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
- **Thursday: Introduction to Python – Part 2**
- **Tuesday, Sept 9:**
  - Task Environments (Chap 2.3)
  - Problem Formulation (Chap 3.1-3.3)
Agents and environments

- An agent is specified by an *agent function* $f$ that maps a sequence of percepts $Y = [y_0, y_1, \ldots, y_t]$ to an action $a \in A$, $A = \{a_0, a_1, \ldots, a_k\}$
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 $Y$ to an action $a$
  - One small problem: exponential in length of $Y$
Example: A Vacuum-cleaner agent

- **Percepts:** location and contents, e.g., \((A, \text{dirty})\)
  - (Idealization: locations are discrete)
- **Actions:** move, clean, do nothing:
  - 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>
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</tr>
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<td>[A, Clean], [A, Clean]</td>
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**function** `REFLEX-VACUUM-AGENT([location, status])` **returns an action**

```python
def REFLEX-VACUUM-AGENT([location, status]):
    if status == 'Dirty':
        return 'Suck'
    elif location == 'A':
        return 'Right'
    elif location == 'B':
        return 'Left'
```

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CIS 391 - Fall 2014
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 $\neq$ 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)
Outline for rest of lecture

- **Rational Agents**
- Defining Task Environments
- Environment types
- Agent types
Agents and environments

- An agent is specified by an agent function \( f: P \rightarrow a \) that maps sequences of percepts \( P \) to an action \( a \) from a set \( A \):

\[
P = [p_0, p_1, \ldots, p_t]
\]

\[
A = \{a_0, a_1, \ldots, a_k\}
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<td>([A, \text{Clean}], [A, \text{Dirty}])</td>
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<td>(\vdots)</td>
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function \textsc{Reflex-Vacuum-Agent}( [\text{location, status}] ) \textbf{returns an action}

\[
\begin{align*}
\text{if } \text{status} = \text{Dirty} \text{ then return } & \text{Suck} \\
\text{else if } \text{location} = A \text{ then return } & \text{Right} \\
\text{else if } \text{location} = B \text{ then return } & \text{Left}
\end{align*}
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  (*Book’s definition – standard usage differs.*)