CHAPTER 1:

Introduction to Information Technology and Computing

Role of IT in Society

1. Communication & Connectivity

- **Instant communication** through email, messaging apps, and video conferencing has made global collaboration seamless.
- Social media platforms enable information sharing, activism, and community building across borders.

2. Education & Knowledge Access

- Online learning platforms (Coursera, Khan Academy) democratize education.
- Digital libraries and e-books provide access to vast knowledge resources.
- Virtual classrooms and simulations enhance interactive learning.

3. Healthcare & Biostatistics

- **Electronic Health Records (EHRs)** improve patient data management.
- Telemedicine expands healthcare access to remote areas.
- Big data analytics supports disease prediction and personalized medicine.

4. Business & Financial Systems

- IT drives **e-commerce**, online banking, and digital payment systems.
- Financial engineering uses IT for risk modeling, algorithmic trading, and fraud detection.
- Cloud-based ERP systems streamline operations and decision-making.

5. Government & Public Services

- Digital governance improves transparency and efficiency (e-tax systems, online licensing).
- Smart city initiatives use IT for traffic management, energy efficiency, and public safety.
- IT enhances disaster management through predictive analytics.

6. Entertainment & Social Life

- Streaming platforms, gaming, and digital media shape cultural consumption.

- IT enables creative industries through digital tools for music, film, and art

CHAPTER 2:
The fundamentals of computer operations.

Involve four core processes:

IPOS (input, processing, output, and storage).

Elements of a computer

Hardware (physical components)

Software (programs and instructions),

Liveware(user)

Key Fundamentals of Computer Operations

1. **Input**

Input refers to any data, instructions, or signals that are entered into a computer system for processing.

To input is the act of keying in data for manipulation under sets of rules so as give an appropriate information

Role in the Data Processing Cycle

Input is the **first stage** of the data processing cycle. Without input, a computer has nothing to process. It acts as the bridge between the external world (users, devices, environment) and the computer's internal system.

- Computers receive ***data*** and ***instructions*** through ***input devices.***
- Examples: **keyboard, mouse, scanner, microphone** etc.
- It's though Input that any computer operation commences.

2. Processing

This is the systematic manipulation of raw data by a computer to convert it into meaningful information under sets of rules called programs.

- This is done by the **CPU (Central Processing Unit)**
- CPU acts as the brain of the computer.
- It performs calculations, logical decisions, and executes instructions.
- Processing involves three main units:
    - **Control Unit (CU):** Just as its name suggests it controls every single activity in the computer.
    - **Arithmetic Logic Unit (ALU):** Handles calculations and logic operations.
    - **Registers & Cache:** Provide fast temporary storage e.g storage of data waiting to be processed

2. Output

Output is the **processed data presented in a usable form (Information)**

- After processing, results are displayed or communicated through output devices.
- Examples: **monitor, printer, speakers**.

Types of Output

- **Soft Copy Output:** Temporary, displayed on a screen (e.g., documents viewed on a monitor).
- **Hard Copy Output:** Permanent, printed on paper or other media.

- **Digital Output:** Signals sent to other systems or devices (e.g., data transmitted over a network).

- **Role in the Data Processing Cycle**
  Output is the **last stage** after input and processing. It transforms raw data into **meaningful information** that users can interpret and apply in decision-making

3. Storage

Storage is the holding of data in a computer system so that it can be retrieved and used later.

Types of Storage

1. Primary Storage (Main Memory):
   - Directly accessible by the CPU.
   - Fast but usually volatile (off-----).
   - Examples: RAM (Random Access Memory), Cache memory.
2. Secondary Storage:
   - Non-volatile,
   - Used for long-term storage of files and applications.
   - Examples: Hard Disk Drives (HDDs), Solid State Drives (SSDs), Optical discs (CD/DVD), USB drives.
3. Tertiary Storage:
   - Used for backup and archiving.
   - Examples: Magnetic tapes, cloud-based archival systems.

4. Offline Storage: ○

Devices not directly connected to the computer but can be used to transfer or store data.

○ Examples: External hard drives, cloud storage services.

Functions of Storage in Computer Operations

Stores operating system files to run the computer.

Keeps user files and applications for future use.

Provides backup and recovery in case of data loss

Retains instructions and data for processing.

CHAPTER 3:

Computer Hardware Overview

Computer hardware refers to the physical components of a computer system.
Input Devices and Output Devices are essential for communication between the user and the computer.

Input Devices

Input devices allow users to enter data and instructions into the computer.

- **Keyboard – Standard input for text, numbers, and commands.**
- **Mouse – Pointing device for navigation and selection.**
- **Scanner – Converts physical documents/images into digital form.**
- **Microphone – Captures audio input.**
- **Camera/Webcam – Captures images and video.**
- **Touchscreen – Acts as both input and output; users interact directly with the display.**
- **Game Controllers/Joysticks – Specialized input for gaming.**
- **Biometric Devices – Fingerprint scanners, facial recognition for authentication.**

Output Devices

Output devices present **processed information** to the user.

- **Monitor/Display Screen** – Shows text, graphics, and video.
- **Printer** – Produces hard copies of documents/images.
- **Speakers** – Output audio (music, voice, alerts).
- **Projector** – Enlarges display for presentations.
- **Headphones/VR Headsets** – Personal audio or immersive visual output.
- **Plotter** – Specialized printer for large-scale graphics (engineering drawings, maps).

Input/Output (I/O) Devices

Some devices serve **both input and output functions**:

- **Touchscreen** – Input via touch, output via display.
- **External Storage (USB drives, external HDDs)** – Input (data transfer to computer) and output (data retrieval).

- **Network Cards/Modems** – Input (receiving data) and output (sending data).

CHAPTER 4:

Computer Hardware II – Storage Devices & Memory

Primary vs Secondary Memory

Primary Memory

- **Definition:** Directly accessible by CPU, volatile (data lost when power is off).
- **Types:**
    - **Registers:** Small, ultra-fast storage inside CPU for immediate operations.
    - **Cache:** High-speed memory close to CPU, reduces access time.
    - **RAM (Random Access Memory):** Temporary storage for active programs and data.
- **Characteristics:**
- Fast access speed.
- Limited capacity compared to secondary storage.
- Essential for program execution.

Secondary Memory

- **Definition:** Non-volatile, long-term storage.
- **Types:**
    - **Hard Disk Drives (HDDs):** Magnetic platters, slower, high capacity.
    - **Solid State Drives (SSDs):** Flash memory, faster, durable.
    - **Optical Discs (CD/DVD/Blu-ray):** Portable, removable.
    - **Flash Drives/Memory Cards:** Portable, solid-state.
- **Characteristics:**
- Larger capacity.
- Slower than primary memory.
- Stores operating system, applications, and datasets.

Cache Memory

- **Purpose:** Reduces CPU wait time by storing frequently accessed data.
- **Levels:**
    - **L1 Cache:** Smallest, fastest, per core.
    - **L2 Cache:** Larger, slower, shared by cores.

    - **L3 Cache:** Largest, slowest, shared across CPU.
- **Impact:** Improves performance in repetitive tasks and large dataset computations.

Solid State Drives (SSDs)

- **Structure:** Uses NAND flash memory, no moving parts.
- **Advantages:**
    - Faster read/write speeds.
    - Shock-resistant, durable.
    - Lower latency.
- **Disadvantages:**
    - Higher cost per GB.
    - Limited write cycles.
- **Applications:**
- Big-data analytics.
- Real-time financial transactions.
- Biostatistical simulations requiring rapid access.

RAID (Redundant Array of Independent Disks)

- **Definition:** Combines multiple disks for performance and redundancy.
- **Levels:**
    - **RAID 0 (Striping):** High speed, no redundancy.
    - **RAID 1 (Mirroring):** Redundancy, slower writes.
    - **RAID 5 (Striping + Parity):** Balance of speed and fault tolerance.
    - **RAID 10 (1+0):** Combines mirroring and striping, high performance + redundancy.
- **Applications:**
- Financial databases (fault tolerance).
- Biostatistical research (speed + reliability).

Cloud Storage

- **Definition:** Data stored on remote servers, accessible via internet.
- **Advantages:**
    - Scalability (expand storage easily).
    - Accessibility (anywhere, anytime).
    - Backup and disaster recovery.
    - Collaboration across teams.
- **Disadvantages:**
    - Internet dependency.
    - Security and privacy concerns.
- **Applications:**
- Distributed computing for biostatistics.
- Financial modeling with global access.

Disk Storage Structure

- **Tracks:** Concentric circles on disk surface.
- **Sectors:** Smallest physical storage unit within a track.
- **Clusters:** Group of sectors, smallest logical storage unit.
- **Surfaces:** Each side of a platter; multiple surfaces increase capacity.
- **Implications:**
- Efficient data organization reduces fragmentation.
- Proper structuring improves retrieval speed.
- Critical for large-scale datasets where access time matters.

Implications for Large-Scale Biostatistical & Financial Datasets

- **Speed:** SSDs + cache accelerate analysis of massive datasets.
- **Reliability:** RAID ensures redundancy for financial records.
- **Scalability:** Cloud storage supports distributed computing for biostatistics simulations.
- **Organization:** Disk structuring (tracks, sectors, clusters) reduces access time, vital for real-time financial transactions.
- **Performance:** Primary memory enables fast computations; secondary memory ensures persistence.

CHAPTER 5:

Computer Software

System Software

- **Definition**: Software that manages and controls computer hardware, enabling application software to run.
- **Examples**:
- **Operating Systems (OS)**: Windows, macOS, Linux — handle memory, processes, and user interfaces.
- **Compilers**: Translate high-level programming languages (like C++ or Java) into machine code.
- **Utilities**: Specialized tools for system maintenance (e.g., antivirus, disk cleanup, file compression).

Application Software

- **Definition**: Programs designed for end-users to perform specific tasks.
- **Key Examples**:

- **Word**: Document creation, editing, formatting.
- **Excel**: Data organization, formulas, pivot tables, statistical analysis.
- **Access**: Database management, relational data handling.
- **PowerPoint**: Presentation design, visual communication.

Workflow Optimization for Statistical Analyses

- **Excel**:
    - Use **functions** like AVERAGE, STDEV, CORREL for quick stats.
    - Automate repetitive tasks with **macros**.
    - Visualize data with **charts** and **conditional formatting**.
- **Access**:
    - Store large datasets efficiently.
    - Query data using SQL for targeted analysis.
- **Integration**:
    - Link Access databases with Excel for advanced statistical modeling.
    - Export results into PowerPoint for clear presentation.
- **Best Practices**:
- Standardize data entry formats to reduce errors.
- Use templates for recurring analyses.
- Automate reporting pipelines where possible.

Big Picture

- **System software** ensures the computer runs smoothly.
- **Application software** empowers users to perform tasks.
- Together, they support **efficient workflows**, especially in technical and statistical contexts.

CHAPTER 6:

Data Files and File Management

Types of Data Files

- **Sequential Files**
    - Records stored one after another in a fixed order.
    - Best for batch processing (e.g., payroll systems).
    - Retrieval requires scanning from the beginning.
- **Random (Direct Access) Files**

    - Records accessed directly using an address or key.
    - Faster retrieval compared to sequential files.
    - Common in databases where quick lookups are needed.
- **Structured Files**
    - Organized with a defined schema (tables, fields, relationships).
    - Examples: relational databases, spreadsheets.
    - Easier to query and maintain consistency.
- **Unstructured Files**
- No predefined format (text documents, images, videos).
- Require specialized tools (e.g., search engines, AI models) for indexing and retrieval.