

BLG435E

Artificial Intelligence



Lecture 2: Agents

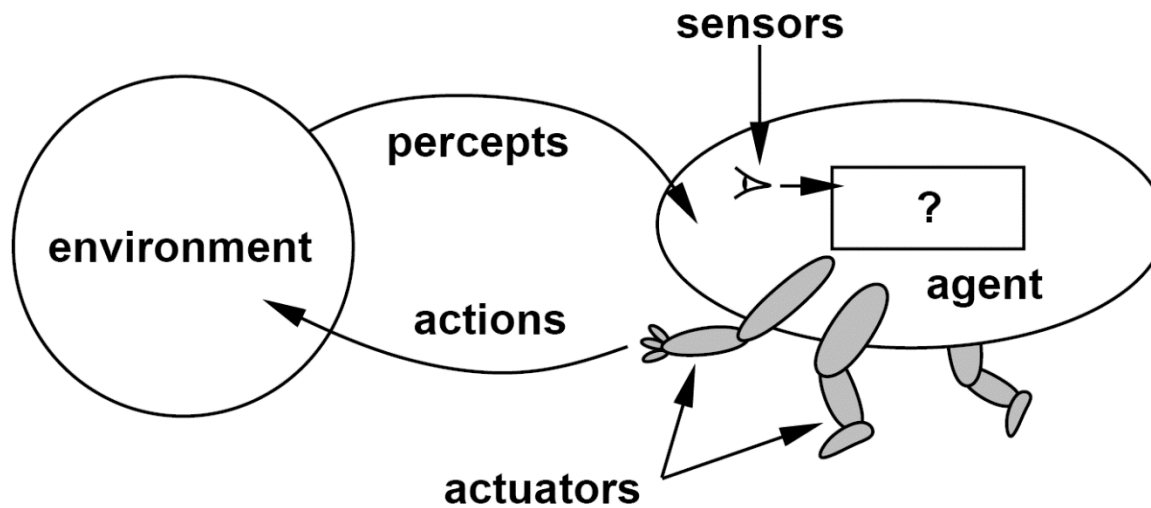


Outline

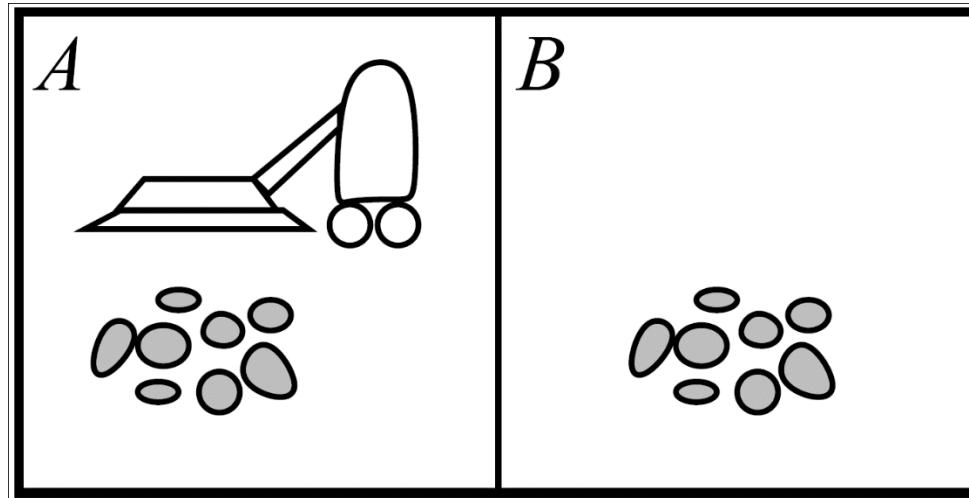


- Agents and Environments
- Rationality
- PEAS
- Environment Types
- Agent Types

Agents



- Agents perceive their own actions
 - Effects?
- Percept: the agent's perceptual input
- Percept sequence: the complete history
- Action choices depend on the percept sequence
- Agent function, abstract mathematical description (agent's behavior)
- Agent program implements the function



Percepts: location and contents, e.g., $[A, \textit{Dirty}]$

Actions: *Left*, *Right*, *Suck*, *NoOp*

A Vacuum-Cleaner Agent Function

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

What is the right way to fill out the table?

What makes an agent good, bad or stupid?

A Vacuum-Cleaner Agent Function

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$[B, Dirty]$	<i>Suck</i>
$[A, Clean], [A, Clean]$	<i>Right</i>
$[A, Clean], [A, Dirty]$	<i>Suck</i>
\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*

- A rational agent does the right thing
- 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

Vacuum Cleaner Agent - PM

- The amount of dirt cleaned up in a single eight-hour shift.
- Rewarding agent for having a clean floor.
- Factoring amount of electricity consumed and the amount of noise generated
- Design PM according to what you want

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.
- With a rational agent, what you ask is what you get

Rationality vs. Perfection

- Omniscience is impossible in reality
- Agents don't estimate the actual outcome of actions
- Rationality maximizes expected outcome, while perfection maximizes actual performance

Further Dimensions in Rationality

- Information gathering
 - Exploration
 - Helps maximize the expected outcome
- Learning
- Autonomy
- With or without initial knowledge

Agents <> Environments

- Task environment forms the problem
 - Rational agents are the solutions
- The task environment affects the appropriate design of the agent

The Nature of Environments



- PEAS for task environments:
 - **P**erformance measure
 - **E**nvironment
 - **A**ctuators
 - **S**ensors
- PEAS for automated taxi driver

Properties of Task Environments

- Fully observable vs. Partially observable
- Deterministic vs. Stochastic
 - Strategic
- Episodic vs. Sequential
- Static vs. Dynamic
 - semidynamic

Properties of Task Environments

- Discrete vs. Continuous
- Single agent vs. Multiagent
 - competitive
 - cooperative

Examples of Task Environments

Task Environment	Observable	Deterministic	Episodic	Static	Discrete	Agents
Crossword puzzle						
Chess with a clock						
Poker						
Backgammon						
Taxi driving						

Examples of Task Environments

Task Environment	Observable	Deterministic	Episodic	Static	Discrete	Agents
Crossword puzzle	Fully	Deterministic	Sequential	Static	Discrete	Single
Chess with a clock						
Poker						
Backgammon						
Taxi driving						

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Task Environment	Observable	Deterministic	Episodic	Static	Discrete	Agents
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Chess with a clock	Fully	Strategic	Sequential	Semi	Discrete	Multi
Poker						
Backgammon						
Taxi driving						

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Backgammon						
Taxi driving						

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Taxi driving	Partially	Stochastic	Sequential	Dynamic	Continuous	Multi

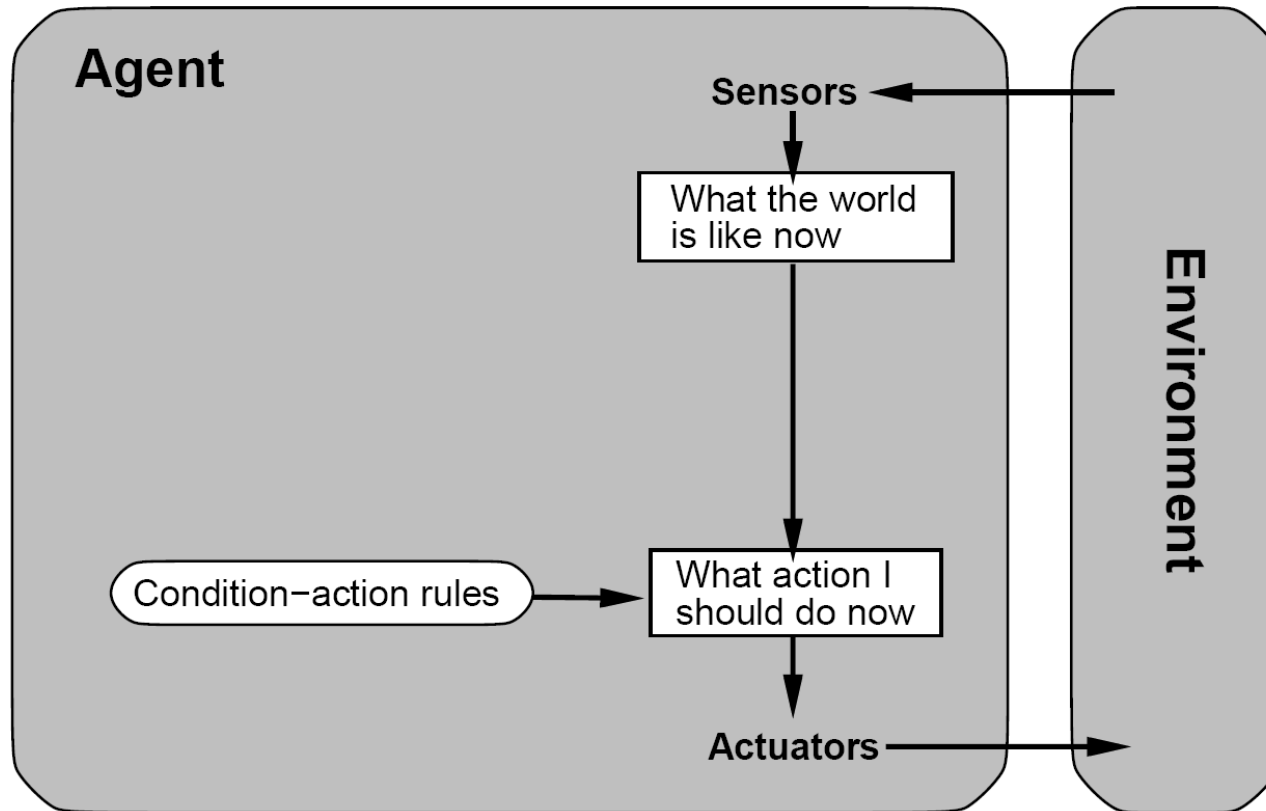
The Structure of Agents

- The job of AI is to design the agent program
- Agent architecture
- Agent = Architecture + Program

Agent Types

- Simple reflex agents
 - Model-based reflex agents
 - Goal-based reflex agents
 - Utility-based agents
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- All these agents can be converted into learning agents

Simple Reflex Agents

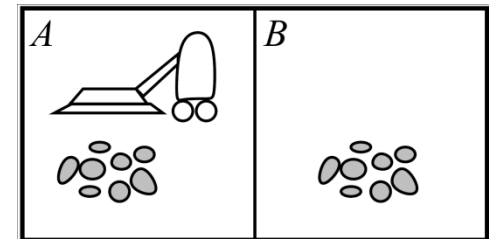


Reflex Vacuum Agent Program

```
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
```

```
(setq joe (make-agent :name 'joe :body (make-agent-body)
                      :program (make-reflex-vacuum-agent-program)))
```

```
(defun make-reflex-vacuum-agent-program ()
  #'(lambda (percept)
      (let ((location (first percept)) (status (second percept)))
        (cond ((eq status 'dirty) 'Suck)
              ((eq location 'A) 'Right)
              ((eq location 'B) 'Left))))))
```

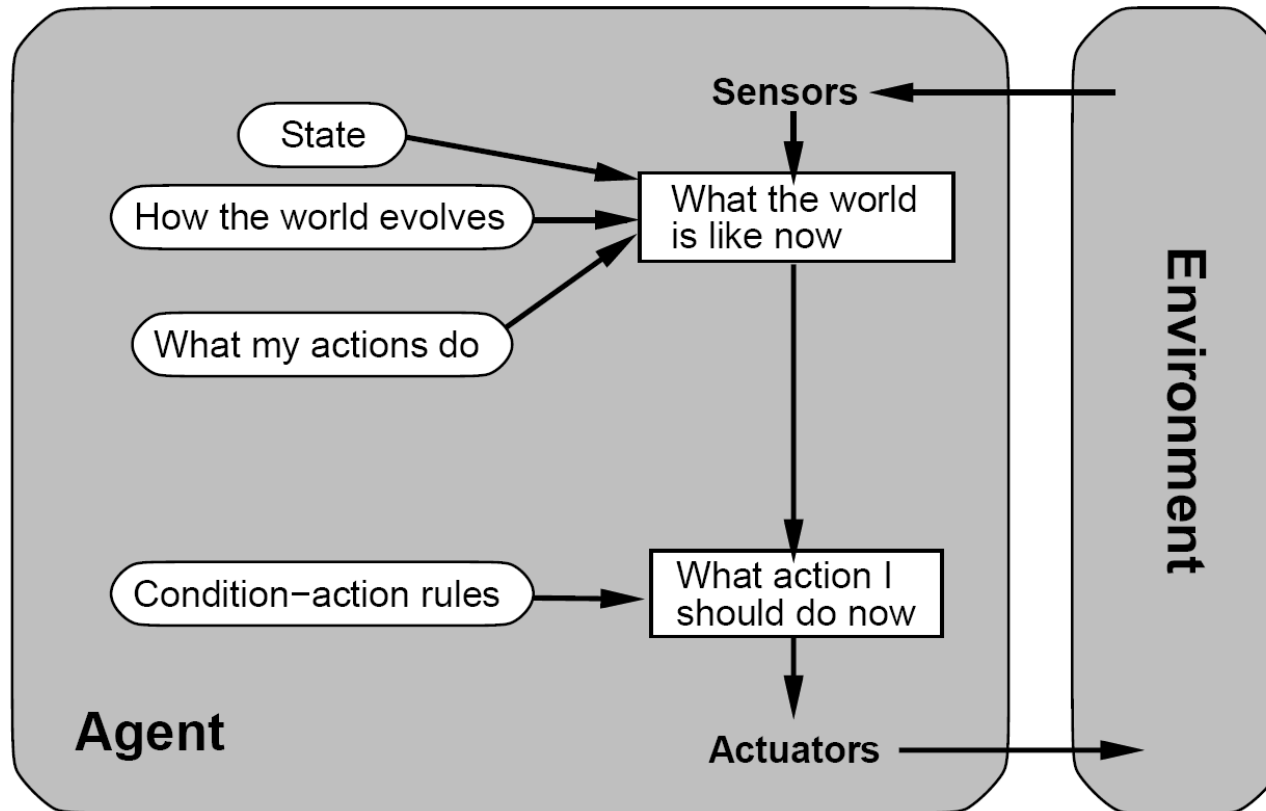


Simple-Reflex Agent Program

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

  state  $\leftarrow$  INTERPRET-INPUT(percept)
  rule  $\leftarrow$  RULE-MATCH(state, rules)
  action  $\leftarrow$  RULE-ACTION[rule]
  return action
```

Model-based Reflex Agents

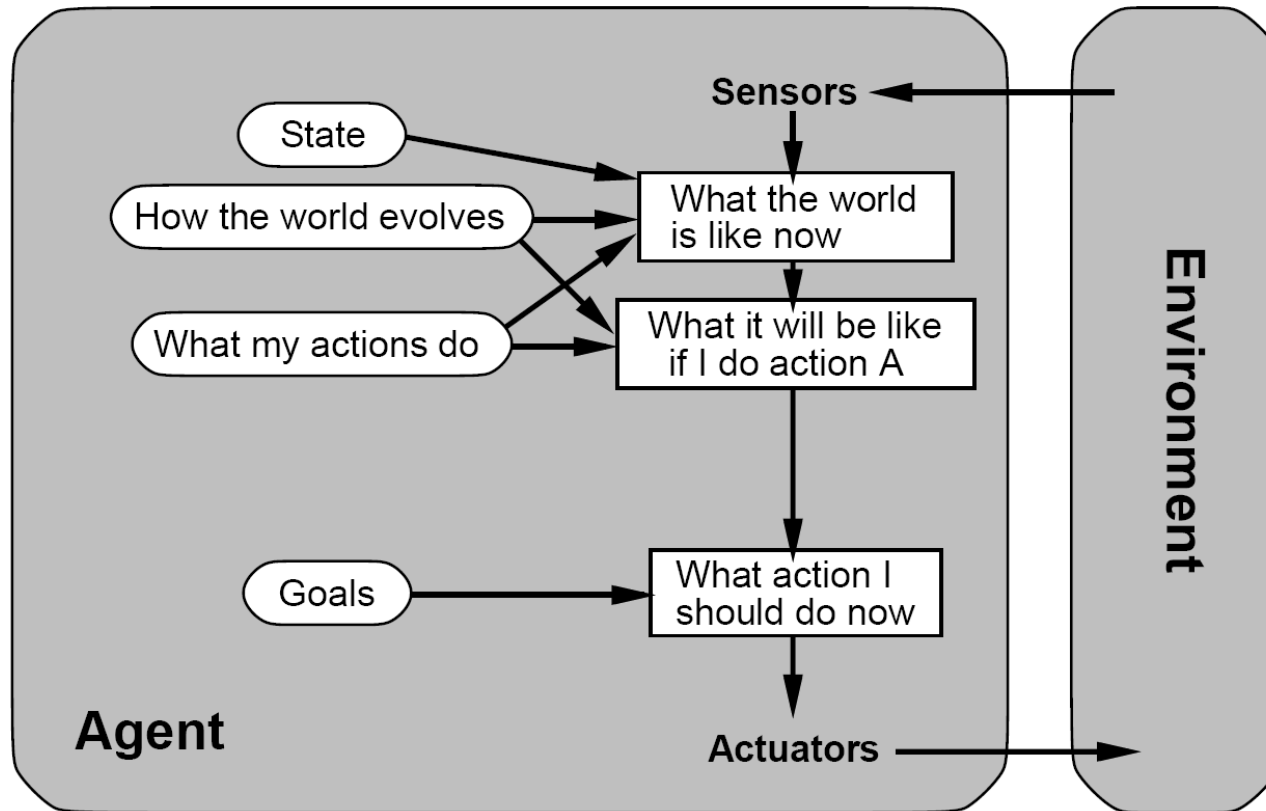


Model-based Agent Program

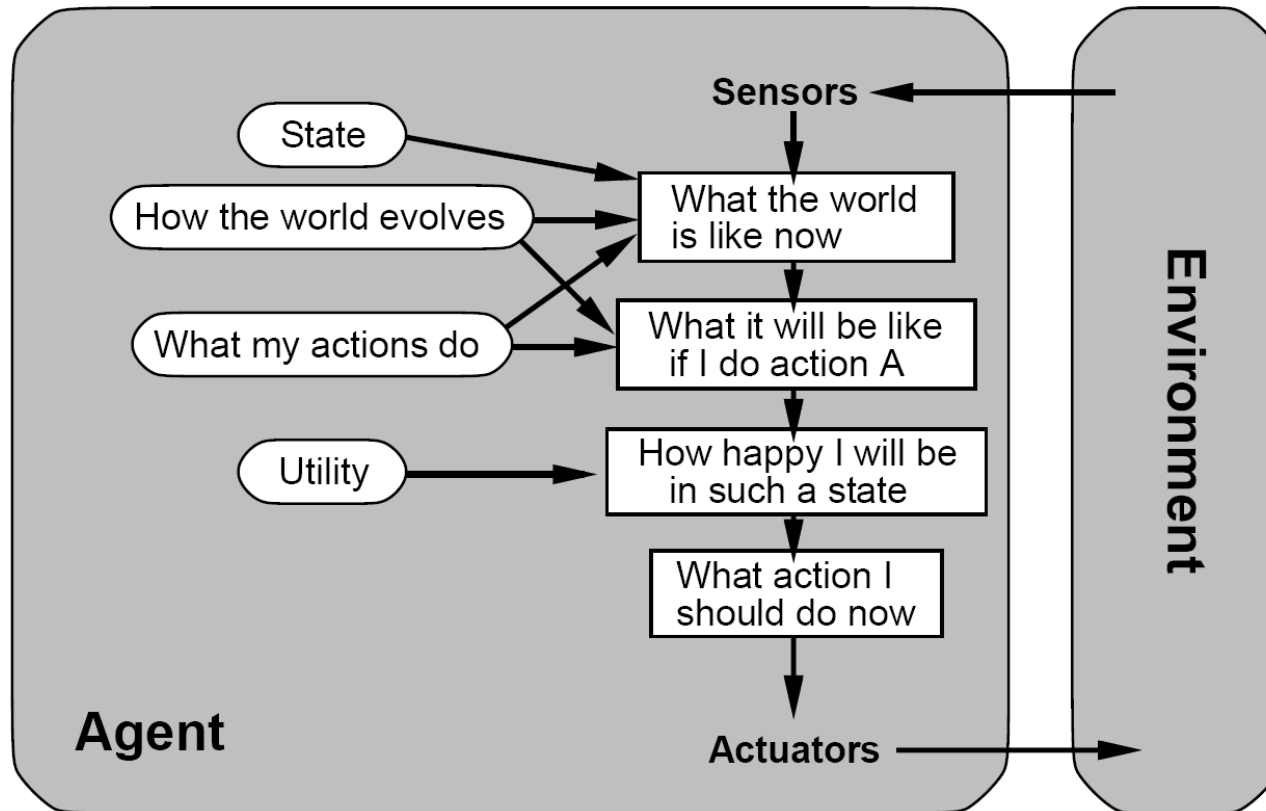
```
function REFLEX-AGENT-WITH-STATE(percept) returns an action
  static: state, a description of the current world state
           rules, a set of condition–action rules
           action, the most recent action, initially none

  state  $\leftarrow$  UPDATE-STATE(state, action, percept)
  rule  $\leftarrow$  RULE-MATCH(state, rules)
  action  $\leftarrow$  RULE-ACTION[rule]
  return action
```

Goal-Based Agents



Utility-based Agents



Learning Agents

