EECS 391: Introduction to AI

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Announcements

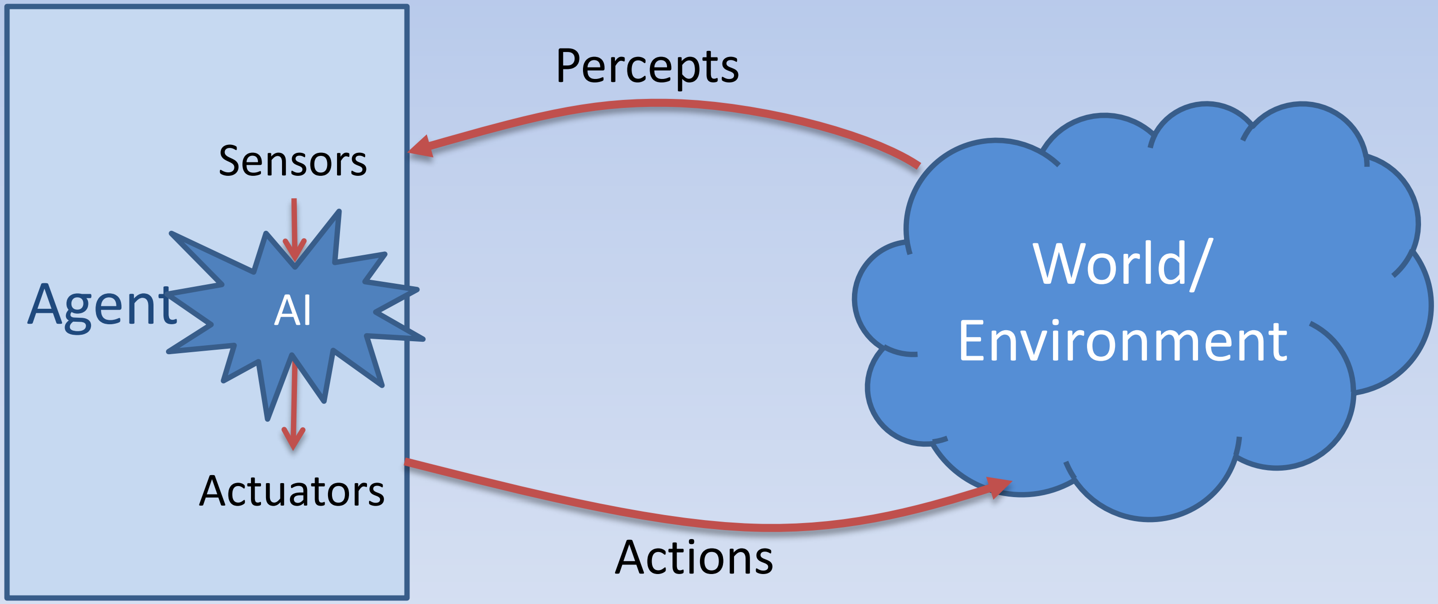
- SEPIA documentation online
- HW1 out later today
- Office hours: F 11:30-2pm
  - 11:30-12:30 I will be available
  - 12:30-2pm I may occasionally be unavailable (send email to check)

Today

- General Architecture of Intelligent Agents (Chapter 2)
- Uninformed Search (Chapter 3)

Basic Agent Architecture

- Agent = something that interacts with the world



"Agent Function" A: Percept Sequences $\rightarrow$ Actions

Examples

- Chess-playing agent
  - Sensors?
  - Actuators?

- Autonomous vehicle agent
  - Sensors?
  - Actuators?

Performance Measures

- Agents are usually "goal-based", i.e. they are designed to achieve certain things in the world
  - Chess-playing agent?
  - Autonomous vehicle agent?
- These are often encoded using a "performance measure"
  - A function that maps a (percept, action) sequence to a real number
  - Generally externally imposed
  - Can think of this as an internal "satisfaction" or "reward" signal

Rational Agents

- A rational agent is one whose agent function always acts to *maximize its performance measure*, given its percept sequence until the current moment

Example

- Suppose the autonomous vehicle agent is given the measure: +1 point every second without a collision
  - What might a rational agent do?

“PEAS” description

- To design the (rational) agent function we need four things:
  - The **P**erformance measure
  - A description of the **E**nvironment
  - A description of what **A**ctions the agent has
  - A description of what **S**ensors the agent has

Examples

- Chess-playing agent PEAS?
- Autonomous vehicle agent PEAS?

Types of Environments

Type	Definition
Fully observable (vs. *Partially Observable*)	Agent's sensors present complete, accurate picture of the world (as far as determining action sequence is concerned)
Deterministic (vs. *Stochastic*)	The next state of the world is completely determined by current state and agent's action
Non-sequential (Episodic) (vs. *Sequential*)	Agent's current action does not affect future actions
Static (vs. *Dynamic*)	The world does not change until the agent takes an action
Discrete (vs. *Continuous*)	States, percepts and actions are discrete
Single Agent (vs. *Multiagent*)	The world has only one agent in it

Example

- Environment of chess-playing agent?

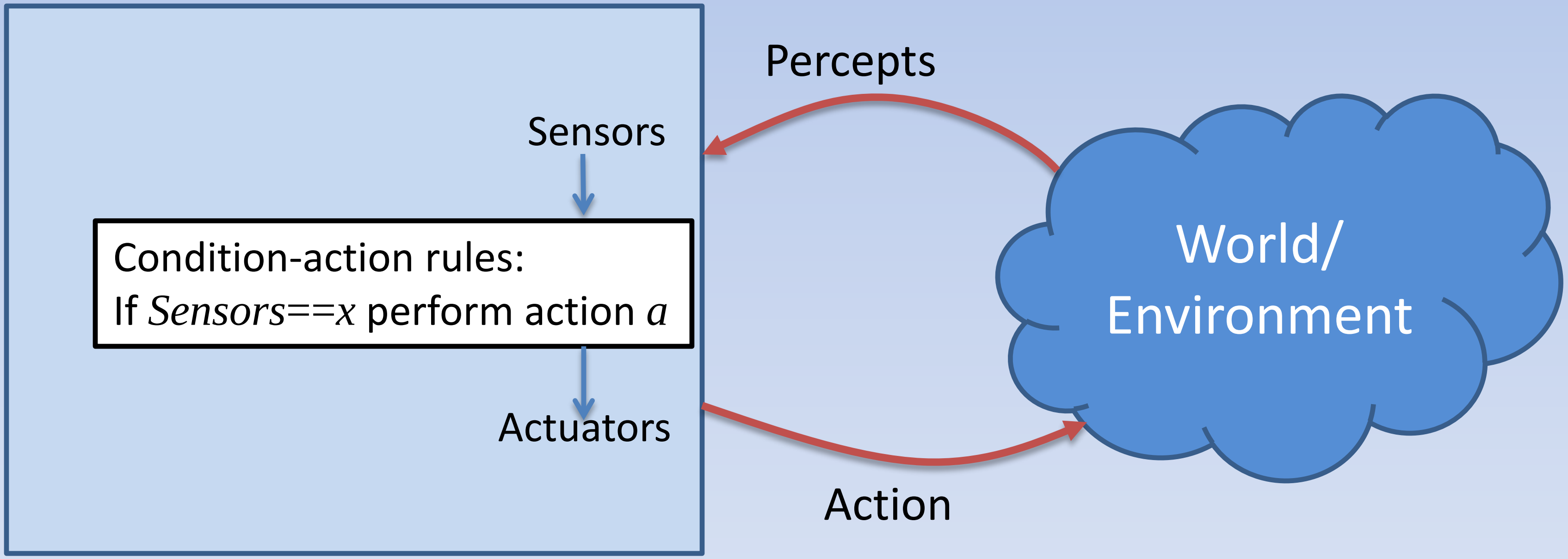
- Environment of autonomous vehicle agent?

Types of Agent Functions

- Simple Reflex
- Model-based Reflex
- Goal-based
- Utility-based

Simple Reflex Agents

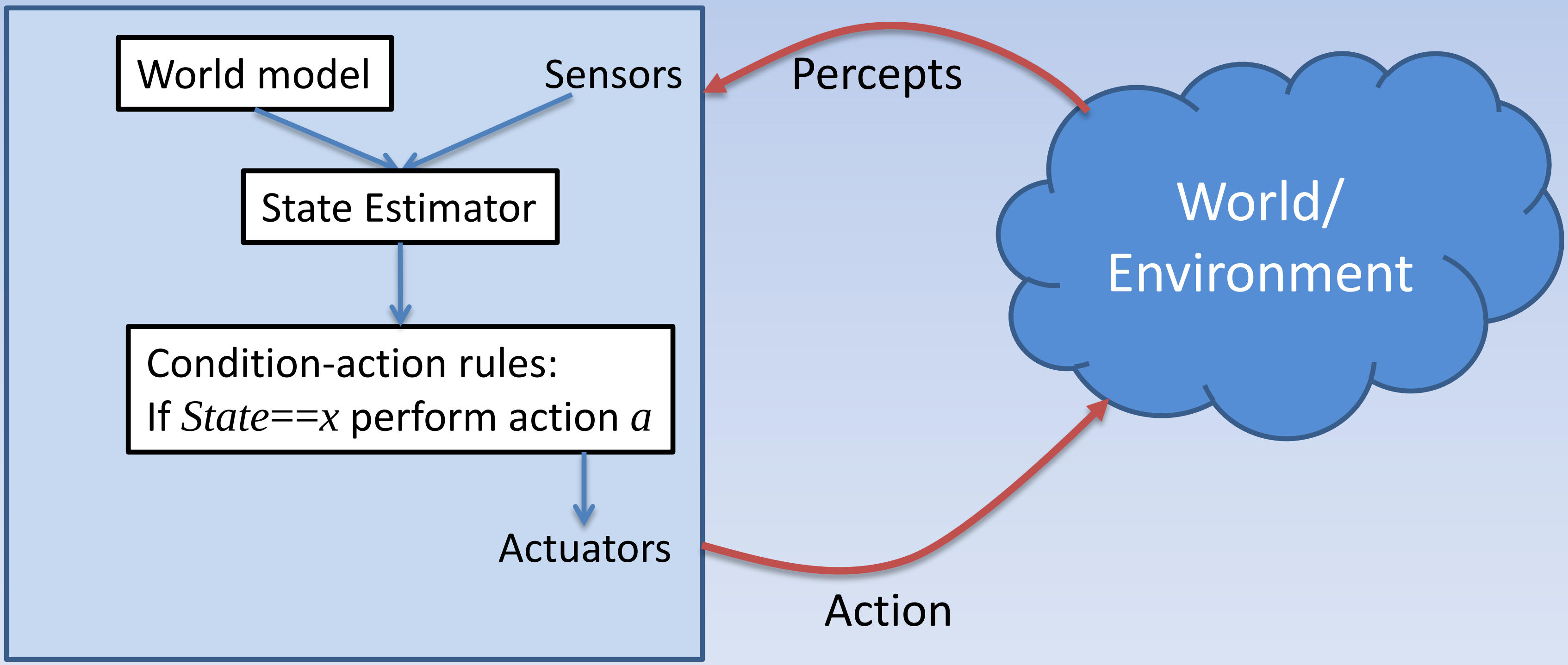
- Agent function maps current state directly to action



Would this work for the chess agent? For the vehicle agent?

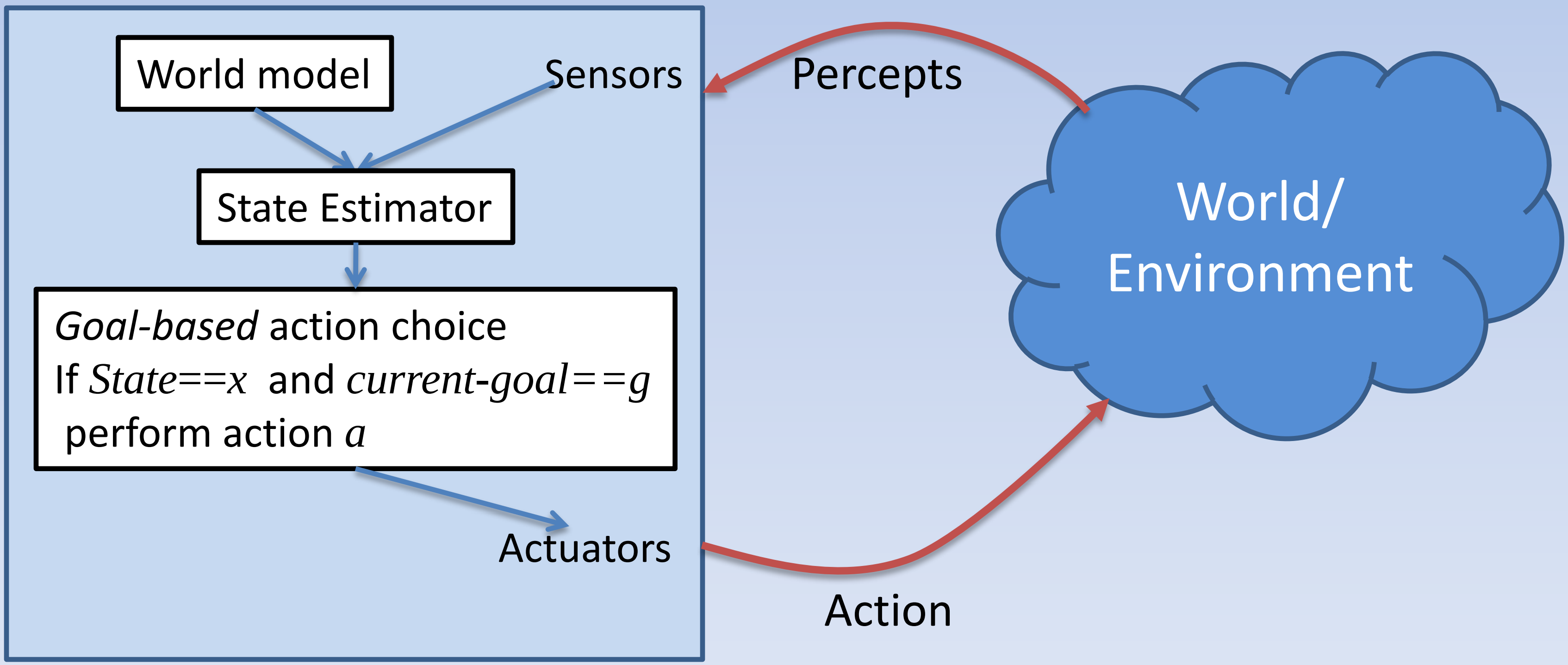
Model-based Reflex Agent

- Maps current percept and *"world model"* to action



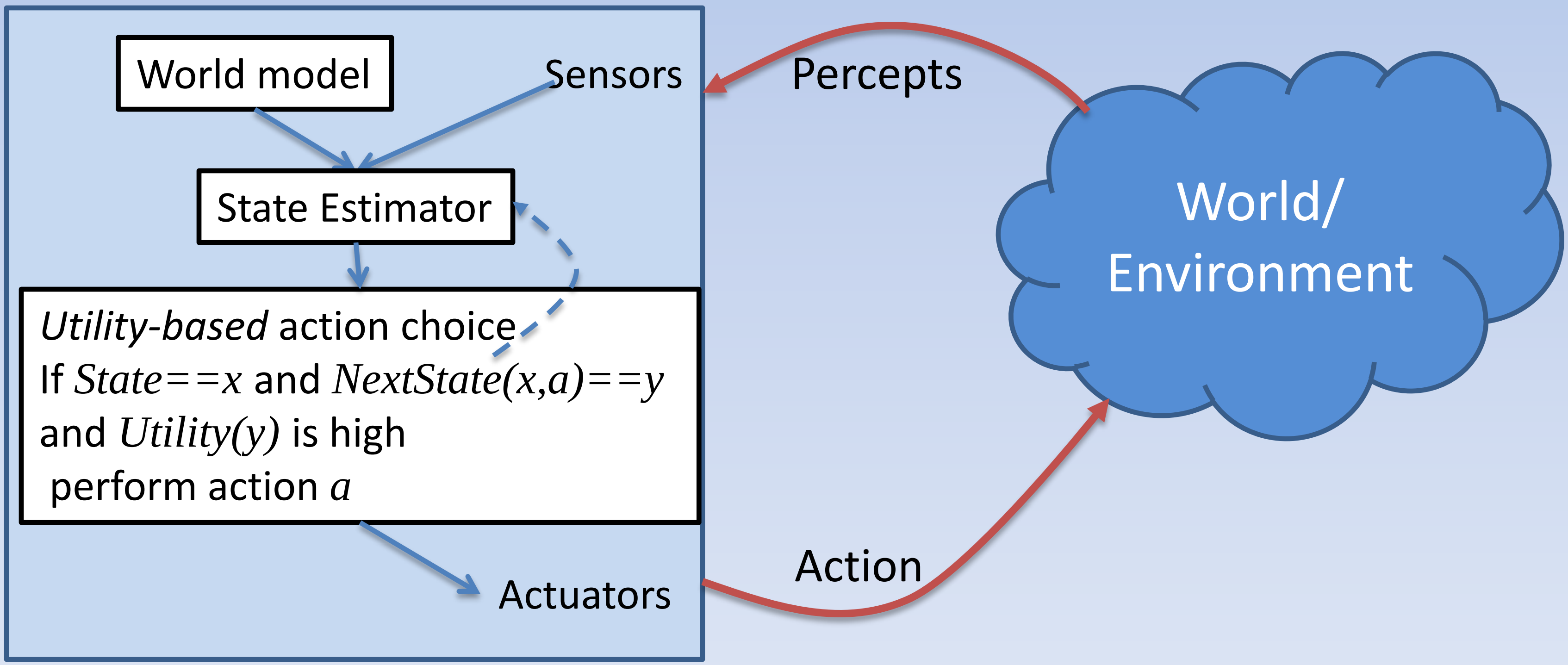
Goal-based Agent

- Maps current percept and knowledge of current goal to action



Utility-based Agent

- Instead of binary goal, an agent could have a fine-grained notion of how useful certain states are



Learning Agents

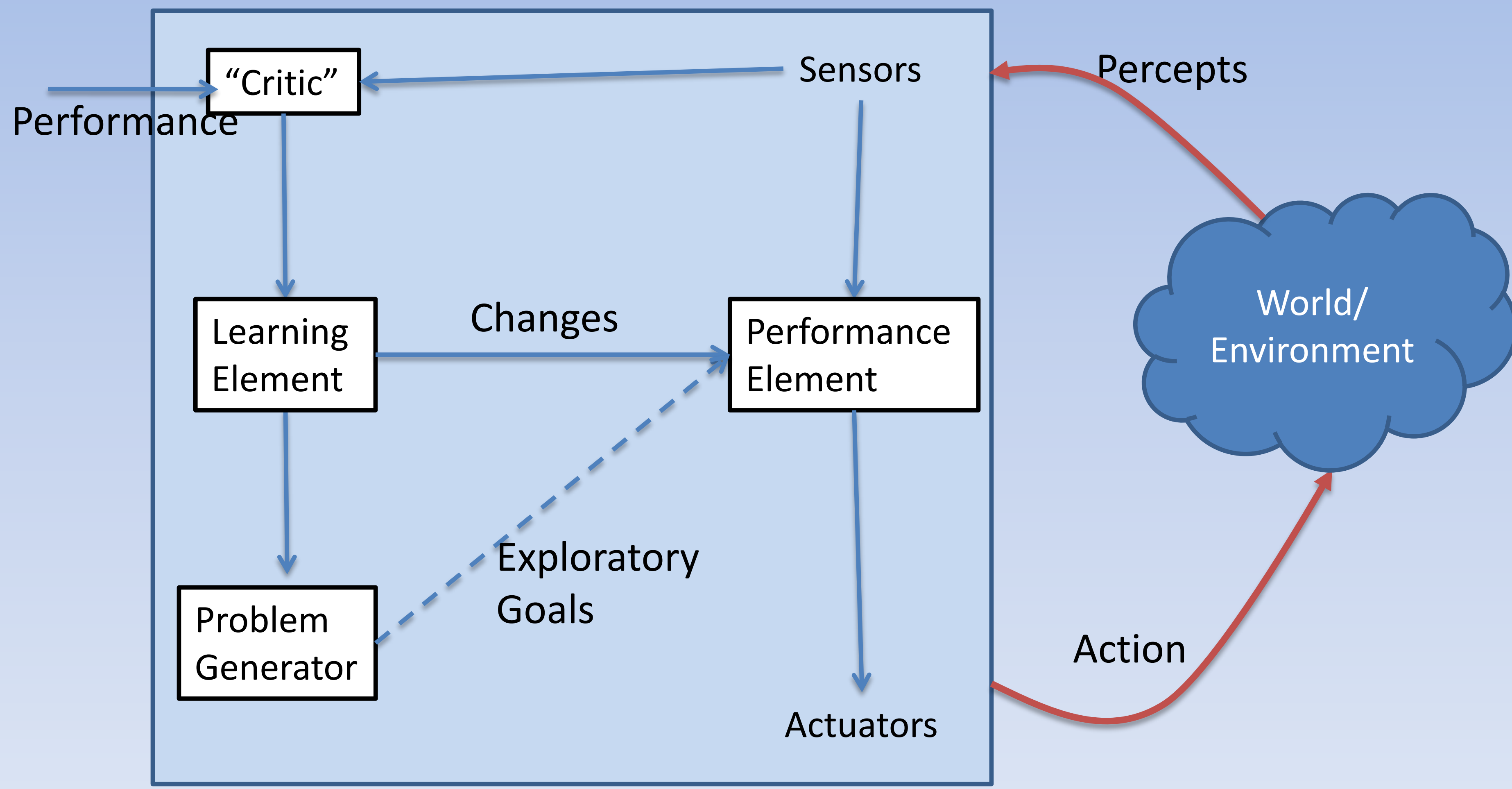
- Who writes all these rules?
  - Or designs the agent function?
  - Could be quite complex!

- Could we have the agent *learn* the agent function on its own?
  - Would also help in unknown environments…

General Architecture

- Before, we had fixed rules (or functions)
  - We'll call this the "performance element"
- Now we need to add something that generates those functions, based on its (partial) knowledge of the environment and any feedback it receives
  - We'll call this the "learning element"

General Architecture



Summary

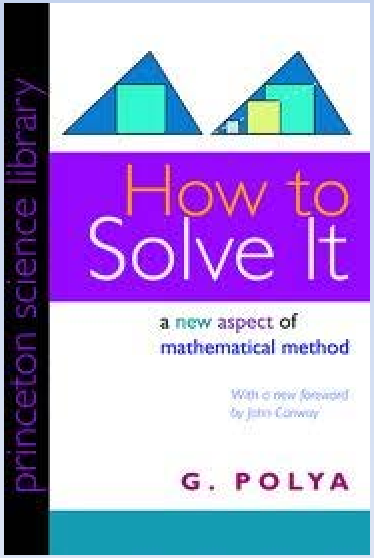
- We learned about:
  - Agent architecture
  - PEAS descriptions
  - Types of environments
  - Types of Agents

Solving Problems Using Goal-Directed Search (Chapter 3)

- Idea
- How to set up the problem
- Basic algorithms
- Characteristics of algorithms

Overview

- We saw that an intelligent agent needs to be flexible
- So we can’t give it solutions to specific problems, we need to give it *problem solving strategies*
- The most basic general purpose problem solving strategy is called “Goal-Directed Search”



Goal-Directed Search

- A fundamental technique in AI
- A strategy when the agent has limited/no idea about the detailed structure of a problem to allow more complex reasoning
- Very easy to implement
- Will show up often when we study the more complex algorithms later

When to use Goal-Directed Search

- The agent *fully perceives* the current state of the world and wants to achieve a certain goal state
  - It can distinguish different states
  - In particular, goal situations from non-goal situations
  - It can tell how the state will change if it takes an action (e.g. “state 5 will become state 43 if I go left”)
- It wants the *least cost path* to get to the goal

“Offline” Problem Solving

- The entire search operation is part of the “agent function”---it is internal to the agent
- After the search is complete and the solution found, the agent can apply them to the world to execute the solution
  - World needs to be static

Environment Type

- We'll assume the environment is:
  - Fully observable (to track the state)
  - Static (shouldn't change while agent is searching)
  - Deterministic (agent needs to be able to precisely predict states resulting after each action)
- Some search algorithms also need discrete environments

Examples

- Route Finding
  - Suppose an agent wants to get from location A to location B
  - Same techniques used by mapping software e.g. Google Maps and GPS systems
- Solving puzzles
  - 8-puzzle
  - Sudoku