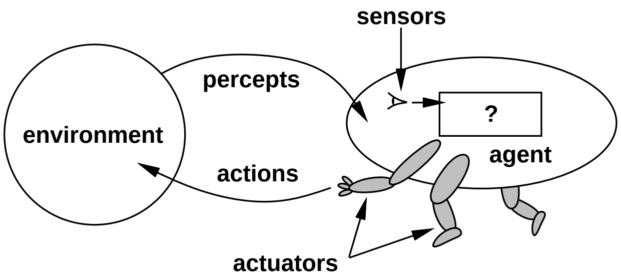
Intelligent Agents

Chapter 2

Outline

- Agents and environments
- Rationality
- PEAS (Performance measure, Environment, Actuators, Sensors)
- Environment types
- Agent types

Agents and environments



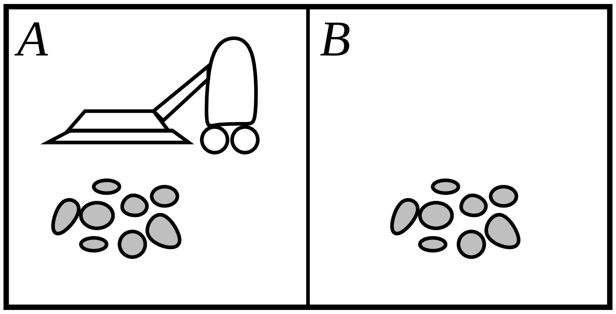
Agents include humans, robots, softbots, thermostats, etc.

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

Vacuum-cleaner world



Percepts: location and contents, e.g., $[A, Dirty]$

Actions: $Left$, $Right$, $Suck$, $NoOp$

A vacuum-cleaner agent

Percept sequence	Action
$[A, Clean]$	$Right$
$[A, Dirty]$	$Suck$
$[B, Clean]$	$Left$
$[B, Dirty]$	$Suck$
$[A, Clean]$, $[A, Clean]$	$Right$
$[A, Clean]$, $[A, Dirty]$	$Suck$
$\vdots$	$\vdots$

```
function REFLEX-VACUUM-AGENT( [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
```

What is the right function?
Can it be implemented in a small agent program?

Rationality

Fixed performance measure evaluates the environment sequence

- one point per square cleaned up in time T?
- one point per clean square per time step, minus one per move?
- penalize for $> k$ dirty squares?

A rational agent chooses whichever action maximizes the expected value of the performance measure given the percept sequence to date

Rational $\neq$ omniscient
Rational $\neq$ clairvoyant
Rational $\neq$ successful

Rational $\Rightarrow$ exploration, learning, autonomy

PEAS

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

Consider, e.g., the task of designing an automated taxi:

Performance measure??

Environment??

Actuators??

Sensors??

PEAS

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

Consider, e.g., the task of designing an automated taxi:

Performance measure?? safety, destination, profits, legality, comfort, . . .

Environment?? US streets/freeways, traffic, pedestrians, weather, . . .

Actuators?? steering, accelerator, brake, horn, speaker/display, . . .

Sensors?? video, accelerometers, gauges, engine sensors, keyboard, GPS, . . .

Internet shopping agent

Performance measure??

Environment??

Actuators??

Sensors??

Environment types

	Solitaire	Backgammon	Internet shopping	Taxi
Observable??				
Deterministic??				
Episodic??				
Static??				
Discrete??				
Single-agent??				

Environment types

	Solitaire	Backgammon	Internet shopping	Taxi
Observable??	Yes	Yes	No	No
Deterministic??				
Episodic??				
Static??				
Discrete??				
Single-agent??				

Environment types

	Solitaire	Backgammon	Internet shopping	Taxi
Observable??	Yes	Yes	No	No
Deterministic??	Yes	No	Partly	No
Episodic??				
Static??				
Discrete??				
Single-agent??				

Environment types

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Discrete??				
Single-agent??				

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Single-agent??				

Environment types

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Episodic??	No	No	No	No
Static??	Yes	Semi	Semi	No
Discrete??	Yes	Yes	Yes	No
Single-agent??	Yes	No	Yes (no auctions)	No

The environment type largely determines the agent design

The real world is (of course) partially observable, stochastic, sequential, dynamic, continuous, multi-agent

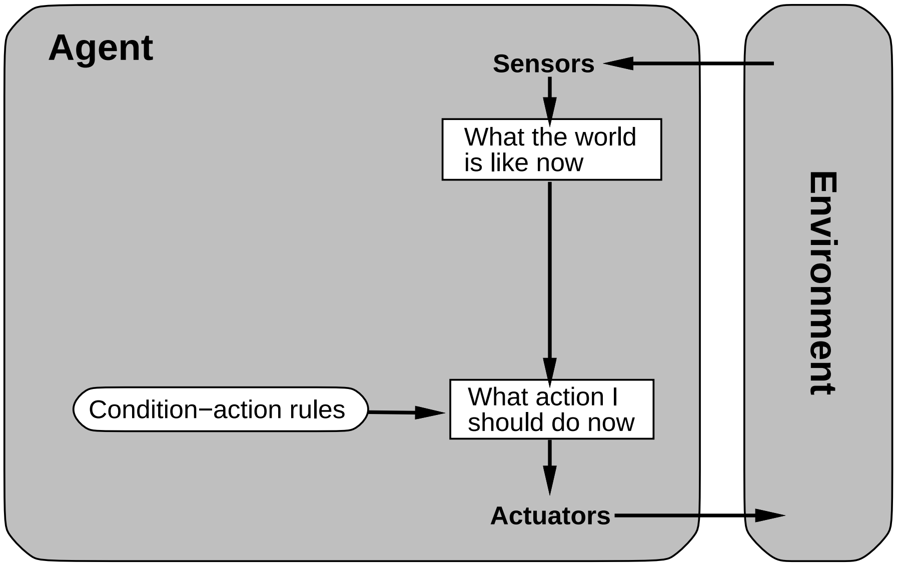
Agent types

Four basic types in order of increasing generality:

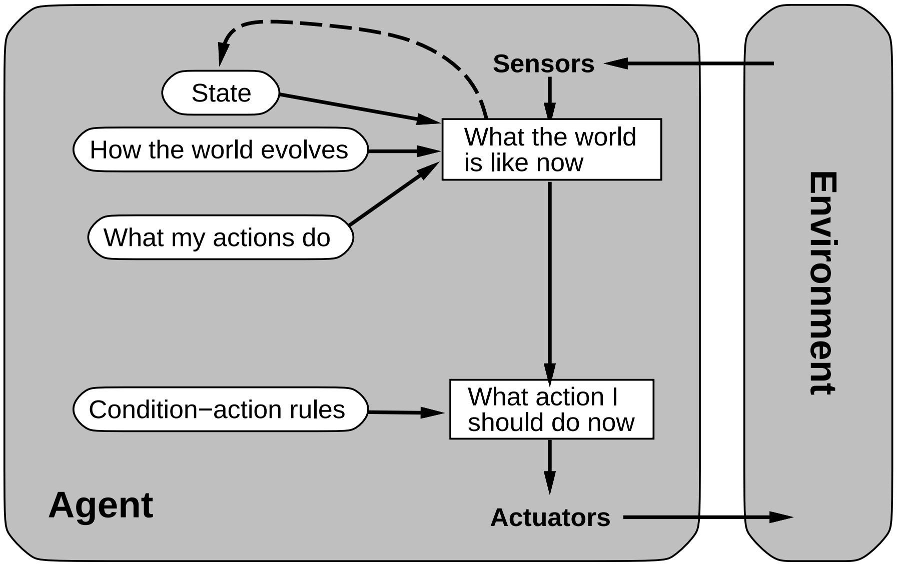
– simple reflex agents
– reflex agents with state
– goal-based agents
– utility-based agents

All these can be turned into learning agents

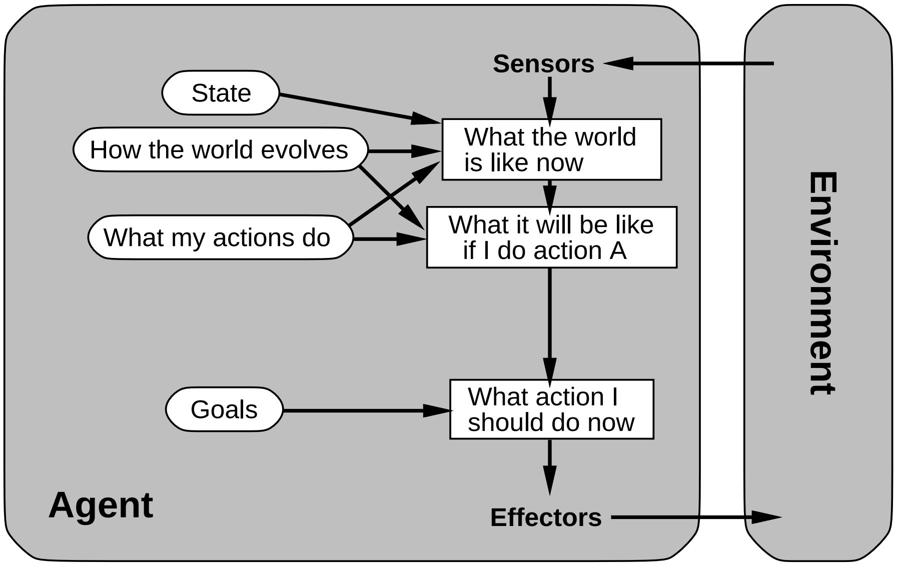
Simple reflex agents



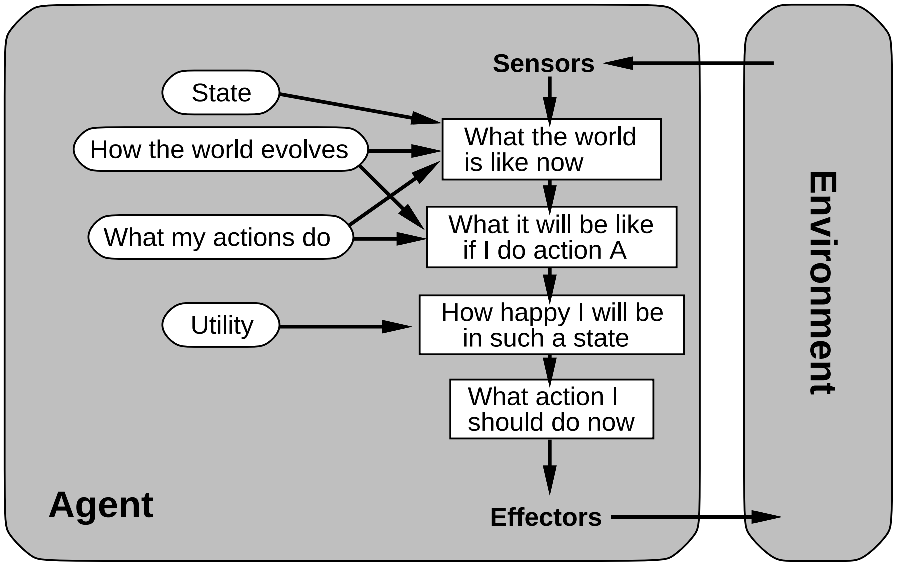
Reflex agents with state



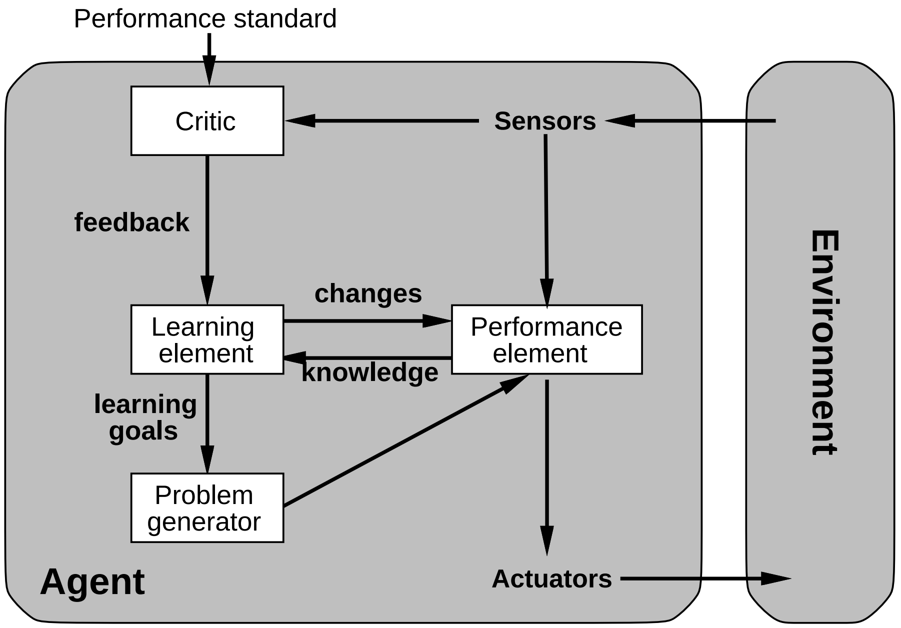
Goal-based agents


Sensors
State
How the world evolves
What my actions do
What the world is like now
What it will be like if I do action A
Goals
What action I should do now
Agent
Effectors
Environment

Utility-based agents


Sensors
State
How the world evolves
What my actions do
What the world is like now
What it will be like if I do action A
Utility
How happy I will be in such a state
What action I should do now
Agent
Effectors
Environment

Learning agents



AIMA code

The code for each topic is divided into four directories:

– `agents`: code defining agent types and programs

– `algorithms`: code for the methods used by the agent programs

– `environments`: code defining environment types, simulations

– `domains`: problem types and instances for input to algorithms

(Often run algorithms on domains rather than agents in environments.)

```
(setq joe (make-agent :name ’joe :body (make-agent-body)
                      :program (make-dumb-agent-program)))
(defun make-dumb-agent-program ()
  (let ((memory nil))
    #’(lambda (percept)
        (push percept memory)
        ’no-op)))
```