Agents
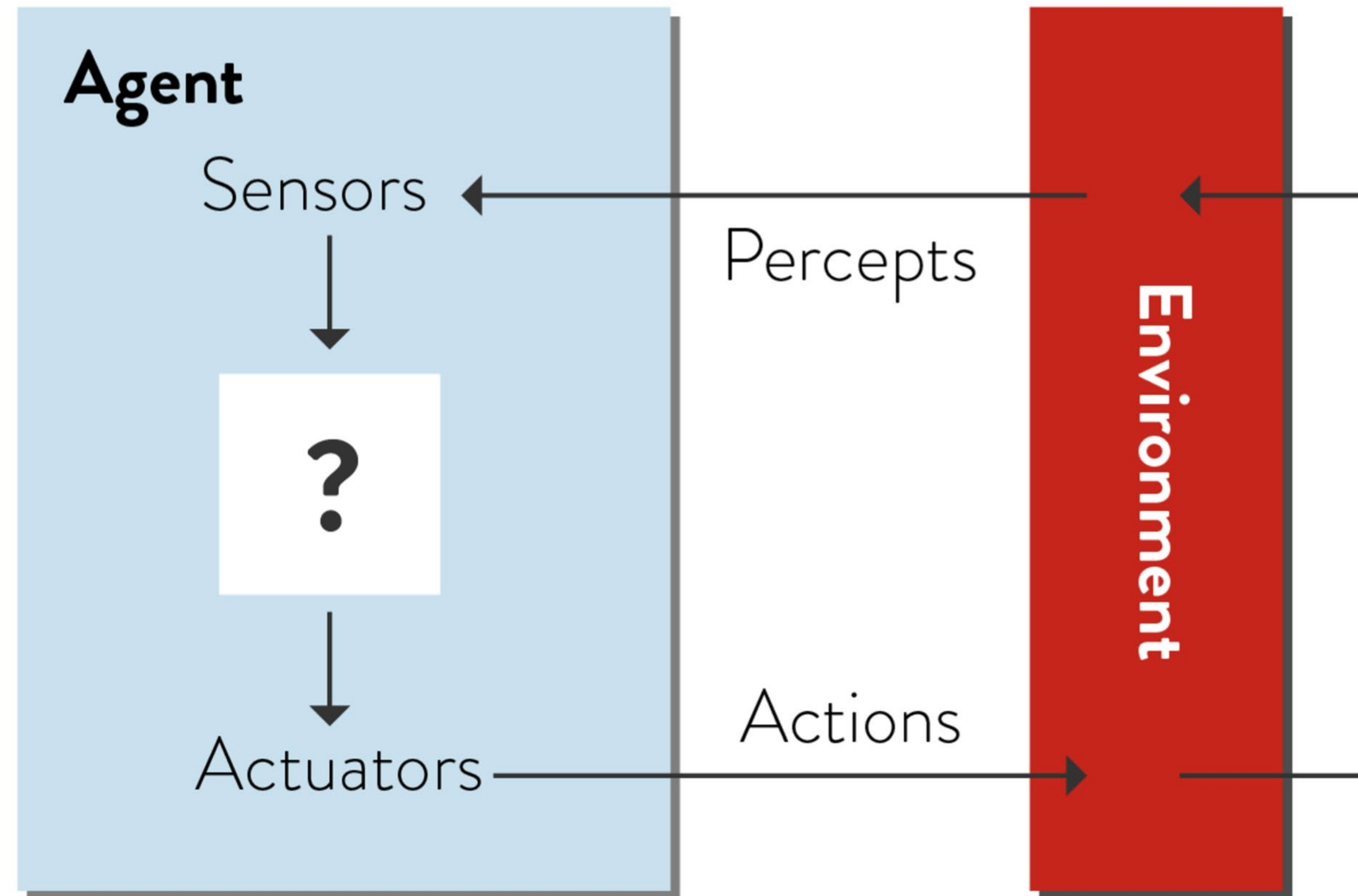
COMP3411/9814: Artificial Intelligence

Types of Agents

- Reactive Agent

- Model-Based Agent

- Planning Agent
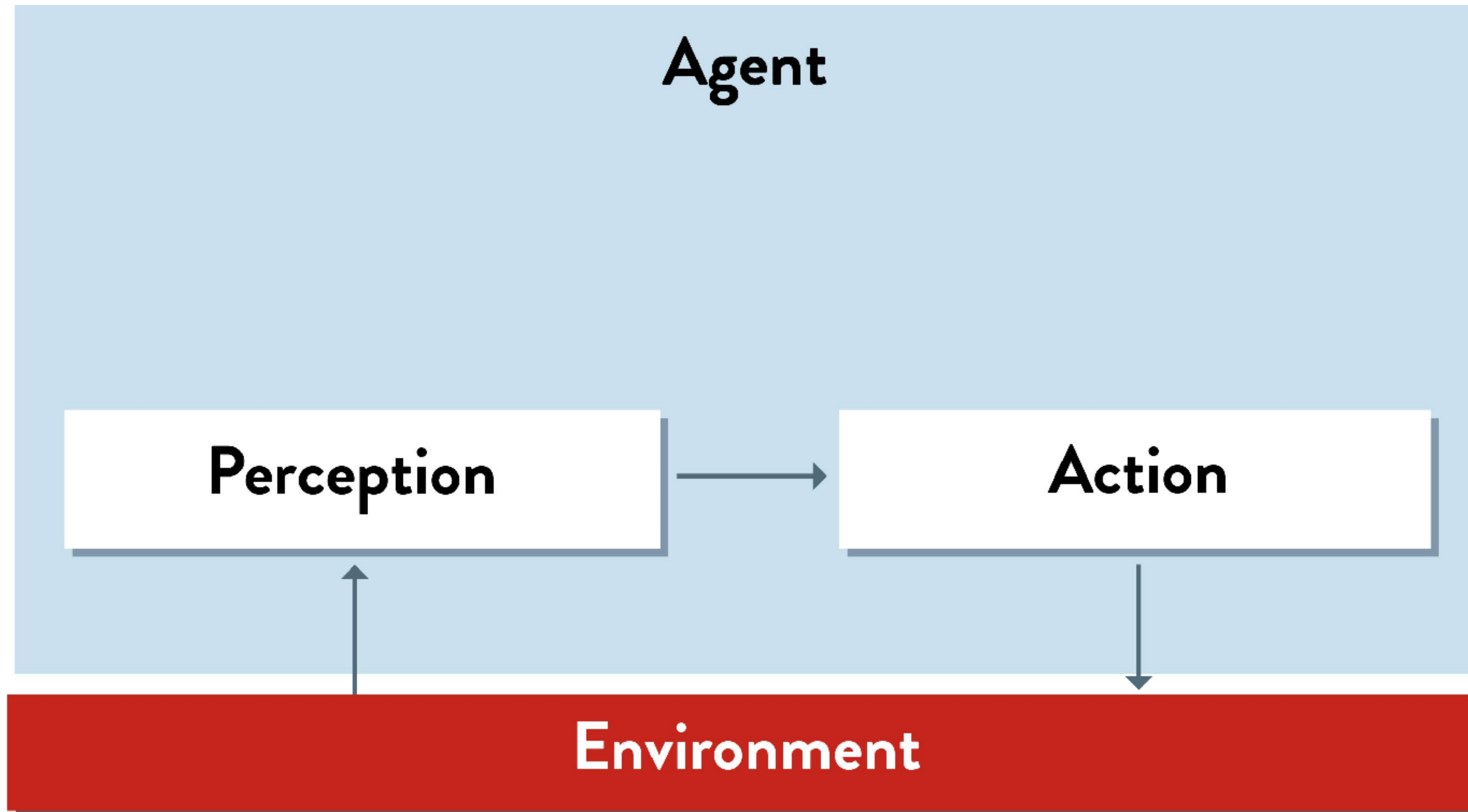
- Learning Agent

Agent Model

Types of Agents

- **Reactive Agent**

- Model-Based Agent

- Planning Agent

- Learning Agent

Reactive Agent

Reactive Agent

- Choose the next action based only on what agent currently perceives

  - Uses a "policy" or set of rules that are simple to apply

- Sometimes called "simple reflex agents"

  - but they can do surprisingly sophisticated things

Reactive Agent

repeat

   if left touch:

      Take one step back

      turn right

   else if right touch:

      Take one step back

      turn left

   else

      go straight

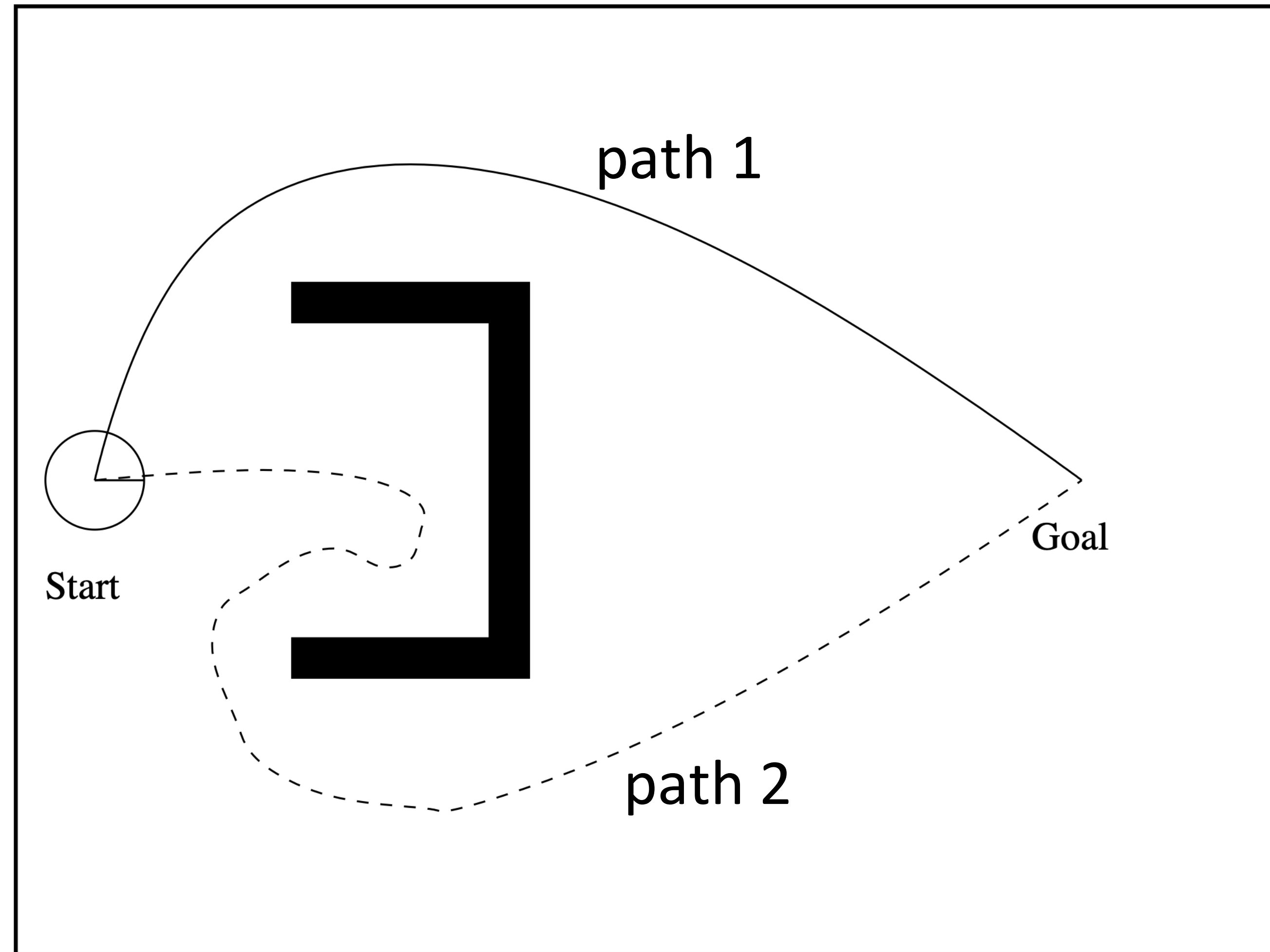**This set of rules is called a policy**

Reactive Robots

Limitations of Reactive Agents

They might have a sub-optimal behavior.
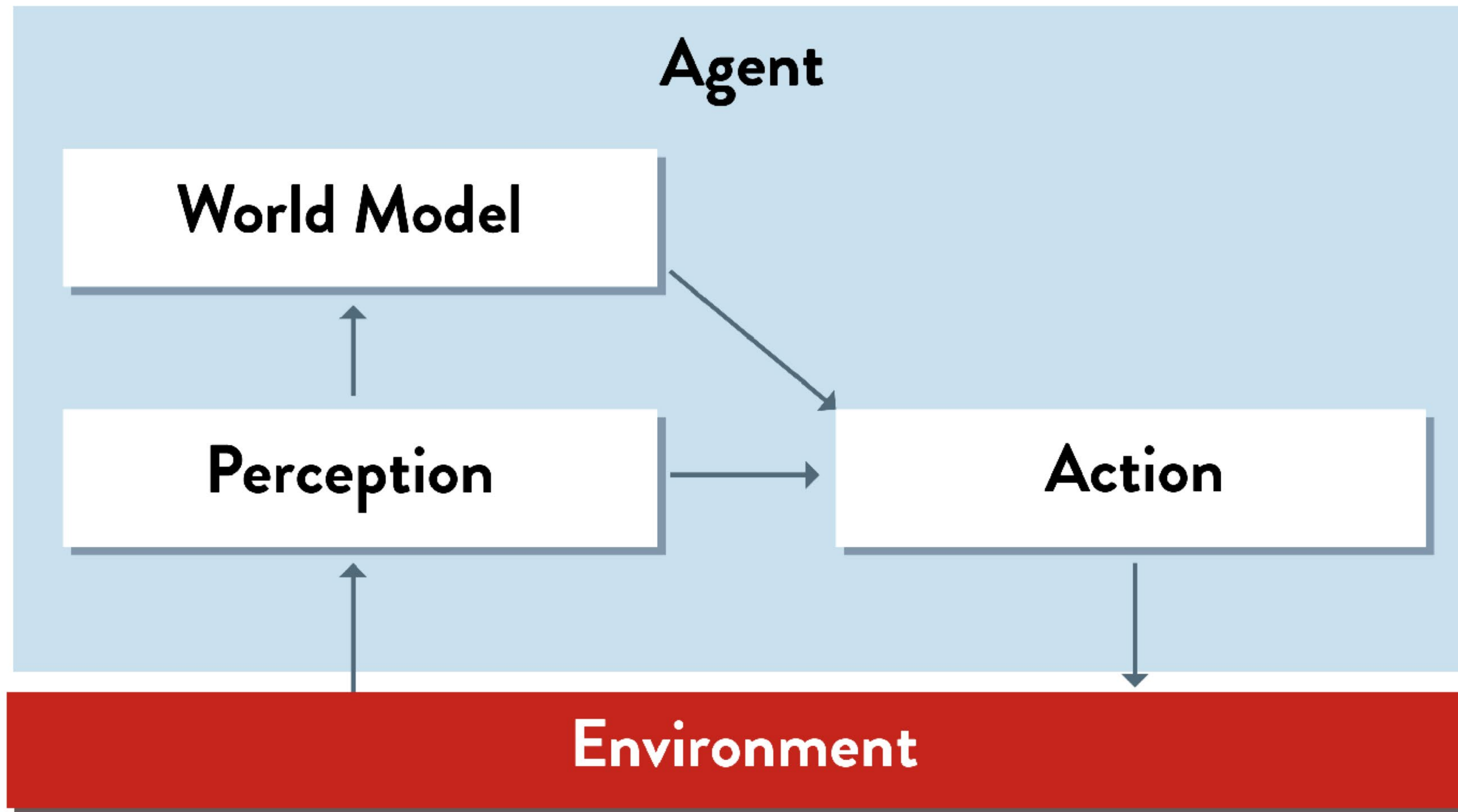
- A reactive agents follows path 2 (reaching the obstacle and turning)

- A reactive agent cannot guarantee path 1 (avoiding the obstacle)

path 1

Goal

Start

path 2

Types of Agents

- Reactive Agent

- **Model-Based Agent**
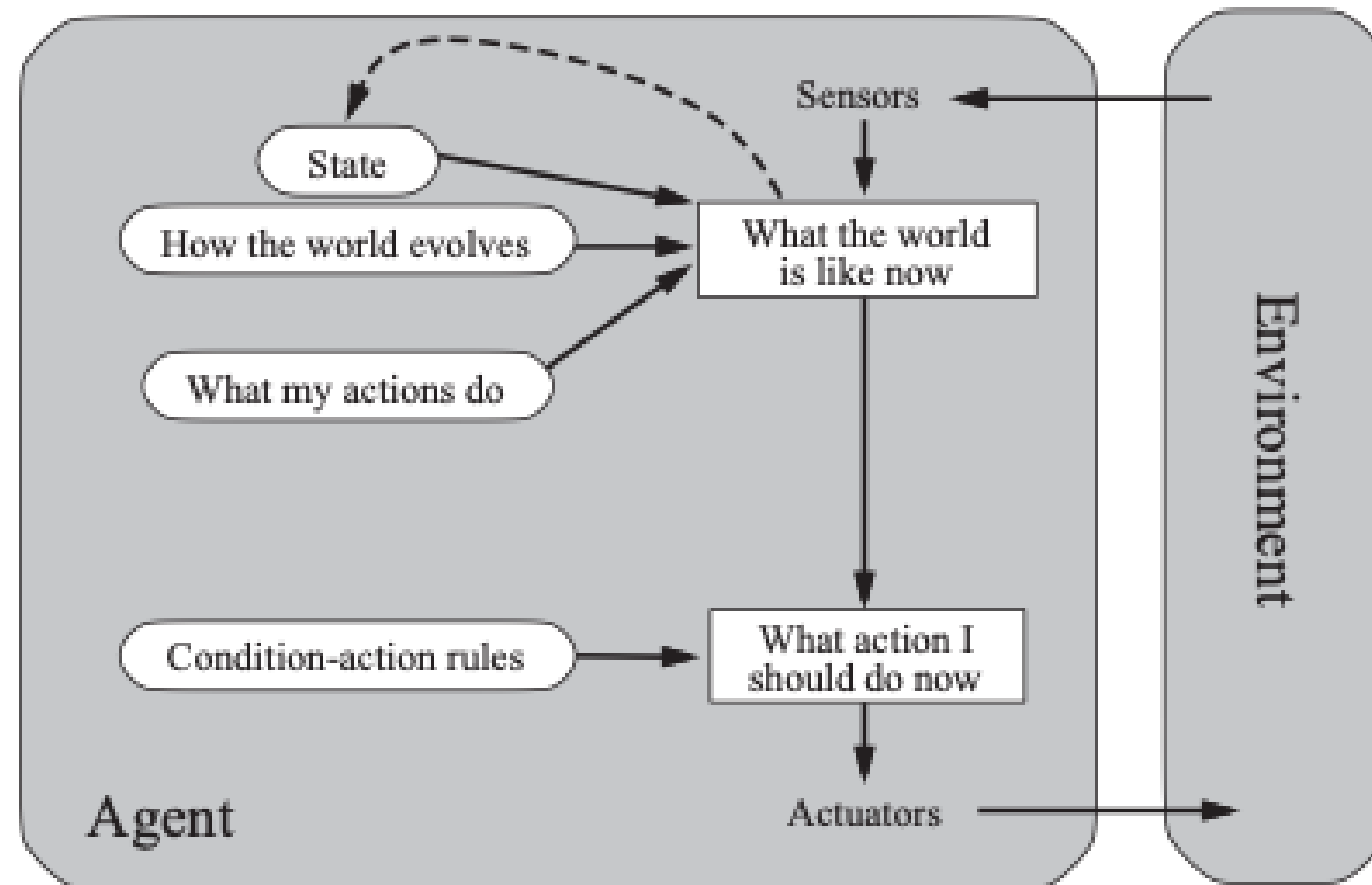
- Planning Agent

- Learning Agent

Model-Based Agent

Model-based Agents

- Handle *partial observability* by *keeping track of the part of the world it can't see now*.

- Maintain internal state that depends on the percept history and remembers at least some of the unobserved aspects of the current state.

- Knowledge about "how the world works" is called a **model** of the world.

- An agent that uses such a model is called a **model-based agent**.

Model-based Reflex Agent

A model-based reflex agent. It keeps track of the current state of the world, using an internal model. It then chooses an action in the same way as the reflex agent.

Model-based Reflex Agent

Model-based Agents

A Self-Driving Car:

➢ The car cannot always see the entire road (due to other cars, bends, or fog).
➢ It maintains an internal model of the road layout, traffic rules, and predictions of where other cars might move.

The Vacuum Cleaner:

➢ It remembers which squares it has already cleaned and uses an internal map of the environment to cover, even if it can't sense dirt everywhere at once.
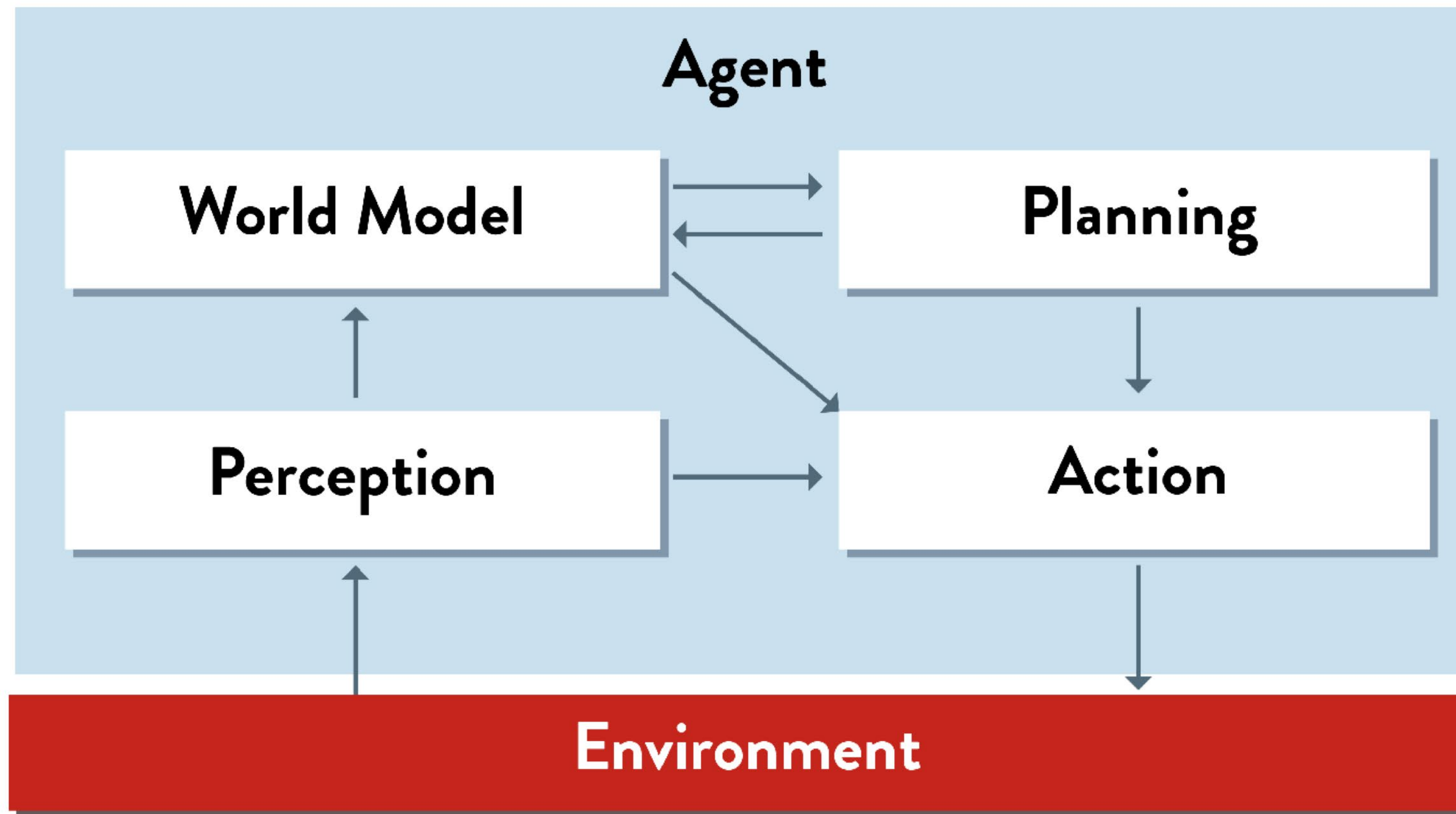
Limitations of Model-Based Agents

- An agent with a world model but no planning can look into the past, but not into the future; it will perform poorly when the task requires any of the following:

- searching several moves ahead

  – Chess, Rubik's cube

- complex tasks requiring many individual step

  – cooking a meal, assembling a watch

- logical reasoning to achieve goals

  – travel to New York

Sometimes we may need to plan several steps into the future. Note only looking into the past, but also the future.

Types of Agents

- Reactive Agent

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- **Planning Agent**

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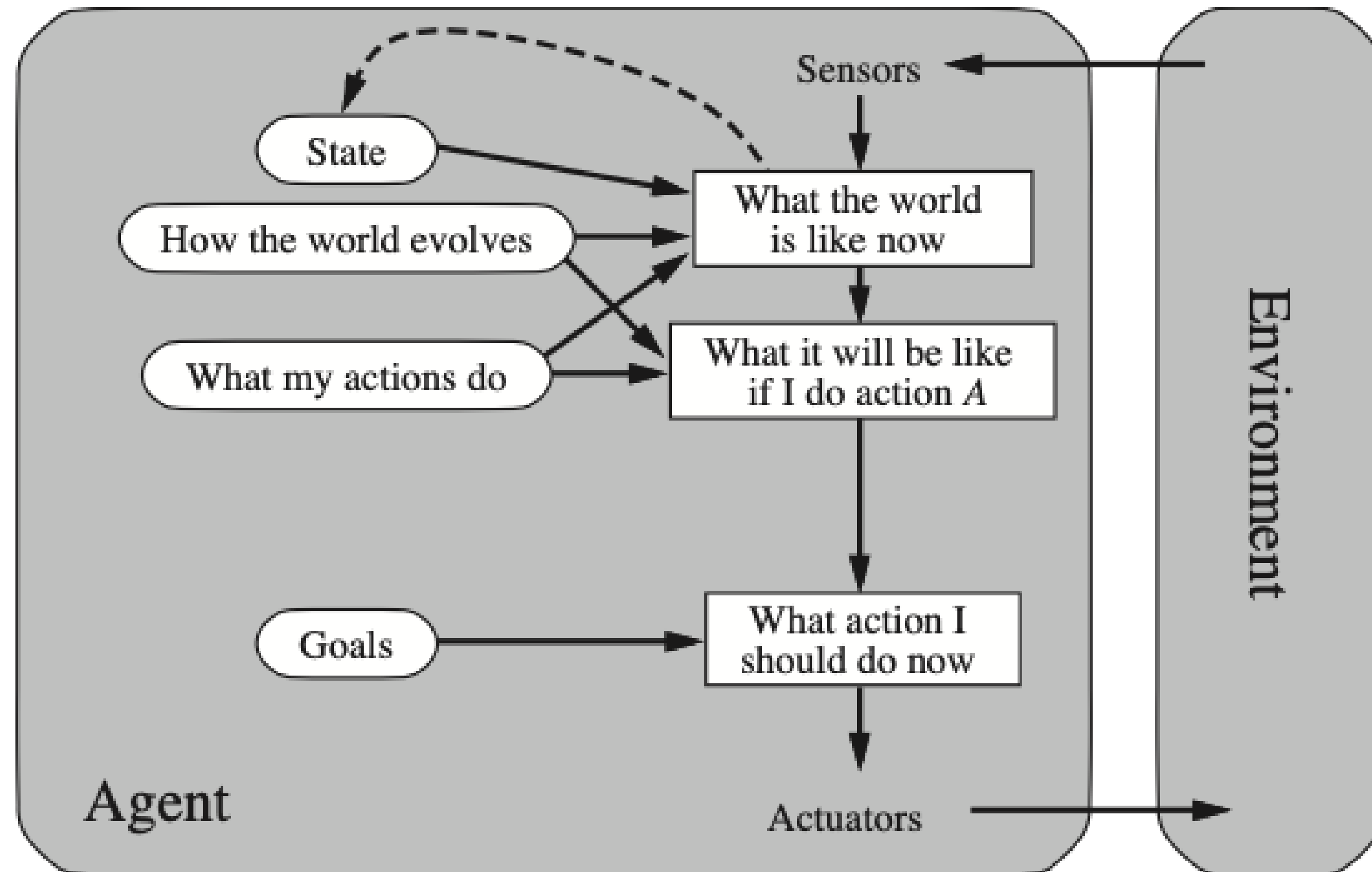
Planning Agent

Goal-Based Agent

Planning Agent

- Decision making of this kind is fundamentally different from the condition–action rules

- It involves consideration **of the future** (consequences of actions)

  – "What will happen if I do such-and-such?" and

  – "Will that make me happy?"

In the reflex agent designs, this information is not explicitly represented, because the built-in rules map directly from states to actions
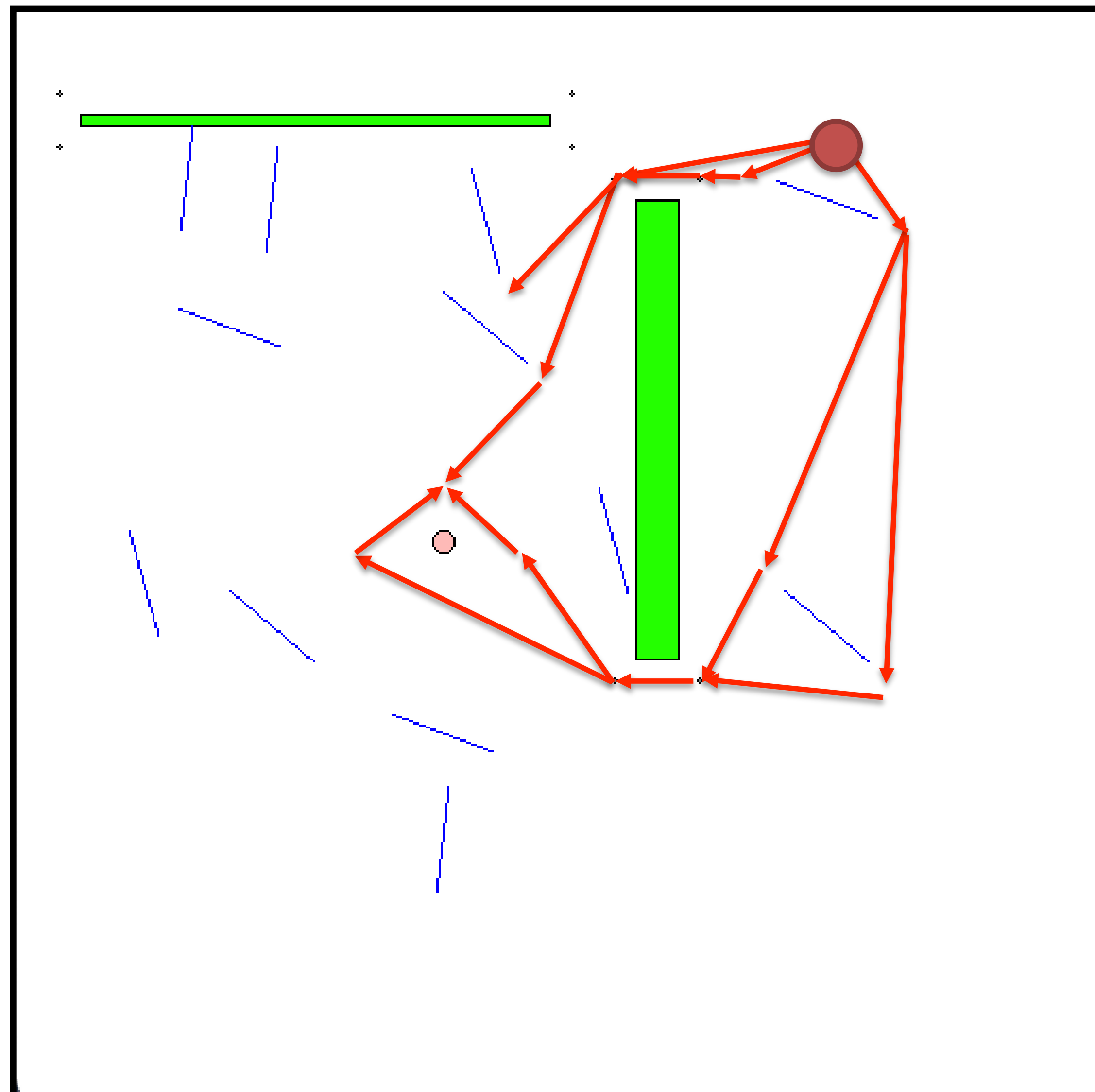
Planning Agent – Goal-based

- The planning agent or goal-based agent is more flexible because the knowledge that supports its decisions is represented explicitly and can be modified.

- The agent's behaviour can easily be changed.

- But …

  - it's slower to react because it has to "think" about what it's doing.

Goal-based (teleological) agent

- State description often not sufficient for agent to decide what to do
- Needs to consider its goals (may involve searching and planning)

Planning usually needs search

Goal-based agent

Chess or Poker Playing Agent:

➢ The goal must first be defined (e.g., win the game).
➢ The agent anticipates possible future moves of its opponent(s) and plans its own sequence of moves accordingly.

Google Maps Route Planner:

➢ The goal must be defined (e.g., find the fastest route, cheapest route, or avoid tolls).
➢ The agent considers possible future conditions, such as traffic, and plans the best route based on this information.
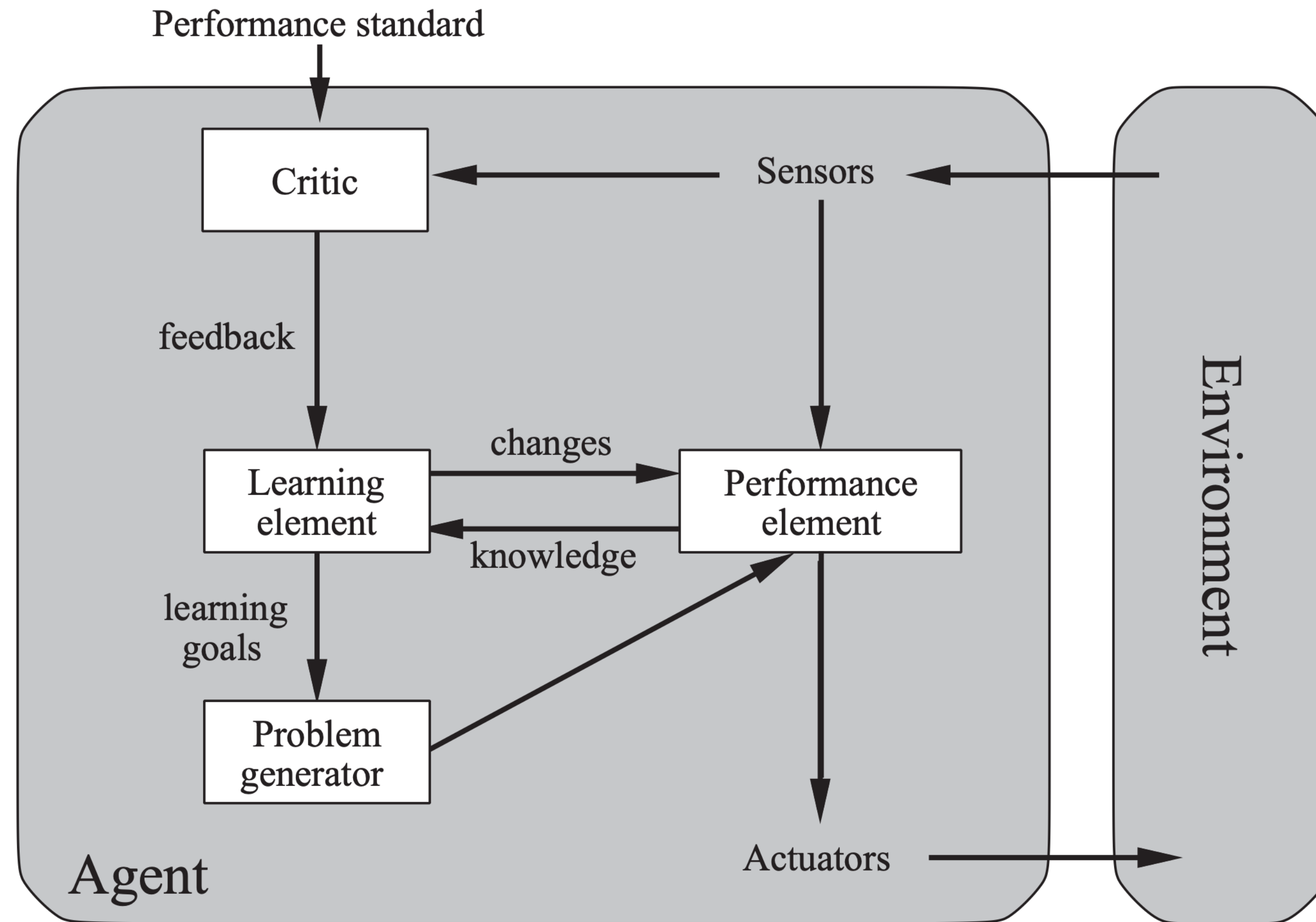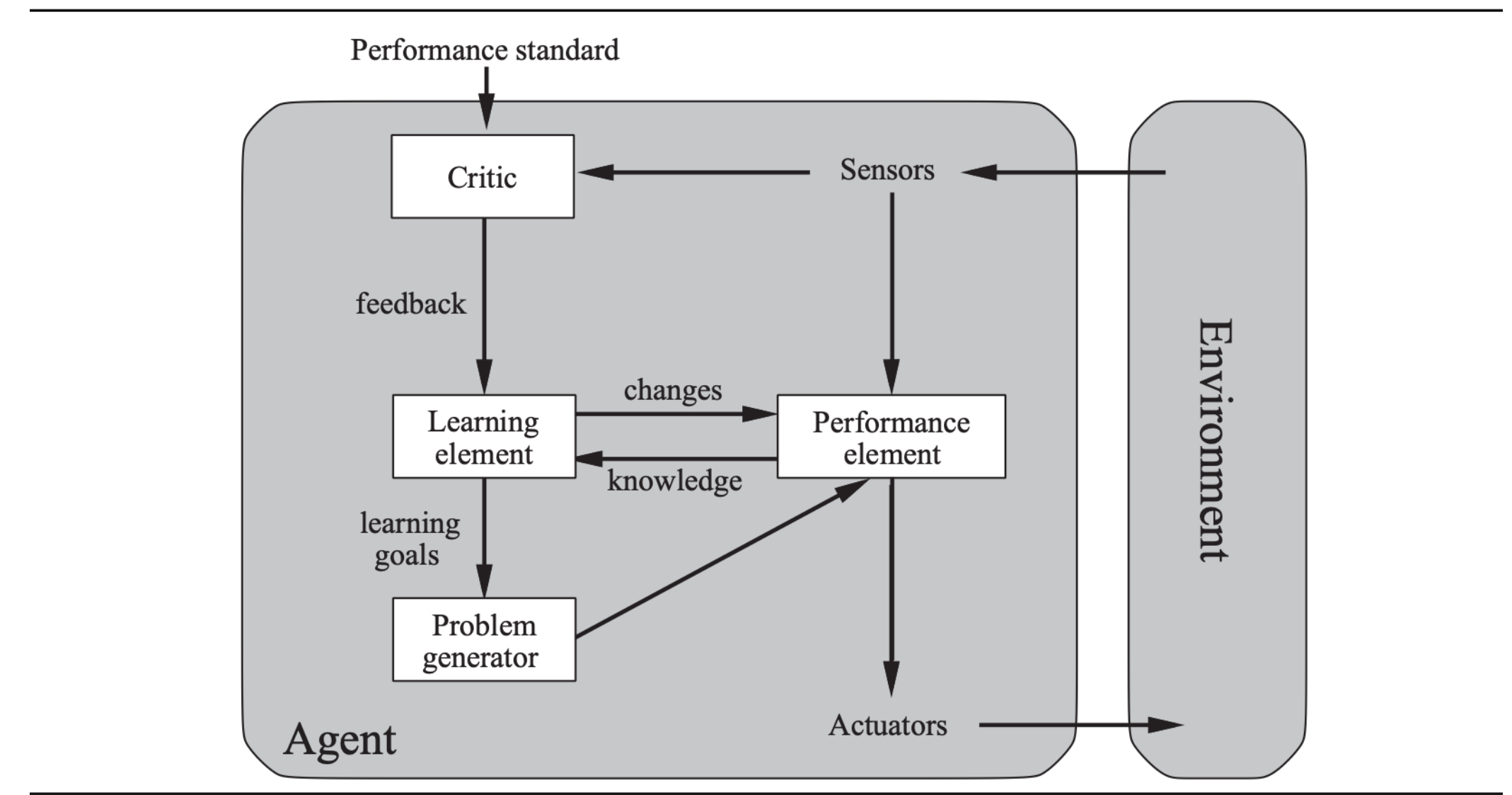
@Home Robot

Types of Agents

- Reactive Agent

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- Planning Agent

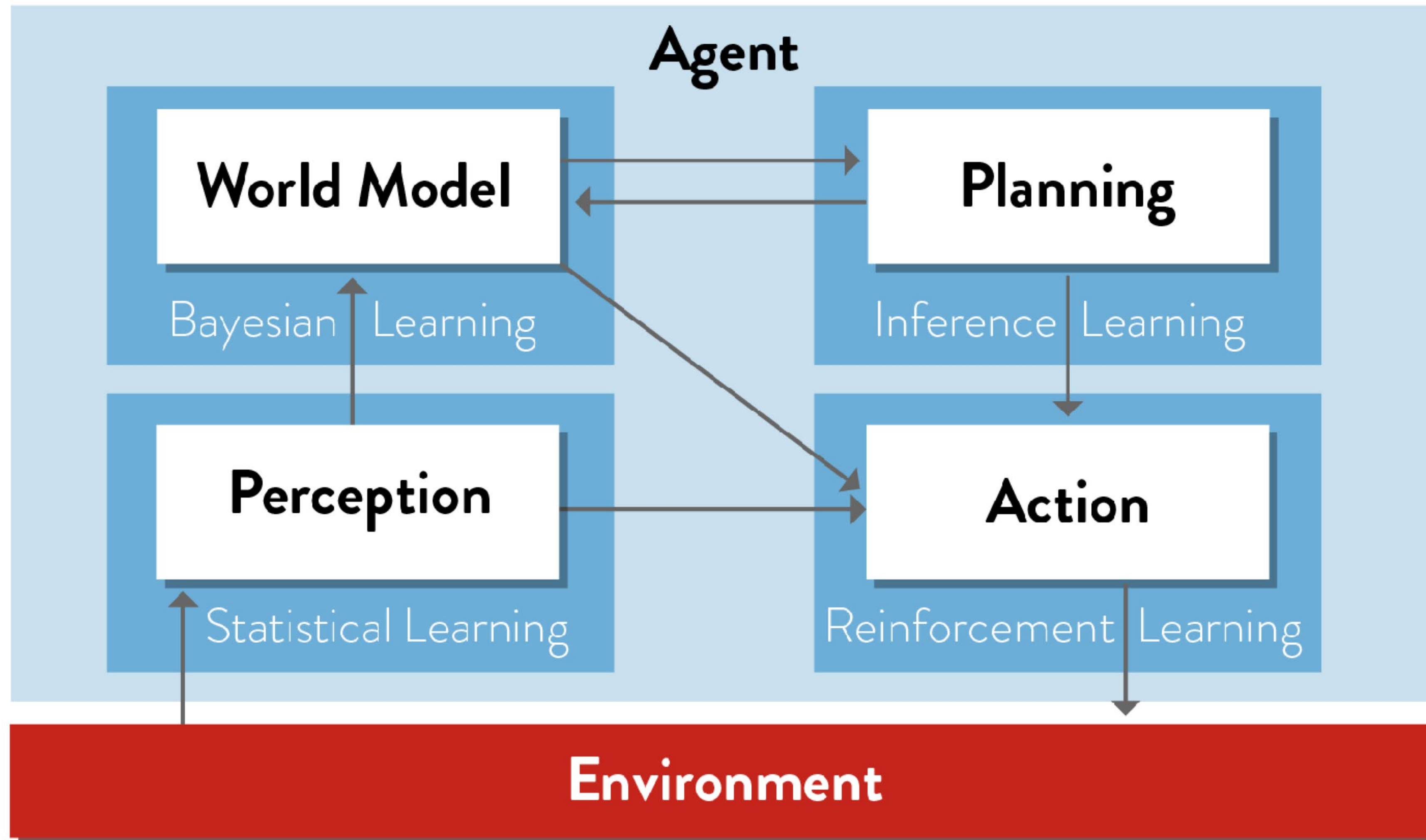- **Learning Agent**

Learning Agent

Learning Agent

- **Performance element** takes percepts; decides actions

- **Critic** gives feedback on how performance element is doing

- **Learning element** uses feedback to determine how performance element should be modified to do better in future

- **Problem generator** creates new tasks to provide new and informative experiences.

Learning Agent

Learning

- Learning is not a separate module, but rather a set of techniques for improving the existing modules

- Learning is necessary because:

  – may be difficult or even impossible for a human to design all aspects of the system by hand

  – the agent may need to adapt to new situations without being re-programmed by a human

Summary

- **Reactive agents** respond directly to percepts

- **Model-based reflex agents** maintain internal state to track aspects of the world that are not evident in the current percept

- **Planning (Goal-based) agents** act to achieve their goals

- All agents can improve their performance through learning.

References

- Poole & Mackworth, Artificial Intelligence: Foundations of Computational Agents, chapters 1 & 2.

- Russell & Norvig, Artificial Intelligence: a Modern Approach, Chapter 2.