

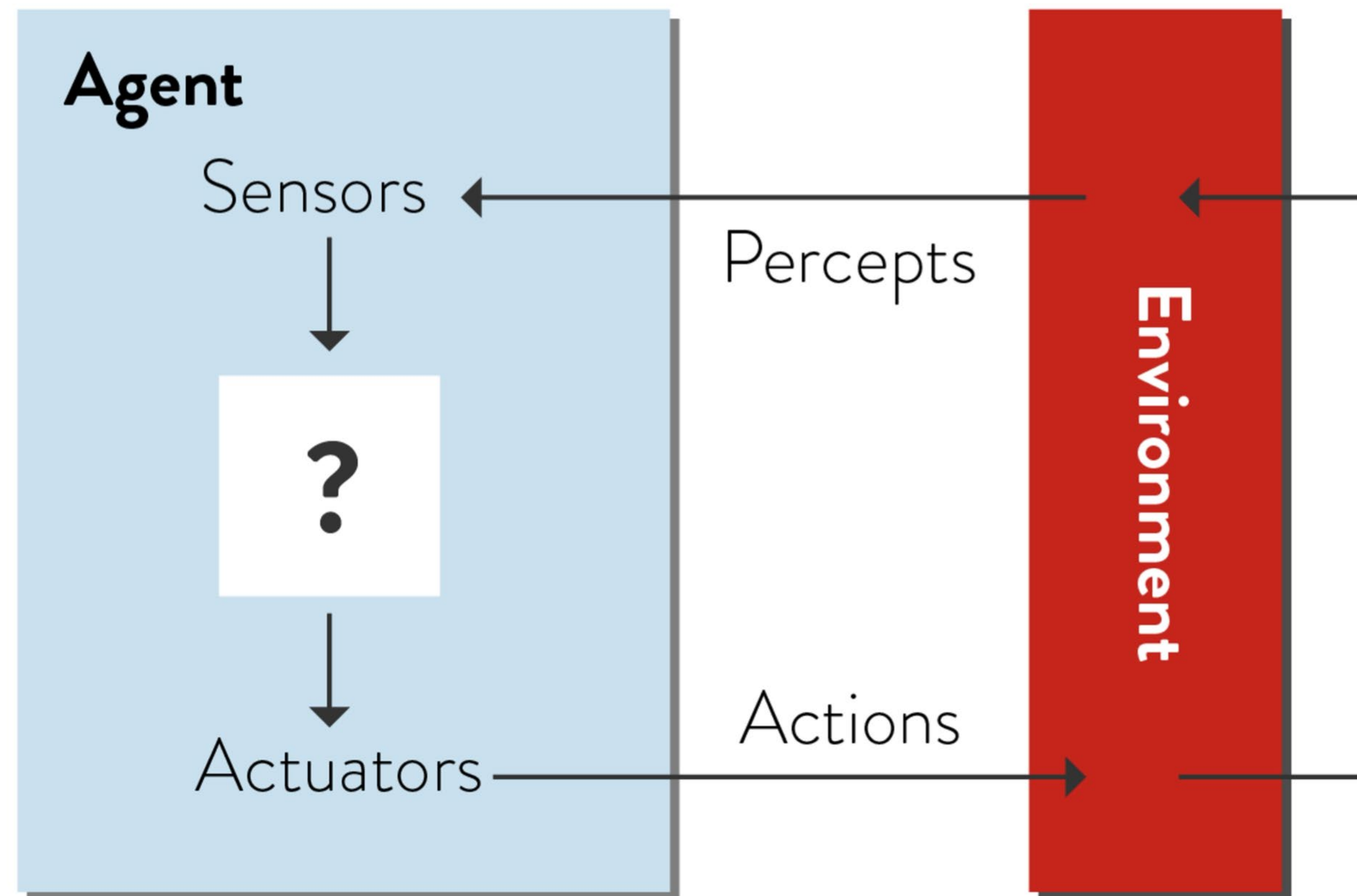
# Agents

COMP9414: Artificial Intelligence

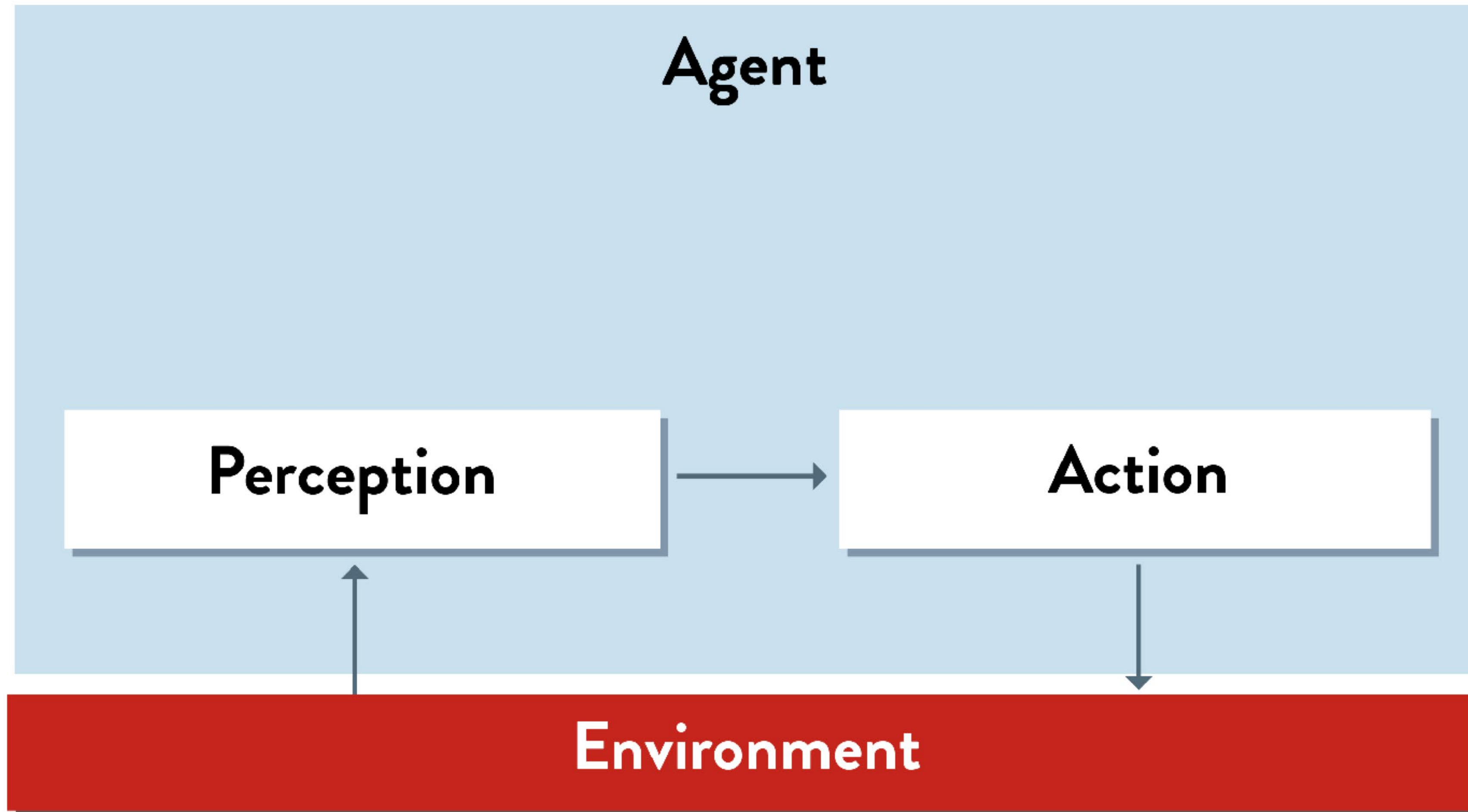
# Types of Agents

- Reactive Agent
- Model-Based Agent
- Planning Agent
- Utility-based agent
- Game Playing Agent
- Learning Agent

# Agent Model



# 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:

    backup

    turn right

**else if** right touch:

    backup

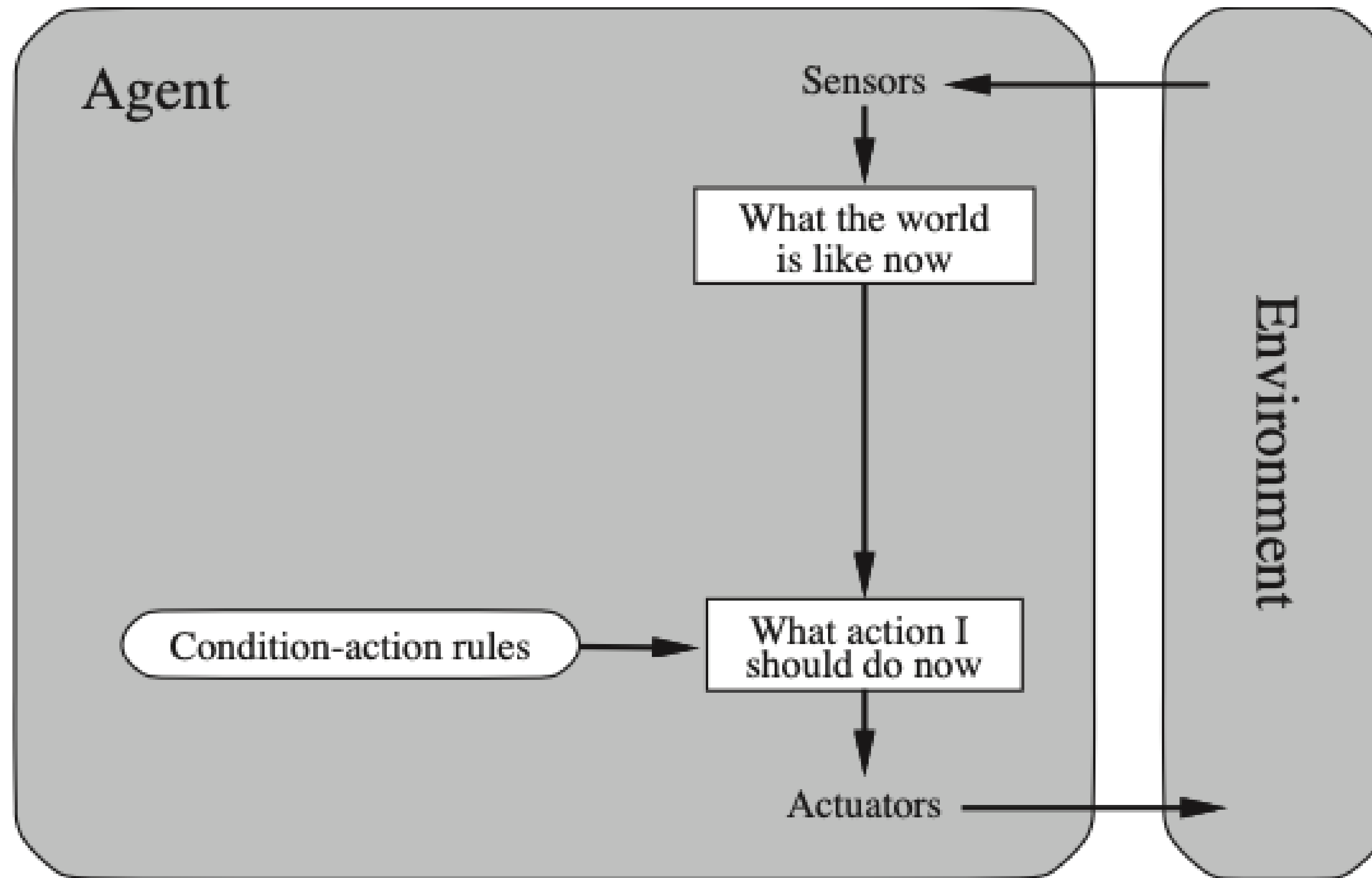
    turn left

**else**

    go straight



# Reactive Agent



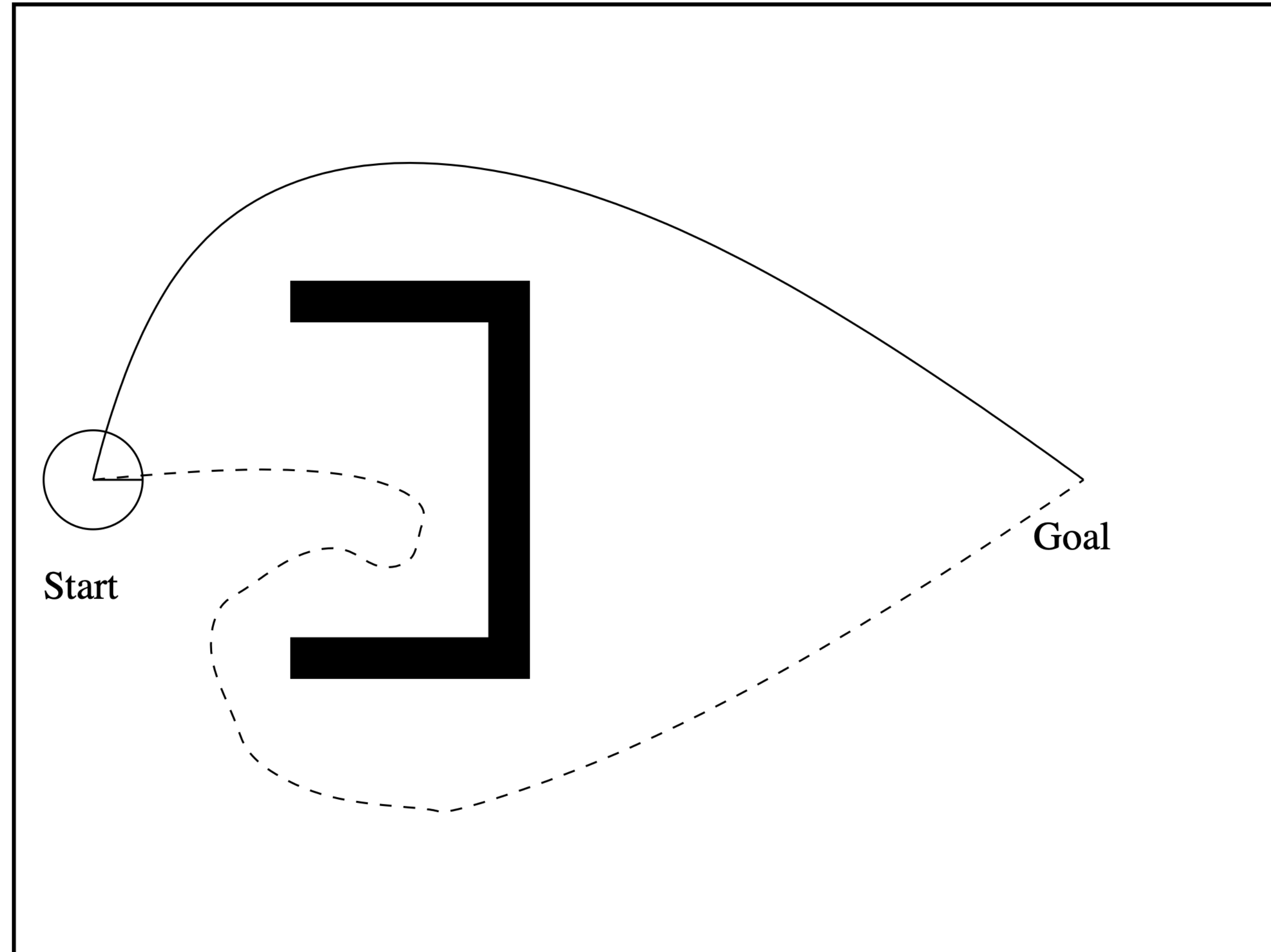
Reflex (reactive) agent — applies condition-action rules to each percept

# Reactive Robots

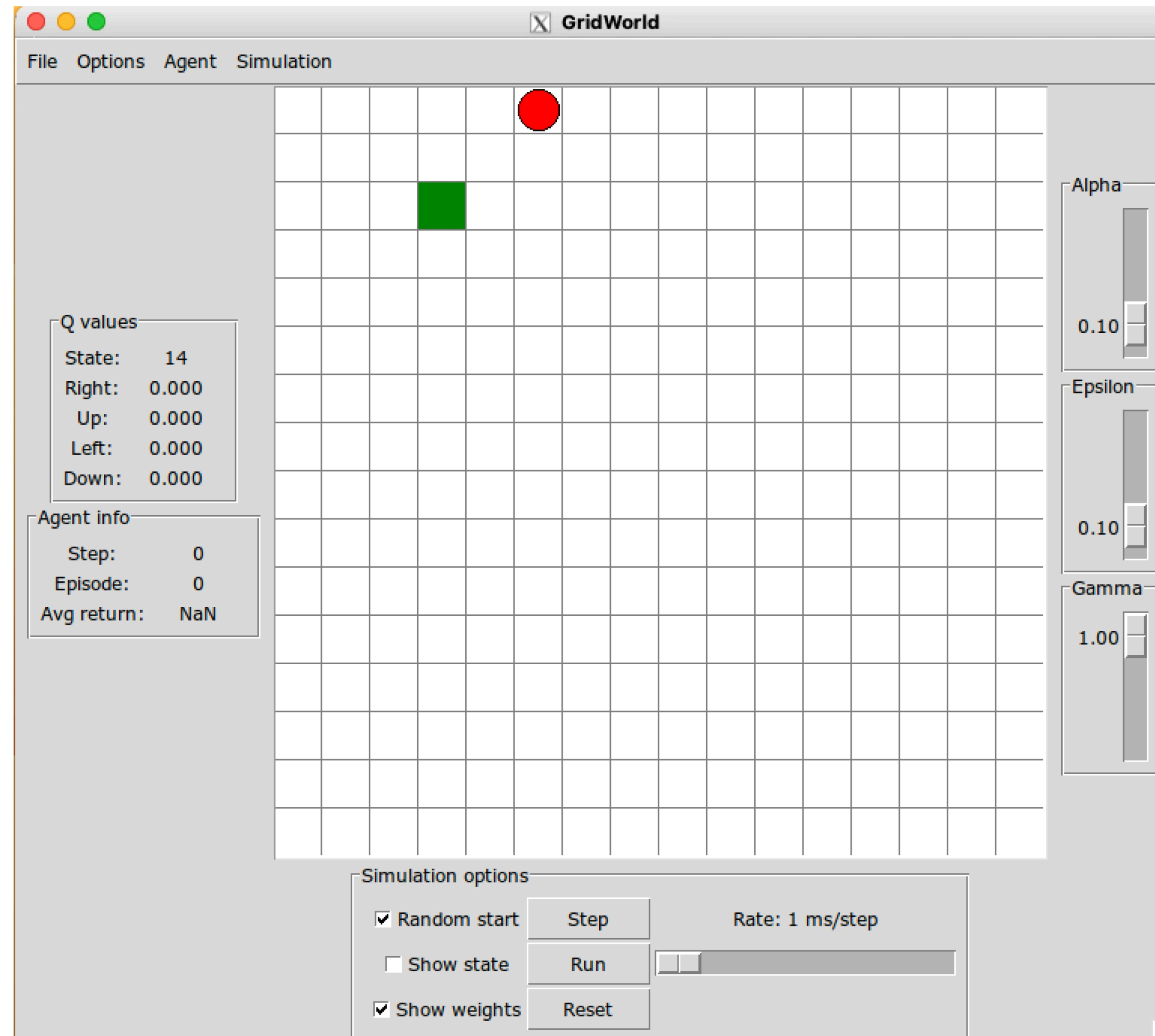




# Limitations of Reactive Agents



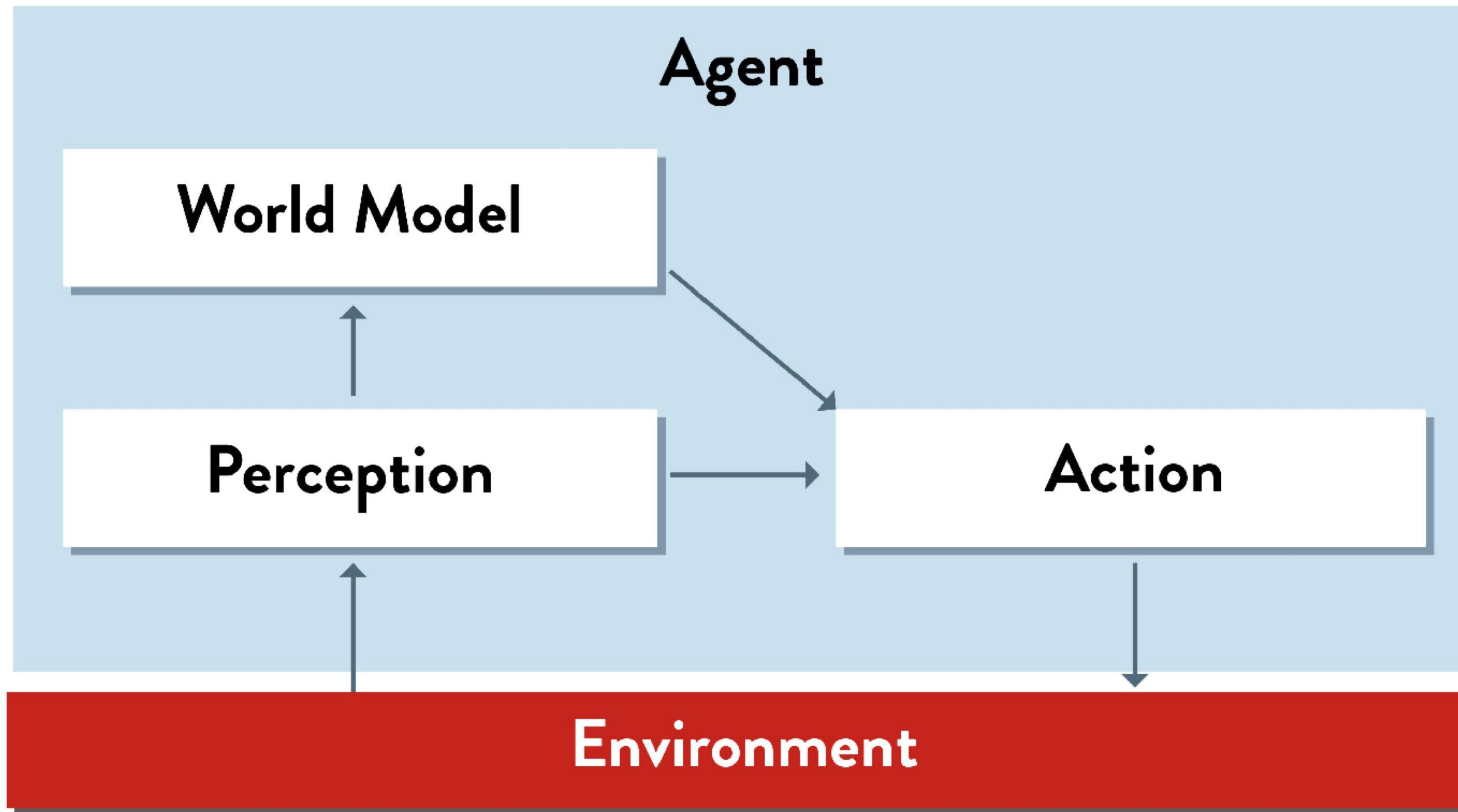
# Simulation of Reactive, Search and Learning Agents



# Limitations of Reactive Agents

- Reactive Agents have no memory or “state”
  - unable to base decision on previous observations
  - may repeat the same sequence of actions over and over
  - Escape from infinite loops is (sometimes) possible if the agent can randomise its actions.

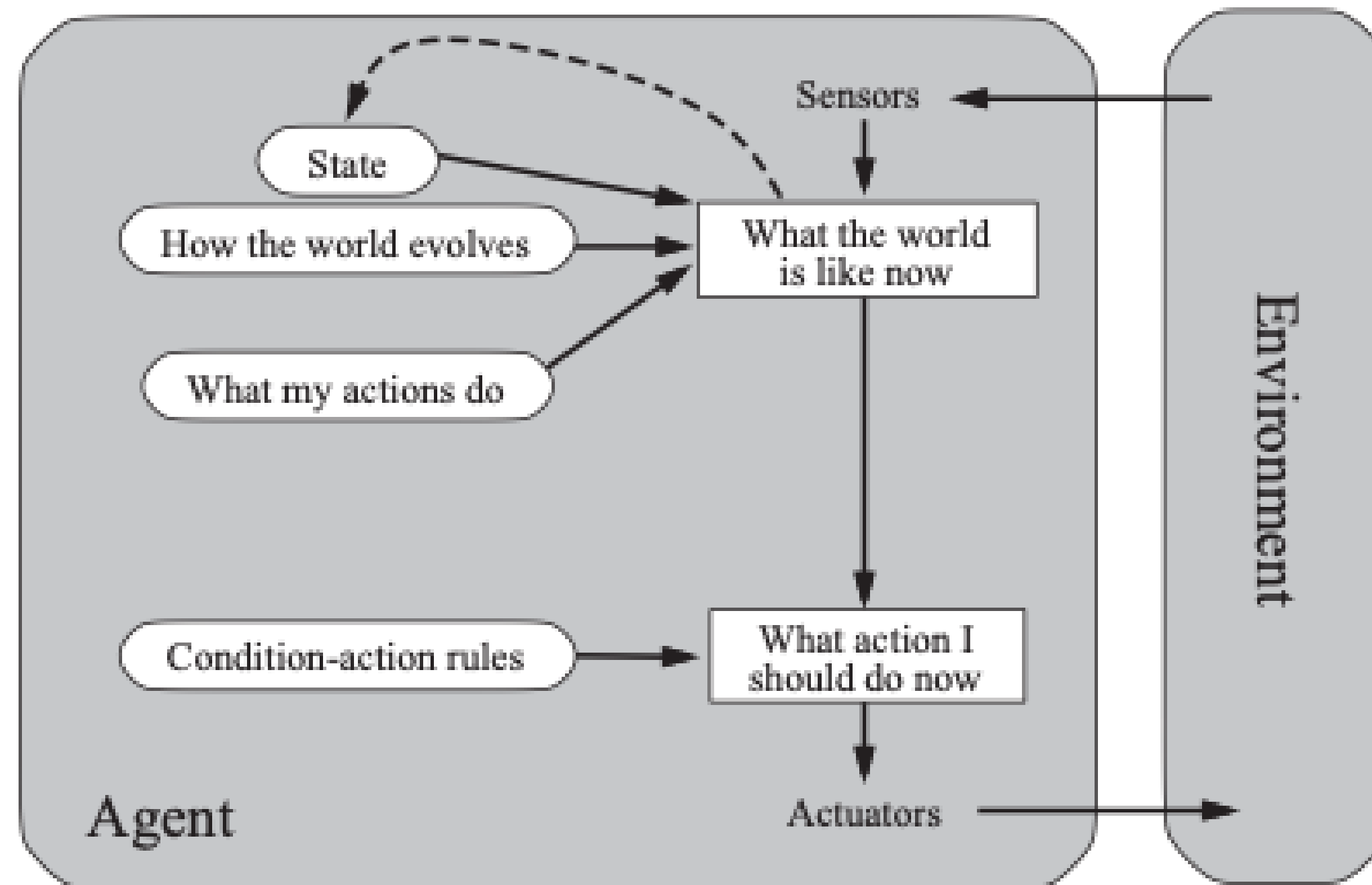
# Model-Based Agent



# 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



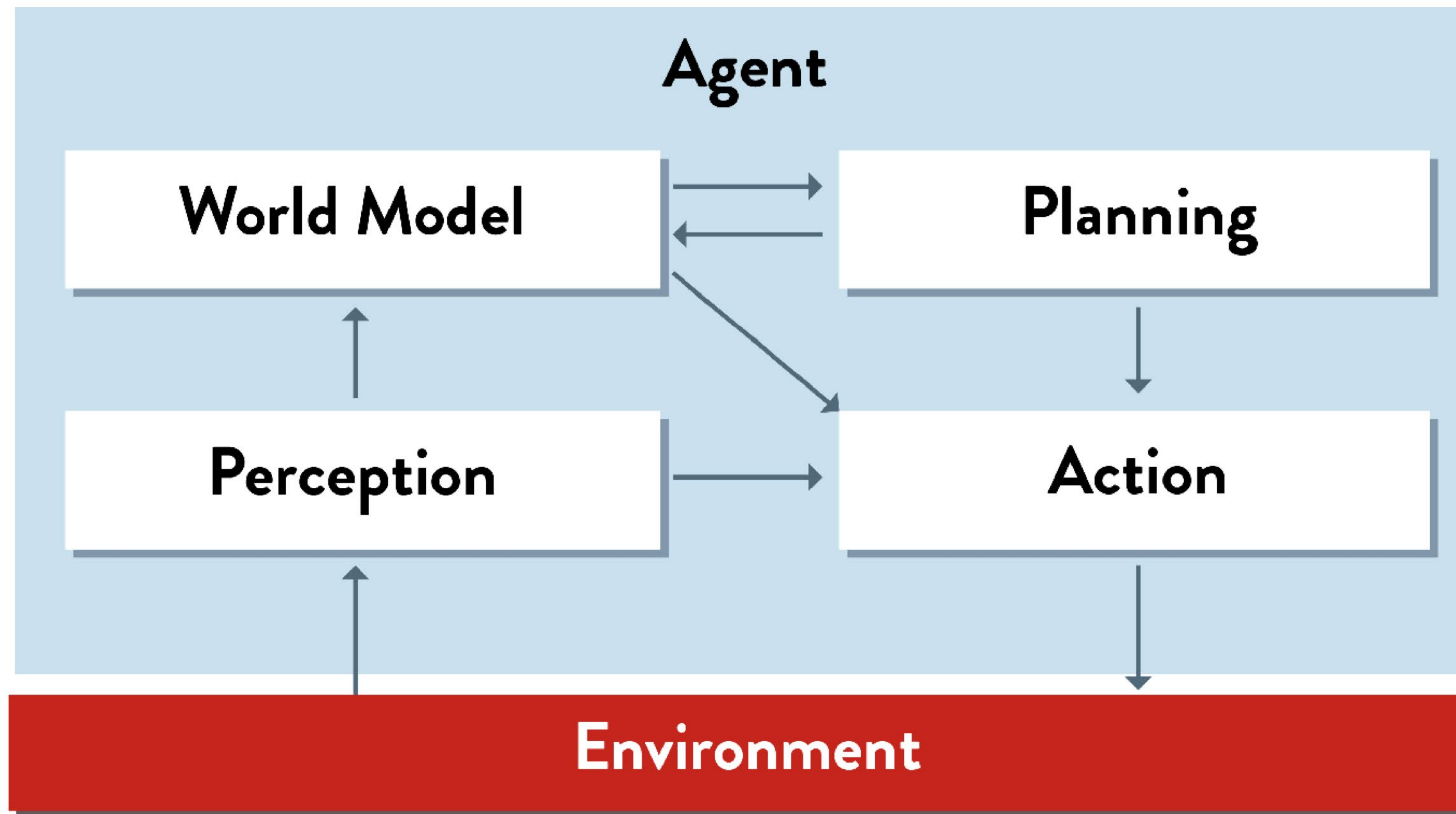
# Limitations of Model-Based Agents

- 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



# Planning Agent



Goal-Based Agent

# Planning Agent

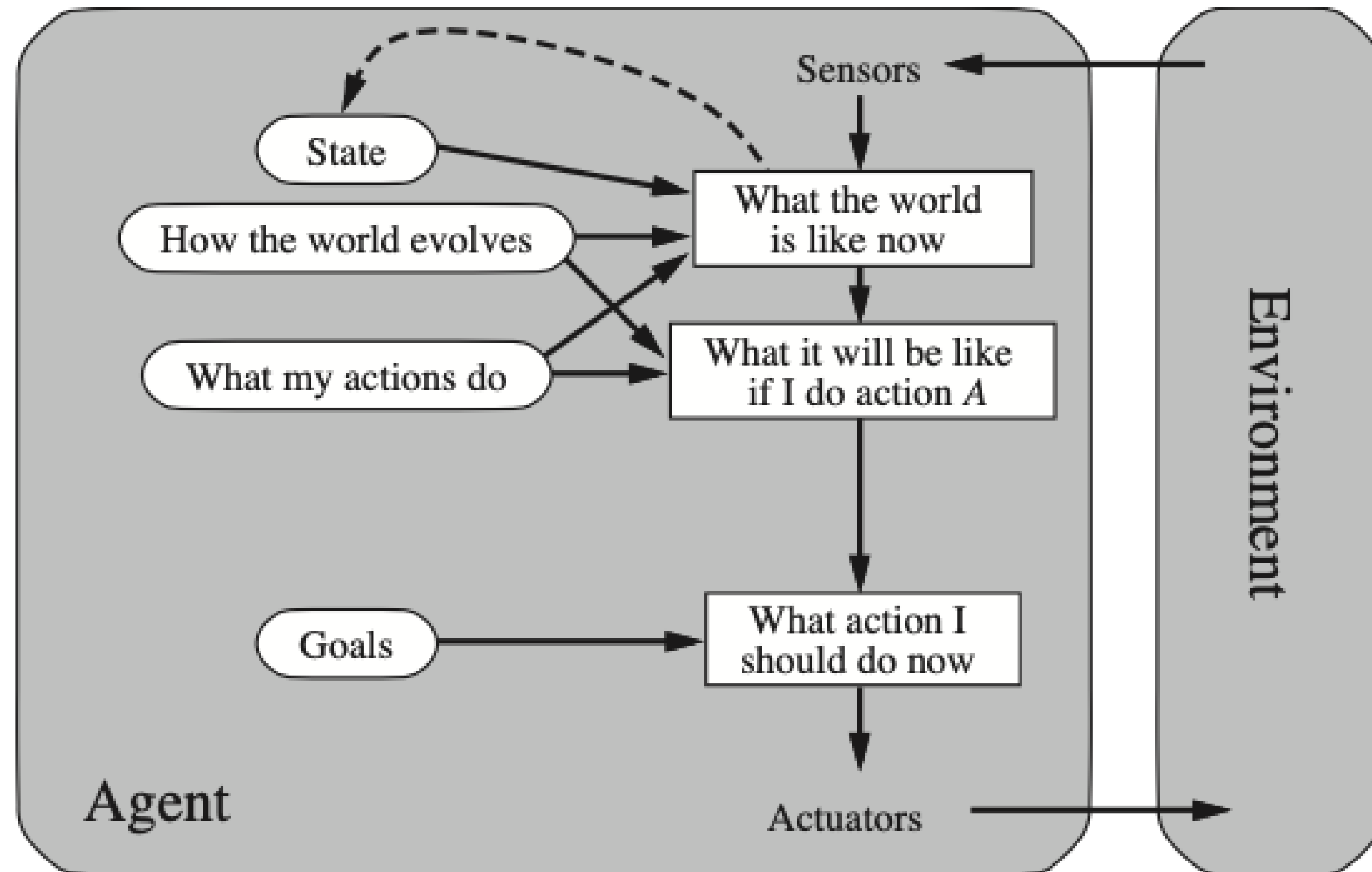
- Decision making of this kind is fundamentally different from the condition–action rules
- It involves consideration of the future
  - “What will happen if I do such-and-such?” and
  - “Will that make me happy?”

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

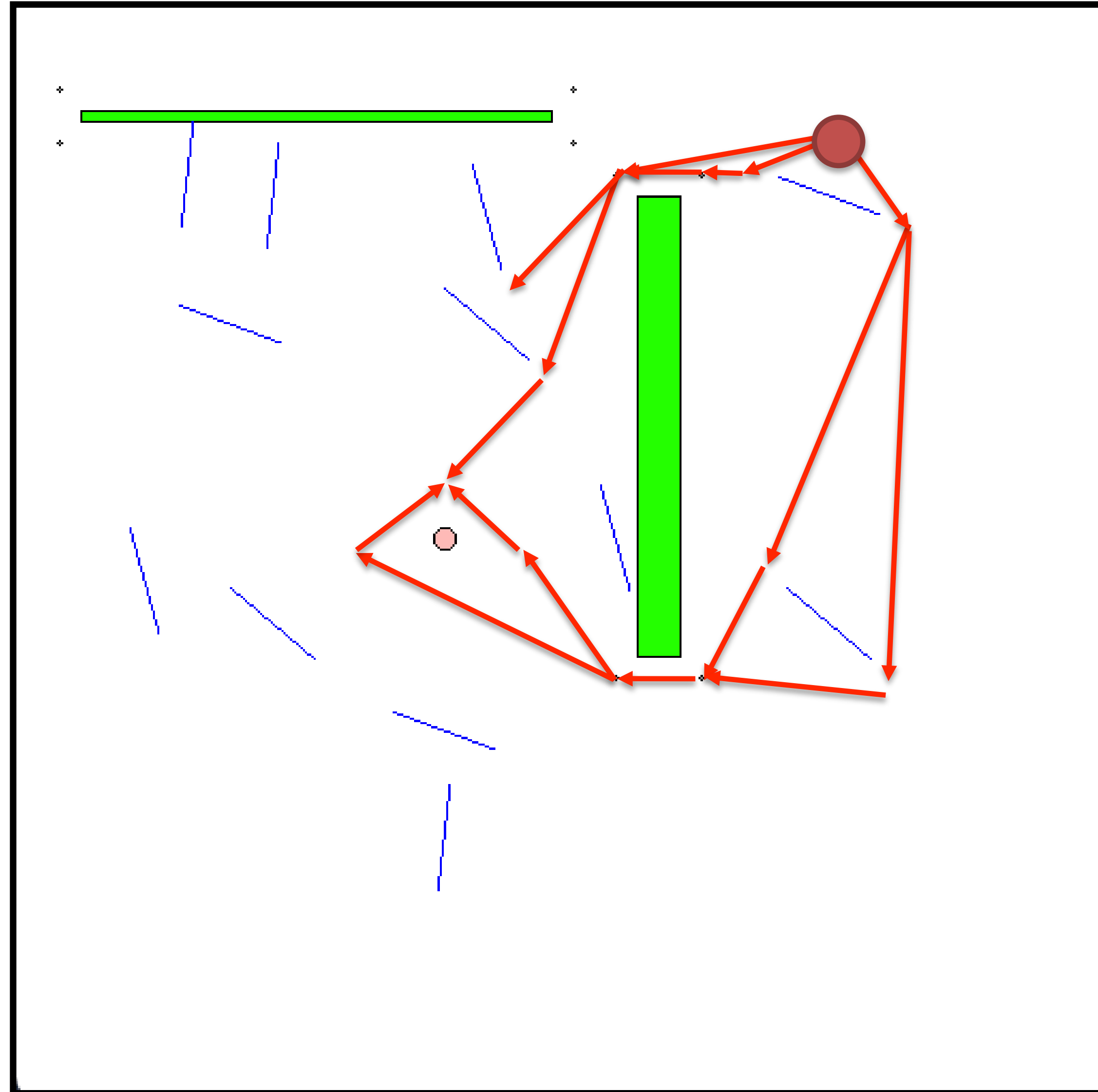
- The planning agent or goal-based agent is more flexible because the knowledge that supports its decisions is represented explicitly and **can be modified**.
- The agent's behaviour can easily be changed.
- But ...
  - **it's slower to react because it has to “think” about what it's doing.**

# 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)

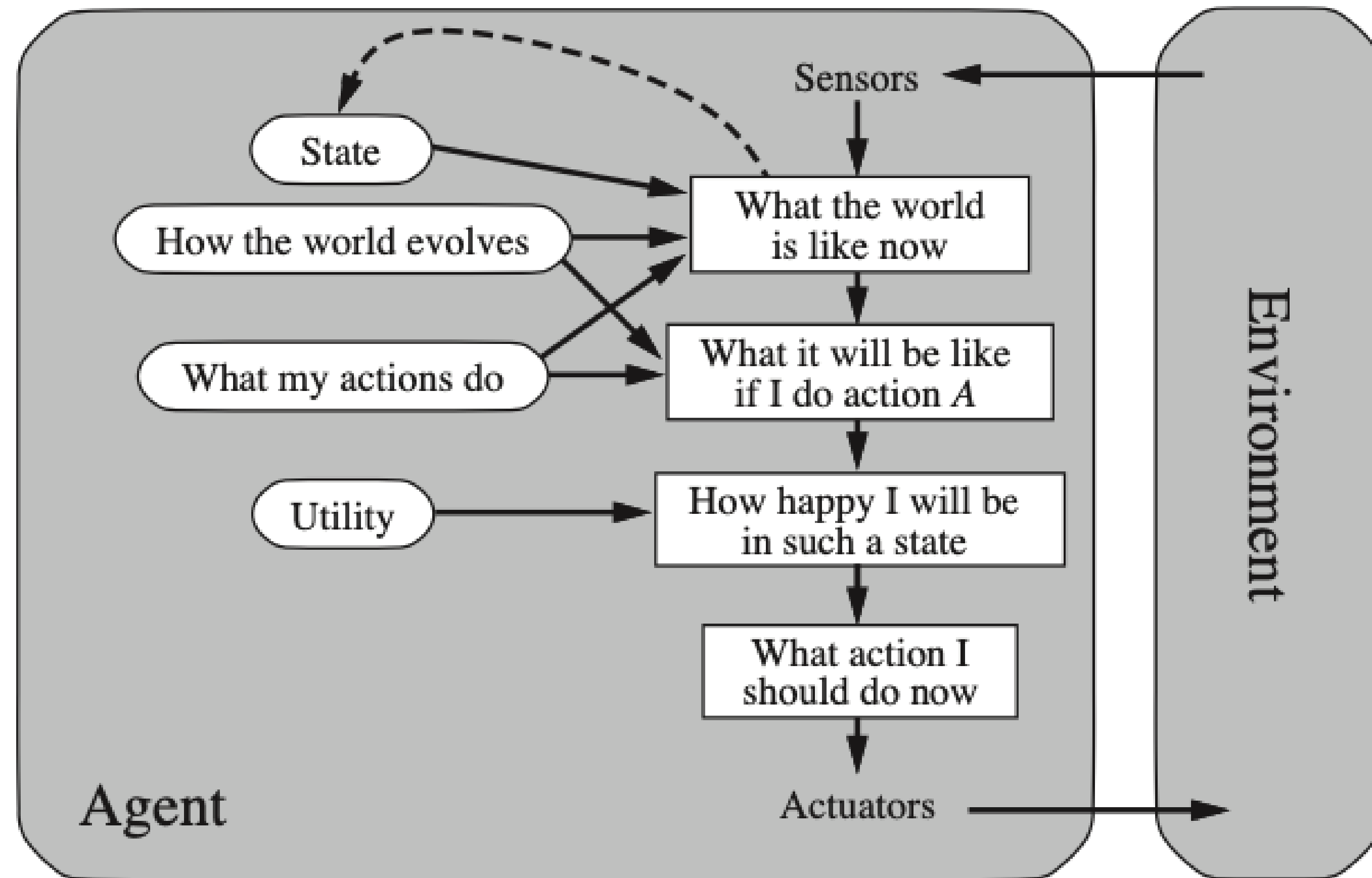
# Planning usually needs search



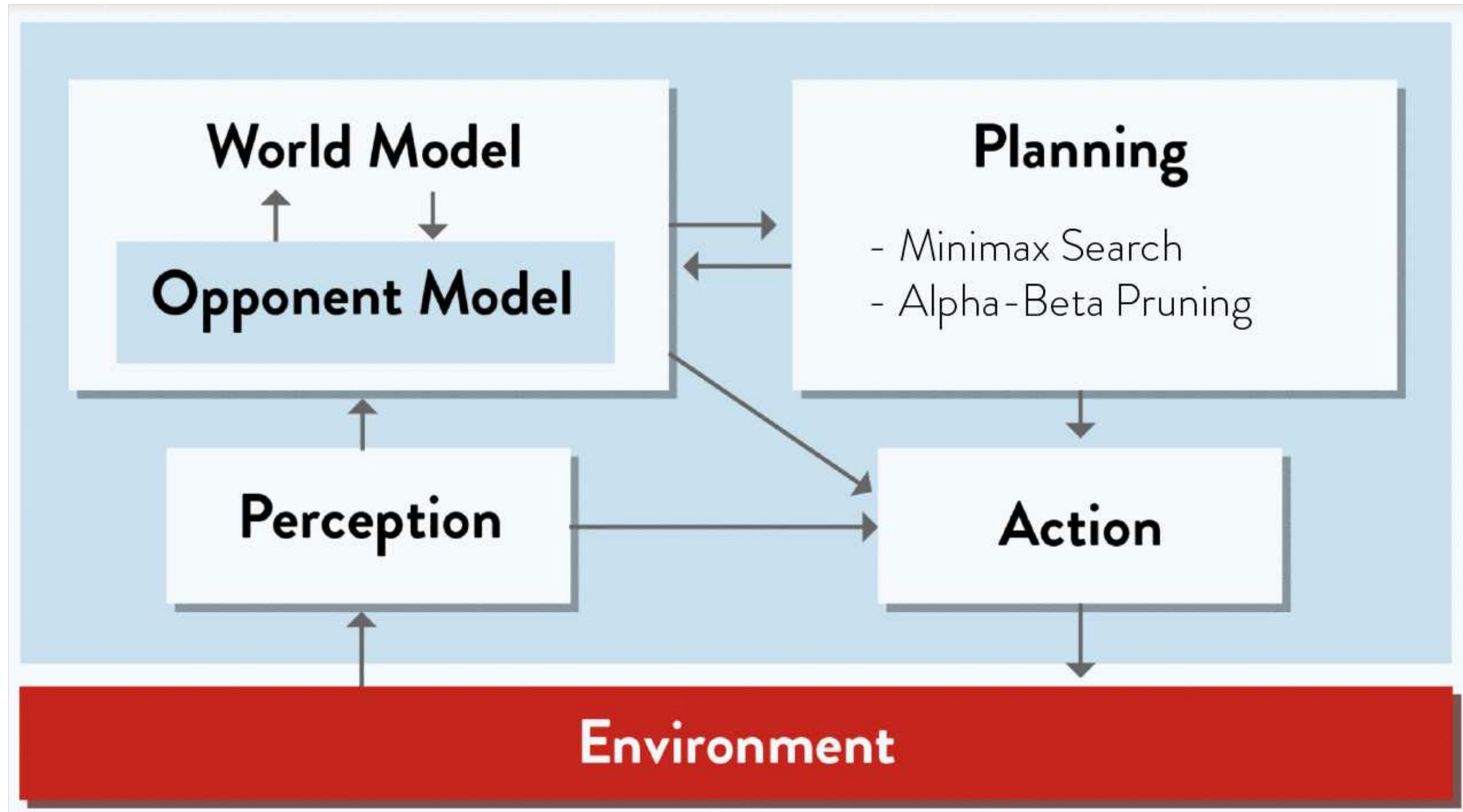
# @Home Robot



# Utility-based agent

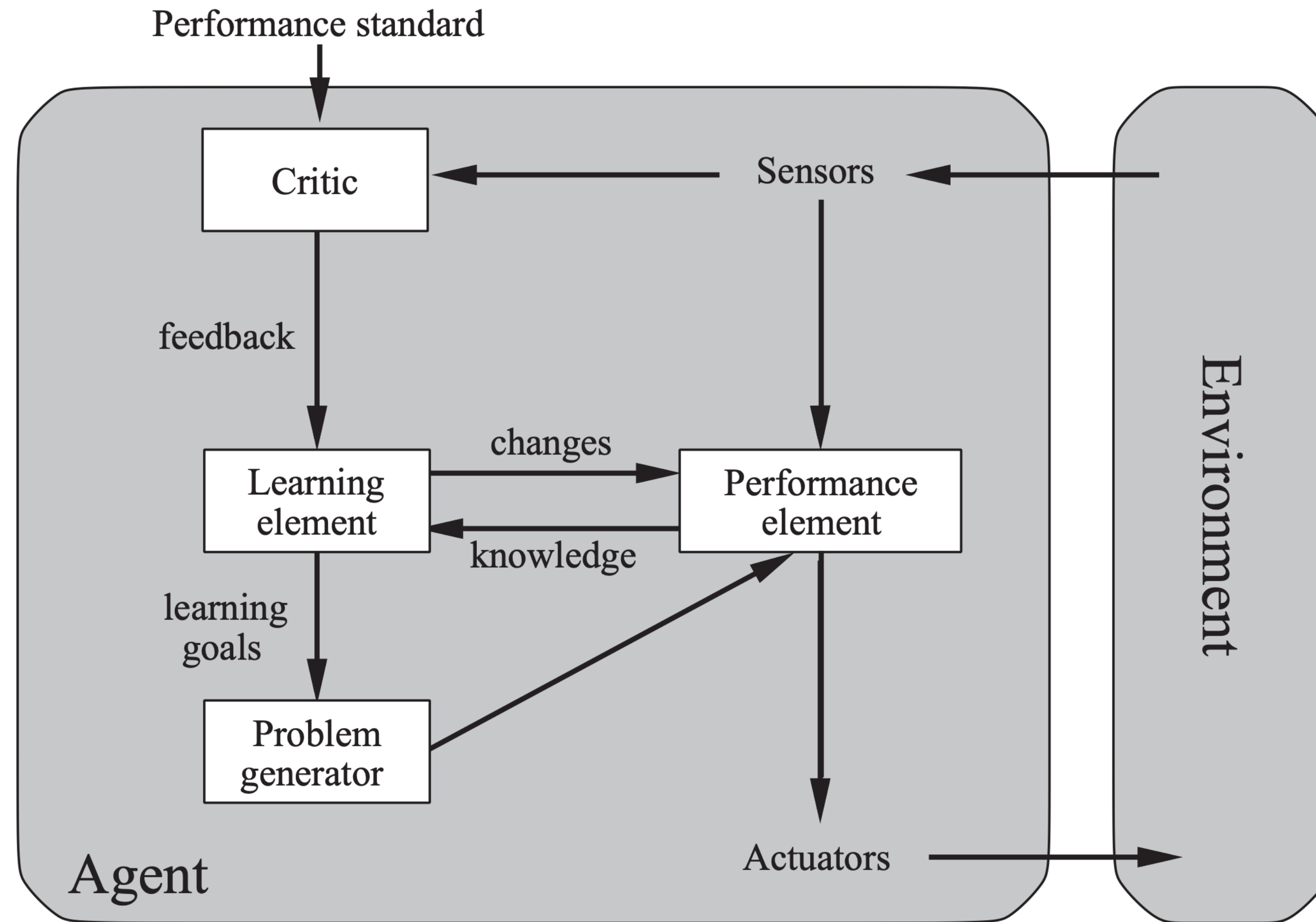


# Game Playing Agent

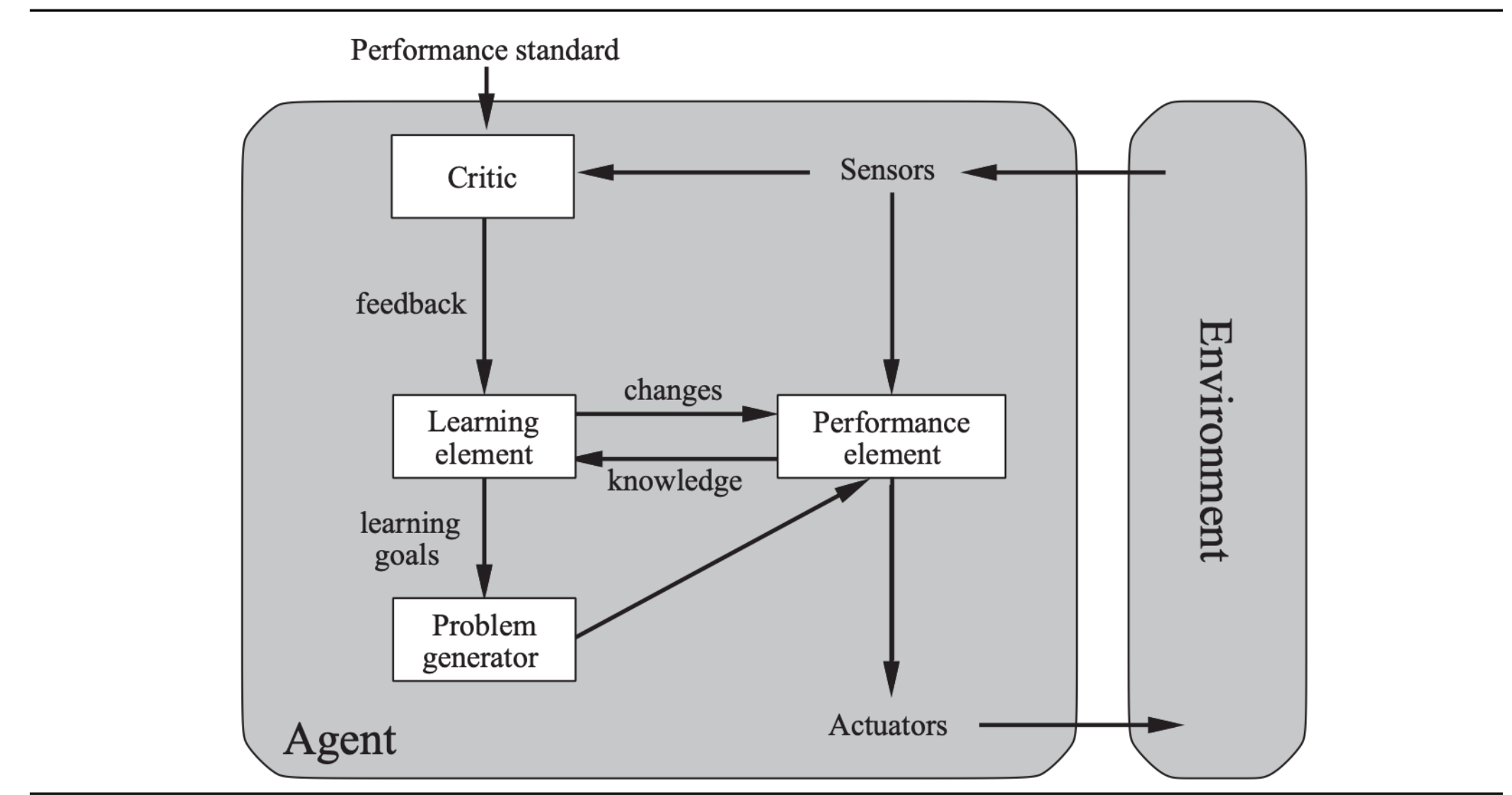




# Learning Agent

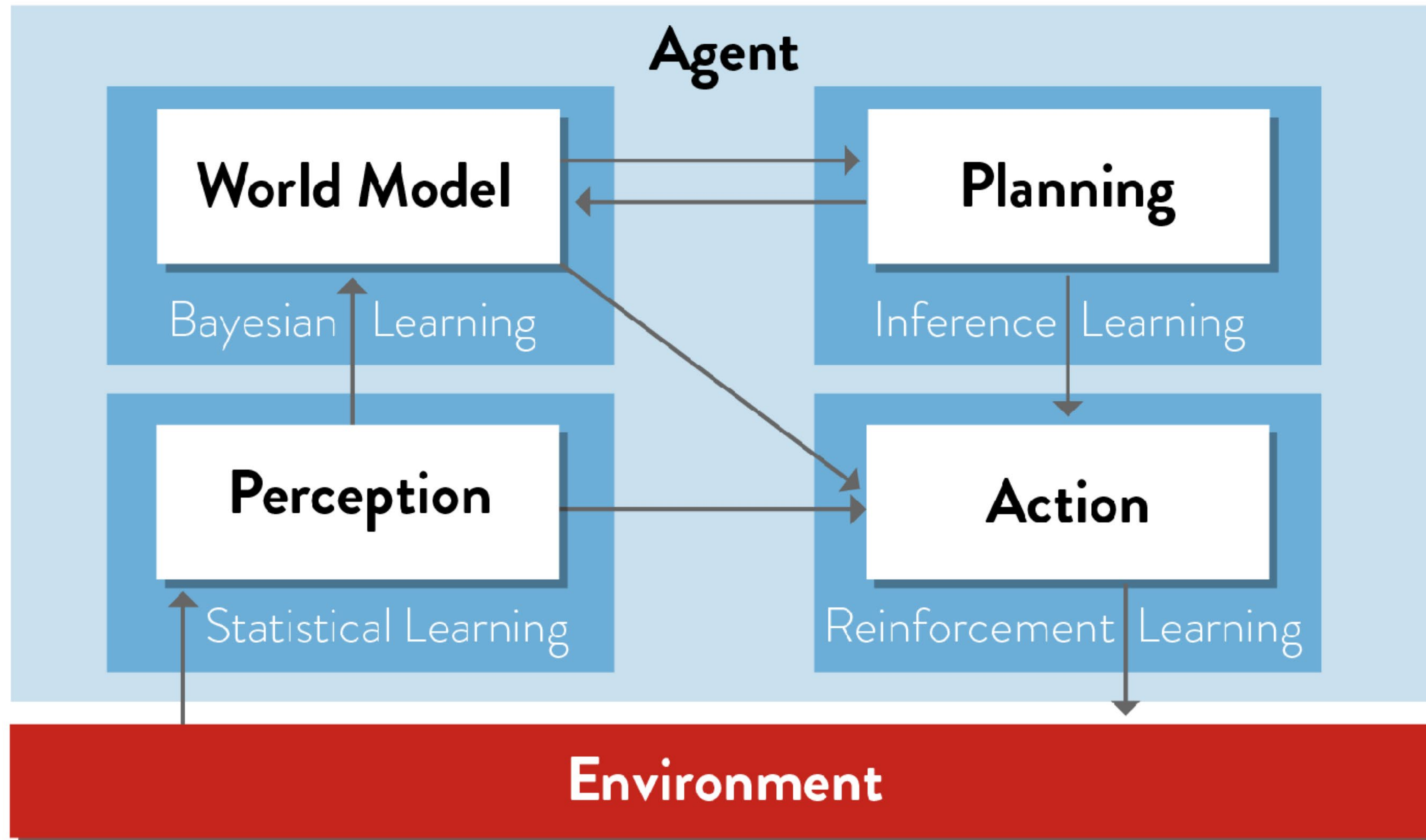


# Learning Agent



- **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
- **Utility-based agents** try to maximise expected “happiness.”
- All agents can improve their performance through learning.

# Representation and Search

- The world model must be represented in a way that makes reasoning easy.
- Reasoning (problem solving and planning) in AI almost always involves some kind of search amongst possible solutions.



# References

- Poole & Mackworth, Artificial Intelligence: Foundations of Computational Agents, chapters 1 & 2.
- Russell & Norvig, Artificial Intelligence: a Modern Approach, Chapter 2.

