**Stock Price Analysis, Forecasting, and Anomaly Detection Using Python**

# Objective

The task was to analyze multi-ticker stock price data, perform time series forecasting using Prophet, and detect price anomalies visually for multiple stock tickers such as AAPL, MSFT, and GOOGL.

# Data Structures & Cahllenges

The stock price data was provided in a MultiIndex DataFrame format, where the columns had two levels:  
- Level 0: Ticker symbol (e.g., 'AAPL', 'MSFT', 'GOOGL')  
- Level 1: Price type (e.g., 'Open', 'High', 'Low', 'Close', 'Volume')  
  
This hierarchical structure posed challenges in data extraction and manipulation. For instance, accessing the close prices for a specific ticker required correct use of pandas .xs() method specifying the correct index level and axis.

# Problem Faced

1. KeyErrors when accessing columns

Initial attempts to select data by ticker or price type raised KeyErrors due to misunderstanding of the MultiIndex structure or incorrect index level names.  
  
2. Mismatch in MultiIndex naming and ordering

The order of the MultiIndex levels in the columns varied between data sources, requiring careful inspection and confirmation of index names ('Ticker' and 'Price') and their order.  
  
3. Inconsistent structure between raw data and anomaly data

The anomaly-labeled dataset (df\_clean) had a different indexing system, which required flexible code to handle either MultiIndex or flat DataFrames with columns.

# Solutions & Methodology

- Corrected MultiIndex Access:  
 Used df.xs(ticker, level='Ticker', axis=1) to extract all price columns for the specified ticker. This approach directly selects the data subset while respecting the hierarchical column indexing.  
  
- Flexible Anomaly Data Handling:  
 Added logic to check if df\_clean used a MultiIndex or standard columns for the ticker label and filtered accordingly. This made the plotting function robust to input variations.  
  
- Time Series Forecasting with Prophet:  
 Reshaped data into the format required by Prophet (ds for date, y for value), and used the additive model to forecast future closing prices. This gave a straightforward and interpretable forecast with seasonal trends.  
  
- Anomaly Visualization:  
 Developed a function to plot closing prices alongside detected anomalies (identified via DBSCAN clustering labels). Anomalies were highlighted with red markers for easy identification.

# Findings

- The MultiIndex format is powerful but requires careful handling in pandas. Proper indexing methods are critical for efficient data selection.  
- Prophet’s additive model performed well for the forecasting of stock closing prices.  
- Anomaly detection combined with visualization enabled intuitive insights into unusual price movements.

# Future Improvements

- Automate multi-ticker looping for batch forecasting and anomaly detection.  
- Integrate other anomaly detection methods for improved accuracy.  
- Develop a dashboard interface for interactive exploration.