It advance the state of the art in AI. What research and some appears to report on the latest (or other recent) winner of the Louette Prize. What techniques does it use? How does it advance the state of the art in AI?

Discussion Point: Louette Prize


Review and Discussion

Homework Questions: Close除了 Greedy Algorithm

Administration

Outline

AGENCY: FUNCTION, PROGRAMS, AND TYPES

ENVIRONMENT SPECIFICATION AND TYPES

RATIONALITY

AGENTS AND ENVIRONMENTS

REVIEW AND DISCUSSION

ADMINISTRATION

AMIA CHARTER 2, 2ND ED. (AFTER RUSSELL AND NORVIG)

INTELLIGENT AGENTS
A robot perceives its environment through sensors and acts upon it. An agent perceives its environment through sensors and acts upon it. Must first specify the settings for intelligent agent design.

Example Sensors and Actuators

- actuators
- sensors
- actions
- environment

Agents Interact with Environments

More Discussion Points

- Suppose we extend a classic ANNA LOGY program so that it can score 200 possible and not enable computers to do anything that animals can do. Why might the use of introspection (reporting on one’s inner thoughts) be a bad methodology?
- Why might the use of introspection (reporting on one’s inner thoughts) be a bad methodology?
- Must first specify the settings for intelligent agent design.

- What about “penny’s mind” as the outer structure? And does it imply the programmer’s influence? It can do any what their minds on.

- Humans, animals, humans and computers cannot be intelligent.

- Why can they do only what their constituent atoms are told to do by the laws of physics? Why can they do only what their constituent atoms are told to do by the laws of physics? Why can they do only what their constituent atoms are told to do by the laws of physics?
Consider the task of designing an autonomous taxi:

- **Environment**: Urban streets, free roads, traffic, pedestrians, weather.
- **Actions**: steer, accelerate, brake, honk, speak/display.
- **Percepts**: video, accelerometers, radars, engine sensors, keyboard, GPS.

Problems from an implementation perspective (why?):

- Percept sequence: an agent's action choice at any instant can depend on the entire percept sequence, complete history.
- Percepts: an agent's perceptual inputs at any instance (and thus describe behavior).
What are reasonable performance measures for the vacuum world?

**Performance Measures**

<table>
<thead>
<tr>
<th>Action</th>
<th>Reward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean (A)</td>
<td>4</td>
</tr>
<tr>
<td>Dirty (B)</td>
<td>-2</td>
</tr>
</tbody>
</table>

**Good Behavior**: Rationally act into agent body (or not) and move around the world unless bump into wall. Stick actions put dirt into agent if it is clean. Otherwise, move according to current state. If the current square is dirty, then stick dirt; otherwise, move to the other square.

**Another Example: Vacuum World**

- A: Agent
- B: Environment

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A performance measure embodies the criterion for success of an agent. Therefore, we need to be able to measure success in a way that one agent will cause the agent to be most successful. A truthful agent is one that does "the right thing" i.e., every entry in the action function table is filled out correctly.
Specifying the Task Environment: P.E.A.S.

- Performance Measure: correct decision, safe, fast, legal, comfortable
- Example: P.E.A.S specification for an automated tax drive agent
- We then need to specify the problem before we develop the solution

Task Environment: "Problems" in which "agents" are solutions

Rational Measures

- Goal: learn (or incorrect - knowledge)
- Learn to be Action-Maximizer (e.g., on policies rather than prior - action partial)
- Learn from policies (or amount of policy prior knowledge)

Rational agents should also

- Take actions to modulate future decisions, exploration
- Cross-walk between looking at next rational because lacks information (off-policy)
- Adapt actions over time (e.g., performance depending on knowledge) to
- Adapt preferences: person crossing street example

Rational = consistent

Cumulative, Learning, and Autonomy

Does our vacuum agent take the rational agent?

Rational agent: For each possible percept sequence, select an action that is expected to maximize the performance measure.

Rational action: Given the percept sequence, select an action that is expected to maximize the expected value of the perfor-

Rational action that maximizes the expected value of the perfor-

Rational action based on the agent's percept sequence to date

Rational action that the agent can perform

Rational action that the agent's prior knowledge of the environment

Rational action that defines the success criterion

Performance Measures

- Difficulty is come up with measures (survived mobidity vs. hills and
- Then how you think the agent should behave
- Generally better to measure what you want in the environment, rather
- Having a clean home
- The amount of dirt cleaned up in an hour

What are reasonable performance measures for the vacuum world?
What is the easiest environment?

- Simultaneous: (Opportunities arise and stochastic behavior)
- only one action can be cooperative, competitive (which can impact choice)
- other agents if their behavior is maximizing a performance measure based
- Single versus Multi Agent
- can be applied to environment state, time, reward and actions
- Discrete versus Continuous
- sociodynamic: environment doesn't change with time but performance
- Dynamic: environment can change during thought

**Environment Dimensions: Examples**

- Deterministic vs stochastic
- Deterministic: next environment state is completely determined by the current state and action choice
- Stochastic: next environment state is not necessarily determined by the current state and action choice
- Episodic vs Sequential
- Episodic: independent episodes (current perception, then perform a single action, e.g. assemble line)
- Sequential: short term actions can have long term consequences
- Partially Observable
- Partially observable due to noise and incompleteness
- rewards or performance measures (this is with respect to observation relevance for action choice)
- Fully vs Partially Observable

**Environment Dimensions: Examples**

- Sensory: Keyboard entry
- Auditory: display exercise suggestions, corrections
- Environmental: students' reading agency
- Text-based: Correlation

**More PEAS Examples**
Agent Programs

Agent types
- utility-based agents
- goal-based agents
- model-based agents with state
- simple reflex agents

Four basic types in order of increasing generality:

Agent Functions

One agent function (or a small collection of functions) is sufficient.

Obviouisly, a lookup table would usually be inefficient. In principle, one can supply each possible sequence to see what it does.

In general, each function maps a percpet

Agent Programs

An agent program takes a single percept as input, keeps internal state:

• agent = architecture + program

The job of AI is to design the agent program that implements the agent

See also Figure 2.6

The real world is (of course) inaccessible, stochastic, sequential, dynamic.

The environment type largely determines the agent design:

Environment Dimensions: Examples

<table>
<thead>
<tr>
<th>Agent Type</th>
<th>Single</th>
<th>Multi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Episodic</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observational</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
These agents consider the future (e.g. make via reasoning, not just reflex)
search and planning deal with tricky goal-based action (sequence) section

State is updated with the model (how the world evolves, agent’s actions):
State handles partial observability

2.3 Note that the programs are smaller than the function they implement (Figure
Figure 2.8 specific to vacuum world) and 2.10 (generalization)

Simple Reflex Agents: Programs: Examples
Learning agents: improve performance via learning
Agent design: best choice (e.g. simple reflex) depends on environment
Agent program: implements the agent function
Performance measure: evaluates the agent's behavior in an environment
Agent function: decides the action taken in response to any percept as-

Previously, concerned with methods for action selection in the agent program
Performance element was previously the agent; problem generator is for ex-
- Task environment: specification via PEGAS, many dimensions
- Rational agent: aims to maximize the expected value of the performance
- Performance measure: evaluates the agent's behavior in an environment
- Agent function: decides the action taken in response to any percept as-

Summary

Usually for conflicting goals and real choice
- A utility function maps a state onto a real number representing a preference
- Goals are just binary