

Agents in Artificial Intelligence

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Agents in AI

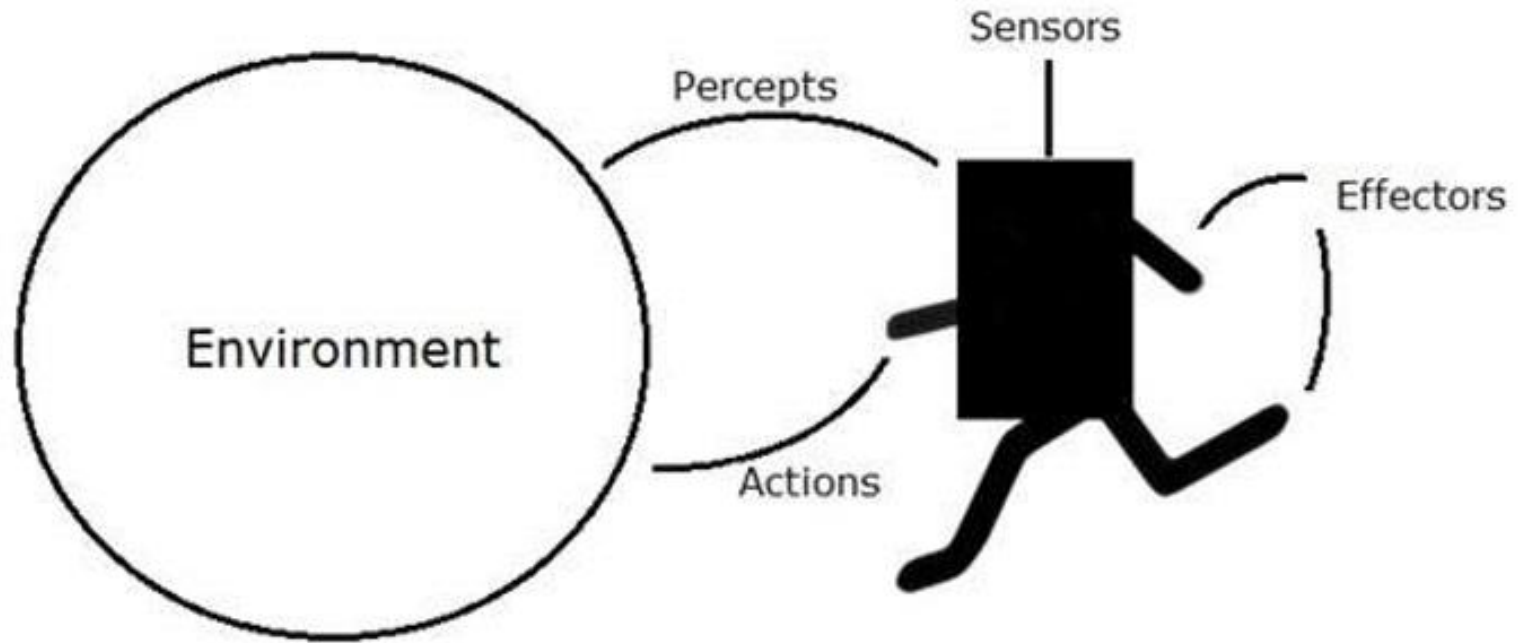
- ▶ An intelligent agent is an entity that makes a decision, that enables artificial intelligence to be put into action.
- ▶ An intelligent agent /agent is anything that can perceive its environment through sensors and acts upon that environment through effectors.
- ▶ **Basic Types of Agent in Real world Environment:**
 - ❖ A human agent
 - ❖ An Artificial (robotic) agent
 - ❖ A software agent

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► **Basic Types of Agent in Real world Environment:**

- ❖ A **human agent** has sensory organs such as eyes, ears, nose, tongue and skin parallel to the sensors, and other organs such as hands, legs, mouth, for effectors.
- ❖ An **Artificial (robotic) agent** replaces cameras and infrared range finders for the sensors, and various motors and actuators for effectors.
- ❖ A **software agent** has encoded bit strings as its programs and actions.

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▶ Agent Terminology:

- ❖ **Performance Measure of Agent** – It is the criteria, which determines how successful an agent is.
- ❖ **Behavior of Agent** – It is the action that agent performs after any given sequence of percepts.
- ❖ **Percept** – It is agent's perceptual inputs at a given instance.
- ❖ **Percept Sequence** – It is the history of all that an agent has perceived till date.
- ❖ **Agent Function** – It is a map from the precept sequence to an action.

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► Rationality:

- ❖ Rationality is nothing but status of being reasonable, sensible, and having good sense of judgment.
- ❖ Rationality is concerned with expected actions and results depending upon what the agent has perceived.
- ❖ Performing actions with the aim of obtaining useful information is an important part of rationality.

► What is Ideal Rational Agent?

- An ideal rational agent is the one, which is capable of doing expected actions to maximize its performance measure, on the basis of –
 - ❖ Its percept sequence
 - ❖ Its built-in knowledge base

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- ▶ **Rationality of an agent depends on the following:**
 - ❖ The **performance measures**, which determine the degree of success.
 - ❖ Agent's **Percept Sequence** till now.
 - ❖ The agent's **prior knowledge about the environment**.
 - ❖ The **actions** that the **agent can carry out**.
- ▶ A **rational agent** always performs **right action**, where the **right action** means the action that causes the agent to be **most successful** in the given percept sequence.
- ▶ The **problem the agent solves** is characterized by **Performance Measure, Environment, Actuators, and Sensors**.

Agents in AI

- ▶ Some Terminologies for Agents in AI:
- ▶ **Percept:** It is agent's perceptual inputs at a given instance.
- ▶ **Actuator:** An **actuator** is a device that makes something move or operate. An **actuator** is a device that uses a form of power to convert a control signal into mechanical motion.
- ▶ **Sensor:** A **sensor** is a device that detects the change in the environment and responds to some output on the other system.
- ▶ **Effector:** An **effector** is any device that affects the environment.
 - ❖ Robots control their **effectors**, which are also known as end **effectors**.
 - ❖ **Effectors** include legs, wheels, arms, fingers, wings and fins.
 - ❖ Controllers cause the **effectors** to produce desired effects on the environment.

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▶ The Structure of Intelligent Agents:

- ❖ Agent's structure can be viewed as –
 - ❖ **Agent = Architecture + Agent Program**
 - ❖ **Architecture** = the machinery that an agent executes on.
 - ❖ **Agent Program** = an implementation of an agent function.

Agents in AI

- ▶ **The Structure of Intelligent Agents:**
 - ❖ **Simple Reflex Agents**
 - ❖ **Model Based Reflex Agents**
 - ❖ **Goal Based Agents**
 - ❖ **Utility Based Agents**
 - ❖ **Learning Based Agents:**

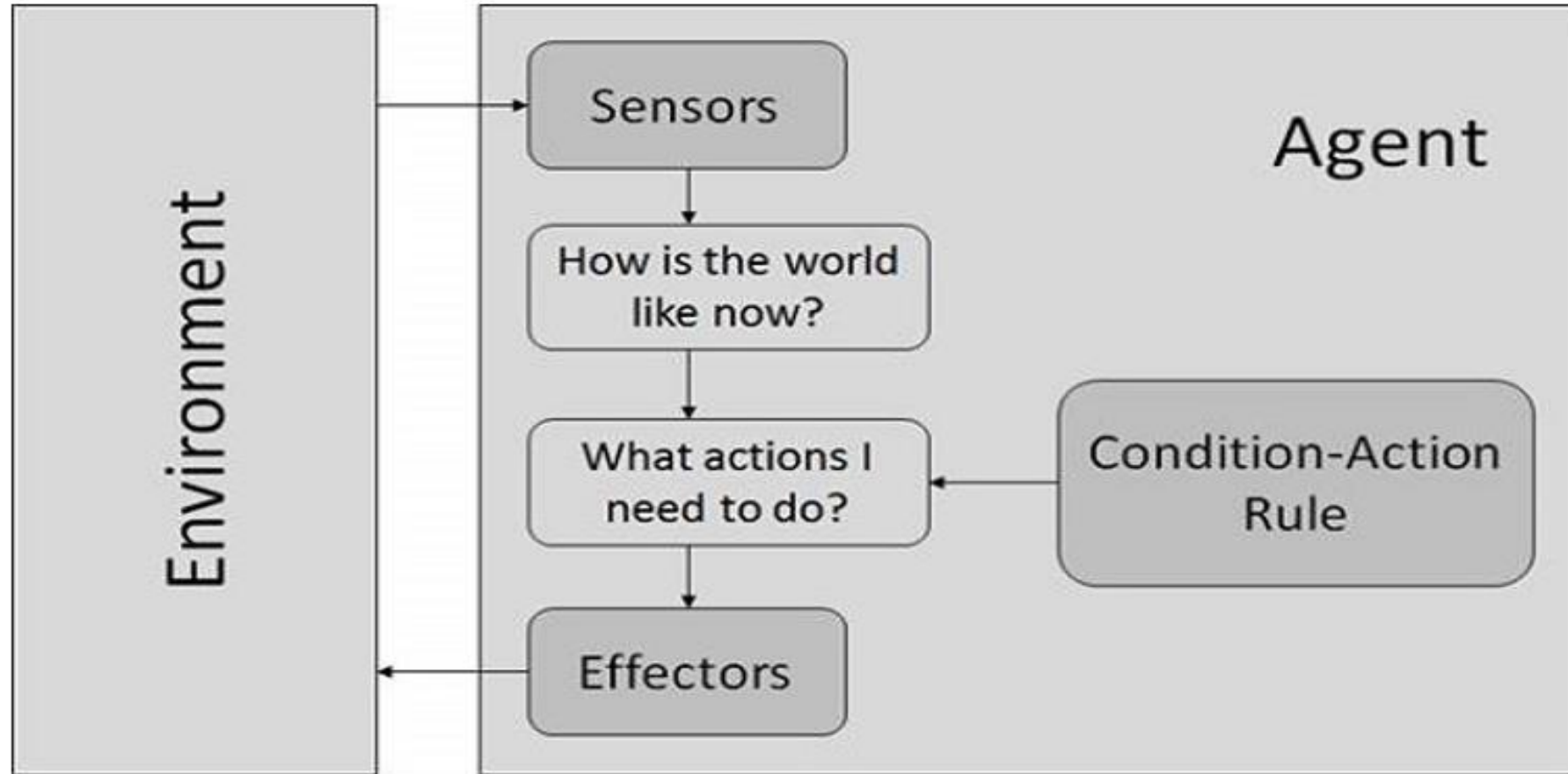
The Structure of Intelligent Agents:

▶ Simple Reflex Agents

- ▶ They choose actions only based on the **current percept**.
- ▶ They are rational only if a **correct decision** is made only on the basis of **current precept**.
- ▶ Their environment is completely **observable**.

Simple Reflex Agents

Condition-Action Rule – It is a rule that maps a state (condition) to an action.



The Structure of Intelligent Agents:

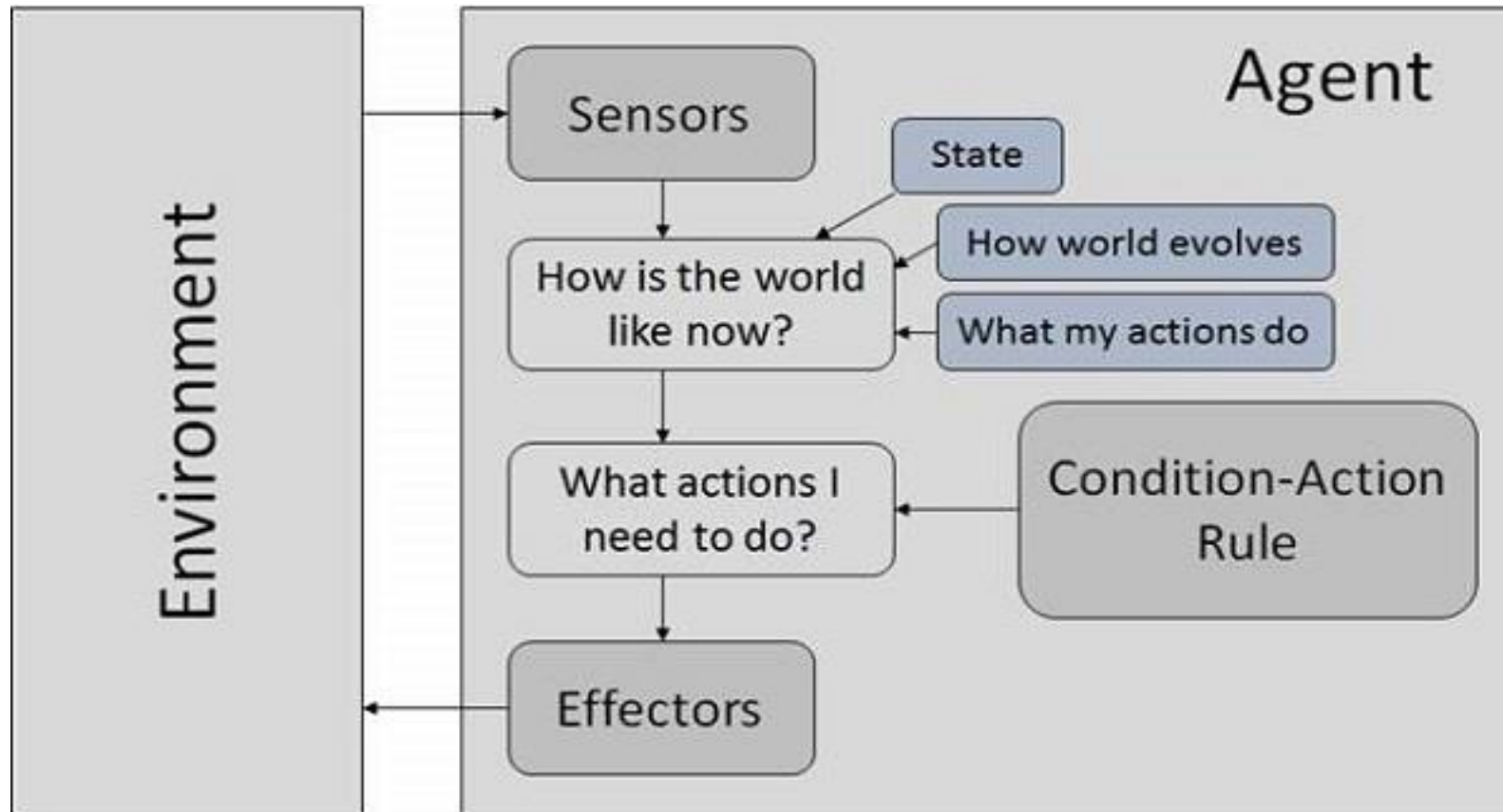
► Model Based Reflex Agents:

- ❖ They use a model of the world to **choose their actions**. They maintain an **internal state**.
- ❖ **Model** – knowledge about “how the things happen in the world”.
- ❖ **Internal State** – It is a representation of unobserved aspects of **current state** depending on **percept history**.

□ Updating the state requires the information about –

- ❖ How the world evolves.
- ❖ How the agent’s actions affect the world.

Model Based Reflex Agents:

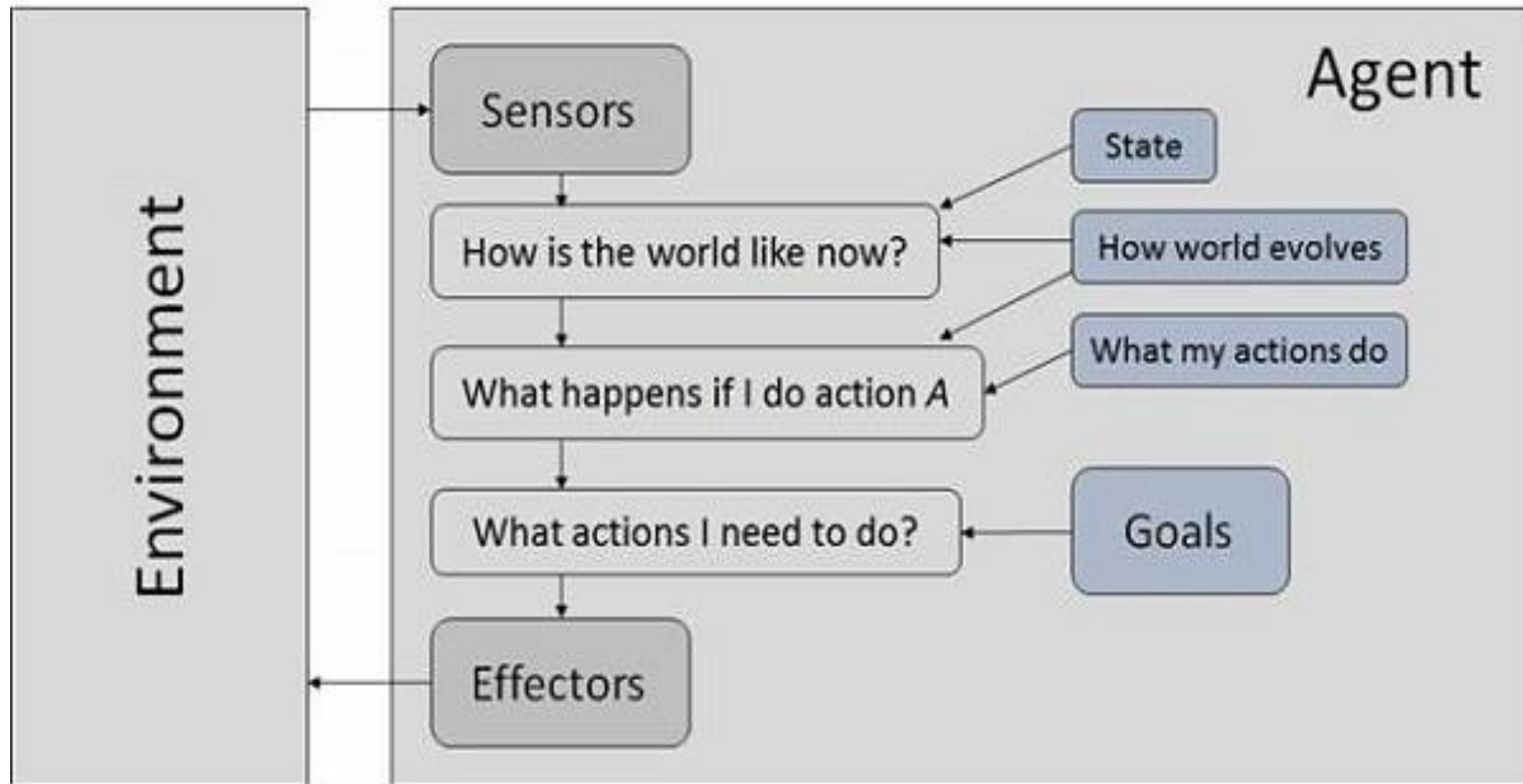


The Structure of Intelligent Agents:

▶ Goal Based Agents:

- ❖ They choose their actions in order to achieve goals.
- ❖ **Goal-based approach** is more flexible than reflex agent since the **knowledge supporting a decision** is explicitly modeled, thereby allowing for **modifications**.
- ❖ **Goal** – It is the description of **desirable situations**.

Goal Based Agents

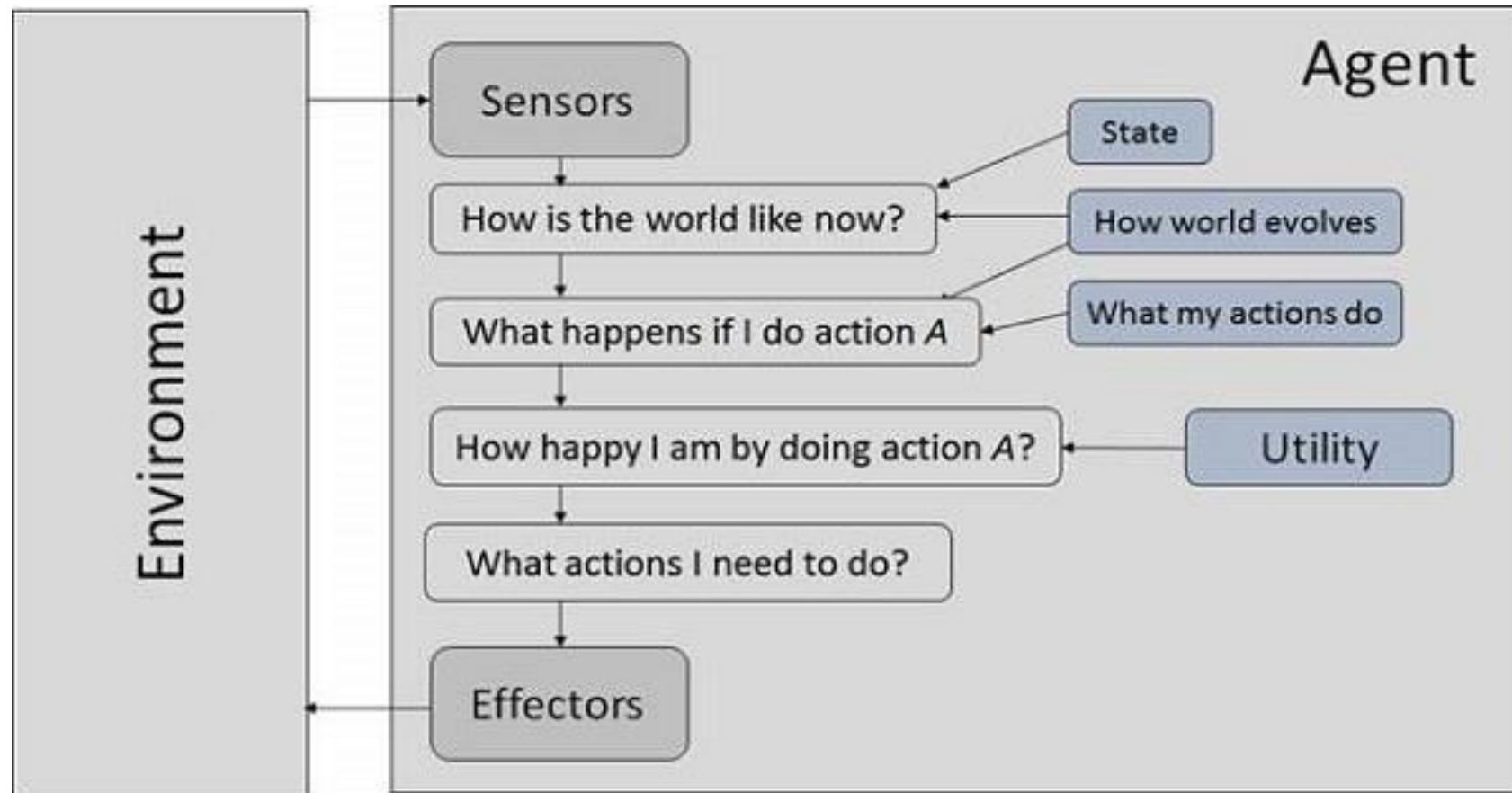


The Structure of Intelligent Agents:

▶ Utility Based Agents:

- ▶ They choose actions based on a **preference (utility)** for **each state**.
- ▶ Goals are **inadequate** when –
- ▶ There are **conflicting goals**, out of which only few can be achieved.
- ▶ Goals have some **uncertainty** of being achieved and you need to consider **likelihood of success** against the **importance of a goal**.

Utility Based Agents:



Learning-based Agent

- ▶ A **learning-based agent** is an agent capable of learning from experience.
- ▶ It has the capability of automatic information acquisition and integration into the system.
- ▶ Any agent designed and expected to be successful in an uncertain environment is considered to be learning agent.

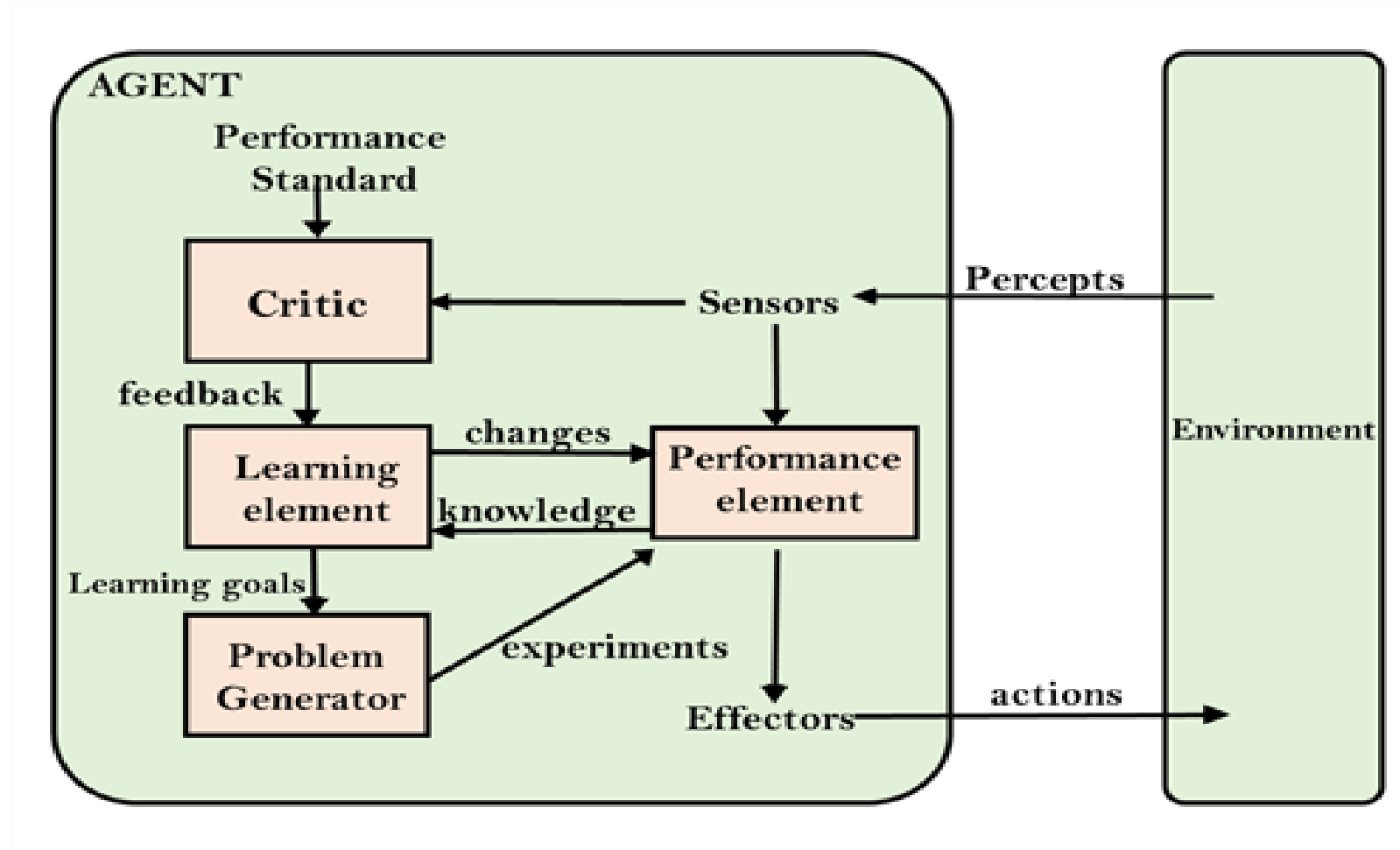
Learning Based Agents:

- ▶ An AI agent with learning capabilities or the ability to learn from its experiences in the past is referred to as a "learning agent."
- ▶ A learning based agent primarily consists of these four conceptual parts:
 1. Element of learning
 2. Critic
 3. Element of performance
 4. Problem Generator

Learning Based Agents:

- ▶ **Element of learning:** It is accountable for producing advancements by absorbing environmental knowledge.
- ▶
- ▶ **Critic:** The learning component uses criticism to gauge how well the agent is performing in relation to a predetermined performance benchmark.
- ▶
- ▶ **Element of performance:** It is in charge of choosing an external action.
- ▶
- ▶ **Problem Generator:** This element is in charge of making recommendations for activities that will result in novel and educational experiences.

Learning Based Agents:



Agents and Environment in AI

▶ The Nature of Environments:

- ▶ Some programs operate in the entirely **artificial environment** confined to keyboard input, database, computer file systems and character output on a screen.
- ▶ In contrast, some **software agents** (software robots or **softbots**) exist in rich, unlimited **softbots domains**.
- ▶ The **simulator** has a very **detailed, complex environment**.
- ▶ The **software agent** needs to choose from a **long array of actions** in real time.
- ▶ A **softbot designed** to scan the online preferences of the customer and show interesting items to the customer works in the **real** as well as an **artificial environment**.

The Nature of Environments:

- ▶ The most famous **artificial environment** is the **Turing Test environment**, in which one real and other artificial agents are **tested on equal ground**.
- ▶ This is a very **challenging environment** as it is **highly difficult** for a **software agent** to **perform as well as a human**.

Turing Test

- ▶ The success of an intelligent behavior of a system can be measured with Turing Test.
- ▶ Two persons and a machine to be **evaluated participate** in the test. Out of the **two persons**, one plays the role of the **tester**.
- ▶ Each of them sits in **different rooms**. The **tester** is **unaware of who is machine** and **who is a human**.
- ▶ He interrogates the questions by typing and sending them to **both intelligences**, to which he receives typed responses.
- ▶ This test aims at fooling the tester. If the tester fails to determine **machine's response** from the **human response**, then the machine is said to be intelligent.

Properties of Environment

- ▶ **The environment has multifold properties –**
 - ▶ **Discrete / Continuous** – If there are a limited number of distinct, clearly defined, states of the environment, the environment is discrete (For example, chess); otherwise it is continuous (For example, driving).
 - ▶ **Observable / Partially Observable** – If it is possible to determine the complete state of the environment at each time point from the percepts it is observable; otherwise it is only partially observable.
 - ▶ **Static / Dynamic** – If the environment does not change while an agent is acting, then it is static; otherwise it is dynamic.

Properties of Environment

- ▶ **Single agent / Multiple agents** – The environment may contain other agents which may be of the same or different kind as that of the agent.
- ▶ **Accessible / Inaccessible** – If the agent's sensory apparatus can have access to the complete state of the environment, then the environment is accessible to that agent.
- ▶ **Deterministic / Non-deterministic** – If the next state of the environment is completely determined by the current state and the actions of the agent, then the environment is deterministic; otherwise it is non-deterministic.
- ▶ **Episodic / Non-episodic** – In an episodic environment, each episode consists of the agent perceiving and then acting. The quality of its action depends just on the episode itself. Subsequent episodes do not depend on the actions in the previous episodes. Episodic environments are much simpler because the agent does not need to think ahead.

END TODAY

Thanks