Intelligent Agent

Agent

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

  - Human agent: eyes, ears, and other organs for sensors; hands, legs, mouth, and other body parts for actuators
  
  - Robotic agent: cameras and infrared range finders for sensors; various motors for actuators
Rationality

Rationality depends on PEAS:

- The performance measure that defines the criterion of success.
- The agent’s prior knowledge of the environment.
- The actions available to the agent that the agent can perform through actuators.
- The agent’s percept sequence to date or history through sensors.
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 whatever built-in knowledge the agent has.

• An agent should strive to "do the right thing", based on what it can perceive and the actions it can perform. The right action is the one that will cause the agent to be most successful.
Rational Agents (Cont.)

- Rationality is distinct from omniscience (all-knowing with infinite knowledge)
- Agents can perform actions in order to modify future percepts so as to obtain useful information (information gathering, exploration)
- An agent is **autonomous** if its behavior is determined by its own experience (with ability to learn and adapt)
Rational Agents (Cont.)

E.g., performance measure of a vacuum-cleaner agent could be amount of dirt cleaned up, amount of time taken, amount of electricity consumed, amount of noise generated, etc.

<table>
<thead>
<tr>
<th>Percept sequence</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>[A, Clean]</td>
<td>Right</td>
</tr>
<tr>
<td>[A, Dirty]</td>
<td>Suck</td>
</tr>
<tr>
<td>[B, Clean]</td>
<td>Left</td>
</tr>
<tr>
<td>[B, Dirty]</td>
<td>Suck</td>
</tr>
<tr>
<td>[A, Clean], [A, Clean]</td>
<td>Right</td>
</tr>
<tr>
<td>[A, Clean], [A, Dirty]</td>
<td>Suck</td>
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<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>[A, Clean], [A, Clean], [A, Clean]</td>
<td>Right</td>
</tr>
<tr>
<td>[A, Clean], [A, Clean], [A, Dirty]</td>
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<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>[A, Clean], [A, Clean], [A, Dirty]</td>
<td>...</td>
</tr>
</tbody>
</table>
Environment types

- **Fully observable** (vs. partially observable): An 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 action executed by the agent. (If the environment is deterministic except for the actions of other agents, then the environment is strategic)

- **Episodic** (vs. sequential): The agent's experience is divided into atomic "episodes" (each episode consists of the agent perceiving and then performing a single action), 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. (The environment is *semidynamic* if the environment itself does not change with the passage of time but the agent's performance score does)
- **Discrete** (vs. continuous): A limited number of distinct, clearly defined percepts and actions.
- **Single agent** (vs. multiagent): An agent operating by itself in an environment.
PEAS

• Consider, e.g., the task of designing an automated taxi driver:

• PEAS:
  – Performance measure: safe, fast, legal, comfortable trip, maximize profits
  – Environment: Roads, other traffic, pedestrians, customers
  – Actuators: Steering wheel, accelerator, brake, signal, horn
  – Sensors: Cameras, sonar, speedometer, GPS, odometer, engine sensors, keyboard
PEAS

• Agent: Medical diagnosis system
• Performance measure: Healthy patient, minimize costs, lawsuits
• Environment: Patient, hospital, staff
• Actuators: Screen display (questions, tests, diagnoses, treatments, referrals)
• Sensors: Keyboard (entry of symptoms, findings, patient's answers)
PEAS

• Agent: Part-picking robot
• Performance measure: Percentage of parts in correct bins
• Environment: Conveyor belt with parts, bins
• Actuators: Jointed arm and hand
• Sensors: Camera, joint angle sensors
The Structure of Agent

• agent = architecture + program

• The job of AI is to design an agent program that implements the agent function.

• The agent function maps from sequence of percepts to actions: \( f: P^* \rightarrow A \)

• The agent program runs on the physical architecture to produce \( f \)
Agent types

Four basic types in order of increasing generality:

• Simple reflex agents
• Model-based reflex agents
• Goal-based agents
• Utility-based agents
Simple reflex agents

Diagram:
- Agent
  - Sensors
    - What the world is like now
  - Condition-action rules
    - What action I should do now
  - Actuators
- Environment
Model-based reflex agents
Goal-based agents

Diagram:
- Agent:
  - Goals
  - State
  - How the world evolves
  - What my actions do
- Sensors:
  - What the world is like now
- Environment:
  - What it will be like if I do action A
  - What action I should do now
- Actuators
Utility-based agents
Learning agents

Diagram:
- Performance standard
- Critic
- Sensors
- Feedback
- Learning element
- Changes
- Knowledge
- Problem generator
- Actuators
- Environment