



Central Processing Unit (CPU)

CPU Basics

Function: The "brain" of the computer, executing instructions and performing calculations.
Key Specs:
<ul style="list-style-type: none"> Clock Speed (GHz): How many instructions the CPU can execute per second. Cores: Number of independent processing units. Threads: Virtual cores that improve multitasking (Hyper-Threading). Cache (L1, L2, L3): Fast memory for frequently accessed data. TDP (Thermal Design Power): Maximum heat the CPU will generate (Watts).
Manufacturers: Intel, AMD
Socket Type: Physical interface on the motherboard (e.g., LGA 1700, AM5).

CPU Architecture

Cores	Independent processing units. More cores generally improve multitasking and performance in multi-threaded applications.
Threads	Virtual cores (Hyper-Threading in Intel CPUs, SMT in AMD CPUs). Allow a single physical core to handle two independent sets of instructions concurrently.
Cache Memory	Small, fast memory used to store frequently accessed data. L1 cache is the fastest and smallest, followed by L2 and L3.

Common CPU Issues

- Overheating:** Can cause performance throttling or system instability. Ensure proper cooling (heatsink, cooler, liquid cooling).
- Incompatible Socket:** CPU must match the motherboard's socket.
- Driver Issues:** Outdated or corrupted drivers can cause problems.

Random Access Memory (RAM)

RAM Fundamentals

Function: Temporary storage for data and instructions that the CPU is actively using.
Key Specs:
<ul style="list-style-type: none"> Capacity (GB): Total amount of RAM. Speed (MHz): Data transfer rate. Type: DDR4, DDR5 (Different generations, not interchangeable). Latency (CAS Latency): Delay in clock cycles between requesting data and receiving it.
Form Factors: DIMM (desktop), SO-DIMM (laptop)
Dual/Quad Channel: Improves memory bandwidth by using multiple memory channels.

RAM Configurations

Single Channel	RAM operates in a single pathway to the CPU. Least efficient configuration.
Dual Channel	RAM operates in two pathways, doubling the bandwidth. Requires two identical RAM sticks in matching slots.
Quad Channel	RAM operates in four pathways, quadrupling the bandwidth. Requires four identical RAM sticks in matching slots. Commonly found in high-end desktop and server platforms.

Common RAM Issues

- Incompatibility:** RAM must be compatible with the motherboard (DDR type, speed).
- Insufficient Capacity:** Can lead to slow performance and frequent disk access (paging).
- Faulty RAM:** Can cause system crashes and data corruption. Memtest86+ can be used to diagnose RAM issues.

Storage Devices

Storage Types

Hard Disk Drive (HDD): Traditional mechanical storage with spinning platters and read/write heads.
Solid State Drive (SSD): Flash-based storage with no moving parts, offering significantly faster performance.
NVMe SSD: High-performance SSDs that connect directly to the PCIe bus, offering even faster speeds than SATA SSDs.

Key Storage Specs

Capacity (TB/GB)	Total storage space.
Interface	SATA (HDDs and some SSDs), NVMe (high-performance SSDs).
Read/Write Speeds	Measured in MB/s (megabytes per second) for SATA drives, and GB/s (gigabytes per second) for NVMe drives. Higher speeds result in faster boot times, application loading, and file transfers.
RPM (for HDDs)	Revolutions per minute. Higher RPMs generally result in faster data access times.

Common Storage Issues

- Slow Performance:** Can be caused by a fragmented HDD, a failing drive, or a full drive.
- Drive Failure:** HDDs are more prone to mechanical failure than SSDs. Regular backups are essential.
- Driver Issues:** Outdated or corrupted storage drivers can cause problems.

Graphics Processing Unit (GPU)

GPU Fundamentals

Function: Renders images, videos, and other visual content. Crucial for gaming, video editing, and other graphics-intensive tasks.

Key Specs:

- **VRAM (Video RAM):** Memory dedicated to storing textures, frame buffers, and other graphics data.
- **Clock Speed (MHz):** Speed of the GPU core.
- **CUDA Cores/Stream Processors:** Parallel processing units used for calculations.
- **Memory Interface Width (bits):** Bandwidth between the GPU and VRAM.
- **TDP (Thermal Design Power):** Maximum heat the GPU will generate (Watts).

Manufacturers: NVIDIA, AMD, Intel (integrated graphics)

Discrete vs. Integrated: Discrete GPUs are separate cards, while integrated GPUs are built into the CPU or motherboard.

GPU Architectures

NVIDIA	Uses CUDA cores for parallel processing. Features like ray tracing and DLSS (Deep Learning Super Sampling) are prominent in newer NVIDIA GPUs.
AMD	Uses Stream Processors for parallel processing. Features like FidelityFX Super Resolution (FSR) compete with NVIDIA's DLSS.
Intel (Integrated)	Integrated GPUs share system memory. Suitable for basic graphics tasks and light gaming.

Common GPU Issues

- **Overheating:** Can lead to performance throttling and artifacts. Ensure proper cooling.
- **Driver Issues:** Outdated or corrupted drivers can cause graphical glitches and crashes.
- **Insufficient VRAM:** Can cause stuttering and low frame rates in games.