Rational Agents (Chapter 2)
Agents

- An **agent** is anything that can be viewed as **perceiving its environment** through **sensors** and acting upon that environment through **actuators**.
Agent function

• The agent function maps from percept histories to actions

• The agent program runs on the physical architecture to produce the agent function

• agent = architecture + program
Vacuum-cleaner world

• Percepts:
  Location and status, e.g., [A,Dirty]

• Actions:
  Left, Right, Suck, NoOp

Example vacuum agent program:

function 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
Rational agents

• 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 the agent’s built-in knowledge.

• Performance measure (utility function): An objective criterion for success of an agent's behavior.

• Can a rational agent make mistakes?
Back to vacuum-cleaner world

- **Percepts:**
  Location and status, e.g., [A, Dirty]

- **Actions:**
  Left, Right, Suck, NoOp

**function 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

- Is this agent rational?
  - Depends on performance measure, environment properties
Specifying the task environment

• Problem specification: **Performance measure, Environment, Actuators, Sensors (PEAS)**

• **Example: automated taxi driver**
  – **Performance measure**
    • Safe, fast, legal, comfortable trip, maximize profits
  – **Environment**
    • Roads, other traffic, pedestrians, customers
  – **Actuators**
    • Steering wheel, accelerator, brake, signal, horn
  – **Sensors**
    • Cameras, LIDAR, speedometer, GPS, odometer, engine sensors, keyboard
Agent: Spam filter

• Performance measure
  – Minimizing false positives, false negatives

• Environment
  – A user’s email account, email server

• Actuators
  – Mark as spam, delete, etc.

• Sensors
  – Incoming messages, other information about user’s account
Environment types

- Fully observable (vs. partially observable): The agent's sensors give it access to the complete state of the environment at each point in time.

- Deterministic (vs. stochastic): The next state of the environment is completely determined by the current state and the agent’s action.
  - Strategic: the environment is deterministic except for the actions of other agents.

- Episodic (vs. sequential): The agent's experience is divided into atomic “episodes,” and the choice of action in each episode depends only on the episode itself.
Environment types

- **Static (vs. dynamic):** The environment is unchanged while an agent is deliberating
  - **Semidynamic:** the environment does not change with the passage of time, but the agent's performance score does

- **Discrete (vs. continuous):** The environment provides a fixed number of distinct percepts, actions, and environment states
  - Time can also evolve in a discrete or continuous fashion

- **Single agent (vs. multi-agent):** An agent operating by itself in an environment

- **Known (vs. unknown):** The agent knows the rules of the environment