2} = (21.25)_{10}$$

Example: convert the number  $(25)_{10}$  from decimal system to binary system

Number	Number/2	remainder
25	$25/2=12$	1
12	$12/2=6$	0
6	$6/2=3$	0
3	$3/2=1$	1
1	0	1

The number in decimal system  $(25)_{10} = (11001)_2$  in binary system.