DSCI-560: Data Science Practicum Laboratory Assignment 4:
Instructor: Young Cho, Ph.D.

This provides hands-on experience building a real-time stock price analysis and algorithmic trading model. The last lab focused on data collection, storage, and pre-processing to prepare your team to perform analysis and algorithmic trading on the stored data.

In this lab, you will work with your team to analyze the stock price data and calculate the portfolio returns using Algorithmic trading to devise an algorithm that provides maximum profit.

1) Algorithm Development

Develop simplified algorithms for predicting when to buy and sell stocks based on the collected real-time stock price data.

Research and develop basic trading algorithms determining when to buy and sell stocks. These algorithms could be based on simple moving averages, momentum indicators, or any other suitable technique.

a) References

Use the following resources to understand how the algorithms work and the factors responsible for the stock market trends.

i) Introduction to Technical Analysis: Investopedia - Technical Analysis
ii) Moving Average Crossover Strategy: Investopedia - Moving Average Strategies
iii) Relative Strength Index (RSI): Investopedia - RSI

b) Algorithm Implementation

Discuss common algorithms: Moving Average, Exponential Smoothing, etc. Implement a simple Moving Average algorithm on the collected stock price data to kick-start your implementation strategy.

Discuss more advanced algorithms: ARIMA, LSTM, etc. Explore evaluation metrics for time series data: Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), etc.
Select an algorithm or develop a hybrid algorithm to predict the stock prices and provide buy/sell signals.

Implement the chosen algorithm(s) in Python. Create functions that generate buy/sell signals based on the stock price data.

2) Mock Trading Environment

For this task, you will create a mock trading environment to test the performance of your trading algorithms.

Define an initial investment fund and allocate it to the chosen stocks for your portfolio. Create a Python script that tracks the portfolio value over time based on the buy/sell actions determined by your trading algorithm(s). Maintain a record of the number of shares held for each stock and update it after each trade.

Choose relevant performance metrics to evaluate the effectiveness of your trading algorithm(s). Calculate metrics such as total portfolio value, annualized returns, and the Sharpe ratio.

a) References
i) Calculating Portfolio Returns: Investopedia - Calculating Portfolio Returns
ii) Calculating Sharpe Ratio: Investopedia - Sharpe Ratio

3) Extra Credit

Additionally, this week's submission would be a competition between all teams. Given the same portfolio and initial starting budget, every team's algorithm would be run and ranked in order of the profit generated by their algorithm.

Team whose algorithm provides the maximum profit would receive extra credit for Lab 3.

4) Team Discussions

Your team is expected to meet in-person / virtually each day of the week and discuss the assignment progress & next steps. Document minutes of each meeting in a separate file.

5) Submission

Make one submission per team. Each team must submit all the code files for the working solution, a readme document containing information for running the code in pdf format, and a document that outlines the minutes of all team meetings in pdf format. Please include the detailed GitHub history.

Provide a video per team which demonstrates the entire working solution and explains which algorithm was used and the rationale behind it. Also include details about the performance metrics used by your team. Please include the team name and the name of all three team members in the video.

There will be a 50% penalty for all late submissions.