# Enhancing Investment decisions with Time series analysis of FAANG stock prices

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## 1. Introduction

The purpose of this report is to present the results of our project on enhancing investment decisions with time series analysis of FAANG stock prices. The FAANG stocks, including Meta, Amazon, Apple, Netflix, and Alphabet, have shown remarkable growth and strong financial performance in recent years, accounting for a significant portion of the S&P 500 and the Nasdaq 100 Index. Our project used time series analysis algorithms, including Prophet and Arima, and a Bi-LSTM neural network model to forecast the FAANG stock prices for the next 12 months. By analyzing past and present performance, we aim to help investors adapt to rapidly changing market conditions and make informed investment decisions. The results of our project can provide valuable insights for investors seeking to navigate the highly volatile and dynamic market conditions in the current economic landscape.

## 2. Dataset

We used a dataset that was sourced from Kaggle and supplemented with the latest data from NASDAQ. The dataset contains historical stock prices of all five FAANG companies and includes features such as date, close, volume, open, high, low, and name. The Date column provides the date of each trading day, while the Close column represents the stock's closing price on that day. The Volume column indicates the number of shares traded on a particular day, while the Open, High, and Low columns represent the opening, highest, and lowest prices of the stock, respectively, on that day. The Name column specifies the FAANG company to which the stock belongs. The total entries in the dataset are 32095.

## 3. Methodology

### 3.1. Low risk task

Our low-risk task included performing exploratory data analysis. The daily mean rate of return of a stock (Fig. 6.1) is the average rate of return that an investor can expect to earn on a daily basis if they invest in that stock over a specific time period. The daily variance (Fig.6.2) of a stock is a measure of the degree to which the daily returns of that stock deviate from its mean rate of return. High variance suggests a higher risk and potentially higher rewards, while low variance indicates a lower risk and lower potential rewards. The graph of FAANG stock closing prices for 2021 to 2023 (Fig. 3.1) has provided valuable insights into the performance of these companies, their volatility, and potential trends like Netflix

always having the highest closing price. FAANG stocks over time (Fig.6.3) shows us the lifetime stock trends, and we can see that stocks of all companies dropped during 2020, which is when the COVID-19 hit the world.

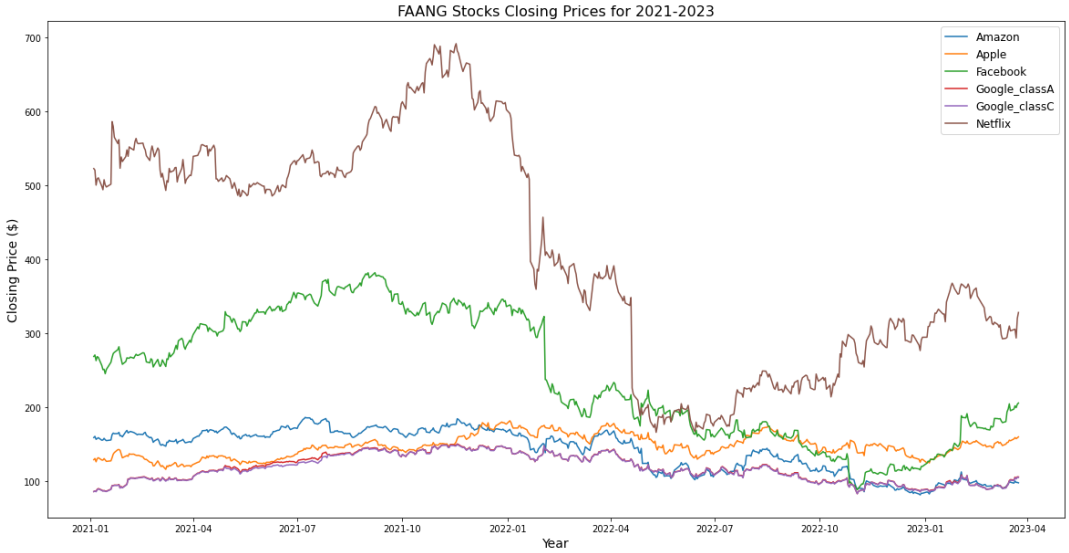



Fig 3.1. FAANG stocks closing Prices for 2021-2023

## 3.2. Medium risk task

### 3.2.1 Arima

ARIMA, an acronym for "AutoRegressive Integrated Moving Average", is a statistical model that is commonly utilized for time-series forecasting. This method entails fitting a combination of autoregressive and moving average models to historical data, thus enabling the prediction of future values. The model's order is defined by three essential parameters, namely p, d, and q, which can be determined by analyzing the autocorrelation function (ACF), differencing, and partial autocorrelation function (PACF) plots of the time series data, respectively.

To facilitate the fitting and tuning of the ARIMA model to time series data, we employed PMDARIMA, a Python library that automates the process using a combination of grid search and stepwise search algorithms. After obtaining the optimal parameters, we fitted the model to the test data and employed it to generate predictions based on the testing data. To evaluate the model's performance, we used the mean squared error (MSE) metric, and the results are presented in the accompanying figure (Fig. 3.2.1)

The overall predictions generated by the ARIMA model on the test data are depicted in the Fig. 6.4, showcasing that the predicted values align closely with the actual values, thereby validating the model's efficacy. Notably, the ARIMA model delivered the most accurate predictions for the Google stock price, with an MSE value of 38 (approx) (Fig 3.2.2)

```
=========For Apple=========
MSE: 71.59
=========For Amazon=========
MSE: 111.46
=========For Facebook=========
MSE: 110.92
=========For Google Class A=========
MSE: 37.37
=========For Google Class C=========
MSE: 38.81
=========For Netflix=========
MSE: 207.94
```

Fig 3.2.1. MSE values of FAANG stocks

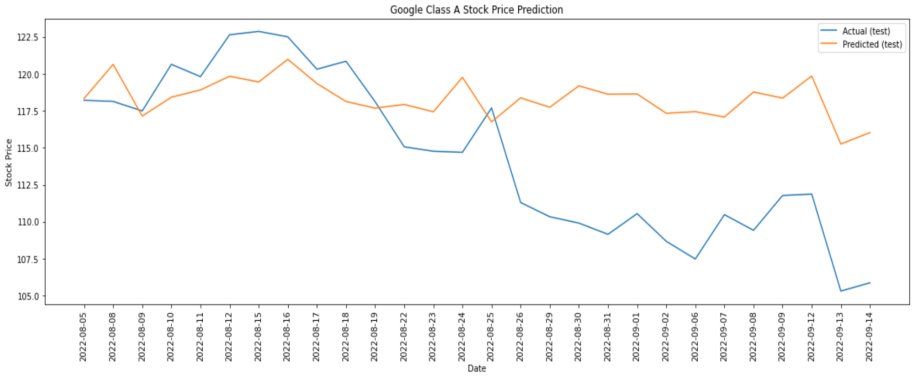



Fig 3.2.2. Predictions on test data of Google Class A stock

### 3.2.2 Prophet

Prophet is a procedure for forecasting time series data based on an additive model where non-linear trends are fit with yearly, weekly, and daily seasonality, plus holiday effects. The Prophet algorithm was applied to analyze the stock prices of the FAANG companies (Facebook, Amazon, Apple, Netflix, and Google) over a period of several years. The equation is as follows: $y(t) = g(t) + s(t) + h(t) + \varepsilon(t)$ where $g(t)$ represents the trend. Prophet uses a piecewise linear model for trend forecasting; $s(t)$ represents periodic changes (weekly, monthly, yearly); $h(t)$ represents the effects of holidays (holidays can impact businesses); $\varepsilon(t)$ represents the error term. The results in Fig. 6.5 showed that the best performance was observed for the Google Class A stock prices.

## 3.3. High risk task

### 3.3.1. BiLSTM

The high risk task includes training a BiLSTM model for time series analysis for stocks. BiLSTM stands for Bidirectional Long Short-Term Memory, which is a type of recurrent neural network architecture used for sequential data processing. The main idea behind BiLSTM is to allow the network to access both past and future inputs in the sequence, unlike traditional LSTMs, which only take past inputs into account. In a BiLSTM, the input sequence is processed in two directions simultaneously: from the beginning of the sequence to the end (i.e., forward direction) and from the end of the sequence to the beginning (i.e., backward direction). The outputs of both directions are then concatenated to form the final output. We have trained a simple model with 2 layers : A Bidirectional LSTM layer with 100 units, ReLU activation function and a dense layer with a single output unit. The stock analysis for Google stocks gave the best result. The plot below indicates the loss per epoch and predictions.


Fig 3.3.1. Loss curve for Google stocks

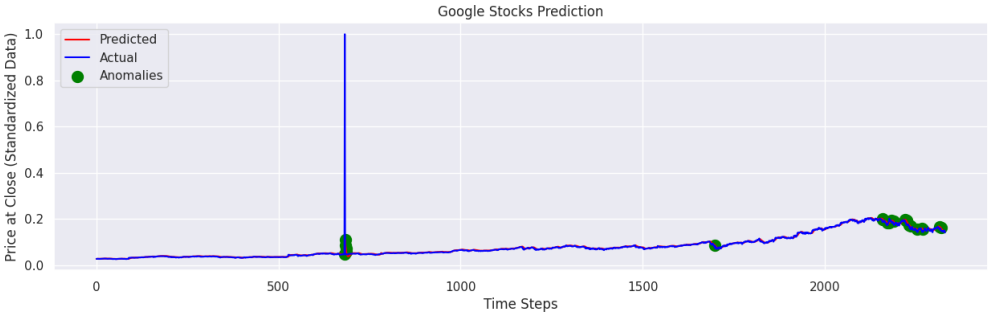



Fig 3.3.2. Actual vs predicted values of Google stocks using BiLSTM

## 4. Conclusion

After conducting time series analysis on FAANG stocks using Arima, Prophet, and BiLSTM algorithms, the results revealed that BiLSTM was the top-performing algorithm, followed by Prophet. It was evident from our analysis that during the COVID-19 pandemic, the FAANG stocks underwent a considerable drop, leading to fluctuations in the data. It is essential to note that while historical data forms the basis of our analysis, there are several other factors such as country relationships, pandemics, or unexpected events that can impact cyclic fluctuations, seasonality, and long-term trends. Interestingly, all the models performed exceptionally well in predicting Google stocks, which have been in the market for the longest time, resulting in more comprehensive data and better performance. However, it was also evident that the model's efficiency reduces after a specific time period, especially during the COVID-19 pandemic, where the stock prices witnessed a significant drop.

## 5. References

5.1.*https://www.kaggle.com/datasets/kaushiksuresh147/faang-fbamazonapplenetflixgoogle-stocks?select=NFLX+Historical+Data.csv*. (n.d.).

5.2. *The performance of LSTM and BiLSTM in forecasting Time Series | IEEE ...* (n.d.). Retrieved April 17, 2023, from https://ieeexplore.ieee.org/document/9005997

5.3. https://machinelearningmastery.com/arima-for-time-series-forecasting-with-python/

## 6. Appendix

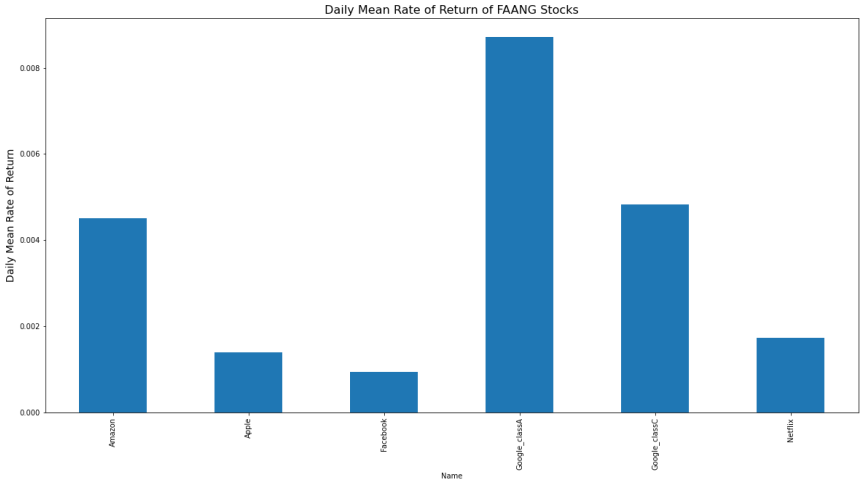



Fig 6.1 - Daily Mean Rate of Return

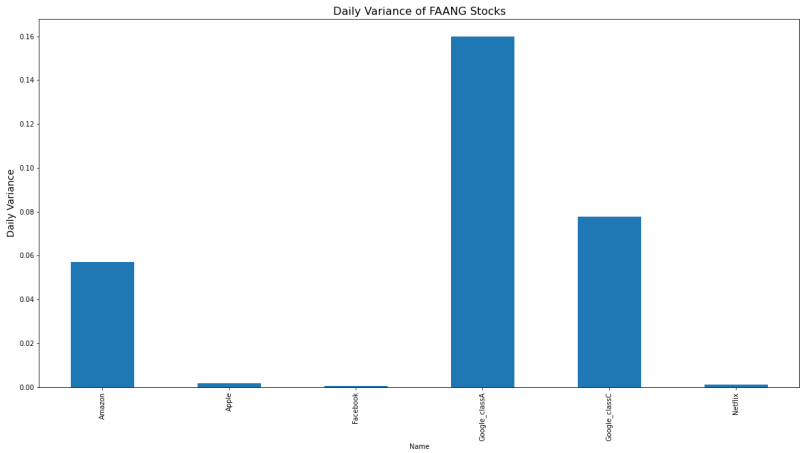



Fig. 6.2: Daily Variance of Stocks

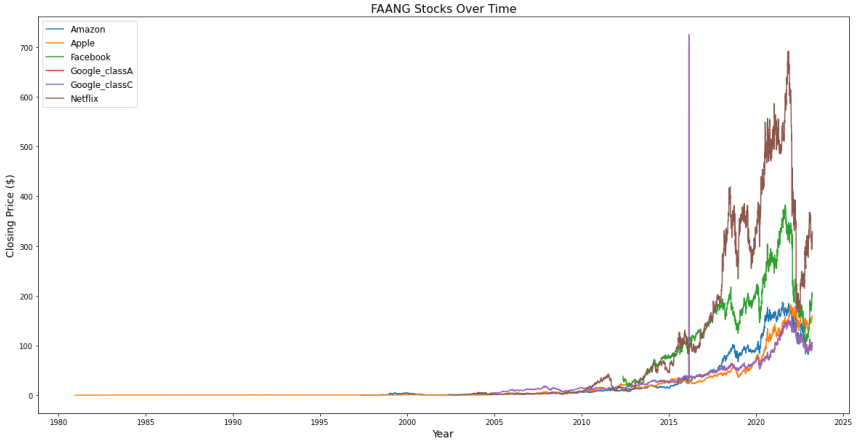
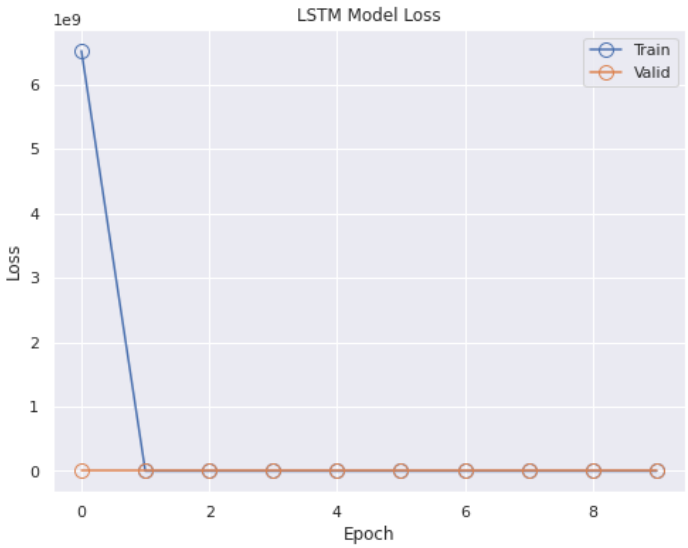
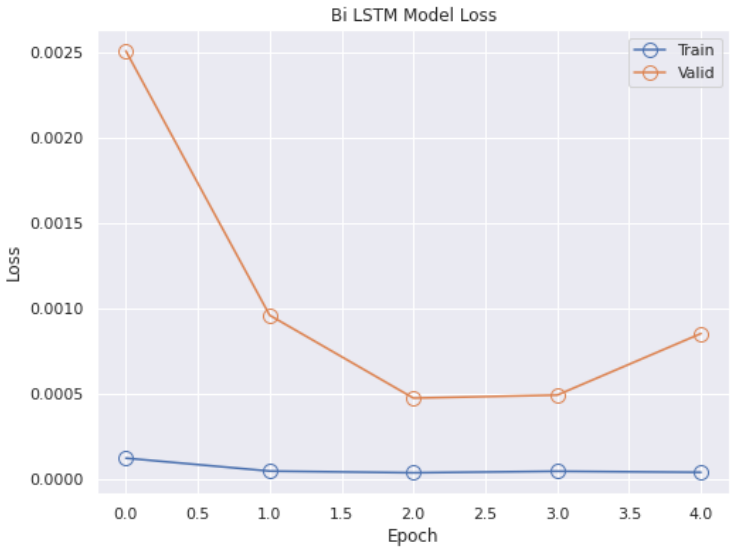


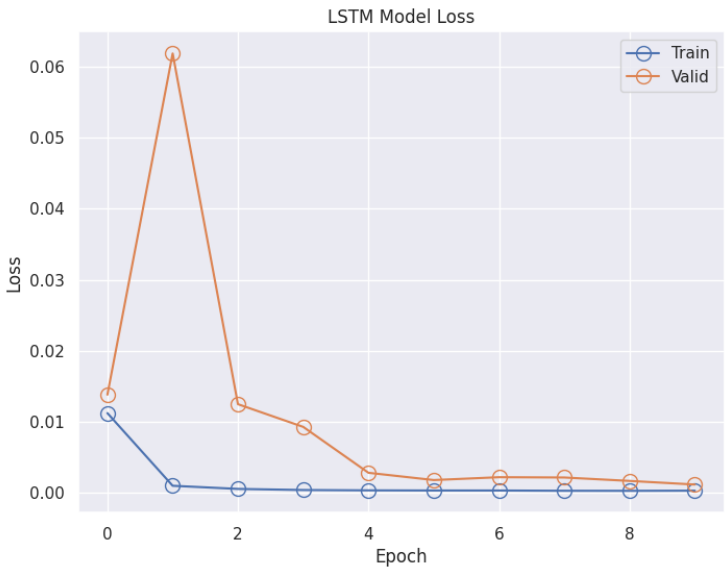

Fig 6.3 : FAANG stocks over time


Fig 6.4 : Arima model predictions


Fig 6.5 : Prophet Model results



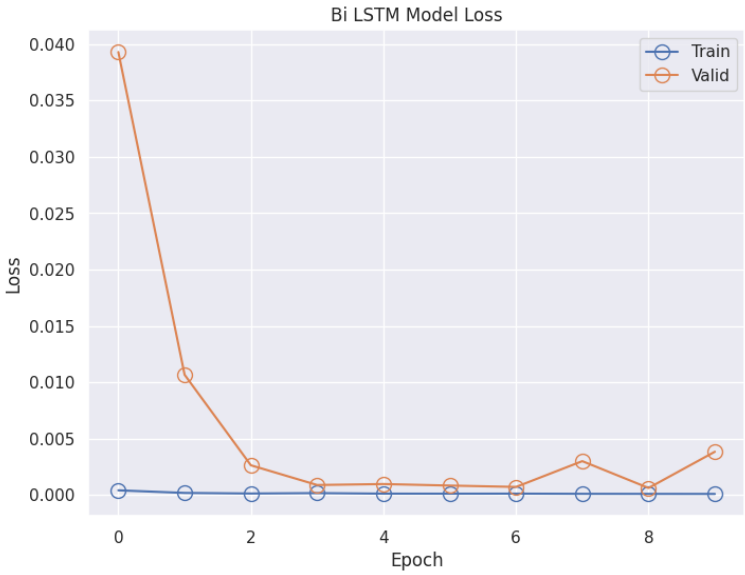
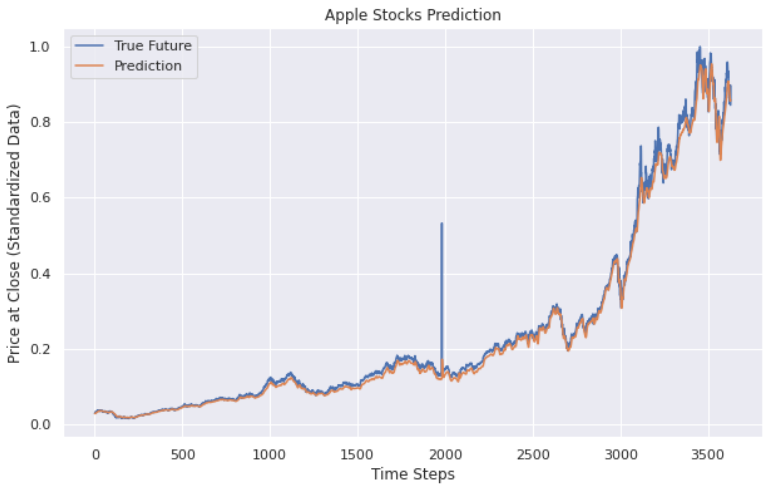
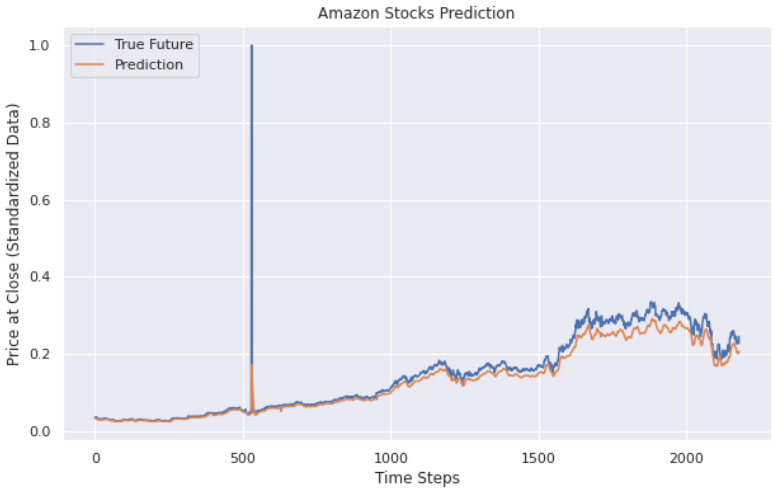
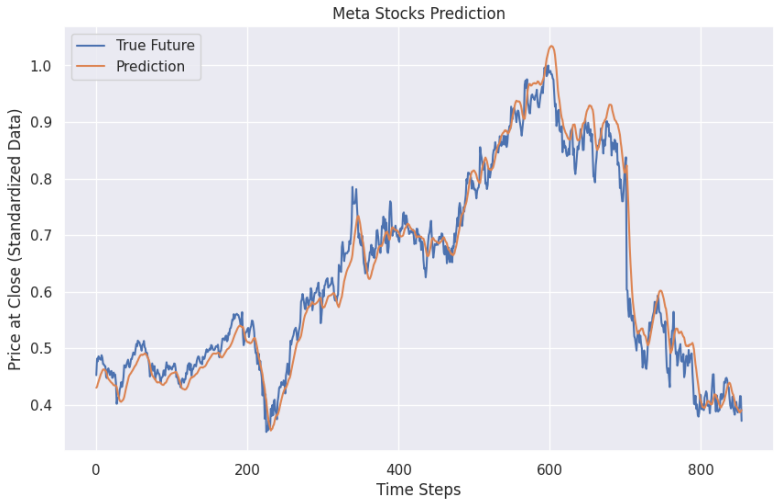



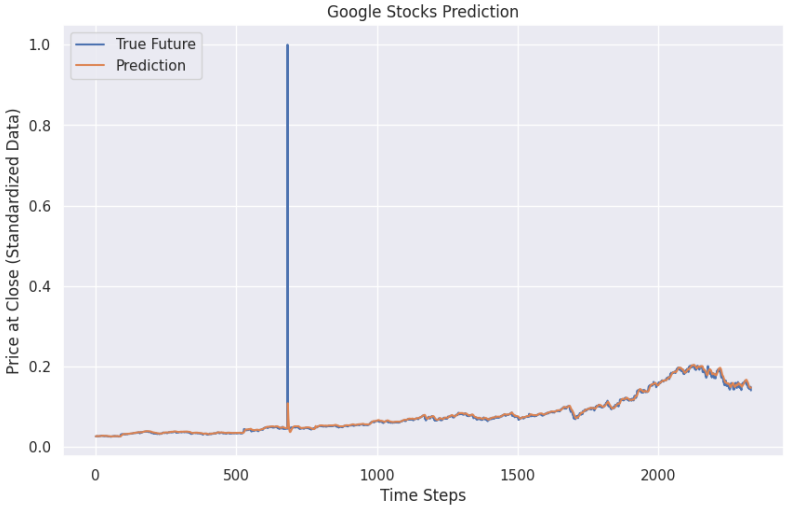


Fig 6.6. Train and test loss with BiLSTM model for Apple, Amazon, Meta, Google and Netflix respectively



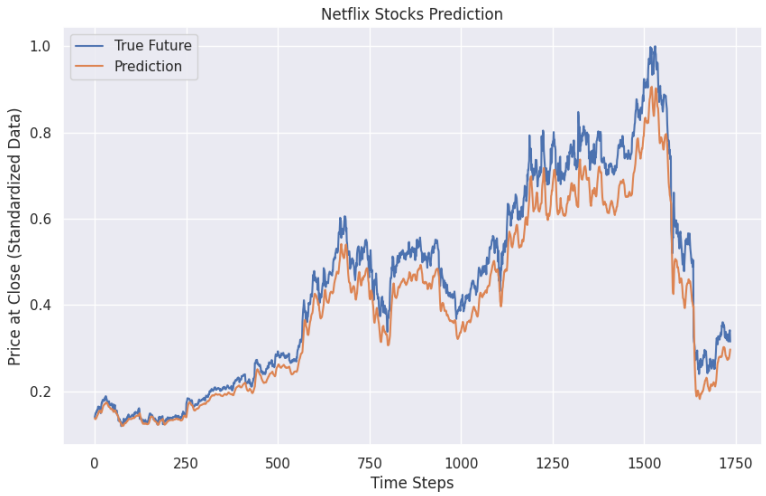
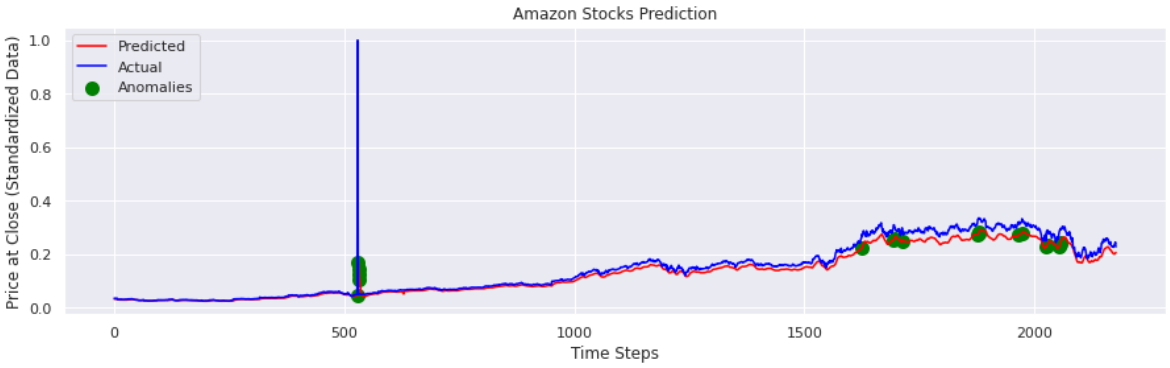
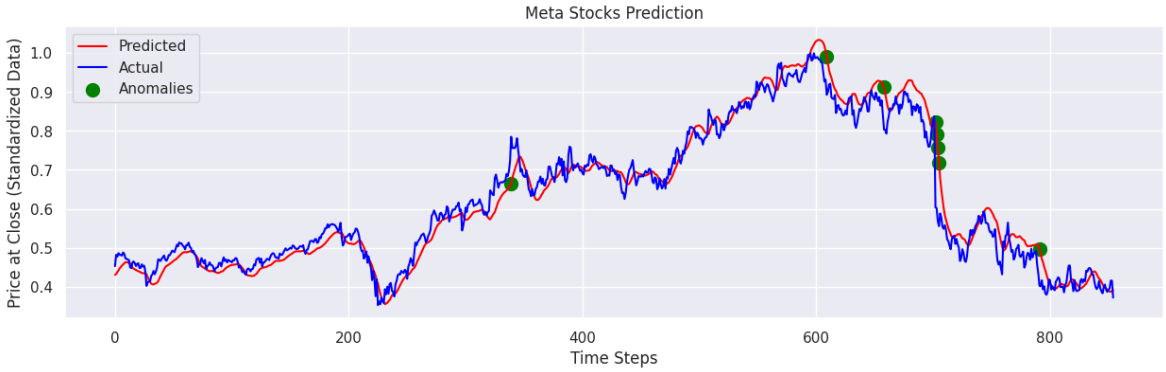
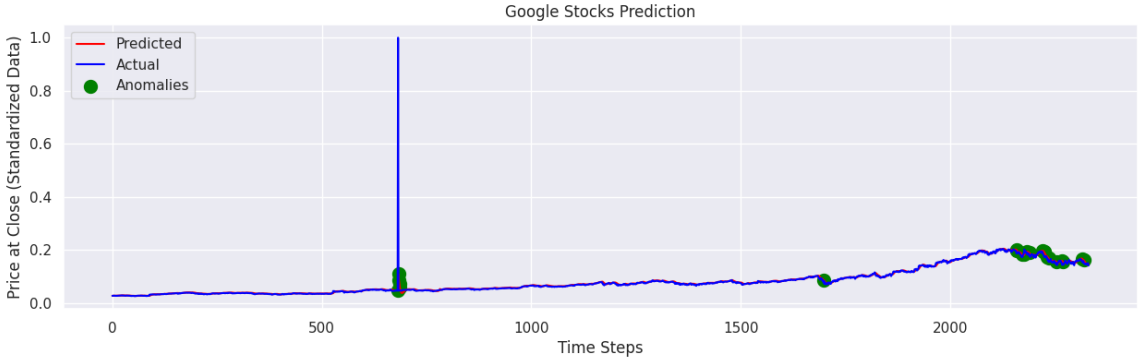




Fig 6.7. Actual vs predicted values with BiLSTM model for Apple, Amazon, Meta, Google and Netflix respectively


Amazon Stocks Prediction
Predicted
Actual
Anomalies
Price at Close (Standardized Data)
Time Steps


Meta Stocks Prediction
Predicted
Actual
Anomalies
Price at Close (Standardized Data)
Time Steps


Google Stocks Prediction
Predicted
Actual
Anomalies
Price at Close (Standardized Data)
Time Steps

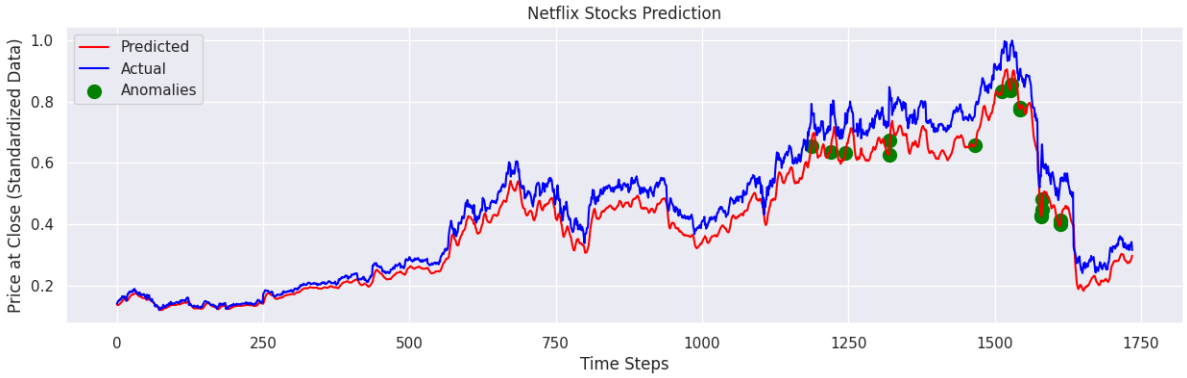

Netflix Stocks Prediction
Predicted
Actual
Anomalies
Price at Close (Standardized Data)
Time Steps


Fig 6.8. Anomalies, Actual vs predicted values with BiLSTM model