Intelligent Agents

AIMA, Chapter 2.1-2.2
Roadmap for Module 1

- **Today: Rational Agents (Chap 2.1-2.2)**
- **Today: Introduction to Python – Part 1**
  - Homework 1 distributed: Python

- Recitation later this week (Friday afternoon?) for those not familiar with Python: Introduction to Python – Part 2

- **Thursday:**
  - Task Environments, Problem Formulation, Search basics
Agents and environments

- An agent is specified by an agent function $f: P \rightarrow a$ that maps sequences of percept vectors $P$ to an action $a$ from a set $A$:

  $P = [p_0, p_1, \ldots, p_t]$
  $A = \{a_0, a_1, \ldots, a_k\}$
Agents

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

• **Human agent:**
  • Sensors: eyes, ears, ...
  • Actuators: hands, legs, mouth, ...

• **Robotic agent:**
  • Sensors: cameras and infrared range finders
  • Actuators: various motors

• **Agents include humans, robots, softbots, thermostats, …**
Agent function & program

• The agent program runs on the physical architecture to produce $f$
  • $agent = architecture + program$

• “Easy” solution: table that maps every possible sequence $P$ to an action $a$
  • One small problem: exponential in length of $P$
Example: A Vacuum-cleaner agent

- Percepts: location and contents, e.g., \((A, \text{dirty})\)
  - (Idealization: locations are discrete)
- Actions: move, clean, do nothing: 
  \(\text{LEFT, RIGHT, SUCK, NOP}\)
Vacuum-cleaner world: agent function

<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>
</tr>
<tr>
<td>(\vdots)</td>
<td>(\vdots)</td>
</tr>
</tbody>
</table>

**function** `REFLEX-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 II

- **Rational Agent**: For each possible percept sequence, a rational agent should select an action that is *expected* to *maximize* its *performance measure*.

- **Performance measure**: An objective criterion for success of an agent's behavior, given the evidence provided by the percept sequence.

- A performance measure for a vacuum-cleaner agent might include one or more of:
  - +1 point for each clean square in time $T$
  - +1 point for clean square, -1 for each move
  - -1000 for more than $k$ dirty squares
Rationality is *not* omniscience

- Ideal agent: maximizes *actual* performance, but needs to be *omniscient*.
  - Usually impossible…..
    - But consider tic-tac-toe agent…
  - Rationality ≠ Success

- 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
  (*Book’s definition – standard usage differs.*)