An Introduction to Intelligent Agents

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Outline

- What are Intelligent Agents?
- Properties of Intelligent Agents
- Taxonomy of Intelligent Agents
- Differences from Other Software
- Reasons for Using Intelligent Agents
- Applications of Intelligent Agents
- Learning Methods for Intelligent Agents

What are Intelligent Agents?

- Some Definitions of Intelligent Agents
  - "Intelligent agents continuously perform three functions: perception of dynamic conditions in the environment; action to affect conditions in the environment; and reasoning to interpret perceptions, solve problems, draw inferences, and determine actions" [Hayes-Roth, 1995].
  - "An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future" [Franklin and Graesser, 1995].
  - "A hardware or (more usually) software-based computer system that enjoys the following properties: autonomy, social ability, reactivity, pro-activeness" [Wooldridge and Jennings, 1995].
Intelligent Agents

“Autonomous agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realize a set of goals or tasks for which they are designed” [Maes, 1995].

“Intelligent agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ some knowledge or representation of the user’s goals or desires” [IBM].

Properties of Intelligent Agents

- Reactivity
- Autonomy
- Inferential capability
- Temporal continuity
- Personality
- Adaptivity
- Learnability
- Collaborative behavior
- Communication ability
- Mobility

[Gilbert et al., 1995]

[inside the diagram:
Agency
- Service interactivity
- Application interactivity
- Data interactivity
- Representation of user
- Asynchrony

Mobility
- Static
- Mobile scripts
- Mobile objects

Intelligence
- Preferences
- Reasoning
- Planning
- Learning

Fixed-Function Agents

Expert Systems

Collaborative Learning Agents

Smart Agents

Cooperate

Learn

Collaborative Agents

Autonomous

Interface Agents

[Nwana, 1996]
Intelligent Agents

Autonomous Agents

- Biological Agents
- Robotics Agents
- Computational Agents
  - Task-specific Agents
  - Entertainment Agents
  - Viruses

Software Agents

[Franklin and Graesser, 1996]

Intelligent Agents

Agent

- Task level skills
- Knowledge
- Communications Skills

- Task
- A priori knowledge
- Learning
- with user
  - with other agents

- Information Retrieval
- Information Filtering
- Electronic Commerce
- Coaching

- Developer Specified
- User Specified
- System Specified

- Interface
- Speech
- Social
- Inter-agent Communication

[Caglayan and Harrison, 1997]

Intelligent Agents

Differences from other Software

- How is an Agent different from other Software?
  - personalized, customized
  - pro-active, takes initiative
  - long-lived, autonomous
  - adaptive

[Intelligent Agents]

Software Agents vs. Expert Systems

<table>
<thead>
<tr>
<th></th>
<th>Software Agents</th>
<th>Expert Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of users</td>
<td>naive</td>
<td>expert</td>
</tr>
<tr>
<td>Tasks</td>
<td>common</td>
<td>high-level task</td>
</tr>
<tr>
<td>Personalized</td>
<td>different actions</td>
<td>same actions</td>
</tr>
<tr>
<td>Active, autonomous</td>
<td>on their own</td>
<td>passively</td>
</tr>
<tr>
<td>Adaptive</td>
<td>learn and change</td>
<td>remain fixed</td>
</tr>
</tbody>
</table>

[Maes, 1997]
Intelligent Agents

Reasons for Using Intelligent Agents

◆ Why do we need Software Agents?
  ■ more everyday tasks are computer-based
  ■ vast amounts of dynamic, unstructured information
  ■ more users, untrained

◆ Change of Metaphor for HCI
  ■ Direct manipulation
  ■ Indirect manipulation

Applications of Intelligent Agents

■ E-mail Agents
  ● Beyond Mail, Lotus Notes, Maxims

■ Scheduling Agents
  ● ContactFinder

■ Desktop Agents
  ● Office 2000 Help, Open Sesame

■ Web-Browsing Assistants
  ● WebWatcher, Letizia

■ Information Filtering Agents
  ● Amalthaea, Jester, InfoFinder, Remembrance agent, PHOAKS, SiteSeer

■ News-service Agents
  ● NewsHound, GroupLens, FireFly, Fab, ReferralWeb, NewT

■ Comparison Shopping Agents
  ● MySimon, BargainFinder, Bazzar, ShopBot, Fido

■ Brokering Agents
  ● PersonalLogic, Barnes, Kasbah, Jango, Yenta
Intelligent Agents

- Auction Agents
  - AuctionBot, AuctionWeb
- Negotiation Agents
  - DataDetectors, T@T

Learning Methods for Agents

- Learning agents: “Agents that change its behavior based on its previous experience.”

- Learning Methods
  - Decision Trees
    - e.g.) InfoFinder
  - Bayesian Learning
    - e.g.) Syskill & Webert, NewsHound

- Neural Networks
  - e.g.) Chaplin, STEALTH, Intruder Alert
- Reinforcement Learning
  - e.g.) WAIR, LASER
- Evolutionary Algorithms
  - e.g.) PAWS, ARACHNID