Features of Environment

1. Fully Observable vs. Partially Observable Environments

- **Fully Observable**: The agent has access to complete information about the environment.
  - **Example**: In chess, the AI knows the positions of all the pieces on the board at any time.
- **Partially Observable**: The agent only has partial information about the environment.
  - **Example**: In a card game like poker, the AI doesn't know the cards of the other players.

2. Deterministic vs. Stochastic Environments

- **Deterministic**: The next state of the environment is completely determined by the agent's actions.
  - **Example**: A maze-solving robot moves in a grid, and each action (move) produces a predictable result.
- **Stochastic**: The next state has some level of randomness.
  - **Example**: In autonomous driving, road conditions (e.g., slippery surfaces) add unpredictability to the car's movements.

3. Static vs. Dynamic Environments

- **Static**: The environment does not change while the agent is thinking.
  - **Example**: In a crossword puzzle, the puzzle doesn't change while the AI is solving it.
- **Dynamic**: The environment changes continuously, even when the agent is not acting.
  - **Example**: In real-time strategy games, other players' actions change the environment while the AI is making decisions.

4. Discrete vs. Continuous Environments

- **Discrete**: The environment has a limited number of actions or states.
  - **Example**: In tic-tac-toe, the AI has a fixed set of possible moves.
- **Continuous**: The environment has infinite possible actions or states.
  - **Example**: In self-driving cars, the AI can make an infinite number of steering adjustments.

5. Single-agent vs. Multi-agent Environments

- **Single-agent**: Only one agent interacts with the environment.
  - **Example**: A robot vacuum cleaner navigating an empty room.
- **Multi-agent**: Multiple agents are interacting and may compete or cooperate.
  - **Example**: In a multiplayer video game, AI agents compete against human players and each other.

6. Competitive vs. Collaborative Environments

Competitive Environment:

- **Definition**: Agents are working against each other. The goal of one agent is in direct conflict with the goal of the other agents.
- **Example**: **Chess AI** – In a chess game, two players (or AIs) are competing to checkmate the opponent. Each move is aimed at outsmarting the other player.

Collaborative Environment:

- **Definition**: Agents work together to achieve a common goal. They cooperate to maximize a shared reward or solve a problem collectively.
- **Example**: **Robot teamwork** – Imagine multiple robots working together in a warehouse. One robot might be responsible for picking items, while another moves them to a different location. The robots must collaborate efficiently to complete tasks faster.

7. Episodic vs. Sequential Environments

Episodic Environment:

- **Definition**: The agent's actions are divided into episodes. Each episode is independent of the others, meaning decisions in one episode do not affect future episodes.
- **Example**: **Image classification** – When an AI classifies images (for example, identifying animals in photos), each image is independent of the next. The AI's decision on one image doesn't impact its performance on the next image.

Sequential Environment:

- **Definition**: Actions taken by the agent in one step affect future decisions. The outcome of one action influences what happens next.
- **Example**: **Self-driving cars** – In autonomous driving, each action (like steering or braking) affects the car's future state. If the car takes a wrong turn, it will influence the rest of its journey and may require further actions to correct the route.

8. Known vs. Unknown Environments

Known Environment:

- **Definition**: The rules of the environment are fully understood by the agent. It knows exactly how the environment responds to its actions.
- **Example**: **Tic-Tac-Toe** – In a simple game like tic-tac-toe, the agent knows all the rules and how its actions (placing an X or O) will affect the game state. The environment behaves in a predictable way.

Unknown Environment:

- **Definition**: The agent does not fully know how the environment will react to its actions. It has to learn the rules and consequences of its actions through exploration or feedback.
- **Example**: **Robot in a new maze** – A robot navigating an unknown maze doesn't know what will happen when it turns left or right. It must explore the maze and learn how different actions affect its position.