

Against the Abuse of Agents

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Contents

Introduction	3
This Presentation	3
Basics of Agents	4
Basics of Computation	6
Example: Economics	7
Introduction	7
Real-life Solution: Controlled Economy	9
Real-life Solution: Market Economy	9
Translation To Computers	10
Solution 1: Centralised Solver	11
Solution 2: Multi-Agent Solver	11
So Why Do Agents Work?	12
So Why Are Agents Good?	13

Conclusion **14**

Basics of Agents Revisited 14

The Abuse of Agents 15

Improving The Technology 16

The End 17

Introduction

This Presentation

Motivation: Confusion over what is an agent.

This presentation will contain:

- A view of agents for solving computational problems.
- A defence of agents technologies.
- A transformation of real-life techniques into agents.
- No statement like ‘agents are computer programs anyway ...’.

Introduction

Basics of Agents

Simple definition^a of agents is a process with:

- autonomy
- social ability
- reactivity
- proactivity
- temporal continuity
- goal orientedness

^a<http://www.hermans.org/agents/>

Introduction

Basics of Agents

Agent producers that make unjust use of the term agent to designate their product, cause users to draw the conclusion that agent technology as a whole has not much to offer. That is - obviously - a worrying development:

In order to survive for the agent, there must be something that really distinguishes agents from other programs, otherwise agents will fail. Researchers, the public and companies will no longer accept things that are called agent and the market for agents will be very small or even not exist.

Wijnand van de Calseyde on the Software Agents Mailing List

Introduction

Basics of Computation

- To solve problems in an optimal fashion.
- To simulate situations for analysis.

Level of difficulty of solving problems is called **computational complexity**. Includes both time and space.

Example: Economics

Introduction

1. Describe problem.
2. Describe real-life solutions.
3. Change comparison criteria for computational purposes.
4. Describe corresponding computational solutions.

Thus we get a motivation for agent-style solution methods, and a comparison with centralised solution methods.

Example: Economics

Introduction

problem: find the most economic production and distribution of goods and services with limited resources and unlimited wants.^a

economics: the branch of social science that deals with the production and distribution and consumption of goods and services and their management

economic: using the minimum of time or resources necessary for effectiveness^b

^aYes, we are on a slight tangent here, but it's necessary background info

^bDefinitions are taken from WordNet

Example: Economics

Real-life Solution: Controlled Economy

Optimal solutions when:

- Everyone works cooperatively.
- Central authority has complete knowledge of the entire market.

Real-life Solution: Market Economy

Optimal solutions when:

- Market forces dominate decisions (infinite buyers/sellers).
- Everyone has complete knowledge of their part of the market.

Example: Economics

Translation To Computers

If we wanted to use these approaches in computers, can ignore some criteria.

enforce cooperation: Self-interest has no purpose in computers.

remove market forces: Without self-interest, no point.

Last remaining criteria is the distribution of knowledge.

Also need to ask 'how easy can we apply theory?'

Example: Economics

Solution 1: Centralised Solver

Optimal solutions because:

- Central solver works with perfect knowledge - **complexity**.
- **Bonus:** can use theory to analyse techniques.^a

Solution 2: Multi-Agent Solver

Optimal solutions despite:

- No single agent requires complete knowledge - **be careful**.
- Difficult to apply theory.^b

^aYou *can* leverage AI without using agents.

^bOne exception is entropy analysis thanks to Mikhail Prokopenko

Example: Economics

So Why Do Agents Work?

- Reasoning with incomplete information gives a good approximation.
- Minimising the information overload for a reasoning engine gives an increase in speed.
- Communication extends positive effects of reasoning to neighbours of agent.

Example: Economics

So Why Are Agents Good?

Because agents work with incomplete information

**They can handle problems of
unknown size.**

Bonus: No agent should know full extent of problem. Thus, approximately linear increase in space/time with size of problem.

Conclusion

Basics of Agents Revisited

By making the primary difference ‘where information is’, can we now give concrete definitions to the following?

- autonomy
- social ability - communication
- reactivity
- proactivity
- temporal continuity
- goal orientedness

Conclusion

The Abuse of Agents

Agents are being abused if any answers are **no**:

- Are your agents trying to solve the problem?
- Are your agents reasoning with their information?
- Are your agents unable to predict^a any other agent?

Warning: sed does not reason with my files.

Warning: An embedded theorem prover does **not** make an agent.

Warning: An agent does not require a general reasoning engine.

^aTo the level of an oracle mapping problems to solutions

Conclusion

Improving The Technology

communication: should propagate only the information **required** to avoid suboptimality. eg. argumentation.

overhead: avoiding full-blown processing of communicated knowledge.

theory: agents are dependent upon communication. Look to information theory.

Conclusion

The End

What is a Multi-Agent System?

A computational system which is most easily described using agents as a concept.

What needs an Agent-Oriented System?

A problem which **naturally** decomposes its processing in such a way that each agent has **highly** imperfect knowledge.

If all agents need to communicate most of their knowledge, odds are you don't need an agent-oriented system.