A **multi-agent AI system** is a system composed of **multiple intelligent agents** that interact with each other within a shared environment. These agents can be software programs, robots, or any entities capable of **perceiving their environment**, **making decisions**, and **taking actions** to achieve individual or collective goals.

Key Concepts:

1. **Agent**:
    - An entity that can perceive its environment (via sensors) and act upon it (via actuators).
    - Each agent may have its own goals, knowledge, and decision-making capabilities.
2. **Multi-agent**:
    - Involves two or more agents.
    - Agents can be:
        - **Cooperative**: Working toward a common goal.
        - **Competitive**: Each pursuing their own (possibly conflicting) goals.
        - **Neutral/Independent**: Coexisting with minimal interaction.
3. **Environment**:
    - The world in which the agents operate. Can be simulated (like a video game) or real (like a factory).

Examples of Multi-Agent AI Systems:

- **Autonomous Vehicles**:
    - Multiple cars navigating traffic while avoiding collisions and optimizing travel time.
- **Smart Grid Systems**:
    - Different energy producers and consumers (agents) coordinate to manage energy distribution.
- **Robotics Swarms**:
    - Drones or robots collaborating to explore an area, such as for search and rescue or agriculture.
- **Online Marketplaces**:
    - Buyers and sellers (software agents) interacting to find the best prices or bids.
- **Video Games**:
    - Non-player characters (NPCs) interacting with the player and each other in complex ways.

Characteristics of Multi-Agent Systems:

Feature	Description
Decentralization	No single agent controls everything; decisions are distributed.

Feature	Description
Scalability	New agents can often be added without major redesign.
Robustness	Failure of one agent doesn't usually break the whole system.
Emergent Behavior	Complex behaviors can emerge from simple local interactions.

Applications:

- Logistics and supply chain optimization
- Distributed AI for IoT systems
- Financial trading systems
- Defense and military simulations
- Healthcare coordination systems

Let me know if you'd like a simple example or visual explanation.