

MODULE 2

Computer Hardware Components

University 100-Level Curriculum | 2026 Edition

Learning Objectives



Internal Core

Identify the Motherboard, CPU, and Memory components that drive modern processing.



Peripherals

Analyze Input/Output devices and their interface with the central system unit.



Auxiliary Gear

Understand secondary support systems including cooling, power, and networking.

Hardware vs. Software

Hardware

Physical, tangible components of a computer system. If you can kick it, it's hardware.

- Circuit Boards (Motherboard)
- Mechanical parts (Drives)
- Physical interfaces (Ports)

Software

Digital sets of instructions that tell the hardware what to do. Intangible and logic-driven.

- Operating Systems
- Application Programs
- Firmware (UEFI/BIOS)

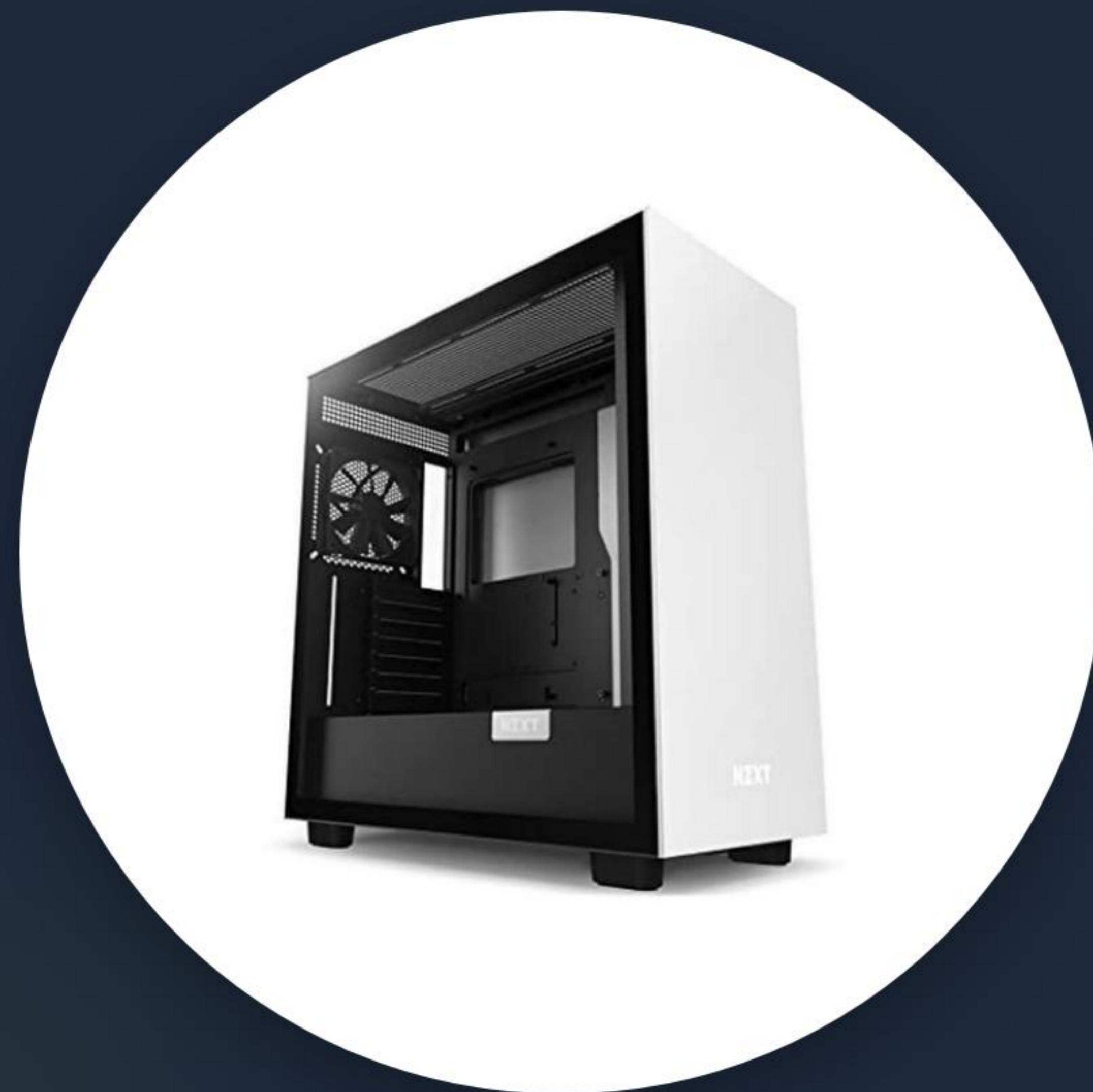
The Von Neumann Architecture

The foundation of almost all modern computing systems (1945-Present):

- ✓ **Processing Unit:** Includes ALU and Registers.
- ✓ **Control Unit:** Decodes instructions.
- ✓ **Memory:** Stores data and programs.
- ✓ **Input/Output:** User interface.



| The System Unit (Chassis)



The Protection Layer

Often called "the tower" or "case," the chassis serves several critical roles:

- 🛡 Physical Protection of components.
- 💨 Airflow Management for cooling.
- 🔌 Structural support for internal mounting.

SECTION 1

Core Hardware Components

Part 1: Internal Architecture & Processing

The Motherboard

The **central hub** that allows every other component to communicate.

- **Chipset:** Controls data flow.
- **Form Factor:** ATX, Micro-ATX, ITX.
- **VRMs:** Regulates power to the CPU.



| CPU: The System Brain



Main Function

Executes instructions by performing basic arithmetic, logic, and I/O operations of the system.



Architecture

Built from billions of microscopic transistors etched onto a silicon wafer.

| ALU and Control Unit



Arithmetic Logic Unit

Performs mathematical (+, -, *, /) and logical (AND, OR, NOT) operations.



Control Unit (cu)

Directs the operation of the processor. It tells memory and I/O how to respond to instructions.

Measuring CPU Power

6.2
GHz (Clock Speed)

Beyond the Speed

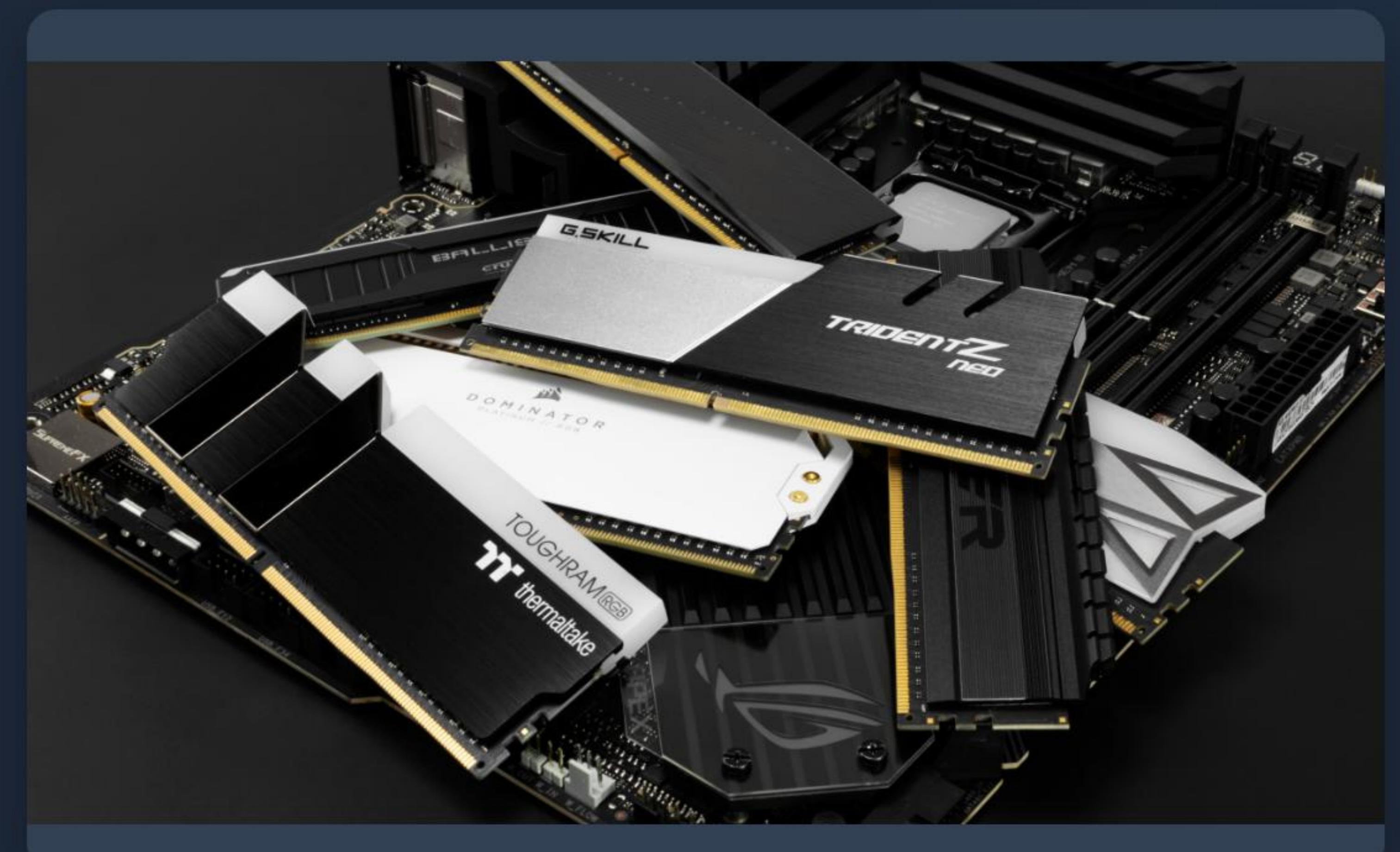
Clock speed is just one part. In 2026, multi-core performance is king.

-  **Cores:** Independent processing units.
-  **Threads:** Virtualized sequences.
-  **Cache:** L1, L2, and massive L3 pools.

RAM: Volatile Memory

Random Access Memory (RAM) provides a fast-access temporary workspace for the CPU.

- ⚡ **Volatile:** Data is lost when power is cut.
- ⌚ **Latency:** Measured in nanoseconds.
- 📦 **Capacity:** Typically 16GB to 128GB in 2026.



RAM Evolution: DDR4 vs DDR5

Feature	DDR4 (Legacy)	DDR5 (2026 Standard)
Data Rate	3200 MT/s	8400+ MT/s
Power Management	On Motherboard	On Module (PMIC)
Channel Architecture	1x 64-bit	2x 32-bit (Independent)
Burst Length	BL8	BL16

| Read-Only Memory (ROM)

Unlike RAM, ROM is non-volatile and used for permanent instructions:

-  **Firmware:** Stores UEFI or BIOS instructions to boot the PC.
-  **Non-Volatile:** Keeps data without electricity.
-  **EEPROM:** Modern variant that can be "flashed" for updates.

Graphics Processing Unit

Specialized circuits designed to accelerate computer graphics and image processing.

- ogl Ray Tracing Acceleration.
- ogl AI / Deep Learning Tasks.
- ogl VRAM (Video Memory) pools.



Integrated vs Dedicated

Integrated

Built directly into the CPU chip. Shares system RAM.
Ideal for efficiency and thin laptops.

Dedicated

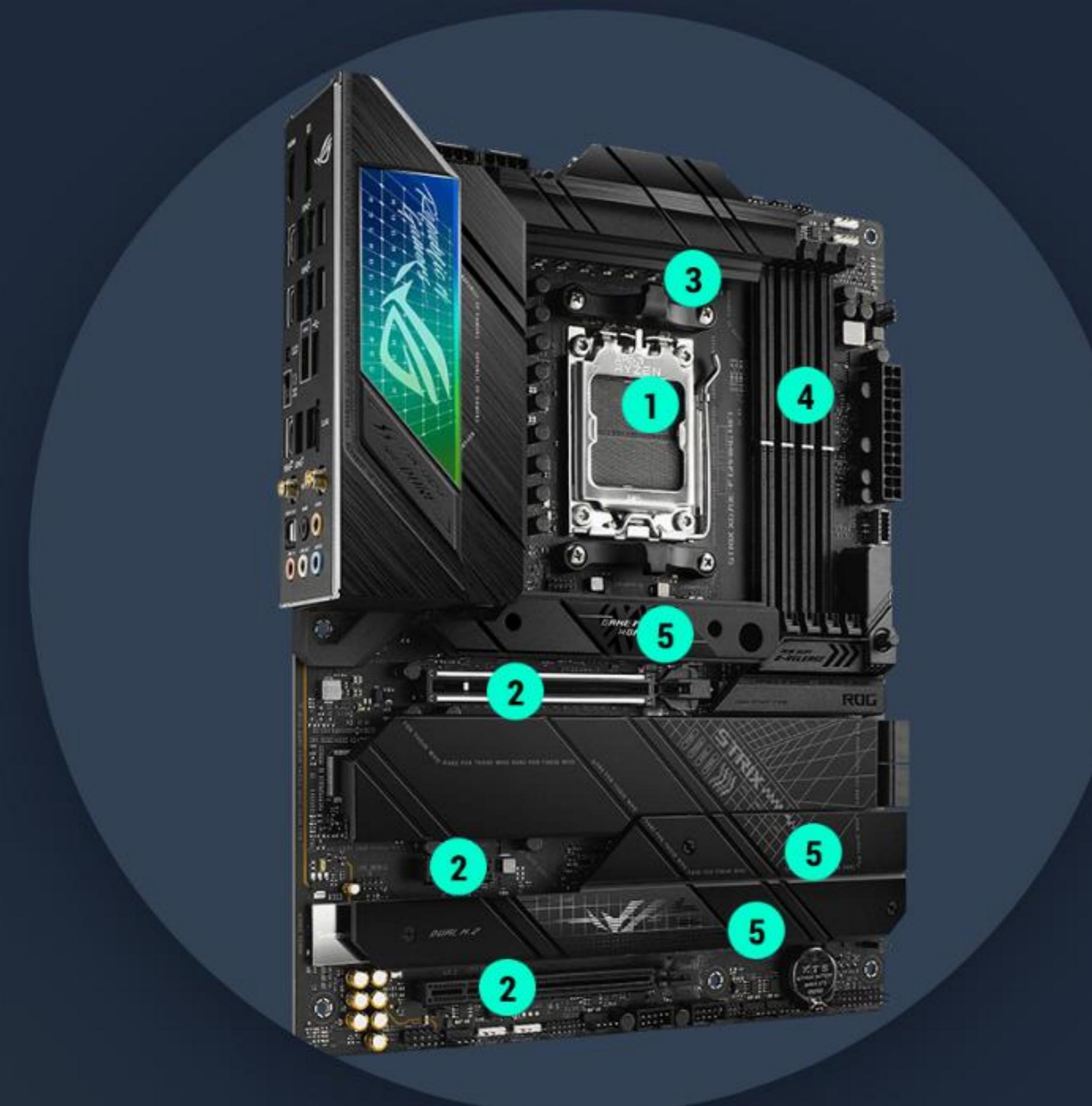
Separate card with its own cooling and memory
(VRAM). Required for gaming and 3D modeling.

| Power Supply Unit (PSU)

The PSU converts wall AC power to lower voltage DC power for internal parts:

-  **Modularity:** Fully modular units reduce cable clutter.
-  **Efficiency:** Rated as 80 Plus (Bronze, Gold, Platinum).
-  **Wattage:** Ranges from 500W to 1600W+ in high-end rigs.

The CMOS Battery



Persistent Memory

A small CR2032 button cell battery on the motherboard that preserves:

- ⌚ System Time and Date.
- 🔧 BIOS/UEFI User Settings.
- 🔌 Hardware configuration states.

The System Bus

The internal communication system consisting of pathways called "traces."

Data Bus

Transports actual data between CPU and memory.

Address Bus

Specifies where data should be sent in memory.

Control Bus

Carries commands (Read/Write) from the CPU.

SECTION 2

Peripheral Devices

Part 2: Expanding System Functionality

Input Devices Overview



Manual

Keyboards and mice for direct user input.



Optical

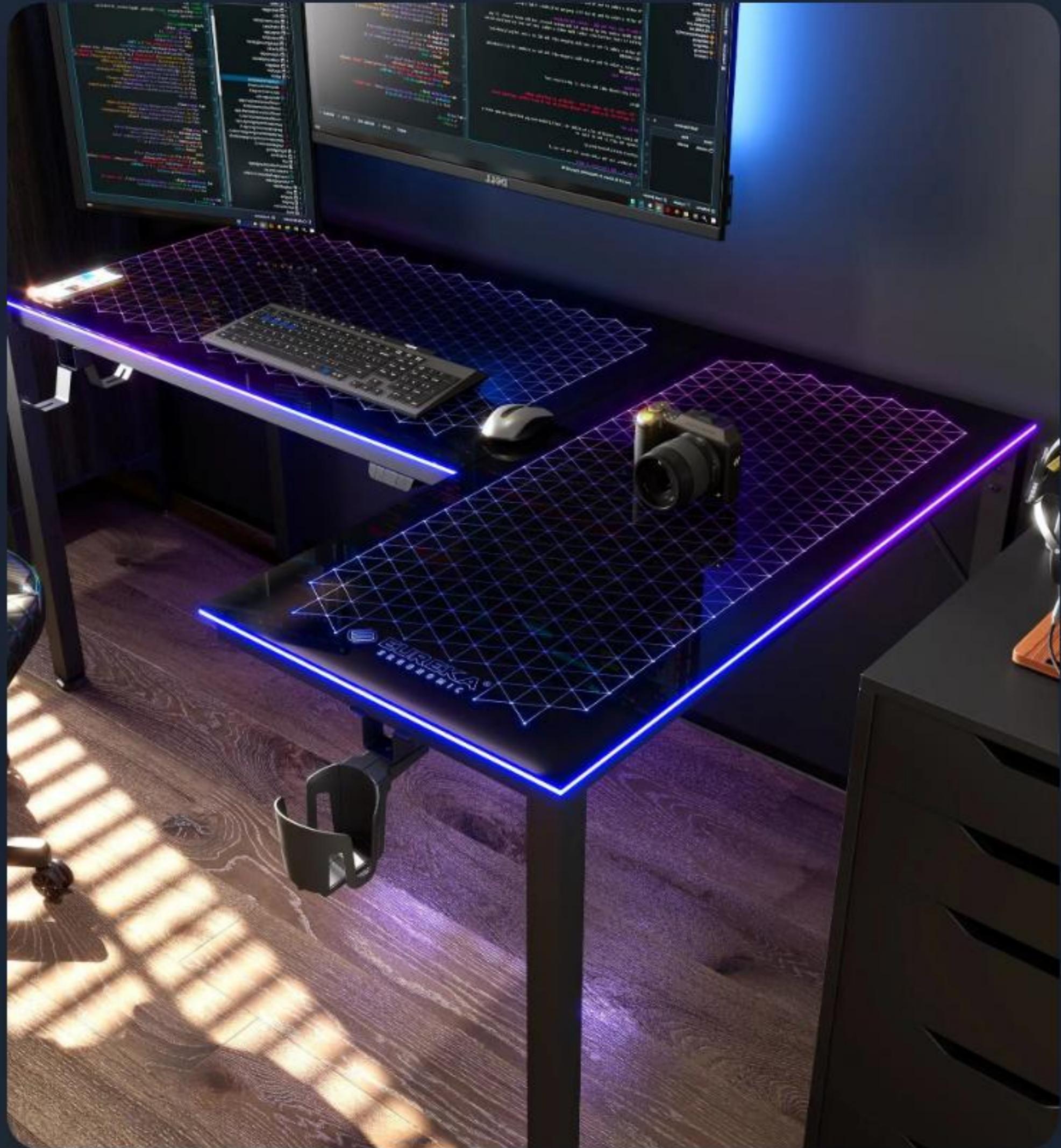
Scanners and cameras for visual data capture.



Audio

Microphones for voice and sound recording.

Modern Keyboards



Mechanical: High durability, tactile feedback.



Membrane: Quiet, portable, budget-friendly.



Ergonomic: Split-design to reduce RSI.

Pointing Devices

Essential for GUI navigation:

- **Optical Mouse:** Uses LED/Laser to track movement.
- **Trackpads:** Pressure-sensitive pads for laptops.
- **Trackballs:** Stationary device with rotating ball.



| Scanning Hardware

-  **Flatbed Scanners:** High-resolution document digitization.
-  **Barcode/QR:** Direct data entry for inventory.
-  **3D Scanners:** Digitizing physical objects for CAD/Printing.

| Audio Input

Transducers

Microphones convert sound waves into electrical signals for processing.

Voice UI

Modern sensors in 2026 support beamforming for spatial voice commands.

Visual Input

Webcams and cameras provide real-time data for:

- ▶ 8K Video Conferencing.
- ⌚ Eye-tracking navigation.
- 👉 Biometric login via IR sensors.



| Output Devices Overview



Visual

Monitors and high-lumen projectors.



Hard Copy

Printers and 3D manufacturing units.



Audio

Speakers and spatial audio arrays.

Monitors (Displays)



Display Technologies

- ✓ **OLED:** Infinite contrast, self-emissive pixels.
- ✓ **Micro-LED:** High brightness without burn-in risk.
- ✓ **Refresh Rate:** 240Hz+ for ultra-smooth motion.

Resolution Trends

Resolution	Pixels (W x H)	Common Usage (2026)
Full HD	1920 x 1080	Entry-level / Mobile
4K (Ultra HD)	3840 x 2160	Professional Standard
8K	7680 x 4320	Content Creation / Vision Pro

| Printing Technologies

Inkjet

Sprays liquid ink. Best for high-quality photos and colored documents.

Laser

Uses toner and static electricity. Faster and more cost-efficient for text.

Audio Output



Spatial Audio

Advanced DSP (Digital Signal Processing) allows for immersive 360-degree sound via:

- 🎧 Active Noise Canceling sets.
- 🔊 Multi-channel surround systems.
- ⚙️ Bone conduction transducers.

| Display Projectors

Used for large-scale viewing in boardrooms or theaters:

-  **DLP:** Uses millions of tiny mirrors.
-  **Laser Projectors:** High color accuracy and 20k+ hours life.
-  **Short Throw:** Projects huge images from inches away.

Biometric Peripherals

99.9

% Accuracy (2026)

Identity Verification

Hardware security integrated into external devices:

 Capacitive Fingerprint Sensors.

 IR-based Face Recognition.

 Iris Scanning for high-security PCs.

| Game Controllers

Haptic Feedback

Advanced actuators provide tactile sensations representing physical environments.

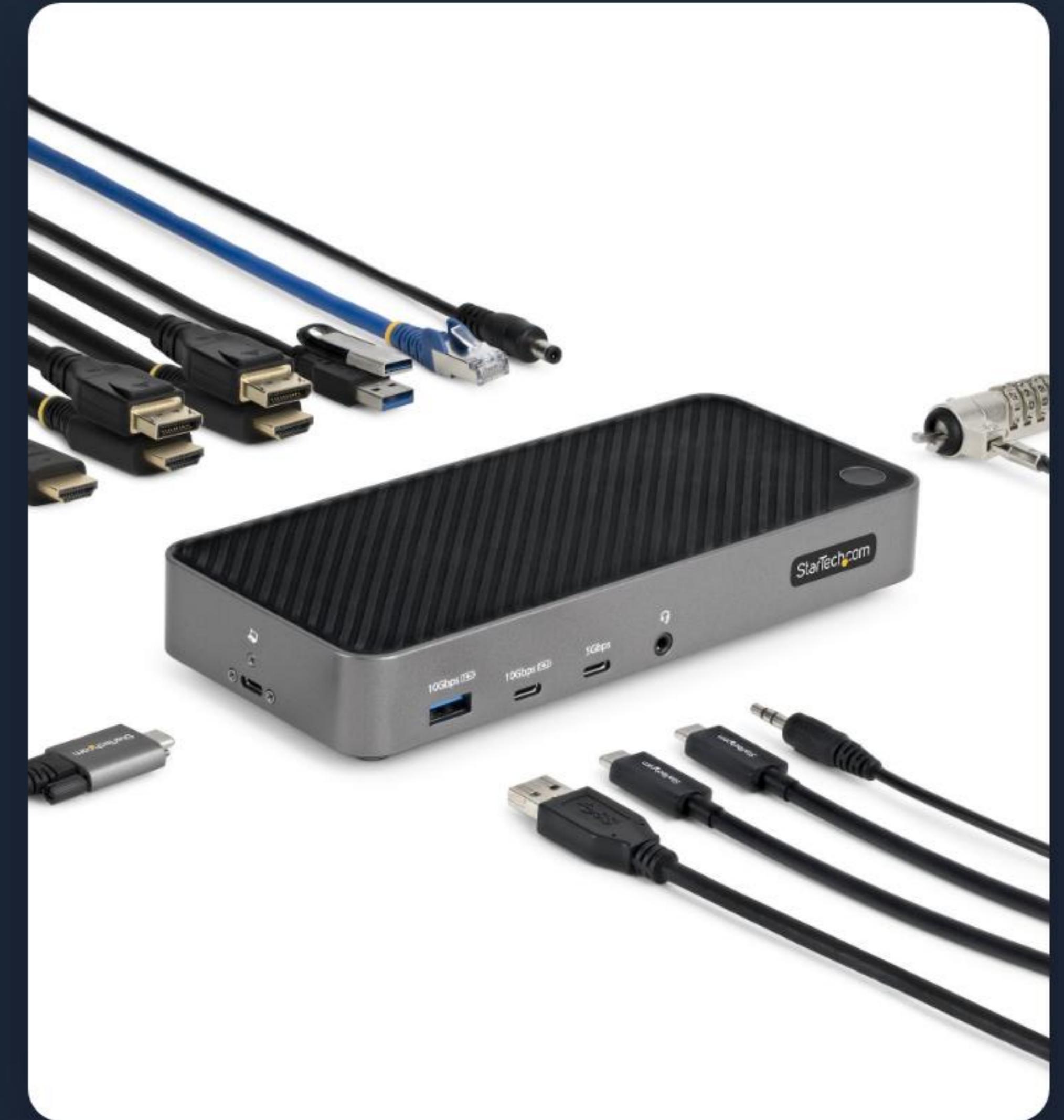
Motion Tracking

6DOF (Degrees of Freedom) sensors track controllers in 3D space.

External Storage



USB Flash: Portable, durable solid-state storage.



SD/MicroSD: Standard for cameras and mobile devices.



Portable NVMe: Extreme speeds (10GB/s+) for pro workflows.

| Device Connectivity

Standard	Max Speed	Physical Connector
USB 4 (v2)	80 Gbps	USB Type-C
Thunderbolt 5	120 Gbps	USB Type-C
Bluetooth 5.4	2 Mbps	Wireless (ISM Band)

SECTION 3

Auxiliary Equipment

Part 3: Protection, Cooling, and Infrastructure

| Cooling Systems

Heat is the primary enemy of silicon performance and longevity.

⌚ Prevents Thermal Throttling.

♾ Increases component life.

🔊 Advanced fans reduce noise.



| Air vs Liquid Cooling

Air Cooling

Uses metal heat sinks and fans. Reliable, cost-effective, and easy to maintain.

Liquid Cooling

Uses coolant pumped through loops. Superior heat dissipation for high-end tasks.

| Power Protection (UPS)



Battery Backup

An Uninterruptible Power Supply (UPS) provides:

- Emergency power for safe shutdown.
- Surge suppression for circuit spikes.
- Line conditioning for "clean" AC.

Network Equipment



Router/Modem

Directs traffic between the ISP and local devices.



NIC

Network Interface Card. Connects the PC to the medium.



Wi-Fi 7

Modern standard (2026) for ultra-low latency wireless.

Expansion Cards

Cards inserted into PCIe slots to add specific features:

-  **Sound Cards:** High-fidelity audio processing.
-  **Capture Cards:** Real-time video encoding for streamers.
-  **NPU Cards:** Dedicated AI accelerators for legacy systems.

Internal Cabling

SATA

Data cables for older HDDs and SSDs. Supports up to 6 Gbps.

PCIe Power

High-wattage cables (like the 12VHPWR) that drive GPUs.

External Display Standards

Connecting output devices:

-  **HDMI 2.1:** Supports 4K/120Hz and eARC.
-  **DisplayPort 2.1:** High-end pro standard with massive bandwidth.
-  **Cat 6a/7:** 10Gbps Ethernet wiring.



| Docking and KVM



Docks: Single-cable multi-monitor setups.



KVM: One set of peripherals for 2+ PCs.

Workstation Ergonomics

Equipment to prevent physical strain:

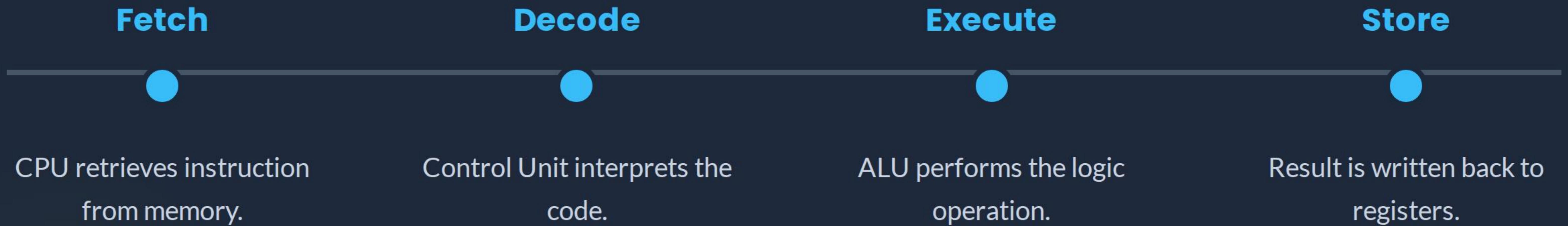
- ↔ **Monitor Arms:** Adjusting screen height for eye level.
- 👉 **Wrist Rests:** Soft support for typing/mouse usage.
- 👈 **Lumbar Support:** Maintaining spinal health in chairs.

SUMMARY

Review and Future Trends

Part 4: Synthesis and System Maintenance

Instruction Cycle



| 2026 Trend: The NPU

45
TOPS (AI Perf)

Neural Processing Units

Integrated AI accelerators that offload local LLM tasks from the CPU/GPU.

-  **Efficiency:** Lower power AI compute.
-  **Modular Laptops:** User-swappable parts.

Hardware Maintenance

-  **Dusting:** Compressed air to prevent fan clogging.
-  **Thermal Paste:** Replacing paste every 2-3 years.
-  **Cable Management:** Ensuring clean airflow paths.
-  **POST Check:** Recognizing beep codes for boot failures.

Questions?

Thank you for participating in Module 2.

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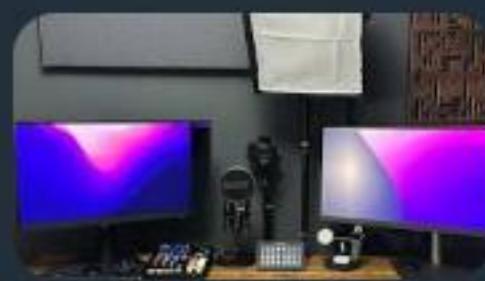
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