인공지능

22년 삼성 AI 전문가과정
6월 7일 화요일 2교시
장병탁

2차시 : Intelligent Agents

서울대학교 컴퓨터공학부
담당 교수: 장병탁

Seoul National University
Byoung-Tak Zhang

Lecture Overview

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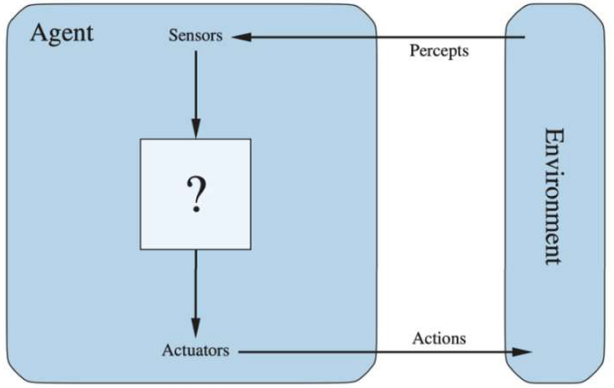
Lecture 2. Intelligent Agents

- ➢ Artificial intelligence as building intelligent agents
- ➢ Agents and Environments
  - ■ The concept of agent with environment
  - ■ Examples of agents: humans, robots etc.
- ➢ Good Behavior: Rationality
  - ■ The concept of rationality
- ➢ The Nature of Environments
  - ■ PEAS: Performance, Environment, Actuators, Sensors
- ➢ The Structure of Agents
  - ■ Simple reflex agents, Model-based reflex agents Goal-based agents, Utility-based agents, Learning agents



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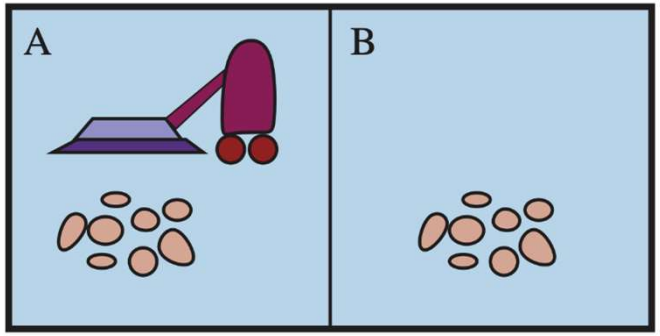


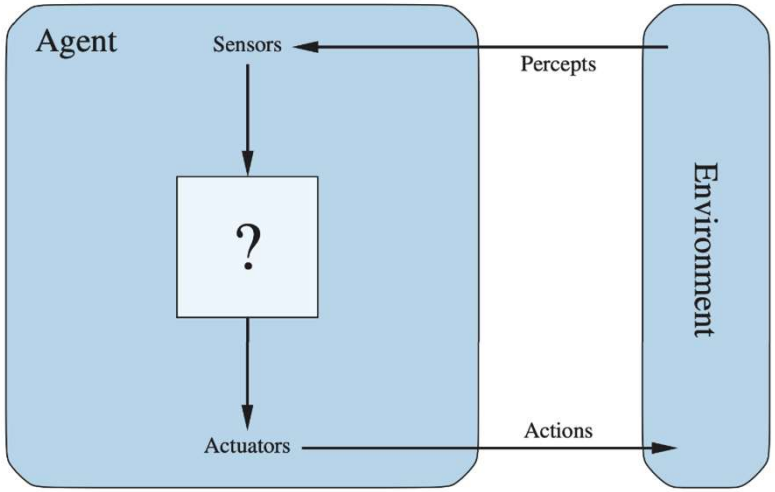
Intelligent Agents

Artificial Intelligence as Building Intelligent Agents

Agent

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators
- Agents include humans, robots, softbots, thermostats, etc.
- The agent function maps from percept histories to actions:

$$f : \mathcal{P}^* \rightarrow \mathcal{A}$$



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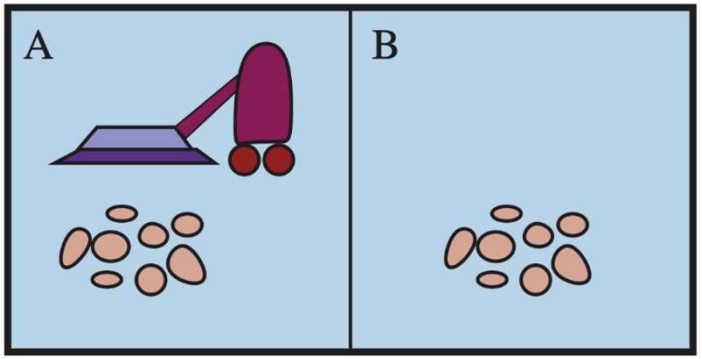
Vacuum Cleaner as an Intelligent Agent

Intelligence = rationality. AI as building a rational agent: A rational agent chooses whichever action maximizes the expected value of the performance measure given the percept sequence to date.

Agent's Environment:

- ➢ To design a rational agent, we must specify the task environment
- ➢ PEAS
  - ■ **Performance**
  - ■ **Environment**
  - ■ **Actuators**
  - ■ **Sensors**



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Lecture 2. Intelligent Agents

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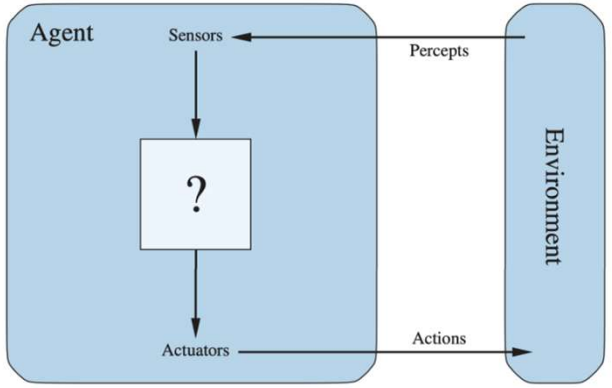

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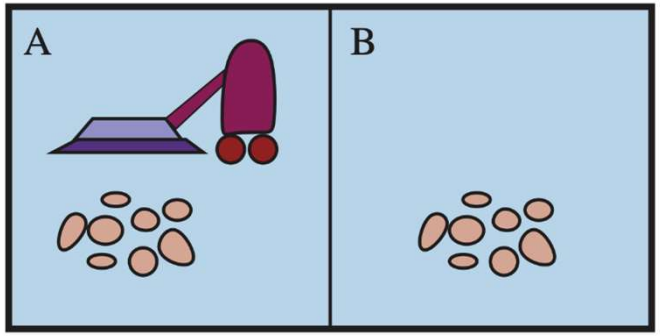


Outline (Lecture 2)

2.1. Agents and Environments

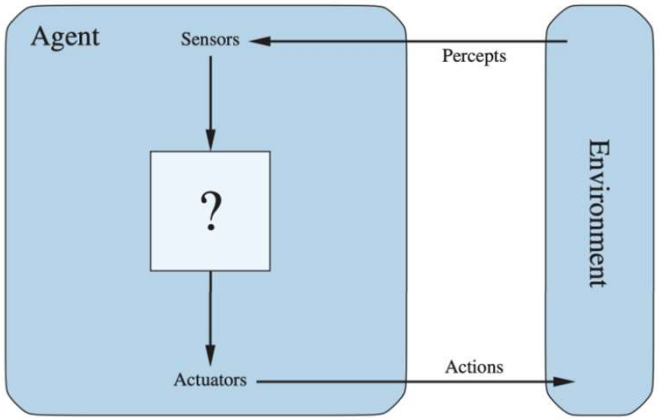
2.1 Agents and Environments (1/2)

1) Agent

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators
- Agents include humans, robots, softbots, thermostats, etc.
- The agent function maps from percept histories to actions:

$$f : \mathcal{P}^* \rightarrow \mathcal{A}$$

- The agent program runs on the physical architecture to produce f



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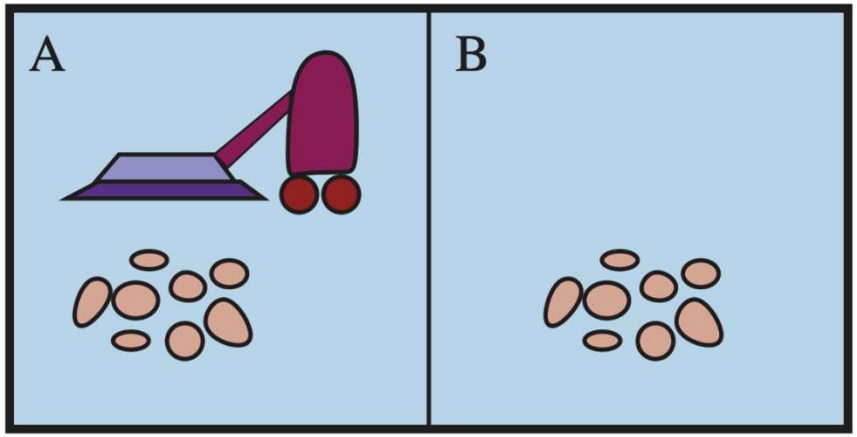
2.1 Agents and Environments (2/2)

2) Example: vacuum-cleaner world

A vacuum-cleaner world
with just two locations



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Partial tabulation of a simple agent function

Percept sequence	Action
[A, clean]	Right
[A, dirty]	Suck
[B, clean]	Left
[B, dirty]	Suck
[A, clean], [A, clean]	Right
[A, clean], [A, dirty]	Suck
…	…
[A, clean], [A, clean], [A, clean]	Right
[A, clean], [A, clean], [A, dirty]	Suck
…	…

2.2. Good Behavior: Rationality

2.2 Good Behavior: Rationality

The concept of rationality

- A rational agent chooses whichever action maximizes the expected value of the performance measure given the percept sequence to date
- Rationality does not require omniscience
  - An omniscient agent knows the actual outcome of its actions and can act accordingly.
  - Rational choice depends only on the percept sequence to date
- A rational agent should be able to explore
  - Doing actions in order to modify future percepts (i.e. information gathering) is an important part of rationality. Exploration.
- A rational agent should learn as much as possible from what it perceives
- A rational agent should be autonomous
  - It should learn what it can to compensate for partial or incorrect prior knowledge

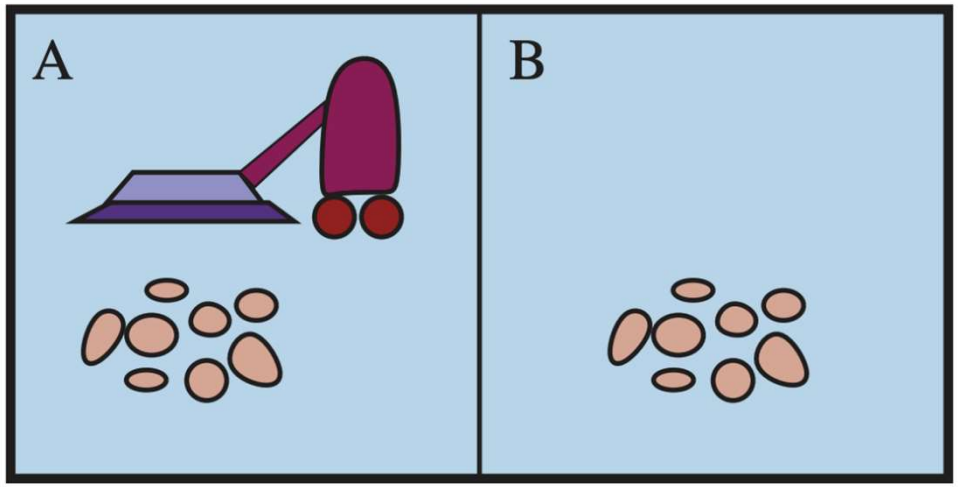
2.3. The Nature of Environments

2.3 The Nature of Environments (1/5)

1) PEAS

- To design a rational agent, we must specify the task environment

- **Performance**
- **Environment**
- **Actuators**
- **Sensors**



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2.3 The Nature of Environments (2/5)

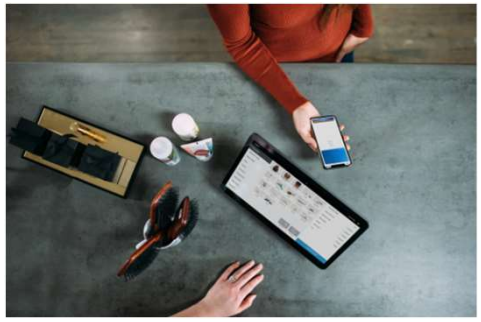
PEAS of automated taxi

- Performance
  - Safety, destination, profits, legality, comfort, …
- Environment
  - US streets/freeways, traffic, pedestrians,
- Actuators
  - Steering, accelerator, brake, horn, speaker/display, …
- Sensors
  - Video, accelerometers, gauges, engine sensors, keyboard, GPS, …

2.3 The Nature of Environments (3/5)

PEAS of internet shopping agent

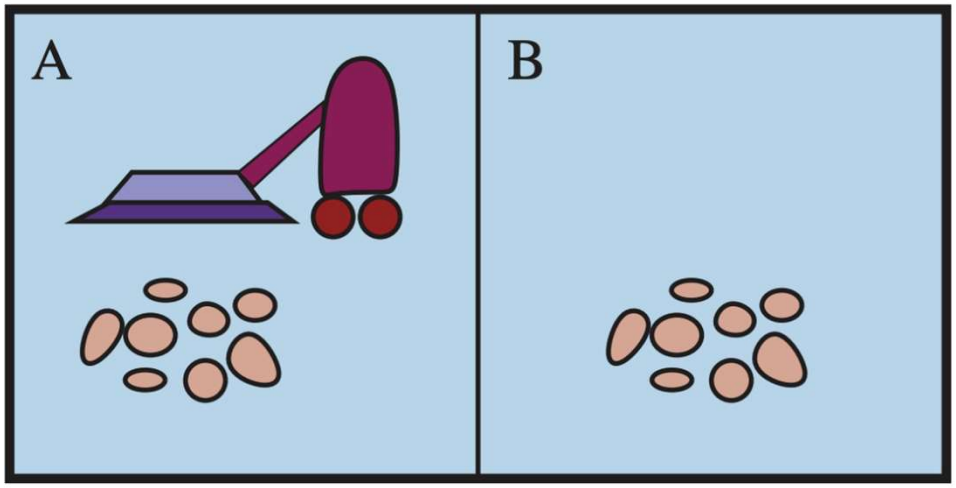
- Performance
  - Price, quality, appropriateness, efficiency
- Environment
  - Current and future WWW sites, vendors, shippers
- Actuators
  - Display to user, follow URL, fill in form
- Sensors
  - HTML pages (text, graphics, scripts)



2.3 The Nature of Environments (4/5)

2) Properties of task environments

- Fully Observable vs. Partially Observable
- Deterministic vs. Stochastic
- Episodic vs. Sequential
- Static vs. Dynamic
- Discrete vs. Continuous
- Single-agent vs. Multi-agent



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2.3 The Nature of Environments (5/5)

3) Examples of environment types

	Solitaire	Backgammon	Internet Shopping	Taxi
Observable?	Yes	Yes	No	No
Deterministic?	Yes	No	Partly	No
Episodic?	No	No	No	No
Static?	Yes	Semi	Semi	No
Discrete?	Yes	Yes	Yes	No
Single-agent?	Yes	No	Yes (except auctions)	No

» The environment type largely determines the agent design

2.4. The Structure of Agents

2.4 The Structure of Agents (1/8)

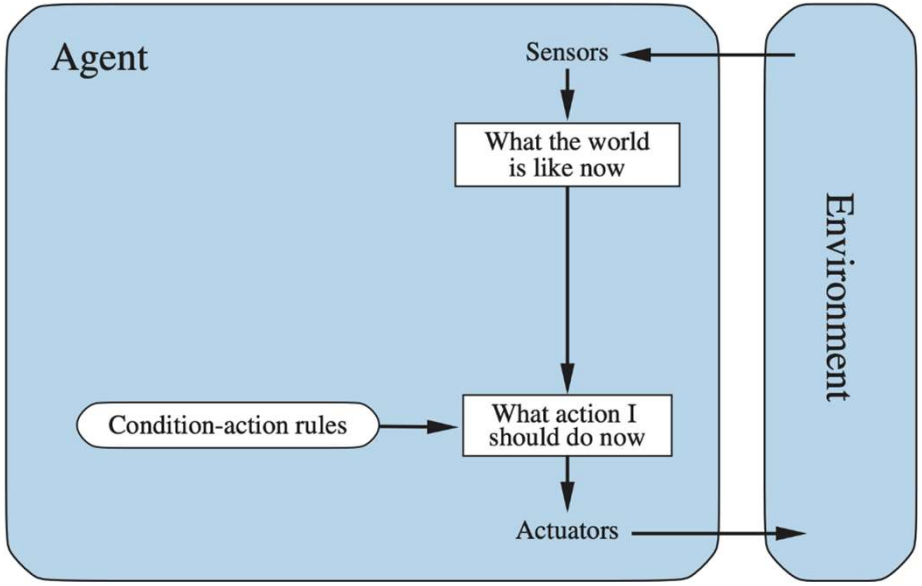
Agent types

- Four basic types in order of increasing generality
  - **Simple reflex agents**
  - **Model-based reflex agents**
  - **Goal-based agents**
  - **Utility-based agents**

- All these can be turned into **learning agents**

2.4 The Structure of Agents (2/8)

1) Simple reflex agents



function SIMPLE-REFLEX-AGENT(*percept*) **returns** an action
  persistent: *rules*, a set of condition–action rules

  state ← INTERPRET-INPUT(*percept*)
  rule ← RULE-MATCH(*state*, *rules*)
  action ← *rule*.ACTION
  return *action*

Figure 2.10 A simple reflex agent. It acts according to a rule whose condition matches the current state, as defined by the percept.

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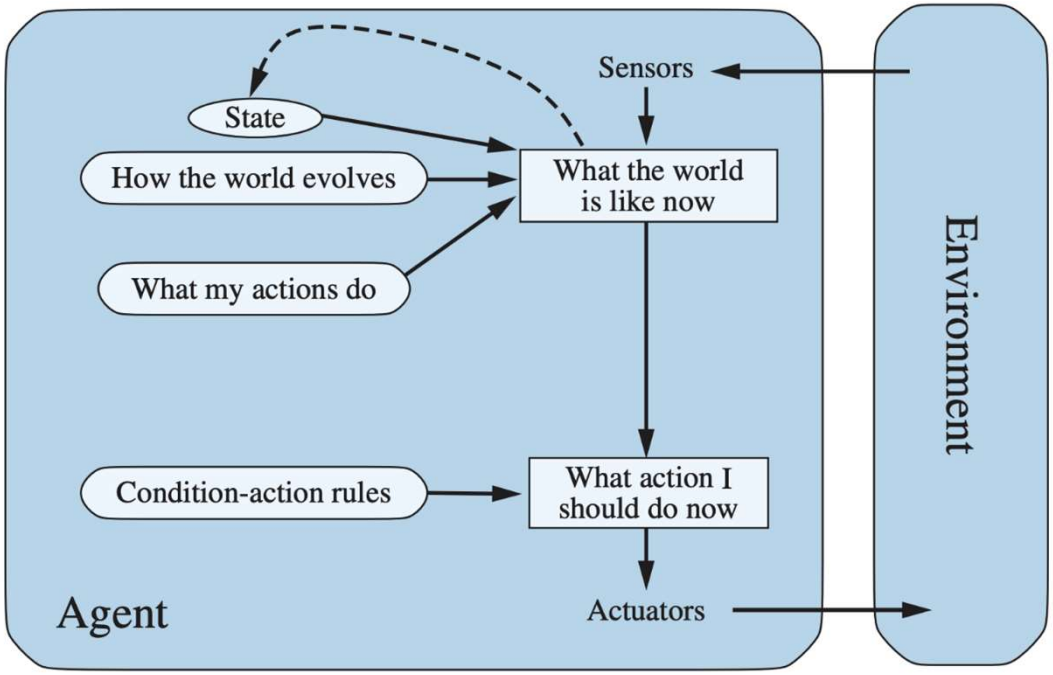
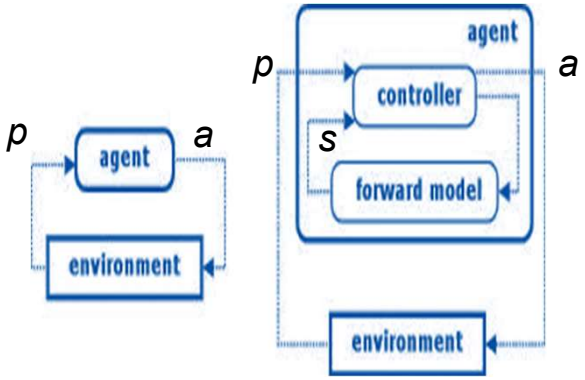
2.4 The Structure of Agents (3/8)

2) Model-based reflex agents





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2.4 The Structure of Agents (4/8)

function MODEL-BASED-REFLEX-AGENT(*percept*) **returns** an action
  persistent: *state*, the agent's current conception of the world state
    transition_model, a description of how the next state depends on the current state and action
    sensor_model, a description of how the current world state is reflected in the agent's percepts
    rules, a set of condition–action rules
    action, the most recent action, initially none

  state ← UPDATE-STATE(*state*, *action*, *percept*, *transition_model*, *sensor_model*)
  rule ← RULE-MATCH(*state*, *rules*)
  action ← *rule*.ACTION
  return *action*

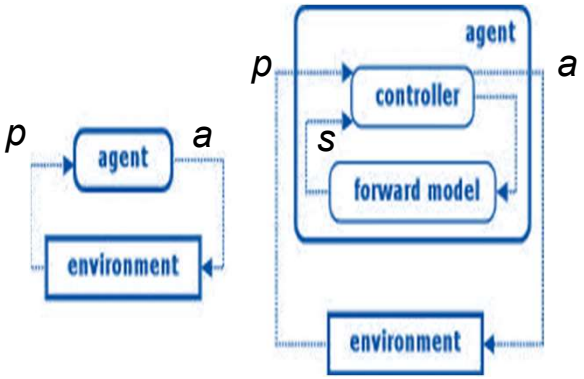

Figure 2.12 A model-based reflex agent. It keeps track of the current state of the world, using an internal model. It then chooses an action in the same way as the reflex agent.

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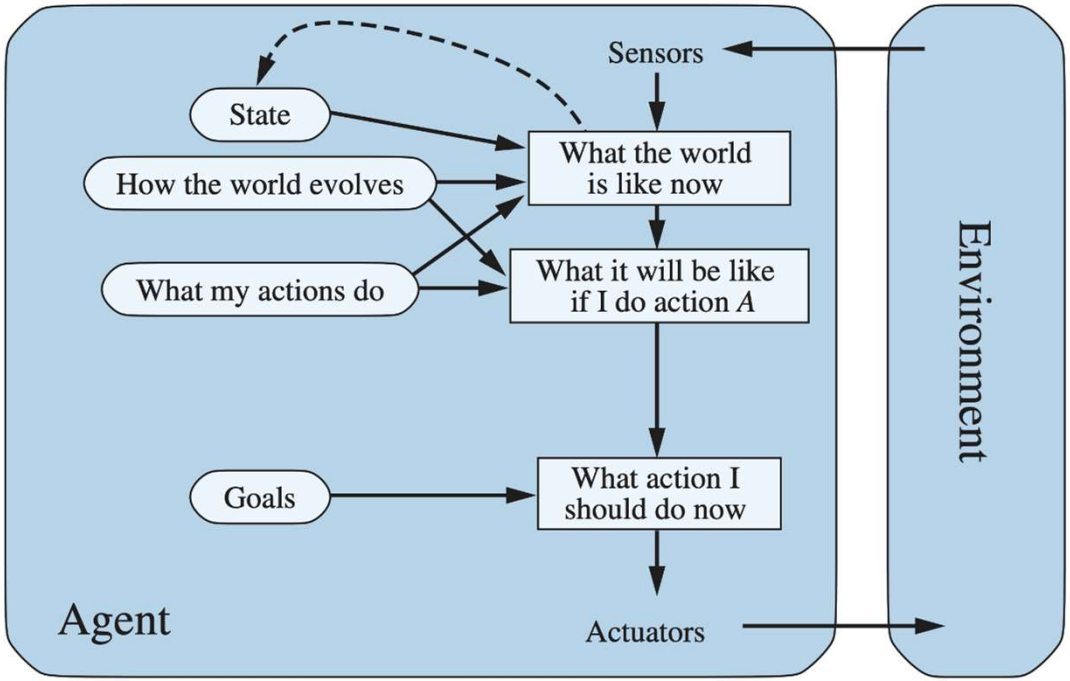
2.4 The Structure of Agents (5/8)

3) Goal-based agents



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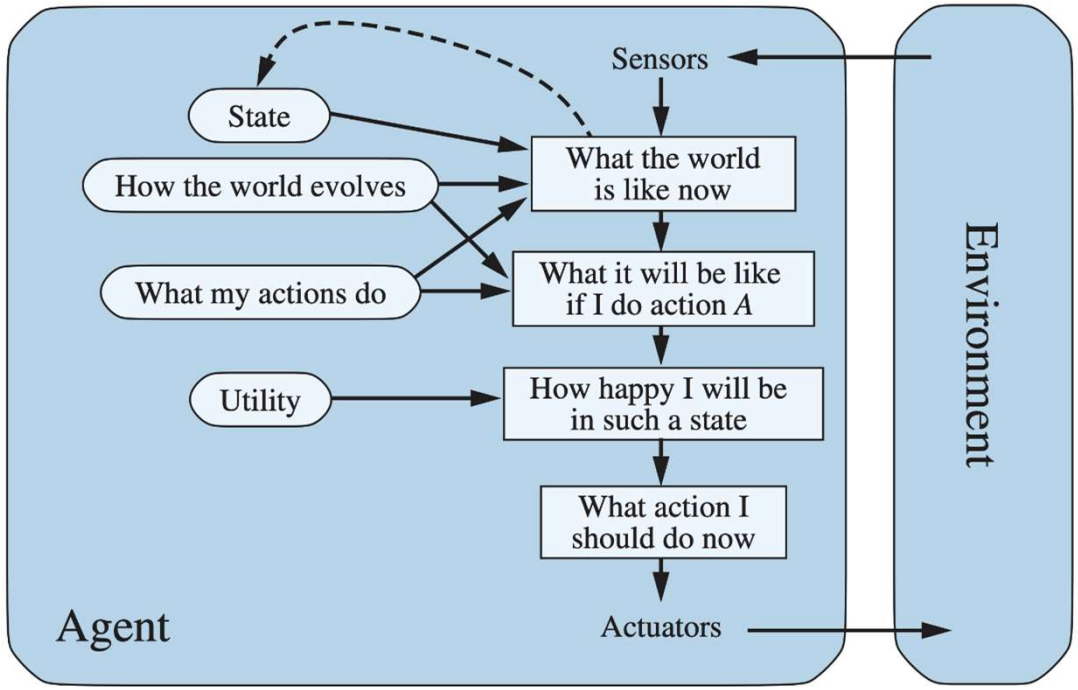
2.4 The Structure of Agents (6/8)

4) Utility-based agents



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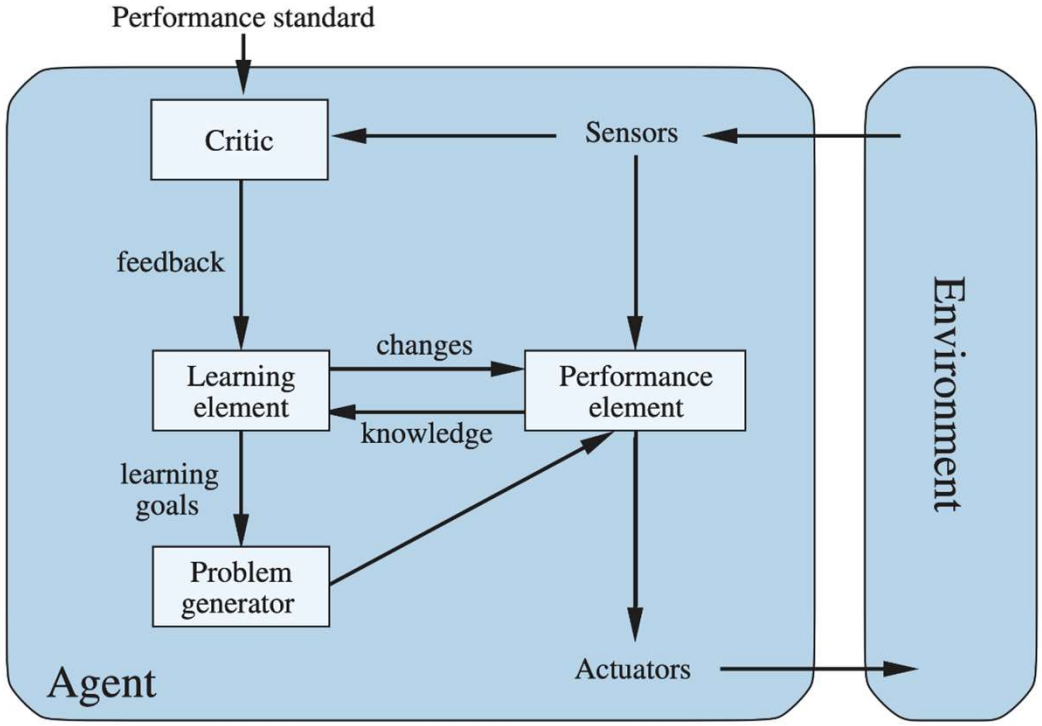
2.4 The Structure of Agents (7/8)

5) Learning agents



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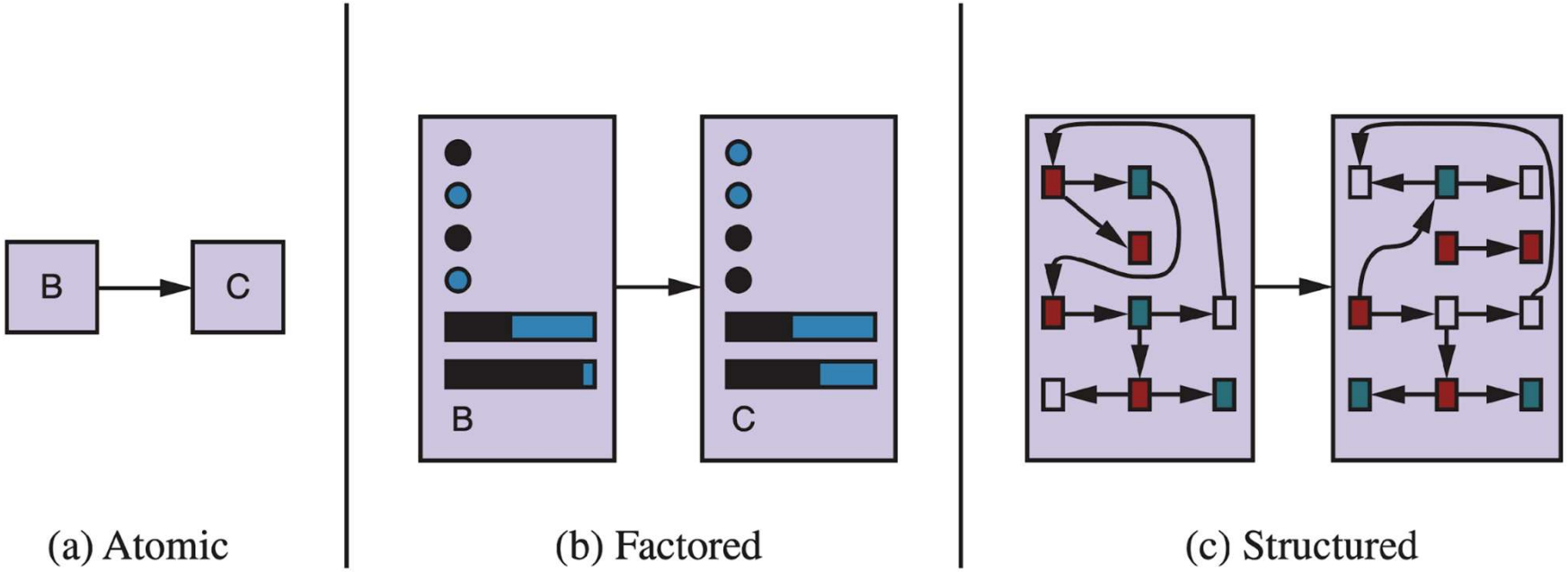
2.4 The Structure of Agents (8/8)

Three ways to represent states and transitions



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Summary

- **Agents** interact with environments through actuators and sensors
- The **agent function** describes what the agent does in all circumstances
- The performance measure evaluates the environment sequence
- A perfectly **rational agent** maximizes expected performance
- Agent programs implement (some) agent functions
- **PEAS** descriptions define task environments
- Environments are categorized along several dimensions:
  - Observable? deterministic? episodic? static? discrete? single-agent?
- Several basic agent architectures exist:
  - Reflex, model-based, goal-based, utility-based, learning agents