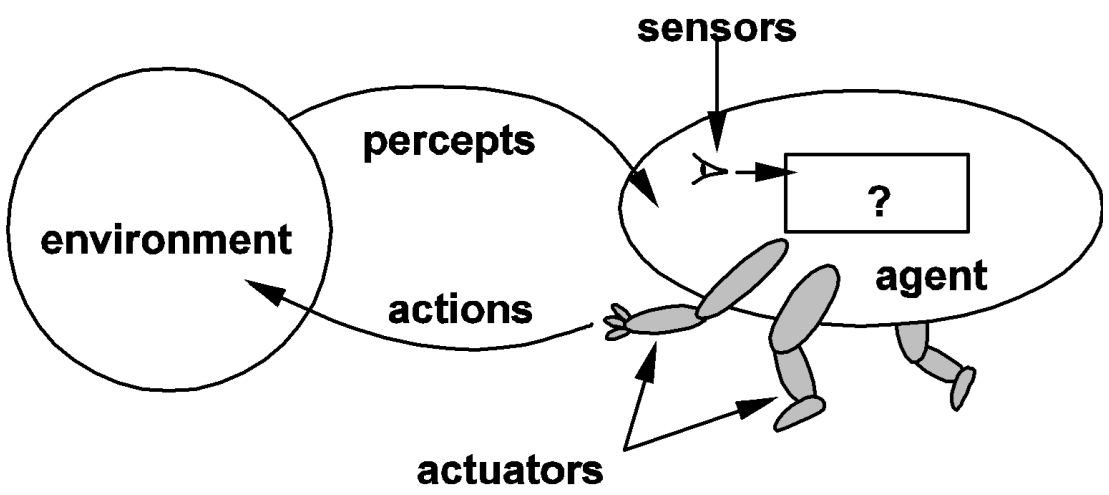
Intelligent Agents

Russell & Norvig: Chapter 2

Agents

"An **agent** is anything that can be viewed as **perceiving** its **environment** through **sensors** and acting upon that environment through **actuators**"



What are the sensors and actuators?

Agents

For example:

- Humans
- Animals
- Robots
- Various software systems

Agents: Terminology

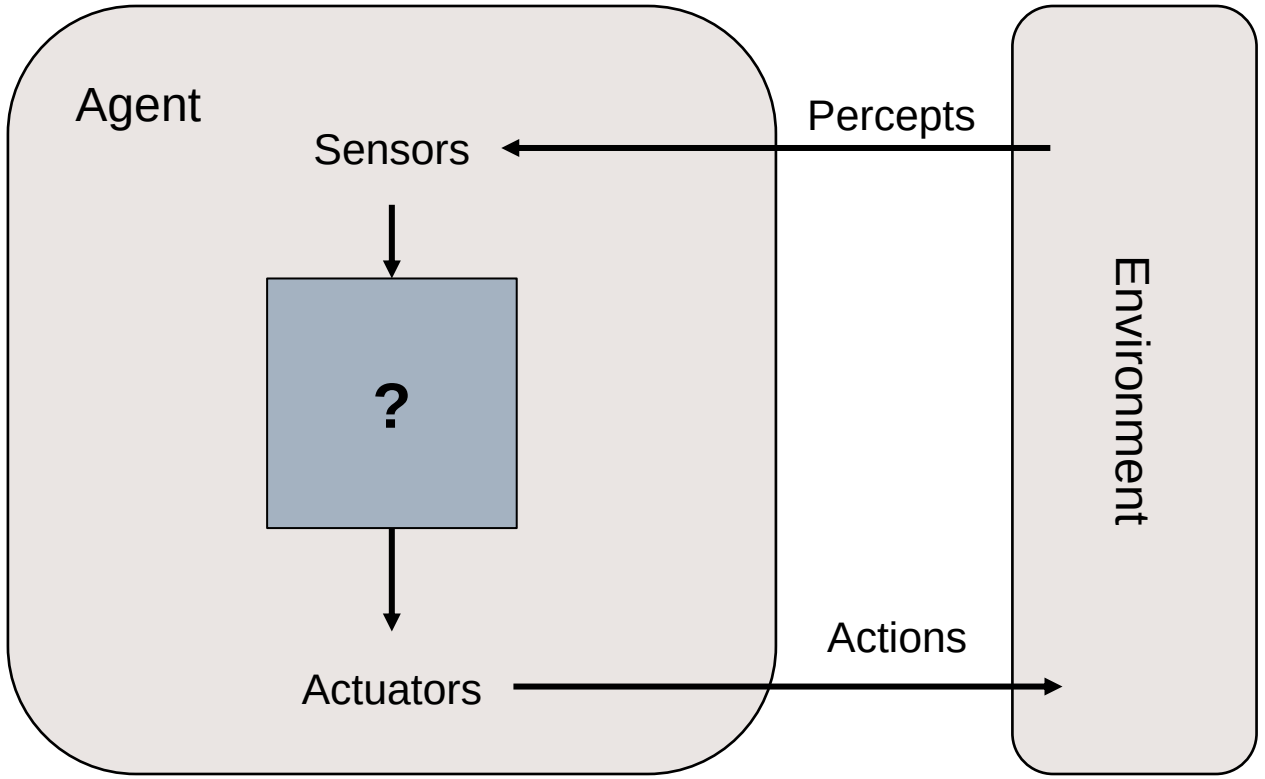
Perceiving:

- **Percept:** Agent's perceptual inputs at any given instant
- **Percept sequence:** Complete history of everything the agent has perceived

Agents: Terminology

Acting:

- **Agent function:** decides what action to take in any given situation (possibly non-deterministic)
- In general, an agent's choice of action can depend on the entire percept sequence observed to date
- **Agent program:** implements an agent function internally


Agent
Sensors
?
Actuators
Percepts
Actions
Environment

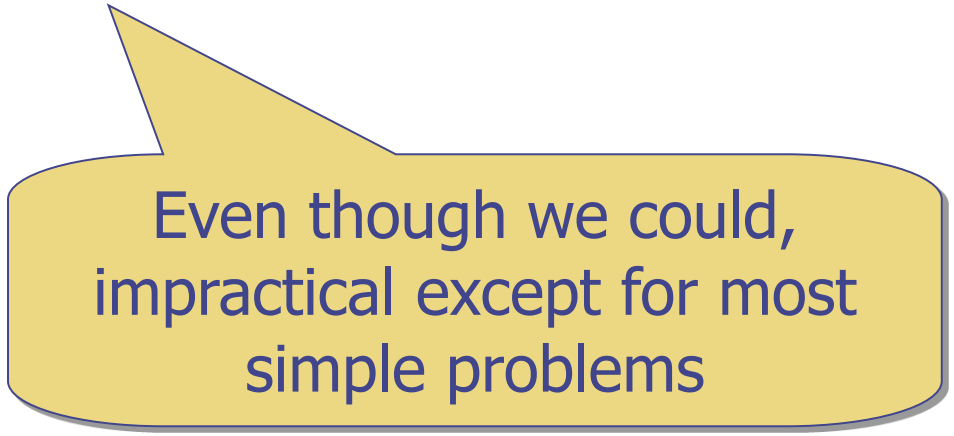
Agent Program

The AI is to design the agent program

- Agent = architecture + program

Easy?

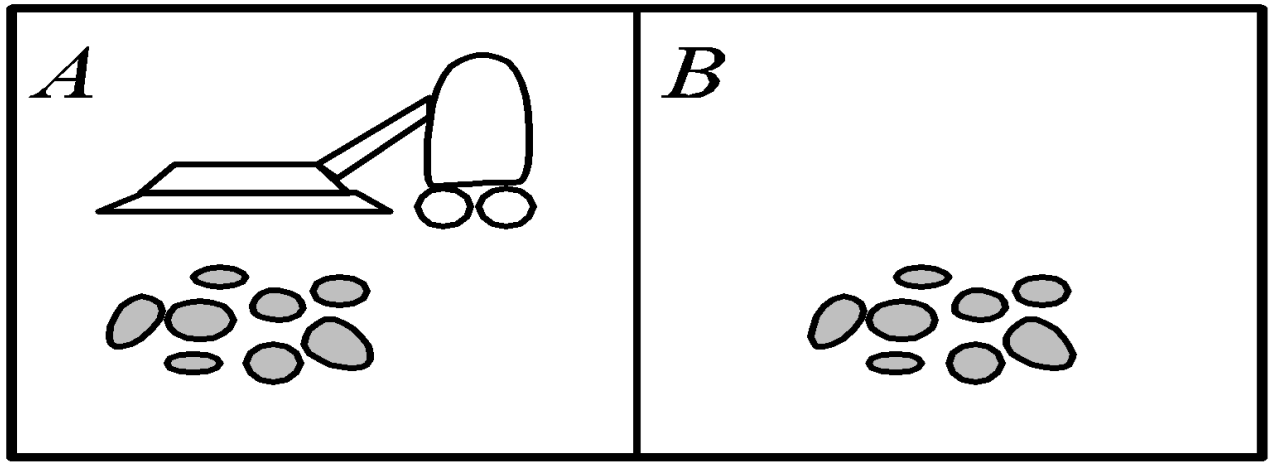
- Simply fill out the agent function table!



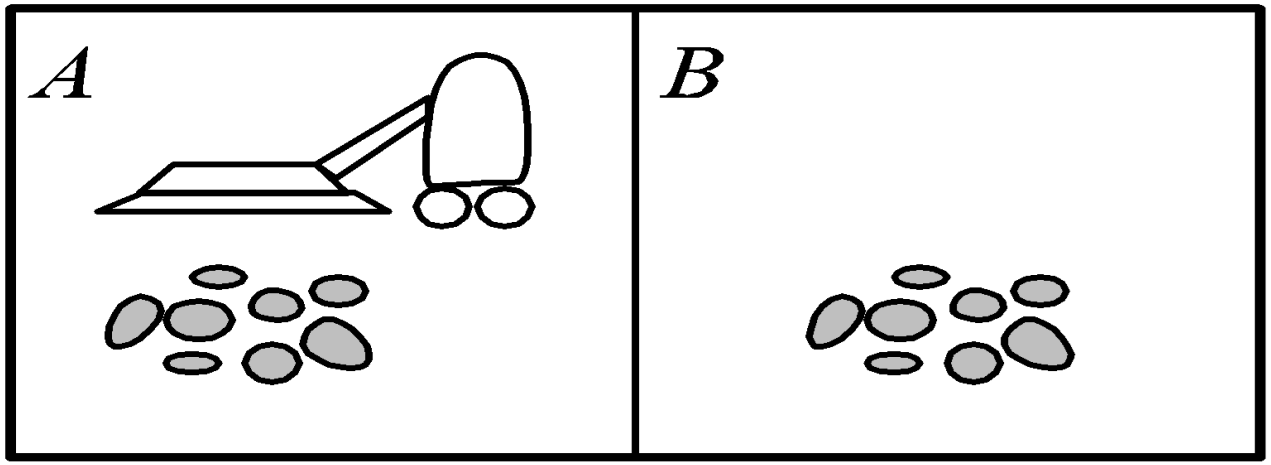
The Vacuum-Cleaner World

Agent Function

Percept sequence	Action
[A, Clean]	Right
[A, Dirty]	Suck
[B, Clean]	Left
[B, Dirty]	Suck
[A, Clean], [A, Clean]	Right
...	



The Vacuum-Cleaner World



Agent Program

function DECIDE([location, status]) returns an **action**

if status = **Dirty** then return **Suck**

else if location = **A** then return **Right**

else if location = **B** then return **Left**

The Concept of Rationality

Rational behavior is making the “right” decisions
based on what you know

What is rational at any given time depends on:

- 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

Rational Agent

"For each possible percept sequence, a **rational agent** should select an action that is **expected** to **maximize its performance** measure, **given the evidence** provided by the percept sequence and whatever built-in knowledge the agent has."

Note:

- Does not imply perfect decision making
- Does usually imply a learning agent

Challenge for AI

“produce rational behavior from a smallish program rather than a vast table”

The Nature of Environments

Task environment:

- “Problem domain”

Specifying the task environment:

- **P**erformance measure
- **E**nvironment
- **A**ctuator
- **S**ensors

See figures 2.5 and 2.6 (book chapter 2) for examples

The Nature of Environments

PEAS description for an automated taxi driver

Performance Measure	**Environment**	**Actuators**	**Sensors**
Safe, fast, legal, comfortable trip, maximize profits	Roads, traffic, pedestrians, customers	Steering, accelerator, brake, signal, horn, display or voice output to passenger	Cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors, keyboard or microphone

The Nature of Environments

Properties of environments:

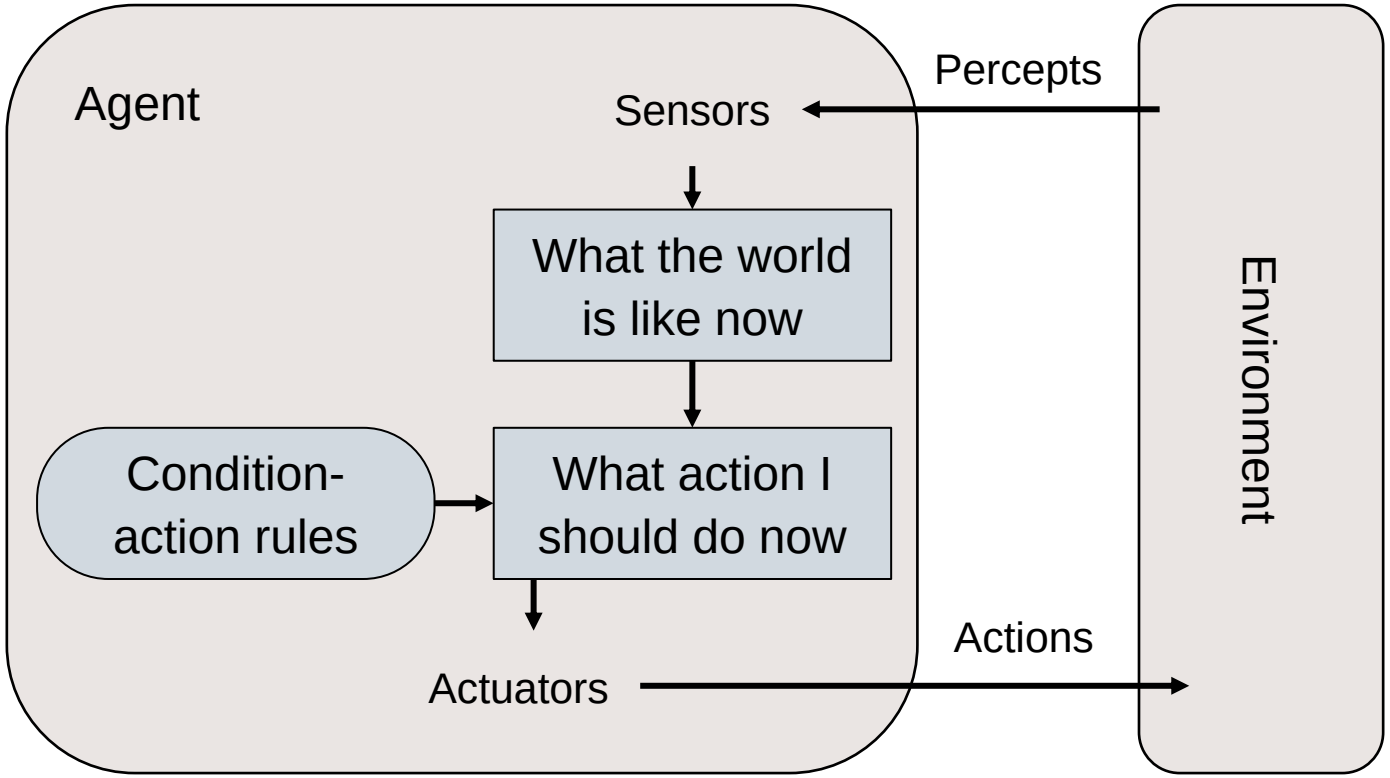
- Fully vs. partially observable
- Deterministic vs. Stochastic
- Episodic vs. Sequential
- Static vs. Dynamic
- Discrete vs. Continuous
- Single vs. Multi-agent:
  - Cooperative
  - Competitive

The hardest case:
Partially observable
Multiagent
Nondeterministic
Sequential
Dynamic
Continuous
Unknown

Simple Reflex Agent

Simple reflex agents:

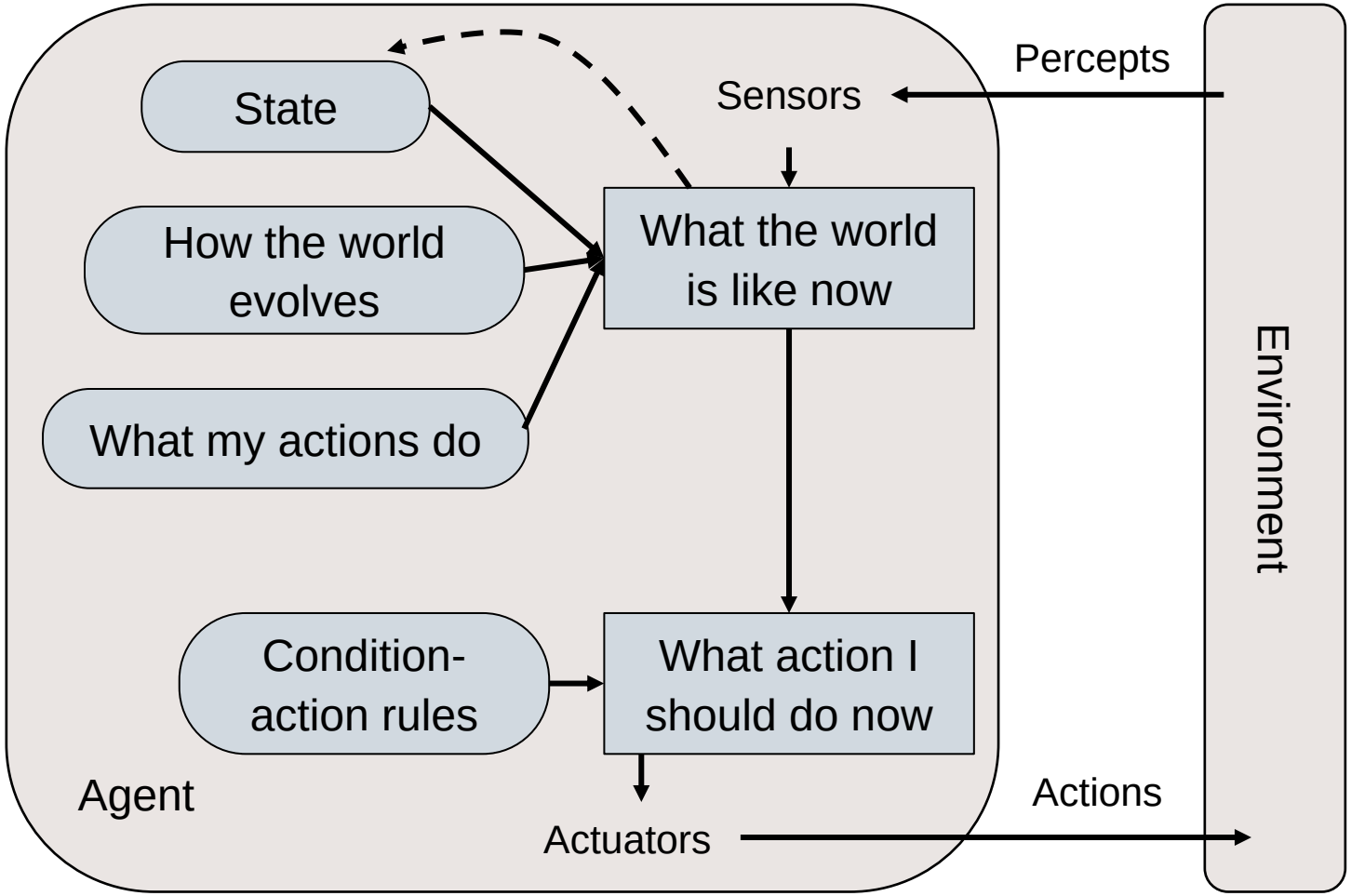
- Only current percept
- Condition-Action Rules



Model-Based Reflex Agent

Model-based reflex agents:

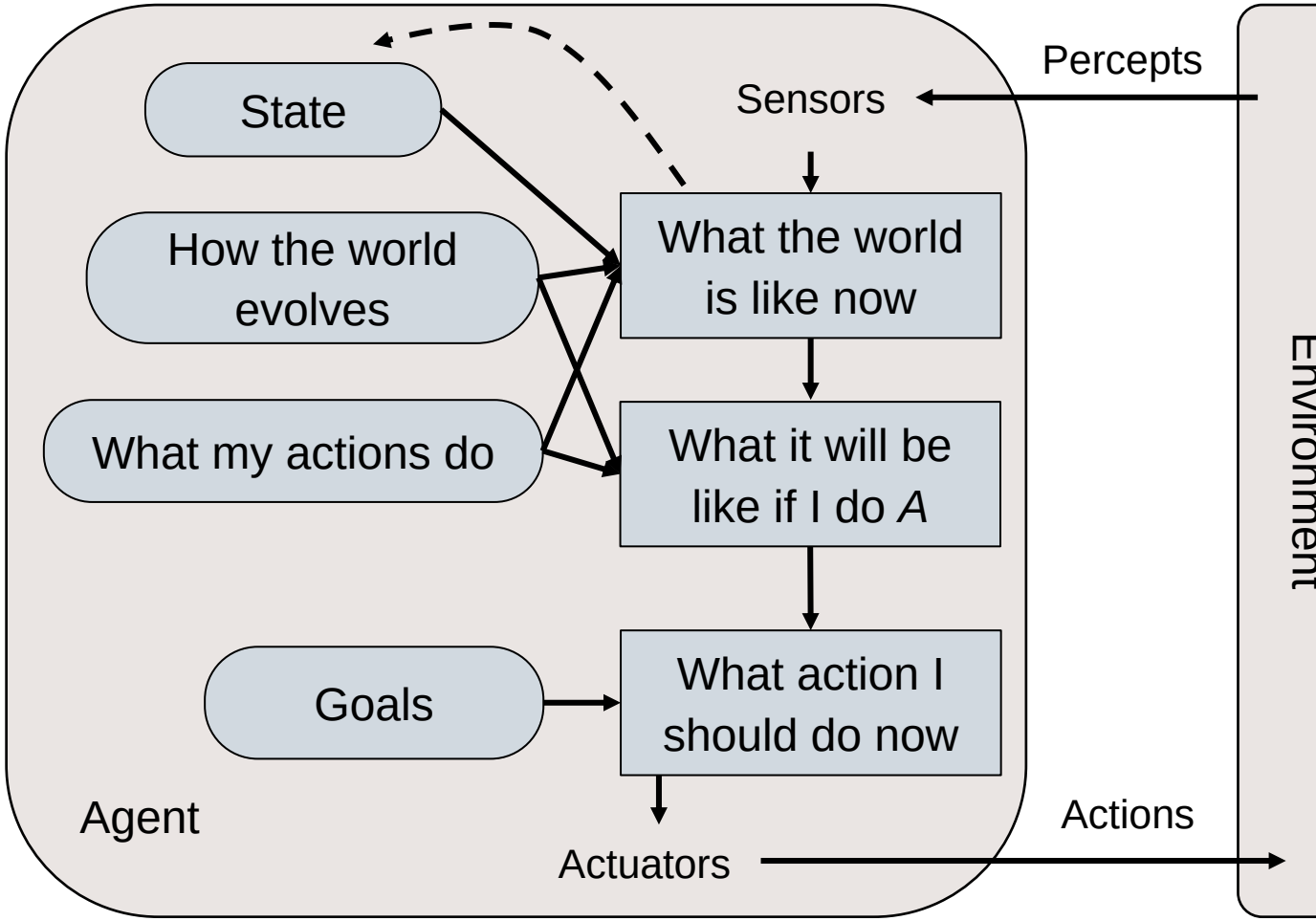
- Model of world – internal state
- World evolves
- Actions affect it



Goal-Based Agent

Goal-based agents

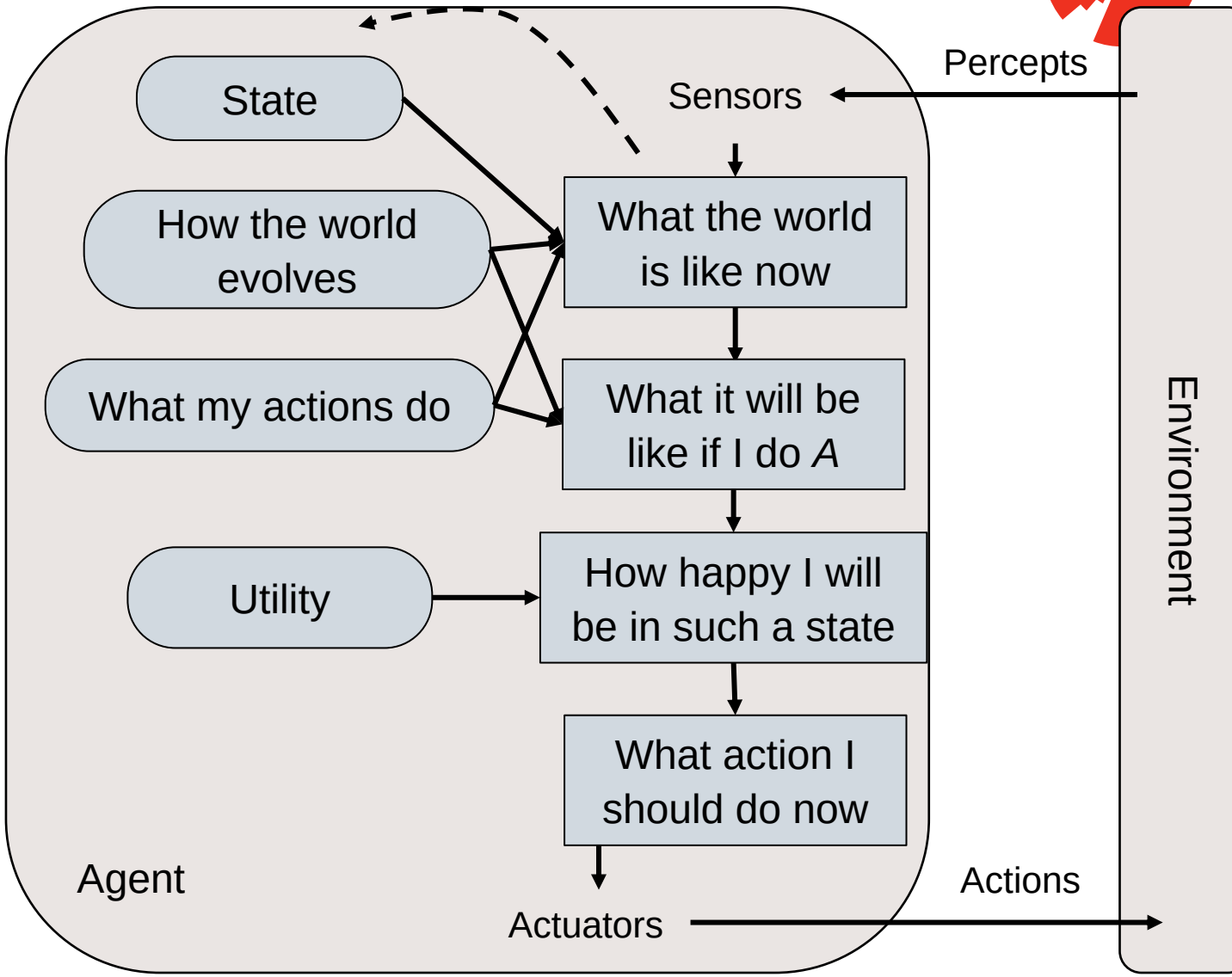
- Current State and a Goal
- Desired Future State: planning/search used
- (condition-action rules insufficient)



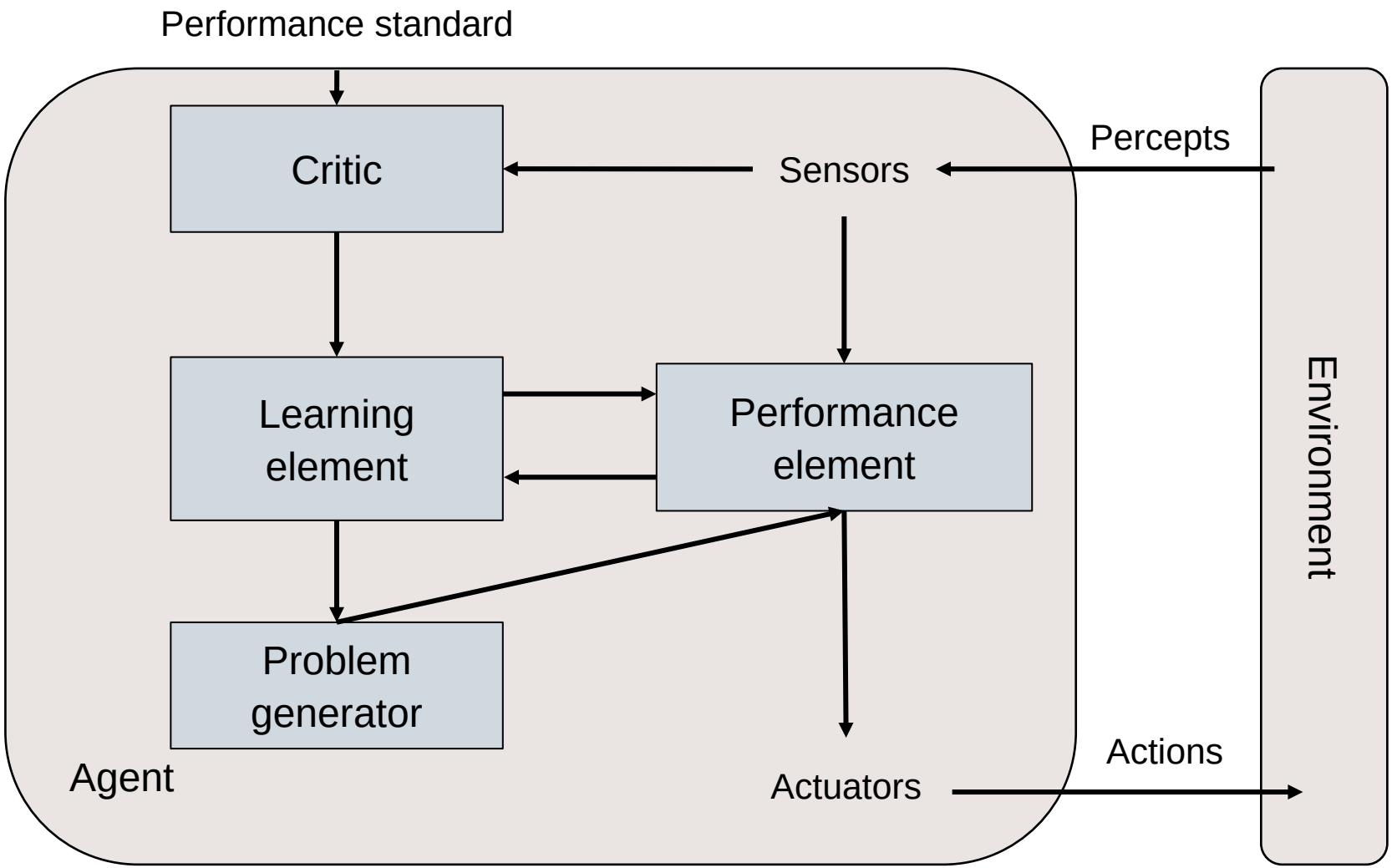
Utility Based Agent

Utility based agents

- Utility function returns a “happy value” about state



Learning Agents



Summary

Agent

Rational Agent

Task environment

Structure of Agents

- Simple Reflex
- Model-Based
- Goal-Based
- Utility-Based

Learning Agents

PEAS Exercise

Task Environment	P	E	A	S
Playing tennis				
Online auction bidder				
Robotic guard dog				
Automatic crib				
Post-meal cleaner				