**Virtual Exchange**

Requirements

**1. Introduction and Context**

Stock exchanges allow ownership of companies to be transferred through the sale of shares in these companies. These exchanges must provide the resources necessary for this exchange of ownership. The goal of this project is to build a virtual stock exchange (and facilitating components) that allows players to participate in this exchange of ownership of companies. This virtual exchange will attempt to simulate an actual trading environment and allow participants to practice making markets by submitting buy-sell orders based on the actions of other participants.

This project meets the project-selection criteria by the following:

* **Must involve at least three distinctly different kinds of shared resources:**
  + **Order Book** - A component of each matching engine which contains a list of buy and sell orders at given price levels
  + **Matching Engine Registry** - Maintains a list of available matching engine IP addresses for each symbol (a company’s identifier)
  + **Player Details** - Maintains a list of how much cash and stock a player holds as well as their last known IP address
* **Must have at least three different kinds of processes for which you must implement programs:**
  + **Players** - Each player will be its own process. Players submit buy and sell orders to the exchange gateway.
  + **Exchange Gateway** - A process which maintains a list of available matching engines and player holdings
  + **Matching Engines** - A process which matches buyers and sellers for a given symbol by maintaining an order book of resting orders.
* **Must allow multiple process to be instantiated of at least one of the programs:**
  + **Players** - There can be an unlimited number of players

**2. Actors and their Goals**

* **Players:** Start with some initial sum of money. Buys and sells stocks from other players with the goal of turning a profit. Buying and selling takes place by submitting orders on the stock exchange via the exchange gateway.
* **Exchange Gateway:** All players much register via the exchange gateway. This gateway is responsible for maintaining a list of available matching engines and routing orders to the appropriate matching engine. The gateway also maintains a list of registered players and their holdings (cash and stock). The gateway broadcasts executed trades and order book information to connected players.
* **Matching Engines:** Maintains an order book (list of buy and sell orders) for that specific engine’s symbol. This order book is a list of all outstanding trades which have not yet been executed (these are known as resting orders). Sends executed trade messages to the exchange gateway.

**3. Functional Requirements**

* A player must be able to register with the gateway
* A matching engine must be able to register with the gateway
* A player must be able to initiate a buy/sell order for a given number of shares in a company
* A player must have enough cash to buy the desired number of shares
* A player must be able to cancel a quote
* A matching engine must exist for each company
* A matching engine must maintain an orderbook to keep track of all available bids and asks for each company
* When a match occurs, a matching engine must execute the trade and send confirmation of that trade to both parties
* A player must receive confirmation of an executed trade
* The exchange gateway must be able to broadcast the top of book prices for each symbol to all registered players
* A player must be able to receive top of book information (the current buy and sell price of a stock)
* <Need to add error conditions>

**4. Non-functional Requirements**

* Developed in Java/JavaFX
* Use UDP as transport-layer protocol (i.e., datagram sockets) for Top of Book Notifications
* Use TCP as transport-layer protocol for trade confirmations
* Test critical methods in processes using automated (executable) test cases
* Run final version of program on AWS EC2 instances

**5. Future Features**

* Score board of players’ cash and stock holdings
* Allow players to chat via chat rooms
* Maintain a history of trades executed (on a per symbol and per player basis)
* Allow players to share their trade history with other players

**6. Glossary**

* **Bid:** Represents a player’s desire to purchase a share or shares of a company. A bid has two components - an asking price and a quantity. For example, a player may place a bid expressing their desire to purchase 5 shares of Google at $500 a share. Bids are one of two components of an Order Book
* **Offer:** Represents a player’s desire to sell a share or shares of a company. An offer has two components - an offered price and a quantity. For example, a player may put out an offer to sell 3 shares of Microsoft at $450 a share. Offers are one of two components of an Order Book. An offer is synonymous to an Ask.
* **Order Book:** An order book consists of bids and offers prioritized by price.
* **Matching Engine:** The matching engine maintains an order book and is responsible for matching offers with bids and vice-versa. Registers with a gateway.
* **Player:** Represents a market participant. Registers with a gateway.
* **Gateway:** Facilitates communication between matching engines and players.