Comprehensive Project

Semester 8

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Overview

Title

Prediction of Stock Market Security Price using Chart Patterns and Indicator Analysis

Guide Name:

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Expected delivery

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Abstract

A large volume of volatile stock-market price data is generated every minute. It would not be wrong to say that the modern world is heavily affected by stock prices and related securities, making stock price prediction one of the most important and sought-after problems in the world of economics and finance. In this project, we have attempted to create and compare different machine learning models that would accurately predict stock prices. For this, we have built five machine learning models for time series and chart pattern analysis. The LSTM, RNN, GRU, and Ensemble models are based directly on historical data of the stock prices, whereas the chart pattern analysis is based on encoder-decoder architecture and DCNN.

Motivation

Stock price prediction is a classic and important problem. An efficient prediction model could help gain valuable insights into the behavior of the market over some time by identifying hidden trends. Although, increased computational power has opened various avenues which have enabled us to use Machine Learning to develop solutions for these types of problems, yet the costs of computations restrict the performance of our models as we need to consider virtually infinite variables involved in this problem. The idea is that, if the historical data of each stock (all parameter values) is known, the future stock prices are somewhat predictable. Thus, our motivation is to design a machine learning model incorporating historical data that will benefit the masses.

Approaches/Models

- DCNN Approach
- LSTM Approach
- RNN Approach
- GRU Approach
- ANN based Ensemble Approach (LSTM, GRU, RNN)

Brief Methodology

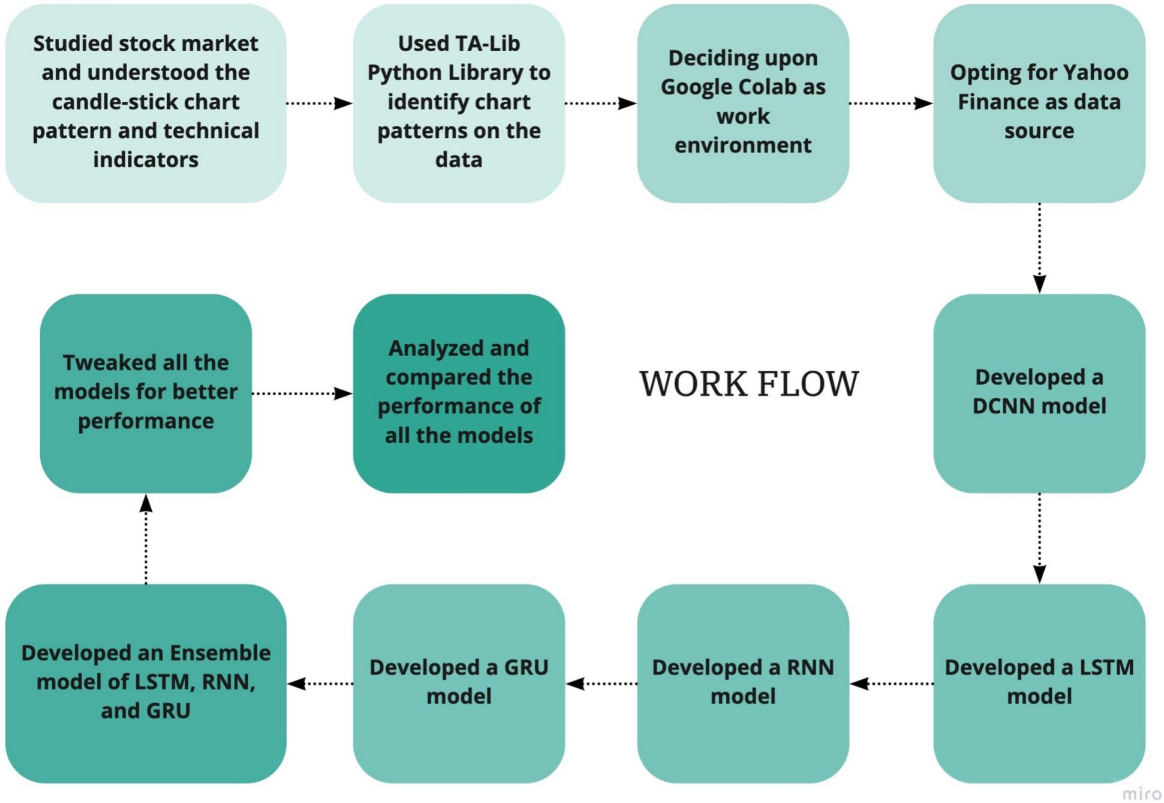
- Our DCNN model inputs images of 150x150 resolution with a window size of 8 and consists of 4 convolutional layers and 3 dense layers. Moreover, we have also used Max Pooling, Batch Normalization, and activation functions like ReLu and Softmax.
- In the LSTM approach, we have considered close price data for a window of 4 days as input to our model, and the data of the upcoming 5th day as the target value. The model consists of 4 LSTM layers with corresponding dropout layers, Tanh activation function, and 1 dense output layer.
- The RNN model considers close prices for a window of 20 days as input to our model, and the data of the upcoming 21st day as the target value. The model consists of 2 RNN layers and 1 dense output layer.

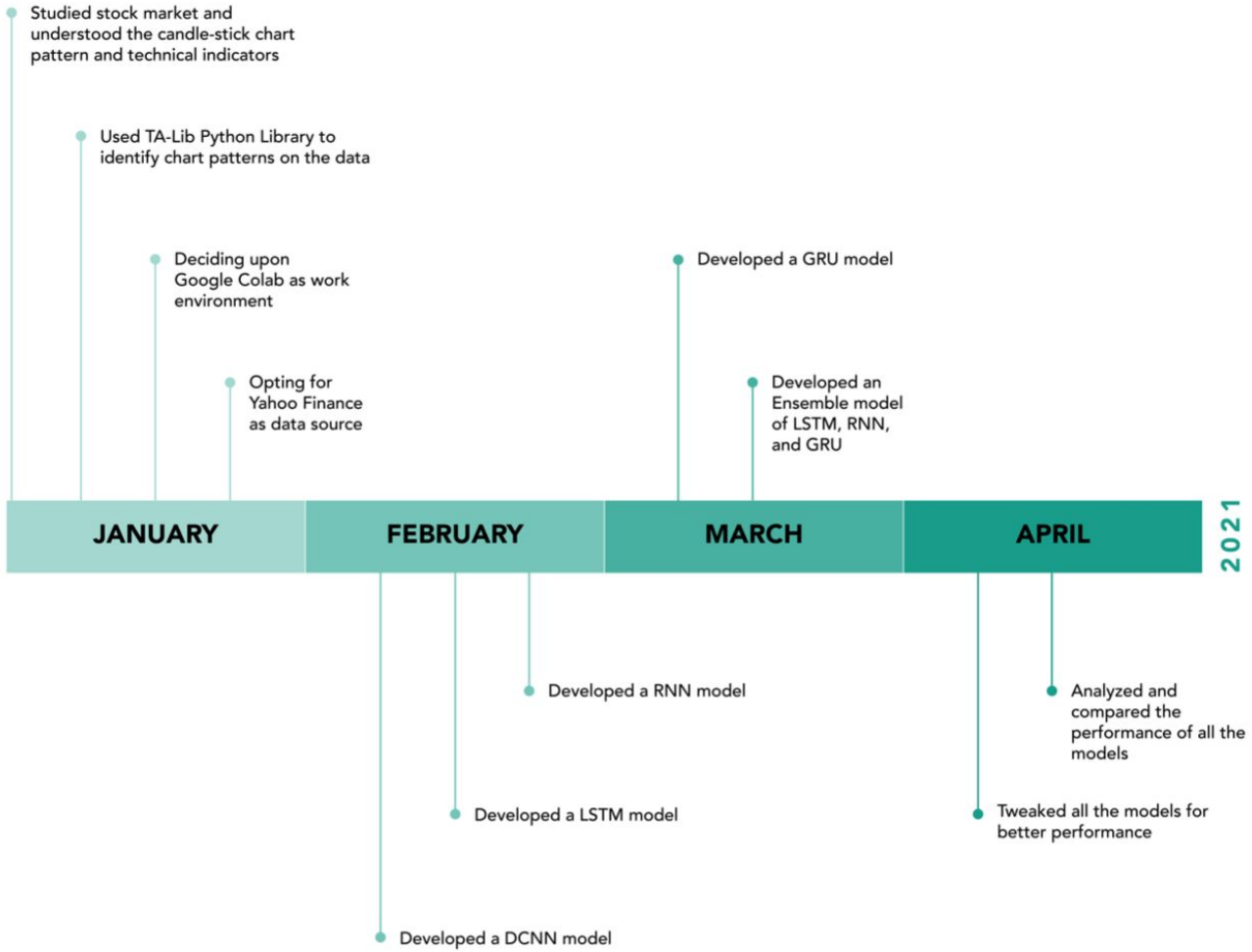
Deep CNN Model

Brief Methodology

- The GRU model considers close prices for a window of 8 days as input to our model, and the data of the upcoming 9th day as the target value. The model consists of 4 GRU layers with corresponding dropout layers, tanh activation function, and 1 dense output layer.
- The simple and weighted average approaches take into account the errors in the prediction of stock prices, for the LSTM, GRU, and RNN models, and take averages accordingly.
- In the Ensemble approach (combination of LSTM, RNN, and GRU), we divided our data-set into 3 parts. We used the first part to train the three models individually. Later, the price prediction errors for the 3 models while predicting prices for the 2nd part of our data were used to train an ANN. We then trained the 3 models again on 2nd part of the data set. The stock prices were predicted again, using the 3 models individually and then the final price prediction is made using the ANN.

Roadmap and Timeline of Execution


Studied stock market and understood the candle-stick chart pattern and technical indicators
Used TA-Lib Python Library to identify chart patterns on the data
Deciding upon Google Colab as work environment
Opting for Yahoo Finance as data source
Developed a DCNN model
Developed a LSTM model
Developed a RNN model
Developed a GRU model
Developed an Ensemble model of LSTM, RNN, and GRU
Tweaked all the models for better performance
Analyzed and compared the performance of all the models
WORK FLOW
miro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JANUARY
FEBRUARY
MARCH
APRIL
2021
Developed a RNN model
Developed a LSTM model
Developed a DCNN model
Analyzed and compared the performance of all the models
Tweaked all the models for better performance

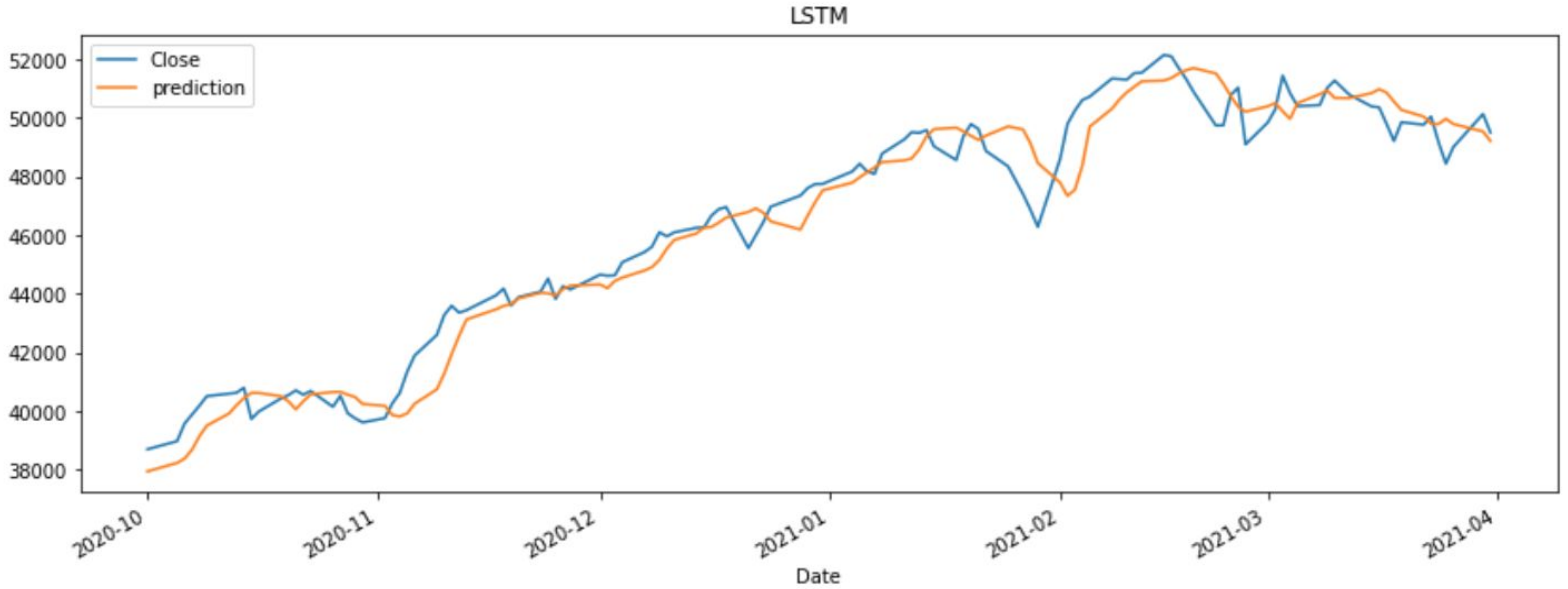
DCNN Performance (General Model)

TICKER SYMBOL	ACCURACY
SBIN.NS	81.07
BANKBARODA.NS	75.92
AXISBANK.NS	78.39
FEDERALBNK.NS	78.39
ICICIBANK.NS	81.44
INDUSINDBK.NS	80.64
PNB.NS	76.65
HDFCBANK.NS	92.24
KOTAKBANK.NS	86.73

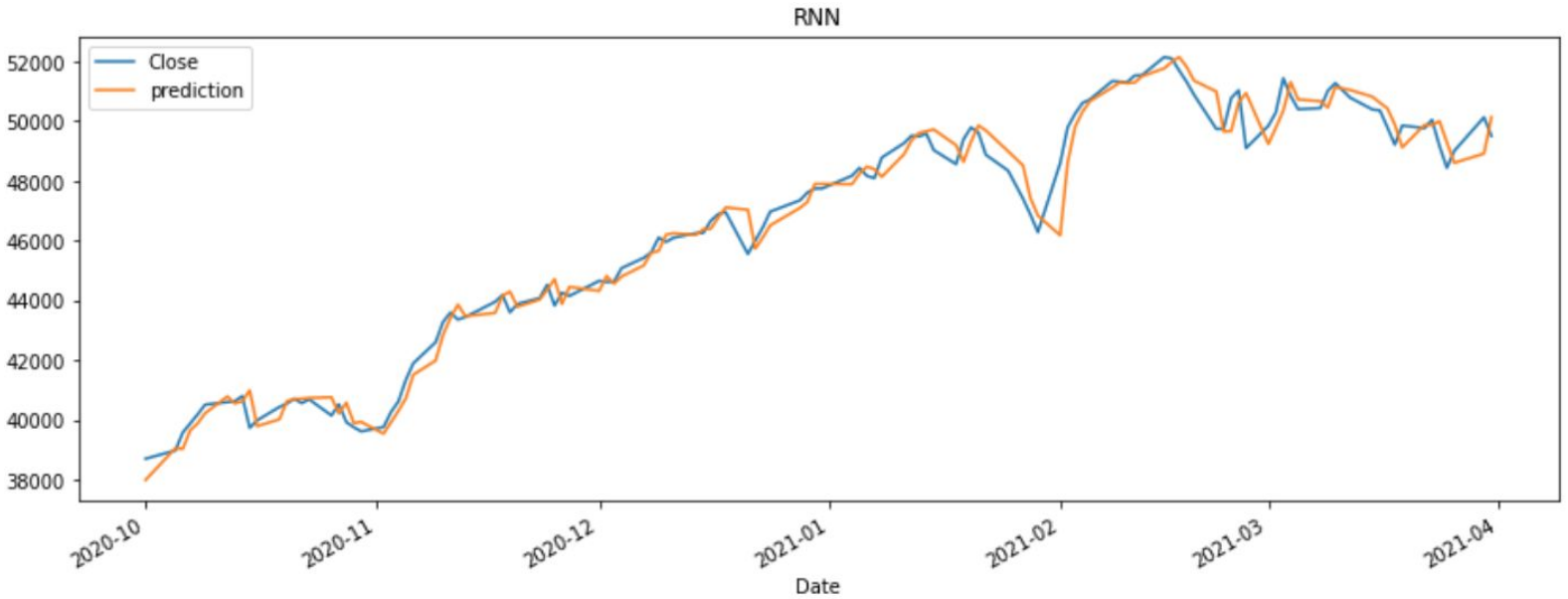
DCNN Insights

- We have considered the Banking Sector stocks as they have higher volatility (beta value) as compared to many other sectors and also give a good idea about the economy's health.
- According to the performance table, Bank of Baroda stock has the lowest prediction accuracy (75.92) and HDFC Bank stock has the highest prediction accuracy (92.24).
- Here the prediction accuracy depends on the trends of the stock. For instance, the Bank of Baroda stock trends varies significantly in both directions, whereas stocks like those of HDFC Bank majorly follow a single trend in a particular direction. Hence, the difference in the prediction accuracy.

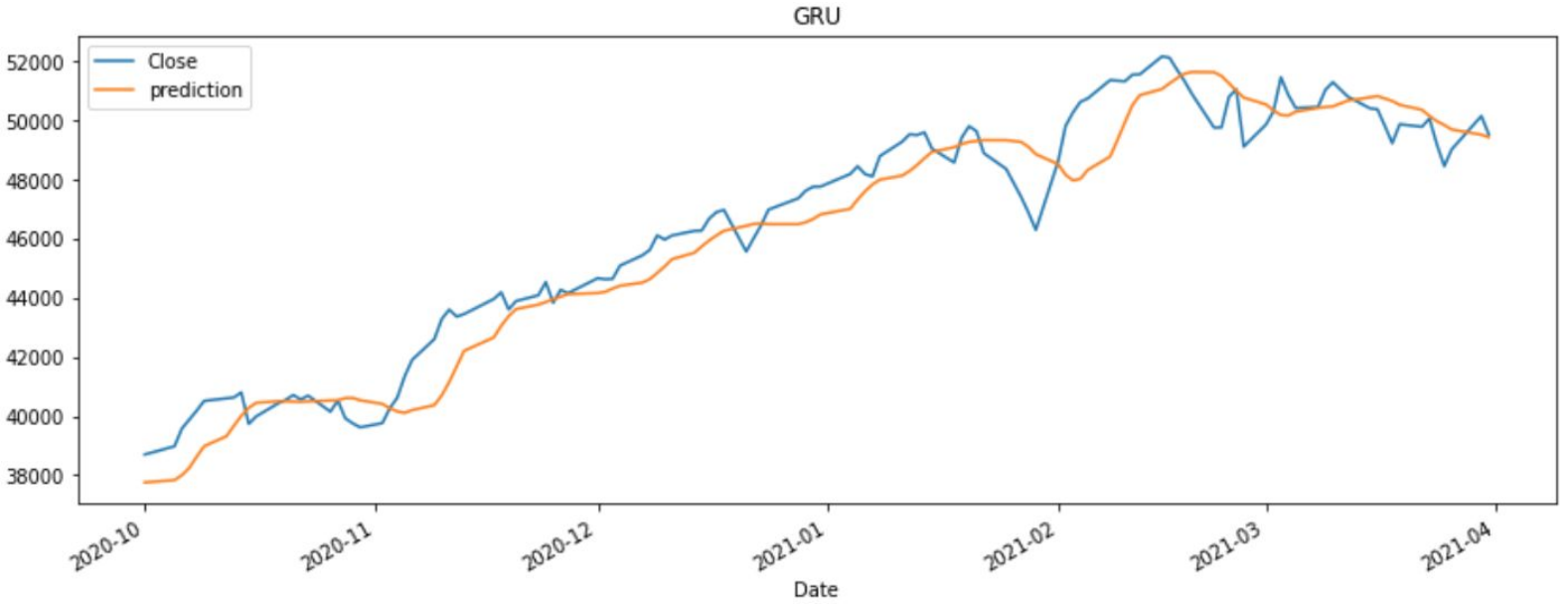
LSTM Performance



RNN Performance



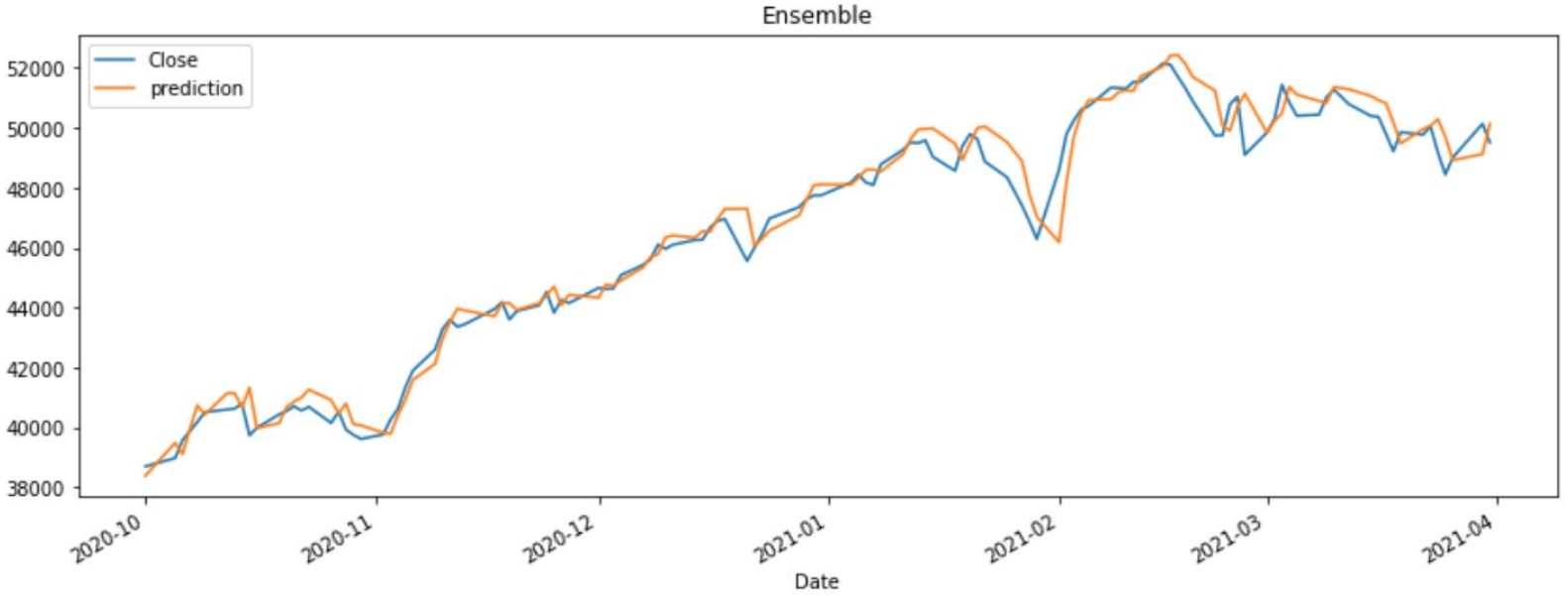
GRU Performance



Simple Average (LSTM, RNN, GRU)

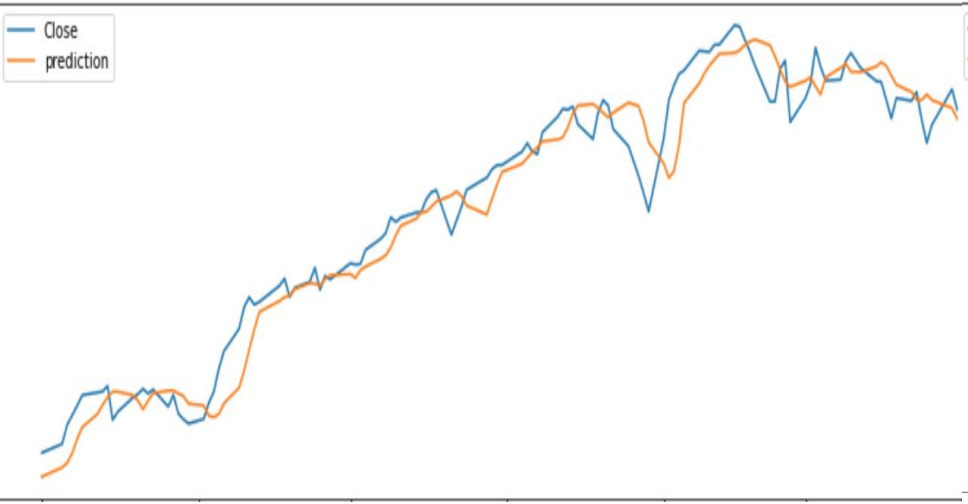
Weighted Average (LSTM, RNN, GRU)

Ensemble (LSTM, RNN, GRU)

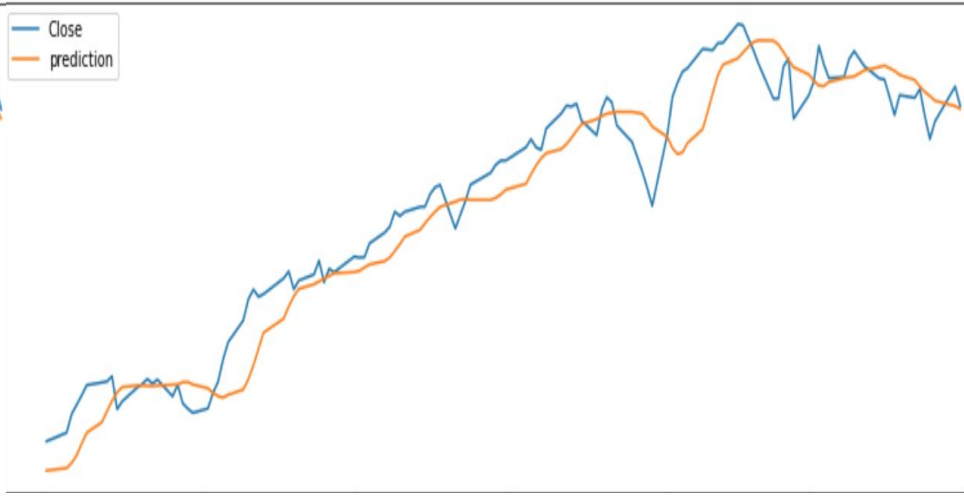


LSTM vs RNN vs GRU vs Ensemble

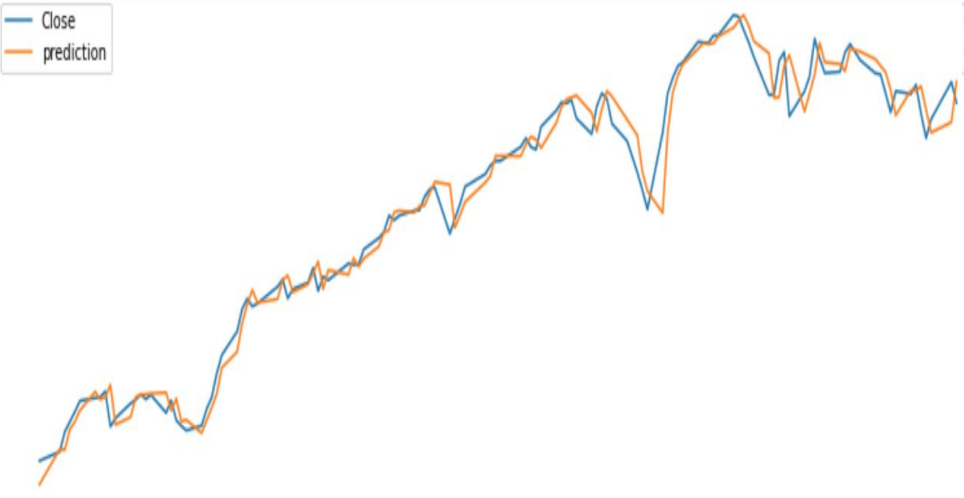
LSTM



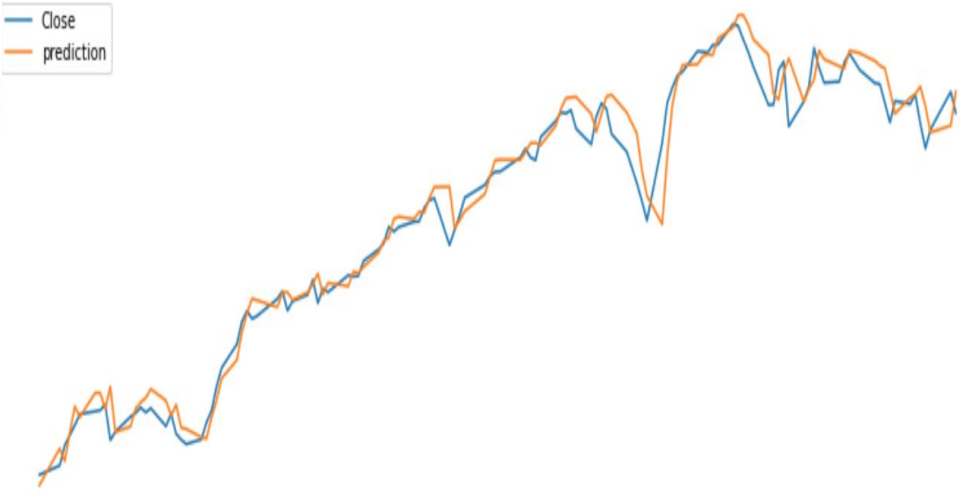
GRU



RNN



Ensemble



Models' Performances

MODEL NAME	SUM of MSEs (Norm. Data)	AVG. MSE (%)	PEAK ERROR (%)
LSTM	0.00043386	16.8328	31.0494
RNN	0.00301170	14.4353	33.0459
GRU	0.00022649	20.6766	37.9117
Simple Average	0.00080520	16.0973	29.6835
Weighted Average	0.00030862	18.5452	34.3259
Ensemble (ANN)	0.00899516	18.9642	57.4312

LSTM vs RNN vs GRU vs Ensemble

- Here, the RNN model has the lowest error whereas GRU has the highest error.
- Here, because of the volatility of the stocks, the feature of long-term memory in LSTM and GRU may prove to be a disadvantage, whereas the RNN model having a short-term memory component may give better results.
- The common scenario across all the models is the lag of one or more days in the predicted stock prices.
- The RNN and Ensemble models followed the trends more accurately than others, except for major deviations (cause by unforeseen circumstances) in the prices.

Conclusion

- We have primarily focused on technical analysis using machine learning approaches
- Our project shows that there is some validity in predicting stock trends using historical data, which may be useful for trading analysis.
- These algorithms could perhaps be used as a buying or selling signal or it could be used to give confidence to a trader's prediction of stock prices.
- Based on the outcomes of our project, we suggest that the RNN model performs significantly better as compared to the GRU, LSTM, and Ensemble models.

Conclusion

- We can use these algorithms for developing various automated trading algorithms like a trading bot.
- Since there are various other machine learning approaches as well as statistical approaches, we cannot state with confidence, which model has the best performance with regards to accurate prediction of the stock price for the next day.
- Lastly, we need to keep in mind that there can be a considerable swing in prices due to unforeseen events like natural disasters, wars, financial crisis or any small incidents which occur time-to-time, and no prediction model or approach can be full-proof.

Contemporary Research

- The issue of lag in the prediction of stock prices has been around for some time now. The removal of such a lag is itself an area of research being pursued by many at present.
- ARIMA (Auto-Regressive Integrated Moving Average) is another strategy being widely used for stock price prediction. It is a class of models that ‘explains’ a given time series based on its past values, that is, its lags and the lagged forecast errors, so that equation can be used to forecast future values.
- Q-Learning uses Reinforcement Learning and Sentiment Analysis from social media which may predict stock movement more accurately using historical data. Using social media comments and tweets analysis regarding a stock along with the reinforcement model, another technique can be developed to predict stock prices with more accuracy.

Contemporary Research

- FLANN and Cascaded FLANN (CFLANN) are other machine learning approaches that are being considered for time-series prediction.
- In addition to historical time-series data, company fundamentals can also be incorporated for the task of stock price prediction. CANSLIM, which was developed by William J. O'Neil, is a system for selecting growth stocks using a combination of fundamental and technical analysis techniques.

Thank You!