Unit 1: Introduction to Computer (3Hrs.)

Introduction

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 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.

Computer can help us in solving many complex tasks and improving the quality of our lives. They can help in producing better quality products, help in teaching and assist in eliminating 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 on the basis of 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 any or limited storage capacity. It is special purpose computer. It cannot be reprogrammed and can be operated only by skilled manpower. 'Presley' is an example of 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 an usually contains larger storage capacity. It is general purpose computer and can be reprogrammed. It can be operated by general users. Device like digital watch, digital speedometer, etc are the examples of digital devices. IBM PC, Dell Laptop, Acer notebook etc are the examples of digital computers.

Hybrid Computer

Hybrid computer is the combination of analog and digital computer. It can operate on both continuous and discrete data. It can convert analog data to digital and vice versa. In a hybrid computer, analog component is used for measuring and comparing, and digital component is used for controlling. Its storage varies from application area. Super computers are usually hybrid computer. It is special purpose computer and can be operated only by skilled manpower.
Major Application 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 any or limited storage capacity.	It usually contains larger storage capacity.
It is special purpose computer.	It is a general purpose computer.
It cannot be reprogrammed.	It can be reprogrammed.
It can be operated only by skilled manpower.	It can be operated by general users.
Devices like thermometer, speedometer, pressure gauge, voltmeter, etc. are the examples of analog devices.	Devices like digital watch, digital speedometer, etc. are the examples of digital devices.

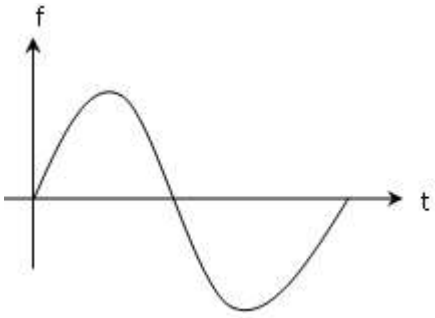
'Presley' is an example of analog computer.	IBM desktop PC, Dell laptop, Acer notebook are the examples of digital computers.

Comparision Table

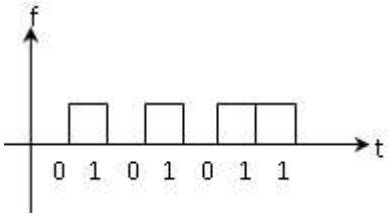
Analog Computer	**Digital Computer**	**Hybrid computer**
Analog computer operates on continuous data like temperature, pressure, speed, voltage, etc.	Digital computer operates on discontinuous or discrete data (0 and 1).	Hybrid computer is the combination of analog and digital computer. It can operate 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 component is used for measuring and comparing, and digital component is used for controlling.
It usually contains either no any or limited storage capacity.	It usually contains larger storage capacity.	Its storage capacity varies from the application area.
It is 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 reprogrammability depending on their specific design
It can be operated only by skilled manpower.	It can be operated by general users.	It can be operated only by skilled manpower.

Devices like thermometer, speedometer, pressure gauge, voltmeter, etc. are the examples of analog devices.	Devices like digital watch, digital speedometer, etc. are the examples of digital devices.	Electrocardiogram (ECG) machine, smartwatch, etc.
'Presley' is an example of analog computer.	IBM desktop PC, Dell laptop, Acer notebook are the examples of digital computers.	Super computers are usually hybrid computer.

* The wave form of analog computer is



* The wave form of digital computer 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 the computers have certain common characteristics irrespective of their type and size. The major characteristics of computer are speed, accuracy, diligence, storage capability, versatility, Word length and automation

- **Speed**: Computer performs its operation at very high speeds. Example, A microcomputer can execute millions of instructions per second over and over again

without any mistake. Super computer can operate at speed measured in nanoseconds and even in picoseconds.

- **Accuracy**: The accuracy of the computer system is very high. Errors in hardware can occur, but error detecting and correcting technique will prevent false results. In most cases, the errors are due to human factor rather than the technological flaws. Example, if a program is wrongly coded, the data is corrupted or the program logic is flawed, then we will always get wrong result. So, if 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**: Computer can store large amount of data. Computers have main memory and auxiliary memory system. With more and more auxiliary storage devices, which are capable of storing huge amount of data the storage capacity of a computer is virtually unlimited. The factor that makes the computer storage unique is not that it can store vast amount of data, but the fact that it can retrieve the information that the user wants in few seconds.
- **Versatility**: It means the capacity of performing completely different types of work. Computer can perform activities from simple calculation to complex CAD modeling and simulation to navigating 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**: Computer is an automatic machine, capable of functioning automatically, once the appropriate set of instructions and data are provided to the computer. 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 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 that 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, divisions and find square roots.

- **Charles Babbage**
  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 in the input, process it and then deliver a result.

Generations of Computer

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

1. **First Generation Computers (1945-1954)** 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 in size and required a large room for installation.
   - Since thousands of vacuums were used, they generated a large amount of heat. So, massive air-cooling system was required
   - Examples: Universal Automatic Computer (UNIVAC), Electronic Numerical Integrator and Calculator (ENIAC), and Electronic Discrete Variable Automatic Computer.
2. **Second Generation Computers (1955-1964)** 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 a number of 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

3. **Third Generation Computers (1965-1979)** replaced transistors with integrated circuits (ICs). These computers could be used 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 coordinate 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, reliable and eficient.
    - Produced much less heat and therefore didn’t require a dedicated cooling system.
    - Example: IBM 370, PDP 11, NCR 395, PDP-8
4. **Fourth Generation Computers (1980 onward)** were characterized by their smaller 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 of 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 the 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 of the hand.
    - 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 the examples of the fourth generation computers.

5. **Fifth Generation Computers (Present and future)** 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. In spite of 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 in making computer work and think like humans. High-level languages like C and C++, Java, .Net etc. are being used in this generation of computer.
    - 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 nano technology could be utilized in fifth generation computer.

Classifications of Computer

On the basis of size and type, computers can be classified as follows:

1. Super Computer
2. main-frame computer
3. mini-computer
4. micro-computer

Super Computers:

- Super computers are the computers with the most processing power.
- The primary application of super computer has been in scientific and military works but their use is growing in business as their prices decreases.
- 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, design aircraft (Boeing 777), 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 super computers.
- Large corporate use mainframe computers for centralized data processing maintaining large databases.
- Application that run on mainframe can be large and complex, allowing for data and information to be shared throughout the organization. Example: 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 on-line computers can be linked to a mainframe.
- Advance mainframe performs more than 1000 MIPS and can handle up to 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 computer that perform the same functions as mainframe computers but to limited extent (capable of supporting 10 to 100's of user simultaneously).
- They are designed especially for accomplishing specific tasks such as process control, scientific research and engineering applications.
- Popular makers of mini-computer include: Digital Equipment corporation (DEC) that built the popular VAX minicomputer used in universities, bank and engineering firms. IBM, built AS/400 series branding of Mini-computer. Hewlett Packard (HP) built HP 9000 series brand. PDP 11, IBM 8000 series, etc.

Micro-computer:

- Micro-computers are also called personal computer (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 now a days.
- It contains memory in the form of ROM (Read Only Memory) and RAM (Random Access Memory), I/O ports, and 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, Compaq are some well known companies which manufacture microcomputers.

Computer System

A computer system is the integration of input unit, memory unit, 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, Linux.

- **Applications:** Programs designed for specific tasks like word processing, gaming, web browsing, etc. Examples include Microsoft Word, Google Chrome, 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 to each other with some medium such as cables and has their own special function. Computer system hardware has following major units:

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

Input Unit

The main function of Input unit is to receive data from user or the surrounding 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 it to the computer. A mouse is another input device that allow the user to point and click on the buttons and menu items on the computer. Some other input devices are microphone for voice commands, joysticks, rumble pads, racing wheels for playing games, trackballs, scanners, digital cameras, etc.

Output Unit

The output unit involves in providing output to the user in the suitable form after processing. The output may be on display on monitor, projector or produce sound on speaker or printout through printer etc. There are some devices like touch screens, modems, etc. That 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): Control unit controls communication with ALU and memory unit; decides which circuit is to be activated for reading instruction. It uses fetch-execute mechanism. Control unit gets instruction from memory and decides what to do with that instruction and transfer it to the ALU.

Arithmetic Logical Unit (ALU): It performs various arithmetic operations like addition, subtraction, multiplication, division and logical operations like AND, OR, NAND etc. on that instruction.

Memory Unit (MU): Memory unit store instructions, data and intermediate results of processing. This units also supplies information to the other unit of 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 instruction and performs the calculation and comparison.

The result is stored in primary storage which is sent to proper output device.

Application of Computers

Computers are used in so many fields in our daily life. From Engineers to Doctors, Teachers, Students, Government Organization they all use computer 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 Computer in various fields are as follows:

Education

Computers are being used in educational institution and research organization in Teaching, learning and research purpose. Computer 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 Computer now a days. 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 is being used in keeping records of patient or acting as surgical instruments and

advance medical purpose and helps in keeping health fit and healthy. Some common ways computers used in health care and medicine are Database, Monitors Treatment Techniques, Laboratory technology and Invasive Surgical Procedures.

Finance

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

Travel and Tourism

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

Governance

Use of computers for the purpose of providing Governance service is commonly known as e-governance. E-Governance is basically 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 transparent are the key features of E-governance Service.

Communication and Data Transfer

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