Intelligent Agents

ARTIFICIAL INTELLIGENCE

JUCHEOL MOON

1

Agents and environments

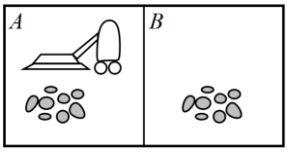
- Agents include humans, robots, softbots, thermostats, etc.
- The agent function maps from percept histories to actions
  - $f: P \rightarrow A$
- The agent program runs on the physical architecture to produce f

2

2

Vacuum-cleaner world

- Equipped component
  - Dirty sensing, move / suck action
- Percepts
  - location and contents
  - e.g., [A; Dirty]
- Actions
  - Left, Right, Suck, NoOp



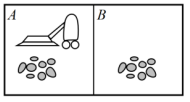
3

3

A vacuum-cleaner agent

- What is the right function?

Percept	Action
[A; Dirty]	Suck
[A; Clean]	Right
[B; Dirty]	Suck
[B; Clean]	Left



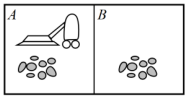
4

4

A vacuum-cleaner agent

- Can it be implemented in a small agent program?

```
function Vacuum-Agent( [location,status])
   if status = Dirty then return Suck
   else if location = A then return Right
   else if location = B then return Left
```



5

5

Rationality

- A rational agent chooses whichever action maximizes the expected value of the performance measure given the percept sequence to date
- Performance measure
  - by the amount of dirt cleaned up?
    - cleaning up the dirt, then dumping it all on the floor, then cleaning it up again, and so on.

6

6

Rationality

- Performance measure
  - designing performance measures according to what one actually wants in the environment
- Rational (= or ≠) omniscient
  - percepts may not supply all relevant information
- Rational (= or ≠) clairvoyant
  - action outcomes may not be as expected
- Hence, rational (= or ≠) successful

7

7

Task environment

- To design a rational agent, we must specify the task environment
  - Performance measure
  - Environment
  - Actuators
  - Sensors

8

8

Task environment of a self-driving car

- Performance measure
  - safety, destination, profits, legality, comfort
- Environment
  - US streets/freeways, traffic, pedestrians, weather
- Actuators
  - steering, accelerator, brake, horn, speaker/display
- Sensors
  - video, accelerometers, gauges, engine sensors, GPS

9

9

Environment types

- Fully observable vs. partially observable
  - If an agent's sensors give it access to the complete state of the environment at each point in time, then we say that the task environment is _fully_ observable.
- Single agent vs. multiagent
  - An agent solving a crossword puzzle by itself is clearly in a _single_ -agent environment, whereas an agent playing chess is in a _multi_ -agent environment.

10

10

Environment types

- Deterministic vs. stochastic
  - If the next state of the environment is completely determined by the current state and the action executed by the agent, then we say the environment is _deterministic_.
- Episodic vs. sequential
  - In an episodic task environment, the agent's experience is divided into atomic episodes. The next episode does not depend on the actions taken in previous episodes.

11

11

Environment types

- Static vs. dynamic
  - If the environment can change while an agent is deliberating, then we say the environment is _dynamic_ for that agent.
- Discrete vs. continuous
  - The chess environment has a finite number of distinct states (excluding the clock). Chess also has a discrete set of percepts and actions.

12

12

Environment types of a self-driving car

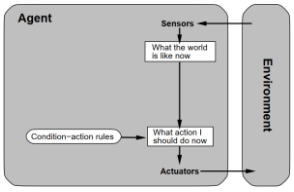
- Observable?
  - Partially
- Agents?
  - Multi
- Deterministic?
  - Stochastic
- Episodic?
  - Sequential
- Static?
  - Dynamic
- Discrete?
  - Continuous

Agent types

- Four basic types in order of increasing generality:
  - Simple reflex agents
  - Model-based reflex agents
  - Goal-based agents
  - Utility-based agents
  - Learning agents

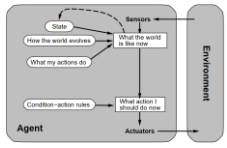
Simple reflex agents

- if car-in-front-is-braking
  - then initiate-braking.



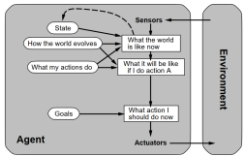
Model-based reflex agents

- We need some information about how the agent's own actions affect the world
  - When the agent turns the steering wheel clockwise
    - The car turns to the right
  - After driving for five minutes northbound on the freeway
    - One is usually about five miles north of where one was five minutes ago.



Goal-based agents

- The agent program can combine this with the model to choose actions that achieve the goal
  - At a cross road, an self-driving car can turn left, turn right, or go straight on.
  - The correct decision depends on where the taxi is trying to get to.



Utility-based agents

- Goals alone are not enough to generate high-quality behavior in most environments
  - Goal: get the taxi to its destination
  - Plus
    - Quicker, safer, more reliable, or cheaper