Agent Systems summary

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Artificial Intelligence & Information Analysis Lab

Agent Systems

- **Intelligent Agents**
- Competitive Multi-Agent Systems
- Simulation tools
- Applications

Introduction to Intelligent Agents

Intelligent agents are used mostly in applications, ranging from small systems, e.g. email filters, to large complex systems, such as air traffic control or human social behavior.

Introduction to Intelligent Agents

Categories of Intelligent Agents

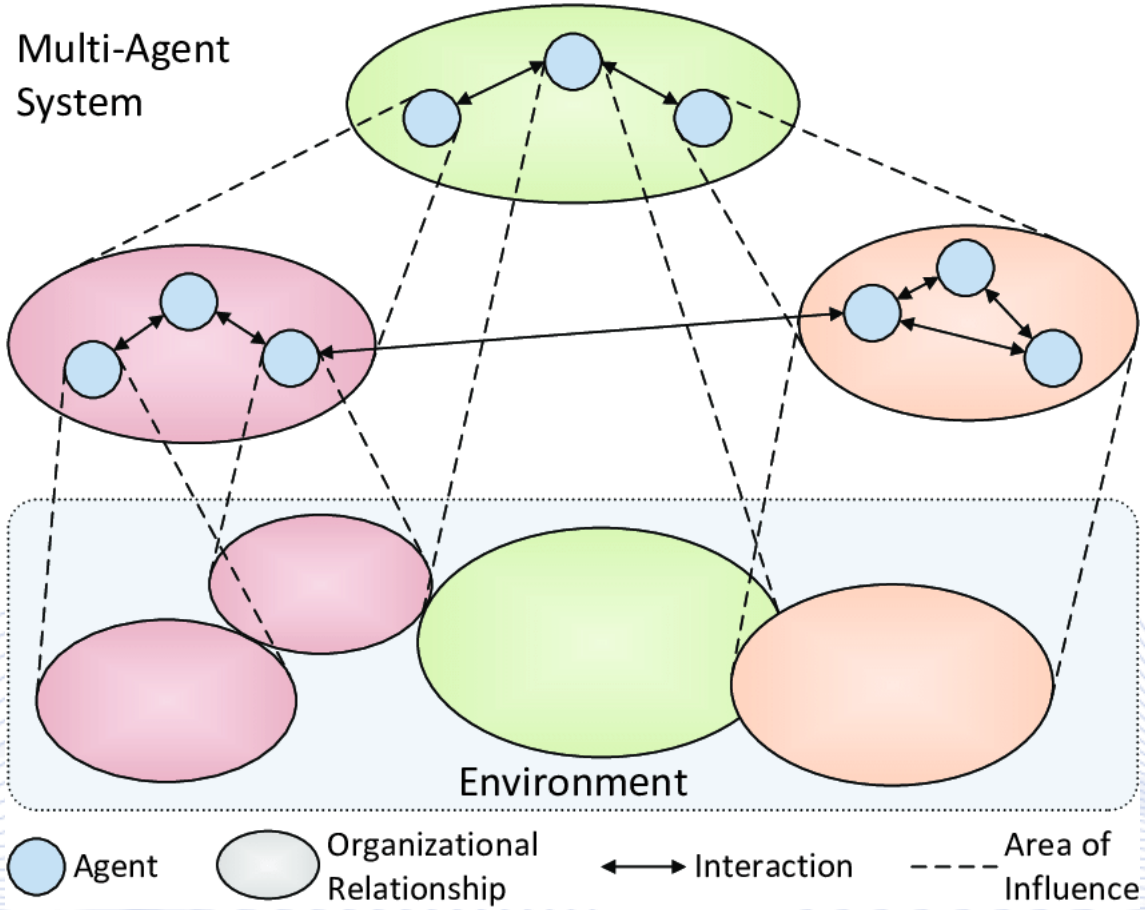
Intelligent agents are classified according to their capabilities and level of intelligence:

- Reflex agents.
- Model-based agents.
- Goal-based agents.
- Utility-based agents.
- Learning agents.

Examples of intelligent agents

- AI assistants, such as **Alexa** and **Siri**, are instances of intelligent agents; they take the user's request and utilize sensors to interpret it, then automatically retrieve data from the internet without the user's involvement. They have the ability to gather data about their perceived surroundings, such as weather and time.

Introduction to Agent Systems



[ResearchGate: https://www.researchgate.net/figure/General-structure-of-a-multi-agent-system-42_fig4_324808821]

Categories of Agent Systems

There are several distinctions between the agents but according to the science book “Computer Standards & Interfaces” there are two types of multi-agent systems so they won’t have coordination problems of how they interact.

- Competitive Multi-Agent Systems.
- Cooperative Multi-Agent Systems.

Agent Systems

- Intelligent Agents
- **Competitive Multi-Agent Systems**
- Simulation tools
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Competitive Multi-Agent Systems

The goal of each agent is to maximize their profit while trying to reach an agreement with the rest. They try to achieve highest or lowest possible price point for their own benefit Without taking into consideration the whole community.

So these agents work for their own profit and do not try to achieve work for a harmonious community.

Competitive Multi-Agent Systems

There are some issues:

- Global utility.
- Fairness.
- Stability.
- Cheating and lying.

Competitive Multi-Agent Systems

The strategy is **dominant,** If an agent can always maximize its utility with a particular strategy.

A set of agent strategies is in **Nash Equilibrium** if each agent's strategy S_i is locally optimal, given the other agents strategies.

Cooperative Multi-Agent Systems

- The **team learning** method involves assigning a single learner to recognize the activities of a group of agents. They're used to traditional machine learning approaches, and as the team grows, scaling issues will arise. Team learning approaches may assign identical actions to numerous team members to make the search space reasonable.

Cooperative Multi-Agent Systems

- **Concurrent learning** is a method of learning that employs numerous processes at the same time. Concurrent learning assigns a learner to each team member in order to divide the common space into N distinct places. With several learners, however, the environment becomes non-stationary. Because there are numerous concurrent learners, the environment is non-stationary, which goes against typical machine learning assumptions. As a result, concurrent learning necessitates the use of machine learning techniques.

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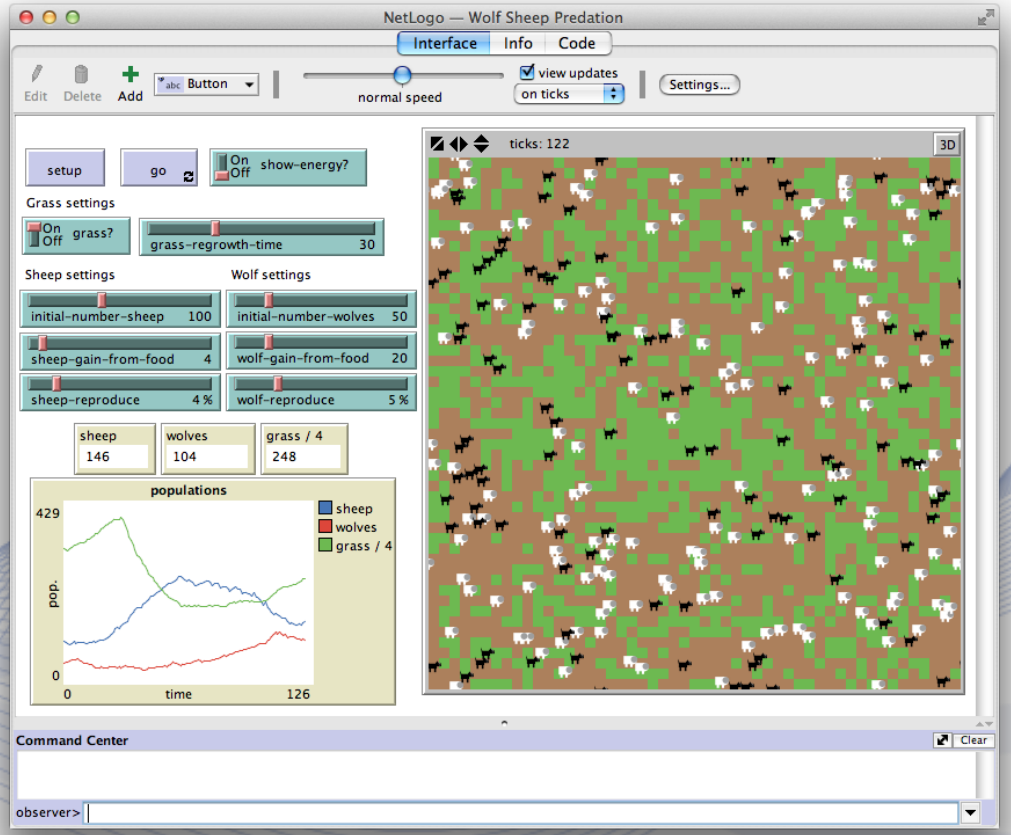
Toolkits and Applications/Simulations

Some of the agent-based modeling toolkits that people may use to create their own agent-based apps.

- NetLogo.
- MASON.
- AnyLogic.
- Altreva Adaptive Modeler.

NetLogo

A Java Virtual Machine is used to execute the NetLogo application. It can, however, operate on major systems such as Windows, Linux, Mac OS X, and Solaris. It uses the Logo programming language rather than Java as its programming language.



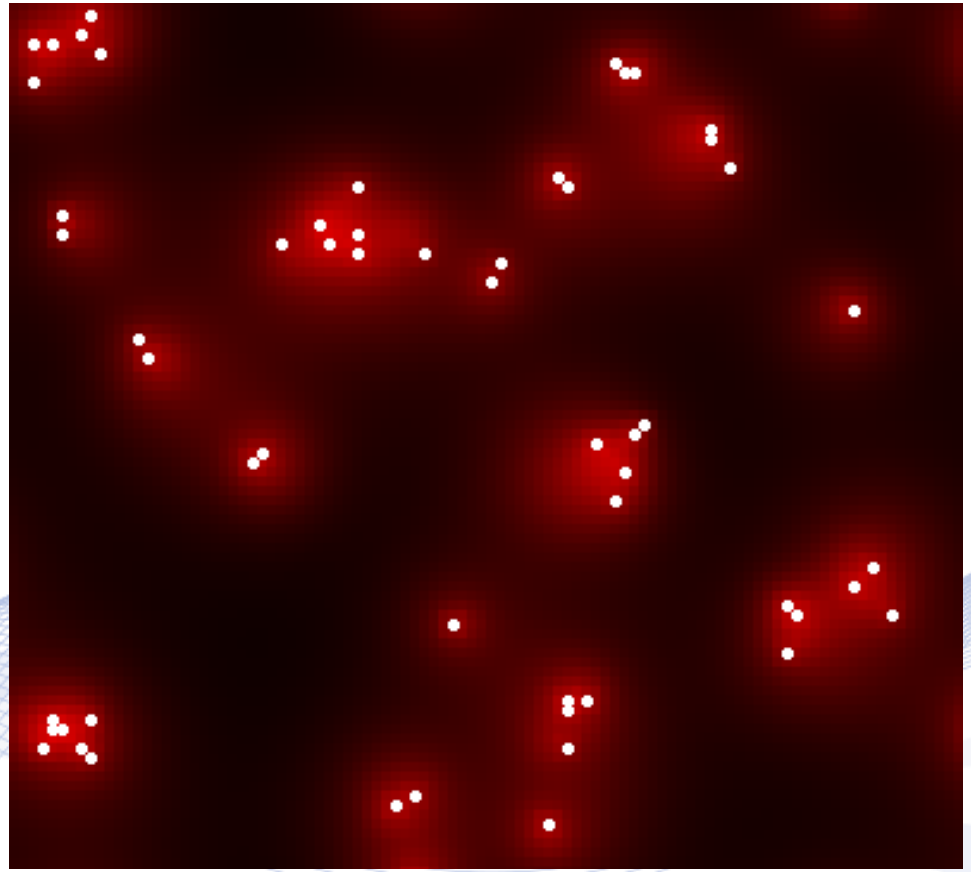
[Wikipedia: https://en.wikipedia.org/wiki/NetLogo]

MASON

MASON was designed by Sean Luke, Keith Sullivan, and Liviu Panait, Gabriel Catalin Balan, with assistance from Sean Paus, Keith Sullivan, Joey Harrison, Claudio Cioffi-Revilla, and Ankur Desai and Daniel Kuebrich of George Mason University's Evolutionary Computation Laboratory and the GMU Center for Social Complexity.

MASON

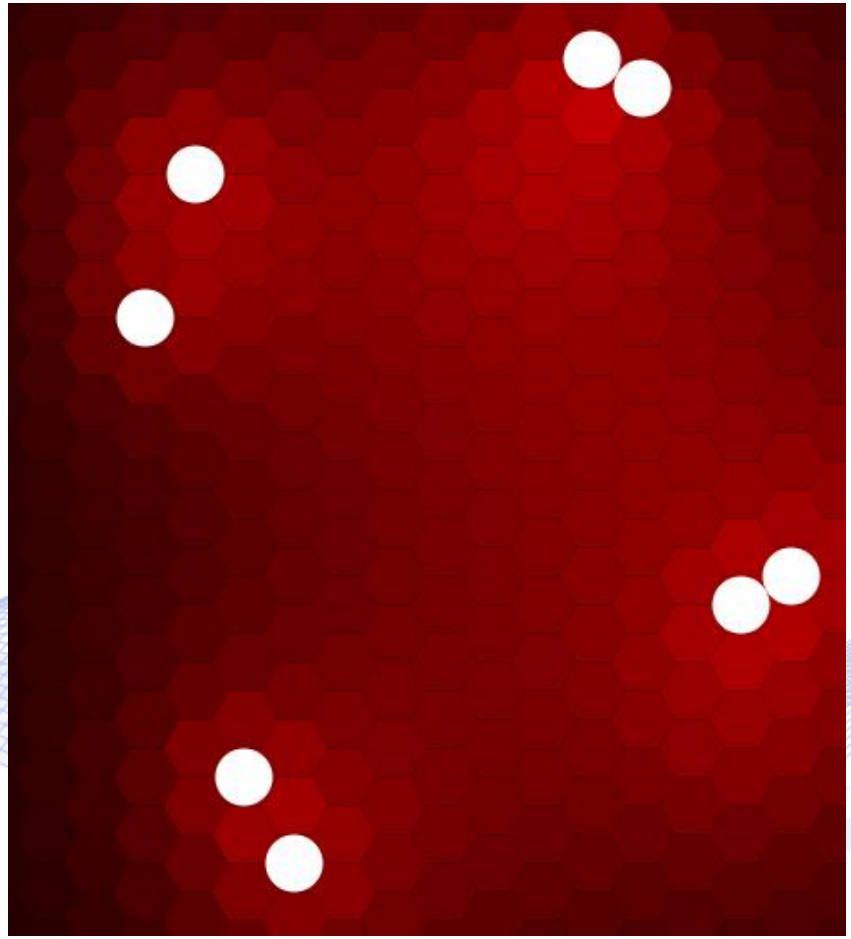
- The Swarm multiagent simulation toolbox popularized the **HeatBugs** multiagent example.



[MASON: https://cs.gmu.edu/~eclab/projects/mason/HeatBugs.png]

MASON

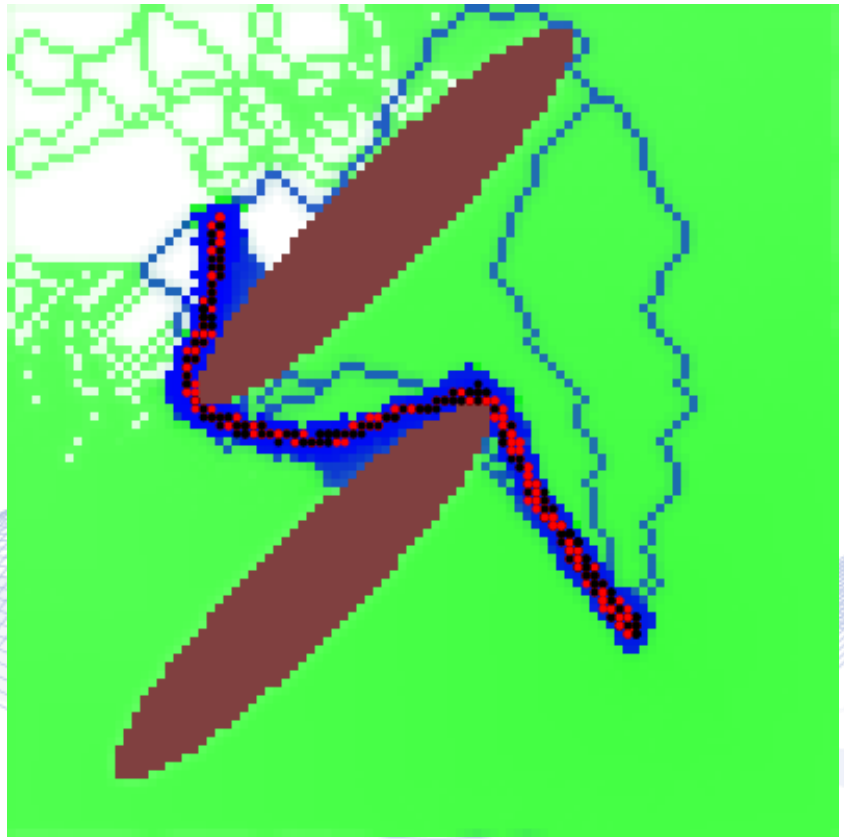
- **HexaBugs** is HeatBugs on a hex grid, inspired by the RePast simulation toolkit.



[MASON : https://cs.gmu.edu/~eclab/projects/mason/HexaBugs.png]

MASON

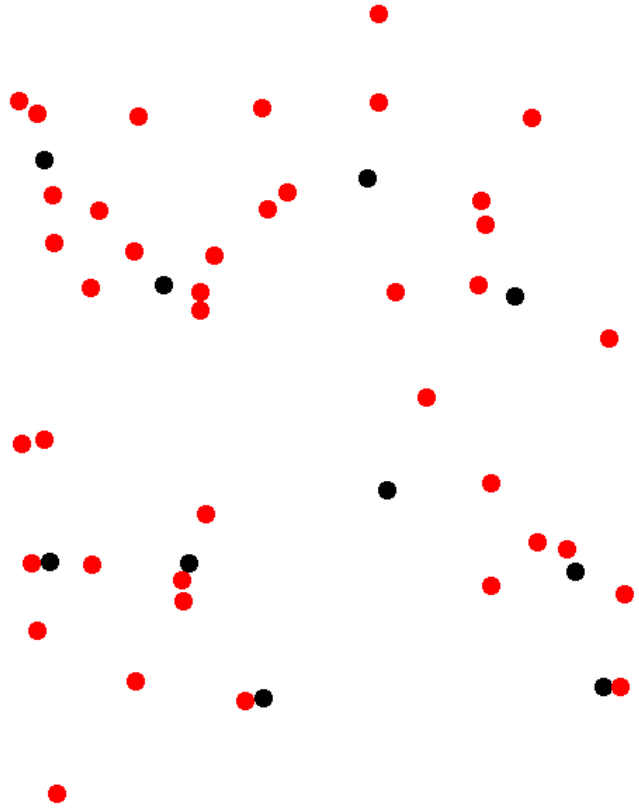
- **Ants** is a pheromone-based ant colony foraging simulation.



[MASON : https://cs.gmu.edu/~eclab/projects/mason/Ants.png]

MASON

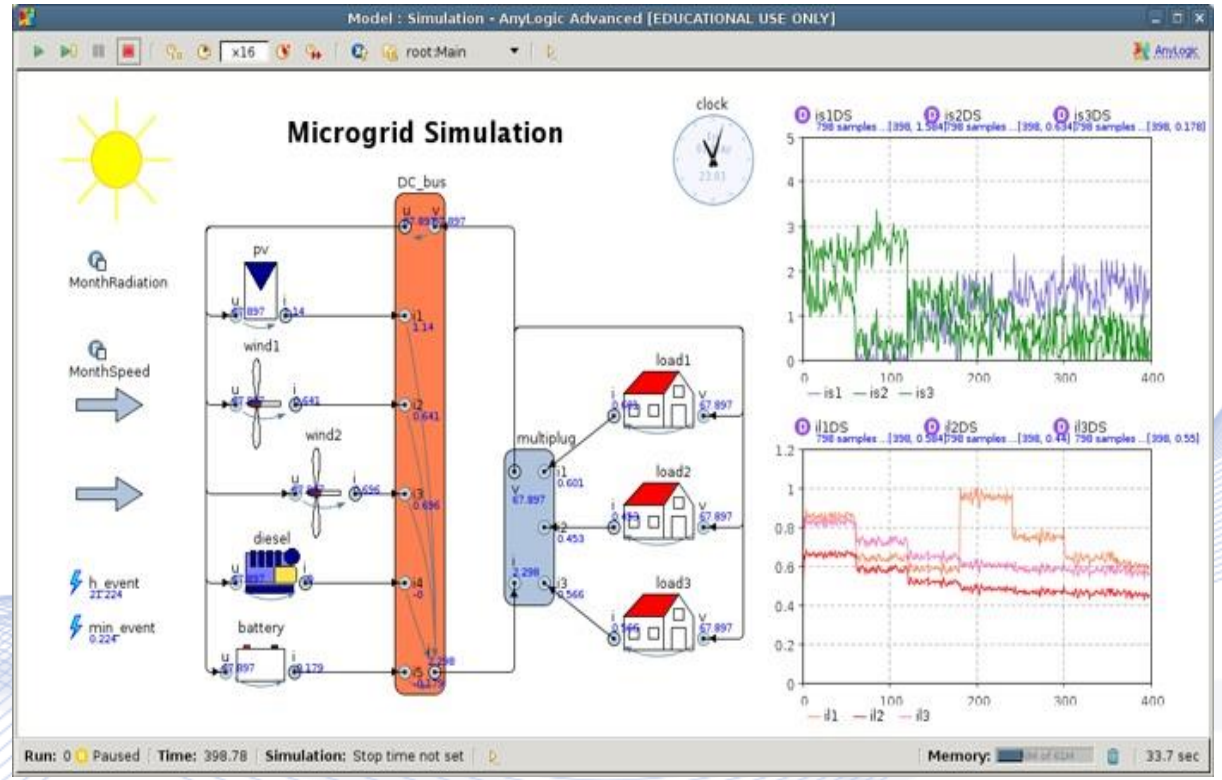
- For cooperative observation of randomly moving objects, **Cooperative Observation** uses a k-means clustering algorithm.



[MASON : https://cs.gmu.edu/~eclab/projects/mason/Observation.png]

AnyLogic

AnyLogic is a multimethod simulation modeling tool built by the AnyLogic Company (former XJ Technologies). Approaches such as agent-based, discrete event, and system dynamics modeling are all supported. AnyLogic is a modeling application for Windows, Mac OS X, and Linux.



[IMG_JMGD,OB,EK,PV: https://www.anylogic.jp/upload/iblock/6f6/6f64a5a91a53cf26048097c5e194c655.pdf]

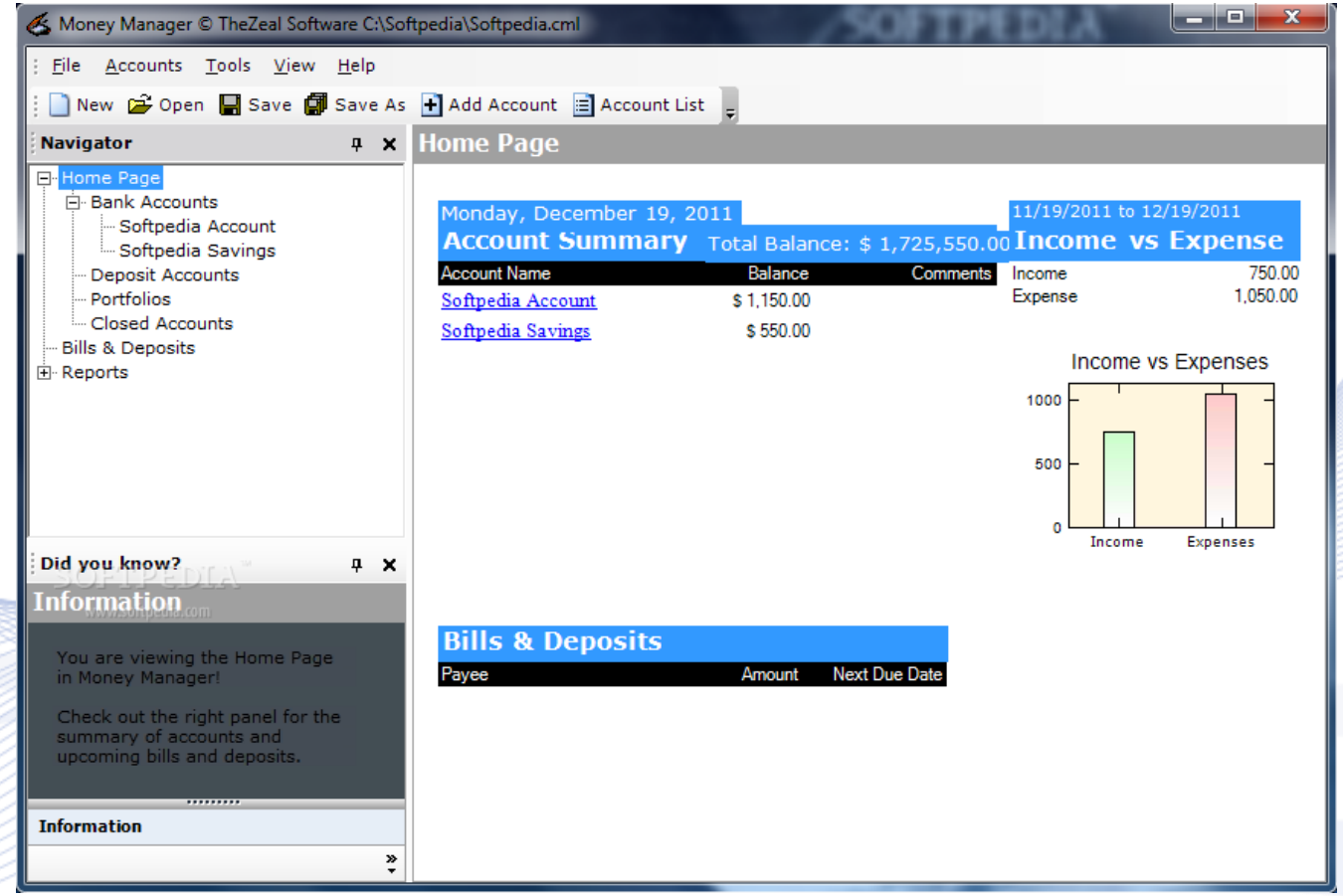
Altreva Adaptive Modeler

Altreva Adaptive Modeler is a piece of software that forecasts stocks, forex currency pairings, Bitcoin and other cryptocurrencies, ETFs, commodities, and other markets. It produces market simulation models based on unique and creative technology in which thousands of virtual traders use their own trading techniques to real-world market data in order to trade, compete, and adapt on a virtual market.

[SOFTPEDIA: https://www.softpedia.com/get/Others/Finances-Business/Adaptive-Modeler.shtml]

Altreva Adaptive Modeler

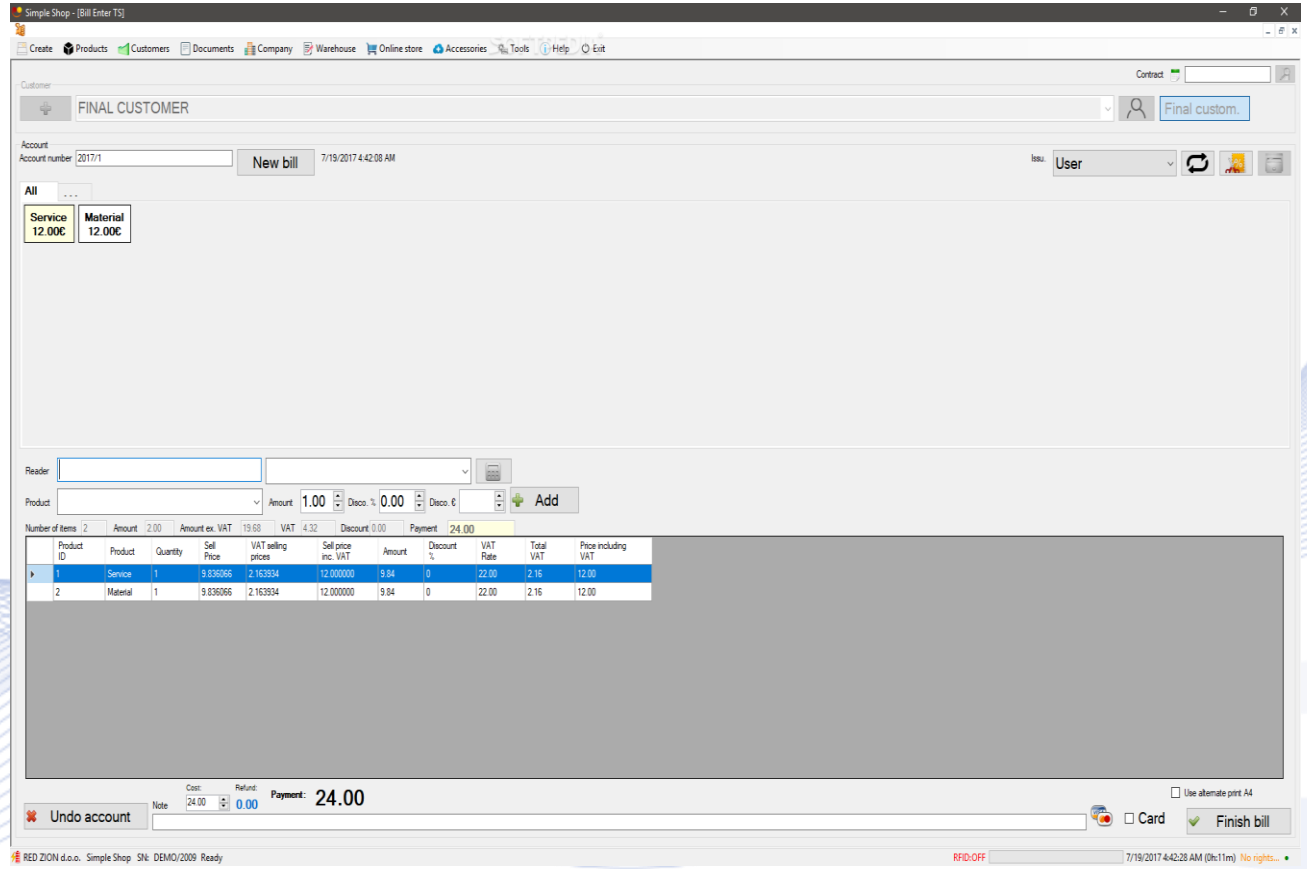
- **Money Manager** is a personal finance software tool that allows you to arrange your funds without having any prior financial experience. When opening new accounts, users must complete out numerous forms, including names, account numbers, current balances, and account currency, which helps the app maintain track of your savings and accounts.



[SOFTPEDIA: https://www.softpedia.com/get/Others/Finances-Business/Money-Manager.shtml]

Altreva Adaptive Modeler

- **Simple Shop** is a sophisticated point-of-sale system that helps you operate your business by creating invoices, managing customer and staff databases, and tracking sales.



[SOFTPEDIA: https://www.softpedia.com/get/Others/Finances-Business/Simple-Shop.shtml]

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Example of Application/Simulation

COM-ELECTRON

It has been implemented in JADE as a simulation. The major goal of the COM-ELECTRON agent-mediated electronic commerce system is to increase profit by increasing the number of transactions and agreements reached after multiple rounds of bilateral negotiations.

Example of Application/Simulation

COM-ELECTRON

The adaptive negotiating paradigm was included into the SmartAgent's design. The pricing negotiating environment is depicted in Figure 6.

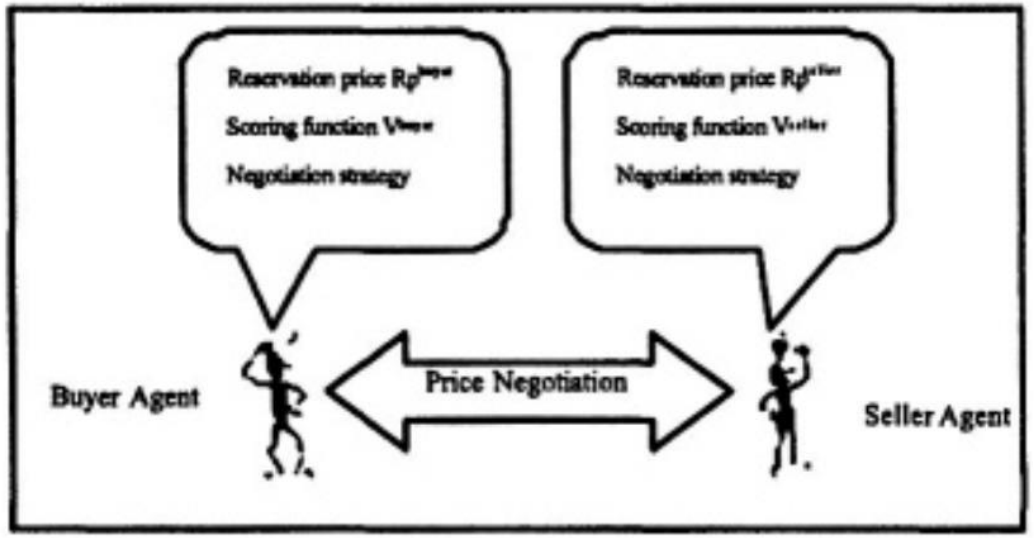

Figure 6. The price negotiation context.

[IMG_MO : https://link.springer.com/content/pdf/10.1007/1-4020-8159-6_9.pdf]

Q & A

Thank you very much for your attention!

More material in
http://icarus.csd.auth.gr/cvml-web-lecture-series/

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