CSCV 471. Artificial Intelligence Module 3: Intelligent Agents

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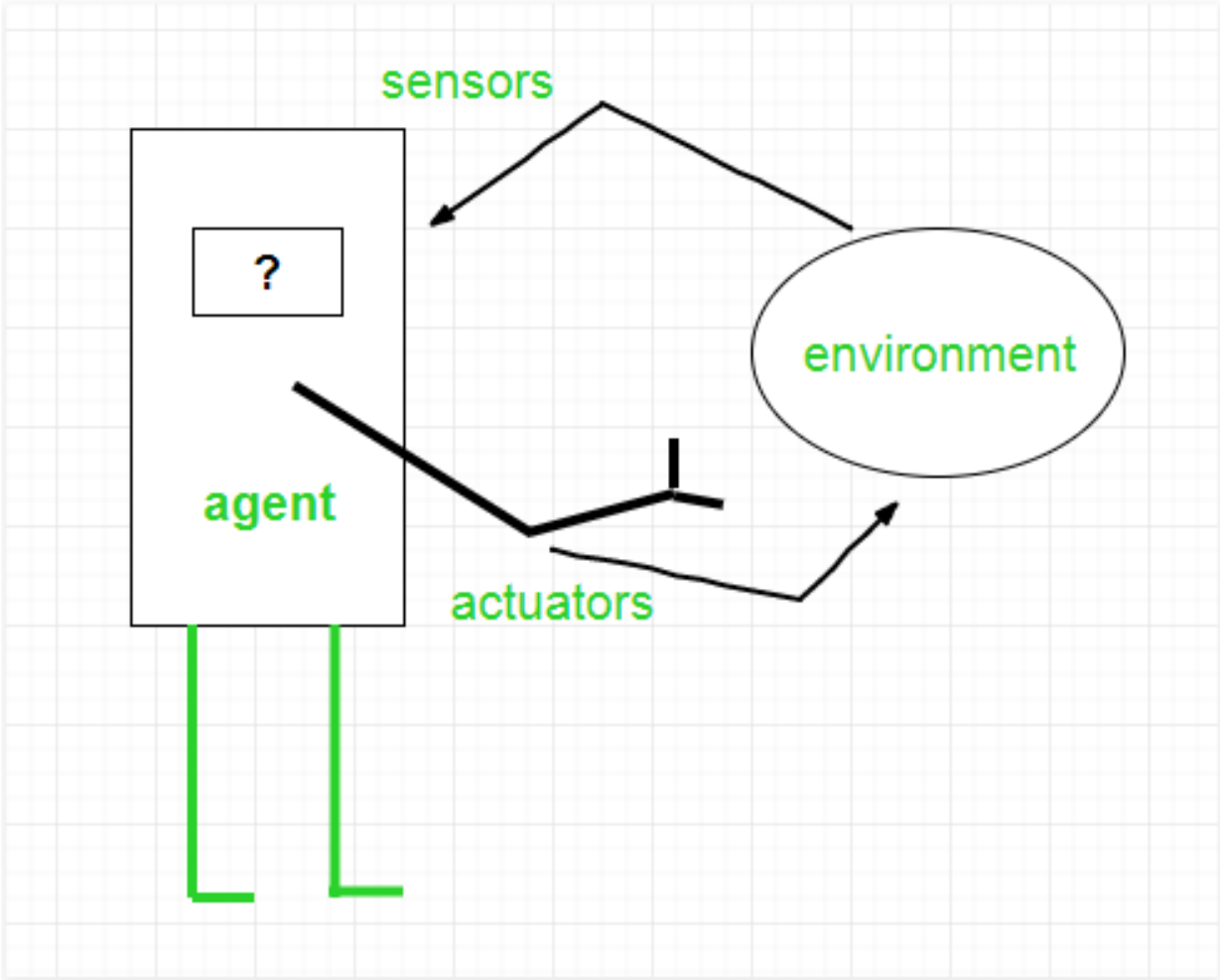
Agents in Artificial Intelligence

- AI is defined as a study of rational agents. A rational agent could be anything which makes decisions, such as a person, firm, machine, or software. The agent carries out an action with the best outcome after considering past and current percepts (agent's perceptual inputs at a given instance).
- An AI system is composed of an agent and its environment. The agents actions in their environment may contain other agents. An agent is anything that can be viewed as:
  - Perceiving its environment through sensors, and
  - Acting upon that environment through actuators.

Learning Agents



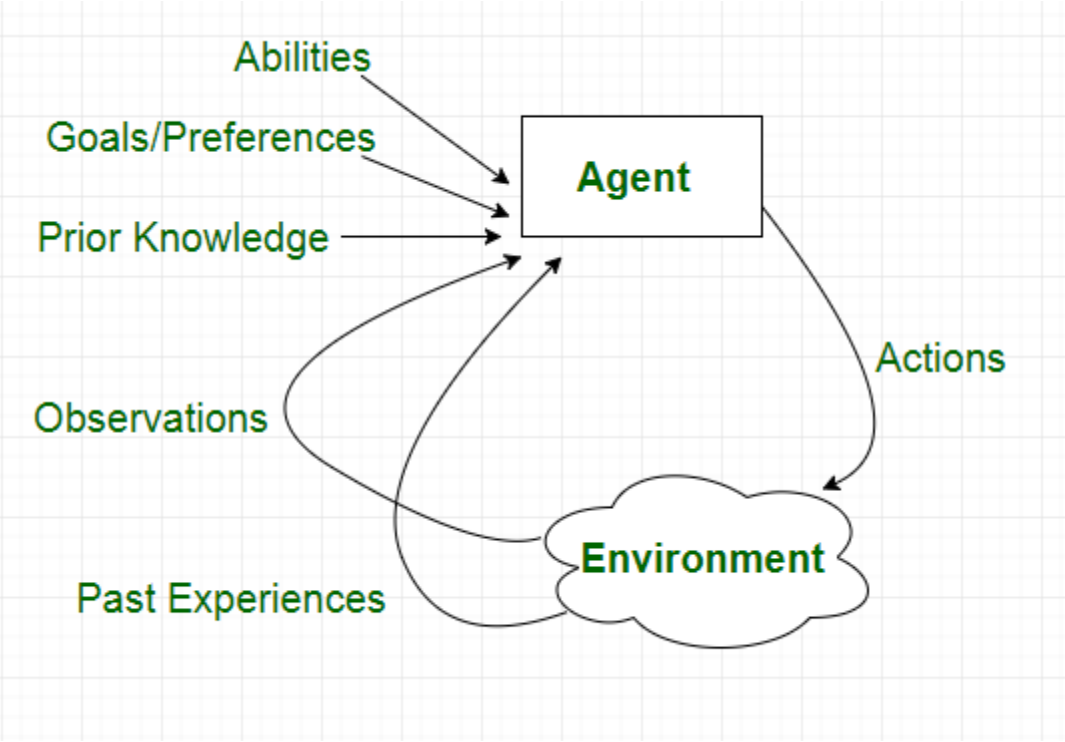
Learning Agents

- To understand the structure of Intelligent Agents, we should be familiar with *Architecture* and *Agent Program*.
- **Architecture** is the machinery that the agent executes on. It is a device with sensors and actuators, for example: a robotic car, a camera, a PC. **Agent program** is an implementation of an agent function.
- An **agent function** is a map from the percept sequence (history of all that an agent has perceived till date) to an action.

Examples of Agent

- A **software agent** has keystrokes, file contents, received network packages which act as sensors and displays on the screen, files, sent network packets acting as actuators.
- A **Human agent** has eyes, ears, and other organs which act as sensors and hands, legs, mouth, and other body parts acting as actuators.
- A **Robotic agent** has Cameras and infrared range finders which act as sensors and various motors acting as actuators.

Agent


Abilities
Goals/Preferences
Prior Knowledge
Agent
Actions
Observations
Environment
Past Experiences

Types of Agents

Agents can be grouped into five classes based on their degree of perceived intelligence and capability:

- Simple Reflex Agents
- Model-Based Reflex Agents
- Goal-Based Agents
- Utility-Based Agents
- Learning Agent

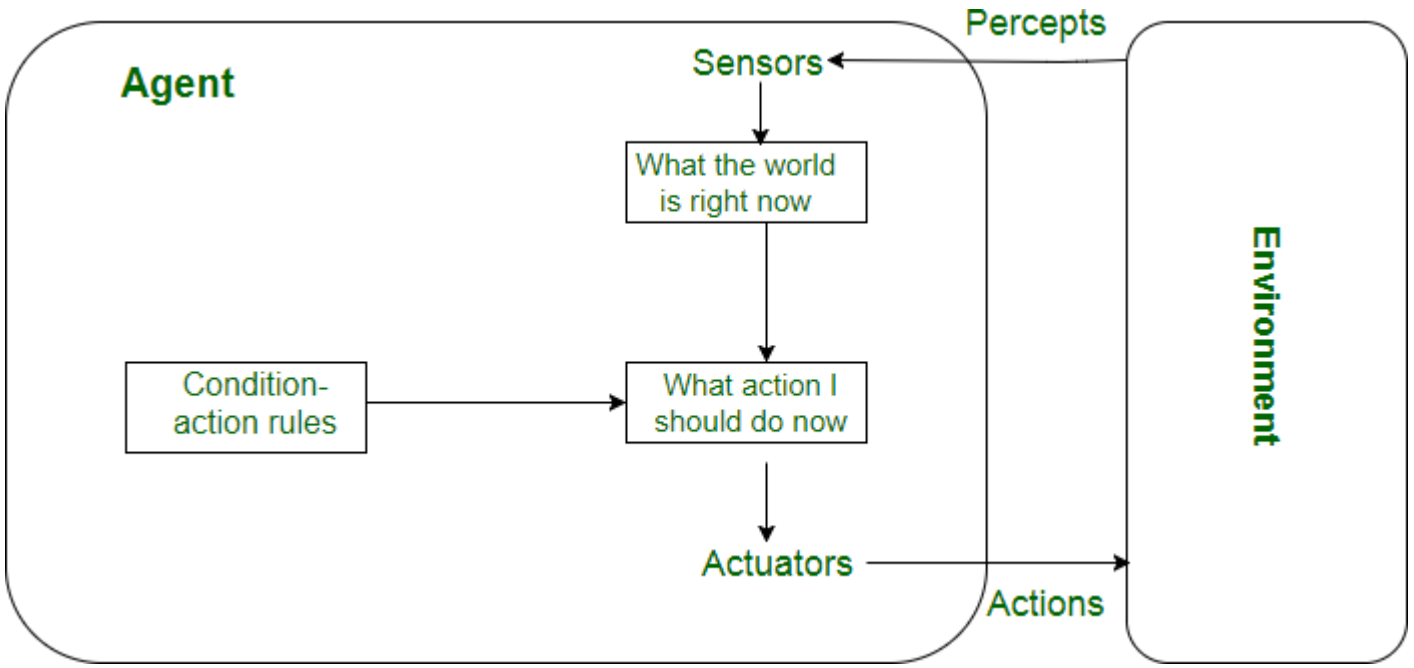
Simple reflex agents

- Simple reflex agents ignore the rest of the percept history and act only on the basis of the **current percept**.
- Percept history is the history of all that an agent has perceived till date.
- The agent function is based on the **condition-action rule**.
- A condition-action rule is a rule that maps a state i.e, condition to an action.
- If the condition is true, then the action is taken, else not.
- This agent function only succeeds when the environment is fully observable.

Simple reflex agents

- For simple reflex agents operating in partially observable environments, infinite loops are often unavoidable.
- It may be possible to escape from infinite loops if the agent can randomize its actions. Problems with Simple reflex agents are:
  - Very limited intelligence.
  - No knowledge of non-perceptual parts of state.
  - Usually too big to generate and store.
  - If there occurs any change in the environment, then the collection of rules need to be updated.
- **Example**: A robot vacuum cleaner that moves left when it detects a wall on the right using its sensor.

Simple reflex agents



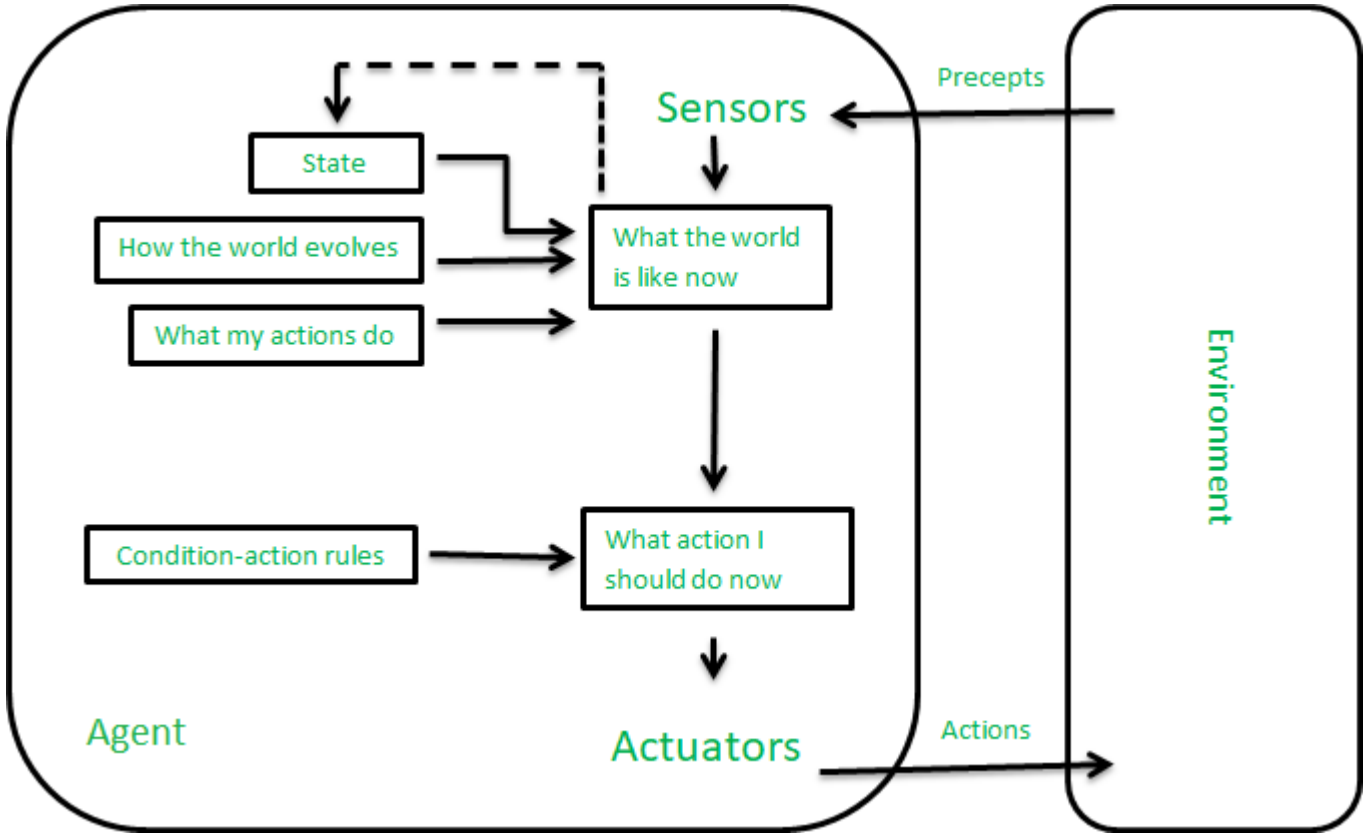
Model-based reflex agents

- Considers both current percept and past percepts in its decision-making process.
- It works by finding a rule whose condition matches the current situation.
- A model-based agent can handle **partially observable environments** by use of a model about the world.
- The agent has to keep track of **internal state** which is adjusted by each percept and that depends on the percept history.

Model-based reflex agents

- The current state is stored inside the agent which maintains some kind of structure describing the part of the world which cannot be seen. Updating the state requires information about:
  - how the world evolves in-dependently from the agent, and
  - how the agent actions affects the world.
- **Example**: A thermostat that keeps track of the current and past temperatures to regulate room temperature.

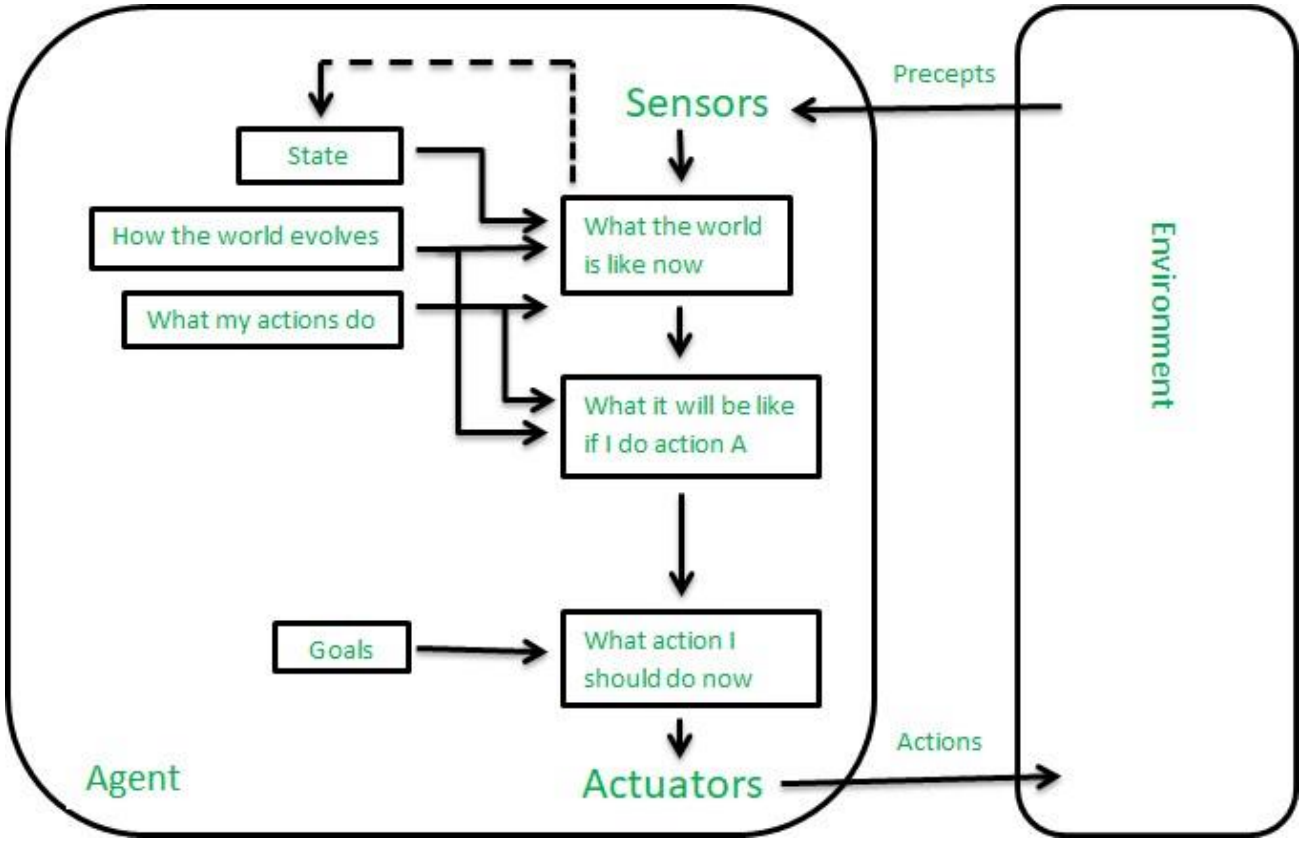
Model-based reflex agents



Goal-based agents

- These kind of agents take decision based on how far they are currently from their **goal** (description of desirable situations).
- Their every action is intended to reduce its distance from the goal. This allows the agent a way to choose among multiple possibilities, selecting the one which reaches a goal state.
- The knowledge that supports its decisions is represented explicitly and can be modified, which makes these agents more flexible.
- They usually require search and planning.
- The goal-based agent's behavior can easily be changed.
- **Example**: A navigation system plotting a path from the source to the destination.

Goal-based agents



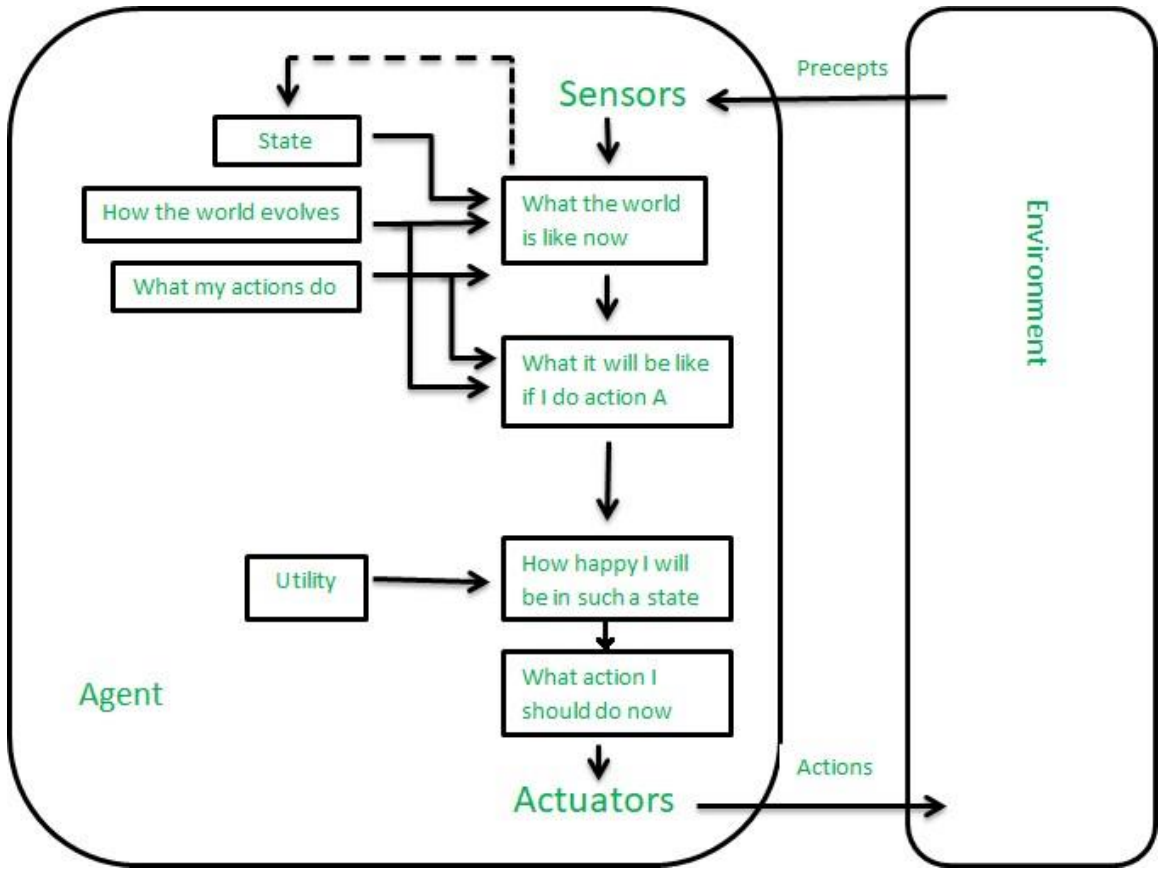
Utility-based agents

- The agents which are developed having their end uses as building blocks are called utility-based agents.
- When there are multiple possible alternatives, then to decide which one is best, utility-based agents are used. Optimizes for best outcome.
- They choose actions based on a **preference (utility)** for each state Sometimes achieving the desired goal is not enough.
- We may look for a quicker, safer, cheaper trip to reach a destination.

Utility-based agents

- Agent happiness should be taken into consideration.
- Utility describes how **“happy”** the agent is. Because of the uncertainty in the world, a utility agent chooses the action that maximizes the expected utility.
- A utility function maps a state onto a real number which describes the associated degree of happiness.
- **Example**: A stock trading bot that not only aims to make profit (goal) but to maximize the profit (utility).

Utility-based agents



Learning Agent

- A learning agent in AI is the type of agent which can learn from its past experiences, or it has learning capabilities.
- It starts to act with basic knowledge and then able to act and adapt automatically through learning.
- Improves its performance based on its experiences over time.

Learning Agents

- A learning agent has mainly four conceptual components, which are:

1. **Learning Element**: Responsible for making improvements.
2. **Performance Element**: Responsible for selecting external actions. This can be any of the previous types of agents (simple reflex, model-based, goal-based, utility-based).
3. **Critic**: Compares the agent's actions with a predefined standard to inform the learning element of how well the agent is doing.
4. **Problem Generator**: Proposes actions that will lead to new, informative experiences.

- **Example**: A game-playing AI that starts with basic strategies but refines and adapts them as it plays more games.