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6-1-2011

A Web Application for Financial Trading Simulation

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Recommended Citation
Chen, Li-Chiou; Tao, Lixin; and Kadiyala, Padma, "A Web Application for Financial Trading Simulation" (2011). *Cornerstone 3 Reports : Interdisciplinary Informatics.* Paper 52.
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June 1st , 2011

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

Interim 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 utilize Web Application for Financial Trading Simulation (WAFTS) in financial trading classes 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 investigate how students behave in 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 the system analysis and design of the online trading system. At this stage, we are developing a prototype of this system. The design includes an analysis of the financial trading process, the computer simulation processes, the user interface and the database design to store the transactions. 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 an user interface for the instructor to determine simulation parameters.

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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 could be stock or bond, and the simulation scenario, i.g. each volume of the bond will worth $1,000 (called "par value") in one year. 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 sell before the trader can buy. In this case, the trader needs to buy back the volume at a later time or at the end of the simulation as the latest.

Order Execution

- A market order will be executed immediately by looking at the ask list or the bid list at the moment.
- A limit order will only be executed when matched with a market order or another limit order.
- When executing an order, order price determines if the two orders can be matched. 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 (initialized to zero), 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 average price allowed and 2) when the average sell price on the market is lower than the lowest average price allowed.
- The price of computer generated limit orders is based on a lognormal distribution with a range between the lowest average price allowed, the highest average price allowed, and the average price expected.

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End of Simulation

- All orders that still remain get cancelled.
- Each trader's 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 the bond, 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.

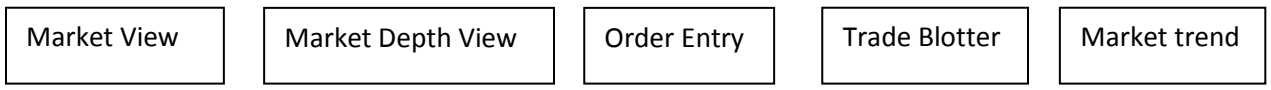
User Interface

For instructors,

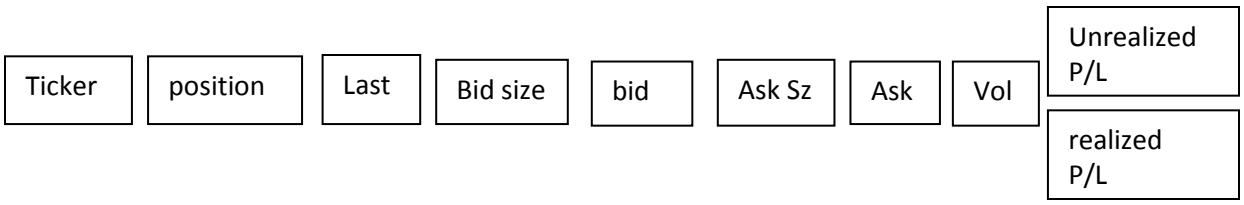
For instructor, there will be a screen for setting simulation parameters including starting time, simulation length, par value, endowment, interest rate, average price expected, variance of price expected)

For students,

Navigation Menu has 4 modules that appear on the top of the screen for all participants



The Market View Module



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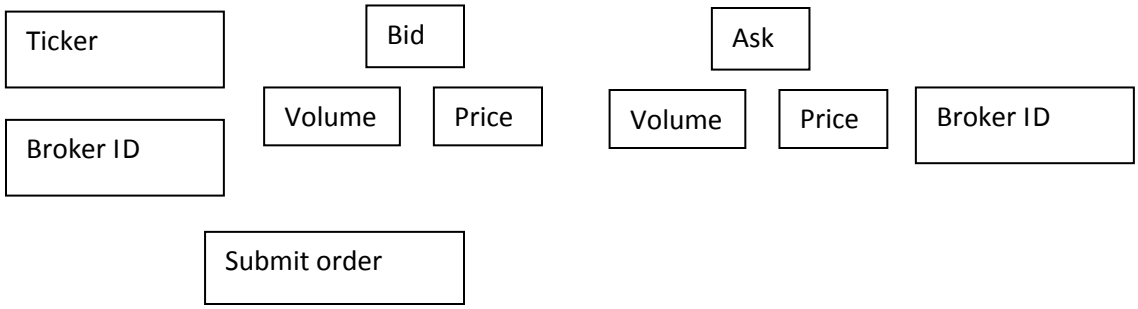
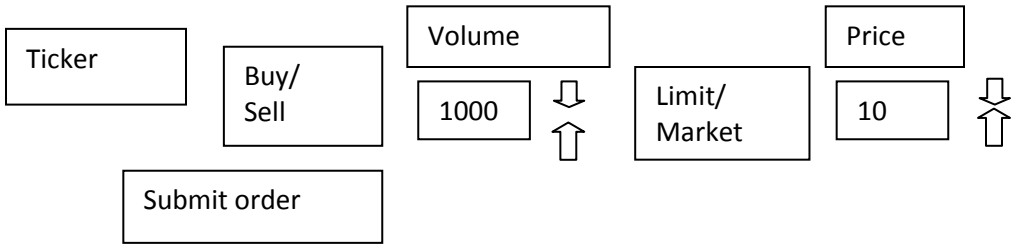
The Market Depth View

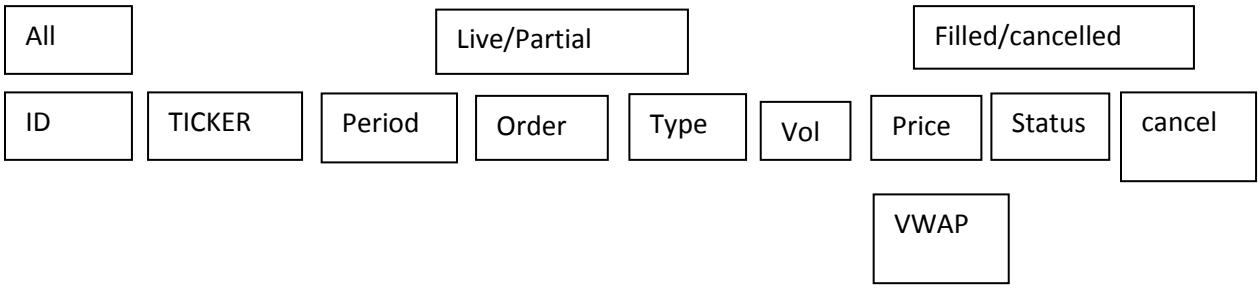


Module

The Order Entry Module



Trade Blotter Module



Database Design

The database will have the following tables:

- Order (simulation id, order id, trader id, order type (market/limit), buy/sell, price, volume, execution complete, time placed)
- Trader (simulation id, trader id, cash owned, volume owned)
- Execute (simulation id, execute id, time executed, sell order id, buy order id, volume, price)

- Simulation (simulation id, starting time, simulation length, par value, endownment, interest rate, average price expected, variance of price expected)

Impacts

C) Has your project impacted students? If so, how many?
We are in the development phase of the system. When the simulation application is fully developed, it will be implemented in both Seidenberg and finance investment classes at both the graduate and undergraduate levels.

D) Has your project impacted other faculty members? If so, how many?
At this stage, the impact of our project is only limited to the faculty participants of this project. The Seidenberg faculty has learned about the process of financial trading and the Lubin faculty has learned about the process of developing web applications. 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

E) What are your next steps?

During Summer 2011, the trading web application will be implemented by Dr. Tao, Dr. Chen and a student assistant from Seidenberg based upon the system analysis and design described above. Dr. Kadiyala will assist in the software testing.

During Fall 2011, we will conduct the financial trading simulation exercises in FIN351 Principles of Investments offered by Lubin. The course will be taught by Dr. Padma Kadiyala and is usually run in the Fall semester. We will also conduct security testing exercises for the trading application in CIT 251 Overview of Computer Security offered by Seidenberg. This course will be taught by Dr. Li-Chiou Chen and is also offered in the Fall 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.