

An Evolutionary Approach for Studying Heterogeneous Strategies in Electronic Markets

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Overview

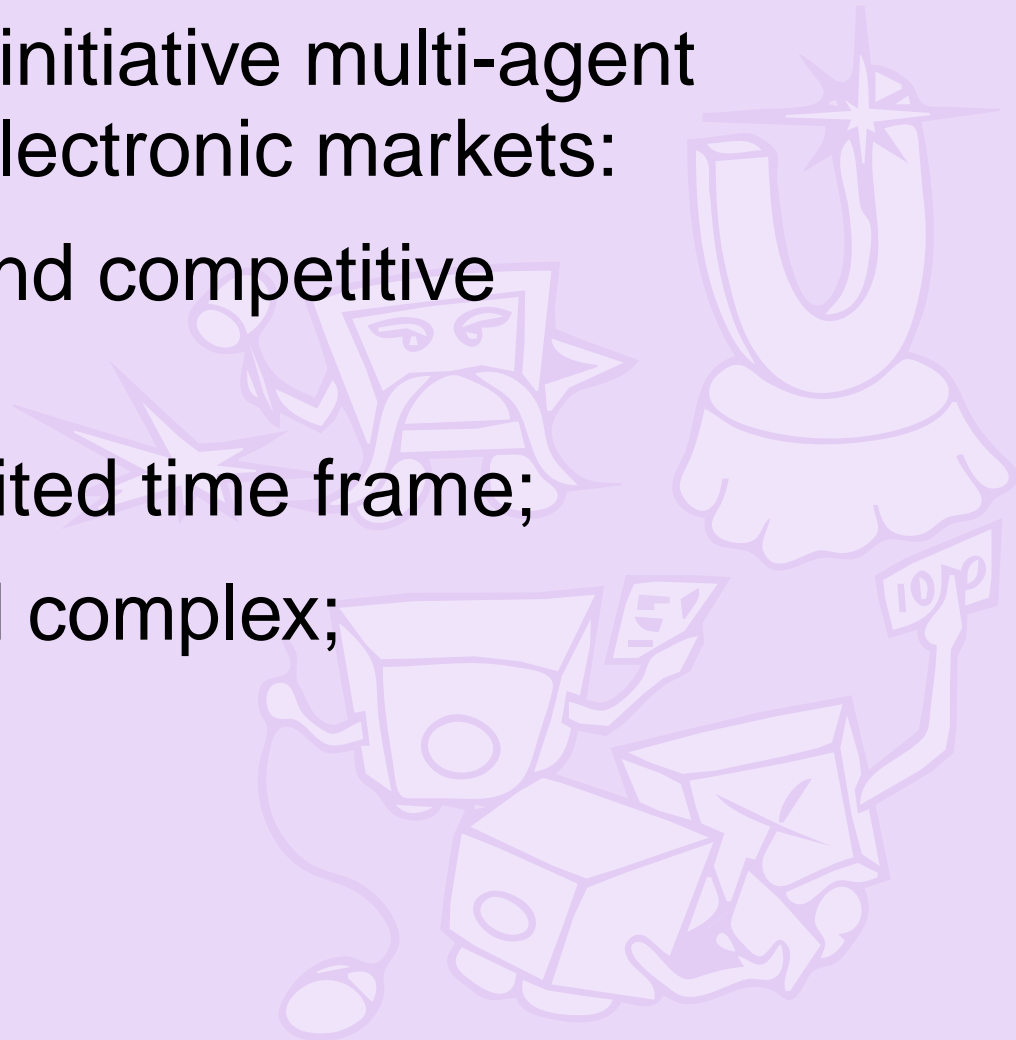
- The problem
- Suggested approach
- Example model and results
- Conclusion



Problem Domain

Automated and mixed-initiative multi-agent systems in emerging electronic markets:

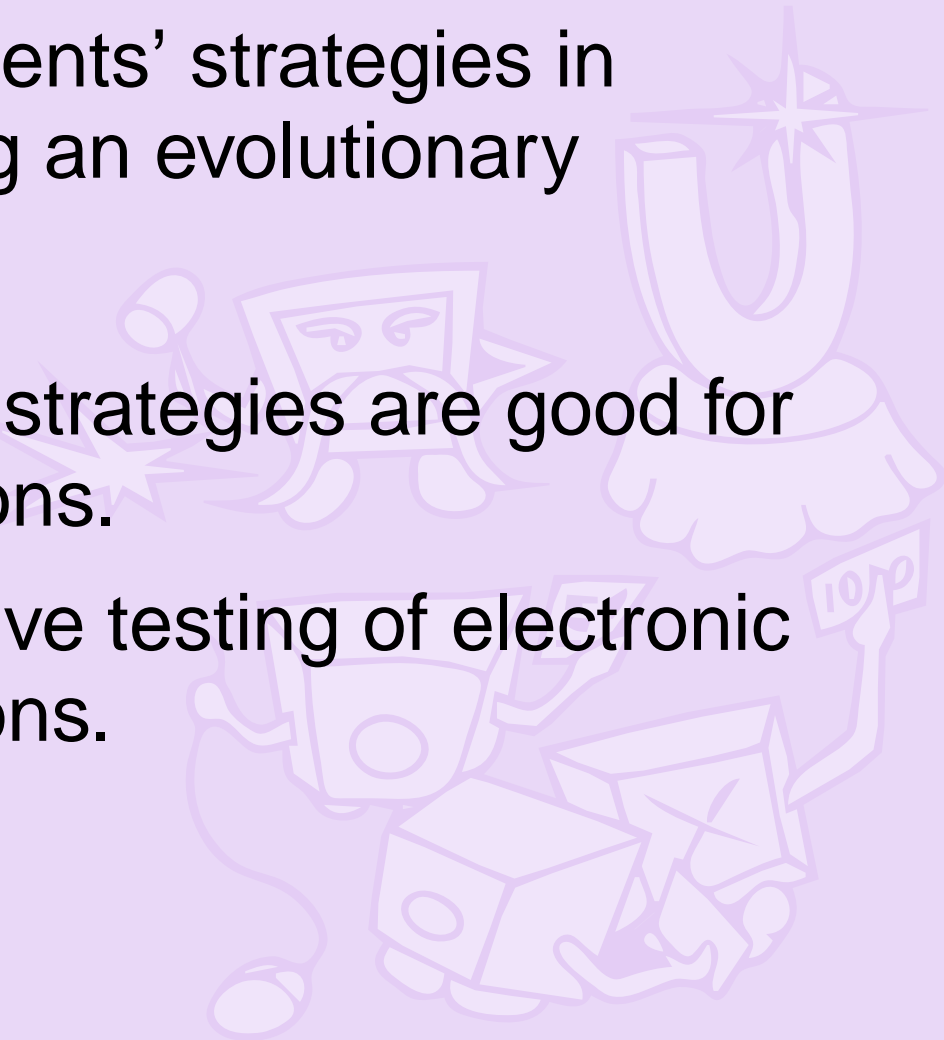
- limited resources and competitive environment;
- dynamic with unlimited time frame;
- heterogeneous and complex;
- open environment.



Objective

Study performance of agents' strategies in multiagent systems using an evolutionary framework.

- Find out which agent strategies are good for which market conditions.
- Perform comprehensive testing of electronic market implementations.



Why an Evolutionary Framework?

- Evolutionary methods are used for studying complex societies, where the structure of a society changes during the simulation, and separate entities change as well in an effort to adapt to the changing environment.
- Evolutionary frameworks allow for rigorous studies through controlled experimentation.

The Citysim Model:

- Simulation of a society of suppliers of a service and their customers.
- The agents live and interact in a circular city.
- The simulation is based on a simple supply and demand model, where multiple service providers compete for customers, and where profitability is the criterion to stay in business.

Customer Agent:

- Anonymous customers come to the market with a fixed frequency, for a single transaction.
- Density of customers is inversely proportional to the distance from the city center.
- A customer minimizes its net cost:

$$\text{netcost} = \text{price} + \text{distance} \times c^{\text{mile}} + \text{delay} \times c^{\text{hour}}$$

- Customers do not change their properties during the simulation.

Supplier Agent:

- Suppliers are characterized by their pricing strategy, and the number of customers they can serve concurrently (size).
- Each supplier is audited at regular time periods and removed from the market if its profit becomes negative.
- The society of suppliers evolves to meet the demands of the customers.

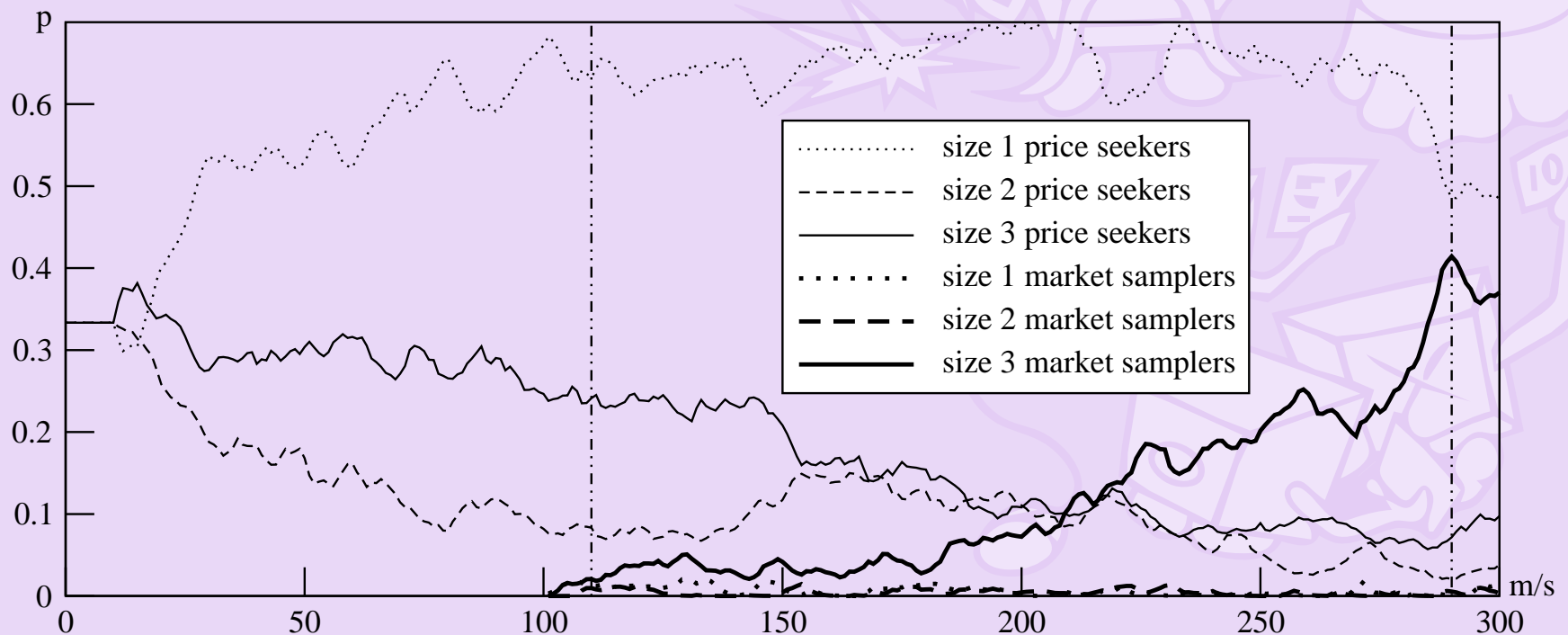
Sample Simulation with Two Different Strategies:

Market Sampler samples the city in several locations to maximize a potential revenue flow given the state of the market. The price and the number of samples it takes are assumed to be distributed normally.

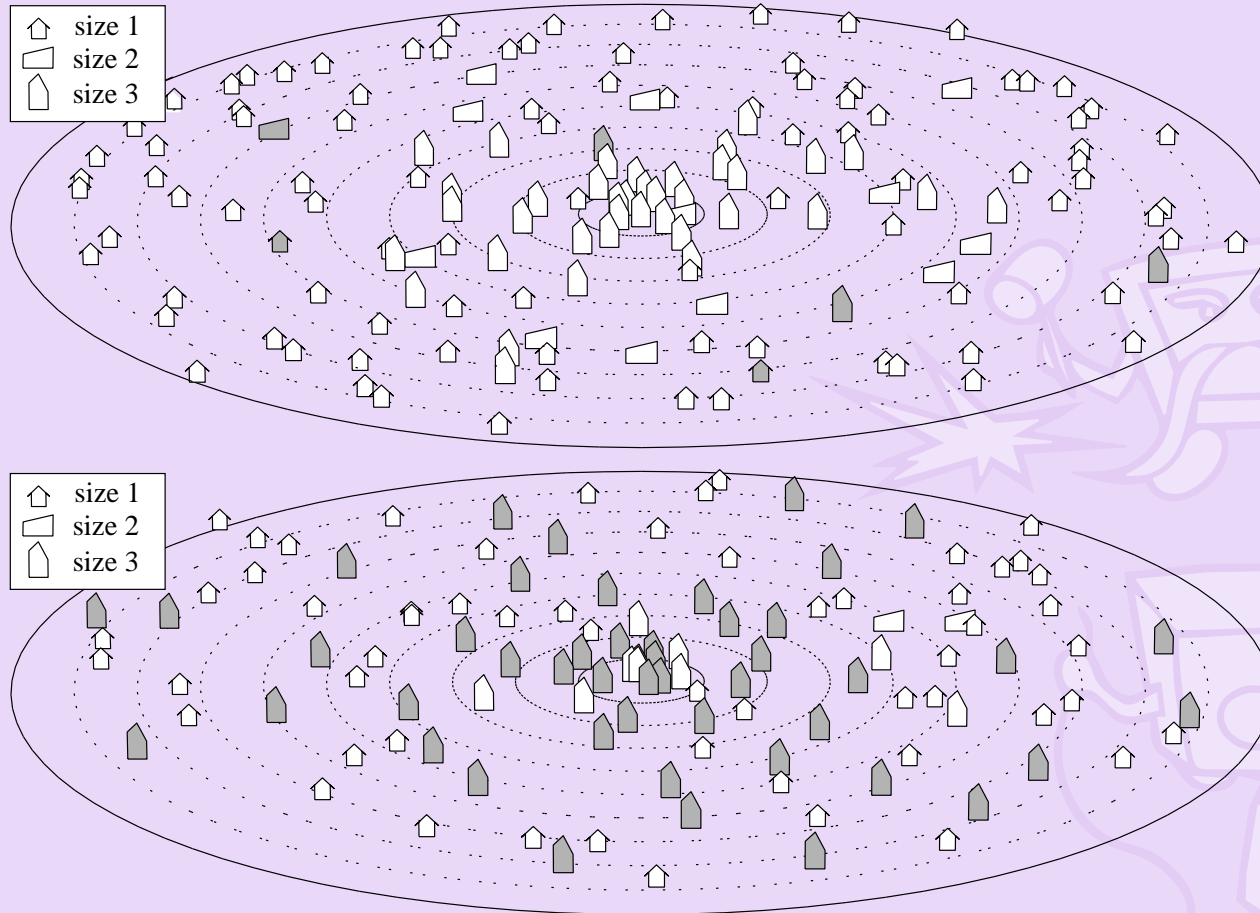
Price Seeker assumes that the “right” price and density of the suppliers depend solely on the distance from the center of a city.

Simulation Time-Line:

Probabilities of a new supplier entry for different supplier types as a function of milestone numbers. Market sampler suppliers are introduced at milestone 100.



Results: Structure of the City

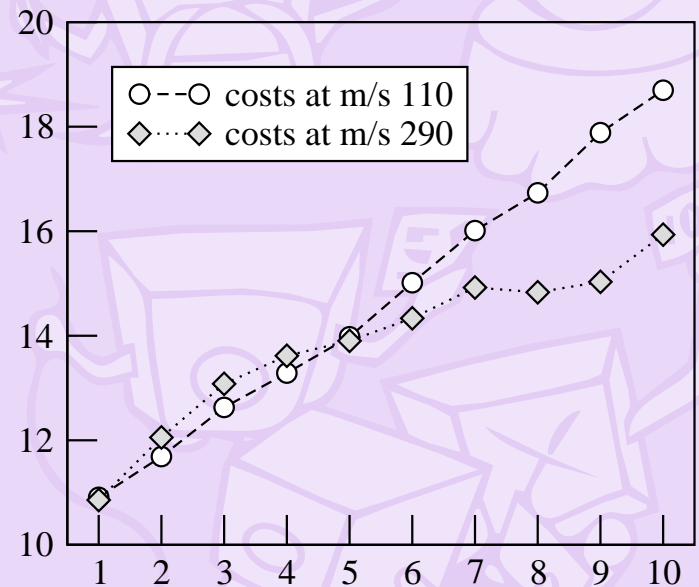
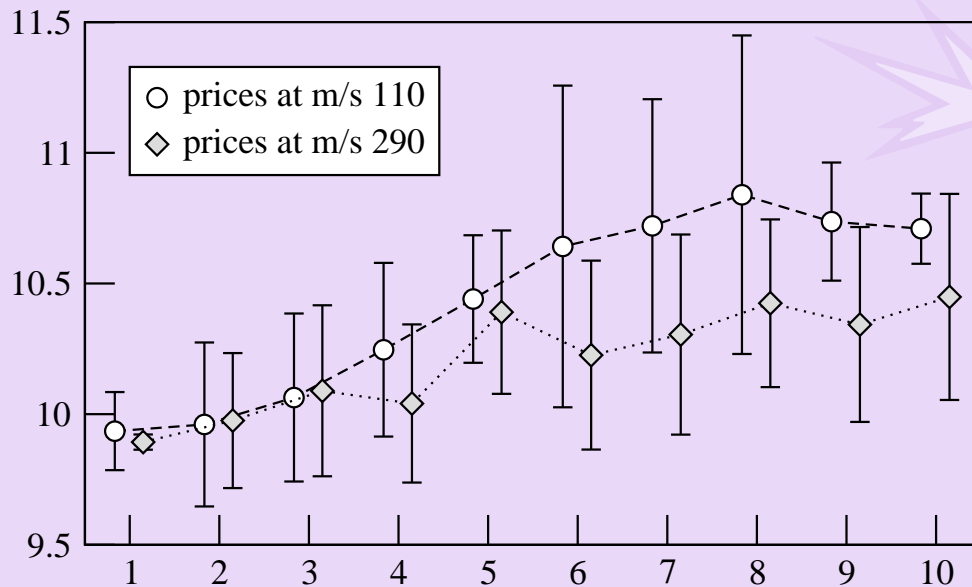


City at milestone 110 (top) and 290 (bottom).

Price seeker suppliers are denoted by white houses, market samplers are gray.

Price Distribution:

Average supplier prices with standard deviations (left) and 25 hour half-life decaying averages of customer costs (right) for 10 concentric city zones at milestones 110 and 290.

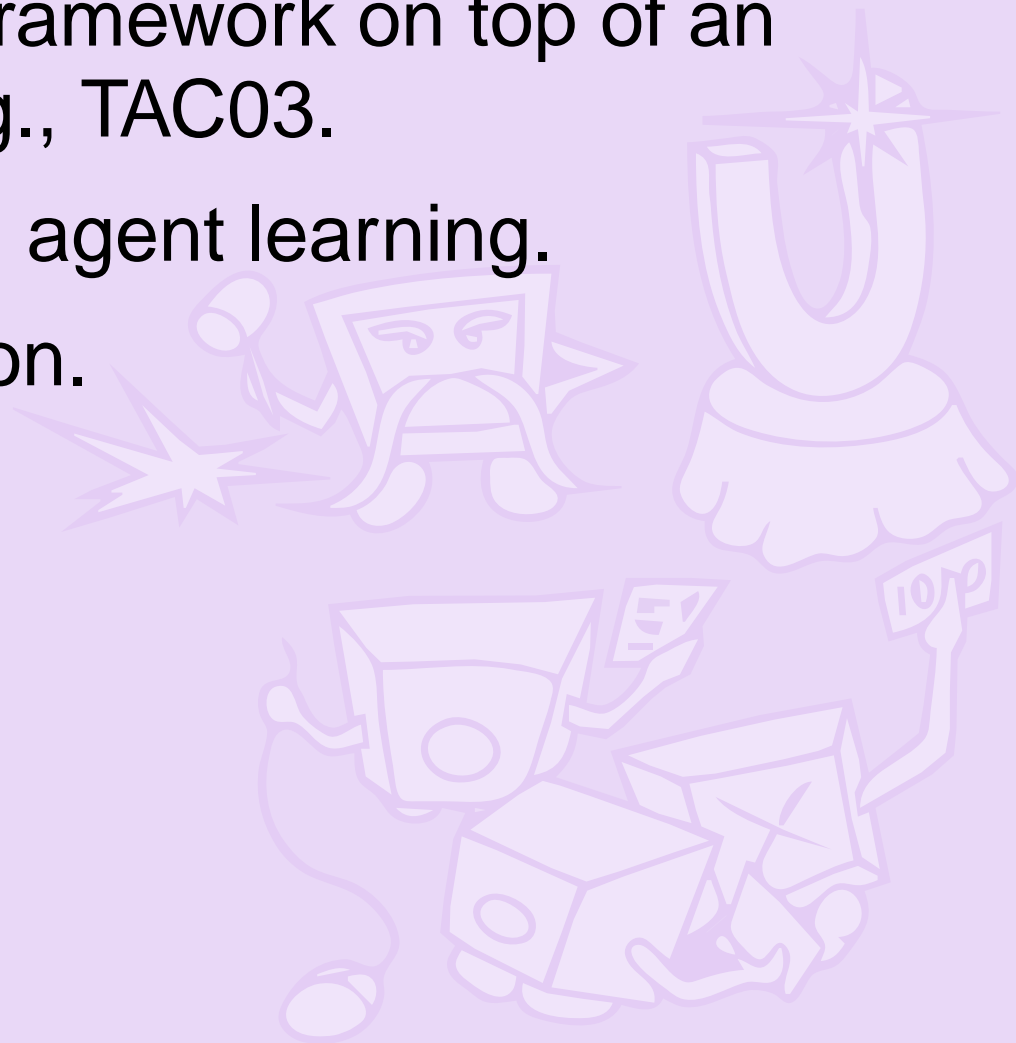


Why another Evolutionary Framework?

- Heterogeneous strategies can co-exist and evolve. New agents are created by choosing the type of the new agents and general initial parameters using statistical information on the number of existing agents of the same type.
- Agents with different strategies can enter the market at any time.
- Strategies never disappear. Even when no agents using a specific strategy are left in the market, the probability of creating new agents using that strategy never becomes zero.

Future Work:

- Build evolutionary framework on top of an existing system, e.g., TAC03.
- Introduce individual agent learning.
- Theoretical Extention.



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