**Computer System Architecture**

**1. Single Processor Systems**

* **Definition**: Systems with **one main CPU** that executes general-purpose instructions.
* **Additional Components**: May include **special-purpose processors** (e.g., **GPU**, **disk controller**), but only **one primary CPU**.
* **Characteristics**:
  + Simpler design
  + Less expensive
  + Common in traditional desktops/laptops

**2. Multiprocessor Systems (Parallel Systems)**

* **Definition**: Systems with **two or more CPUs** that work together.
* **Shared Resources**:
  + **Physical memory**
  + **Peripheral devices**
  + **Common bus** for communication
* **Advantages**:
  + ✅ **Increased Throughput**: More processes handled simultaneously.
  + ✅ **Economy of Scale**: Cost-effective compared to multiple single-CPU systems.
  + ✅ **Increased Reliability**: Failure of one processor may not crash the system (fault tolerance).

**3. Clustered Systems**

* **Definition**: A group of **independent computers** that work together and appear to users as a **single system**.
* **Communication**: Nodes in a cluster are typically connected via a **high-speed network**.
* **Types of Clustering**:
  + 🔹 **Asymmetric Clustering**:
    - One machine is **active**, others are in **hot-standby** mode.
    - Standby takes over if active fails (used for **high availability**).
  + 🔹 **Symmetric Clustering**:
    - All machines are **active** and run applications.
    - Load is shared across all systems (used for **load balancing** and **high performance**).