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Unit 1: Introduction to Computer

Introduction

A computer is a machine that takes raw data as input, performs calculations, and processes

information with astonishing speeds and precision. A computer can take thousands of individual pieces of data and turn them into more usable information with blinding speed and almost unfailing accuracy.

All the computers have the following common characteristics irrespective of their type and size;

Word length, speed, storage, accuracy, versatility, automation, and diligence. Computers can help us solve many complex tasks and improve the quality of our lives. They can help produce better-quality products, teach, and eliminate human error.

Importance of Computers:

- Solving numerical problems
- Storing and retrieving information
- Creating and displaying documents and pictures

Digital and Analog Computers

(Types of computers based on Working Principle)

1. Analog Computer

2. Digital Computer

3. Hybrid Computer

Analog Computer

An analog computer is a form of computer that operates on continuous data like temperature, pressure, speed, voltage, etc. by measuring and comparing. It has low accuracy and usually contains no or limited storage capacity. It is a special-purpose computer. It cannot be reprogrammed and can be operated only by skilled manpower. 'Presley' is an example of an analog computer. Modern Analog computers are used today for some applications, such as scientific calculation, engineering design, industrial process control, and spacecraft navigation.

Digital Computer

Digital computer operates on discontinuous or discrete data by counting and calculation. It has higher accuracy and usually contains a larger storage capacity. It is a general-purpose computer and can be reprogrammed. It can be operated by general users. Devices like digital watches, digital speedometers, etc. are examples of digital devices. IBM PC, Dell Laptop, Acer notebook, etc. are examples of digital computers.

Hybrid Computer

A hybrid computer is a combination of analog and digital computers. It can operate on both continuous and discrete data. It can convert analog data to digital and vice versa. In a hybrid computer, the analog component is used for measuring and comparing, and the digital component is used for controlling. Its storage varies from the application area. Supercomputers are usually hybrid computers. It is a special-purpose computer and can be operated only by skilled manpower.

Major Applications of hybrid computers are

- Weather forecasting
- Automated industry control
- Automated vehicles
- Rocket launching system
- Diagnosis in hospital

Difference Between Analog Computer and Digital Computer

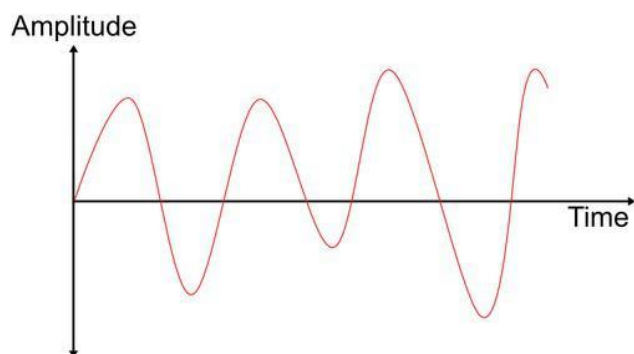
Analog Computer	Digital Computer
Analog computer operates on continuous data like temperature, pressure, speed, voltage, etc.	Digital computer operates on discontinuous or discrete data (0 and 1).
It operates by measuring and comparing.	It operates by counting and calculation.
It has low accuracy.	It has higher accuracy.
It usually contains either no or limited storage capacity.	It usually contains a larger storage capacity.
It is a special purposeful computer	It is a general-purpose computer.
It cannot be reprogrammed	It can be reprogrammed
It can be operated only by skilled manpower	General users can operate it.
Devices like thermometers, speedometers, pressure gauges, voltmeters, etc. are examples of analog devices.	Devices like digital watches, digital speedometer, etc. are examples of digital devices.
Presley is an example of an analog computer.	IBM desktop PC, Dell laptop, Acer notebook are examples of digital computers.

Comparison Table

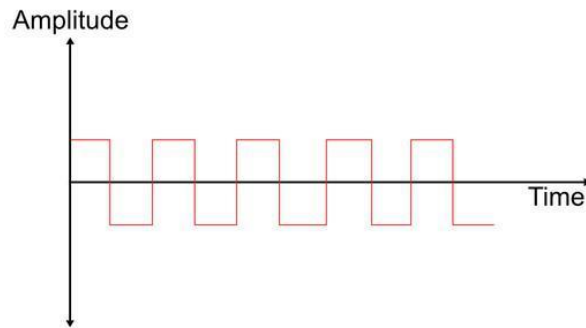
Analog Computer	Digital Computer	Hybrid computer
Analog computer operates on continuous data like temperature, pressure, speed, voltage, etc.	Digital computer operates on discontinuous or discrete data (0 and 1).	A hybrid computer is a combination of analog and digital computers. It can operate on both continuous and discontinuous data.
It operates by measuring and comparing.	It operates by counting and calculation.	It can convert analog data to digital and vice versa.
It has low accuracy	It has higher accuracy	In a hybrid computer, analog the component is used for measuring and comparing, and the digital component is used for controlling.
It usually contains either no any or limited storage capacity.	It usually contains a larger storage capacity.	Its storage capacity varies from the application area.
It is a special purpose computer.	It is a general-purpose computer.	It is a special-purpose computer.
It cannot be reprogrammed	It can be reprogrammed	hybrid computers, which combine analog and digital

		components can exhibit varying degrees of re-programmability depending on their specific design
It can be operated only by skilled manpower.	It can be operated by a general users.	It can be operated only by skilled manpower.
Devices like thermometers, speedometer, pressure gauge, voltmeter, etc. are the examples of analog devices.	Devices like digital watches, digital speedometer, etc. are examples of digital devices.	Electrocardiogram (ECG) Machine, smartwatch, etc. Analog computer.
Presley is an example of an analog computer	IBM desktop PC, Dell laptop, Acer notebooks are examples of digital computers.	Supercomputers are usually hybrid computer.

* The waveform of analog computers is



* The waveform of digital computers is



* **Major application areas of hybrid computers are**

- ❖ Weather forecasting
- ❖ Automated industry control
- ❖ Automated vehicles
- ❖ Rocket launching system
- ❖ Diagnosis in hospital

Characteristics of Computer

All computers have certain common characteristics irrespective of their type and size.

The major characteristics of computers are speed, accuracy, diligence, storage capability, versatility, Word length, and automation

Speed

The computer performs its operation at very high speeds. For example, A Microcomputer can execute millions of instructions per second over and over again without any mistakes. Super computer can operate at speed measured in nanoseconds and even in picoseconds.

Accuracy

The accuracy of the computer system is very high. Hardware errors can occur, but error-detecting and correcting techniques will prevent false results. In most cases, the errors are due to human factors rather than technological flaws. For example, if a program is wrongly coded, the data is corrupted or the program logic is flawed, then we will always get the wrong result. So, if the wrong input is given, the output will be wrong-GIGO (i.e., garbage in garbage out)

Diligence

A computer is free from tiredness, lack of concentration, fatigue, etc. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy.

Storage capability

The computer can store large amounts of data. Computers have main memory and auxiliary memory systems. With more and more auxiliary storage devices, which are capable of storing huge amounts of data the storage capacity of a computer is virtually unlimited. The factor that makes computer storage unique is not that it can store vast amounts of data, but the fact that it can retrieve the information that the user wants in a few seconds.

Versatility

It means the capacity to perform completely different types of work. Computers can perform activities from simple calculations to complex CAD modeling and simulation to navigate missiles and satellites.

Word Length

The number of bits that a computer can process at a time in parallel is called its word length. Word lengths of computer are varying such as 8, 16, 32, or 64 bits. It is the measurement of the computing power of a computer i.e., the longer the word length, the more powerful the computer is. When we talk of a 16-bit computer, it means that its word length is 16 bits.

Automatic

A computer is an automatic machine, capable of functioning automatically, once the appropriate set of instructions and data are provided to the computer. The user is required to give the data and utilize the result but the processing is automatic.

History of Computer

Rome wasn't built in a day, nor was the computer! The computer as we know it today has a long history.

The first calculator

One of the first computing machines known is the Abacus. It was used in Europe as well as Asia around the 15th century.

Blaise Pascal

In 1642, Blaise Pascal invented the Pascaline which was a mechanical calculator. Almost 30 years later, Gottfried Von Leibniz took things a step further. He called it the Stepped Reckoner. Pascal's machine could now do multiplications, and divisions and find square roots.

➤ Charles Babbage

In the early 1800s, Charles Babbage made history by building The Difference Engine. The world now had a machine that mechanized a whole series of complex calculations and provided an output. He is called the Father of the Computers. One of the most remarkable things is that this machine had a memory. Here data could be held temporarily for later usage.

➤ Alan Turing

The Turing Machine was the first description of the modern-day computer. Built in 1936, it consisted of a long magnetic tape that had a combination of symbols, a head that could read and write symbols to the tape, and a set of simple instructions That directed the head to read and change the symbols on the tape. A computer we would recognize today works on the same theory as the Turing Machine but is much more complex. However, whether we talk of the simple computers built by Babbage and Turing or the complex computer you are reading, the idea remains the same. Accept the input, process it, and then deliver a result.

Generations of Computer

Based on the period of development and the features incorporated, the computers are classified into the following five generations.

First Generation Computers (1945-1954)

They were made to order for specific tasks. Each computer had a different binary-coded program called a machine language that told it how to operate. The computers used vacuum tubes and magnetic drums for data storage. These computers were enormous and required a large room for installation. Since thousands of vacuums were used, they generated a large amount of heat. So, a massive air-cooling system was required

- **Examples:** Universal Automatic Computer (UNIVAC), Electronic Numerical Integrator and Calculator (ENIAC), and Electronic Discrete Variable Automatic Computer.

Second Generation Computers (1955-1964)

They used vacuum tubes with transistors and machine language with assembly language. They also contained all the components we associate with the modern-day computer. Printers, tape storage, disk storage, memory, operating systems, and stored programs. Throughout the early 1960's, there were many commercially successful second-generation computers used in businesses, universities, and government.

- Transistors are smaller in size compared to vacuum tubes, thus, the size of the computer was also reduced.
- Better portability and generated less amount of heat as compared to the first-generation computers but still required air conditioning.
- Examples: PDP-8, IBM 1401, and CDC 1604

Third-generation computers (1965-1979)

They replaced transistors with integrated circuits (ICs). These computers could be used in both scientific and nonscientific applications. These computers allowed to use of an operating system that allowed machines to run many different programs at once with a central program that monitored and coordinated the computer's memory. In this generation, user interacted through keyboards and monitors as input and output.

- The size of these computers was quite small compared to the second-generation computers.
- Since IC replaced several individually wired transistors so, this made computers smaller in size, more reliable, and more efficient.
- Produced much less heat and therefore didn't require a dedicated cooling system.
- Example: IBM 370, PDP 11, NCR 395, PDP-8

Fourth Generation Computers (1980 onward)

They were characterized by their small size, the processor (chip), and more processing power. This era also marked the introduction and popularity of the personal computer (PC) and also the popularity Internet and WWW. The size of the computers shrank and the processing power increased. The computers became easier to operate with new operating systems that supported graphical user interfaces (GUIs) operation.

- These computers are microprocessor-based computers using Large Scale Integration (LSI) and Very Large-Scale Integration (VLSI) technology.
- Semiconductor memory replaced the earlier magnetic core memory, resulting in fast random access to memory.
- Smaller than previous generation computers. Some can even fit into the palm
- Became widely available for commercial purposes. Personal computers became available to the home user.
- Examples: CRAY-1, Apple II, IBM PCs, Intel PCs, etc. are examples of fourth-generation computers.

Fifth Generation Computers (Present and Future)

They aim to solve highly complex problems that require reasoning, intelligence, and expertise. They are intended to be able to cope with large subsets of natural languages and draw on very large knowledge bases. Despite their complexity, fifth-generation computers are being designed to be used by people who are not necessarily computer experts. The parallel processing hardware and AI (Artificial intelligence) based software make the computer of this generation highly advanced. AI is the modern branch of computational science that involves making computers work and think like humans. High-level languages like C and C++, Java, .Net, etc. are being used in this generation of computers.

- Based on parallel processing architecture.
- Aims to solve highly complex problems, which require reasoning, intelligence, and expert knowledge.
- The research and advancement in quantum computation and molecular and nanotechnology could be utilized in fifth-generation computers.

Classifications of Computer

Based on size and type, computers can be classified as follows:

- 1. Super Computer**
- 2. Main-frame computer**
- 3. Mini-computer**
- 4. Micro-computer**

Super Computers

- Supercomputers are the computers with the most processing power.
- The primary application of supercomputers has been in scientific and military works but their use is growing in business as their prices decrease.

- They are especially valuable for large simulation models of real-world phenomena where complex mathematical representation and calculations are required or for image creation and processing.
- They are also used in weather prediction, designing aircraft (Boeing 777), and motion pictures like Star Wars and Jurassic Park.
- They operate generally at 4 to 10 times faster than the next most powerful computer class, the mainframe.
- Examples of supercomputers are CRAY-XMP/14, CDC-205, CYBER 205, ETA 10 etc.

Main-frame computer

- Main-frames are powerful multi-user computers capable of supporting many hundreds of users simultaneously in a network.
- They are comparatively less powerful and less expensive than supercomputers.
- Large corporations use mainframe computers for centralized data processing and maintaining large databases.
- Applications that run on a mainframe can be large and complex, allowing for data and information to be shared throughout the organization. Examples: Airline reservation system, corporate payroll, student information, etc.
- A mainframe may have anywhere from 50 megabytes to several gigabytes of primary storage.
- Secondary storage may use high capacities magnetic and optical storage media with capacities in the gigabytes to terabyte range.
- Typically, several hundreds or thousands of online computers can be linked to a mainframe.
- Advanced mainframe performs more than 1000 MIPS and can handle up to a billion transactions per day.
- Examples of these computers are IBM 1401, ICL 2959/10, IBM S/390, etc.

Mini-computer

- Also called midrange computers, mini-computers are relatively small, inexpensive, and compact computers that perform the same functions as mainframe computers but to a limited extent (capable of supporting 10 to 100 users simultaneously).
- They are designed especially for accomplishing specific tasks such as process control, scientific research, and engineering applications.
- Popular makers of mini-computers include Digital Equipment Corporation (DEC) which built the popular VAX minicomputer used in universities, banks, and engineering firms. IBM built the AS/400 series branding of the Mini-computer. Hewlett Packard (HP) built the HP 9000 series brand. PDP 11, IBM 8000 series, etc.

Micro-computer

- Micro-computers are also called personal computers (PCs) and are small, single-user systems, that provide a simple microprocessor and just a few input/output devices.
- Micro-computer ranges from palmtops to Desktop computers. Laptops/Notebooks are very popular nowadays.
- It contains memory in the form of ROM (Read Only Memory) and RAM (Random Access Memory), I/O ports, and a bus or system of interconnecting wires, housed in a unit that is usually called a motherboard.
- The lower cost in the development and production of CPU and various components of the micro-computer allowed it to become a broad market general-purpose computer.
- IBM, Hewlett Packard, Apple, and Compaq are some well-known companies that manufacture microcomputers.

Computer System

A computer system is the integration of input units, memory units, and software working together to perform different activities in data processing which will make it a complete set.

The computer system consists of four parts

i. Hardware,

ii. Software,

iii. Data, and

iv. Users

Hardware

These are the physical components you can touch and see, forming the "body" of the computer. They work together to process information and complete tasks.

Here are some essential hardware elements:

- **Central Processing Unit (CPU):** The brain of the computer, responsible for performing calculations and executing instructions.
- **Memory (RAM):** Holds data and instructions the CPU needs for immediate use.
- **Storage Devices:** Hard drives, SSDs, etc., store data and programs permanently.
- **Input Devices:** Keyboard, mouse, touchpads, scanners, etc., used to provide information to the computer.
- **Output Devices:** Monitor, printer, speakers, etc., used to display or output information from the computer.

Software

Software is the set of instructions and programs that tell the hardware what to do, acting as the "mind" of the computer. Here are some important software categories:

- **Operating System (OS):** Manages the hardware resources and provides a platform for other software to run. Examples include Windows, macOS, and Linux.

- **Applications:** Programs designed for specific tasks like word processing, gaming, web browsing, etc. Examples include Microsoft Word, Google Chrome, and Photoshop.
- **System Software:** Software used to manage different aspects of the computer system, like device drivers or security software.

Data

This is the raw information processed and manipulated by the computer. It can be anything from text and numbers to images, videos, and audio.

Users

The people who interact with the computer system, providing input, using applications, and interpreting the output. They're like the drivers of the computer, setting the course and utilizing its capabilities.

All these parts work together seamlessly to make a computer system function. The hardware provides the physical components, the software controls and instructs them, and the users interact with the system providing the necessary input data to achieve their desired outcomes.

The Computer Hardware

Computer System hardware consists of different units. These units are connected with some medium such as cables and have a special function. Computer system hardware has the following major units:

- ❖ Input/output unit
- ❖ Central Processing Unit
- ❖ Memory Unit

Input Unit

The main function of the Input unit is to receive data from the user or the surroundings to the computer. The most common input device is the keyboard. The keyboard accepts letters, numbers, special characters, and commands from the user and transmits them to the computer. A mouse is another input device that allows the user to point and click on the buttons and menu items on the computer. Some other input devices are microphones for voice commands, joysticks, rumble pads, racing wheels for playing games, trackballs, scanners, digital cameras, etc.

Output Unit

The output unit is involved in providing output to the user in a suitable form after processing. The output may be on display on the monitor, or projector or produce sound on speaker or printout through printer, etc. There are some devices like touch screens, modems, etc. They act as both input and output devices.

Central Processing Unit:

The CPU, as its name implies, is where the data processing is done. It consists of three basic units:

Control Unit (CU):

The control unit controls communication with ALU and memory unit; and decides which circuit is to be activated for reading instruction. It uses a fetch-execute mechanism. The control unit gets instruction from memory decides what to do with that instruction and transfers it to the ALU.

Arithmetic Logical Unit (ALU):

It performs various arithmetic operations like addition, subtraction, multiplication, and division, and logical operations like AND, OR, NAND, etc. on that instruction.

Memory Unit (MU):

The memory unit stores instructions, data, and intermediate results of processing. This unit also supplies information to the other unit of a computer when needed. It is also known as internal storage, main memory, or primary memory.

#Mechanism-

- An instruction is fetched from primary storage by the control unit.
- The control unit decodes the instruction.
- The ALU receives the data and the instructions and performs the calculation and comparison.
- The result is stored in primary storage which is sent to the proper output device.

Application of Computers

Computers are used in so many fields in our daily life. From Engineers to Doctors, Teachers, Students, and government Organizations all use computers to perform various kinds of tasks. With greater precision and accuracy and less time consumption computer can do a lot of tasks while that task can consume lots of time while doing manually. Some of the uses of Computers in various fields are as follows:

Education

Computers are being used in educational institutions and research organizations for Teaching, learning, and research purposes. Computers are widely used in curricular development, research, record-keeping, computer literacy training, data processing and presentation. Distance learning is one of the important uses of computers nowadays. This offers a variety of internet and video-based online courses.

Health Care and Medicine

The use of computer technology is steadily increasing in Health Care and Medicine. Computers are being used in keeping records of patients or acting as surgical instruments and advance medical purposes and help in keeping health fit and healthy. Some common ways computers are used in health care and medicine are Databases, Monitors Treatment Techniques, Laboratory technology, and Invasive Surgical Procedures.

Finance

The most common applications of Information Technology in the Finance sector are online banking, Electronic Payment Systems, and online investment. Through online payment systems, users can pay their bills via the Internet from any place. Online banking helps users to manage accounts from the internet. Business people can make multiple investments within a few times with the help of online investment.

Travel and Tourism

Technology plays an important role in the hospitality and tourism industry. Both customers and businesses can benefit from advances in communication, reservations, and guest service systems. Technology allows continuous communication and streamlines the guest experience, from reservation to checkout.

Governance

The use of computers to provide Governance services is commonly known as e-governance. E-governance is associated with carrying out the functions and achieving the results of governance through the utilization of ICT (Information and communication technology). Speed, cost reduction, and transparency are the key features of E-governance Service.

Communication and Data Transfer

E-mail, internet, E-fax, etc. are computer-based communications. Computer and Internet integration is the backbone of recent data communication. Social media networking has been the revolution in Communication and Data Transfer in the last ten years.

