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Thinkfinity Cornerstone 3: Interdisciplinary Informatics - Grant Application (4nd Round)

Final Project Report

A Web Application for Financial Trading Simulation

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Project Goals

A) Please outline your original goals.

This project has three objectives. First, we will develop Web Application for Financial Trading Simulation (WAFTS) for trading simulation exercises. Second, we will train students in computer security classes to secure a web based financial application and WAFTS will serve as a platform for computer security testing exercises. Third, we will use WAFTS in financial trading classes. We will investigate how students behave during the financial trading simulation exercises in the events when computer security risk occurs.

Progress

B) What progress have you made towards your original goals on your project to date?

We have completed a prototype of WAFTS. At this stage, we are conducting the final testing of this simulation application. The trading simulation application will provide a web user interface for students to connect to a web service where the server manipulates trading transactions. The application will also provide a user interface for the instructor to determine simulation parameters. Below is a description of the design of WAFTS.

Trading Simulation Web Application - System Analysis and Design

Scenario

All traders will be given a certain amount of money, i.g. $100,000 (called “endowment”), at the beginning of the simulation. The instructor will announce the trading target, which is to maximize the return on this initial endowment. Traders place orders (either buy or sell) throughout the simulation in order to earn profit from the trading. The system will zero out all

traders' position at the end of the simulation to calculate the profit or loss of each trader. The instructor needs to develop a simulation scenario by presetting the simulation parameters, such as simulation starting time or length, before a simulation starts.

Order Type

A trader is allowed to place either a limit order or a market order, as explained below:

- **Limit order**: if a trader places a limit order, the order will contain price, buy or sell decision and volume. A **buy** order will be put on the **bid** list waiting for execution and a **sell** order will be put on the **ask** list waiting for execution.
- **Market order**: if a trader places a market order, the order will contain buy or sell decision and volume, but not the price. A **buy** order will be executed against the lowest price on the ask list on the market at the moment. A **sell** order will be executed at the highest price on the bid list on the market at the moment.
- A trader is allowed to short sell. In this case, the trader needs to buy back the volume at a later time or at the end of the simulation.

Order Execution

- A market order will be executed immediately by looking at the ask list or the bid list at the time the order is placed.
- A limit order will only be executed when matched with a market order or another limit order.
- When executing an order, the priority rules of the National Market System (NMS) will apply. If the volume of the two matched orders differs, the one with the smaller volume will be executed completely and the one with the larger volume will be executed partially by subtracting the volume from the smaller order.

Computer Generated Orders

- The system also plays the role of a computer simulated trader. The system will keep track of three price values: the average sell price on the market, the average price expected (reset parameter), and the variance of expected price (preset parameter).
- The system will generate a limit order under two circumstances: 1) when the average sell price on the market is higher than the highest price change allowed and 2) when the average sell price on the market is lower than the lowest price change allowed.
- The price of computer generated limit orders is based on a lognormal distribution with a pre-determined variance, and the average expected return.

End of Simulation

- All orders that still remain get cancelled.
- Each trader gets zeroed out at the best bid and ask price, whichever applies. If the trader owns negative volume, the system will automatically buy enough volume to zero it out at the lowest price on the current ask list. If the trader still owns securities, the system will automatically sell it all at the highest price on the current bid list.
- The system will calculate each trader's profit or loss based on each trader's trading history during the simulation.

Impacts

C) What activities have been completed to contribute to meeting/progressing toward these goals?

We will conduct trading simulations in financial trading classes in Lubin after the final testing of WAFTS is done. Below is a description of various functionalities that can be accomplished by WAFTS. To participate in the trading simulation, students have to connect to a trading server using a web browser. By entering a specific URL, the student can connect to the trading simulation web server.

WAFTS provides students with a list of stocks for trading. As in Figure 1, a trading transaction page provides the following features:

- A log that records all the transactions from all the users throughout the duration of the simulation.
- A toolbar that allows the user to sort the transaction log by criteria (time, transaction, user, quantity, stock, price) by clicking on the respective parameter.
- A dropdown option to filter the transaction log by criteria(All, Traded, Active, and Inactive)
- A stock table that shows all the available stocks with their respective bid and ask price, shares available, and which trader owns the ticket.
- Notification(red, green) when a stock price goes up or down
- Notification(red/green arrow) when quantity goes up or down
- Spinning effect/notification when there is a change in stock price
- Pop-out stock tickers for user-friendly visual effects.

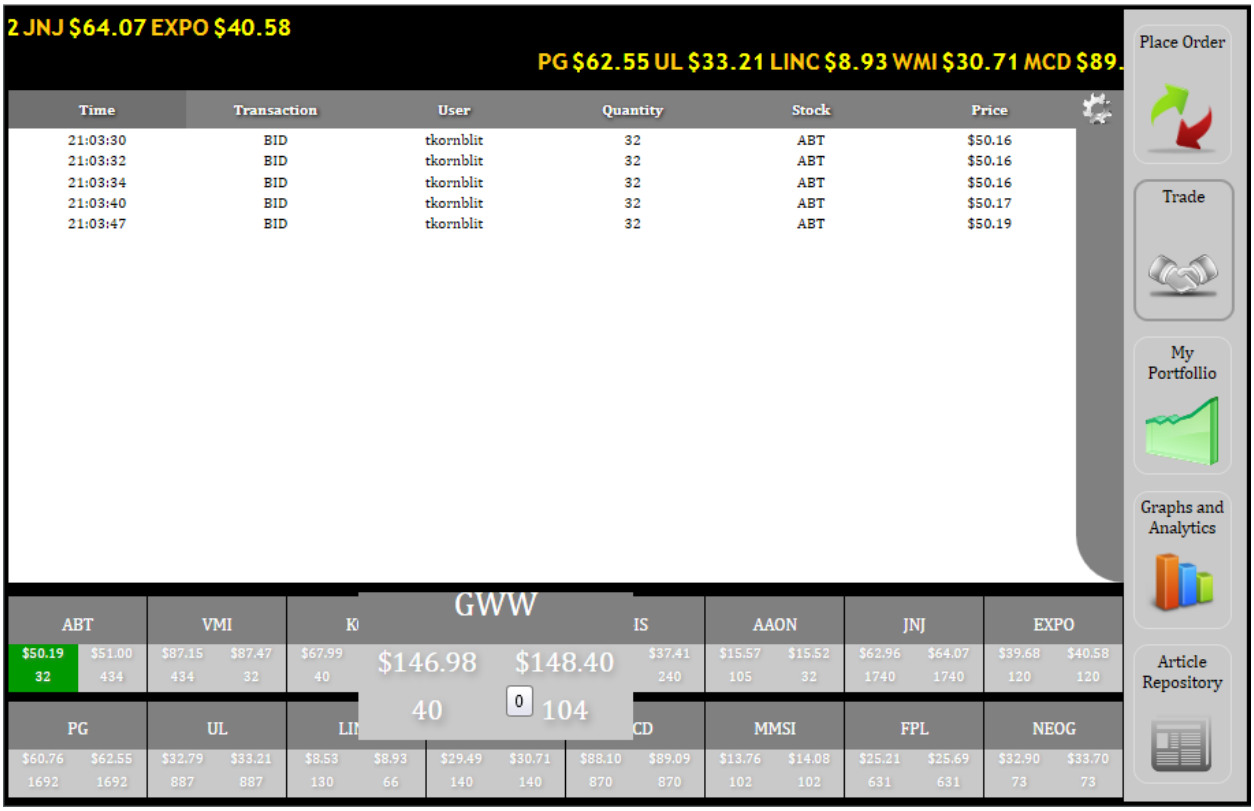

Figure 1. Demonstration of Trading Transactions from WAFTS Interface

Students can place orders by using the order page. As in Figure 2, this page provides the following features:

- Limit order – includes stock, appropriate action, price, and quantity. This type of order will post the bid/ask on the stock board (trading table) or if there is a more attractive offer it will be put on the waiting list.
- Market order- includes stock, action, and quantity. This type of order will take the lowest available ask, or highest available bid at any given time and execute the trade.
- Automatically populates fields when you click on a bid/ask box in the stock table.
- Confirmation message once you have filled out the buy/sell/ask/bid form appropriately
- Error checking to make sure you have posted appropriate information in the form
- Autocomplete in the stock form field to assist the user in choosing the correct stock.

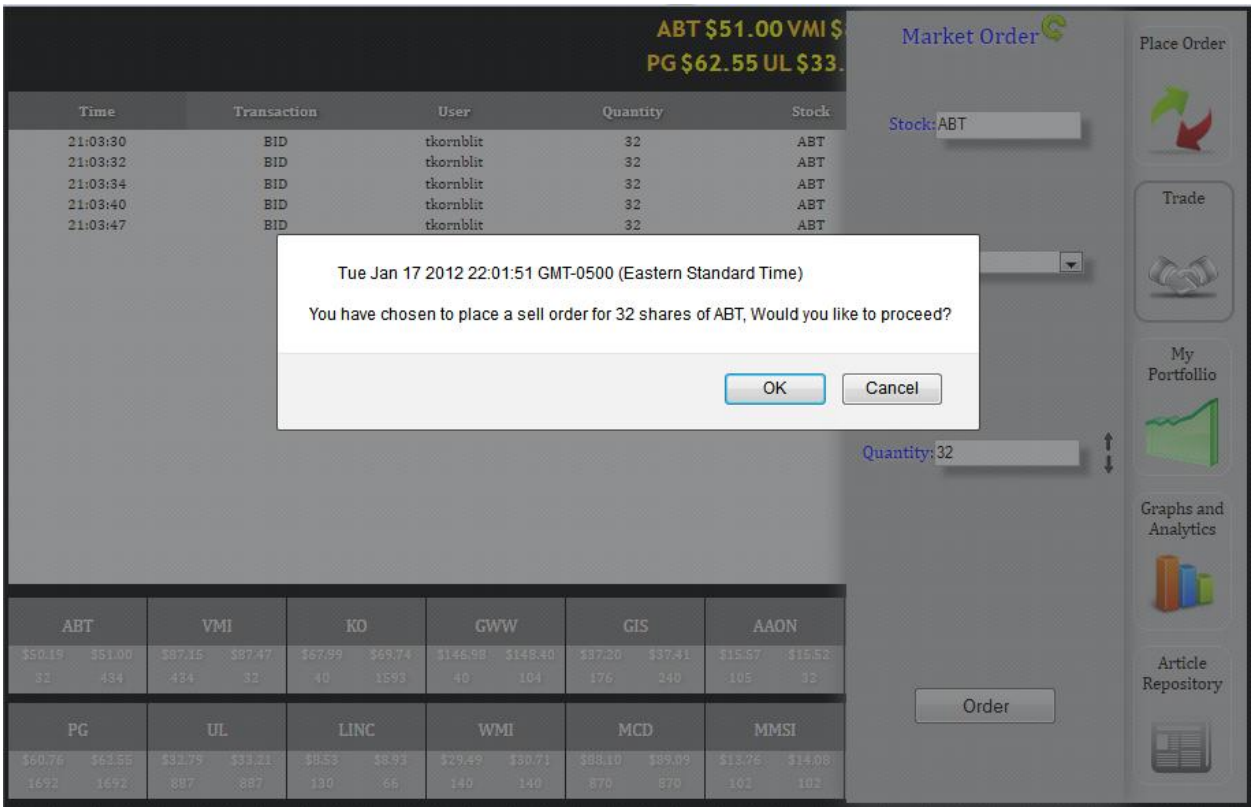

Figure 2. Placing an order

A student can also view his/her portfolio. Figure 3 shows the portfolio page that provides the following functionalities:

- Table that presents all the users current stock holdings, as well as all relevant attributes associated with each respective stock.
- A graphical representation of the table using a pie chart
- Keep track of total portfolio worth from the beginning of the simulation to the end
- Profit/Loss Graph that's calculated by FIFO methodologies.
- Export profit analysis graph feature to hand in to instructor.

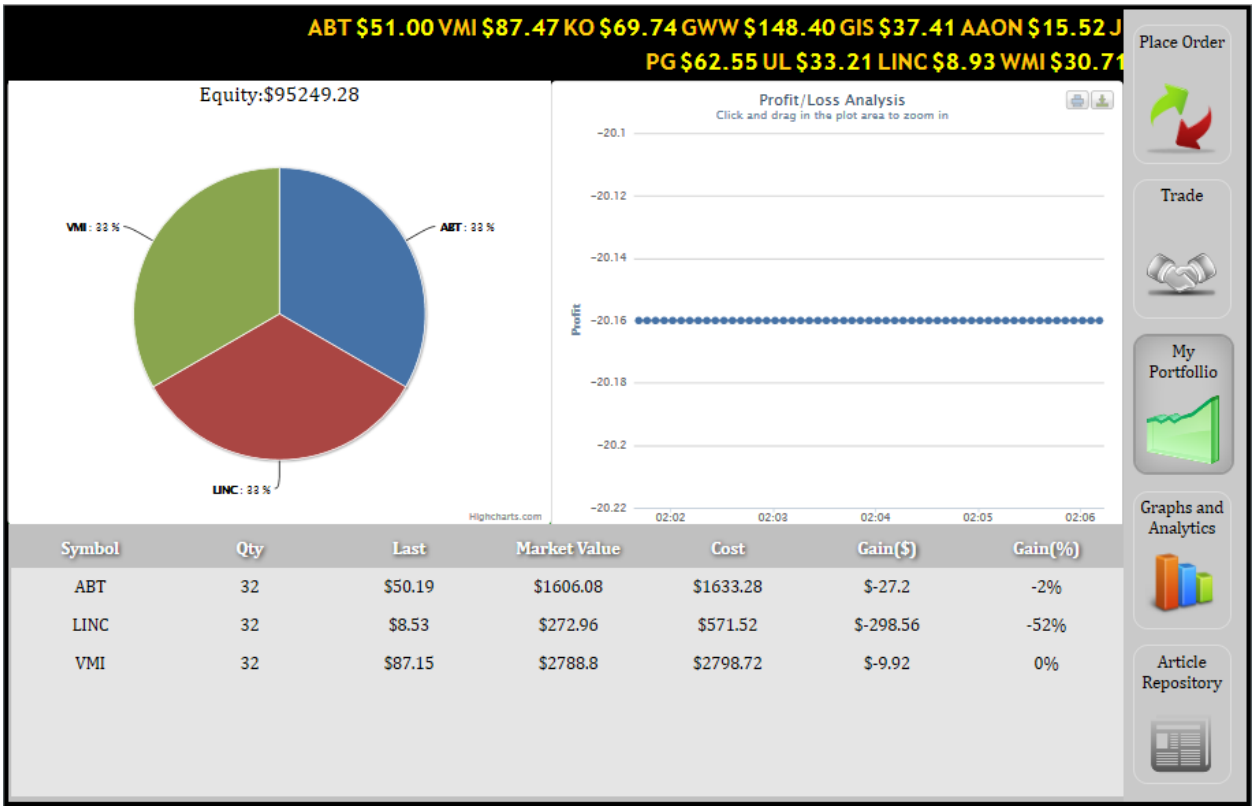

Figure 3. Portfolio

WAFTS also provides several graphical features to analyze stock prices, as shown in Figure 4.

- A graphical representation of the stocks life at price changes it undergoes.
- Different views for different time periods.
- A table that represents relevant stock information

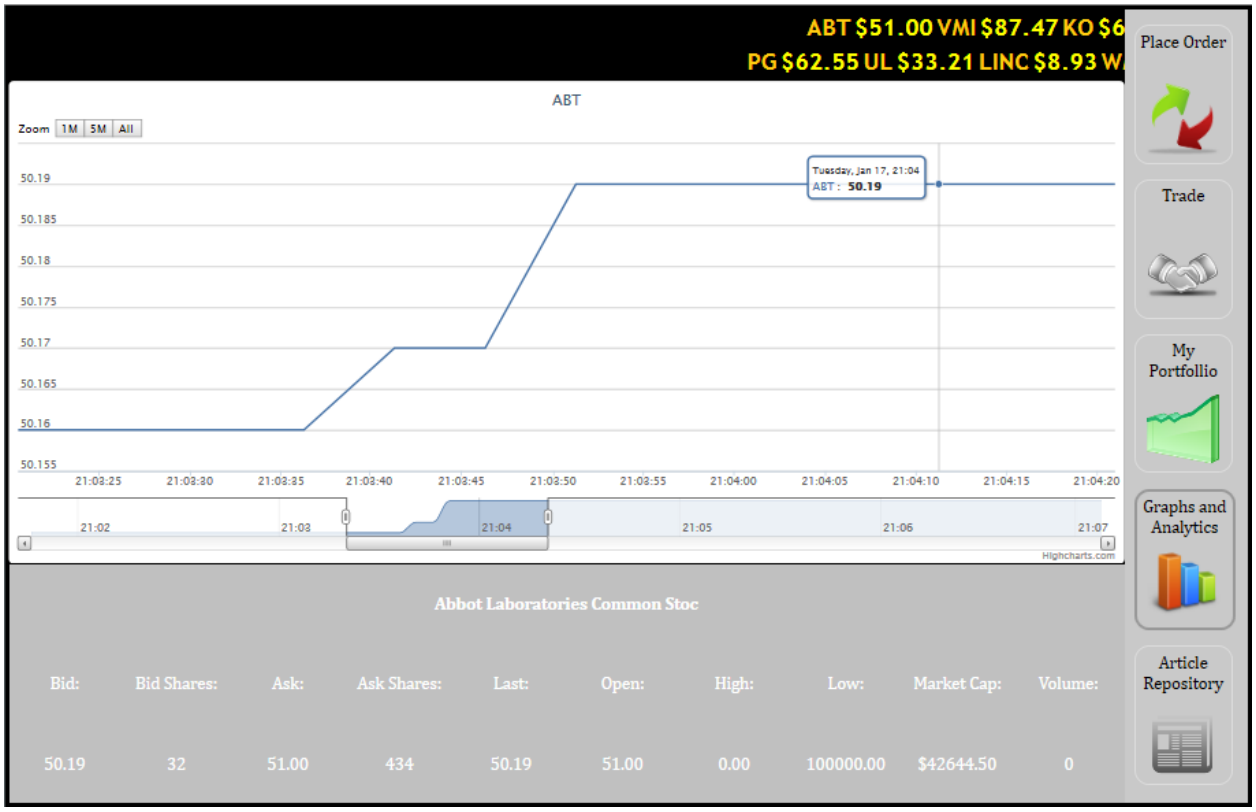

Figure 4. Stock price analysis

D) What activities have not been completed? Please indicate why they have not been completed.

Software development of WAFTS took more time than we previously estimated. We have to delay the trading simulations in financial trading classes since we are still in the final testing stage of the software. We plan to conduct the trading simulation during Spring 2012 with no increase in the cost of completing this project.

E) Please outline the outcomes you have received as a result.

Two project outcomes have been completed at this stage, which include a publication and a web application for financial trading.

Publications

- Lixin Tao and Li-Chiou Chen. "Effective Web and Java Security Education with the SWEET Course Modules/Resources", *SSITE International Conference on Computers and Advanced Technology in Education*, November 3-4, 2011, Beijing, China

Web application

The financial trading application is currently configured and will be accessible through http://community.seidenberg.pace.edu/trader/. The login credential for testing this application is test for login and test for password.

F) Has your project impacted students? If so, how many?

When the simulation application is fully tested, it will be implemented in both Seidenberg and finance investment classes at both the graduate and undergraduate levels. There will be at least 30 students impacted during the first trial. Once the trial is successful, we can utilize this application repeatedly in later trading simulation classes, which will be around 10-20 students per year.

In addition, we provided an opportunity for one undergraduate student to work as a research assistant in this project. The student, Tom Kornblit, has learned a great deal in designing and programming the web-based trading simulation application.

G) Has your project impacted other faculty members? If so, how many?

Our project has impacted the three faculty participants of this project. The three faculty in this project has learned to work together and contributed to interdisciplinary knowledge in both financial trading and web application development.

In the future, the trading simulation application that we plan to develop can be used for professors in both Pace and other schools to conduct trading simulations.

Next Steps

H) Were there any unintended outcomes achieved?

None.

I) Do your outcomes reflect the change or benefit you were hoping to receive?

We currently have fulfilled our first objective of developing a trading simulation web application, which had solved the software problem for the Lubin School in running trading simulations.

J) How has your project furthered the Thinkfinity Cornerstone you selected?

Yes. Our project did further the interdisciplinary informatics cornerstone that we selected. We learned that the key to accomplish this project required a great deal of understanding into a field that is beyond one's own academic domain. Dr. Kadiyala from the Lubin School needed to communicate her expertise in financial trading so that Dr. Tao, Dr. Chen and the student assistant from Seidenberg School can translate the knowledge into the design and implementation of the web application. These communications required various meetings and discussions to understand each other's domain expertise. At the end, the Seidenberg faculty had learned about the process of financial trading and the Lubin faculty had learned about the process of developing web applications.

K) Describe your future plans for sustaining the program or project.

During Spring 2012, we will conduct the financial trading simulation exercises in FIN351 Principles of Investments offered by Lubin. The course is taught by various instructors. We will also conduct security testing exercises for the trading application in CIT 352 Internet and Network Security offered by Seidenberg. This course will be taught by Dr. Li-Chiou Chen and is also offered in the Spring semester. We will then collect trading simulation data and student survey responses. All data collected will be anonymous. We will analyze these data using statistical software, such as SPSS, to infer students' risk perception in various trading scenarios and the effectiveness of the simulation software in learning.

Once the first testing is successful, the application will be used for later trading simulations needed in financial classes. Both the Seidenberg School and the Lubin School are discussing a long term plan to put the web application on a permanent server so that the application will be easily accessible to students.