

CENG 466

Artificial Intelligence

Lecture 2

Agents and Environments

Topics

- ▶ Artificial Intelligence
- ▶ Agents
- ▶ Rational Agent
- ▶ Performance Measurement
- ▶ Agent Types
- ▶ Environment

What Is Artificial Intelligence

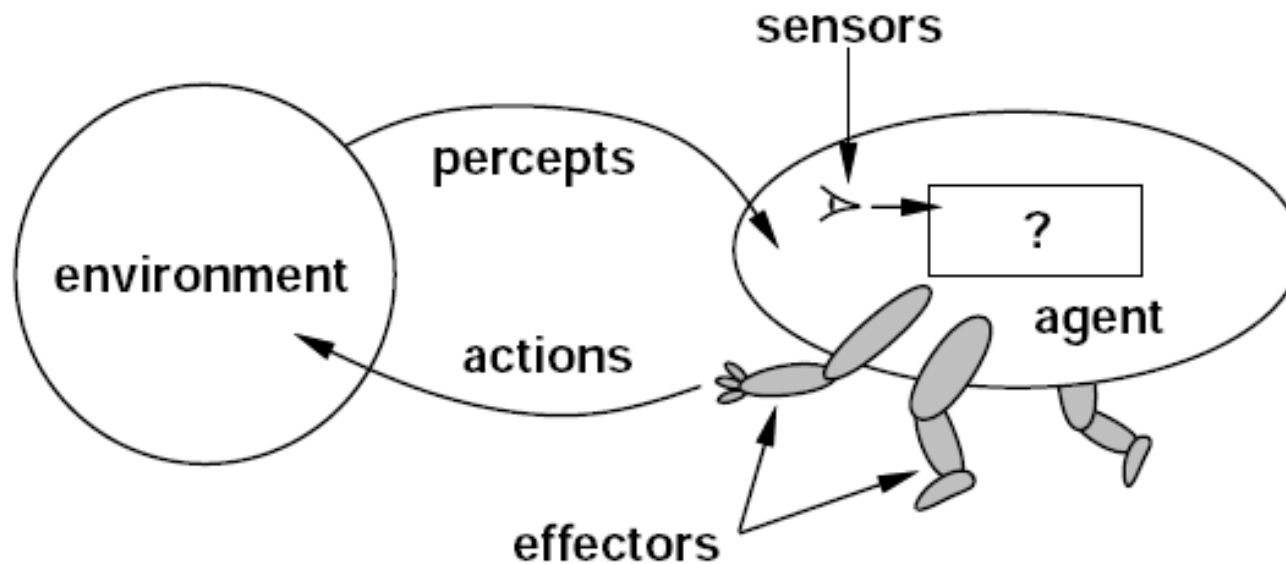
- ▶ “The art of creating machines that perform functions that require intelligence when performed by people” (Kurzweil, 1990).
- ▶ “The branch of computer science that is concerned with the automation of intelligent behavior.” (Luger and Stubblefield, 1993)

Can Machines Act/Think Intelligently?

- ▶ **Turing Test:**
- ▶ Test proposed by Alan Turing in 1950
- ▶ A human asks questions from the computer.
- ▶ The computer passes the test if the person cannot tell whether the responses come from a computer or a person

Intelligent Agents

- ▶ An agent is something that perceives and acts in an environment
- ▶ An ideal agent always takes actions that maximizes its performance
- ▶ An agent adopts a goal and searches the best path to reach that goal



What is Perception?

- ▶ Perception is the ability to see, hear, or become aware of something through the senses
 - ▶ Sensors receive input from environment
 - ▶ Keyboard
 - ▶ Camera
 - ▶ Microphone
 - ▶ Bump sensor

What is Action?

- ▶ Action is affecting the environment through actuators
- ▶ Action can be:
 - ▶ Moving an object
 - ▶ Generating output for computer display
 - ▶ Creating a sound
 - ▶ And so on

Rational Agent

- ▶ A rational agent is an agent which does the right action
- ▶ The right action will cause the agent to be most successful
- ▶ How can we evaluate the agent's success? (performance measure)

Performance Measure

- ▶ We agree on what an agent must do
- ▶ Can we evaluate its quality?
- ▶ **Performance Metrics are**
 - ▶ Very Important
 - ▶ The hardest part of any research problem
 - ▶ Generally based on what we really want to happen

Performance Measure Example

- ▶ An agent which will vacuum clean the floor.
- ▶ Performance measure can be:
 - ▶ Amount of dirt cleaned up
 - ▶ The electricity used
 - ▶ The noise generated
 - ▶ The time spent for cleaning

Rational Behavior

- ▶ A rational behavior depends on four issues:
 - ▶ The performance measure (How successful the agent is)
 - ▶ The perceptions of the agent. (complete perception history, or percept sequence)
 - ▶ What the agent knows about the environment
 - ▶ The actions that the agent can take

Example

- ▶ **Agent** : A taxi driver
- ▶ **Percepts** : Camera, speedometer, GPS, etc.
- ▶ **Actions** : Steer, Accelerate, Brake
- ▶ **Goals** : Safe, fast, legal driving to the destination
- ▶ **Environment** : Roads, other cars, people

Ideal Rational Agent

- ▶ Definition: An ideal rational agent is an agent that:
 - ▶ For each percept the agent does whatever action is expected to:
 - ▶ Maximize its performance
 - ▶ Considering its knowledge

An Agent as a Function

- ▶ Agent maps percept sequence to action
- ▶ Agent Function
 - ▶ Agent gets percept sequence as inputs and provides action as output

Agent Types

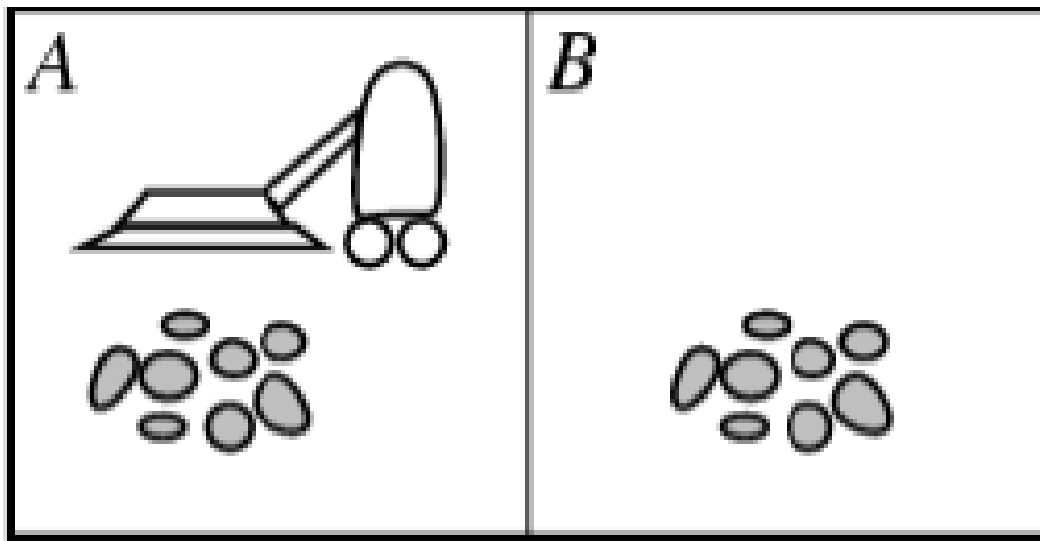
- ▶ Simple Reflex agent
- ▶ Agents that can remember
- ▶ Goal-based agents
- ▶ Utility-based agents

Simple Reflex Agent

- ▶ A reflex agent does:
 - ▶ Sense environment
 - ▶ Search in its database of rules
 - ▶ Choose an action
- ▶ Inaccurate information
 - ▶ Wrong perception can cause wrong reflex
- ▶ But rules databases can be made large and complex

Example: Simple Reflex Agent

- ▶ Percepts: [location and contents], e.g., [A, Dirty]
- ▶ Actions: Left, Right, Clean, No_Operation



Example: Simple Reflex Agent (cont.)

Percept sequence	Action
[A;Clean]	Right
[A;Dirty]	Clean
[B;Clean]	Left
[B;Dirty]	Clean
[A;Clean], [B;Clean]	No Operation

Agents that Can Remember

- ▶ These agents have an internal state value
- ▶ The action (decision) is based on the values coming from the sensors (perceptions), and the internal state of the agent
- ▶ Agent updates its internal state and remembers it for next action

Example: Agents that Can Remember

- ▶ Agent: Taxi driver
- ▶ State: Driving with a speed of 100km/h
- ▶ Percept: Brake lights of the car in front turned on
- ▶ Rule: Use brakes to slow down
- ▶ New state: Driving with a speed of 70km/h

- ▶ If the state was waiting in the traffic lights, the percept of “Brakes lights turned on” would cause no action

Goal-based agents

- ▶ A goal-based agent has a known goal
- ▶ How to get from A to the goal?
 - ▶ Any action puts the agent in a new state
 - ▶ **Agent should:** Search and Plan to find the paths in the state space to go from A to its goal

Example: Goal-based Agent

▶ 8-puzzle

7	2	4
5		6
8	3	1

Start State

	1	2
3	4	5
6	7	8

Goal State

- ▶ State: The current location of the numbers and the blank in the puzzle
- ▶ Possible actions: Sliding a number to the blank space
- ▶ **Should find a sequence of actions to reach the goal state**

Utility-based agents

- ▶ Sometimes reaching the goal is not enough for evaluating an agent.
- ▶ For example, a taxi driver may use safer, faster, or cheaper road to reach the destination.
- ▶ **Utility** is a metric to compare the sequence of states used to reach a goal.
- ▶ Utility gives a score to each state and the agent tries to maximize it

Environment

- ▶ An agent acts in an **environment**.
- ▶ An agent's environment may well include other agents.
- ▶ An agent together with its environment is called a **world**.
- ▶ An agent **acts** on its environment and changes it

Review

- ▶ An intelligent system can be defined in terms of rational agents
- ▶ A rational agent is an agent which takes **right** actions
- ▶ An agent gets information from its environment (perception), makes a decision using its knowledge, then takes an action
- ▶ An agent can be a simple reflex agent, or an agent which knows its state, has a goal, or chooses the best sequence of states to reach its goal.
- ▶ An agent should find the best sequence of states to reach its goal.
- ▶ Next week we will study the search algorithms

Questions?