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Introduction to Computer Fundamental

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Module 1

Introduction to Computer

Computer

- The term "computer" is derived from the Latin word "computare" which means to calculate.
- A computer is a programmable electronic device that accepts raw data as input and processes it with a set of instructions (a program) to produce the result as output.
- Data is a collection of unorganized facts & figures and does not provide any further information regarding patterns, context, etc. Hence data means "unstructured facts and figures".
- Information is structured data i.e. organized meaningful and processed data. To process the data and convert into information, a computer is used.

A complete computer system consists of four parts:

- **Hardware:** Hardware represents the physical and tangible components of the computer.
- **Software:** Software is a set of electronic instructions consisting of complex codes (Programs) that make the computer perform tasks.
- **User:** The computer operators are known as users.
- **Data:** Consists of raw facts, which the computer stores and reads in the form of numbers.

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Functions of Computers

A computer performs the following functions –

Receiving Input

Data is fed into the computer through various input devices like keyboard, mouse, digital pens, etc. Input can also be fed through devices like CD-ROM, pen drive, scanner, etc.

Processing the information

Operations on the input data are carried out based on the instructions provided in the programs.

Storing the information

After processing, the information gets stored in the primary or secondary storage area.

Producing output

The processed information and other details are communicated to the outside world through output devices like monitor, printer, etc.

The Basic parts without which a computer cannot work are as follows:

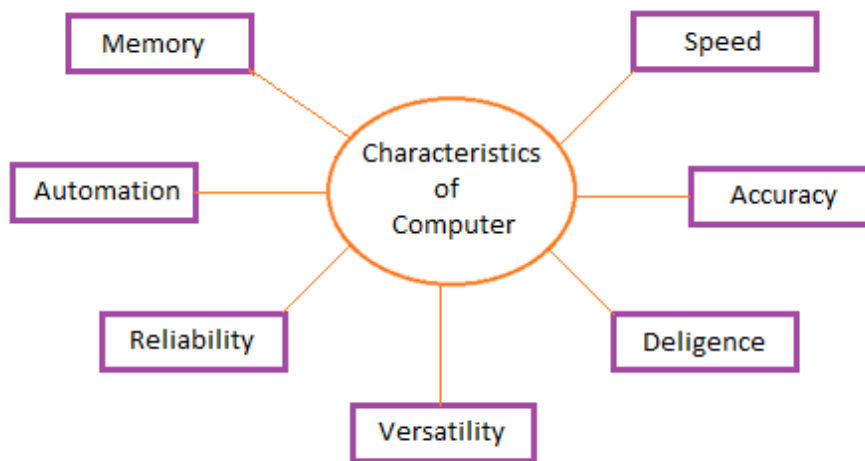
- **Processor:** It executes instructions from software and hardware.
- **Memory:** It is the primary memory for data transfer between the CPU and storage.
- **Motherboard:** It is the part that connects all other parts or components of a computer.
- **Storage Device:** It permanently stores the data, e.g., hard drive.
- **Input Device:** It allows you to communicate with the computer or to input data, e.g., a keyboard.
- **Output Device:** It enables you to see the output, e.g., monitor.

The following are the characteristics of Computers :

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Speed

A computer works with much higher speed and accuracy compared to humans while performing mathematical calculations. Computers can process millions (1,000,000) of instructions per second. The time taken by computers for their operations is microseconds and nanoseconds.

Accuracy

Computers perform calculations with 100% accuracy. Errors may occur due to data inconsistency or inaccuracy.

Diligence / Repeated Processing Capabilities

A computer can perform millions of tasks or calculations with the same consistency and accuracy. It doesn't feel any fatigue or lack of concentration. Its memory also makes it superior to that of human beings.

Versatility

Versatility refers to the capability of a computer to perform different kinds of works with same accuracy and efficiency.

Reliability

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A computer is reliable as it gives consistent result for similar set of data i.e., if we give same set of input any number of times, we will get the same result.

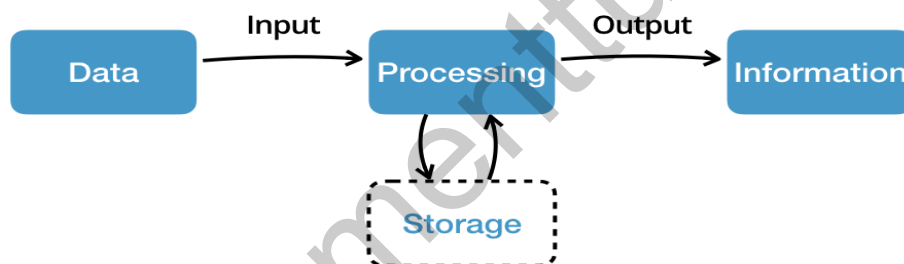
Automation

Computer performs all the tasks automatically i.e. it performs tasks without manual intervention.

Memory

A computer has built-in memory called primary memory where it stores data. Secondary storage are removable devices such as CDs, pen drives, etc., which are also used to store data.

DATA PROCESSING CYCLE OF COMPUTER.

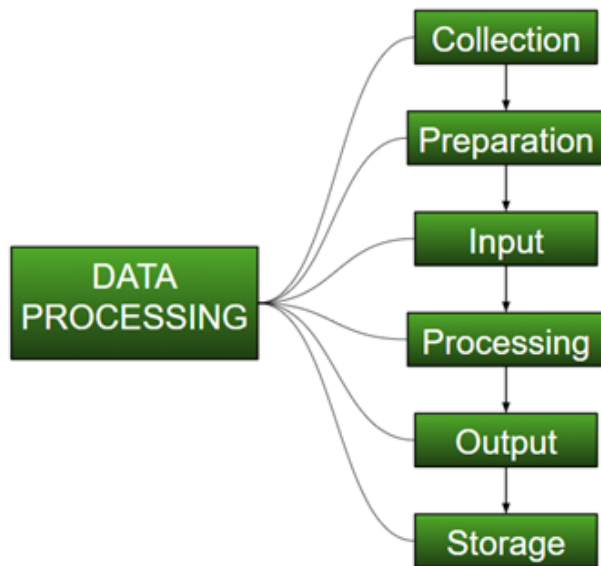


Data processing is a process of converting raw facts or data into meaningful information.

Stages of Data Processing

Data processing consists of following 6 stages –

Stages of the Data Processing Cycle



Collection

Collection of data refers to gathering of data. The data gathered should be defined and accurate.

Preparation

Preparation is a process of constructing a dataset of data from different sources for future use in processing step of cycle.

Input

Input refers to supply of data for processing. It can be fed into computer through any of input devices like keyboard, scanner, mouse, etc.

Processing

The process refers to the concept of an actual execution of instructions. In this stage, raw facts or data is converted to meaningful information.

Output and Interpretation

In this process, output will be displayed to the user in the form of text, audio, video, etc. Interpretation of output provides meaningful information to users.

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Storage

In this process, we can store data, instruction and information in permanent memory for future reference.

History of Computers

The history of the computer dates back to several years. There are five prominent generations of computers. Each generation has witnessed several technological advances which change the functionality of the computers. This results in more compact, powerful, robust systems which are less expensive. The brief history of computers is discussed below –

First Generation (1940-1956)

The first generation computers had the following features and components –

Hardware

The hardware used in the first generation of computers was: Vacuum Tubes and Punch Cards.

Features

Following are the features of first generation computers –

- It supported machine language.
- It had slow performance
- It occupied large size due to the use of vacuum tubes.
- It had a poor storage capacity.
- It consumed a lot of electricity and generated a lot of heat.

Memory

The memory was of 4000 bits.

Data Input

The input was only provided through hard-wired programs in the computer, mostly through punched cards and paper tapes.

Examples

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The examples of first generation computers are –

- ENIAC
- UNIVACTBM 701

Second Generation (1956-1963)

Several advancements in the first-gen computers led to the development of second generation computers. Following are various changes in features and components of second generation computers –

Hardware

The hardware used in the second generation of computers were –

- Transistors
- Magnetic Tapes

Features

It had features like –

- Batch operating system
- Faster and smaller in size
- Reliable and energy efficient than the previous generation
- Less costly than the previous generation

Memory

The capacity of the memory was 32,000 bits.

Data Input

The input was provided through punched cards.

Examples

The examples of second generation computers are –

- Honeywell 400
- CDC 1604
- IBM 7030

Third Generation (1964-1971)

Following are the various components and features of the third generation computers –

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Hardware

The hardware used in the third generation of computers were –

- Integrated Circuits made from semi-conductor materials
- Large capacity disks and magnetic tapes

Features

The features of the third generation computers are –

- Supports time-sharing OS
- Faster, smaller, more reliable and cheaper than the previous generations
- Easy to access

Memory

The capacity of the memory was 128,000 bits.

Data Input

The input was provided through keyboards and monitors.

Examples

The examples of third generation computers are –

- IBM 360/370
- CDC 6600
- PDP 8/11

Fourth Generation (1972-2010)

Fourth generation computers have the following components and features –

Hardware

The Hardware used in the fourth generation of computers were –

- ICs with Very Large Scale Integration (VLSI) technology
- Semiconductor memory
- Magnetic tapes and Floppy

Features

It supports features like –

- Multiprocessing & distributed OS
- Object-oriented high level programs supported
- Small & easy to use; hand-held computers have evolved

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- No external cooling required & affordable
- This generation saw the development of networks and the internet
- It saw the development of new trends in GUIs and mouse

Memory

The capacity of the memory was 100 million bits.

Data Input

The input was provided through improved hand held devices, keyboard and mouse.

Examples

The examples of fourth generation computers are –

- Apple II
- VAX 9000
- CRAY 1 (super computers)

Fifth Generation (2010-Present)

These are the modern and advanced computers. Significant changes in the components and operations have made fifth generation computers handy and more reliable than the previous generations.

Hardware

The Hardware used in the fifth generation of computers are –

- Integrated Circuits with VLSI and Nano technology
- Large capacity hard disk with RAID support
- Powerful servers, Internet, Cluster computing

Features

It supports features like –

- Powerful, cheap, reliable and easy to use.
- Portable and faster due to use of parallel processors and Super Large Scale Integrated Circuits.
- Rapid software development is possible.

Memory

The capacity of the memory is unlimited.

Data Input

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The input is provided through CDROM, Optical Disk and other touch and voice sensitive input devices.

Examples

The examples of fifth generation computers are –

- IBM
- Pentium
- PARAM

Types of Computer

We can categorize computers in two ways: on the basis of data handling capabilities and size.

On the basis of data handling capabilities, the computer is of *three* types:

- Analogue Computer
- Digital Computer
- Hybrid Computer

1) Analogue Computer

Analogue computers are designed to **process analogue data**. Analogue data is continuous data that changes continuously and cannot have discrete values. We can say that analogue computers are used where we don't need exact values always such as speed, temperature, pressure and current.

Analogue computers directly accept the data from the measuring device without first converting it into numbers and codes. They measure the continuous changes in physical quantity and generally render output as a reading on a dial or scale. *Speedometer* and *mercury thermometer* are examples of analogue computers.

Advantages of using analogue computers:

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- It allows real-time operations and computation at the same time and continuous representation of all data within the range of the analogue machine.
- In some applications, it allows performing calculations without taking the help of transducers for converting the inputs or outputs to digital electronic form and vice versa.
- The programmer can scale the problem for the dynamic range of the analogue computer. It provides insight into the problem and helps understand the errors and their effects.

2) Digital Computer

Digital computer is designed to perform calculations and logical operations at high speed. It accepts the raw data as input in the form of digits or binary numbers (0 and 1) and processes it with programs stored in its memory to produce the output. All modern computers like laptops, desktops including smartphones that we use at home or office are digital computers.

Advantages of digital computers:

- It allows you to store a large amount of information and to retrieve it easily whenever you need it.
- You can easily add new features to digital systems more easily.
- Different applications can be used in digital systems just by changing the program without making any changes in hardware
- The cost of hardware is less due to the advancement in the IC technology.
- It offers high speed as the data is processed digitally.
- It is highly reliable as it uses error correction codes.
- Reproducibility of results is higher as the output is not affected by noise, temperature, humidity, and other properties of its components.

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3) Hybrid Computer

Hybrid computer has features of both analogue and digital computer. It is ***fast like an analogue*** computer and has memory and ***accuracy like digital computers***. It can process both continuous and discrete data.

It accepts analogue signals and convert them into digital form before processing. So, it is widely used in specialized applications where both analogue and digital data is processed.

For example, a processor is used in petrol pumps that converts the measurements of fuel flow into quantity and price. Similarly, they are used in airplanes, hospitals, and scientific applications.

Advantages of using hybrid computers:

- Its computing speed is very high due to the all-parallel configuration of the analogue subsystem.
- It produces precise and quick results that are more accurate and useful.
- It has the ability to solve and manage big equation in real-time.
- It helps in the on-line data processing.

On the basis of size, the computer can be of *five* types:

1) Supercomputer

Supercomputers are the ***biggest and fastest computers***. They are designed to process huge amounts of data. A supercomputer can ***process trillions of instructions in a second***. It has thousands of interconnected processors.

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Supercomputers are particularly used in **scientific and engineering applications** such as weather forecasting, scientific simulations and nuclear energy research. The first supercomputer was developed by **Roger Cray in 1976**.

Characteristics or applications of supercomputers:

- It has the ability to decrypt your password to enhance protection for security reasons.
- It produces excellent results in animations.
- It is used for virtual testing of nuclear weapons and critical medical tests.
- It can study and understand climate patterns and forecast weather conditions. It can run in NOAA's system (National Oceanic and Atmospheric Administration) that can execute any type of simple and logical data.
- It helps in designing the flight simulators for pilots at the beginner level for their training.
- It helps in extracting useful information from data storage centres or cloud system. For example, in insurance companies.
- It has played a vital role in managing the online currency world such as stock market and bitcoin.
- It helps in the diagnosis of various critical diseases and in producing accurate results in brain injuries, strokes, etc.
- It helps in scientific research areas by accurately analysing data obtained from exploring the solar system, satellites, and movement of Earth.
- It also used in a smog control system where it predicts the level of fog and other pollutants in the atmosphere.

2) Mainframe computer

Mainframe computers are designed to support hundreds or thousands of users simultaneously. They can support multiple programs at the same time. It means they can execute different processes simultaneously. These features of mainframe computers make them ideal for big organizations like banking and telecom sectors, which need to manage and process high volume of data.

Mainframe computers are designed to **support hundreds or thousands of users simultaneously**. They can **support multiple programs** at the same time. It means they can execute different processes simultaneously. These features of mainframe computers make them ideal for big organizations like banking and telecom sectors, which need to manage and process a high volume of data that requires integer operations such as indexing, comparisons, etc.

Characteristics of Mainframe Computers:

- It can process huge amount of data, e.g. millions of transactions in a second in the banking sector.
- It has a very long life. It can run smoothly for up to 50 years after proper installation.
- It gives excellent performance with large scale memory management.
- It has the ability to share or distribute its workload among other processors and input/output terminals.
- There are fewer chances of error or bugs during processing in mainframe computers. If any error occurs it can fix it quickly without affecting the performance.
- It has the ability to protect the stored data and other ongoing exchange of information and data.

Applications of mainframe computers:

- In **health care**, it enabled hospitals to maintain a record of their millions of patients in order to contact them for treatment or related to their appointment, medicine updates or disease updates.
- In the **field of defence**, it allows the defence departments to share a large amount of sensitive information with other branches of defence.
- In the **field of education**, it helps big universities to store, manage and retrieve data related to their courses, admissions, students, teachers, employees and affiliated schools and colleges.
- In the **retail sector**, the retail companies that have a huge customer base and branches use mainframe computers to handle and execute information related to their inventory management, customer management, and huge transactions in a short duration.

3) Miniframe or Minicomputer

It is a **midsize multiprocessing computer**. It consists of two or more processors and can support **4 to 200 users at one time**. Miniframe computers are used in institutes and departments for tasks such as billing, accounting and inventory management. A minicomputer **lies between the mainframe and microcomputer** as it is smaller than mainframe but larger than a microcomputer.

Characteristics of miniframe or minicomputer:

- It is light weight that makes it easy to carry and fit anywhere.
- It is less expensive than mainframe computers.
- It is very fast compared to its size.
- It remains charged for a long time.
- It does not require a controlled operational environment.

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Applications of minicomputers:

A minicomputer is mainly used to perform three primary functions, which are as follows:

- **Process control:** It was used for process control in manufacturing. It mainly performs two primary functions that are collecting data and feedback. If any abnormality occurs in the process, it is detected by the minicomputer and necessary adjustments are made accordingly.
- **Data management:** It is an excellent device for small organizations to collect, store and share data. Local hospitals and hotels can use it to maintain the records of their patients and customers respectively.
- **Communications Portal:** It can also play the role of a communication device in larger systems by serving as a portal between a human operator and a central processor or computer.

4) Workstation

Workstation is a **single user computer** that is designed for **technical or scientific applications**. It has a faster microprocessor, a large amount of RAM and high speed graphic adapters. It generally **performs a specific job with great expertise**; accordingly, they are of different types such as graphics workstation, music workstation and engineering design workstation.

Characteristics of workstation computer:

- It is a high-performance computer system designed for a single user for business or professional use.
- It has larger storage capacity, better graphics, and more powerful CPU than a personal computer.
- It can handle animation, data analysis, CAD, audio and video creation and editing.

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Any computer that has the following **five features**, can be termed as a workstation or can be used as a workstation.

- **Multiple Processor Cores:** It has more processor cores than simple laptops or computers.
- **ECC RAM:** It is provided with Error-correcting code memory that can fix memory errors before they affect the system's performance.
- **RAID (Redundant Array of Independent Disks):** It refers to multiple internal hard drives to store or process data. RAID can be of different types, for example, there can be multiple drives to process data or mirrored drives where if one drive does not work then other starts functioning.
- **SSD:** It is better than conventional hard-disk drives. It does not have moving parts, so the chances of physical failure are very less.
- **Optimized, Higher end GPU:** It reduces the load on CPU. E.g., CPU has to do less work while processing the screen output.

5) Microcomputer

Microcomputer is also known as a personal computer. It is a general-purpose computer that is designed for individual use. It has a microprocessor as a central processing unit, memory, storage area, input unit and output unit. Laptops and desktop computers are examples of microcomputers. They are suitable for personal work that may be making an assignment, watching a movie, or at the office for office work.

Characteristics of a microcomputer:

- It is the smallest in size among all types of computers.
- A limited number of software can be used.
- It is designed for personal work and applications. Only one user can work at a time.

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- It is less expensive and easy to use.
- It does not require the user to have special skills or training to use it.
- Generally, comes with single semiconductor chip.
- It is capable of multitasking such as printing, scanning, browsing, watching videos, etc.

Explain the Block Diagram of Computer

- **Computer Block Diagram System:** Mainly computer system consists of three parts, that are central processing unit (CPU), Input Devices, and Output Devices.
- The Central Processing Unit (CPU) is divided into two parts again: arithmetic logic unit (ALU) and the control unit (CU). The set of instruction is in the form of raw data.
- A large amount of data is stored in the computer memory with the help of primary and secondary storage devices. The CPU is like the heart/brain of the computer. The user does not get the desired output, without the necessary option taken by the CPU.
- The Central processing unit (CPU) is responsible for the processing of all the instructions which are given by the user to the computer system.

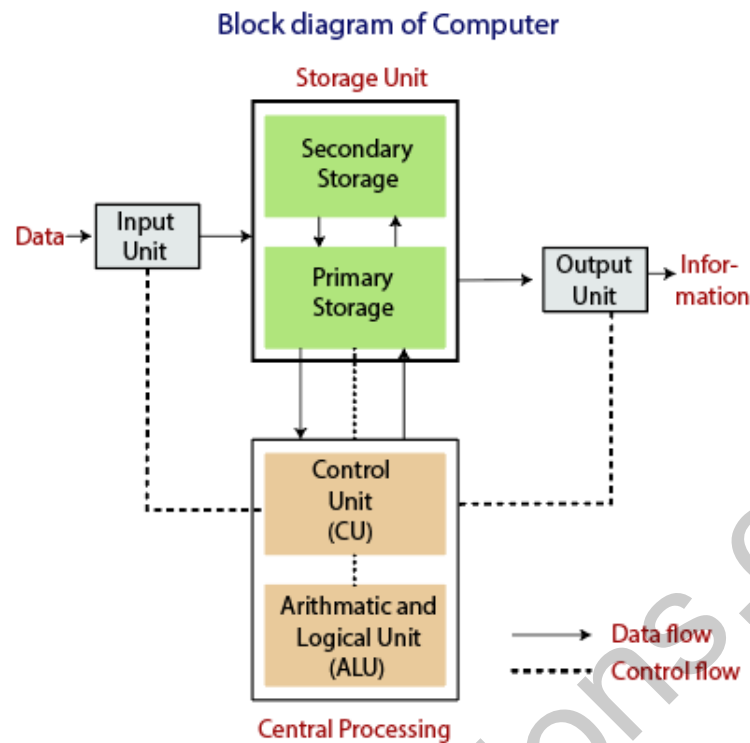


Fig: Block Diagram of the computer.

The data is entered through input devices such as the keyboard, mouse, etc. This set of instructions is processed by the CPU after getting the input by the user, and then the computer system produces the output. The computer can show the output with the help of output devices to the user, such as monitor, printer, etc.

- CPU (Central Processing Unit)
- Storage Unit
- ALU(Arithmetic Logic Unit)
- Control Unit

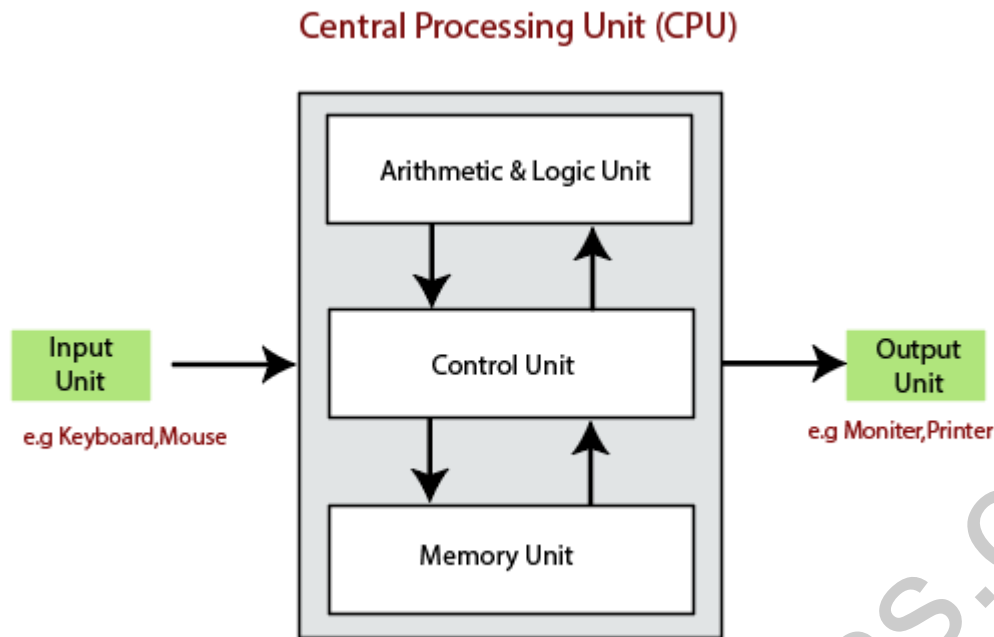
Central Processing Unit (CPU)

- The computer system is nothing without the Central processing Unit so, it is also known as the brain or heart of computer.
- The CPU is an electronic hardware device which can perform different types of operations such as arithmetic and logical operation.

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The CPU contains two parts: the arithmetic logic unit and control unit. We have discussed briefly the arithmetic unit, logical unit, and control unit which are given below:

Control Unit

- The control unit (CU) controls all the activities or operations which are performed inside the computer system. It receives instructions or information directly from the main memory of the computer.
- When the control unit receives an instruction set or information, it converts the instruction set to control signals then; these signals are sent to the central processor for further processing. The control unit understands which operation to execute, accurately, and in which order

Arithmetic and Logical Unit

- The arithmetic and logical unit is the combinational digital electronic circuit that can perform arithmetic operations on integer binary numbers. It presents the arithmetic and logical operation.
- The outputs of ALU will change asynchronously in response to the input. The basic arithmetic and bitwise logic functions are supported by ALU.

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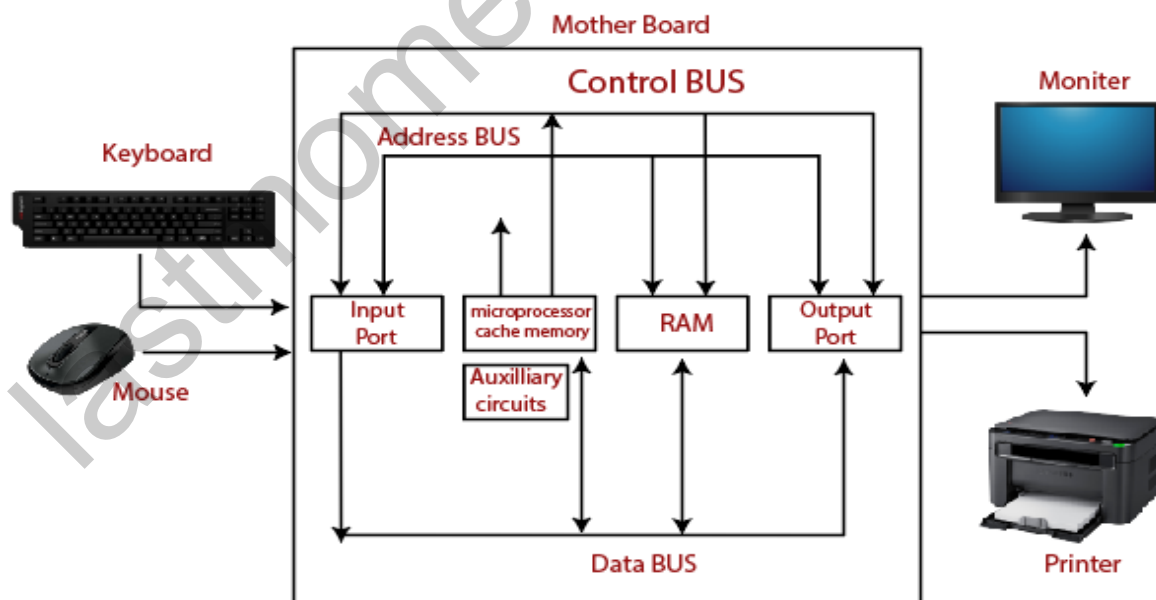
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Storage Unit

- The information or set of guidelines are stored in the storage unit of the computer system.
- The storage unit provides the space to store the data or instruction of processed data. The information or data is saved or hold in computer memory or storage device.
- The data storage is the core function and fundamental of the computer components.

Components of Computer System

- The hardware and software exist on the computer. The information which is stored through the device is known as computer software. The hardware components of the computer system are related to electronic and mechanical parts, and the software component is related to data and computer programs.
- Many elements are connected to the main circuit board of the computer system called a “motherboard.”



Components of a Computer System

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- Processor.
- Main Memory.
- Secondary Memory.
- Input Devices.
- Output Devices.

These are mainly five components of the computer system. The computer hardware, computer software, and liveware exist in the element of the computer system.

Processor

The processor is an electric circuitry within the computer system. The Central processing unit is the central processor or main processor of the computer system. The processor carries out the instructions of the computer program with the help of basic arithmetic and logic, input/output operations.

Main Memory

The Random Access Memory is the main memory of the computer system, which is known as RAM. The main memory can store the operating system software, application software, and other information. The Ram is one of the fastest memory, and it allows the data to be readable and writeable.

Secondary memory

- We can store the data and programs on a long-term basis in the secondary memory. The hard disks and the optical disks are the common secondary devices. It is slow and cheap memory as compared to primary memory. This memory is not connected to the processor directly.
- It has a large capacity to store the data. The hard disk has a capacity of 500 gigabytes. The data and programs on the hard disk are organized into files, and the file is the collection of data on the disk. The secondary storage is direct access by the CPU; that's why it is different from the primary storage.
- The hard disk is about 100 times the capacity of the main memory. The main difference between primary and secondary storage is speed and

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capacity. There are several large blocks of data which are copied from the hard disk into the main memory.

Input Devices

- The user provides the set of instructions or information to the computer system with the help of input devices such as the keyboard, mouse, scanner, etc.
- The data representation to the computer system is in the form of binary language after that the processor processes the converted data. The input unit implements the data which is instructed by the user to the system.
- We can enter the data from the outside world into the primary storage as the input through input devices. The input devices are the medium of communication between the outside world and the computer system.

There are some important features of input devices which are given below:

1. The input devices receive or accept the data or instruction from the user, who exist in the outside world.
2. These devices convert the data or instruction into the machine-readable form for further processing.
3. The input device performs like the connection between the outside world and our computer system.
4. The keyboard and mouse are common examples of input devices.
5. When the whole procedure is finished, we get the desired output from the output devices such as monitor, printer, etc.

Output Devices

- The output devices produce or generate the desired result according to our input, such as a printer, monitor, etc. These devices convert the data into a human-readable form from binary code.

- The computer system is linked or connected to the outside world with the help of output devices. The primary examples of output devices are a printer, projector, etc.

These devices have various features which are given below:

1. These devices receive or accept the data in the binary form.
2. The output devices convert the binary code into the human-readable form.
3. These devices produce the converted result and show to the user.