

Multiagent Systems: Local Decisions VS. Global Coherence

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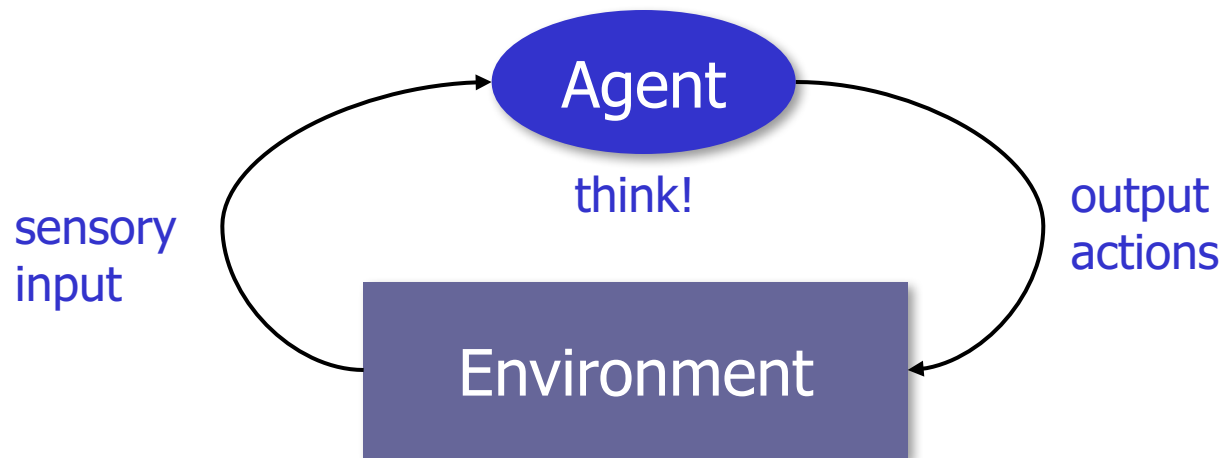


A couple of episodes ... from Seinfeld

- <http://www.youtube.com/watch?v=e64nHicE1bY&feature=related>
- <http://www.youtube.com/watch?v=dSZYsyrP3Co>
- <http://www.youtube.com/watch?v=vZwnSrAvfrI>
 - 0:18 – 0:54

Agents

- What is an **agent**?
 - An agent is an entity that **takes sensory input from its environment, makes **autonomous** decisions, and carries out actions that affect the environment**
 - A thermostat is an agent
 - A calculator is *not* an agent



Intelligent Agents

- What is an **intelligent agent**?
 - An intelligent agent is one that is capable of **flexible** autonomous actions in order to meet its design objectives, where flexibility means:
 - **Reactivity**: agents are able to perceive their environment, and respond in a **timely** fashion to changes that occur in order to satisfy their design objectives
 - **Pro-activeness**: agents are able to exhibit **goal-directed behavior** by **taking the initiative** in order to satisfy their design objectives
 - **Social ability**: agents are capable of **interacting** with other agents (and possibly humans) in order to satisfy their design objectives

(Wooldridge and Jennings 1995)

Intelligent Agents: Learning

- Machine Learning in AI says

The acquisition of new knowledge and motor and cognitive skills and the incorporation of the acquired knowledge and skills in future system activities, provided that this acquisition and incorporation is conducted by the system itself and leads to an improvement in its performance.

- Agents that learn are intelligent
- Not all agents are intelligent!

Agent Environment

- **Inaccessible vs. accessible**
 - Incomplete vs. complete data
- **Deterministic vs. non-deterministic**
 - Certainty vs. uncertainty
- **Episodic vs. non-episodic**
 - Each episode is independent or not
- **Static vs. dynamic**
 - Remain unchanged except by the performance of actions by the agent?
- **Discrete vs. continuous**
 - “Chess game” vs. “taxi driving”

Why Agents?

- If the system-to-be-built has, during the execution of the system
 - Incomplete data
 - Uncertainty in the assessment/interaction of its environment
 - Inter-dependent episodes of events
 - No full control over the events in the environment
 - An “open world”, instead of a “closed world”
- In other words, agents are used when you need to build a system that is adaptive to an uncertain, dynamic, and at times unexpected environment
 - So you can make full use of the **autonomous** property of an agent

Why does a person hire an agent?

Agents vs. Objects ...

To quote Yoav Shoham from his paper in 1990 for a basic difference between of AOP against OOP:

“.. .agent-oriented programming (AOP), which can be viewed as a specialization of object-oriented programming...”

	OOP	AOP
Basic unit	object	agent
Parameters defining state of basic unit	unconstrained	beliefs, commitments, capabilities, choices....
Process of computation	message passing and response methods	message passing and response methods
Types of message	unconstrained	inform, request, offer, promise, decline....
Constraints on methods	none	honesty, consistency....

Multiagent Systems

- A multiagent system is a system where multiple agents perform a task better when working together
 - Interaction (communication)
 - Coordination
 - Collaboration
- Example: A group of basketball players who do not observe or communicate with each other is not a team—simply a group of individual agents.

Why Multiagent Systems?

- Distributed control, databases, knowledge bases, experience, expertise, execution, planning, and views of environment
 - Scalability, flexibility, **autonomy**

From the Solution point of view

- Distributed control, proprietary concerns, security levels, communities
 - Efficiency, flexibility, **autonomy**

From the Logistics point of view

Local Decisions vs. Global Coherence

- Agents making **local** decisions have high autonomy
 - Less reliant on other agents
 - No explicit global control
 - May lead to unexpected, “chaotic” results due to lack of coordination
- A multiagent system should strive for **global coherence**
 - How well a system behave as a unit

Local Decisions vs. Global Coherence

