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COLLEGE OF ARTS AND SCIENCE
(AUTONOMOUS)
Accredited by NAAC (Cycle-III) with 'A+' Grade

DEPARTMENT OF COMPUTER APPLICATIONS

Course Name: OPEN ELECTIVE (PC HARDWARE AND TROUBLESHOOTING)

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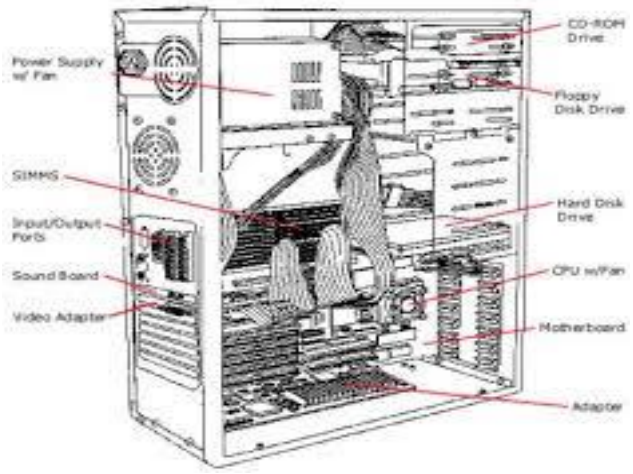
UNIT-I

Introduction PC Hardware

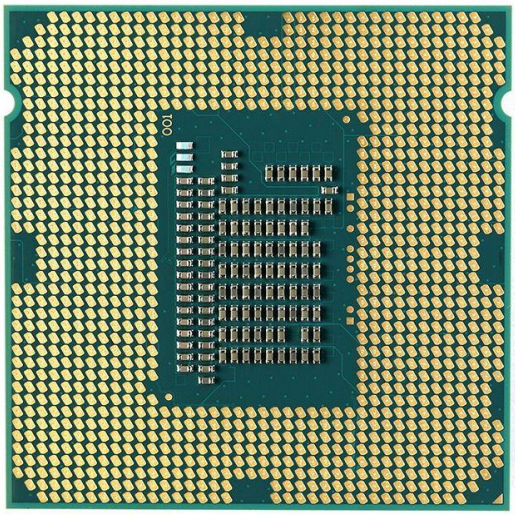
Computer hardware includes the physical parts of a computer, such as the case, central processing unit (CPU), monitor, mouse, keyboard, computer data storage, graphics card, sound card, speakers and motherboard. By contrast, software is the set of instructions that can be stored and run by hardware.



Although the design of hardware differs between desktop PCs and laptops due to their differences in size, the same core components will be found in both. Without hardware, there would be no way of running the essential software that makes computers so useful. Software is defined as the virtual programs that run on your computer; that is, operating system, internet browser, word-processing documents, etc

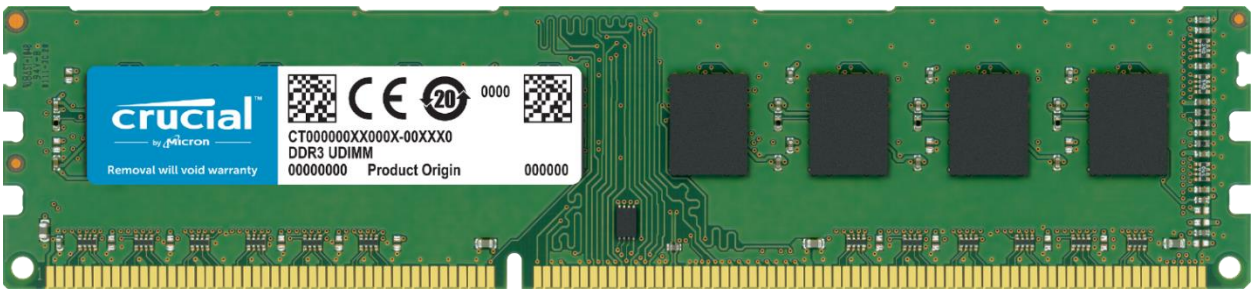
- The motherboard is at the center of what makes a PC work. It houses the CPU and is a hub that all other hardware runs through. The motherboard acts as a brain; allocating power where it's needed, communicating with and coordinating across all other components – making it one of the most important pieces of hardware in a computer.
- When choosing a motherboard, it's important to check what hardware ports the motherboard supplies. It's vital to check how many USB ports, and what grade (USB 2.0, 3.0, 3.1) they are, as well as what display ports are used (HDMI, DVI, RGB) and how many of each there are. The ports on the motherboard will also help you define what other hardware will be compatible with your computer, such as what type of RAM and graphics card you can use.

- The CPU (Central Processing Unit or processor) is responsible for processing all information from programs run by your computer. The ‘clock speed’, or the speed at which the processor processes information, is measured in gigahertz (GHz). This means that a processor advertising a high GHz rating will likely perform faster than a similarly specified processor of the same brand and age.



- Random Access Memory, or RAM, is hardware found in the memory slots of the motherboard. The role of RAM is to temporarily store on-the-fly information created by programs and to do so in a way that makes this data immediately accessible. The tasks that require random memory could be;

rendering images for graphic design, edited video or photographs, multi-tasking with multiple apps open (for example, running a game on one screen and chatting via Discord on the other).



- The hard drive is a storage device responsible for storing permanent and temporary data. This data comes in many different forms, but is essentially anything saved or installed to a computer: for example, computer programs, family photos, operating system, word-processing documents, and so on.
- There are two different types of storage devices: the traditional hard disk drive (HDD) and the newer solid state drives (SSD). Hard disk drives work by writing binary data onto spinning magnetic disks called platters that rotate at high speeds, while a solid-state drive stores data by using static flash memory chips.

- Especially important for 3D rendering, the GPU does exactly what its name suggests and processes huge batches of graphic data. You will find that your computer's graphics card has at least one GPU. As opposed to the basic on-board graphic capabilities that PC motherboards supply, dedicated graphics cards interface with the motherboard via an expansion slot to work almost exclusively on graphic rendering. This also means you can upgrade your graphics card if you want to get a bit more performance from your PC.

- A power supply unit, commonly abbreviated as PSU, does more than just supply your computer with power. It is the point where power enters your system from an external power source and is then allocated by the motherboard to individual component hardware. Not all power supplies are made equally however, and without the right wattage PSU your system will fail to work.
- A modern computer will generally need a PSU that's rated between 500W – 850W to effectively power all hardware, although the size of the PSU will depend entirely on the power consumption of the system. Computers that are used for highly intensive tasks such as graphic design or gaming will require more powerful components and thus will need a bigger PSU to cater to this additional need.
- Without the right amount of power, components won't be able to run effectively and the computer might experience crashes or simply fail to boot at all. It's recommended to have a power supply that more than covers your system usage. Not only do you guard yourself against system failure, you also future-proof yourself against needing a new PSU when you upgrade to more powerful PC components.

Software describes a **collection of programs and procedures** that perform tasks on a computer. Software is an ordered sequence of instructions that change the state of a computer's hardware.There are three general types of software:

- System software
- Programming software
- Application software

When you think of computer science, software is probably what comes to mind. Software is what developers actually **code**. Those programs are then installed onto a hard drive.

Hardware is anything **physically connected to a computer**. For example, your display monitor, printer, mouse, and hard drive are all hardware components..

Hardware and software **interact with each other**. The software "tells" the hardware which tasks to perform, and hardware makes it possible to actually perform them.

System software and Application software:

System software	Application software
It is the kind of software which is the interface between the application software and system.	It is the kind of software which runs according to the user.
This kind of software is written in low level language.	This kind of software is written in high level language.
It is used for operating computer hardware.	It is used by users to perform any specific task they want.
System software is hardware so they are not in interaction with the user.	Users can interact with this as this user interaction is needed at each and every point.
This is installed on the computer when the operating system is installed.	Users can install them as according to their choice.
This can run independently.	This can run independently.They need the presence of system software.
Example-bugger compiler,etc.	Example-word processor,media player,etc.

Output and Input:

INPUT DEVICE	OUTPUT DEVICE
It accepts data from user.	It reflects processed data to user.
It is directly commanded by user.	It is commanded by processor.
It converts user friendly instruction into machine friendly.	It converts machine's instructions to user intelligible.
It takes the data from the user and sends it to the processor for execution.	It takes the processed data from the processor and sends it back to the user.
It helps the computer is accepting the data.	It helps the computer is displaying the data.
The design of input devices are more complex.	The design of output devices are less complex.
Ex: Keyboard, Image Scanner, Microphone, Pointing device, Graphics tablet, Joystick.	Ex: Monitor, Printers, Plotters, Projector, Speakers.

Hardware and software:

Hardware	Software
Physical devices that store and run software	Collection of coded instructions that all us to interact with a computer
Works as the delivery system	Performs specific tasks
Monitor, printer, scanners , label makers, routers and hard drive	Adobe, Google Chrome, Microsoft Excel, Spotify
Hardware begins functioning when software is loaded.	Software must be installed on hardware
Hardware will wear down over time	Software will not wear down, but it is vulnerable to bugs / becoming outdated

computer architecture design

This computer architecture design, created by John von Neumann in 1945, is still used in most computers produced today. The Von Neumann architecture is based on the concept of a **stored-program computer**. Instruction and program data are stored in the same memory.

This architecture includes the following components:

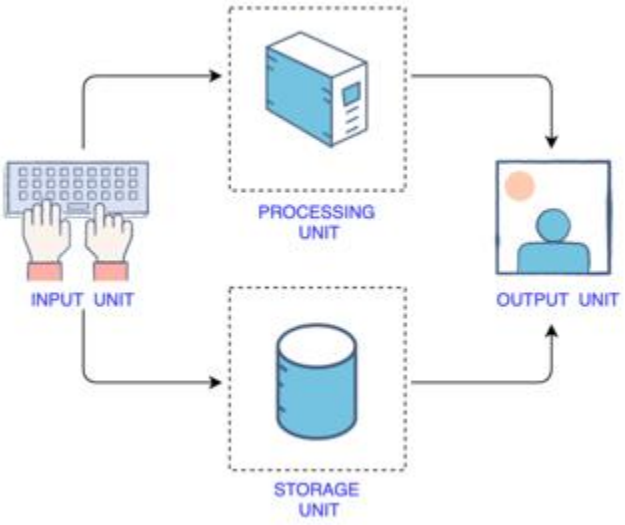
Control Unit

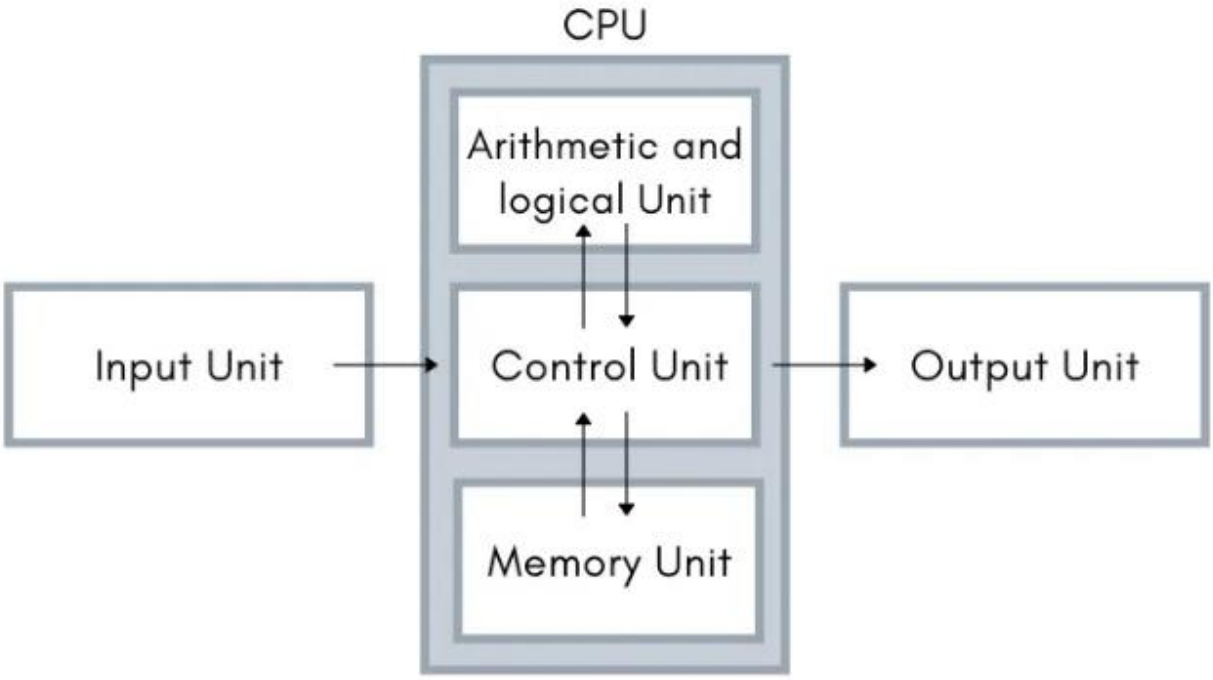
Inputs/Outputs

Arithmetic and Logic Unit (ALU)

Memory Unit

Registers





- The basic structure of computer system consists mainly of three parts which are the central processing unit (CPU), Input devices, and output devices. Further, the Central processing unit can be divided into two more parts i.e. control unit (CU) and arithmetic logic unit (ALU).

- The basic structure of the computer describes a simple concept that the data is entered into the central processing unit with the help of input devices such as a keyboard, mouse, joystick, scanner, secondary storage devices, etc and then when the central processing unit receives the data from the input devices it has a pre-programmed set of instruction to follow and the result of instruction execution will lead to output and these output produce are mostly for the user which requires output devices such as a monitor, speaker, etc to understand the processed output data.
- We can categorize computer 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:
- It allows real-time operations and computation at the same time and continuous representation of all data within the rage 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 smart phones 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.
- 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 amount of data. A supercomputer can ***process trillions of instructions in a second***. It has thousands of interconnected processors.

- 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.

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.
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Differenciate ROM and RAM:

RAM	ROM
1- Used in the computer's regular operations, after loading the OS.	Used mostly in a computer's start-up process.
2- With RAM, writing data is a fast process.	Writing data to ROM is very slow.
3- RAM is a type of volatile memory, meaning the stored data is lost when powering off.	ROM is a type of non-volatile memory, meaning that the data will not be lost when power is removed.
4- A RAM chip can store quite a lot of data, up to 16 GB.	ROM chips usually store only a few megabytes of information, around 4 MB per chip.
5- There are two main types of RAM: dynamic (DRAM) and static (SRAM).	ROM types include EPROM, EEPROM, PROM and Mask ROM.
6- Example of RAM: RAM chips like 2GB, 4GB, 8GB etc of different companies like Corsair, Kingston etc.	Example of ROM: cartridge in video game consoles, computer BIOS.

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.

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.
- 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.
- ***five features***
- **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 than other starts functioning.

5) Microcomputer

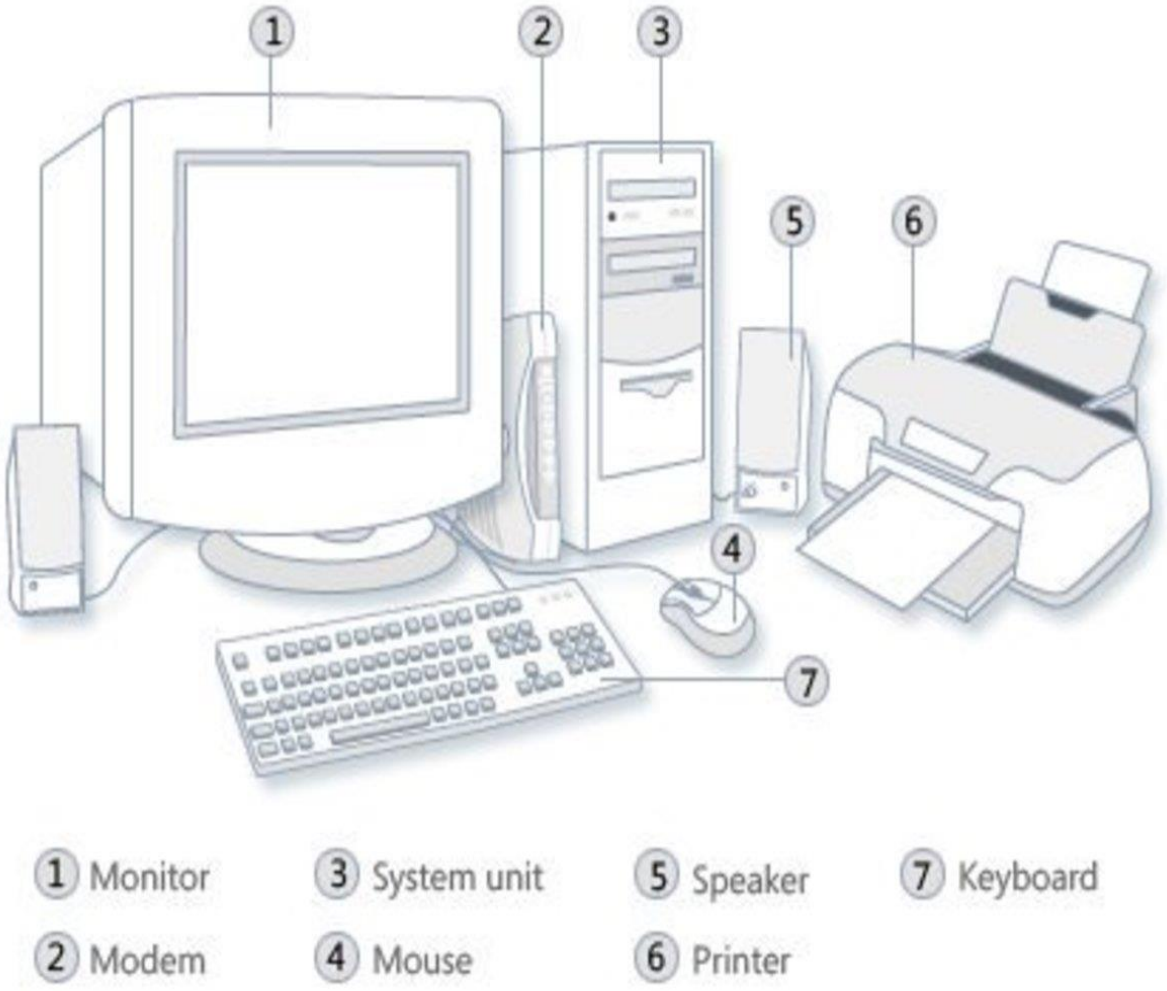
- Microcomputer is also known as a personal computer. It is a general-purpose computer that is designed for individual use. It has a microprocessor as a central processing unit, memory, storage area, input unit and output unit. Laptops and desktop computers are examples of microcomputers. They are suitable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

When referring to hardware, to **disassemble** is to break down a device into separate parts. A device may be disassembled to help determine a problem, to replace a part, or take the parts and use them in another device or sell them individually. For example, if a computer has a bad processor, you may need to open the computer case, disassemble the heat sink and processor, and manually replace it.

- Parts of Computer System
- CPU cabinet
- Monitor
- Keyboard
- Mouse
- Printer/scanner (if attached)



- **Step 1: Detach the Power Cable**

The disassembling of the computer system starts with externally connected device detachment. Make sure the computer system is turned off, if not then successfully shut down the system and then start detaching the external devices from the computer system.

- **Step 2: Remove the Power Supply**

The power supply is attached into tower cabinet at the top back end of the tower. Make sure the power connector is detached from the switchboard. Start removing the power connector connected to motherboard including CPU fan power connector, cabinet fan, the front panel of cabinet power buttons and all the remaining drives if not detached yet.

- **Step 3: Remove the Cover**

The standard way of removing tower cases used to be to undo the screws on the back of the case, slide the cover back about an inch and lift it off. The screwdrivers as per the type of screw are required to do the task.

- **Step 4: Remove the Adapter Cards**

Make sure if the card has any cables or wires that might be attached and decide if it would be easier to remove them before or after you remove the card. Remove the screw if any, that holds the card in place. Grab the card by its edges, front and back, and gently rock it lengthwise to release it.

- **Step 5: Remove the Drives**

Removing drives is easier. There can be possibly three types of drives present in your computer system, Hard disk drive, CD/DVD/Blu-ray drives, floppy disk drives (almost absolute now a day). They usually have a power connector and a data cable attached from the device to a controller card or a connector on the motherboard. CD/DVD/Blu-ray drive may have an analog cable connected to the sound card for direct audio output.

- **Step 6: Remove the Memory Module**

- Memory modules are mounted on the motherboard as the chips that can be damaged by manual force if applied improperly. Be careful and handle the chip only by the edges. SIMMs and DIMMs are removed in a different way:

- **SIMM** - Gently push back the metal tabs while holding the SIMM chips in the socket. Tilt the SIMM chip away from the tabs until a 45% angle. It will now lift out of the socket. Put SIMM in a safe place.

- **DIMM** - There are plastic tabs on the end of the DIMM sockets. Press the tabs down and away from the socket. The DIMM will lift slightly. Now grab it by the edges and place it safely. Do not let the chips get dust at all.

- **Step 7: Remove the Motherboard**

Before removing all the connectors from the motherboard, make sure you memorize the connectors for assembling the computer if required, as that may require connecting the connectors at its place. Remove the screws from the back of the motherboard and you will be able to detach it from the cabinet. Now remove the CPU fan from the motherboard. The heat sink will be visible now which can be removed by the pulling the tab upward. Finally, the processor is visible now, which can be removed by the plastic tab which can be pulled back one stretching it side way.

- SIMM-single inline memory

- DIMM-Double inline memory.