Al-Mustaqbal University

College of Engineering Technology

Department of Communication Techniques Engineering

Introduction to Computer

Computer

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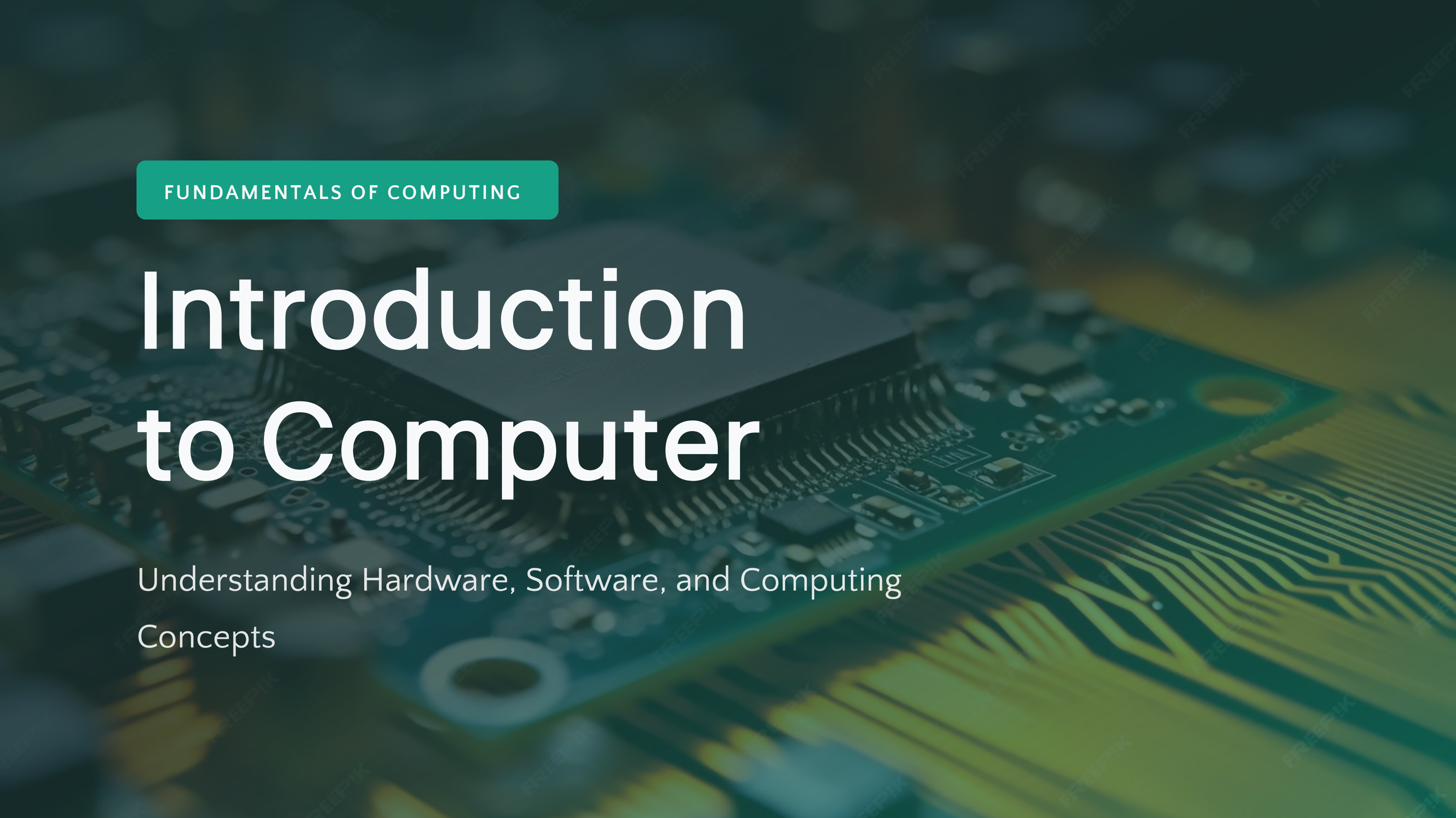
Learning Objectives

By the end of this lecture, students will be able to:

- Understand what computing is and how it works
- Identify the main parts of a computer
- Recognise different types of computers
- Understand the difference between data and information
- Give simple examples of IECT applications
- Know how input and output devices connect to the computer



FUNDAMENTALS OF COMPUTING

Introduction to Computer

Understanding Hardware, Software, and Computing Concepts

Learning Path

What You'll Learn

01

Computer Hardware Components

Explore the physical parts of computers, from processors to memory systems

02

Computer Software Types

Understand system software and application software with examples

03

Computing, Data & Information

Learn the DIKW hierarchy and transformation from data to wisdom

04

IECT Applications

Discover real-world applications in governance, education, and healthcare

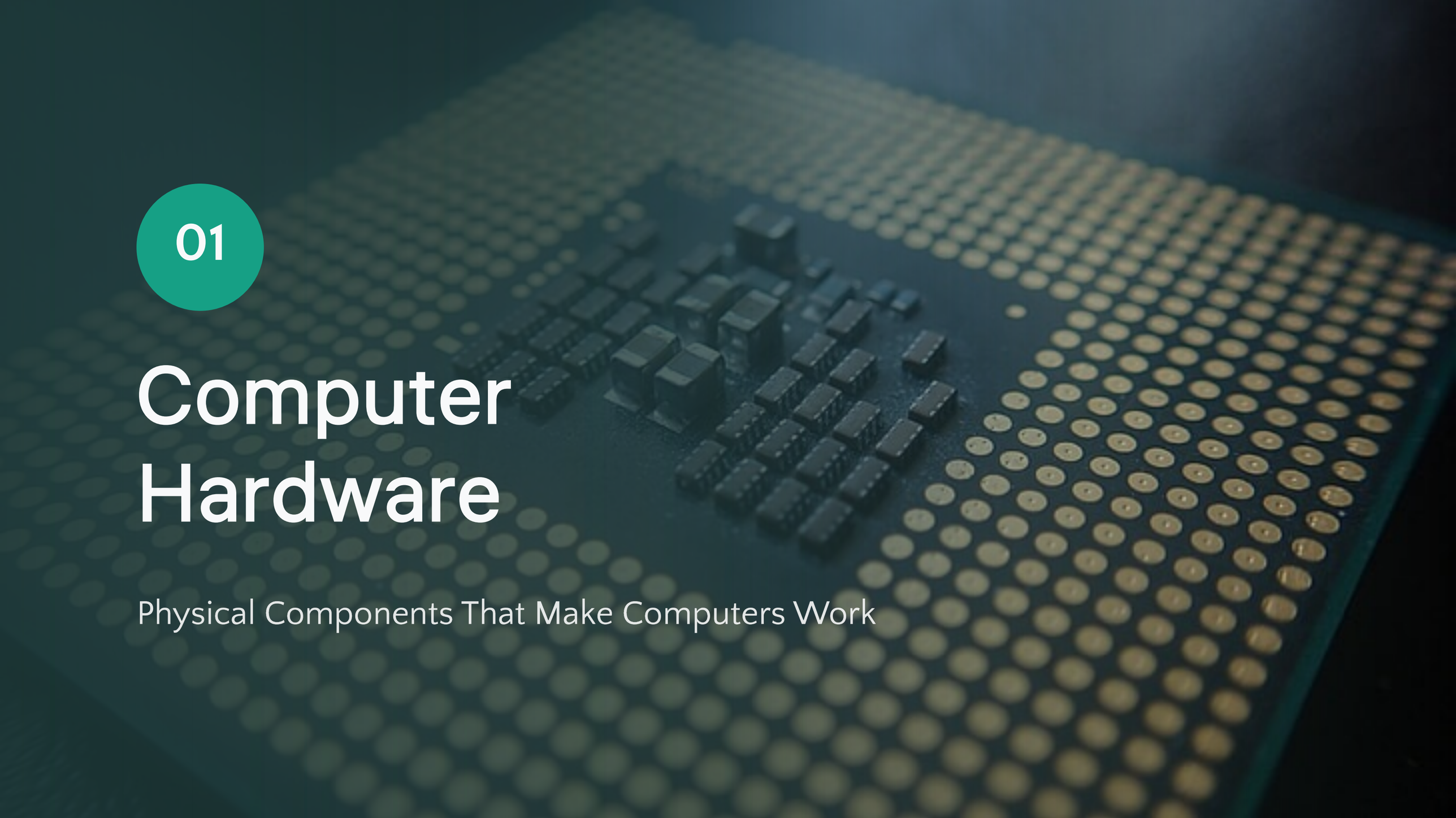
05

Connecting I/O Devices

Master USB, HDMI, DisplayPort, and wireless connections

Key Takeaway

By the end, you'll understand how computers process information and how to leverage technology effectively in various domains.



01

Computer Hardware

Physical Components That Make Computers Work

Hardware Fundamentals

Core Hardware Components

Central Processing Unit (CPU)

The brain of the computer that executes instructions and processes data. It performs calculations, makes decisions, and controls all computer operations through the fetch-decode-execute cycle.

- Arithmetic Logic Unit
- Control Unit
- Registers

Memory (RAM & ROM)

RAM (Random Access Memory): Volatile, temporary memory that stores data and programs currently in use. **ROM (Read-Only Memory):** Non-volatile memory containing permanent startup instructions.

- Volatile vs Non-volatile
- Fast Access Speed

Storage Devices

HDD (Hard Disk Drive): Magnetic storage with large capacity and lower cost. **SSD (Solid State Drive):** Flash-based storage with no moving parts, offering faster speeds and better reliability.

- Magnetic vs Flash
- Capacity & Speed

Motherboard

The main circuit board connecting all components. It contains slots for RAM, CPU socket, expansion slots, and interfaces for storage and I/O devices.

Power Supply

Converts AC power to regulated DC power at correct voltages for computer components.

How They Work Together

Components communicate via the motherboard. The CPU processes data loaded from storage into RAM, executing instructions to transform input into output.

Processor Deep Dive

Central Processing Unit (CPU) Architecture

ALU

Arithmetic Logic Unit (ALU)

The computational engine performing all arithmetic (+, −, ×, ÷) and logical operations (AND, OR, NOT, XOR). It processes data and sets status flags based on results.

Arithmetic
Addition, subtraction, etc.

Logical
AND, OR, NOT, XOR

CU

Control Unit (CU)

The orchestra conductor managing the fetch-decode-execute cycle. It fetches instructions, decodes them, and generates control signals to coordinate all CPU components.

Instruction Fetch | Decode | Execute

The Fetch-Decode-Execute Cycle

The CPU continuously fetches instructions from memory, decodes them to understand what to do, executes the operation, and stores results, cycling millions of times per second.

CPU Registers

High-speed temporary storage within the CPU for immediate processing needs.

Program Counter (PC):
Stores address of next instruction

Memory Address Register(MAR):
Stores address of data being accessed

Memory Data Register (MAR):
Buffers data between CPU and memory

Instruction Register (IR):
Holds current instruction being executed

Accumulator (AC):
Stores operands and operation results

Buses

Data highways connecting CPU components.

A **Address Bus**
Carries memory addresses

D **Data Bus**
Transfers actual data

C **Control Bus**
Transmits control signals

Memory Hierarchy

Memory and Storage Systems

Primary Memory

Fast, directly accessible memory for immediate processing needs.

RAM (Volatile)

Temporary memory for active data. Volatile: Data is lost when power is off.

SRAM:
Fast, cache

DRAM:
Main memory

ROM (Non-Volatile)

Permanent memory with unchanging data. **Stores firmware** like BIOS/UEFI.

Secondary Storage

Long-term data storage that retains information without power.

HDD

Magnetic storage with spinning disks. Pros: Large capacity, low cost. Cons: Slower, less durable.

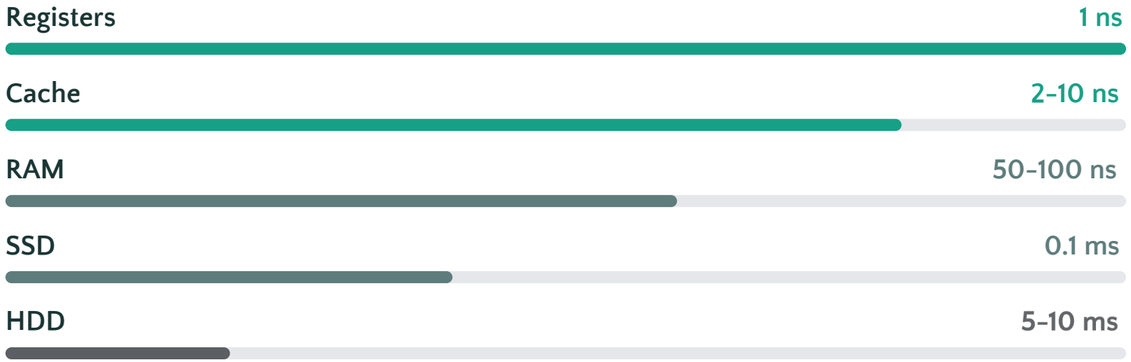
SSD

Flash-based storage with no moving parts. Pros: Very fast, durable, energy-efficient. Cons: Higher cost.

Memory Hierarchy Principle

Smaller, faster memory (registers, cache) at top; larger, slower storage (HDD, SSD) at bottom.

Speed & Capacity Comparison



Peripheral Devices

Input and Output Devices

Input Devices

Devices that **send data and commands** to the computer, allowing users to interact and provide instructions.

Keyboard
Primary text input device

Mouse
Point-and-click interface

Microphone
Audio input and voice commands

Webcam
Video input for calls

Scanner
Converts documents to digital

Touchpad
Laptop cursor control

Output Devices

Devices that **receive and display** processed information from the computer in human-readable form.

Monitor
Primary visual display

Printer
Physical document output

Speakers
Audio output for media

Headphones
Private audio listening

Projector
Large screen display

Storage
Saves data for later use

Real-World Example

Creating a document: use a keyboard to type, a mouse to navigate, and a microphone for voice-to-text.

Input vs Output

Input → Computer: You provide data.

Computer → Output: Computer provides processed info.

Bidirectional: Some devices are both (e.g., touchscreen, network).

02

Computer Software

Programs That Bring Hardware to Life

Software Classification

Types of Software: System vs Application

System Software

Controls hardware and provides a platform for apps. Runs in the background and is essential for the system to function.

Operating System (OS)
Manages hardware (e.g., Windows, macOS, Linux, Android).

Device Drivers
Enable OS-hardware communication (e.g., printer drivers).

Firmware
Embedded software for low-level hardware control (e.g., BIOS).

Utility Software
Maintains and optimizes systems (e.g., antivirus, disk tools).

Key Characteristics

- ✓ **Mandatory:** System cannot run without it.
- ✓ **Background operation:** Users don't interact with it directly.
- ✓ **Pre-installed:** Comes with the operating system.

Application Software

User-oriented programs designed for specific tasks. Interacts directly with users and cannot run without system software.

Productivity Software
Document creation (e.g., MS Word, Excel, PowerPoint).

Web Browsers
Accessing the internet (e.g., Chrome, Firefox, Safari).

Multimedia Software
Media editing and playback (e.g., VLC, Photoshop).

Communication Tools
Email, messaging, video calls (e.g., Slack, Zoom).

Key Characteristics

- ✓ **Optional:** Users choose what to install.
- ✓ **User interaction:** Direct interface for tasks.
- ✓ **Specific purpose:** Designed for one type of task.

System Integration

How Software Works with Hardware

Software provides instructions, and hardware executes them. This interaction happens in milliseconds every time you use a computer.

The Interaction Flow

1. **Input Device** — Signal sent
2. **OS Interprets** — Input decoded
3. **App Processes** — Command executed
4. **CPU Executes** — Instructions run
5. **Output Device** — Result displayed

Abstraction Layers

Software creates abstraction layers, allowing developers to build apps without managing hardware directly.

APIs & Drivers

APIs let apps communicate with the OS, while drivers let the OS communicate with hardware.

Real-Time Example

Pressing a key sends a signal through the chain, resulting in a character appearing on screen in milliseconds.

> **Key Insight:** Hardware without software is inert. Software without hardware is theoretical. Together, they create the digital experience.

03

Computing Concepts

From Data to Wisdom

Understanding Information

Data vs Information: Understanding the Difference

What is Data?

Raw, unprocessed facts without context or meaning. Data can be numbers, symbols, or observations that need processing to become useful.

Key Characteristics:

- Raw and unorganized
- Context-free and meaningless alone
- Discrete units (numbers, text)
- Abundant and continuously generated

What is Information?

Processed, organized data with context and meaning. Information answers "what," "when," and "where" questions, enabling understanding.

Key Characteristics:

- Processed and organized
- Contextualized and meaningful
- Answers specific questions
- Supports decision-making

Transformation Process

Data → (Processing, Organization, Context) → Information → (Analysis, Experience) → Knowledge → (Judgment) → Wisdom

The DIKW Hierarchy

A framework showing how value is extracted from raw data.

D — Data
Raw facts (e.g., 100, 75, 50).

I — Information
Processed data with context.

K — Knowledge
Understanding patterns.

W — Wisdom
Making sound judgments.

Practical Example: Student Grades

Data: 85, 92, 78, 88, 90

Information: Average score is 86.6%.

Knowledge: Scores are consistently high, indicating strong performance.

Wisdom: Student should be recommended for advanced courses.

04

IECT Applications

Real-World Impact of Information Electronics and Communication Technology

Real-World Impact

IECT in Governance, Education, and Healthcare

IECT (Information Electronics and Communication Technology) integrates computing, electronics, and communications to transform how we live, work, and connect. It improves efficiency, accessibility, and quality of services across all sectors.

E-Governance

Uses IECT to improve government operations, transparency, and citizen services.

Digital Identity:
Aadhaar, digital passports

Online Services:
Tax filing, license renewals

Digital Platforms:
MyGov, India.gov.in

E-Learning

Delivers education via digital platforms, breaking geographical barriers.

Virtual Classrooms:
Zoom, Google Classroom

MOOCs:
Coursera, edX, Khan Academy

Digital Libraries:
E-books, journals, videos

Telemedicine

Delivers healthcare remotely using telecommunications technology.

EHRs:
Digital patient records

Remote Consultations:
Video appointments

Other Key Sectors

E-Commerce: Online shopping, digital payments.

Smart Cities: IoT for traffic, utilities, safety.

Finance: Online banking, trading, crypto.

05

Device Connections

Connecting Your Digital World

Connectivity Standards

Connection Interfaces and Protocols

USB (Universal Serial Bus)

Most common interface for peripherals. **Plug-and-play** and **hot-swappable**.

USB 2.0	480 Mbps
USB 3.0/3.1	5-10 Gbps
USB-C Reversible, supports power & video.	10-40 Gbps

HDMI

Standard for TVs, monitors, and projectors. Transmits digital video and audio.

HDMI 1.4	4K @ 30Hz
HDMI 2.0	4K @ 60Hz
HDMI 2.1	4K @ 120Hz, 8K

Display Port

Favored for high-performance displays. Supports higher bandwidth and daisy-chaining.

DP 1.2	4K @ 60Hz
DP 1.4	4K @ 120Hz, 8K
DP 2.1 Up to 80 Gbps bandwidth.	8K @ 120Hz+

Other Connections

- **Ethernet (RJ-45):**
  Wired internet connection.
- **Audio Jack (3.5mm):**
  For analog audio devices.
- **Bluetooth:**
  For wireless peripherals.

Practical Guide

Connecting Peripherals to CPU

Connecting devices properly ensures they work reliably. Most modern connections use **plug-and-play**, where the OS automatically detects and configures new devices.

Connection Methods

Wired Connections

- **USB:** Keyboards, mice, printers.
- **HDMI/DP:** Monitors, projectors.
- **Ethernet:** Network cable for internet.

Wireless Connections

- **Bluetooth:** Pair in OS settings.
- **Wi-Fi:** Wireless internet.

Troubleshooting Common Issues

Device Not Recognized?

- Try a different port.
- Restart the computer.
- Reinstall the device driver.

No Display Signal?

- Check cable connections.
- Select the correct input source.

Device Drivers

Software that enables the OS to communicate with hardware. Most are auto-installed, but some may require manual installation.

Driver Functions:

- Translate OS commands for hardware
- Enable advanced features
- Ensure compatibility

Connection Checklist

- [ ] Power off device (if required).
- [ ] Connect to the correct port.
- [ ] Power on and wait for detection.
- [ ] Install drivers if necessary.
- [ ] Test the device to confirm it works.

Your Computing Journey Begins

Understanding computer fundamentals empowers you to leverage technology effectively. From hardware components to software applications, from raw data to meaningful information—computers transform how we work, learn, and connect.

Master the Hardware

Understand the physical components and how they work together.

Embrace the Software

Leverage programs and applications to accomplish your goals.

Apply in Real World

Use IECT to make a positive impact in your community.

The future belongs to those who understand technology.