Introduction to Peripherals & Smart Chips

Cours: 1st year computer science students.

Open source cours

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What Will We Learn Today?

Understand The fundamental difference between peripherals and smart chips

Identify Common peripherals and their roles in a computer system

Explore The world of smart chips and how they power modern technology

Learn The basic working principles behind these essential hardware components

Our Roadmap for Today

1

Part 1: Peripherals

- What is a Peripheral?
- Exploring 10 Common Examples

2

Part 2: Smart Chips

- What is a Smart Chip?
- Discovering 8 Key Technologies

3

Summary & Q&A

- Key Takeaways
- Questions & Discussion

Part 1: Peripherals - Extending Your Computer

Definition

A peripheral is an external device that connects to a computer to add functionality. Think of them as helpers that allow the computer to interact with the outside world.

Main Categories

Input

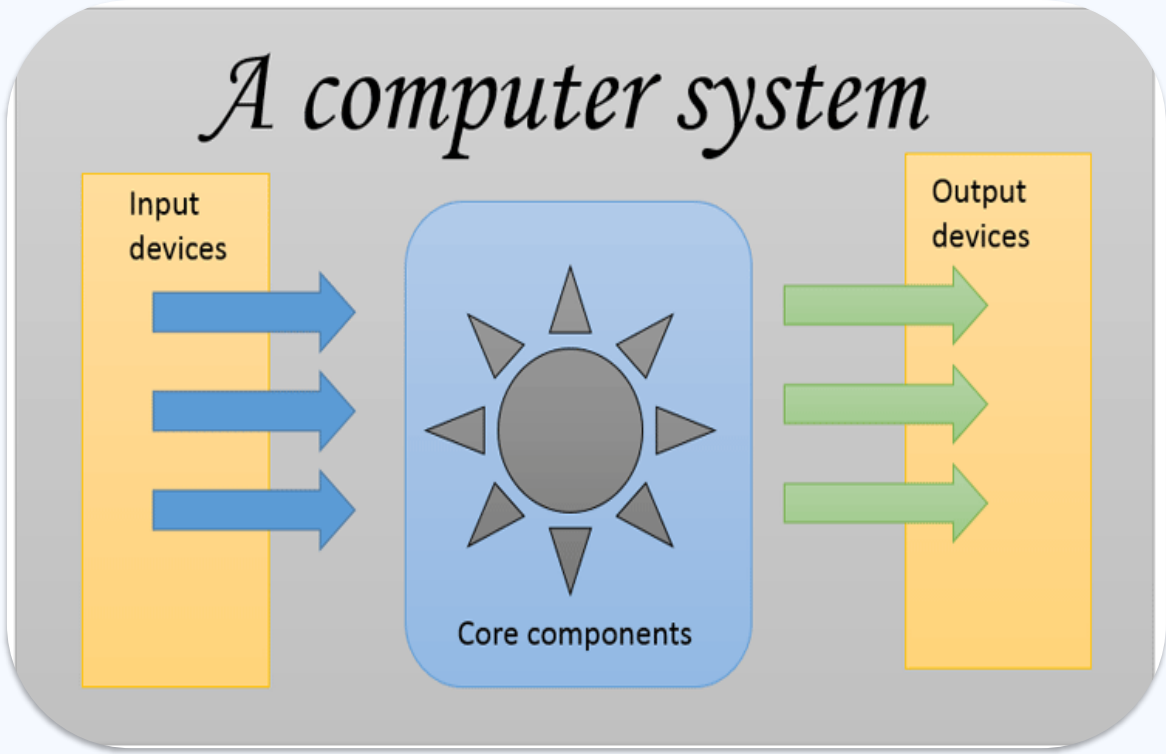
Devices that send data to the computer (e.g., keyboard)

Output

Devices that receive data from the computer (e.g., monitor)

Storage

Devices that store data (e.g., external hard drive)



The Primary Input Device

Goal

To input text, numbers, and commands into a computer

How it Works

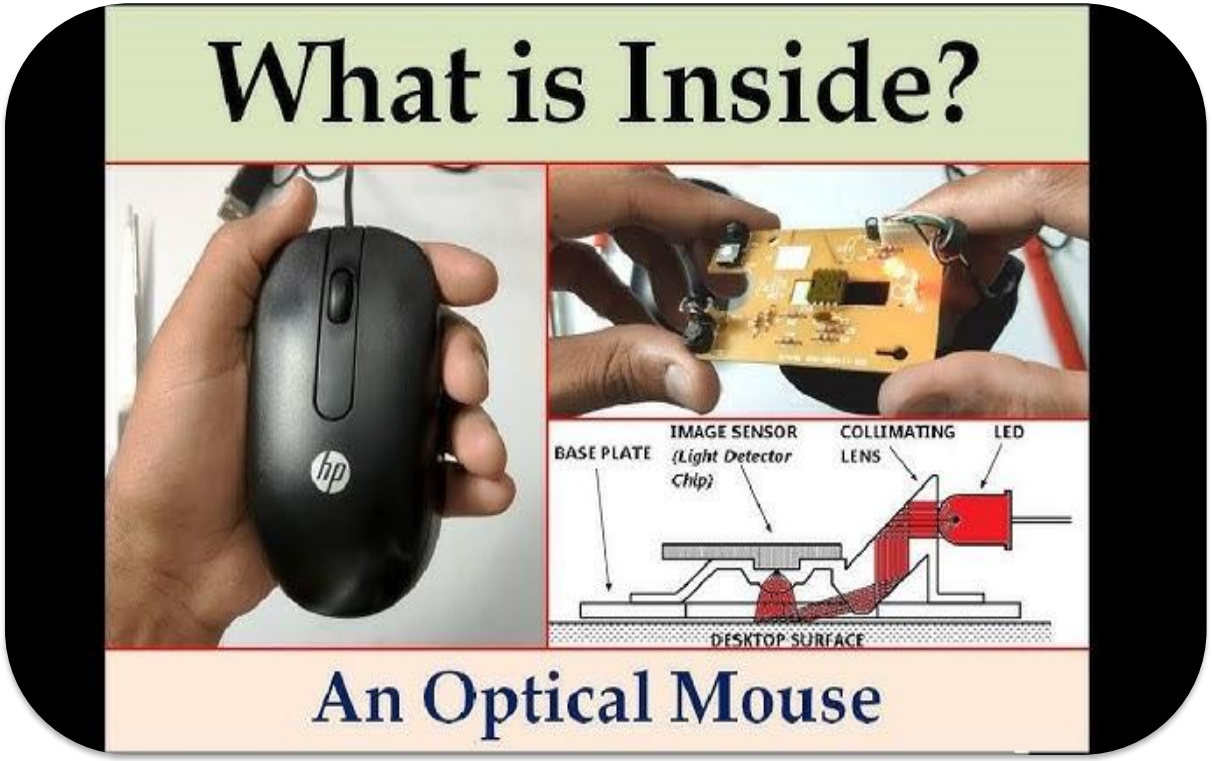
1. Press a key → Complete an electrical circuit
2. Keyboard processor detects which key was pressed
3. Sends unique "scan code" to computer
4. Computer displays corresponding character

Pointing and Clicking

Goal: To control the on-screen cursor, select objects, and navigate interfaces.

How it Works

- Optical/laser sensor takes thousands of pictures per second
- Compares images to detect direction and speed
- Movement data sent to computer
- Cursor moves accordingly on screen



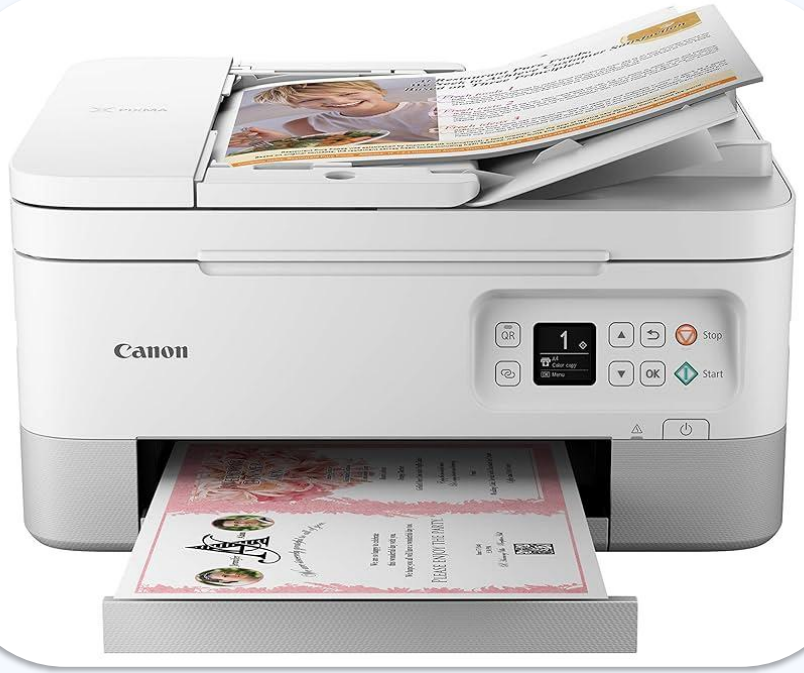
From Digital to Physical

Goal

Create a physical copy ("hard copy") of a digital document or image

How it Works (Inkjet)

1. Computer sends document data to printer
2. Tiny nozzles spray microscopic ink droplets
3. Ink applied in precise pattern on paper
4. Ink dries, forming image or text



Modern inkjet printers can produce high-quality color prints with precise detail

From Physical to Digital

Goal

Convert a physical document or image into a digital file

How it Works

1. Bright light moves across document, illuminating it
2. Sensor array captures reflected light as dots
3. Data assembled by software into complete digital image
4. Digital file saved in various formats (PDF, JPG, etc.)

Modern scanners can capture high-resolution images with precise color accuracy

Capturing the World in Pixels

Goal

Capture still images and video in a digital format

How it Works

1. Light passes through lens, focusing onto image sensor
2. Sensor (CCD/CMOS) with millions of pixels converts light to electrical signal
3. Processor converts signal into digital image file (JPEG, RAW)
4. Digital file stored on memory card or transmitted to computer

Modern DSLR cameras can capture high-resolution images with exceptional detail and color accuracy

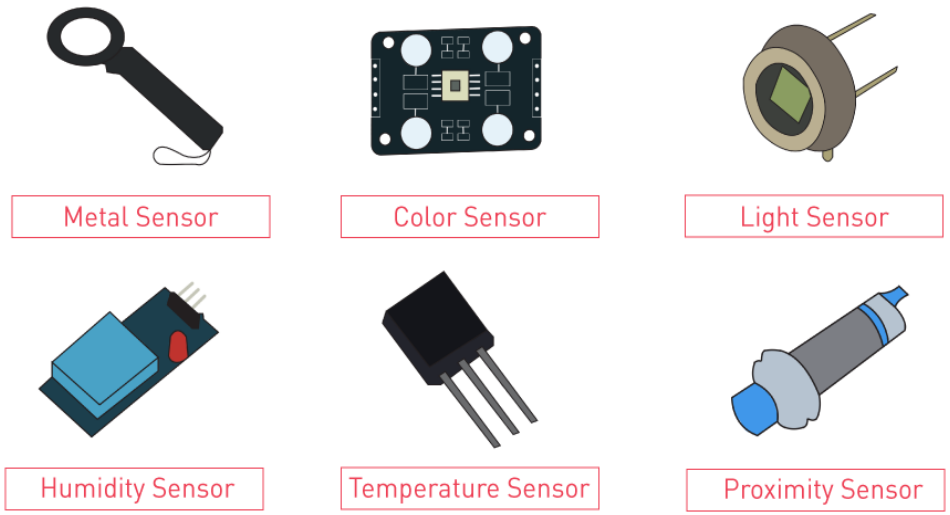
Sensing the Environment

Goal

Detect physical properties from the real world and convert them into data a computer can understand

How it Works (Motion Sensor)

1. Infrared (IR) sensor detects heat signatures in its field of view
2. When a warm object (person) moves past, sensor registers change
3. Sends electrical signal to computer
4. Triggers action (e.g., turning on a light)



Common Sensor Types

- Temperature
- Motion
- Light
- Humidity
- Sound
- Pressure

Capturing Sound

Goal

Convert sound waves into electrical audio signal for computer recording/processing

How it Works

1. Sound waves hit thin diaphragm, causing vibrations
2. Vibrations converted into electrical signal
3. Signal amplified and sent to computer
4. Sound card interprets signal as digital audio data

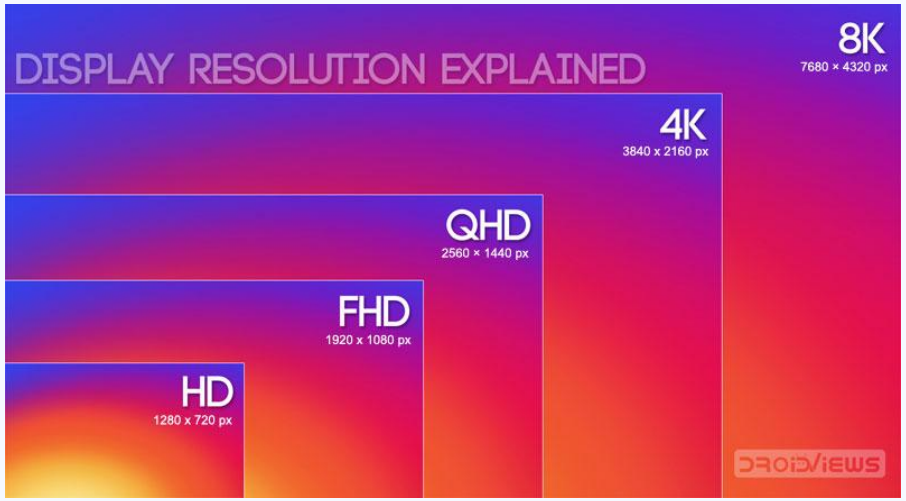
The Visual Output

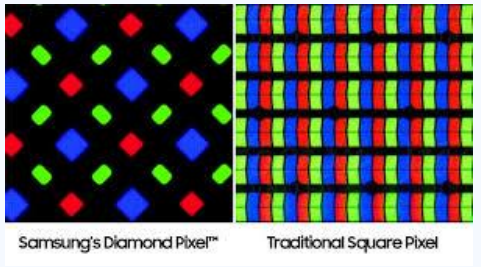
Goal

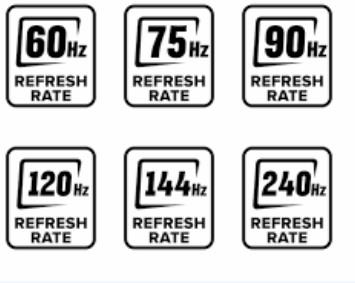
Display visual output from the computer

How it Works

1. Computer sends video signal to monitor
2. Screen composed of millions of tiny dots (pixels)
3. Each pixel assigned specific color and brightness
4. Pixels combine to form complete image







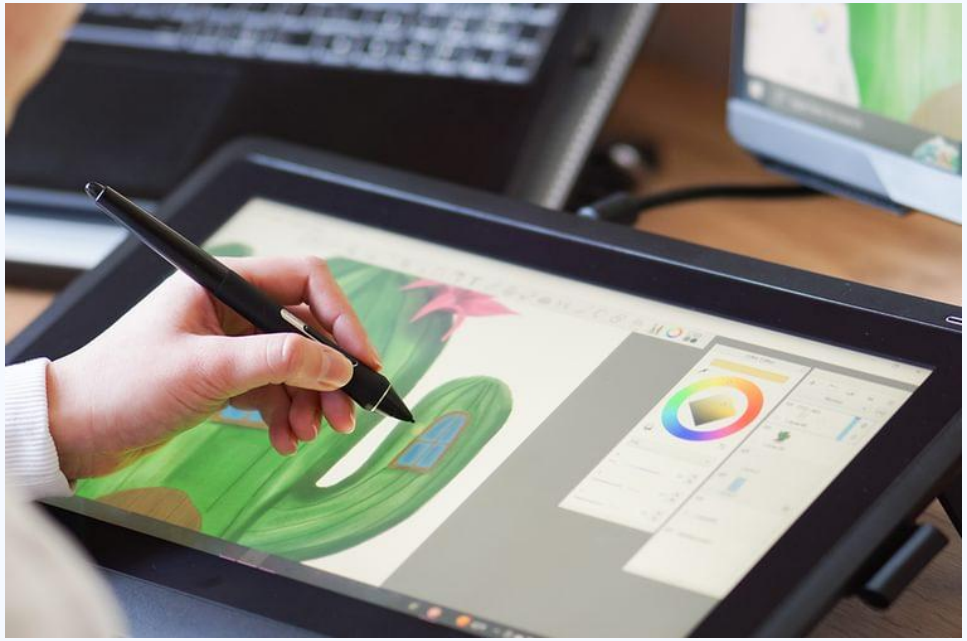
Drawing Digitally

Goal

Allow artists to draw or paint digitally with a stylus, offering more control than a mouse

How it Works

1. Tablet surface contains grid of sensors
2. Stylus emits signal detected by sensors
3. Sensors pinpoint exact position and pressure
4. Data sent to computer for natural brushstrokes



Graphics tablets provide precise control for digital art and design work

Pressure Sensitivity

Tilt Recognition

Natural Feel

Your Eyes on the Web: webcam

Goal

Capture video and stream it over the internet for video calls, streaming, or recording

How it Works

1. Lens and image sensor capture video
2. Video compressed in real-time
3. Data sent to computer via USB connection
4. Computer processes and streams video

Modern webcams provide high-quality video for remote communication and content creation

- HD Resolution
- Built-in Mic
- Auto-focus

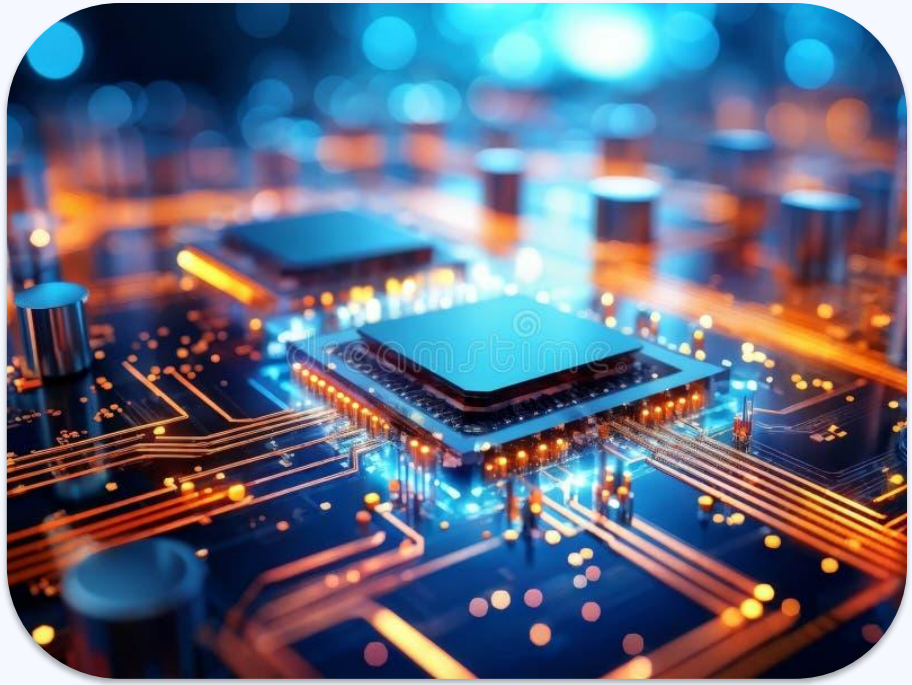
Part 2: Smart Chips - The Brains Inside

Definition

A smart chip is a small, integrated circuit (microchip) designed to perform a specific, intelligent function. They are the dedicated "brains" inside countless modern devices.

Key Characteristics

- Specialized functionality
- Integrated circuit design
- Intelligent processing capabilities
- Found in everyday technology



Did You Know?

Modern smart chips can contain billions of transistors on a single piece of silicon smaller than a fingernail!

Radio-Frequency Identification

Goal

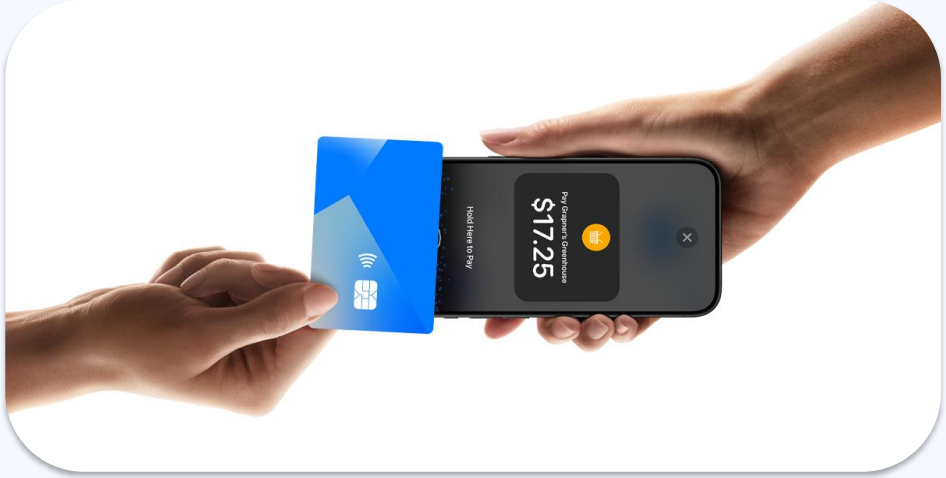
To wirelessly identify and track objects

How it Works

1. RFID reader emits radio waves
2. Waves hit RFID tag with tiny antenna and chip
3. Tag powers up from radio energy
4. Tag transmits unique ID back to reader

Common Uses

- Inventory
- Access Cards/passport
- animal Microchips



RFID Range

Passive RFID: Up to 25 meters
Active RFID: Up to 100+ meters

Near Field Communication

Goal

Allow two devices to exchange data when very close together (few centimeters)

How it Works

1. Both devices create small magnetic field
2. When devices touch or get very close, fields interact
3. Small amount of data transferred securely
4. Process completes in milliseconds

Common Uses

- Contactless Payments
- File Sharing
- Contactless identification

Security Features

Short range (≤4cm) prevents accidental connections
Encrypted data transmission
Requires physical proximity for access

The Dedicated Brain: Computer-on-a-chip

Goal

Provide processing power for specific, single-purpose devices

How it Works

1. Computer-on-a-chip designed for fixed programs (firmware)
2. Takes input from buttons or sensors
3. Controls device components (motors, displays, etc.)
4. Optimized for specific tasks with minimal power

Found In

- Washing Machines
- Microwaves
- Cars
- Digital TVs

Key Advantage

Embedded processors are highly specialized, efficient, and cost-effective for dedicated tasks

Connecting the Physical World to the Internet: internet of things: IOT

Goal

Collect data from the environment and send it over the internet for analysis or control

How it Works

1. Standard sensor (temperature, motion, etc.) combined with communication chip
2. Measures environmental conditions
3. Transmits data to cloud server or another device
4. Enables remote monitoring and control

Common Uses

- Smart Homes
- Precision Agriculture
- Industrial/military Monitoring

Connectivity

IoT sensors typically use Wi-Fi, Bluetooth, Zigbee, or cellular networks to transmit data

The microcontroller

Goal

Control specific electronic functions within a device.
Like a small, simple computer.

How it Works

1. Contains processor, memory, and I/O peripherals on one chip
2. Runs simple program that constantly checks inputs
3. Controls outputs based on input conditions
4. Optimized for low power and specific tasks

Found In

- Toys
- Remote Controls
- Robots
- IoT Devices

Key Advantage

MCUs provide cost-effective, low-power control for dedicated tasks in embedded systems

Finding Your Place on Earth

Goal

Receive signals from satellites to determine device's precise location on Earth

How it Works

1. Module listens for signals from multiple satellites
2. Calculates time it took for each signal to arrive
3. Triangulates exact position (latitude, longitude, altitude)
4. Provides location data to device applications

Common Uses

- Navigation
- Location Tracking
- Geotagging Photos

GPS Constellation

GPS uses a network of satellites orbiting Earth to provide positioning data

31	20,200	3-5m
Active Satellites	km Altitude	Accuracy

The Complete Computer on One Chip:SOC

Goal

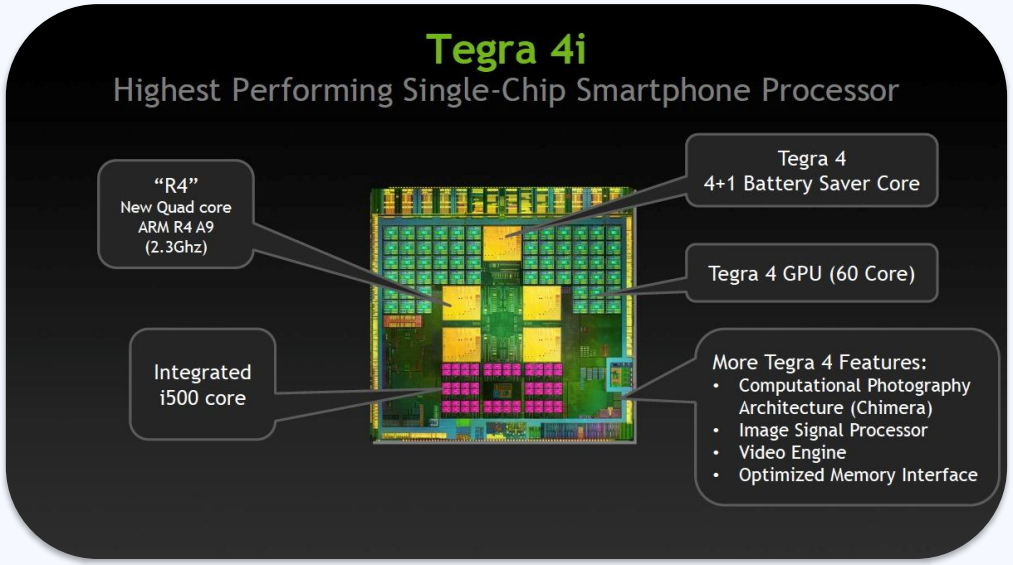
Integrate all core components of a computer onto a single, tiny chip

How it Works

1. Contains CPU, GPU, memory, and controllers in one package
2. Components connected via high-speed internal buses
3. Reduces power consumption and physical size
4. Lowers manufacturing costs for complex devices

Found In

- Smartphones
- Tablets
- Smart TVs
- Game Consoles



Key Components

SoCs integrate multiple computer components onto a single chip for efficiency

CPU Processing

GPU Graphics

RAM Memory

I/O Interfaces

Key Takeaways

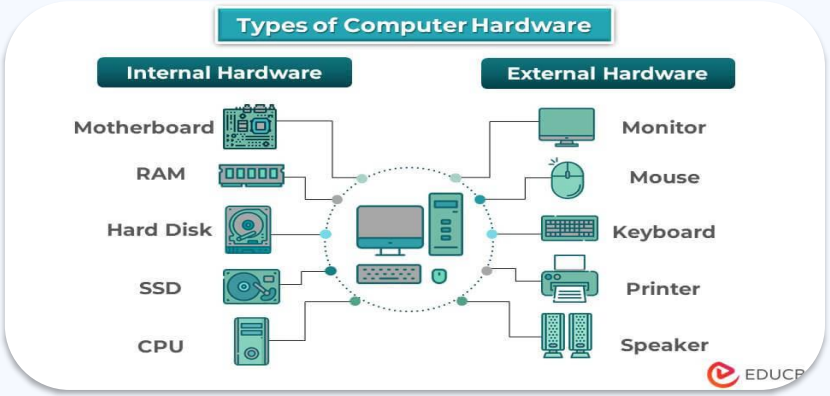
What We've Learned

Peripherals are external helpers that extend a computer's capabilities. They can be input, output, or storage devices.

Smart Chips are the specialized, intelligent "brains" that live inside our devices, making them work.

From a simple keyboard press to a complex GPS calculation, hardware is the physical bridge between our ideas and the digital world.

Understanding these components is the first step to understanding how all technology is built.



Remember

Hardware components work together to create the technology we use every day

Peripherals

External devices

Smart Chips

Internal processors

Questions?

What would you like to know about peripherals and smart chips?