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Automated Trading Simulation

Detail of Topic

More and more today, computers have become tools to financial brokers and analysts when trading stocks and commodities. The financial giants have spent millions of dollars in researching algorithms to properly simulate and hopefully predict the ever shifting motions of the markets. Computers have also expanded globalization to the point that a broker in the United States can trade in markets around the world, 24 hours a day. The effects of these digital markets are still not completely known. Some see benefits in essentially having a global market while other point out potential risks with allowing computer systems to be so closely integrated in financial markets. With all this in mind, we hope to build a dynamic system of individual traders in a variety of market types. Each trader will act independently of the others, but like in the real life stock market, the decisions and goals of each trader will be effected by the actions of other traders and the effects such actions have on the market as a whole. Our system will be able to take in data relating to various market positions and will run simulations where all traders make their actions. The system will also be able to handle different conditions such as international traders and traders with differing goals. We will then be able to analyze the results and see how different combinations of traders affect the market in different ways. Hopefully, we will be able to use our system to replicate the motions in the markets based on historical inputs.

Algorithms Considered and Implementation

There are a number of different strategies used by investors in today's markets. The most general categories are fundamental analysis and technical analysis. Fundamental analysis deals

with the intrinsic value of a financial instrument and whether the investor thinks the instrument is overvalued or undervalued. Technical analysis depends on the market surrounding the instrument. The data used in technical analysis is the price and volume. The value of an instrument in this case is determined by supply and demand and not by the assessment of the value of the underlying asset. In this project, we will be focusing primarily on the agents using market data such as opening and closing prices and the intraday highs and lows to make investment decisions and to react to the decisions of the other agents, thus using technical analysis.

While the instruments will be technically analyzed based on price and volume, game theory will be used by the agents in order to make decisions on how to react to the trades of the other agents. This theory is used in multi-agent systems in order to implement strategic and cooperative interaction between agents. By understanding the motives of other agents, i.e. sell when prices are high, the agent should be able to predict the next actions of the other agents, thus determining their own action. Each agent will mathematically capture the behaviors of the other agents and then make a decision based upon that data.

For this project, we will not be building the multi-agent system from scratch. At this point, we plan to use a multi-agent simulation library core in Java called MASON. The library provides model and visualization tools, but they are loosely coupled, allowing the user to implement visual effects as needed. It is able to serve a wide variety of multi-agent projects including robots, machine learning, and social complexity, which is why we think it would be suitable for our automated trading simulation project.

System Evaluation and Measurement of Results

Since our goal is to simulate the behaviors of real investors, our evaluation will be based

on how close to actual human behavior we can get. It is hard to quantify such a comparison since our goal is to get close to a reality and not to say, win a game or some other easy to gauge condition. Therefore, we will have to find a scenario where general investor reaction is recorded, some historical event in the markets for example. We can then run our simulation on historical data relating to the event, like conditions just before the event. Since we know what actually happened, we cans see if our system "predicted" the actions of the human investors during the actual event. How far or close we are to how humans behaved in the same circumstances will tell us how good our system is at simulating the markets and how useful it will be as a predictor of market motions.

Submission as Conference Paper

We hope that our project will result in a conference paper submission, but we need to discuss this possibility further with Dr. Adams.

Project Schedule

1/28 - Meeting with Tom Ho to discuss market simulation algorithms.
1/31-2/4 - Research other algorithms and tools to help in development.
2/7 - 2/10 - Work on a more detailed design document, keeping in mind the tools and algorithms researched.
2/10 - Hand in more detailed design.
2/11 - 2/18 - Begin getting familiar with the algorithms and tools to be used. Start writing early code.
2/18 - 2/28 - Start serious coding based on our designs.
3/1 - Hand in code so far.
3/2 - 3/22 - Code the system, including the types of traders and the simulated markets they will be working in.
3/22 - Hand in a (hopefully) mostly working system.
3/23 - 4/7 - Debug the system and clean up any remaining issues.
4/7 - Hand in a debugged system as well has some testing results.
4/8 - 4/14 - Run additional tests to see how well the system works. Continue working towards a presentation ready project. Prepare the presentation for the class.
4/14 - 4/26 - Give presentation.

Website
TBD