

Birla Institute of Technology & Science, Pilani
Work Integrated Learning Programmes Division
First Semester 2022-2023

Assignment II

Course No. : DSECL ZC556
Course Title : Stream Processing and Analytics
Nature of Exam : Take Home
Weightage : 15%
Duration : 30 days

No. of Pages	= 4
No. of Questions	= 5

Design and Development of Electronic Stock Exchange

Stock trading broadly refers to any buying and selling of stock, but is colloquially used to refer to more short-term investments made by very active investors. Most stocks are traded on physical or virtual exchanges. The New York Stock Exchange (NYSE), for example, is a physical exchange where some trades are placed manually on a trading floor—yet, other trading activity is conducted electronically. NASDAQ, on the other hand, is a fully electronic exchange where all trading activity occurs over an extensive computer network, matching investors from around the world with each other in the blink of an eye. Investors and traders submit orders to buy and sell shares, either through a broker or by using an online platform such as an E*Trade.

A buyer bids to purchase shares at a specified price (or at the best available price) and a seller asks to sell the stock at a specified price (or at the best available price). When a bid and an ask match, a transaction occurs and both orders will be filled. In a very liquid market, the orders will be filled almost instantaneously. In a thinly traded market, however, the order may not be filled quickly or at all. On an electronic exchange, such as NASDAQ, buyers and sellers are matched electronically. Market makers (similar in function to the specialists at the physical exchanges) provide bid and ask prices, facilitate trading in certain security, match buy and sell orders, and use their own inventory of shares, if necessary.

Active trading is when an investor who places 10 or more trades per month. They often use strategies that rely heavily on timing the market. They try to take advantage of short-term events (at the company or in the market) to turn a short-term profit. Day trading means playing hot potato with stocks — buying and selling the same stock in a single trading day. Day traders care little about the inner workings of the businesses. They try to make a few bucks in the next few minutes, hours or days based on daily price swings.



You have to design and implement an electronic exchange where day trading is facilitated. Make necessary assumptions while designing and implementing such a system and ensure that you have carefully drafted out the critical design decisions.

Exercise 1: Architecture [3 marks]

Provide a suitable architecture diagram with appropriate description matching the system specification described in the following exercises.

Exercise 2: Order Producer [3 marks]

Write a Python program that enables the traders to place various types of orders on the variety of instruments traded on the electronic exchange.

- Program should first read the list of instruments (with relevant details) available on the exchange.
- Based on the received data from the exchange, trader should be able to place an order which is valid for certain time only.
- You have to write your own code for order placement.
- Add comments at appropriate place so that it's easy to understand your thought process.
- The program should clearly output the order details on the console.

Exercise 3: Exchange – Match Maker [5 marks]

As an outcome of Exercise 2, your system will receive the orders placed by various traders for different instruments.

- Apply a match making algorithm so that the trades are completed for the instruments.

- Explain your logic behind match making algorithm.
- Program should output both the orders resulted into a trade

Stock data analysis is used by investors and traders to make critical decisions related to the stocks. Investors and traders study and evaluate past and current stock data and attempt to gain an edge in the market by making decisions based on the insights obtained through the analyses.

Exercise 4: Exchange – Simple Moving Average Calculator [2 marks]

As an outcome of Exercise 3, your system has generated the trades for the various instruments. The simple moving average can be used to identify buying and selling opportunities. Moving averages are one of the core indicators in technical analysis, and there are a variety of different versions. SMA is the easiest moving average to construct. It is simply the average price over the specified period. The average is called "moving" because it is plotted on the chart bar by bar, forming a line that moves along the chart as the average value changes.

- Closing prices are used mostly by the traders and investors as it reflects the price at which the market finally settles down. The SMA (Simple Moving Average) is a parameter used to find the average stock price over a certain period based on a set of parameters
- The simple moving average is calculated by adding a stock's prices over a certain period and dividing the sum by the total number of periods.
- Calculate the simple moving average closing price of the four instruments in a 5-minute sliding window for the last 10 minutes.

Exercise 5: Exchange – Profit Calculator [2 marks]

Find the stock out of the four instruments giving maximum profit (average closing price - average opening price) in a 5-minute sliding window for the last 10 minutes.

In order to realize the above expectations, you need to design and construct a streaming data pipeline integrating the various technologies, tools and Programmes covered in the course that will harvest this real time data of trader's orders and produces the trades / analytics that can be sent on the trader's mobile devices. You can think of various aspects related to streaming data processing such as:

- Real time streaming data ingestion
- Data's intermittent storage
- Data preprocessing – cleaning, transformations etc.
- Data processing – filters, joins, windows etc.
- Business logic for placing the offers
- Final representation of the outcome

Submission requirements:

- 1) Document describing the architecture and tech-stack
- 2) Python program for order placement with sample input and outputs
- 3) Short note on criteria used for order match-making
- 4) Python program for trade generation
- 5) Short note on describing
 - the streaming data pipeline architecture

- components used and purposes of the same
 - data flows
 - business logic used
- 6) Programs / Queries used in exercise 4 and 5
 - 7) A short demo describing the overall thought process for approaching this problem and data flow through the pipeline. **Share the Google drive link for the same.**

References:

- 1) [What Happens When You Buy or Sell Stocks?](#)
- 2) [How Stock Trading Works?](#)
- 3) [Kaggle Stock Market Analysis](#)
- 4) [Simple Moving Average \(SMA\)](#)
- 5) [Zerodha Kite Connect 3 / API documentation](#)
