

## Instructions:

This document defines and explains the problem statement for the hackathon.

You have 6 hours to provide the technical solution to the problem.

All data and tools that you need to solve the problem are available for free in the public domain.

You are free to choose a technology stack of your choice to solve the problem, although we would suggest using open-source technologies.

The Hackathon deals with creating reports based on daily Stock Prices and generating appropriate visualizations on top of it.

This document has the following sections:

- Introduction
- Details of each step with the information on the technical solution that needs to be developed.
- Sample Calculations to calculate metrics for one month.
- Take time to read the document carefully to fully understand the problem.
- You may look-up the internet to further understand/research the problem.

Your technical evaluation will be based on:

- Ability to understand a real-life problem.
- Research on the problem domain
- Technical approach/Solution design
- Accuracy of the solution
- Presenting your **research, approach, design, and solution** to the evaluators

Members of the technical team are around you. You can ask them questions when you have exhausted all your means on Google.

## Introduction

This hackathon involves developing a reporting system. This system should have the ability to provide customized reports that include historic price data for a defined period.

## Key Requirements:

1. **Reports:** Participants must develop a system capable of generating reports based on client requests, ensuring that all visualizations are included to facilitate a clear understanding of their portfolio.
2. **Download Feature:** An essential feature to be developed for users to download their reports in PDF format for convenient offline access.
3. **User Interface:** Participants are expected to design an intuitive interface allowing clients to select the desired report type and date range. Additionally, appropriate filter options should be provided to refine the data according to specific criteria.

4. **Visualization:** The interface should enable users to choose the type of visualization they prefer, along with the relevant date range. This customization enhances the clarity and relevance of the reports.
5. **Access Control:** Implementation of access controls is crucial. The client should be able to register/login. You should use a middleware to authorize the user (preferably JWT)

## Deliverables

The participants are expected to include the following in the application demonstration:

1. **Frontend:** Design a frontend user interface allowing users to log in or sign up and generate reports. The interface should include options to filter data based on ticker, start, and end dates, and download the generated report in PDF format. For the purposes of this Problem Statement, consider Start Date as 1-Nov-2023 and End Date as 31-Jan-2024  
Preferred libraries/frameworks: react.js
2. **Backend:** An appropriate backend server should be set up locally to process and serve the requests coming from the client(frontend). The user information should be stored in a database, preferably an SQL database.  
Preferred libraries: python FastApi, MySQL.
3. **Middleware:** The middleware should be used to authorize the users based on JWT claims.
4. **Report generation:** A reporting engine to generate reports in pdf/excel.  
Preferred libraries: jspdf, jspdf-autoable, pdfkit ([pdfkit · PyPI](#))
5. **Visualizations:** participants should create visualizations and render it to the UI by following modern UI/UX practices.  
Preferred libraries: react-chartjs2.

## Metrics

- **Exponential Moving Average (EMA)**  
EMA is the type of moving average that places a greater weight and significance on the most recent data points. It reacts more quickly to recent price changes compared to a simple moving average.

$$EMA_{today} = ClosingPrice * multiplier + EMA_{previousDay} * (1 - multiplier)$$

- ClosingPrice is the closing price of the stock on the current day.
- **Multiplier is calculated as follows.**

- $\frac{2}{n+1}$
- n is the number of days used for the calculation. (n-day average)

The current problem statement deals with calculation of MACD for 3 stocks for the period of last 3 months (i.e., Nov 2023, Dec 2023, and Jan 2024)

- **Moving Average Convergence/Divergence (MACD)**
  - This is a trend-following momentum indicator that shows the relationship between two moving averages of an asset's price. It consists of a MACD line (the difference between a short-term and a long-term exponential moving average) and a signal line (a shorter-term moving average of the MACD line). Traders use MACD crossovers and divergences to identify trend reversals and momentum shifts.
  - MACD is best used with daily periods, where the traditional settings of 26/12/9 days is the default.

MACD=12-Period EMA – 26-Period EMA

#### **Signal Line:**

This represents a nine-day Exponential Moving Average (EMA) of the Moving Average Convergence Divergence (MACD). **The initial value is essentially a nine-day average of the most recent data points.**

Subsequent values are determined using the following formula, with a period of nine days.

$$signal_n = MACD_n \frac{2}{Time\ Period + 1} + signal_{n-1} \left( 1 - \frac{2}{Time\ Period + 1} \right)$$

Where,

MACD<sub>n</sub> = MACD of previous day

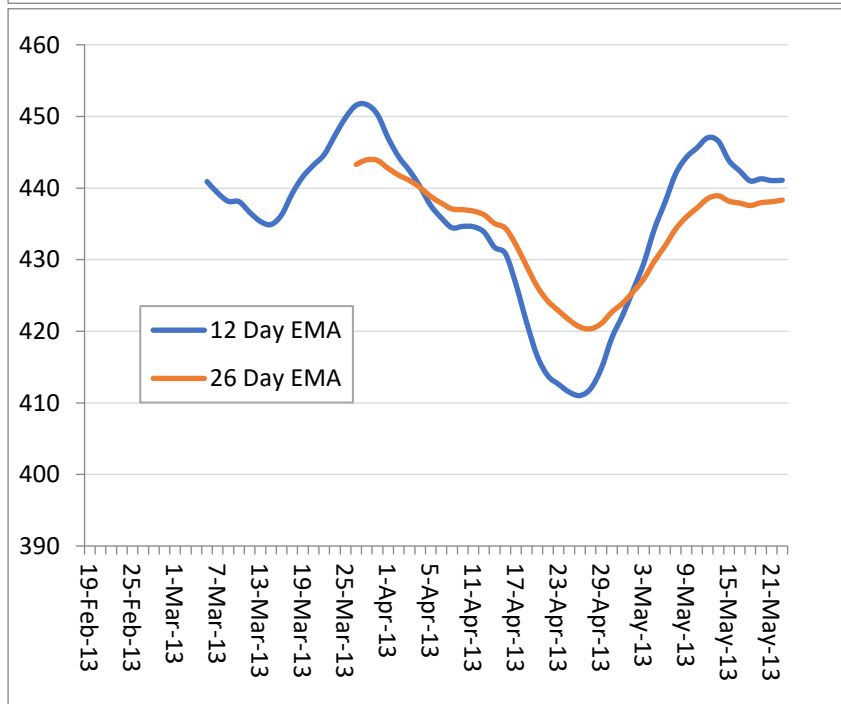
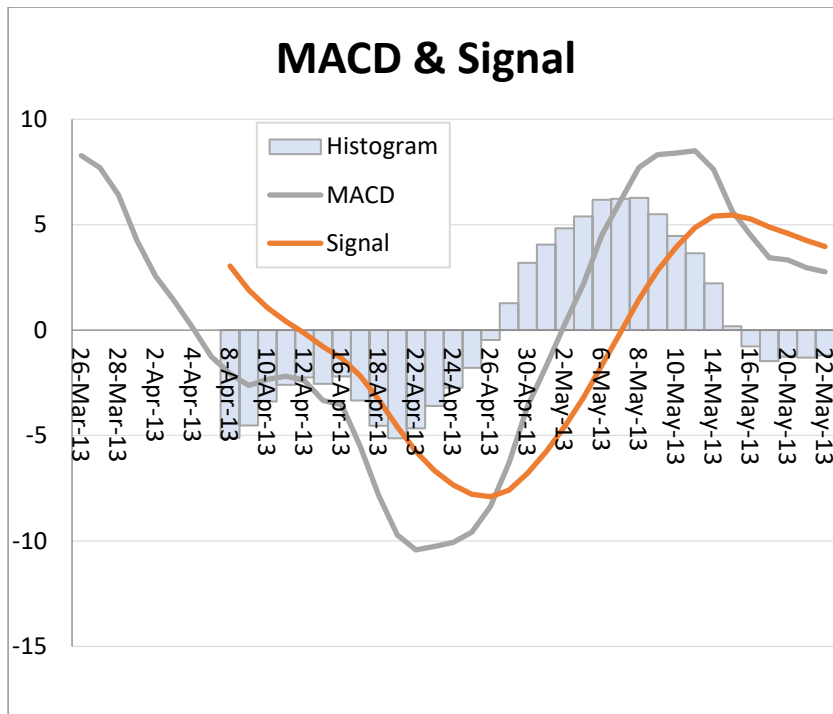
Signal<sub>n-1</sub> = Signal of previous day

## Illustration

Calculate the metrics for MACD and plot appropriate graphs to get the insights from the data. Below is the example calculations and visualizations for MACD.

### a) MACD

Date	Close	12 Day EMA	26 Day EMA	MACD	Signal	Histogram
19-02-2013	459.99					
20-02-2013	448.85					
21-02-2013	446.06					
22-02-2013	450.81					
25-02-2013	442.8					
26-02-2013	448.97					
27-02-2013	444.57					
28-02-2013	441.4					
01-03-2013	430.47					
04-03-2013	420.05					
05-03-2013	431.14					
06-03-2013	425.66	440.8975				
07-03-2013	430.58	439.31019				
08-03-2013	431.72	438.14247				
11-03-2013	437.87	438.10055				
12-03-2013	428.43	436.61277				
13-03-2013	428.35	435.34158				
14-03-2013	432.5	434.90441				
15-03-2013	443.66	436.25143				
18-03-2013	455.72	439.24659				
19-03-2013	454.49	441.59173				
20-03-2013	452.08	443.20531				
21-03-2013	452.73	444.67065				
22-03-2013	461.91	447.32286				
25-03-2013	463.58	449.82395				
26-03-2013	461.14	451.56488	443.28962	8.2753		
27-03-2013	452.08	451.64413	443.94075	7.7034		
28-03-2013	442.66	450.26196	443.84588	6.4161		
01-04-2013	428.91	446.97704	442.73952	4.2375		
02-04-2013	429.79	444.33288	441.7803	2.5526		
03-04-2013	431.99	442.43398	441.05509	1.3789		
04-04-2013	427.72	440.17029	440.06731	0.103		
05-04-2013	423.2	437.55947	438.81788	-1.258		
08-04-2013	426.21	435.8134	437.88396	-2.071	3.0375	-5.1080841
09-04-2013	426.98	434.45442	437.07626	-2.622	1.9057	-4.5274946
10-04-2013	435.69	434.64451	436.97357	-2.329	1.0587	-3.3877752
11-04-2013	434.33	434.59612	436.77775	-2.182	0.4106	-2.5922724
12-04-2013	429.8	433.85826	436.26088	-2.403	-0.152	-2.2506133
15-04-2013	419.85	431.70314	435.04526	-3.342	-0.79	-2.5520869
16-04-2013	426.24	430.86266	434.39302	-3.53	-1.338	-2.1922627
17-04-2013	402.8	426.54532	432.0528	-5.507	-2.172	-3.3354967
18-04-2013	392.05	421.23835	429.08963	-7.851	-3.308	-4.5434397
19-04-2013	390.53	416.51399	426.23336	-9.719	-4.59	-5.1292264
22-04-2013	398.67	413.76876	424.19163	-10.42	-5.757	-4.6661803
23-04-2013	406.13	412.59357	422.85373	-10.26	-6.657	-3.6027808
24-04-2013	405.46	411.4961	421.5653	-10.07	-7.34	-2.7294626
25-04-2013	408.38	411.0167	420.58862	-9.572	-7.786	-1.7857381
26-04-2013	417.2	411.96797	420.33761	-8.37	-7.903	-0.4667616
29-04-2013	430.12	414.76059	421.06223	-6.302	-7.583	1.280989
30-04-2013	442.78	419.07127	422.67095	-3.6	-6.786	3.1863545
01-05-2013	439.29	422.18184	423.90199	-1.72	-5.773	4.0527102



### **Accessing Data**

Use the [Yahoo Finance API](#) to retrieve historical data for the symbols **IVZ, BLK, and STT** for the last three months i.e., from November 1, 2023, to January 31, 2024

### Reading Material:

1. [Exponential Moving Average \(EMA\) \(groww.in\)](#)
2. [MACD \(investopedia.com\)](#)
3. [Portfolio Management \(investopedia.com\)](#)