

Chapter One

Introduction

1.1 Introduction to Information and Communication Technology

- ICT is an umbrella term that covers all technical means for processing and communicating information.
- It is most often used to describe digital technologies including:
 - ✓ Communication methods:
 - communication protocols and equipments (media), and
 - Techniques for storing, processing, and transmission of information (data computing and storage)
- The term ICT has gained popularity partially due to the convergence of information technology (IT) and telecommunication technology.
- ICT is technology's version of economic growth, to satisfy the needs and wants of the community over time.

1.2 Information Technology

- It is the combination of computer and communication technologies.
- It deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and securely retrieve information.
- It is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware."
- It is a general term that describes any technology that helps to produce, manipulate, store, communicate, and/or disseminate information.

1.3 Data processing

- Think of data as a "raw material" - it needs to be processed before it can be turned into something useful, hence, the need for "data processing".
- Data processing is the conversion of data into the usable and desired form.
- This conversion or "processing" is carried out using a predefined sequence of operations either manually or automatically.
- Most of the processing is done by using computers and thus done automatically.

- Data comes in many forms - numbers, words, symbols.
- Data relates to transactions, events, and facts.

1.4 Information

- Information is data that has been processed in such a way as to be meaningful to the person who receives it.
- "Processed" and "meaningful" data.

1.5 What is Computer Science?

- It's a science concerned with information.
- Concerned with the representation, storage, manipulation, or processing and presentation of information.
- Computer Science uses a special device called **COMPUTER**.

1.6 Sub-disciplines of Computer Science

The seven fields of specialization or sub-disciplines of computer science are the following:

- **Software engineering:** – It is concerned about the development of better quality software by applying scientific & basic engineering principles.
- **Computer engineering (Architecture):** deals with studying, analyzing, and designing computer hardware (organization and interconnection of computer system components) and its working principle.
- **Automata theory:** is the study of machines or devices which accept certain inputs such that the output or at least the probabilities of output s are determined by the input.
- **Formal Language Theory:** Embraces the study of programs of programming languages, which is important for the understanding, and construction of compilers.
- **Complexity theory:** concerned with the study and analysis of algorithms, which helps in measuring the efficiency of the algorithms.
- **Database Architecture:** involves the study and design of efficient methods for information storage, process & retrieval.
- **Artificial intelligence:** Is concerned with the means by which Computers may perform tasks that would be characterized as intelligent if performed by human beings.

1.7 What is Computer?

- The word computer comes/derived from a Latin word “Computare”, which means, “to calculate” or “compute”.

- A computer can perform arithmetic operations at high speed.
- A **computer** is an electronic device that accepts data, performs computations, and makes logical decisions according to instructions that have been given to it;
- A computer is also called a data processor because it can store, process, and retrieve data whenever desired.

1.8 Characteristics of Computers

- ✓ **Automatic:** Given a job, the computer can work on it automatically without human interventions.
- ✓ **Speed:**
 - ✓ A computer can perform data processing jobs/carry out their instructions very fast; usually measured in:
 - ✓ Microseconds (10^{-6}),
 - ✓ Nanoseconds (10^{-9}), and
 - ✓ Picoseconds (10^{-12})
- ✓ **Accuracy:**
 - ✓ The computer is accurate and consistent.
 - ✓ The degree of its accuracy depends on its design.
 - ✓ Computer errors are caused due to incorrect input data or unreliable programs referred to as Garbage In-Garbage-Out (GIGO).
- ✓ **Reliability** is the measurement of the performance of a computer.
 - ✓ The results obtained by the computer are very reliable. But this is true when the data given to it is correct and reliable.
 - ✓ The major reason behind the reliability of the computers is that, at a hardware level, it does not require any human intervention between its processing operations.
 - ✓ Moreover, computers have built-in diagnostic capabilities, which help in continuous monitoring of the system.
 - ✓ A computer is reliable as it gives consistent results for a similar set of data i.e., if we give the same set of input any number of times, we will get the same result.
- **Versatility:** The computer can perform multiple tasks simultaneously with equal ease.

- ✓ It is capable of performing almost any task if the task can be reduced to a finite series of logical steps.
- **Diligence:** The computer is free from monotony, tiredness, and lack of concentration.
 - ✓ It can continuously work for hours without creating any error and without grumbling.
 - ✓ If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy. Due to this capability, it overpowers human beings in a routine type of work.
- **Storage capability:**
 - ✓ Computers can store large amounts of data and they can recall the required information almost instantaneously.
- **No I.Q.:** A computer does only what it is programmed to do. It can't take its own decision in this regard.
- **No Feelings:** computers are devoid of emotions.
 - ✓ Their judgment is based on the instructions given to them in the form of programs that are written by human beings.

1.9 Types of Computers

There are different types of Computers. Their difference depends on different categories of characteristics.

1. Classification by the method of operation (processing):

- 1.1 Analog Computers
- 1.2 Digital Computers
- 1.3 Hybrid Computer

Analog Computers:

- Analog computer works with natural phenomena and physical values; operate by measuring and comparing.
- They don't compute directly with numbers, rather they operate by measuring physical magnitude such as pressure, temperature, voltage, current, etc.
- Works up on continuous data/value and gives continuous output.
- Outputs are in the form of graphs, signals, movements, etc.

- Works on real-time and has no storage capacity
- They are special purpose computers.
- Example: Speedometer in cars, Thermometer, Voltmeter, watch, etc.

Examples

- ◆ **Thermometer, Voltmeter, Speedometer in Cars, etc**
- ◆ Gasoline pump – Contains an analog Computer that converts the flow of pumped fuel into two measurements the price of the delivered gas and the quantity of pumped fuel.

Note:

- ◆ They are special-purpose computers.
- ◆ Analog computers have limited accuracy.

Digital Computers:

- Works on **discrete variables** (digits/numbers) or **discontinuous data**.
- I.e. digits are either 0 or 1
 - ✓ 0 means Off
 - ✓ 1 means On
- The digits are used to represent numbers, letters, or other special characters.
- Operate by counting and adding rather than measuring.
- They are general purpose computers
- They have higher accuracy and speed than analog computers.
- Popular for actual computer works like documentation, report preparation, billing, etc.

Examples:

- ◆ Abacus
 - ◆ Desktop, laptop, smart phones & pocket computers
 - ◆ The general-purpose computers are digital computers.
- ✓ Digital computers have higher accuracy and speed than analog ones.

Hybrid Computers:

- The best features of analog and digital computers can be combined into a single device to form a hybrid computer.

- A hybrid computer processes the information by collecting input data with the analog method, converting it into digital quantities, processing the digital values, and converting the output from digital to analog form. i.e They transfers the data from analog to digital and vice versa.
- They are designed for special purpose and not versatile.
- They have limited storage capacity.
- They are Expensive and complex systems.

Example:

In hospital insensitive-care unit analog devices may measure a patient's heart function, temperature, and other vital signs. These measurements may then be converted into numbers and supplied to a digital component in the system. This component is used to monitor the patient's vital signs and to send an immediate signal to the nurse's station. If any abnormal readings are detected.

2. Classification by purpose of application

2.1 Special-purpose Computers (Dedicated Computers))

2.2 General-purpose Computers

Special Purpose Computers:

- ♦ Designed to be task-specific and most of the time their job is to solve one particular problem.

Example:

- ♦ The public telephone box
- ♦ Traffic control system
- ♦ Ticket machines (used in grocery, supermarket, etc.)
- ♦ Pocket calculators
- ♦ Counters etc...

✓ Most analog computers are special-purpose computers.

General Purpose-Computers:

- Designed to be able to carry out many different tasks through the use of the “store program concept”.

- A program or set of instructions designed to solve a problem is read and stored into the memory and then executed by the computer one by one.
- The same computer can be applied to solve another set of problems using a different program.
- General-purpose computers are more flexible and versatile.

Examples

- Microcomputers
- Minicomputers
- Supercomputers etc.

3. Classification by physical size, price, capacity, and performance

3.1 Super Computer

3.2 Mainframe Computer

3.3 Mini Computer

3.4 Micro Computer

Super Computers:

- The largest, fastest, and most potential and expensive computers.
- They can handle many instructions in parallel.
- They are used to process huge amounts of data, solve complex mathematical calculations, weather forecasting, nuclear science, and space science (rocket launching and astronomical observation).
- They have a speed of hundreds of millions of operations per second.
- The primary memory capacity of supercomputers is about 80 million characters.
- Their secondary memory capacity is 20 times their primary memory.
 - ✓ They are multi-user systems in the intercontinental range.
 - ✓ They can carry out enormously complex scientific calculations.
- They are used to process huge amounts of data and are commonly used in
 - Space technology centers,
 - Meteorology stations,
 - Astronomical observatories,
 - Inter-continental communications, and

- Airline organizations.
- Example: Summit, Sierra, Deep Blue, etc.

Mainframe Computers:

- Designed to handle huge volume of data and information.
- Lower in speed and storage capacity and smaller in size than super computers.
- Performs multiple instructions in parallel from multiple users.
- A mainframe computer has multiple processors.
- Typically used by large organizations for bulk data processing.
- However, they are multi-user systems and handle hundreds of users, usually used in large organizations.
- Example: IBM Z, UNIVAC, etc.

Mini Computers

- They are typically multi user systems (handle multi users)
- Smaller in size and less storage capacity and processing speed than mainframe computers.
- They use terminals for inputs and outputs.
- Used in small organizations.
- Example: MAGNUM and VAX

Micro Computers:

- A microcomputer (personal computer) is a computer whose CPU is a microprocessor.
- The microprocessor is a processor all of whose components are on a single integrated circuit chip; Since its CPU is integrated with a single circuit, it can serve only a single user at a time.
- Most home and personal office computers are microcomputers.
- The relative performance and usage of the personal computer are relatively increased with a very high rate.
- Most common micro computers are personal/desktop computers
- The other micro computers are laptops, workstations, mobile phones, workstations, and embedded computers.

- **Workstations** are like desktop computers but they have more powerful CPU and higher memory capacity; they are expensive; used to designing purpose, animation, and complex calculations.
- **Laptops** are portable computers and also known as notebook computers.
- Many of devices today have an embedded small computer like Smart TV, Smart watches, Smart cars, microwaves, etc.

1.10 Application of Computers

Why do we use Computers?

The following are some of the capabilities of Computers, which are reasons to use Computers.

- Store and process a large amount of information with high speed and accuracy;
- Transmit information across continents via communication channels;
- Simulate events;
- Perform complex mathematical computations and make comparisons;
- Monitor ongoing industrial operations;
- Perform repetitive processes with great ease, speed, and reliability;

The main areas of computer applications can be listed as follows:

1. Learning Aids:

Example: learning toys, programs range from simple arithmetic to calculus, from English grammar to creative writing and foreign language, and from basic graphics to engineering design models.

2. Entertainment: listening music, watching movies, and palying game Games

3. Commercial or business applications

Examples are:

- ✓ Text processing
- ✓ Accounting and Finance management
- ✓ Inventory control
- ✓ Database management
- ✓ Statistical Analysis

4. Scientific – engineering and research applications

Using computers for scientific research, complex mathematical calculations, design work, and analysis and control of physical systems.

Examples are:

- ✓ Space technology
- ✓ Meteorological observatory systems
- ✓ Astronomical investigations
- ✓ Design of machines and
- ✓ Control of manufacturing process

5. Information Utilities

- We use large computers that store a huge amount of information about many different subjects.
- For example, information utilities can allow a computer user to read the daily news, research published works, send a letter to a friend, play games, make airline reservations, obtain the latest stock market quotations, and perform many other activities.

Example: Internet.

6. Electronic Banking and Service:

- Example: Teller Machine (customers are issued cards that permit them to use other banks teller machines)
- Online banking (A bank customer can use his/ her computer to check account balances, transfer funds, pay bills)

7. Shopping from Home

- An individual may now shop by computer in the comfort of their home.

8. Household Control

- For example, Security systems, refrigerators, microwave ovens, washers, stereos, and televisions.
- This computer-controlled home security system monitors movements, broken glass, unlawful entry without a security code, and so on, and alerts the local police department.

9. Weather and Environment

- Computer equipment may show temperature ranges, precipitation levels, and wind flow and can be used in weather forecasting.
- A computer can also help in overcoming environmental hazards.

10. Transportation

- Many aircraft can fly under the control of the computer; in this situation, the captain simply serves as a manager by telling the computer what to do.
- In Cars, computers have provided functional controls such as spark and fuel control.

11. Medical and Health Care

- Computers have long been used by hospitals for routine record keeping.
- Computers are used in hospitals as sensors (the device that detects changes in blood pressure, heart rate, temperature), testing (scan the body and provide 3-D figure), patient treatment.

12. Routine and Dangerous Tasks

- Computers can perform a task in environments that are dangerous for human workers.

13. Consultant (Expert system)

- An Expert system is a computer program, which can solve problems from a specific knowledge base.
- These systems don't replace expert humans because the knowledge base of an expert system is given by the skilled specialist.
- **Example: Mycin** (a medical diagnostic program by using a sophisticated decision-making process).