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1. What is AI agent? Explain configuration & properties of AI agent.

An AI agent is an autonomous entity in artificial intelligence that perceives its environment through sensors and acts upon it using actuators to achieve a specific goal. It combines perception, reasoning and acting.



*Figure 1: Agents interact with environments through sensors and actuators*

Configuration of AI agent:

The configuration of an AI agent consists of the following main components:

1. **Sensors:**

Sensors are devices that perceive data from the environment. It helps AI agents to observe the environment and detect any changes. Example: cameras, microphones, GPS.

1. **Actuators:**

Actuators are devices that convert energy into motion. They power and control effectors. Example: motors, rails, gears.

1. **Effectors:**

Effectors are tools used by the AI agent to actually perform actions in the environment. Example: arms, wheels, display screen.



*Figure 2: Configuration of AI agents*

The above diagram shows how these components are positioned in the AI system. Input from the environment is received through sensors by the AI agent. Using this observation, it uses artificial intelligence to make decisions. Actuators will then trigger actions. Percept history and past actions will influence future decisions.

Properties of AI Agent:

The properties of AI agents are categorized into internal and external characteristics.

1. Internal Characteristics:

* **Learning/Reasoning:** An AI agent learns from past experiences and successively.
* **Reactivity:** An AI agent responds appropriately to environmental changes.
* **Autonomy:** An AI agent acts independently, controls its internal states and decisions.
* **Goal-oriented:** An AI agent works toward influencing its environment to achieve well defined objectives.

1. External Properties:

* **Communication:** An AI agent interacts with humans or other agents in its environment to fulfil its tasks.
* **Cooperation:** An AI agent collaborates with other agents for better results for problems that exceed the capabilities of a single agent.
* **Mobility:** An AI agent can move across electronic communication networks (e.g. software agents).
* **Character:** An AI agent can imitate human-like behaviour.

1. What is PEAS? Explain with suitable example.

PEAS stands for Performance measure, Environment, Actuators and Sensors. It is a model that specifies the task environment of an AI agent. Before designing an AI agent, defining its PEAS description helps to understand what the agent is supposed to do and how.

The PEAS components are:

1. Performance measure:

It is the criteria for succuss of the agent’s behaviour. All the necessary results that an agent gives after processing comes under its performance. Example: for a self-driving car, its performance factors are its speed, safety of car and user, comfort of user, etc.

1. Environment:

It is the surrounding and context in which the AI agent operates in. Example: for a self-driving car, the environment is the road which the car is driving on, other cars on the road, pedestrians, traffic signals, road signs, etc.

1. Actuators:

They are the hardware/software used by AI agents to perform actions and affect the environment. Example: for a self-driving car, the actuators are those devices that control the car like steering, accelerator, breaks, horns, music system, etc.

1. Sensors:

They are the devices used by AI agents to observe and perceive the environment. Example: for a self-driving car, the sensors are those devices through which the car gets estimates about its surroundings and draw perceptions like camera, speedometer, GPS, sonar, etc.

Other PEAS Examples:

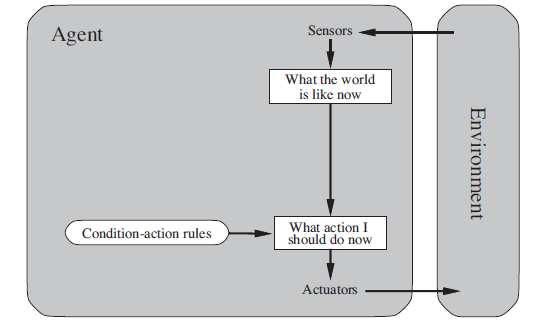
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Agent Type** | **Performance Measure** | **Environment** | **Actuators** | **Sensors** |
| **Medical diagnosis system** | Healthy patient costs, lawsuits | Patient, hospital equipment | Display questions, tests, diagnoses, treatments, referrals | Keyboard entry of symptoms, findings, patient’s answers |
| **Satellite image analysis system** | Correct image categorization | Downlink from orbiting satellite | Display categorization of scene | Colour pixel arrays |
| **Part picking robot** | Percentage of parts in correct bins | Conveyer belt with parts, bins | Jointed arm and hand | Camera, joint angle sensors |
| **Refinery controller** | Purity, yield, safety | Refinery, operators | Valves, pumps, heater displays | Temperature, pressure, chemical sensors |
| **Interactive English tutor** | Student test scores | Set of students, testing agency | Display exercises, suggestions, corrections | Keyboard entry |

1. Explain in detail about types of AI agent.

There are four main types of AI agents:

1. Simple Reflex Agent:

Simple reflex agent acts based only on current percept and ignore rest of the percept history. It uses condition-action rules; if the condition is true, action is taken, else not (e.g. if traffic light is red, then stop). It is best suited for fully observable environments. Example: vacuum cleaner that turns left when it hits a wall.



*Figure 3: Schematic diagram of simple reflex agent*

1. Model-Based Reflex Agent:

Model-based reflex agent handles partially observable environments by using a model of the world to update knowledge and make decisions. It maintains an internal state (memory of past percepts) to keep track of environment. Updating the states requires knowledge about how about the world evolves independently from the agent and how the agent’s actions affect the world. This knowledge about how the world works is called a model of the world, hence it is named as model-based agent. Example: A thermostat that remembers past temperatures and adjusts accordingly.



*Figure 4: Schematic diagram of model-based reflex agent*

1. Goal-Based Agent:

Goal-based agent uses goal information to select one among multiple possibilities that lead to desired states. Goal information describes situations that are desirable. It requires search and planning to determine how to achieve goals. The decision making of goal-based agent is different from simple reflex agent’s condition-action rules as it also involves the consideration of the future, not only the current state of the environment. Example: A pathfinding robot aiming to reach a destination.



*Figure 5: Schematic diagram of goal-based agent*

1. Utility-Based Agent:

Utility-based agent uses a utility function to measure preference among multiple goals since goals alone aren’t enough to generate high-quality behaviour in most environments. The term utility describes how “happy” the agent is. It compares and prefers better outcomes, even among several ways to reach the goal. Example: A delivery drone that selects the route with the best balance of speed, safety, and battery usage.



*Figure 6: Schematic diagram of utility-based agent*

1. Explain in detail about types of environments.

An environment is everything in the world surrounding the agent but isn’t a part of the agent itself. It is where an agent lives, operates in, and provides the agent with something to sense and act upon it. It is classified based on certain characteristics:

1. Fully Observable vs. Partially Observable:

* In a fully observable environment, agent can sense/has access to the complete state at each point of time. It is easier as there is no need to maintain internal state to keep track of the world. Example: chess.
* In a partially observable environment, agent has incomplete access or noisy sensors. Example: self-driving car in fog.
* In an unobservable environment, the agent has no sensors. Example: agent playing chess without visual input.

1. Deterministic vs. Stochastic:

* In a deterministic environment, the next state is completely determined by current state and action. The agent doesn’t need to worry about uncertainty. Example: puzzle games.
* In a non-deterministic environment, actions are characterized by their possible outcomes, but probabilities aren’t attached to them. Example: stock market prediction (actions like buying/selling have uncertain outcomes due to many unknown external factors.
* In a stochastic environment, outcomes involve randomness which is quantified in terms of probabilities. Example: card games, weather systems.

1. Episodic vs. Sequential:

* In an episodic environment, experience is divided into episodes; past actions don’t affect future ones. In each episode, the agent receives a percept and performs a single action, but the next episode doesn’t depend on the actions taken in previous episodes. Example: robot that detects defective parts.
* In a sequential environment, current decision could affect all future actions. The agent requires memory of past actions to determine next best actions. Example: driving a car.

1. Static vs. Dynamic:

* In a static environment, the environment doesn’t change while agent is thinking. Example: crossword puzzle. It is easier to deal with.
* In a dynamic environment, the environment can change during agent's computation. The agent needs to keep looking at the world at each action. Example: real-time games.

1. Discrete vs. Continuous:

* In a discrete environment, there are a finite number of distinct states, percepts, and actions. Example: board games.
* In a continuous environment, there are infinite number of states or actions. Example: robot navigation.

1. Single-agent vs. Multi-agent:

* In a single-agent environment, only one agent is operating by itself. Example: solitaire.
* In a multi-agent environment, multiple agents interact (cooperative or competitive). Example: soccer, online auctions.

1. Known vs. Unknown:

* In a known environment, the result for all actions is known to the agent. Example: tic-tac-toe.
* In an unknown environment, the agent needs to learn how it works in order to perform an action. Example: robot exploring a new building.

1. Accessible vs. Inaccessible:

* In an accessible environment, an agent can obtain complete and correct information about the environment. Example: automated weather station measuring temperature, humidity, and pressure with reliable sensors.
* In an inaccessible environment, the agent can’t get full/accurate information about the environment. Example: understanding human emotions based on facial expressions.