Agents and Environments

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What are Agent and Environment?

- An **agent** is anything that can perceive its environment through **sensors** and acts upon that **environment** through **effectors**.
- **Human agent**
- 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.
- **Robotic agent**
- A **robotic agent** replaces cameras and infrared range finders for the sensors, and various motors and actuators for effectors.
- **Software agent**
- **A Software agent** has encoded bit strings as its programs and actions.

Agents 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.

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.

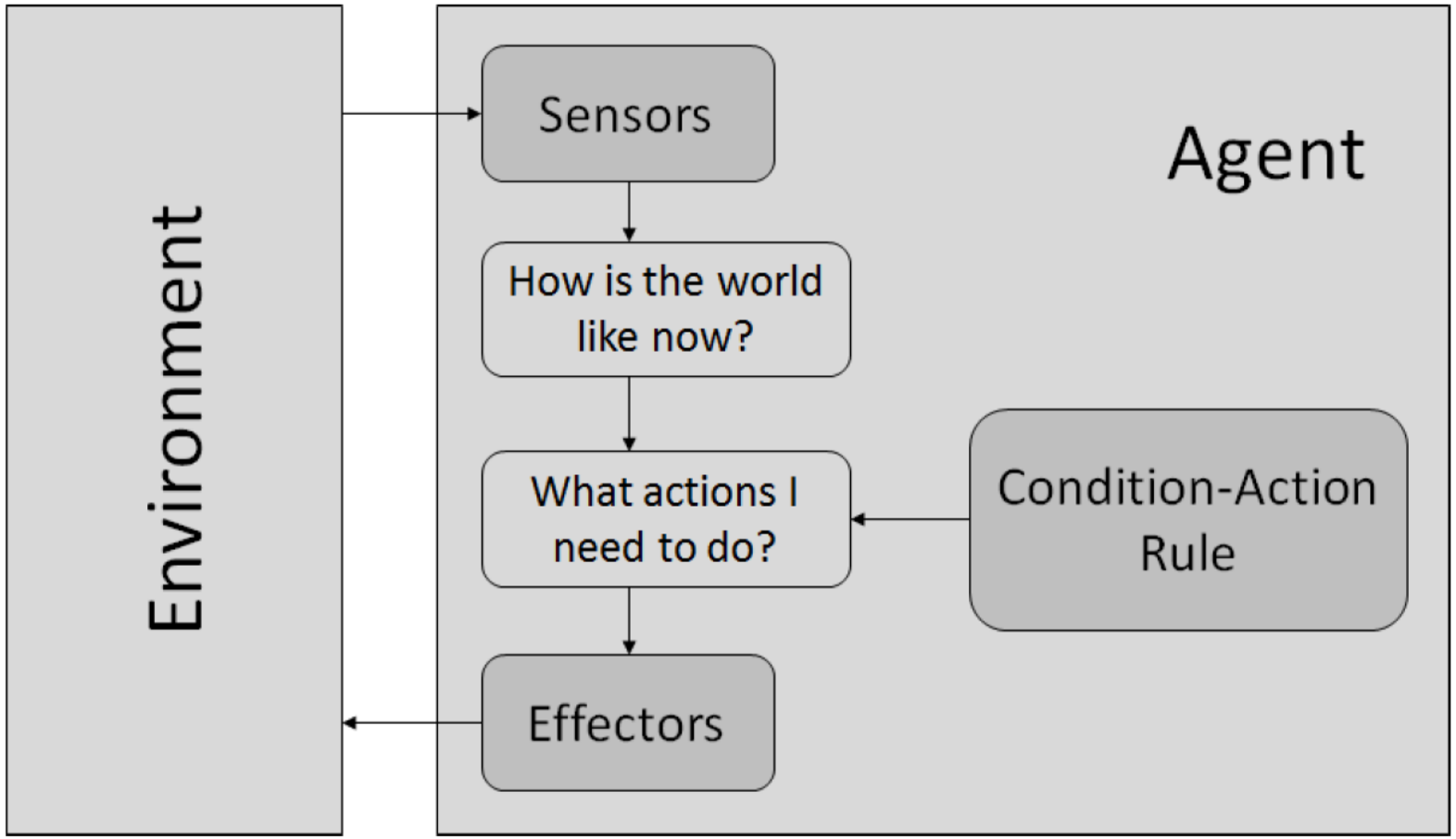
What is Ideal Rational Agent?

- 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
- Rationality of an agent depends on the following:
  - **1.** The **performance measures**, which determine the degree of success.
  - **2.** Agent's **Percept Sequence** till now.
  - **3.** The agent's **prior knowledge about the environment**.
  - **4.** 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 (PEAS).

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

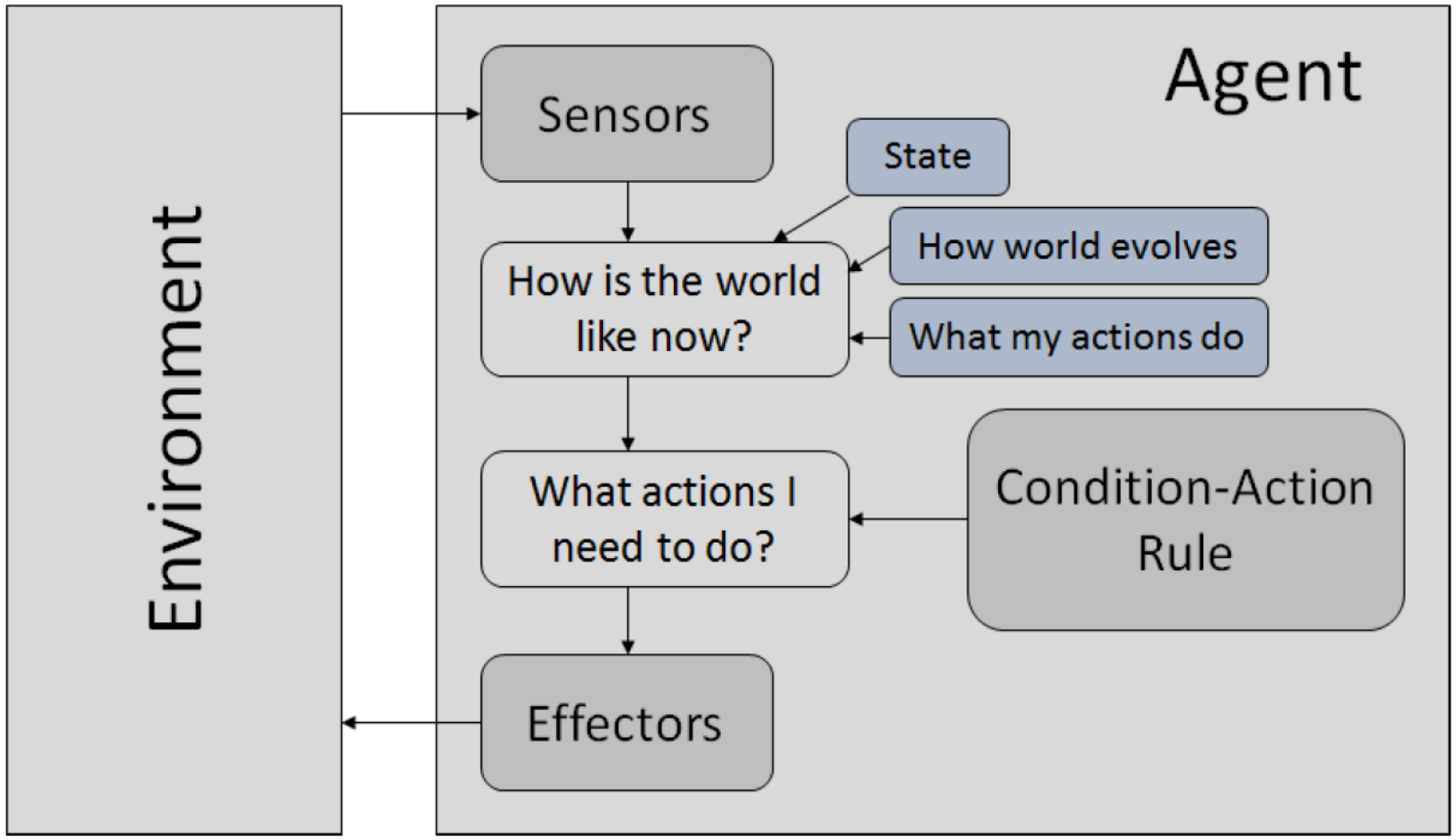
The Structure of Intelligent Agents



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 state requires the information about**
  - How the world evolves.
  - How the agent’s actions affect the world.

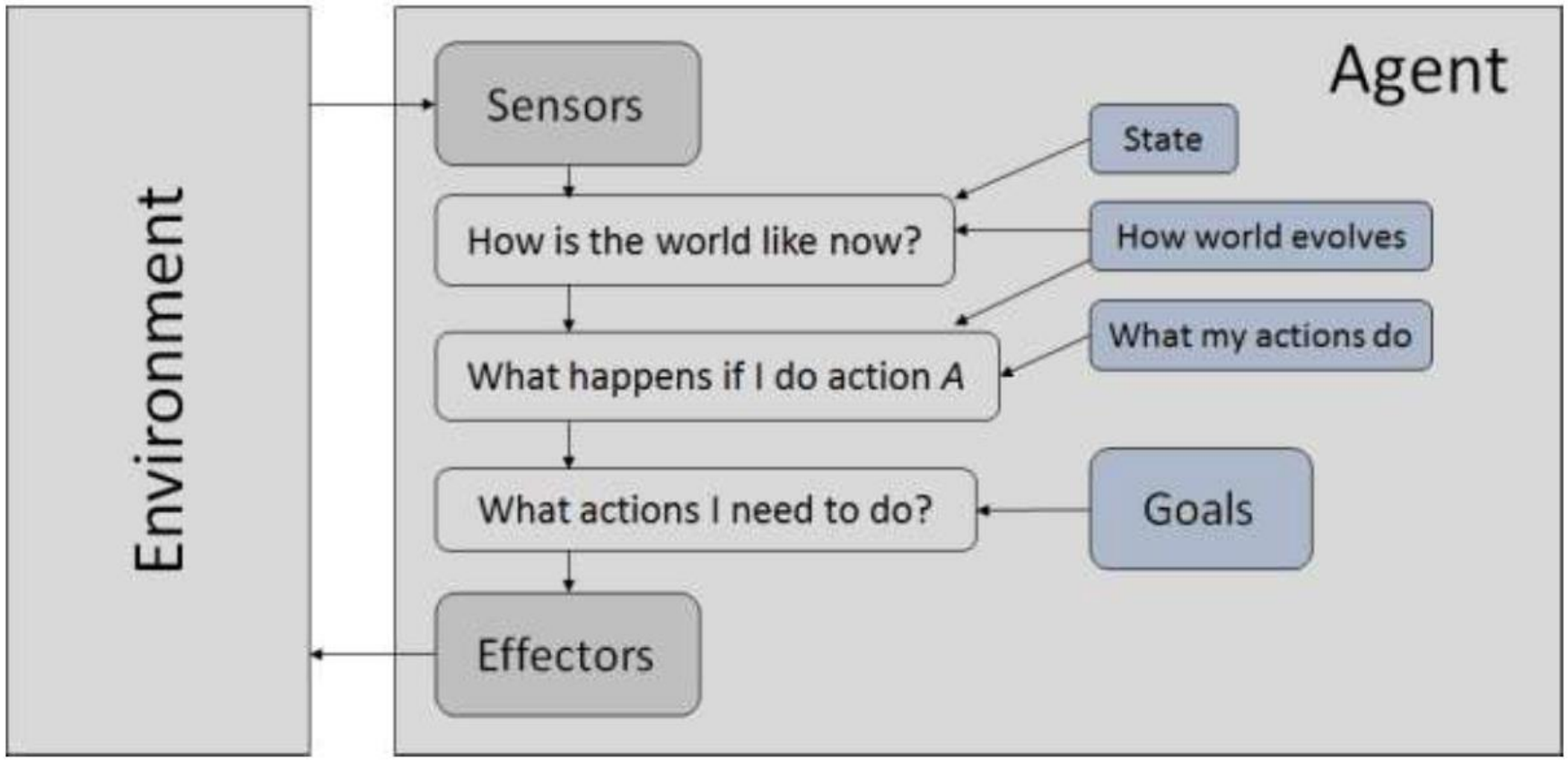
Model-Based Reflex Agents



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.

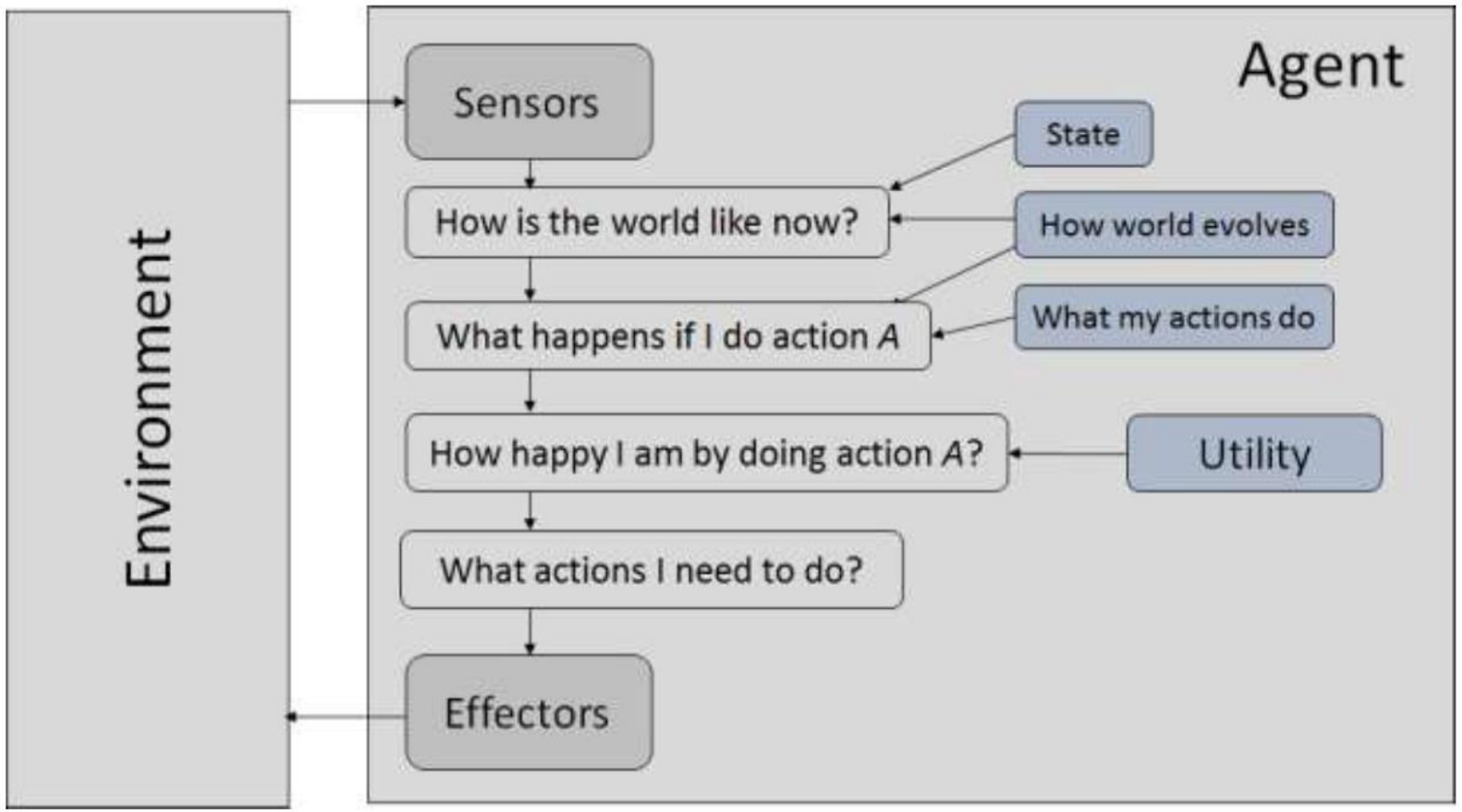
Goal-Based Agents



Utility-Based Agents

- They choose actions based on a preference (utility) for each state.
- Goals are inadequate when:
  - There are conflicting goals only some of which can be achieved.
  - Goals have some uncertainty of being achieved and one needs to weigh likelihood of success against the importance of a goal.

Utility-Based Agents



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 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

- **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.
- **Single agent / Multiple agents**: The environment may contain other agents which may be of the same or different kind as that of the agent.

Properties of Environment

- **Accessible vs. 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 vs. 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 vs. 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.