

# CENG 466

## Artificial Intelligence

### Lecture 2

## Agents and Environments

# Topics

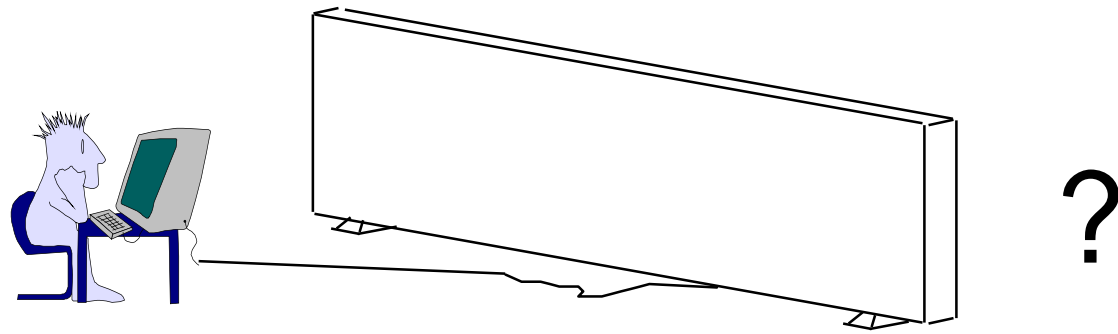
- ▶ Artificial Intelligence
- ▶ Agents
- ▶ Rational Agent
- ▶ Performance Measurement
- ▶ Agent Types
- ▶ Environment

# 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:



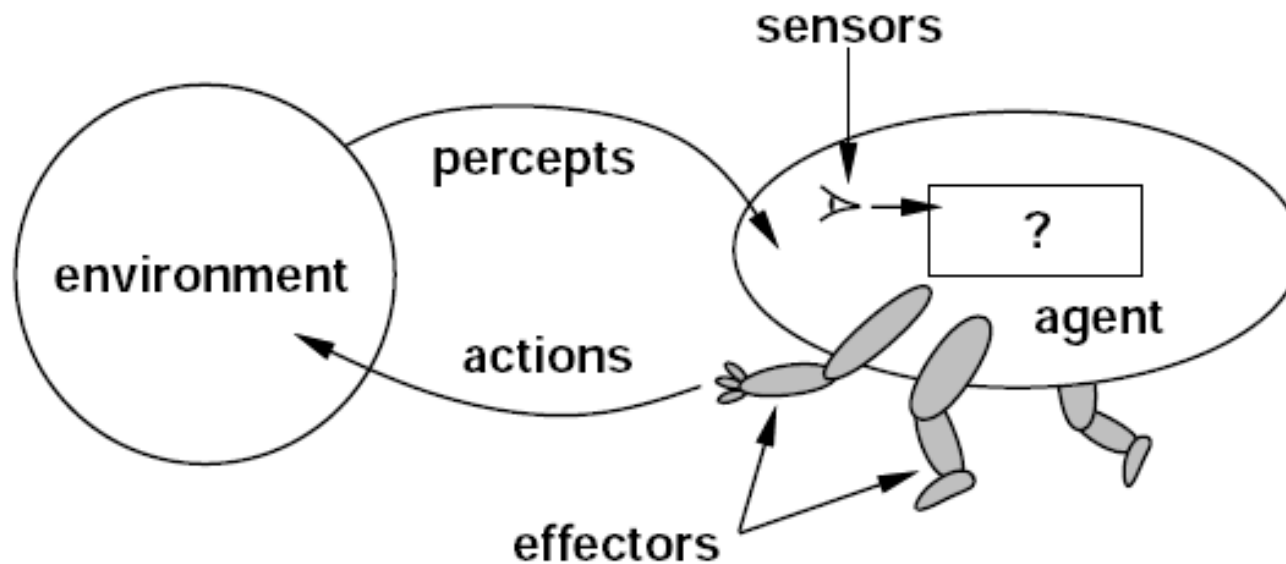
- ▶ Test proposed by Alan Turing in 1950
- ▶ A human asks questions from the computer.
- ▶ The computer passes the test if the person cannot tell whether the responses come from a computer or a person

# Systems that Act Rationally: “Rational Agent”

- ▶ I don't care whether a system:
  - ▶ replicates human thought processes
  - ▶ makes the same decisions as humans
- ▶ **Rational** behavior: doing the right thing
- ▶ **The right thing**: maximizes goal achievement, given the available information

# 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

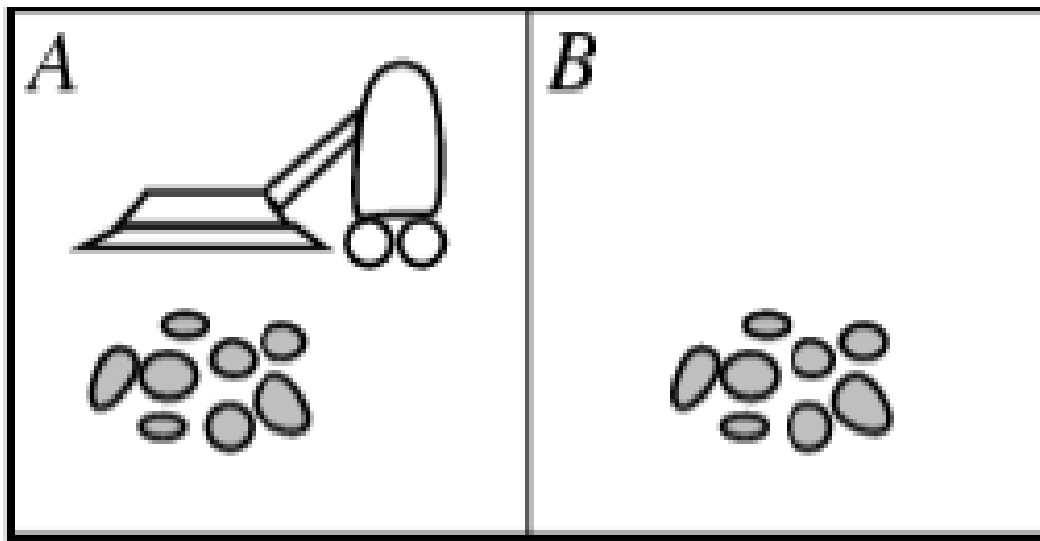


# Simple Reflex Agent

- ▶ 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?