

1.1 COMPUTER

A computer, in simple terms, can be defined as an electronic device that is designed to accept data, perform the required mathematical and logical operations at high speed, and output the result.

1.2 CHARACTERISTICS OF COMPUTERS

Computer is an electronic device that performs a function based on a given set of instructions known as a **program**.

A computer accepts data, processes it, and produces information. Here, **data** refers to some raw fact or figure, and information implies the processed data.

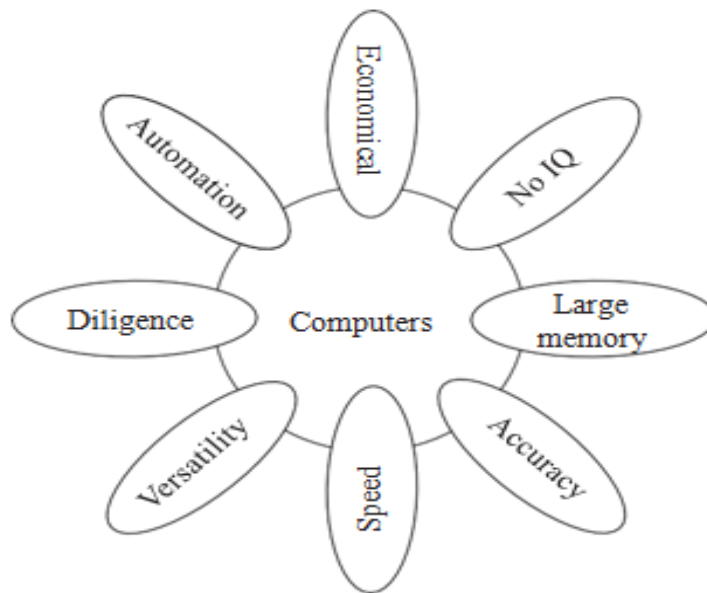


Figure 1.1 Characteristics of computers

Speed:

- Computers can perform millions of operations per second, which means that data that may otherwise take many hours to process is output as information in the blink of an eye.
- The speed of computers is usually given in nanoseconds and picoseconds, where 1 nanosecond = 1×10^{-9} seconds and 1 picosecond = 1×10^{-12} seconds.

Accuracy:

- A computer is a very fast, reliable, and robust electronic device. It always gives accurate results, provided the correct data and set of instructions are input to it.
- If the user who has fed the incorrect data/program is responsible. This clearly means that the output generated by a computer depends on the given instructions and input data.
- If the input data is wrong, then the output will also be erroneous. In computer terminology, this is known as *garbage-in, garbage-out (GIGO)*.

Automation:

- Computers are automatable devices that can perform a task without any user intervention. The user just needs to assign the task to the computer, after which it automatically controls different devices attached to it and executes the program instructions.

Diligence:

- Unlike humans, computers never get tired of a repetitive task. It can continually work for hours without creating errors.
- Even if a large number of executions need to be executed, each and every execution requires the same duration, and is executed with the same accuracy.

Versatile:

- Versatility is the quality of being flexible.
- Today, computers are used in our daily life in different fields. For example, they are used as personal computers (PCs) for home use, for business-oriented tasks, weather forecasting, space exploration, teaching, railways, banking, and medicine.
- On the PC that you use at home, you may play a game, compose and send e-mails, listen to music, etc. Therefore, computers are versatile devices as they can perform multiple tasks of different nature at the same time.

Memory:

- Similar to humans, computers also have memory. Computers also have internal or primary memory (storage space) as well as external or secondary memory. While the internal memory of computers is very expensive and limited in size, the secondary storage is cheaper and of bigger capacity.
- The computer stores a large amount of data and programs in the secondary storage space. The stored data and programs can be retrieved and used whenever required.
- Secondary memory is the key for data storage. Some examples of secondary devices include floppy disks, optical disks (CDs and DVDs), hard disk drives (HDDs), and pen drives.
- When data and programs have to be used, they are copied from the secondary memory into the internal memory, often known as random access memory (RAM).

No IQ:

- Although the trend today is to make computers intelligent by inducing artificial intelligence (AI) in them, they still do not have any decision-making abilities of their own. They need guidance to perform various tasks.

Economical:

- Today, computers are considered as short-term investments for achieving long-term gains.
- Using computers also reduces manpower requirements and leads to an elegant and efficient way of performing various tasks. Hence, computers save time, energy, and money. When compared to other systems, computers can do more work in lesser time.

1.3 STORED PROGRAM CONCEPT

Stored program architecture is a fundamental computer architecture where in the computer executes the instructions that are stored in its memory.

All digital computers are based on the principle of stored program concept, which was introduced by Sir John von Neumann in the late 1940s.

The following are the key characteristic features of stored program concept:

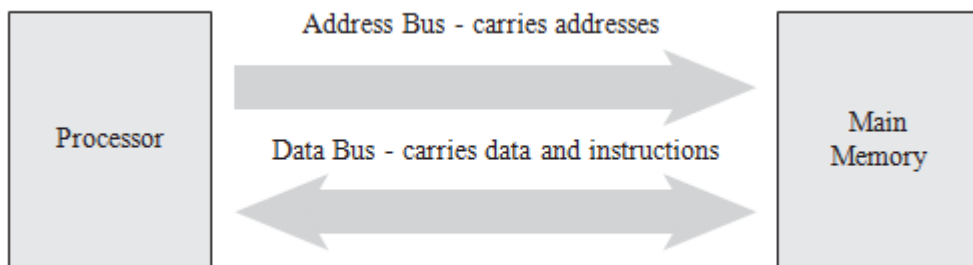
- Before any data is processed, instructions are read into memory.
- Instructions are stored in the computer's memory for execution.
- Instructions are stored in binary form (using binary numbers—only 0s&1s).
- Processing starts with the first instruction in the program, which is copied into a control unit circuit. The control unit executes the instructions.
- Instructions written by the users are performed sequentially until there is a break in the current flow.
- Input/output and processing operations are performed simultaneously. While data is being read/written, the central processing unit (CPU) executes another program in the memory that is ready for execution.

1.3.1 Types of Stored Program Computers

There are two types of stored program computers

(a) Shared memory for instructions and data

- A computer with a Von Neumann architecture stores data and instructions in the same memory. There is a serial machine in which data and instructions are selected one at a time.
- Data and instructions are transferred to and from memory through a shared data bus. Since there is a single bus to carry data and instructions, process execution becomes slower.



(a)

(b) Separate memories for instructions and data

- Later Harvard University proposed a stored program concept in which there was a separate memory to store data and instructions.
- Instructions are selected serially from the instruction memory and executed in the processor. When an instruction needs data, it is selected from the data memory. Since there are separate memories, execution becomes faster.

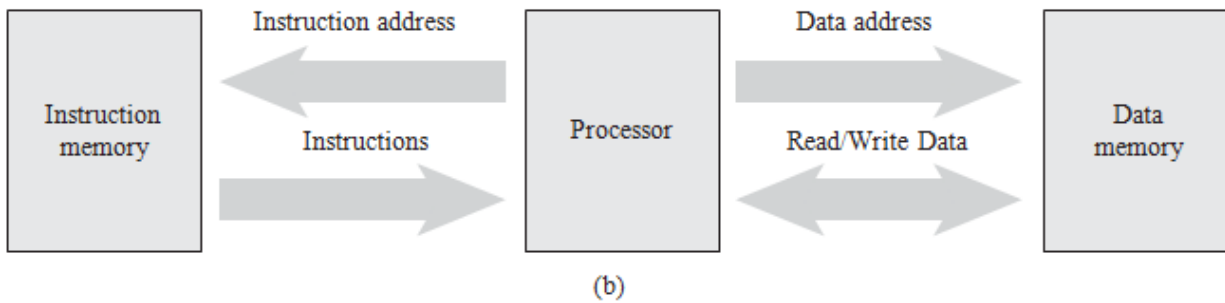


Figure 1.2 Von Neumann architecture (a) Shared memory for instructions and data (b) Separate memories for instructions and data

1.4 HISTORY OF COMPUTERS

Early computers were designed not for entertainment but for solving number-crunching problems. These computers were punch-card based computers that took up entire rooms.

Today, our smart phones have much more computing power than that was available in those early computers.

1.4.1 Generations of computer

First Generation (1942–1955)

Hardware Technology First generation computers were manufactured using thousands of vacuum tubes, vacuum tube is a device made of fragile glass.

Memory Electromagnetic relay was used as primary memory and punched cards were used to store data and instructions.

Software Technology Programming was done in machine or assembly language.

Used for Scientific applications

Examples ENIAC, EDVAC, EDSAC, UNIVAC I, IBM 701

Highlights

- They were the fastest calculating device of those times
- Computers were too bulky and required a complete room for storage
- Highly unreliable as vacuum tubes emitted a large amount of heat and burnt frequently
- Required air-conditioned rooms for installation
- Costly
- Difficult to use
- Required constant maintenance because vacuum tubes used filaments that had limited life time. Therefore, these computers were prone to frequent hardware failures.

Second Generation (1955–1964)

Hardware Technology Second generation computers were manufactured using transistors. Transistors were reliable, powerful, cheaper, smaller, and cooler than vacuum tubes.

Memory Magnetic core memory was used as primary memory; magnetic tapes and magnetic disks were used to store data and instructions. These computers had faster and larger memory than the first generation computers.

Software Technology Programming was done in high level programming languages. Batch operating system was used.

Used for Scientific and commercial applications

Examples Honeywell 400, IBM 7030, CDC 1604, UNIVAC LARC

Highlights

- Faster, smaller, cheaper, reliable, and easier to use than the first generation computers
- They consumed 1/10th the power consumed by first generation computers
- Bulky in size and required a complete room for its installation
- Dissipated less heat than first generation computers but still required air-conditioned rooms
- Costly
- Difficult to use

Third Generation (1964–1975)

Hardware Technology Third generation computers were manufactured using integrated chips (ICs). ICs consist of several components such as transistors, capacitors, and resistors on a single chip.

Memory Larger magnetic core memory was used as primary memory; larger capacity magnetic tapes and magnetic disks were used to store data and instructions.

Software Technology Programming was done in high level programming languages such as FORTRAN, COBOL, Pascal, and BASIC.

Used for Scientific, commercial, and interactive online applications

Examples IBM 360/370, PDP-8, PADP-11, CDC 6600

Highlights

- Faster, smaller, cheaper, reliable, and easier to use than the second generation computers
- They consumed less power than second generation computers
- Bulky in size and required a complete room for installation
- Dissipated less heat than second generation computers but still required air-conditioned rooms
- Costly
- Easier to use and upgrade

Fourth Generation (1975–1989)

Hardware Technology Fourth generation computers were manufactured using ICs with LSI (Large Scale Integrated) and later with VLSI technology (Very Large Scale Integration). Microcomputers came into existence. Use of personal computers became widespread. Besides mainframes, supercomputers were also used.

Memory Semiconductor memory was used as primary memory, large capacity magnetic disks were used as built-in secondary memory. Magnetic tapes and floppy disks were used as portable storage devices.

Software Technology Programming was done in high level programming language such as C and C++. Graphical User Interface (GUI) based operating system (e.g. Windows) was introduced. Apple Mac OS and MS DOS were also released during this period.

Used for Scientific, commercial, interactive online, and network applications

Examples IBM PC, Apple II, TRS-80, VAX 9000, CRAY-1, CRAY-2, CRAY-X/MP

Highlights

- Faster, smaller, cheaper, powerful, reliable, and easier to use than the previous generation computers.

Fifth Generation (1989–Present)

Hardware Technology Fifth generation computers are manufactured using ICs with ULSI (Ultra Large Scale Integrated) technology. The use of Internet became widespread and very powerful mainframes, desktops, portable laptops, and smartphones are being used commonly. Supercomputers use parallel processing techniques.

Memory Semiconductor memory is used as primary memory; large capacity magnetic disks are used as built-in secondary memory. Magnetic tapes and floppy disks were used as portable storage devices, which have now been replaced by optical disks and USB flash drives.

Software Technology Programming is done in high-level programming languages such as Java, Python, and C#. Graphical User Interface (GUI)-based operating systems such as Windows, Unix, Linux, Ubuntu, and Apple Mac are being used. These operating systems are more powerful and user friendly than the ones available in the previous generations.

Used for Scientific, commercial, interactive online, multimedia (graphics, audio, video), and network applications

Examples IBM notebooks, Pentium PCs, SUMworkstations, IBM SP/2, Param supercomputer

Highlights

- Faster, smaller, cheaper, powerful, reliable, and easier to use than the previous generation computers
- Speed of microprocessors and the size of memory are growing rapidly.
- High-end features available on mainframe computers in the fourth generation are now available on the microprocessors
- They consume less power than computers of prior generations.

1.5 CLASSIFICATION OF COMPUTERS

Computers can be broadly classified into four categories based on their speed, amount of data that they can process, and price. These categories are as follows:

- Supercomputers
- Mainframe computers
- Minicomputers
- Microcomputers

Supercomputers

- The supercomputer is the fastest, most powerful, and most expensive computer.
- Supercomputers were first developed in the 1980s to process large amounts of data and to solve complex scientific problems.
- Supercomputers use parallel processing technology and can perform more than one trillion calculations in a second.

- A single supercomputer can support thousands of users at the same time. Such computers are mainly used for weather forecasting, nuclear energy research, aircraft design, automotive design, online banking, controlling industrial units, etc.
- Some examples of supercomputers are CRAY-1, CRAY-2, Control Data CYBER 205, and ETA A-10.

Mainframe Computers

- Mainframe computers are large-scale computers (but smaller than supercomputers).
- These are very expensive and need a very large clean room with air conditioning, thereby making them very costly to deploy.
- The two types of terminals that can be used with mainframe systems are as follows:

Dumb Terminals

- Dumb terminals consist of only a monitor and a keyboard (or mouse).
- They do not have their own CPU and memory and use the mainframe system's CPU and storage devices.

Intelligent Terminals

- In contrast to dumb terminals, intelligent terminals have their own processor and thus can perform some processing operations. However, just like the dumb terminals, they do not have their own storage space.
- IBM is the major manufacturer of mainframe computers. Some examples of mainframe computers include IBM S/390, Control Data CYBER 176, and Amdahl 580.

Minicomputers

- Minicomputers are smaller, cheaper, and slower than mainframes. They are called minicomputers because they were the smallest computer of their times. Also known as midrange computers.
- Minicomputers are widely used in business, education, hospitals, government organizations, etc. While some minicomputers can be used only by a single user, others are specifically designed to handle multiple users simultaneously.
- As with mainframes, minicomputers can also be used as servers in a networked environment, and hundreds of PCs can be connected to it.
- The first minicomputer was introduced by Digital Equipment Corporation (DEC) in the mid-1960s.

Microcomputers

- Microcomputers, commonly known as PCs, are very small and cheap.
- The first microcomputer was designed by IBM in 1981 and was named IBM-PC.
- Another type of popular PC is designed by Apple, PCs and PC-compatible computers commonly use the Windows operating system, while Apple computers use the Macintosh operating system (MacOS).
- PCs can be classified into the following categories:

Desktop PCs

A desktop PC is the most popular model of PCs. The system unit of the desktop PC can be placed flat on a desk or table. It is widely used in homes and offices.

Laptops

- Laptops are small microcomputers that can easily fit inside a briefcase. They are very handy and can easily be carried from one place to another. They may also be placed on the user's lap (thus the name).
- The memory and storage capacity of a laptop is almost equivalent to that of a desktop computer. As with desktop computers, laptops also have hard disk drives, USB drives, etc. For input, laptops have a built-in keyboard and a trackball/touchpad, which is used as a pointing device (as a mouse is used for a desktop PC).
- These computers are very popular among business travelers.

Workstations

- Workstations are single-user computers that have the same features as PCs.
- Workstation computers have advanced processors, more RAM and storage capacity than PCs. Therefore, they are more expensive and powerful than a normal desktop computer.
- Workstation computers are widely used as powerful single-user computers by scientists, engineers, architects, and graphic designers.

Network Computers

- Network computers have less processing power, memory, and storage than a desktop computer.
- These are specially designed to be used as terminals in a networked environment. For example, some network computers are specifically designed to access data stored on a network (including the Internet and intranet).
- Network computers that are specifically designed to access only the Internet or intranet are often known as Internet PCs or Internet boxes.
- Some network computers used in homes do not even have a monitor. Such computers may be connected to a television, which serves as the output device. The most common example of a home-based network computer is Web TV, which enables the user to connect a television to the Internet.

Handheld Computers

The mid-1990s witnessed a range of small personal computing devices that are commonly known as handheld computers, or mobile computers.

Some examples of handheld computers are as follows:

- Smartphones
- Tablet PCs

Smartphones

- Cellular phones are web-enabled telephones. Such phones are also known as smartphones because, in addition to basic phone capabilities, they also facilitate the users to access the Internet and send e-mails, edit Word documents, generate an Excel sheet, create a presentation, and lots more.
- Smartphones run an advanced mobile operating system that enables it to run various applications.
- The four major mobile operating systems are iOS, Android, BlackBerry OS, and Windows Mobile.
- Smartphones also have a CPU, more storage space, more memory, and a larger screen than a regular cell phone.

Tablet PCs

- A tablet PC is a computing device that is smaller than a laptop, but bigger than a smartphone. Features such as user-friendly interface, portability, and touch screen have made them very popular in the last few years. These days, a wide range of high-performance tablets are available in the market.
- Some operating systems that are used in tablets are Android Jellybean (an open-source operating system built by Google), Windows 8, and iOS (developed by Apple).
- While users can easily type directly on the surface of a tablet, some users prefer a wireless or bluetooth-connected keyboard.
- The following are the uses of Tablet PCs:
 - View presentations
 - Videoconferencing
 - Reading e-books, e-newspaper
 - Watching movies
 - Playing games
 - Sharing pictures, video, songs, documents, etc.
 - Browsing the Internet
 - Keeping in touch with friends and family on popular social networks, sending emails
 - Business people use them to perform tasks such as editing a document, exchanging documents, taking notes, and giving presentations
 - Tablets are best used in crowded places such as airports and coffee shops, where size and portability become more important.

1.6 APPLICATIONS OF COMPUTERS

1. Word processing:

- Word processing software enables users to read and write documents.
- Users can also add images, tables, and graphs for illustrating a concept.
- The software automatically corrects spelling mistakes and includes copy-paste features.

2. Internet:

- The Internet is a network of networks that connects computers all over the world.
- It gives the user access to an enormous amount of information, much more than available in any library.
- Using e-mail, the user can communicate in seconds with a person who is located thousands of miles away.
- Chat software enables users to chat with another person in real-time.
- Video conferencing tools are becoming popular for conducting meetings with people who are unable to be present at a particular place.

3. Digital video or audio composition:

- Computers make audio or video composition and editing very simple.
- Graphics engineers use computers for developing short or full-length films and creating 3-D models and special effects in science fiction and action movies.

4. Desktop publishing:

- Desktop publishing software enables us to create page layouts for entire books.

5. **e-Business:**

- e-Business or electronic business is the process of conducting business via the Internet. This may include buying and selling of goods and services using computers and the Internet.
- Companies today use e-commerce applications for marketing, transaction, processing, and product and customer services processing.

The following are techniques in which e-commerce helps users to conduct business transactions.

- **Business-to-consumer or B2C:** In this form of electronic commerce, business companies deploy their websites on the Internet to sell their products and services to the customers.
- **Business-to-business or B2B:** This type of electronic commerce involves business transactions performed between business partners (customers are not involved).
- **Consumer-to-consumer or C2C:** This type of electronic commerce enables customers to carry business transactions among themselves
- **Electronic banking:** Electronic banking, also known as cyber banking or online banking, supports various banking activities conducted from home, a business, or on the road instead of a physical bank location.

6. **Bioinformatics:**

- Bioinformatics is the application of computer technology to manage large amount of biological information. Computers are used to collect, store, analyse, and integrate biological and genetic information to facilitate gene-based drug discovery and development.
- Scientists also use bioinformatics to identify diseases and discover drugs for them.

7. **Health care:**

- Computers have also become a necessary device in the health care industry. The following are areas in which computers are extensively used in the health care industry.
- **Storing records:** To begin with, computers are first and foremost used to store the medical records of patients. the entire medical history of patients is easily accessible. Since the records are electronically stored, they can be easily shared between different doctors (in same or different healthcare organizations) who are treating the same patient.
- **Surgical procedures:** Computers are used for certain surgical procedures. They enable the surgeon to use computer to control and move surgical instruments in the patient's body for a variety of surgical procedures.
- **Better diagnosis and treatment:** Computers help physicians make better diagnoses and recommend treatments. Moreover, computers can be used to compare expected results with actual results in order to help physicians make better decisions.

8. **Geographic Information System and Remote Sensing:**

- A geographic information system (GIS) is a computer- based tool for mapping and analysing earth's features. It integrates database operations and statistical analysis to be used with maps.
- Remote sensing is the science of taking measurements of the earth using sensors on airplanes or satellites.
- Remote sensing is a sub-field of geography, which can be applied in the following areas:

- Monitoring deforestation in areas like the Amazon Basin
- Studying features of glaciers in Arctic and Antarctic regions
- Analysing the depth of coastal and ocean areas
- Studying land usage in agriculture
- Examining the health of indigenous plants and crops
- Determining the prospect for minerals
- Locating and measuring intensity of earthquakes (after they had occurred) by comparing the relative intensity and precise timings of seismograms collected from different locations.

9. **Meteorology:**

- Meteorology is the study of the atmosphere. This branch of science observes variables of Earth's atmosphere such as temperature, air pressure, water vapour.
- Meteorology has applications in many diverse fields such as the military, energy production, transport, agriculture, and construction.
- Some of the applications include the following:
 - **Weather forecasting:** It includes application of science and technology to predict the state of the atmosphere (temperature, precipitation, etc.) for a future time and a given location. Weather forecasts are especially made to generate warnings regarding heavy rainfall, snowfall, etc.
 - **Aviation meteorology:** Aviation meteorology studies the impact of weather on air traffic management. It helps cabin crews to understand the implications of weather on their flight plan as well as their aircraft.
 - **Agricultural meteorology:** Agricultural meteorology deals with the study of effects of weather and climate on plant distribution, crop yield, water-use efficiency, plant and animal development.
 - **Nuclear meteorology:** Nuclear meteorology studies the distribution of radioactive aerosols and gases in the atmosphere.
 - **Maritime meteorology:** Maritime meteorology is the study of air and wave forecasts for ships operating at sea.

10. **Multimedia and Animation:**

- Multimedia and animation that combines still images, moving images, text, and sound in meaningful ways is one of most powerful aspects of computer technology.
- Multimedia and animation is used to add special effects in movies.

11. **Legal System:**

- Computers are used by lawyers to shorten the time required to conduct legal precedent and case research.
- Lawyers use computers to look through millions of individual cases and find whether similar or parallel cases have been approved.

12. **Retail Business:**

- Computers are used in retail shops to enter orders, calculate costs, and print receipts. They are also used to keep an inventory of the products available and their complete description.

13. Sports:

- In sports, computers are used to compile statistics, identify weak players and strong players by analysing statistics, sell tickets, create training programs and diets for athletes, and suggest game plan strategies based on the competitor's past performance.

14. Travel and Tourism:

- Computers are used to prepare tickets, monitor the train's or airplane's route, and guide the plane to a safe landing. They are also used to research about hotels in an area, reserve rooms, or to rent a car.

15. Simulation:

- Supercomputers that can process enormous amount of data are widely used in simulation tests.
- Supercomputers also enable engineers to design aircraft models and simulate the effects that winds and other environmental forces have on those designs.

16. Astronomy:

- Spacecrafts are usually monitored using computers that not only keep a continuous record of the voyage and of the speed, direction, fuel, and temperature, but also suggest corrective action if the vehicle makes a mistake.

17. Education:

- A computer is a powerful teaching aid and can act as another teacher in the classroom. Teachers use computers to develop instructional material.
- Teachers may use pictures, graphs, and graphical presentations to easily illustrate an otherwise difficult concept.

18. Industry and Engineering:

- Computers are found in all kinds of industries, such as thermal power plants, oil refineries, and chemical industries, for process control, computer-aided designing (CAD), and computer-aided manufacturing (CAM).

19. Robotics:

- Robots are computer-controlled machines mainly used in the manufacturing process in extreme conditions where humans cannot work.

20. Decision Support Systems:

- Computers help managers to analyse their organization's data to understand the present scenario of their business, view the trends in the market, and predict the future of their products.

21. Expert Systems:

- Expert systems are used to automate the decision-making process in a specific area, such as analysing the credit histories for loan approval and diagnosing a patient's condition for prescribing an appropriate treatment.

1.7 BASIC ORGANIZATION OF A COMPUTER

A computer is an electronic device that performs five major operations:

- Accepting data or instructions (input)
- Storing data
- Processing data
- Displaying results (output)
- Controlling and coordinating all operations inside a computer

Figure, which shows the interaction between the different units of a computer system.

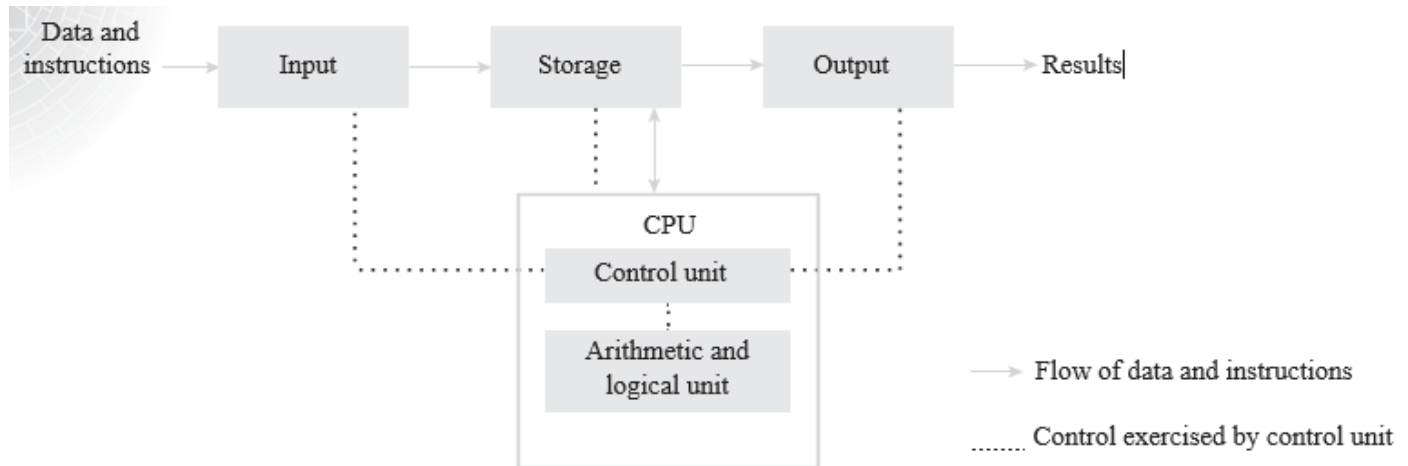


Figure: Block diagram of a computer

Input:

- This is the process of entering data and instructions (also known as programs) into the computer system.
- The data and instructions can be entered by using different input devices such as keyboard, mouse, scanner, and trackball.
- Note that computers understand binary language, which consists of only two symbols (0 and 1), so it is the responsibility of the input devices to convert the input data into binary codes.

Storage:

- Storage is the process of saving data and instructions permanently in the computer so that they can be used for processing.

A computer has two types of storage areas:

➤ Primary storage:

- Primary storage, also known as the main memory, is the storage area that is directly accessible by the CPU at very high speeds.
- It is used to store the data and parts of programs, the intermediate results of processing.
- Primary storage space is very expensive and therefore limited in capacity. Another drawback of main memory is that it is volatile in nature.
- An example of primary storage is random access memory (RAM).

➤ **Secondary storage:**

- Also known as auxiliary memory, this memory is just the opposite of primary memory.
- It is cheaper, non-volatile, and used to permanently store data and programs of those jobs that are not being currently executed by the CPU.
- An example is the magnetic disk used to store data, such as C and D drives, for future use.

Output:

- Output is the process of giving the result of data processing to the outside world (external to the computer system).
- The results are given through output devices such as monitor, and printer.

Control:

- The control unit (CU) is the central nervous system of the entire computer system.
- It manages and controls all the components of the computer system.
- It is the CU that decides the manner in which instructions will be executed and operations performed. CPU is a combination of the arithmetic logic unit (ALU) and the CU.
- The CPU is better known as the brain of the computer system because the entire processing of data is done in the ALU, and the CU activates and monitors the operations of other units (such as input, output, and storage) of the computer system.

Processing:

- The process of performing operations on the data as per the instructions specified by the user (program) is called processing.
- Data and instructions are taken from the primary memory and transferred to the ALU, which performs all sorts of calculations. The intermediate results of processing may be stored in the main memory,

1.8 MAJOR PARTS OF THE COMPUTER

The following are some of the major parts of the computer:

CPU:

The CPU is the brain of the computer. It performs all calculations and controls the devices connected to the computer system.

RAM(Random access memory):

RAM is the computer's memory which stores information used by applications that are currently being executed by the CPU.

Hard disk drive (HDD):

The HDD of the computer is the secondary memory of the computer system where information is stored permanently. All types of data, documents, and programs are stored on the hard disk.

Video card: The video card is a board that plugs into the motherboard of the computer and generates images for display. Many computers come with an in-built video chip.

Sound card:

As with video cards, sound cards are expansion boards that are used to enable a computer to manipulate sound.

Modem:

A modem (modulator–demodulator) is a device that enables the computer to use a telephone line to communicate and connect to the Internet.

Network card:

A network card is used to connect the computer either to other computers or to the Internet.

Fans:

There are one or more fans inside the computer to keep the air moving and the computer cool.

Cables:

There are multiple wires inside the computer that are flat, ribbon-like cables. They are used to provide power and communication to the various parts inside the computer.

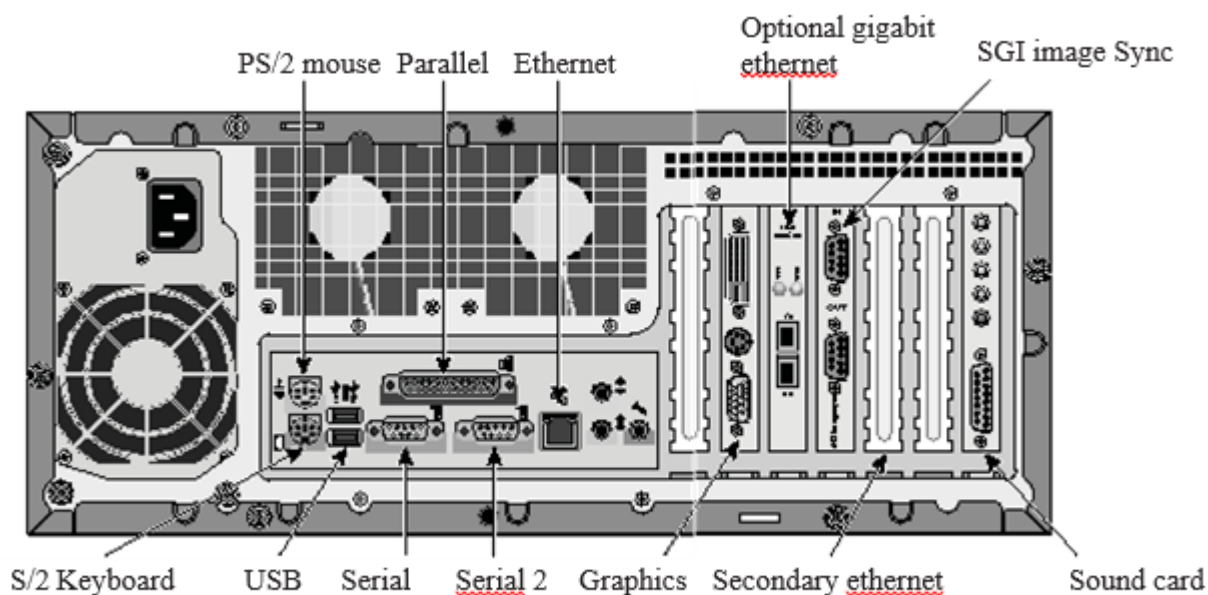


Figure: Computer case and its parts

1.9 MOTHERBOARD

The motherboard, also known as the mainboard or the parent board, is the primary component of a computer. It is used to connect all the components of the computer. The motherboard is a printed circuit that has connectors for expansion cards, memory modules, the processor, etc.

1.9.1 Characteristics of a Motherboard

A motherboard can be classified depending on the following characteristics:

- Form factor
- Chipset
- Type of processor socket used
- Input–Output connectors

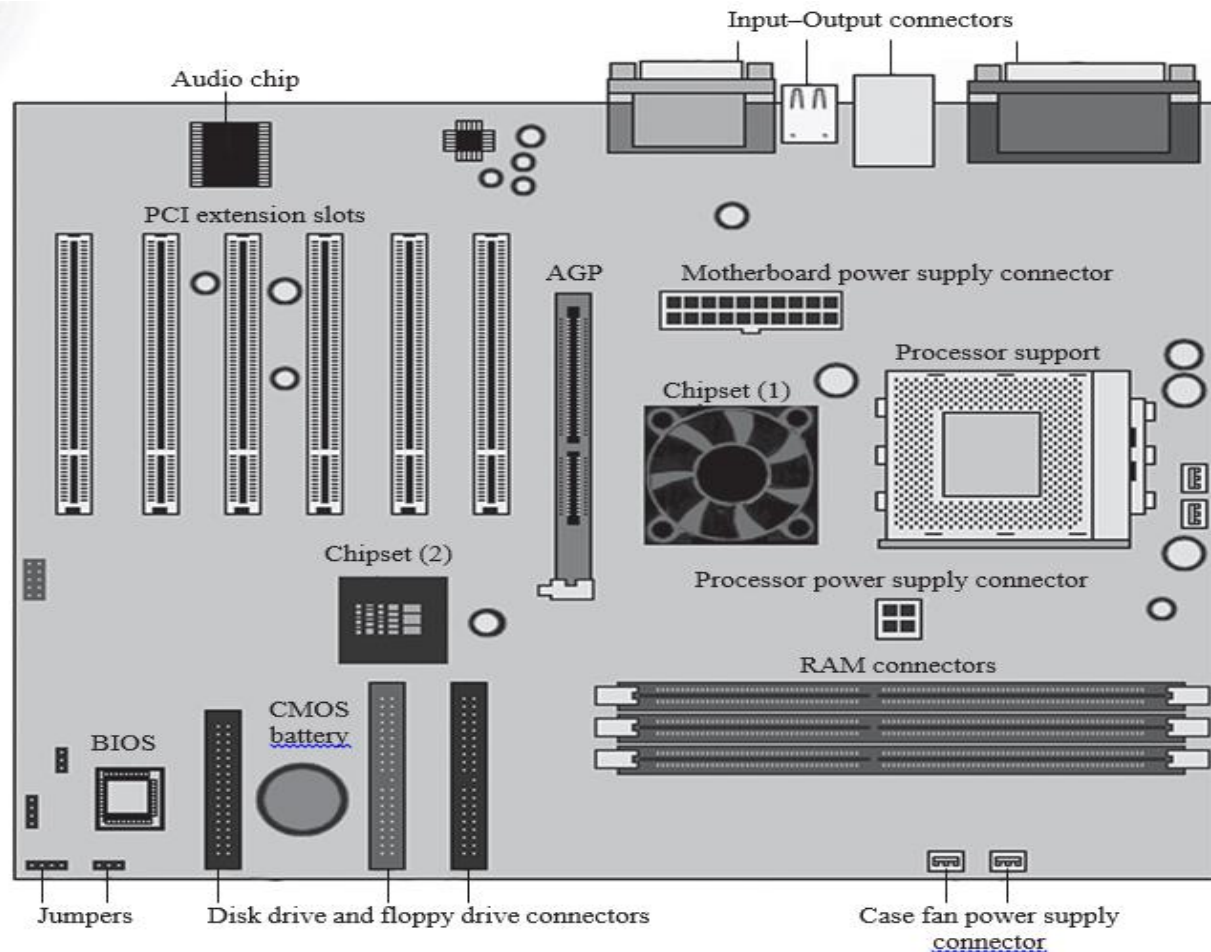


Figure: Computer's motherboard

Form factor:

- Form factor refers to the motherboard's geometry, dimensions, arrangement, and electrical requirements.
- The industry has defined a few standards for the form factors, so that they can be used in different brands of cases.

Integrated components:

Some of the motherboard's components are integrated into its printed circuitry. These include the following:

- The chipset is a circuit that controls the majority of the computer's resources such as the bus interface with the processor, cache memory, RAM, and expansion cards.
- CMOS clock and battery
- BIOS
- System bus and expansion bus

➤ Chipset:

The chipset is an electronic circuit that basically coordinates data transfers between the different components of the computer (such as the processor and memory).

➤ CMOS clock and battery:

The real-time clock (or RTC) is a circuit that is used to synchronize the computer's signals. The complementary metal-oxide semiconductor (CMOS) chip, saves some system information, such as the time, date, and other essential system settings.

The CMOS chip is powered by a battery located on the motherboard.

➤ **BIOS:**

The basic input/output system (BIOS) is an interface between the operating system and the motherboard. The BIOS is stored in the read-only memory (ROM), which cannot be rewritten. To configure the BIOS, the user can use an interface known as *BIOS setup*, which can be accessed when the computer is booting.

Processor socket:

The processor (also called the *micro-processor*) is the brain of the computer. The processor is characterized by its speed or frequency, which is the rate at which it executes instructions.

RAM connectors:

RAM is the primary storage area that stores data while the computer is running. However, its contents are erased when the computer is turned off or restarted. The fast processor accesses data from RAM and not from the hard disk. RAM is available in the form of modules that plug into motherboard connectors.

Expansion slots:

Expansion slots are compartments into which expansion cards can be inserted. Example: Graphic cards.

I/O connectors:

The motherboard has a number of input–output sockets (Figure 1.14) on its rear panel, some of which include:

- A serial port to connect some old peripherals
- A parallel port to connect old printers
- USB ports to connect more recent peripherals such as mouse and pen drive.
- RJ45 connector (also known as LAN or Ethernet port) to connect the computer to a network. It corresponds to a network card integrated into the motherboard.
- Video graphics array (VGA) connector to connect a monitor. This connector interfaces with the built-in graphics card.
- Audio plugs that include the *line in*, *line out*, and *microphone* to connect sound speakers, hi-fi system, or microphone. This connector interfaces with the built-in sound card.

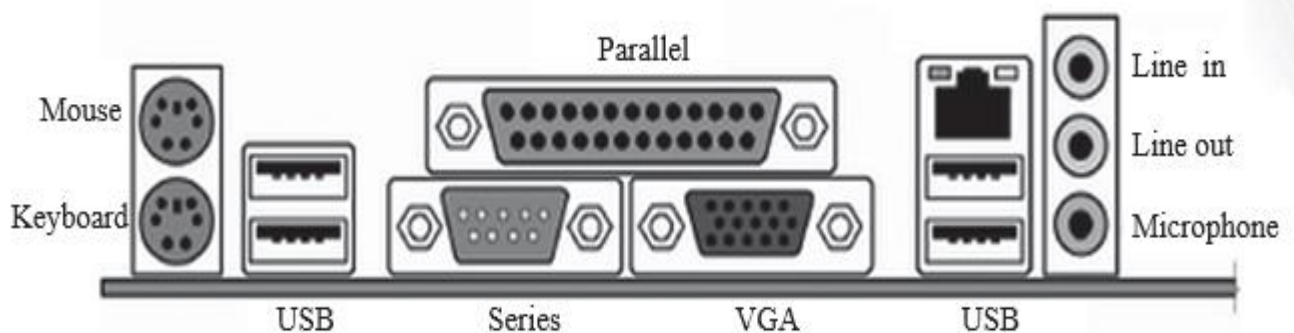


Figure: I/O connectors