CS 486/686
Introduction to Artificial Intelligence

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Lecture 2

Readings: R & N 2.1, 2.2, 2.3 (esp 2.3.2)

Based on work by K. Leyton-Brown, K. Larson, and P. van Beek

Outline

Learning goals - CS 486/686 Lecture 2

By the end of the lecture, you should be able to

- Given examples of sensors and actuators.
- Define rational agents.
- Given a task environment, describe its properties.
- Given a property, give examples of task environments that have this property.

Agents

- Interact with the environment.
- Perceive the environment using sensors.
- Act on the environment using actuators.

As a human, what sensors and actuators do we have?
Consider a software agent. What sensors and actuators does it have?

Definition of a 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 **prior knowledge** the agent has.

Properties of Task Environments

The problems: the task environments
The solutions: the rational agents

Properties of the task environment:

- Fully observable v.s. partially observable
- Deterministic v.s. stochastic
- Static v.s. dynamic
- Episodic v.s. sequential
- Known v.s. unknown
- Single agent v.s. multi-agent

Uncertainty

Given the observations, can the agent determine the state?

- Fully observable: The agent knows the state of the world from the observations.
- Partially observable: Many states are possible given an observation.

CQ: Fully versus Partial Observability

CQ: Which pair of environments has different observability?

(A) Poker and autonomous cars

(B) Chess and medical diagnosis

(C) Crossword puzzle and Go

Examples of Uncertainty

Come up with some additional examples yourself.
Fully observable:
Partially observable:

Uncertain dynamics

Given the current state and an action, can the agent predict the next state?

- Deterministic: The next state is completely determined given the current state and the action.
- Stochastic: The current state and an action can lead to multiple possible next states.

CQ: Deterministic versus Stochastic

CQ: Consider Chess and Poker.
Which of the following is correct?

(A) Both are deterministic.

(B) Both are stochastic.

(C) Chess is deterministic. Poker is stochastic.

(D) Chess is stochastic. Poker is deterministic.

Examples of uncertain dynamics

Come up with some additional examples yourself.
Deterministic:
Stochastic:

An uncertain environment

An environment is uncertain if

- It is not fully observable, or
- It is not deterministic.

Can the environment change?

Can the environment change while the agent interacts with it?

- Static: The environment does not change.
- Dynamic: The environment changes while the agent interacts with it.

CQ: Static versus dynamic

CQ: Consider autonomous cars and medical diagnosis.
Which of the following statement is correct?

(A) Both are static.

(B) Both are dynamic.

(C) Autonomous cars is static. Medical diagnosis is dynamic.

(D) Autonomous cars is dynamic. Medical diagnosis is static.

Examples of changing environments

Come up with some additional examples yourself.
Static:
Dynamic

Long-term consequence of actions

Can the agent's current action affect future actions?

- Episodic: The current action does not affect future actions.
- Sequential: The current action could affect all future actions.

CQ: Episodic v.s. Sequential

CQ: Consider crossword puzzle and image classification.
Which of the following statement is correct?

(A) Both are episodic.

(B) Both are sequential.

(C) Crossword puzzle is episodic. Image classification is sequential.

(D) Crossword puzzle is sequential. Image classification is episodic.

Learning the rules of the environment

Does the agent know the rules of the environment?

- Known: The agent knows all the rules of the environment.
- Unknown: The agent does not know all the rules of the environment.

Number of agents

Does the agent consider all other agents to be part of the environment?

- Single agent: The agent assumes that any other agents are part of the environment.
- Multi-agent: The agent explicitly models other agents and reasons strategically about the other agents.

CQ: Single or multi agent

CQ: Is autonomous cars single agent or multi-agent?

(A) Definitely single agent.

(B) Definitely multi-agent.

(C) It depends.

Revisiting the learning goals

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