

INTRODUCTION TO INFORMATION TECHNOLOGY AND COMPUTING

1. Roles of IT in society

Information Technology is important in the society since it plays some major role in modern society by enabling communication support of decision being made and processing the information.

a) Education

- It enables student to access to global knowledge at low cost
- It enables students to access to e-learning platforms, virtual classes, digital libraries and etc

b) Communication

- It enables fast reliable communication for example emails message apps such as whatsup and video conferencing
- It supports social media platforms, virtual meeting and digital collaboration

c) Business and commerce

- By implementing platforms such as e-commerce systems which enables online shopping, digital payment run efficiently
- Automation of process such as payroll customer management
- Enables business intelligence and data analytics

d) Healthcare

- It helps in keeping health records
- Enables telemedicine and remote diagnosis
- It uses biostatistics for disease tracking and their prediction

e) Government services

Helps in public data management

Helps the government to conduct programs such as tax filing, licensing and online voting

Data vs Information

Data

means

- It raw unprocessed facts or figures that have no meaning on their own

Data is the basic input that must be processed to become useful information example numbers, names, dates, readings

Information

It means processed, organized and meaningful data that can be used for decision making

Example Temperature increased from 28°C to 35°C in a hour

Relationship

↑

Data → processing → information

Data is useless what is not processed

Computing Applications in Biostatistics

Biostatistics involves the use of statistical methods to analyze biological and health-related data. IT supports this through

a) Data collection

It helps collecting data in various firms such as Electronic surveys, hospital data systems, lab equipment

b) Data storage

It helps to store large health datasets eg disease prevalence and patient records

c) Data analysis

Biostatistician uses statistical software (R, SPSS, Python, SAS) to analyze disease prevalence mortality ratios are clinical trial results

d) predictive modeling

Biostatistician uses machine learning and AI to detect patterns and predict outbreaks

3) Visualization

Here we use graphs, GIS maps showing disease spread, dashboards.

High-performance computing

High-performance computing refers to using powerful computers and parallel processing to solve complex problems quickly.

Uses of IT and computing

climate and weather modeling

large-scale simulations (e.g., epidemics)

processing massive datasets in seconds

Genome sequencing

Characteristics

Very fast processing

Large memory capacity for storage of information

uses many CPUs/GPUs at the same time

2) Learning outcomes

- 1) Explain the basic concepts of information
- 2) Differentiate between data and information
- 3) Describe the roles of IT in modern society
- 4) Explain how computing is applied in biostatistics
- 5) Understand the importance of high-performance computing
- 6) Identify common IT applications in different sectors
- 7) Use basic computing tools for data management and analysis

3) Case study: Use of IT in disease outbreak management

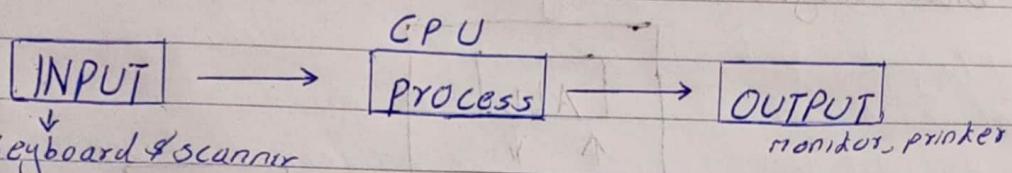
1. Data collection	OUTCOME
2. Data Analysis	Faster detection and response
3. Information sharing	Better management of hospital resources
4. Decision making	Improved public awareness and prevention measures

Computer hardware II - Storage & memory

What is a computer

Computer is an electronic device which is developed by "Charles Babbage" nearby 19th century.

So a computer is an electronic device that takes input devices, stores and processes it and produces output



Components of computer

1) Hardware

- * Input devices (Keyboard, mouse)
- * Output devices (Monitor, printer)
- * Storage devices (HDD, SSD)
- * CPU

2) Software

* Application software

* System software

Characteristics of computers

Speed → Computer can complete any kind of calculation in a few seconds because it is a super fast machine

Accuracy :- Computer is very accurate about its result. Each calculation performed by computer is 100% right.

Automation :- Computer are automatic machines because once

Versatility :- Started on a job the carry out the sub until it is finished

Versatility :- Computer is versatile device because it

Storage :- Computer have high storage capacity due to which they can store large amount of data

Reliability :- Computer is a reliable machine that can be trusted for a long time. This is the reason that today every organisation depend on the computer for their work

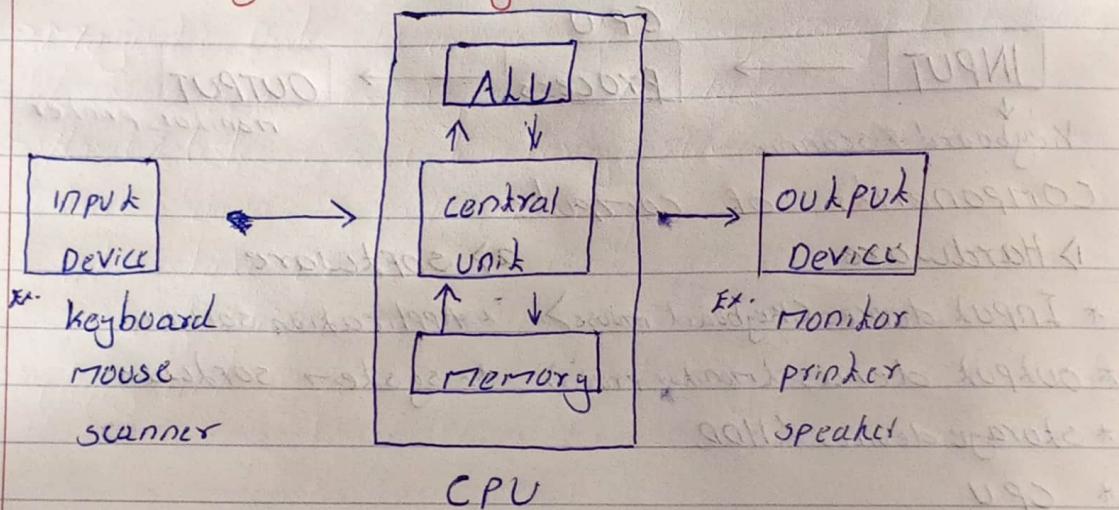
Security :- The biggest feature of computer is that it provides us high security

Diligence: computer is a machine that can do any work without being tired non-stop & without fault.

Multitasking is one of the great feature of computer because they can do many tasks at same time.

Sharing: it is possible to share data from one computer to another.

Block diagram of digital computer



Function of each unit

Input unit is a device which accepts the information from the user and communicates those to the processing unit in machine language form.

Output unit the output unit receives information from the CPU and present it to the user in the desired form.

Memory unit the memory unit stores the program instruction as well as input output and intermediate data temporarily.

This is also referred as primary storage or main memory.

ALU it performs two types of operations. Arithmetic and logical operations.

Memory

is a storage device / place that is used to store information

Types :- Primary memory
secondary memory

Primary memory

is also known as main memory. The memory unit that directly communicate with the CPU is called primary memory.

Types

RAM ROM

RAM :- RAM stands for Random access memory

Ram chip is made with metal-oxide semiconductor(MOS)

It works only when our mobile / computer is working on

Types of RAM

- | → SRAM → static random access memory
- | → DRAM → dynamic random access memory
Data remains longer

ROM :- stands for read only memory. On this memory information can only be read no write operation can take place

Types of ROM

- PROM programmable
- EEPROM Electronic erasable programmable ROM
- EPROM Erasable

Difference between RAM & ROM

RAM

- 1) RAM stands for Random access memory
 - 2) RAM data is volatile
 - 3) Data can be modified
 - 4) CPU can access data stored on RAM
 - 5) RAM is faster memory
 - 6) RAM is expensive
- Types of RAM | → SRAM
 | → DRAM

ROM

- ROM stands for Read only memory
- ROM data is permanent
Data can't be modified
Data to be copied from ROM to RAM so that CPU can access its data
ROM is slower than RAM
ROM is cheaper than RAM
ROM / PROM / EEPROM

Secondary memory

is also known as auxiliary memory & it is used to store data & programs permanently.

In this memory data & programs are retained when the power is turned off (non-volatile)

Types = Magnetic disk

- Magnetic Disk → It offers high storage capacity & reliability & the capacity to directly access the data
- Hard disk is a disk storage device that offers very large storage capacity in the TB range
- Solid State Drive → is fast access time, less power consumption & many more
- Floppy Disk Drive → It is a soft magnetic disk unlike HDD, these disks are portable but it has slower than HDD and most importantly they are much less expensive

Difference between primary & secondary memory

Primary

It is temporary memory of a computer

It has fast access time

It is smallest in size

It is directly communicate to CPU

It is more expensive
volatile in nature except
ROM

Ex → RAM, ROM

Secondary

It is permanent memory of a computer

It has slow access time

It is biggest in size

It is not directly communicate to CPU, it requires primary memory for its operation

It is cheaper than primary
non volatile in nature

Ex → HDD, FDD, DVD, Pendrive etc.

FUNDAMENTALS OF COMPUTER OPERATION

1> Control unit

Is a critical component of the central processing unit.

Its role is to manage and coordinate all activities within the computer.

It directs how data and instructions flow between the CPU, memory and input/output devices.

Functions of the control unit

i> Instruction Fetching

It retrieves instructions from the main memory (RAM) into the CPU for processing.

ii> Decoding

CU interprets or decodes the fetched instructions to determine the action required.

3> Controlling data movement

Directs the movement of data between the CPU registers, memory, ALU.

4> Timing and control signals

It sends control signals that synchronize operations across the CPU.

5> Managing Execution order

Ensures instructions are processed in the correct sequence.

6> Coordinating with the ALU

Informs the ALU on what operation to perform (add, compare etc.)

Types of control unit

- Hardwired control unit: It uses physical circuits. It is very fast but less flexible.
- Microprogrammed control unit: Uses programs stored in ROM; slower but more flexible and easier to modify.

1.2> System clock → is an electronic device inside the CPU that generates a series of regular pulses.

Key concepts

System clock speed is measured in Hz. More instruction can be executed.

Run at speed such as 2.4 GHz or higher.

Importance of system clock

i> Synchronizes the CPU - Ensures all components work in harmony.

ii> Regulates machine cycles - each machine cycle is tied to one or more clock pulses.

iii> Affects processor speed - Higher clock speed = faster instruction execution.

1.3> Machine cycle is a basic operation cycle of the CPU.

a> Fetch: CU fetches an instruction from memory.

b> Decode: The CU interprets the instruction to determine what action is required.

c> Execute: ALU performs the actual operation (Arithmetic, logic, comparison).

d> Store: Results are written back to memory.

1.4> Parallel processing refers to the simultaneous execution of multiple tasks or parts of a task by multiple processing units.

Types

1> Bit level parallelism

2> Instruction level parallelism

3> Data-level parallelism

4> Task level parallelism

parallel processing in Biostatistics
large medical datasets
Epidemiological models
genetic sequencing data
statistical simulations in python
machine learning algorithms in health predictions

15) PERFORMANCE EVALUATION FOR Biostatistics

1) computation

important performance metrics

- 1) clock speed
- 2) CPU architecture
- 3) memory (RAM)
- 4) storage speed
- 5) throughput
- 6) latency
- 7) Benchmark

Test

performance in Biostatistics

Handling millions of patient records
Running heavy statistical models
Large-scale data cleaning
Machine learning predictions

Learning outcomes

- Functions of the control unit and its role in computer operations

- Describe how the system clock works and its importance in CPU performance

- Identify and explain the stages of the machine cycle

- Apply computing techniques to support biostatistics data analysis

- Handle large datasets using efficient computing methods

- Use Excel or Python to perform benchmark and performance tests

COMPUTER HARDWARE INPUT AND OUTPUT DEVICES

Computer hardware is all the physical components of a computer system that you can touch

1) **input devices** - are hardware components used to enter data, commands and instructions into a computer system

Characteristics of input devices

Allows user-computer interaction

collect raw data for processing

improve accuracy and speed of data entry

Types of input devices

Keyboard → used for typing text

Mouse → pointing device used to control the cursor on the screen

Touchscreen → Allows users to interact directly with the display by touching it

Scanner converts physical document and images into digital format

Microphone camera Light Pen sensor

2) **output devices** produces the results of computer processing in a human readable format

Characteristics of output devices

present processed information to users

convert digital signals to audio

used in communication presentation documentation

Types of output

Monitor 2) printer 3) speakers 4) headphones

5) projector 6) plotters 7) LED indicators

Difference Between input and output devices

Input devices

Send data into the computer
convert human action to digital signals
Examples keyboard
Used to feed raw data

Output devices

Displays results from the computer
convert processed data to human readable format
Examples monitor printer
Used to present information

Both in input and output devices

Touchscreen modem network cards

FAX machine VR headsets

Importance of input

Allow data entry \Rightarrow improve accuracy and efficiency
Enable communication with computer

Output provide feedback to the user
present processed information

enable printing support presentation

Application of devices in various fields

Healthcare \rightarrow Education

\rightarrow Business \rightarrow Engineering \rightarrow security

\rightarrow Learning outcomes

\rightarrow Identify various computer input and output devices

\rightarrow Explain the functions and uses of each device

\rightarrow Differences between the input & output

\rightarrow Understand the importance of I/O devices in different fields

\rightarrow Appreciate how input and output device processing support computer study base

COMPUTER SOFTWARE

refers to programs and instructions that tell a computer what to do

\rightarrow system software

It manages and controls the hardware
 \rightarrow operating system (OS)

The main software that controls computer operations

\rightarrow manages file memory processor input and output devices / security

Examples of OS : Windows macOS Linux android

Function of an OS

Multitasking

Resource management

File management

Device management

Security and user account

\rightarrow utility software

It supports system maintenance
Examples

\rightarrow Backup tools - Disk cleanup - File repair

\rightarrow Antivirus software - system update

Purpose to improve performance

4) Application software

designed for specific tasks

Examples

productivity apps: ms word, Excel etc

statistical software: Python packages

multimedia apps: VLC, Photoshop

web browsers: chrome, Firefox

purpose: helps users perform real world task

5) powerpoint overview

used for presentations and visual communication

supports slides, animation, charts and videos

for presenting data analysis findings

⇒ work flow optimization for statistical analysis

improving efficiency when working with statistical data

key techniques

use templates for repeated analysis tasks

Automate calculations

use chart and pivot table for visualization

organize datasets clearly

summary

computer software includes (OS and utilities)

system software and application software.

The OS controls hardware resources and manages

files while utilities help maintain system

performance and security. Application software

allows users to perform tasks such as

writing document - power point helps create visual presentation especially

useful for summarizing statistical results. Work flow optimization techniques such as using templates and visualization tools make statistical analysis faster and more accurate

Learning outcomes

1) Explain the difference between system and application software

2) Describe the function of operating systems and utility programs

3) Identify different types of application software

4) Understand how power point is used in presentations

5) Apply data cleaning processing and analysis techniques efficiently

DATA FILES AND FILE MANAGEMENT

DATA FILES - is a collection of related information stored on computer in a structured format

Types of Data Files

- 1) Text Files 2) Binary Files 3) Database
- 4) Sequential files 5) Random Access Files

File management

is the process of organizing, storing, retrieving and maintaining files on a computer

FUNCTIONS OF FILE MANAGEMENT

- 1) Storage organisation
- 2) File naming identification
- 3) File access control 4) Backup & Recovery 5) File operation eg creating opening Reading updating/editing deleting copying Renaming

File structure

Flat File * Hierarchical File *

Relational File

FILE MANAGEMENT SYSTEMS

is software that manages files and directories on storage devices

FUNCTIONS

Provides an interface for file operation

Handles file storage, retrieval and backup

Ensures data security and integrity

Handles location, size, type and access rights of files

EXAMPLES OF FMS Windows File Explorer

Linux File System macOS Finder

Importance

Efficient organization of data
Easy and quick retrieval of files
Prevents accidental loss of data
Supports security and access control

BEST PRACTICES IN FILE MANAGEMENT

- Use meaningful names
- Organize files into folders and subfolders
- Regularly back up important files
- Set proper permissions for sensitive files
- Use consistent formats for similar files
- Avoid storing too many files in a single folder

EXAMPLES OF FM IN PRACTICE

Office environment

Education

Research

Health sector

LEARNING OUTCOME

Define a data file and explain its purpose in a computer

Identify different types of data files

Explain the importance of file management

Describe the structure of files

Explain the functions of FMS

Perform basic file operation

Apply best practices in file management

Demonstrate the ability to maintain data integrity, security and reliability