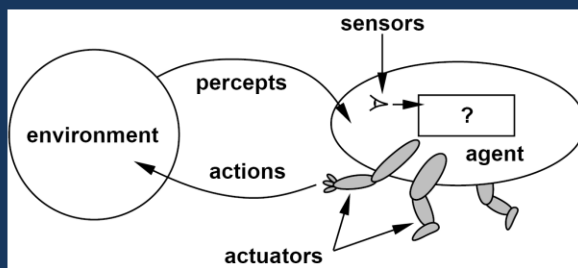
BLG435E
Artificial Intelligence

Lecture 2: Intelligent Agents

Outline

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

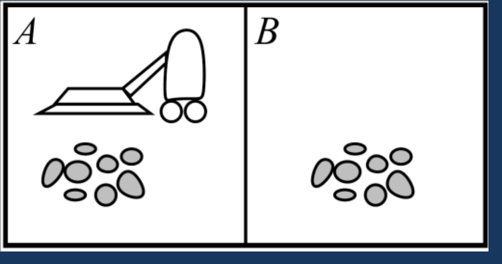
Agents



Agents

- Agents perceive their own actions
  - Effects?
- Percept: the agen’t 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

Vacuum-Cleaner World



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

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

A Vacuum-Cleaner Agent Function

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

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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$[A, Clean]$	$Right$
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$[B, Clean]$	$Left$
$[B, Dirty]$	$Suck$
$[A, Clean], [A, Clean]$	$Right$
$[A, Clean], [A, Dirty]$	$Suck$
⋮	⋮

```
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
```


Rationality

- 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. Continous
- 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						

Examples of Task Environments

Task Environment	Observable	Deterministic	Episodic	Static	Discrete	Agents
Crossword puzzle	Fully	Deterministic	Sequential	Static	Discrete	Single
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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Backgammon	Fully	Stochastic	Sequential	Static	Discrete	Multi
Taxi driving	Partially	Stochastic	Sequential	Dynamic	Continuous	Multi

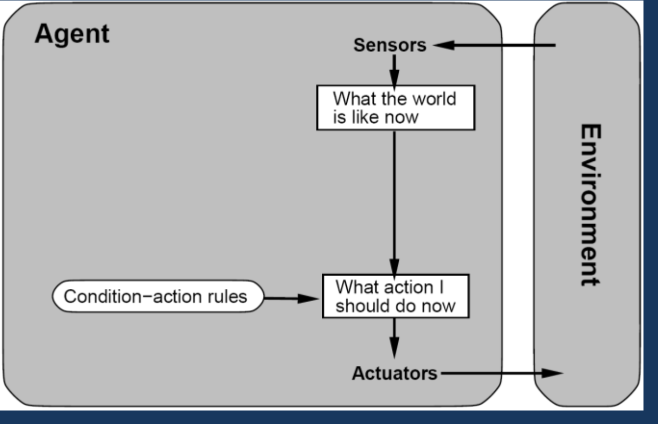
The Structure of Agents

- 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
- All these agents can be converted into learning agents

Simple Reflex Agents

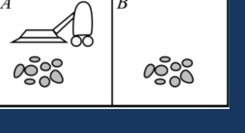


Reflex Vacuum Agent Program

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)))))
```

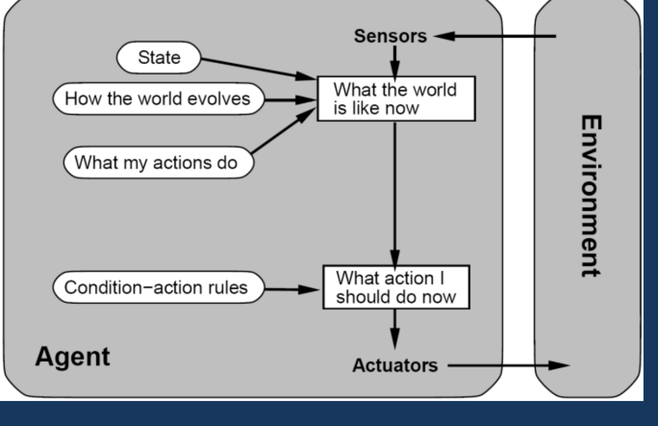


Simple-Reflex Agent Program

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

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


Model-based Reflex Agents

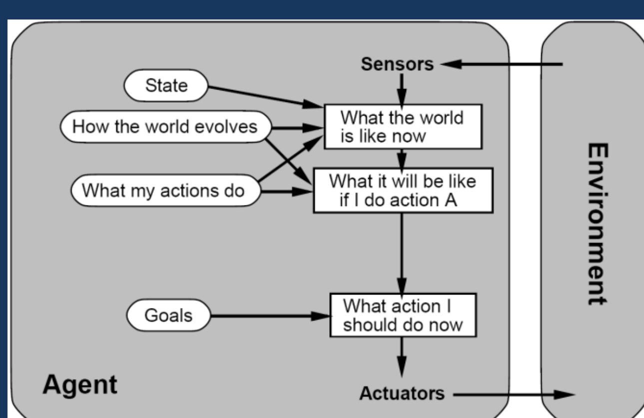


Model-based Agent Program

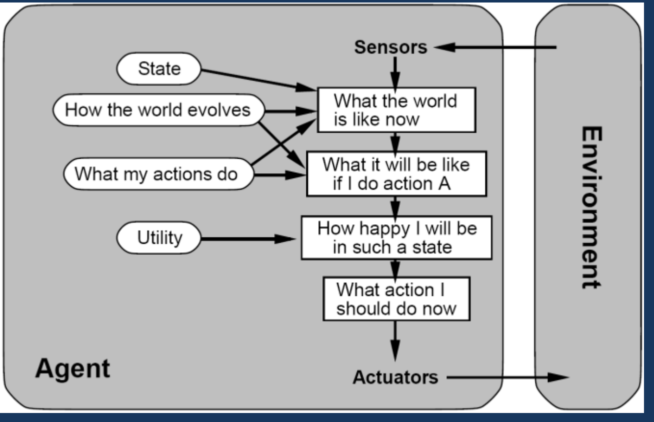
function REFLEX-AGENT-WITH-STATE(*percept*) **returns** an action
  static: *state*, a description of the current world state
    rules, a set of condition–action rules
    action, the most recent action, initially none

  state ← UPDATE-STATE(*state*, *action*, *percept*)
  rule ← RULE-MATCH(*state*, *rules*)
  action ← RULE-ACTION[*rule*]
  return *action*

Goal-Based Agents



Utility-based Agents



Learning Agents