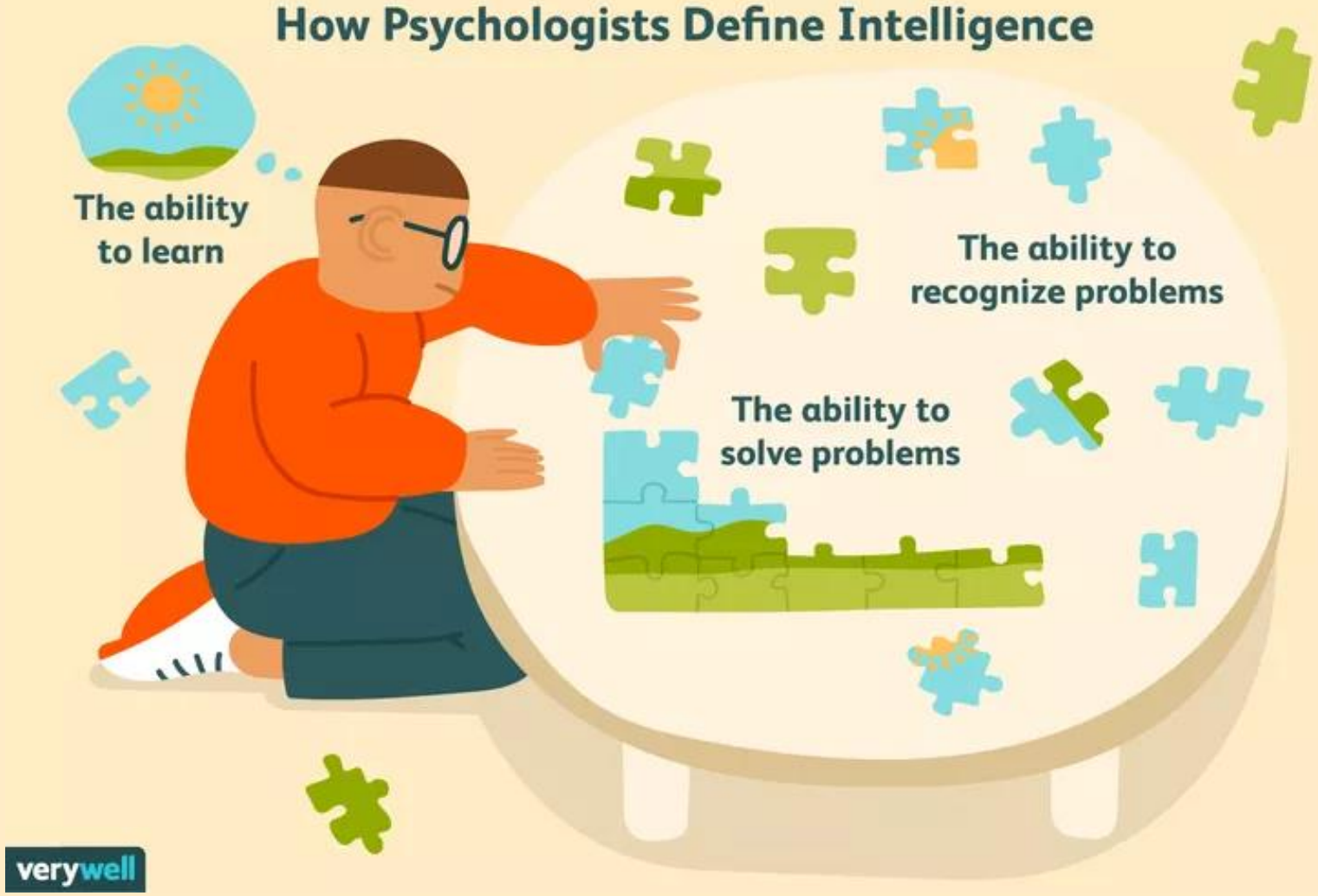
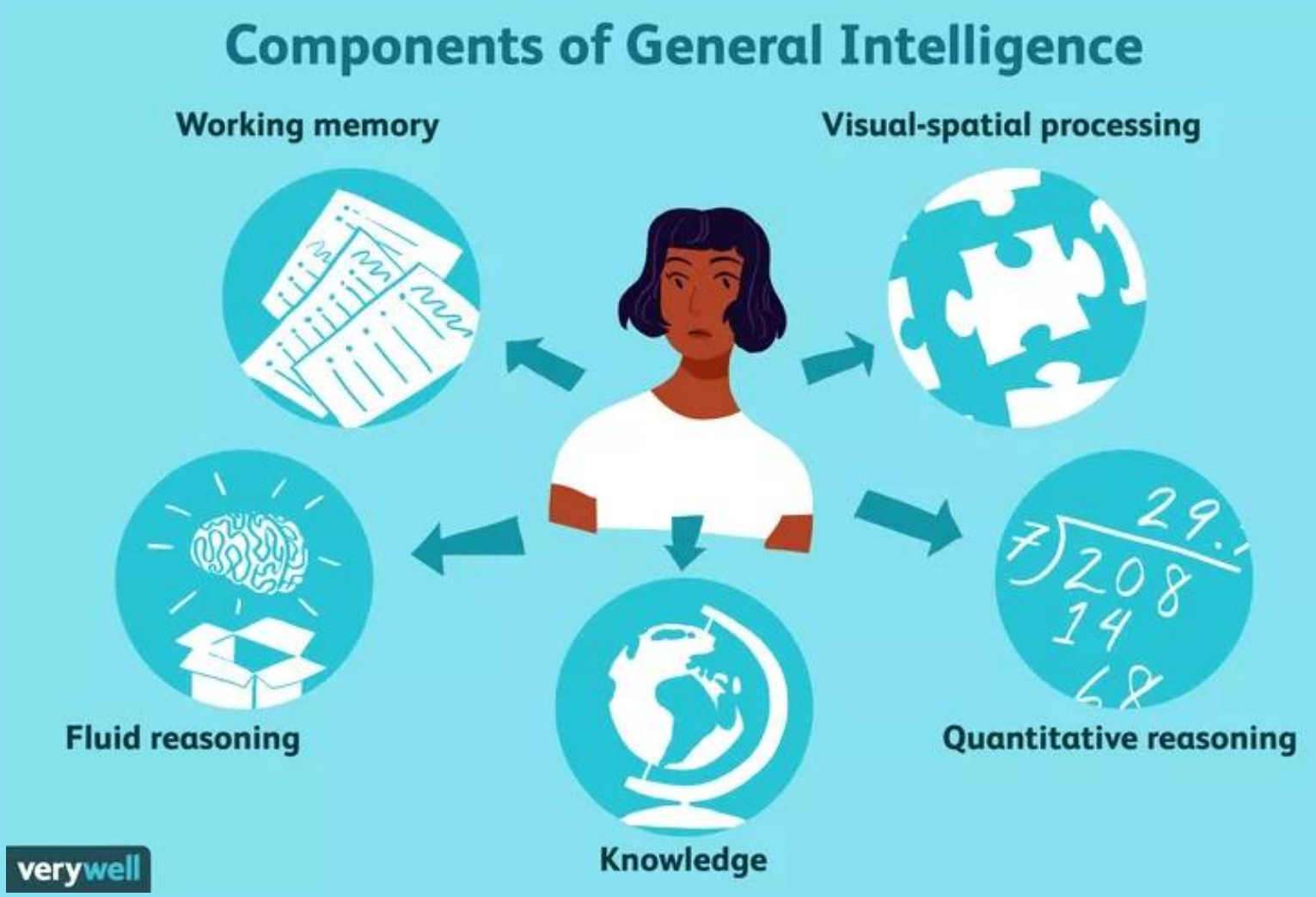
Intelligent Agents Review

Ahmed Ibrahim



Source: https://www.verywellmind.com



Cherry, K. (n.d.). *What is general intelligence?* Verywell Mind. Retrieved January 8, 2025, from https://www.verywellmind.com/what-is-general-intelligence-2795210

What is an Agent?

- An **agent** can be anything that ***perceives its environment through sensors and acts*** upon that environment through ***actuators*.**
- An Agent runs in the cycle of ***perceiving***, ***thinking***, and ***acting***.
- **An agent can be:**
  - **Human-Agent:** A human agent has ***eyes, ears***, and other organs which work for **sensors** and ***hand, legs***, and others work for **actuators.**
  - **Robotic Agent:** A robotic agent can have ***cameras, infrared range finder***, for **sensors** and various ***motors*** for **actuators.**
  - **Software Agent:** Software agent can have **keystrokes**, file contents as sensory input and act on those inputs and display output on the screen.


FORTNITE
OG
CHAPTER 1 - SEASON 1

In Gaming!

- **Sensors** for players are inputs like their eyes (screen visuals), ears (game audio), and touch (keyboard, mouse, or controller).
- **Actuators** are their outputs, such as hand movements (aiming, shooting), button presses (building, switching weapons), and voice communication (team strategies).
- The game's sensors detect player actions, while actuators provide feedback like visuals, sounds, and vibrations.

Agent Function

- Agent Function: maps a percept to an action. $[f: P* \rightarrow A]$
- An agent function for a Fortnite player maps their **percept history** (sensory input from the game) to actions (responses).
- The agent function continuously processes inputs (visual, auditory, and tactile) and determines appropriate actions to maximize survival and performance in the game.

Example:

Percept History:

- Enemy spotted on screen.
- Footsteps were heard nearby.
- Health bar low.

Action:

- Build a defensive structure.
- Switch to a weapon.
- Heal using a health kit.

What is Intelligent Agents?

- An **intelligent agent** is an autonomous entity which acts upon an environment using ***sensors*** and ***actuators*** to achieve goals.
- An intelligent agent may learn from the environment to achieve their goals.
- Following are the main four rules for an AI agent:
  - **Rule 1:** An AI agent must be able to perceive the environment.
  - **Rule 2:** The observation must be used to make decisions.
  - **Rule 3:** A decision should result in an action.
  - **Rule 4:** The action taken by an AI agent must be rational.

Structure of an AI Agent

- The structure of an intelligent agent is a combination of architecture and agent program. It can be viewed as:

  Agent = Architecture + Agent program

- **There are three main structures of an AI agent:**

  i. Architecture: machinery that an AI agent executes.

  ii. Agent Function: maps a percept to an action. $[\boldsymbol{f}: \boldsymbol{P} * \rightarrow \boldsymbol{A}]$

  iii. Agent program: is an implementation of agent function.

  ✓ An agent program executes on the physical architecture to produce a function f.

iRobot Roomba series

Rational Agents

- A **rational agent** should strive to "**do the right thing**" based on what it can **perceive** and the **actions** it can perform.
- The **right action** is the one that will cause the **agent to be most successful.**
- **Performance measure:** An objective **criterion for the success of an agent's behaviour**.
- **E.g.**, the **performance measure** of a **vacuum-cleaner agent** could be:
  - *Amount of dirt cleaned up,*
  - *Amount of time taken,*
  - *Amount of electricity consumed,*
  - *Amount of noise generated, etc.*

Rationality

- Rationality can be judged on the basis of following four points:
  - *The **performance measure** that defines the criterion of success.*
  - *The agent's **prior knowledge** of the environment.*
  - *The **actions** that the agent can perform.*
  - *The **agent's percept sequence** to date.*

PEAS Description

- PEAS-is a type of model on which an AI agent works upon.
- When we define an AI agent or rational agent, then we can group its properties under PEAS representation model.
- **PEAS stands for:**
  - **Performance measure:** *A measure of **how good the behaviour of agents** operating in the environment is.*
  - **Environment:** *What **things are considered** to be a part of the environment, and what **things are excluded**?*
  - **Actuators:** *How can an **agent perform actions** in the environment?*
  - **Sensors:** *How can the **agent perceive the environment**?*

Autonomous Vehicles

- **Performance:** *Safety, time, legal drive, comfort,* maximize profits
- **Environment:** *Roads, other cars, pedestrians(*walkers), customers
- **Actuators:** *Steering wheel, accelerator, brake, signal,* indicators, horn(alert or alarm)
- **Sensors:** *Camera, sonar, GPS, Speedometer, odometer, accelerometer, engine sensors, keyboard.*

Agent Environment in AI

- An **environment** is everything in the world which surrounds the agent, *but it is not a part of the agent itself.*
- **The environment is where the agent lives, operates and provides the agent with something to sense and act upon**.
- There are major types of environments:
  - *Fully Observable & Partially Observable, Episodic & Sequential, Static & Dynamic, Discrete & Continuous, Deterministic & Stochastic*

  Single-agent vs. multi-agent and Known vs. Unknown

Environment!

Example: Fortnite Environment!

Based on the following: Fully Observable & Partially Observable, Episodic & Sequential, Static & Dynamic, Discrete & Continuous, Deterministic & Stochastic, Single agent vs. multi-agent and Known vs. Unknown

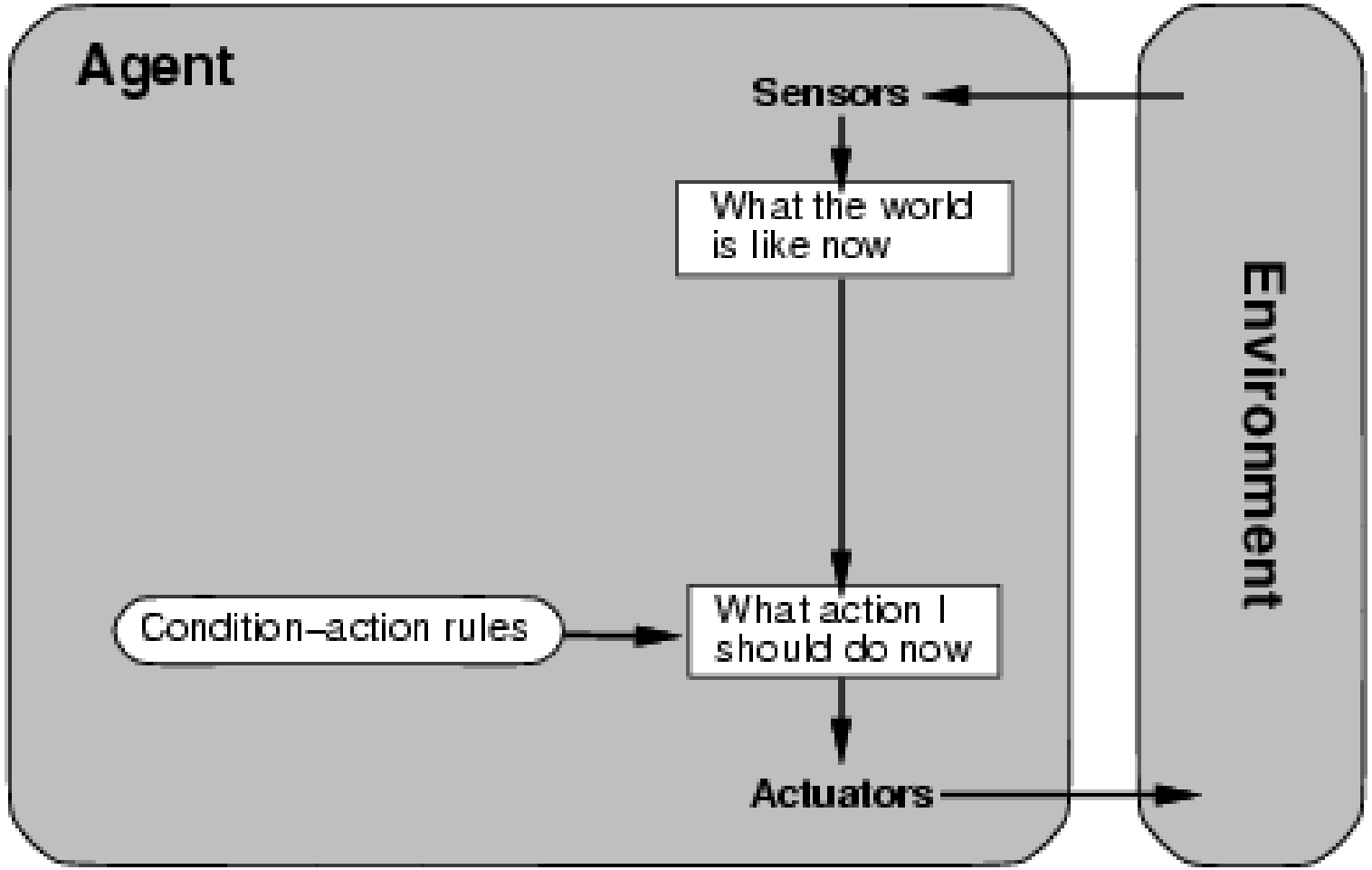
- Partially Observable: Players cannot see the entire map or know the exact location of other players and items; they rely on sensory inputs like visuals and sounds
- Sequential: Each action (e.g., moving, shooting, or building) affects future states, and gameplay requires planning based on past decisions
- Dynamic: The game environment changes in real - time due to other player 's actions, the shrinking storm circle, and loot spawns
- Continuous: Players can move and aim freely within the game world, making it a continuous environment
- Stochastic: Outcomes involve randomness (e.g., loot availability, weapon damage variability) and depend on other players' unpredictable actions.
- Multi-Agent: Players compete or cooperate with other human players, making interactions critical to the gameplay.
- Known: The game rules, mechanics, and map are pre-defined and known to players, though the precise state (e.g., enemy locations) can remain unknown during gameplay.

Agent Types

- Simple Reflex: Based on condition-action rules.
- Model-based: Uses internal state.
- Goal-based: Plans actions to achieve goals.
- Utility-based: Maximizes utility.
- Learning: Adapts and improves over time.

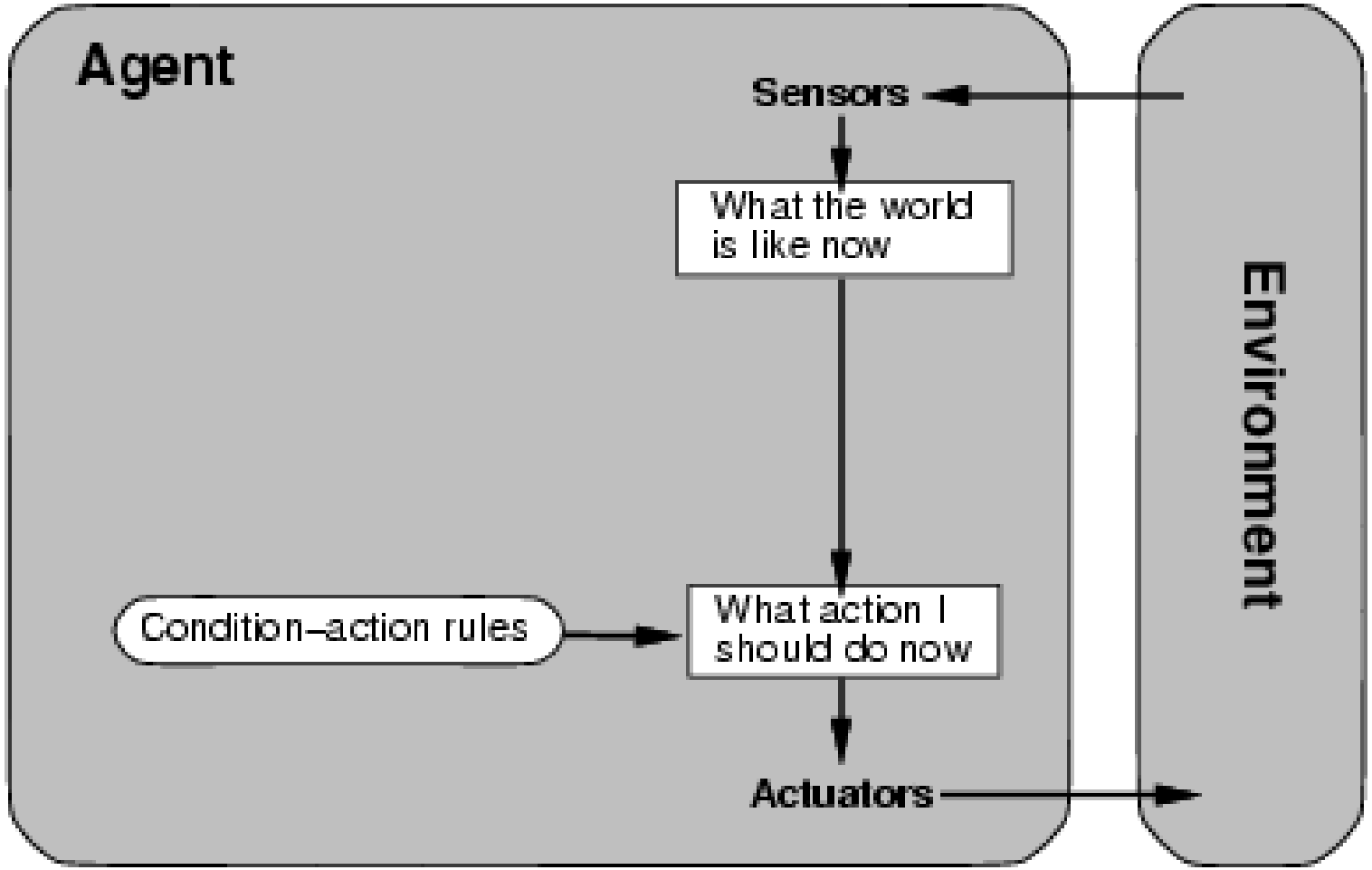
Simple Reflex Agents

SimpleReflexAgent.java

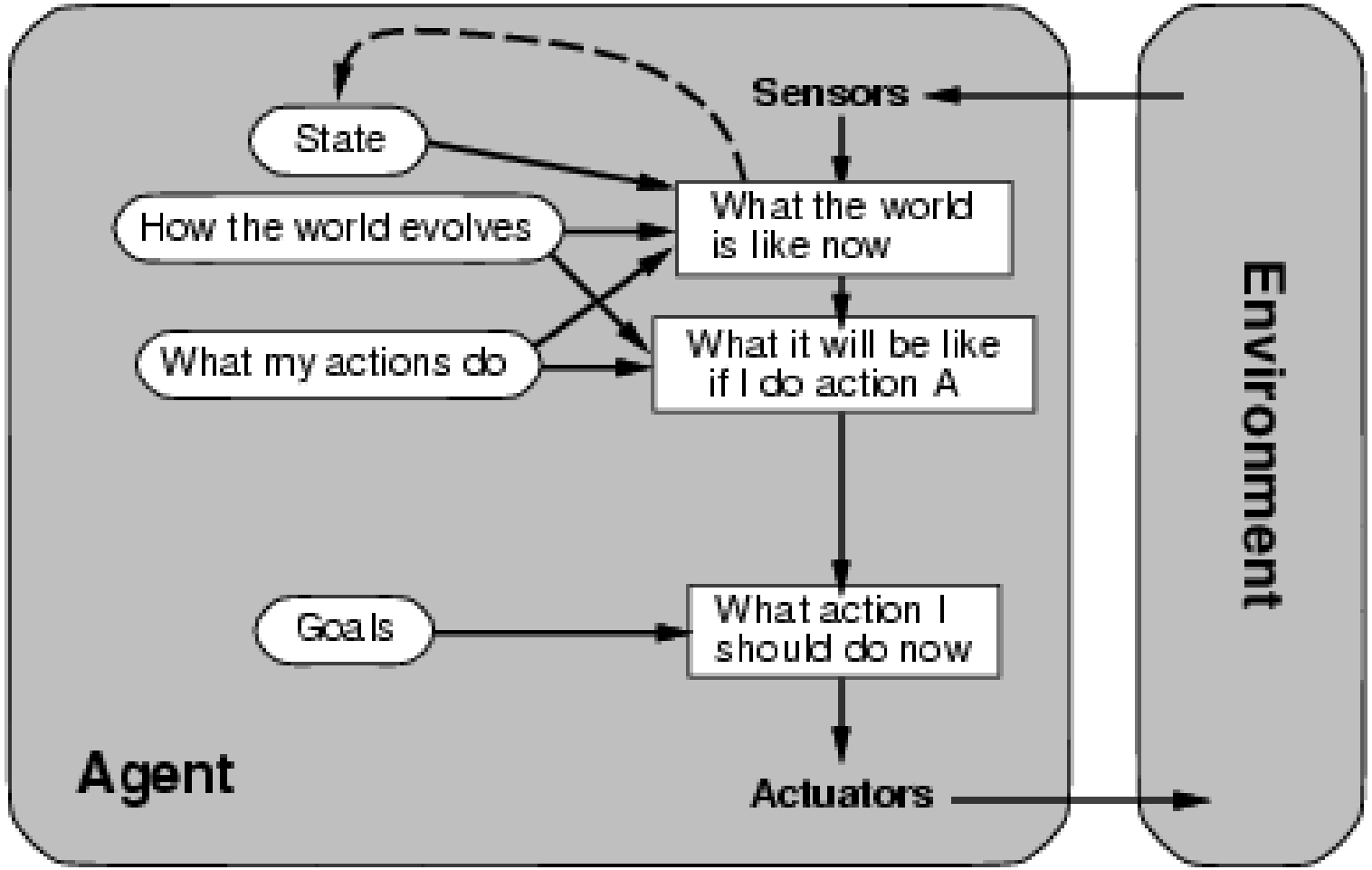


Model-based Reflex Agents

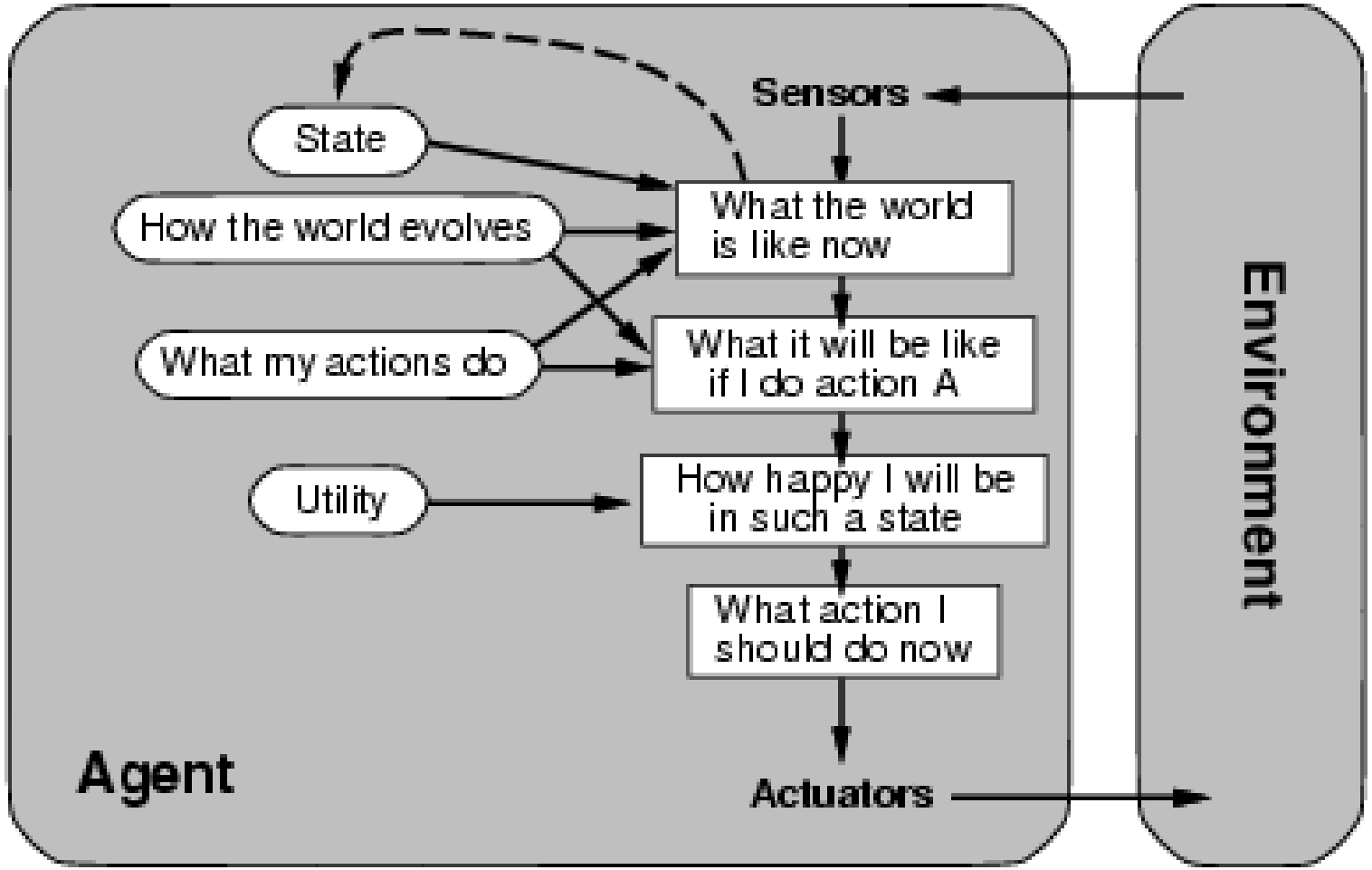
ModelBasedReflexAgent.java



Goal-based Agents



Utility-based Agents



Learning Agents

- A **learning agent in AI** is the type of agent which can learn from its past experiences or has learning capabilities.
- It starts to act with essential knowledge and then is able to act and adapt automatically through learning.
- A learning agent has mainly four conceptual components, which are:
  - Learning element: It is responsible for making improvements by learning from the environment
  - Critic: The learning element takes feedback from the critic, which describes how well the agent is doing with respect to a fixed performance standard.
  - Performance Element: It is responsible for selecting external action
  - Problem Generator: This component is responsible for suggesting actions that will lead to new and informative experiences

Conclusion

- Agents interact with environments to achieve objectives.
- Design depends on the environment's properties.
- Focus: Rationality, performance, and adaptability.