STOCK PRICE PREDICTION

Project report submitted

in

Partial fulfilment of requirement for the award of the degree of

Bachelor of Technology

in

Artificial Intelligence

by

Aditya Bhagwat

Khushal Shinde

Monali Patle

Om Barde

Under the guidance of

Prof. Rahul Suryawanshi

Asst. Prof. AI Department

Department of Artificial Intelligence

G H Raisoni Institute of Engineering and Technology, Nagpur

(An Autonomous Institute Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Accredited by NAAC with A+ Grade

2021-22

STOCK PRICE PREDICTION

Project report submitted

in

Partial fulfilment of requirement for the award of the degree of

Bachelor of Technology

in

Artificial Intelligence

by

Aditya Bhagwat

Khushal Shinde

Monali Patle

Om Barde

Under the guidance of

Prof. Rahul Suryawanshi

Asst. Prof. AI Department

Department of Artificial Intelligence

G H Raisoni Institute of Engineering and Technology, Nagpur

(An Autonomous Institute Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

Accredited by NAAC with A+ Grade

2021-22

G H Raisoni Institute of Engineering and Technology, Nagpur
(An Autonomous Institute)

Department of Artificial Intelligence

Certificate

The report of project titled **Stock Price Prediction** submitted by Aditya Bhagwat, Khushal Shinde, Monali Patle, Om Barde in the partial fulfilment of the degree of Bachelor of Technology in **Artificial Intelligence** during academic year 2021-22, has been carried out under our supervision at the Department of Artificial Intelligence of G H Raisoni Institute of Engineering and Technology, Nagpur. The work is comprehensive, complete and fit for evaluation.

Prof. Rahul Suryawanshi
Asst. Prof. AI Department

Dr. Smita Nirkhi
HOD, AI Department

Dr. Vivek Kapur
Director, GHRIETN

G H Raisoni Institute of Engineering and Technology, Nagpur

(An Autonomous Institute)

Department of Artificial Intelligence

Declaration

We certify that

a. The work contained in this project has been done by us under the guidance of our supervisor.

b. The work has not been submitted to any other Institute for any degree or diploma.

c. We have followed the guidelines provided by the Institute in preparing the project report.

d. We have confirmed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.

e. Whenever We have used materials (data, theoretical analysis, figures, and text) from other sources, we have given due credit to them by citing them in the text of the report and giving their details in the references. Further, We have taken permission from the copyright owners of the sources, whenever necessary.

(Aditya Bhagwat) *(Khushal Shinde)*

(Monali Patle) *(Om Barde)*

G H Raisoni Institute of Engineering and Technology, Nagpur

(An Autonomous Institute)

Department of Artificial Intelligence

Acknowledgement

We have taken efforts in this project. However, it would not have been possible without the kind support and help from many individuals and organizations. We would like to extend my sincere thanks to all of them.

Our deepest thanks to **Prof. Rahul Suryawanshi** lecturer from Artificial Intelligence department In G. H. Raisoni Institute of Engineering and Technology, Nagpur for guiding, supervising, providing us with necessary information about the project and correcting various prototypes and documents of us with attention and care. He has gone with us through the project and without his help we were not able to complete our project.

We also would like to express our gratitude towards our college and all our professors in the college who have given us a great chance to undergo this project and also provide us with knowledge to complete it.

Our thanks and appreciations also go to our colleagues in developing this project and people who have willingly helped us out with their abilities.

Name of Projectees

1. Aditya Bhagwat
2. Khushal Shende
3. Monali Patle
4. Om Barde

TABLE OF CONTENT

ABSTRACT

The purpose of this thesis is to investigate the effectiveness of Ensembles of long short-term memory networks trained by backpropagation through time for stock price prediction. Predicting exchange prices could also be a sophisticated task that traditionally involves intensive human-computer interaction. Due to the correlative nature of stock prices, standard execution methods cannot be utilized expeditiously for exchange analysis. we've an inclination to propose a web learning rule that utilizes a form of continual neural network (RNN) cited as Long Short-Term Memory (LSTM), wherever the weights are unit adjusted for individual info points mistreatment random gradient descent.

It has never been easy to invest in a portfolio of assets; the abnormalities of the financial market prevent simple models from accurately predicting future asset values. Machine learning, which is teaching computers to execute activities that would ordinarily need human intelligence, is the current scientific study hot topic. This article tries to develop a model for predicting future stock market values using Recurrent Neural Networks (RNN) and, in particular, the Long-Short Term Memory model (LSTM). The main goal of this paper is to investigate how accurate a Machine Learning algorithm can predict and how much the epochs can help our model.

For many experts and analysts, projecting stock prices has proven to be a difficult undertaking. In reality, stock price prediction research has piqued the curiosity of investors. Many investors are interested in knowing the stock market's future scenario in order to make a smart and successful investment. Traders, investors, and analysts benefit from good and successful stock market prediction systems since they provide helpful information such as the stock market's future direction. In this paper, we show how to predict stock market indices using a recurrent neural network (RNN) and a Long Short-Term Memory (LSTM) technique.

CHAPTER 1: INTRODUCTION

1.1 Background of study

Financial statistical prediction has been addressed since the Eighties. Stocks are terribly volatile; this complicated nature of stock costs could be a vital attraction for researchers and statisticians to search out some way to predict them. Despite the many analysis publications in this field, there are still many who claim that stock markets can't be expected. This can be primarily attributable to the quantity of things that have an effect on stocks costs and people factors themselves rely on other, probably unknown factors.

The additional ordinarily used approach for securities market predictions is to use past experiences in worth amendments to predict future change in costs. "Financial prediction is associate degree example of a symptom process drawback that is difficult because of tiny sample sizes, high noise, non-stationarity. and non-linear", in line with Lee Giles With stocks, the info is usually the stock values from period of time transactions and thus obtaining an outsized sample can rely on a additional extended period of time. an extended amount of your time doesn't continuously provide the correct result because the monetary markets don't seem to be stable at such intervals. However, if the factors that impact stock costs is understood, then it may well be potential to predict {the costs the costs} while not looking forward to historical prices most. Understanding

all the factors are nearly not possible, therefore a possible resolution to its drawback is mentioned during this thesis. Given the complicated nature of stocks, machine learning is maybe the most effective approach for this application. There are several analysis papers that mistreat some style of machine learning, like feed forward neural networks 121, SVM, and repeated neural networks for securities market predictions.
additionally, recently used neural networks to predict the price for successive days.

1.2 Problem statement

Financial analysts who invest in stock markets usually are not aware of the stock market behaviour. They are facing the problem of stock trading as they do not know which stocks to buy and which to sell in order to gain more profits. All these users know that the progress of the stock market depends a lot on relevant news and they have to deal daily with vast amounts of information. They have to analyse all the news that appears in newspapers, magazines and other textual resources. But analysis of such a large amount of financial news

and articles in order to extract useful knowledge exceeds human capabilities. Text mining techniques can help them automatically extract the useful knowledge out of textual resources.

Considering the assumption that news articles might give much better predictions of the stock market than analysis of past price developments, and in contrast to the traditional time series analysis, where predictions are made based solely on the technical and fundamental data, we want to investigate the effects of textual information in predicting the financial markets. We would develop a system which is able to use text mining techniques to model the reaction of the stock market to news articles and predict their reactions. By doing so, the investors are able to foresee the future behaviour of their stocks when relevant news is released and act immediately upon them.

As input we use real-time news articles and intra-day stock prices of some companies in Tehran Stock Exchange. From these a correlation between sure options found in these articles And changes available costs would be created and therefore the prophetic model is learned through an acceptable text classifier. Then we tend to feed the system with new news articles and hope that the options found within these articles can cause identical reactions as in the past. Hence the prediction model will notify the up or down of the stock price movement when upcoming news is released and investors can act upon it in order to gain more profit. To find the relationship between stock price movement and the features in news articles, appropriate data and text mining techniques would be applied and different programming languages are used to implement the different data and text mining techniques.

1.3 Objectives and scope of study

The financial market may be a complicated, biological process, and non-linear phase space. the sector of economic statements is characterized by knowledge intensity, noise, and non-stationary. unstructured nature, high degree of uncertainty, and hidden relationships. several factors act in finance as well as political events, general economic conditions, and traders" expectations. Therefore, predicting worth movement in monetary markets is kind of troublesome.

- The main objective of this study is to predict the longer term stock worth by analyzing the past historical knowledge that we tend to collect from the National exchange.
- Predicting the exchange value in such a way that it'll offer the most correct results.

Stock market worth statements ought to be drained in such a way that foreseen worth ought to minimize the brink price (difference between actual price and foreseen price additionally called mispricing) and shut enough to the particular price.

- Process of analysing historical knowledge ought to be easy and simple to know. For this feature identification will be done showing intelligence to produce most correct results.
- To increase the potency of the information analysis technique by victimization some cloud primarily based tools.
- To analyse the performance and scrutiny projected formula with the prevailing algorithms in terms of foreseen worth accuracy, shut worth foreseen and correct shut worth etc.
- The overall purpose of study are often summarized within the following analysis questions:
- How to predict the reaction of stock worth trends victimization matter monetary news?
- How knowledge and text mining techniques facilitate to get this prophetical model?

In order to analyse the impact of reports on a stock trend movement, we've to form a prediction model. to form the prediction model, we've to use totally different completely different} knowledge and text mining techniques and so as to implement these techniques; we've to use different programming languages. totally different steps within the analysis method area unit programmed and coded and area unit combined along to form the prediction model.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A stock is a type of security that signifies ownership in a corporation and represents a claim on the part of the corporation's assets and earnings. Stocks are also known as shares or equity. Owning shares in a company gives the owner the right to vote in shareholder meetings, receive dividends and the right to sell the shares. If one owns more shares, then they have more voting power and hence indirectly control the direction of a company. However, for a stock trader, the primary concern is the value of a stock.

Stock market is a very important part of national economic development. foretelling stock worth movements is vital for governments, investors and investment establishments. Therefore, it attracts several students to conduct analysis. However, the worth trend of the securities market could also be influenced by political factors, economic science factors, legal factors, etc., leading to nice uncertainty and volatility of the stock worth, creating a serious drawback in analysis [3].

This model considers the historical equity share worth of an organization and applies RNN (Recurrent) technique referred to as Long Short-Term Memory (LSTM) [7]. The planned approach considers obtainable historic knowledge of a share and it provides predictions on a specific feature. The options of shares are gap worth, day High, day Low, previous day of worth, shut worth, Date of commerce, Total Trade amount and Turnover. The planned model uses statistical analysis so as to predict a share worth for a needed time span. the planned are going to be considering Bharat securities market Company named because the National securities market of India restricted (NSE).The National securities market (NSE) is that the Indian securities market entity, the NSE was the primary exchange in Bharat to produce a contemporary, provides latest facility to the investors unfold across the length and breadth of the country.

Recently, LSTM has attracted several students to use it in predicting the stock costs [10]. we tend to introduce the subsequent connected works. In 2016, paragraph vector was applied to get distributed representations of newspaper articles, and a LSTM model that takes under consideration matter info was planned to take care of the influence of your time series. In 2018, the Conv1D-LSTM model, a mix of 1-dimensional convolution neural network (CNN) and LSTM model, was planned to predict stock costs. This model will absorb strengths from 2 networks: CNN will effectively perform feature extraction and LSTM will handle ordered knowledge well.

Buying and Selling Stocks

For most stock traders the most crucial aspect of stocks is the ability to buy and sell to make profits. A company's stock price is initially set based on the company's value, revenues, and some other factors. After that its value changes based on the availability and demand of the stock. When a large portion of the available stock is purchased, then the stock's value goes up after that purchase. Similarly, if a large portion of the stock is sold and available, then its value goes down. Typically, it is essential for a trader to understand what a company's stock should be valued at. Having this information will allow the trader to buy those stocks if its present value is below what it should be and sell it if its value is above its actual value. 6 In stock markets, there is always an upward trend due to inflation and other forces because new money goes into the market every day. Hence making a profit does not automatically imply a good trading system; one can merely buy well fairing stocks, and over a long period of time, they tend to make a profit.

CHAPTER 3: METHODOLOGY

3.1 Research Methodology

This idea of research we got from the "Stock Price Prediction Using Long Short-Term Memory" [9] where the author wants to predict the data using Long Short-Term Memory.

3.1.1 Existing System

The approaches to exchange analysis and stock worth prediction embrace basic analysis, that look at a stock's past performance and thus the overall quality of the corporate itself, and math analysis, that's entirely involved with computing and characteristic patterns available price variation. The latter is typically achieved with the help of Genetic Algorithms (GA) or Artificial Neural Networks (ANN's), but these fail to capture correlation between stock prices inside the variability of long-run temporal dependencies. Another major issue with exploiting simple ANNs for stock prediction is that the event of exploding / vanishing gradient, where the weights of associated oversized networks either become large or insufficient (respectively), drastically pace their convergence to the most effective worth. This can be sometimes caused by a pair of factors: weights are initialized arbitrarily, and thus the weights nearer to the highest of the network conjointly tend to change a good deal over those at the beginning. Another approach to exchange analysis is to chop back the property of the pc file and apply feature choice algorithms to vary a core set of choices (such as GDP, oil price, rate, etc.) that have the most effective impact on stock prices or currency exchange rates across markets. However, this technique does not rely on long term commerce ways as a result of it fails to want the entire history of trends into account; what is more, there is no provision for outlier Short-Term are a special set of RNs which can capture context-specific temporal dependencies for long periods of your time. Each LSTM somatic cell could also be a memory cell which can store totally different info i.e., it maintains its own cell state.

3.2 Project Activities

3.2.1 Long Short-Term Memory (LSTM)

LSTM square measures a special set of RNs which will capture context-specific temporal dependencies for long periods of your time. Each LSTM vegetative cell can be a memory cell which will store various data i.e., it maintains its own cell state.

whereas neurons in ancient RNN's merely absorb their previous hidden state and therefore the current input to output a replacement hidden state, the associated LSTM nerve cell in addition takes in its recent cell state and outputs its new cell state.

An LSTM memory cell has the subsequent 3 parts, or gates:

- Forget gate: the forget gate decides once specific parts of the cell state square measure to get replaced with newer data. It outputs values on the point of one for elements of the cell state that ought to be maintained, and 0 for values that ought to be neglected.
- Input gate: supported the input (i.e., previous output o(t-1), input x(t), and former cell state c(t-1)), this section of the network learns the conditions beneath that any data ought to be hold on (or updated) within the cell state
- Output gate: reckoning on the input and cell state, this portion decides what data is propagated forward (i.e., output o(t) and cell state c(t)) to the ensuing node within the network.

3.2.2 Advantages of LSTM

The main advantage of associate LSTM is its ability to search out context specific temporal dependence. Each LSTM unit remembers data for either associate extended or a brief amount of it slow (hence the name) whereas not expressly victimizing associate activation performed among the continual components.

A vital truth to note is that any cell state is hyperbolic solely by the output of the forget gate, which varies between zero and one. That is, the forget gate in an associated LSTM cell is answerable for every of the weights and additionally the activation performance of the cell state. Therefore, information from a previous cell state can labour under a cell unchanged instead of increasing or decreasing exponentially at each timestep or layer, and therefore the weights can converge to their best values in associate extremely low-cost quantities of it slowly.

This permits LSTM to resolve the vanishing gradient drawback – since the value unbroken in an associated extreme memory cell isn't iteratively modified, the gradient does not vanish once trained with backpropagation.

An overview of Recurrent Neural Network (RNN)

In a classical neural network, final outputs rarely act as associate degree output for subsequent steps; however, if we tend to listen to a real-world development, we tend to observe that in several things our final output depends not solely on the external inputs however additionally on earlier output. As an example, once humans browse a book, understanding of every sentence depends not solely on the current list of words

however additionally on the understanding of the previous sentence or of the context that's created victimisation of past sentences. Humans don't begin their thinking from scratch each second. As you browse

this essay, you perceive every word primarily based on your understanding of previous words. This construct of 'context' or 'persistence' isn't accessible with classical neural networks. Inability to use context-based reasoning becomes a major limitation of ancient neural networks. repeated neural networks (RNN) square measure conceptualized to alleviate this limitation square measure networked with feedback loops among to enable persistence of knowledge. The Figure 1Error! Reference supply not found. shows a straightforward RNN with a circuit and its unrolled equivalent version aspect by aspect.

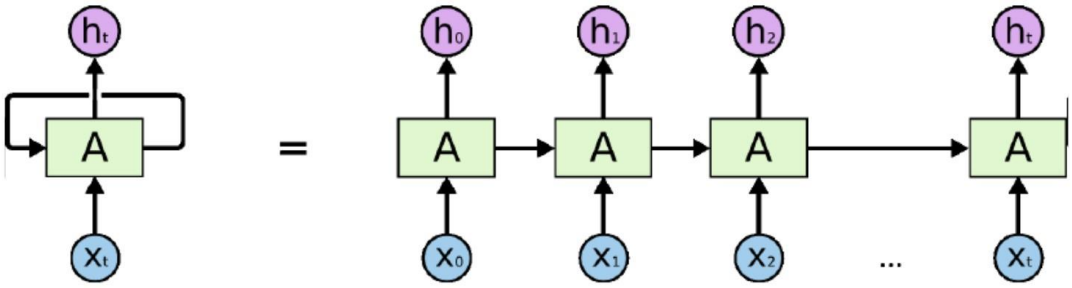


Figure 1: An unrolled recurrent neural network

Initially (at time step t) for some input Tx the RNN generates an output of ht. In the next time step (t+1) the RNN takes two inputs Xt+1 and hit to generate the output ht+1. A loop allows information to be passed from one step of the network to the next. RNNs are not free from limitations though. When the 'context' is from the near past it works great towards the correct output. But when an RNN has to depend on a distant 'context' (i.e., something learned long past) to produce correct output, it fails miserably. This limitation of the RNNs was discussed in great detail by Hochester [8] and Bengio, et al. [9]. They also traced back to the fundamental aspects to understand why RNNs may not work in long-term scenarios. The good news is that the LSTMs are designed to overcome the above problem.

Recurrent neural networks are in the form of a chain of repeating modules of the neural network. In standard RNNs, this repeating module has a simple structure like a single tanh layer as shown in Figure 2.

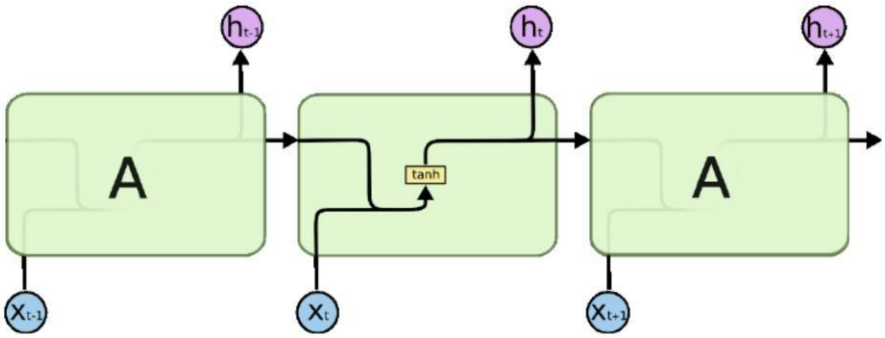


Figure 2: The repeating module in a standard RNN contains a single layer

The repeating module in a standard RNN contains a single layer. LSTMs follow this chain-like structure; however, the repeating module has a different structure. Instead of having a single neural network layer, there are four layers, interacting in a very special way as shown in Figure 3.

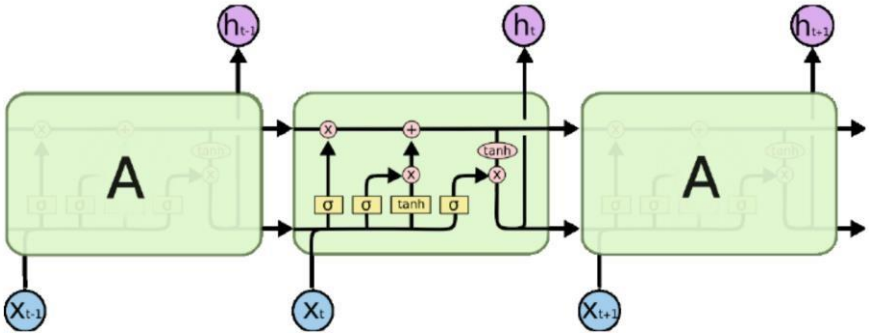


Figure 3: The repeating module in an LSTM contains four interacting layers

In Figure 3, every line represents an entire feature vector, from the output of one node to the inputs of others. The pink circles represent pointwise operations, like vector addition, while the yellow boxes are learned neural network layers. Lines merging denote concatenation, while a line forking denotes its content being copied and the copies going to different locations.

The Working of LSTM

The key to LSTMs is the cell state, the horizontal line running through the top of the diagram. The cell state is like a conveyor belt. This runs straight down the entire chain, having some minor linear interactions. LSTM has the ability to add or remove information to the cell state, controlled by structures called gates.

Gates are used for optionally letting information through. Gates are composed of a sigmoid neural net layer and a pointwise multiplication operation. The sigmoid layer outputs numbers between 0 and 1, describing how much of each component should be let through. A value of 0 means “let nothing through,” while a value of 1 means “let everything through!” An LSTM has three of these gates, to protect and control the cell state. The first step of LSTM is to decide what information is to be thrown out from the cell state. It is made by a sigmoid layer called the “forget gate layer.” It looks at ht−1 ht−1 and xtxt, and outputs a number between 00 and 11 for each number in the cell state Ct−1 Ct−1. A 11 represents “completely keep this" while a 00 represents “completely remove this.” In the next step it is decided what new information is going to be stored in the cell state. It has two parts. First, a sigmoid layer called the “input gate layer” decides which values are to be updated. Thereafter, a tanh layer creates a vector of new candidate values, C~tC~t, that could be added to the state. In the next step, these two are combined to create an update to the state. It is now time to update the old cell state, Ct−1Ct−1, into the new cell state CtCt. We multiply the old state by ftft. Then we add it∗ C~tit∗C~t. This is the new candidate values, scaled by how much we decide to update each state value.

Finally, we need to decide on the output. The output will be a filtered version of the cell state. First, we run a sigmoid layer which decides what parts of the cell state we’re going to output. Then, we put the cell state through tanh-tanh (to push the values to be between −1−1 and 11) and multiply it by the output of the sigmoid gate, so that we only output the parts we decided to.

3.3. TOOLS

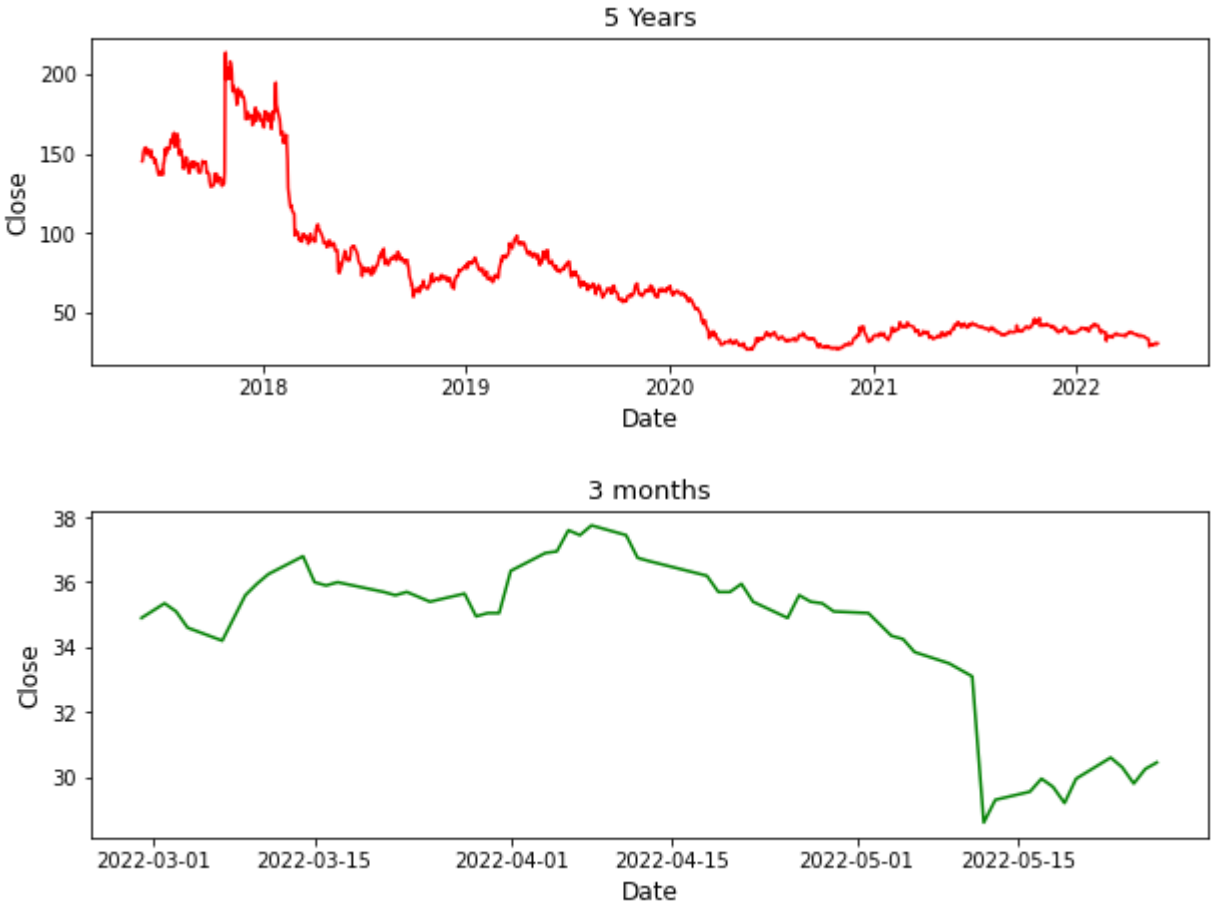
The tools/ software required to develop this website are:

- Frontend Programming Language: Python
- Styling and Front End: Python
- Backend: Deep Learning
- Database: Yahoo finance

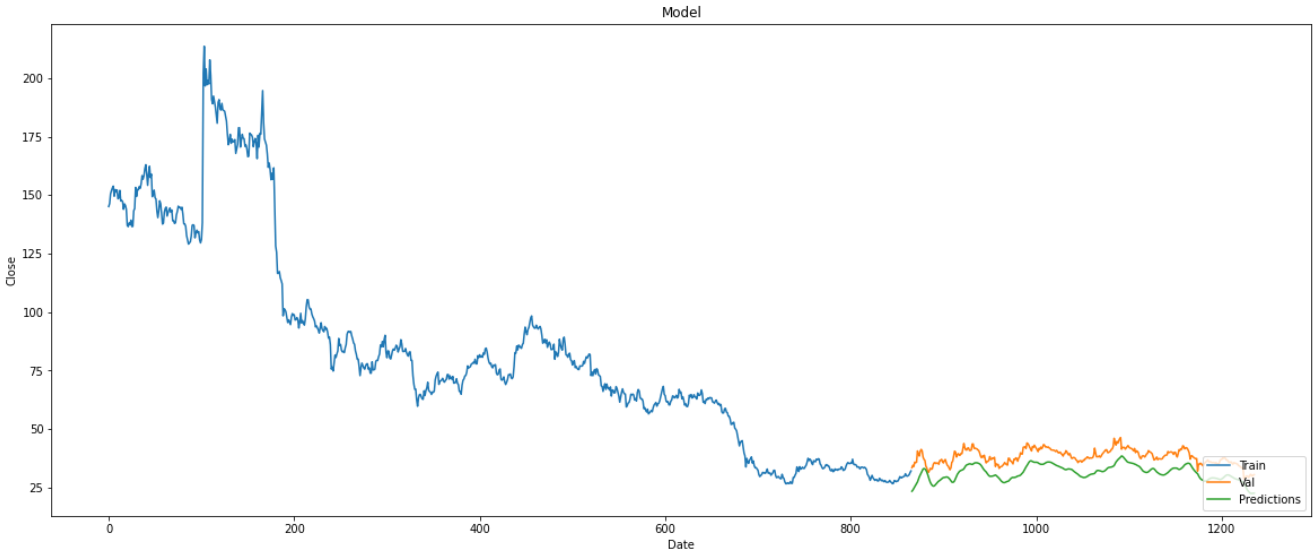
CHAPTER 4: RESULTS AND DISCUSSIONS

The exchange could also be an outsized array of investors and traders United Nations agency get and sell stock, pushing the worth up or down. the prices of stocks unit dominated by the principles of demand and supply, and thus the ultimate goal looking for Shopping for} shares are to make money by shopping for stocks in corporations whose perceived price (i.e., share price) is foreseen to rise. algorithm predictions and models are typically at home with produce future predictions applied to historical info. Predicting the end of the day has been a daunting task, one that many have found difficult to grasp. This type of prediction is even heaps additional appealing once it involves money and risks like exchange speculation. d. Short-term Memory (LSTM) is one in each of a spread of RNNs structures. LSTM replaces ancient artificial neurons at intervals the hidden network layer into the foremost useful memory cells. With these memory cells, networks are a unit able to associate memory with remote input over time, that's why it's worthy to grasp the formation of durable info over time with nice foreboding power.

Initially the data for MRF is,



After the data normalization and formatting to feed the model, the model was trained and the result is,



4.1. Use Case Diagram

A use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system. To build one, you'll use a set of specialized symbols and connectors.

An effective use case diagram can help your team discuss and represent:

- Scenarios in which your system or application interacts with people, organizations, or external systems
- Goals that your system or application helps those entities (known as actors) achieve ● The scope of your system

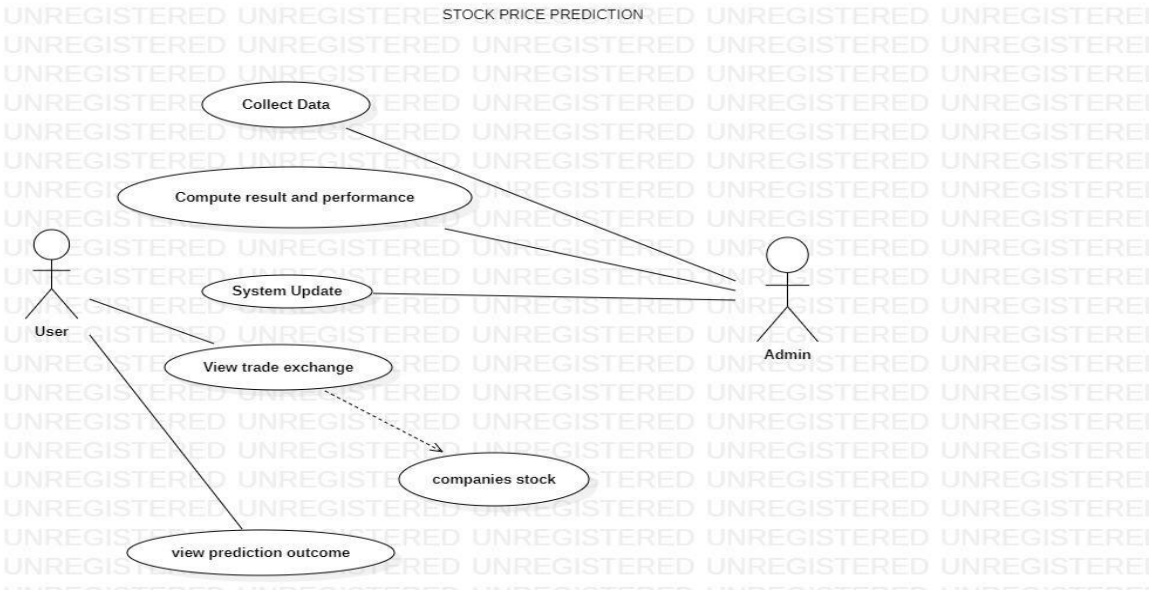


Figure 4: Use Case Diagram for Stock Price Prediction

4.2. System Flow Chart

System flowcharts are a way of displaying how data flows in a system and how decisions are made to control events. System Architecture of Stock Market Prediction using LSTM.

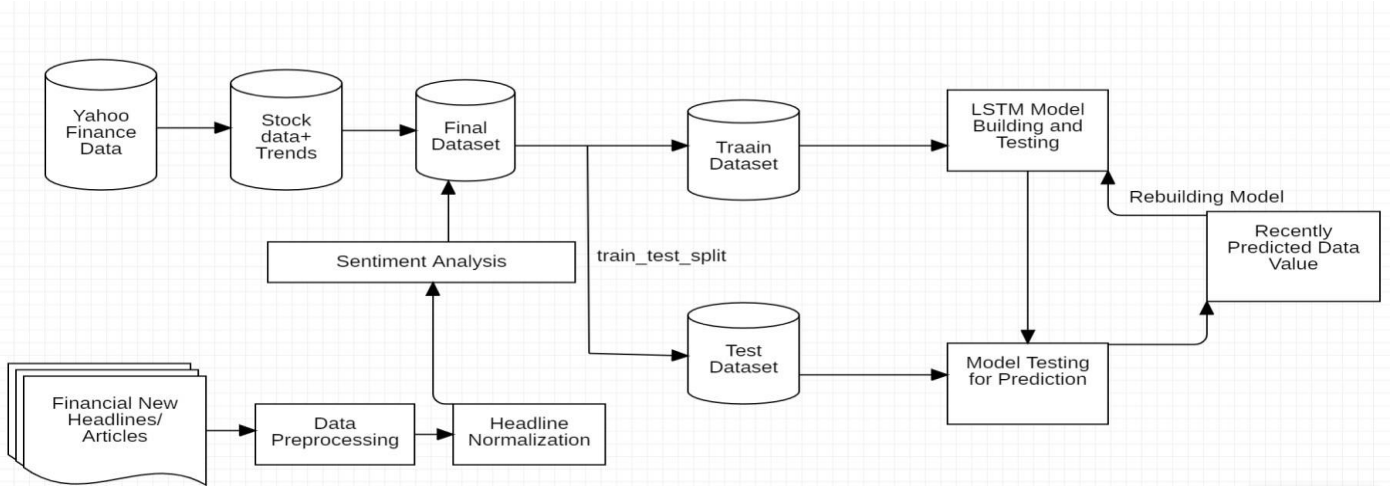


Figure 5: System Flow Chart for Stock Price Prediction

4.4. Data Flow Diagram

A data-flow diagram is a way of representing a flow of data through a process or a system (usually an information system). The DFD also provides information about the outputs and inputs of each entity and the process itself. A data-flow diagram has no control flow — there are no decision rules and no loops.

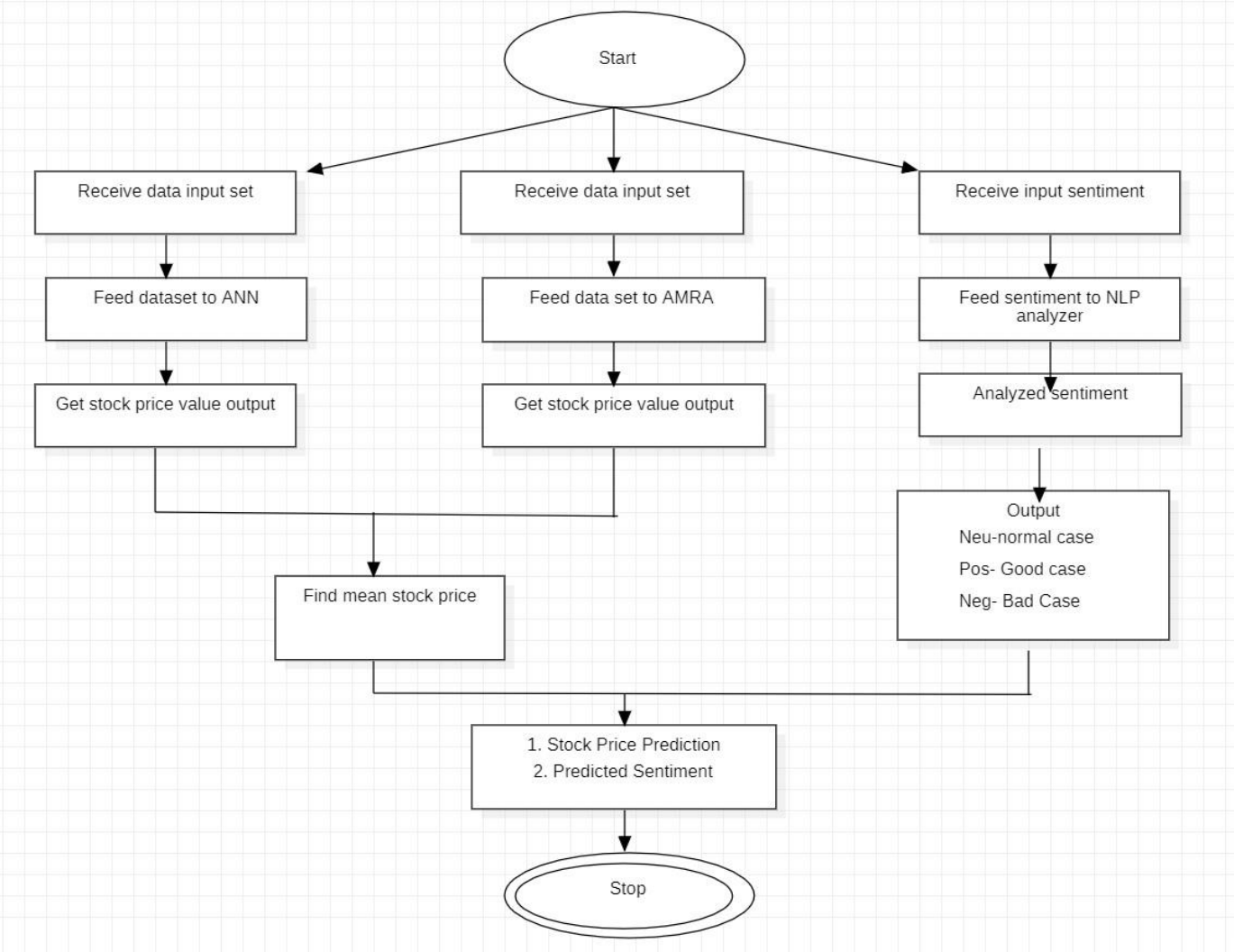


Figure 6: Data Flow Diagram for Stock Price Prediction

4.5. Class Diagram

Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application.

The purpose of the class diagram can be summarized as −

- Analysis and design of the static view of an application.
- Describe responsibilities of a system.
- Base for component and deployment diagrams.
- Forward and reverse engineering.

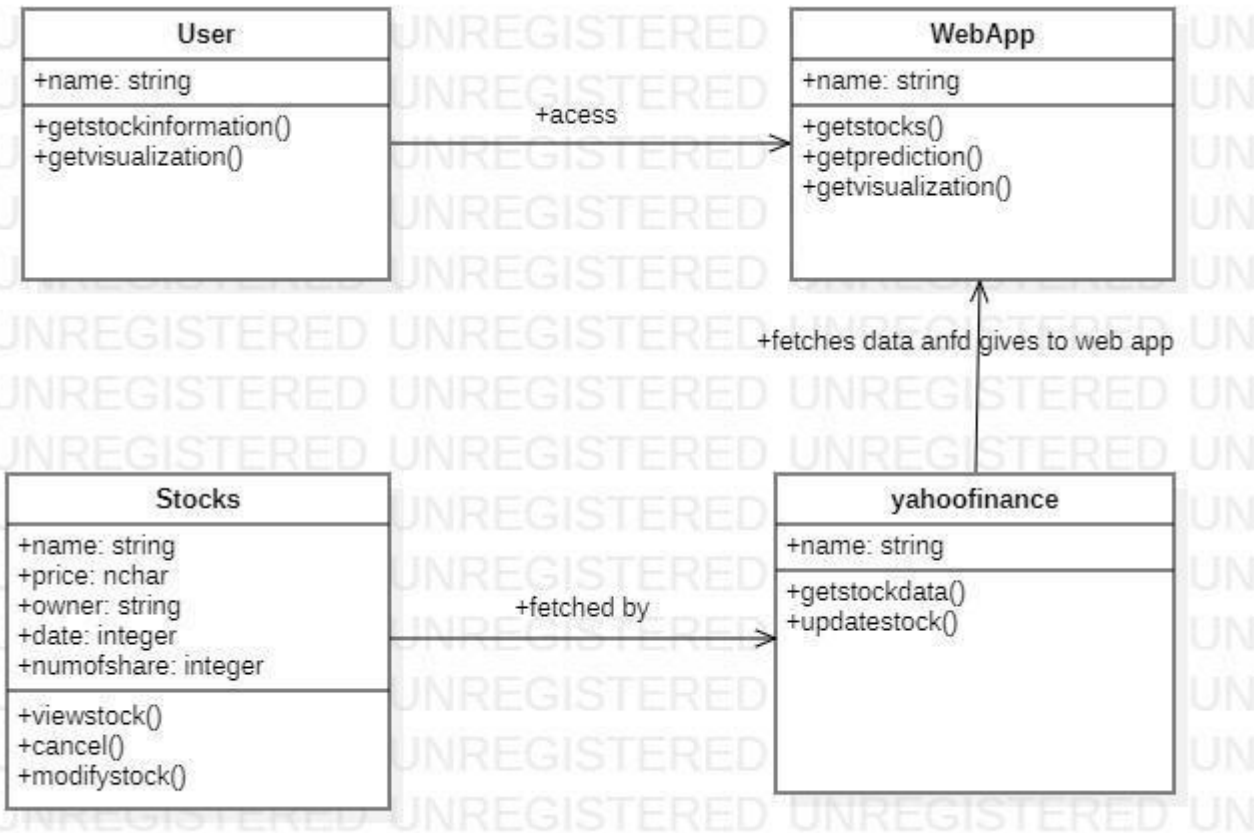


Figure 7: Class Diagram for Stock Price Prediction

CHAPTER 5: SUMMARY AND CONCLUSIONS

The results of comparison between Long Short-Term Memory (LSTM) and Artificial Neural Network (ANN) show that LSTM features a higher prediction accuracy than ANN. Stock markets are exhausting to observe and need lots of context once attempting to interpret the movement and predict prices. In ANN, every hidden node is solely a node with a single activation operation, whereas in LSTM, every node may be a memory cell that may store discourse data. As such, LSTMs perform higher as they're ready to keep track of the context-specific temporal dependencies between stock prices for an extended amount of your time whereas playacting predictions.

REFERENCES

[1] *Rao, Polamuri Subba, Kudipudi Srinivas, and A. Krishna Mohan. "A survey on stock market prediction using machine learning techniques." In ICDSMLA 2019, pp. 923-931. Springer, Singapore, 2020.*

[2] *Ghosh, Pushpendu, Ariel Neufeld, and Jajati Keshari Sahoo. "Forecasting directional movements of stock prices for intraday trading using LSTM and random forests." Finance Research Letters 46 (2022).*

[3] *Wen, Yulian, Peiguang Lin, and Xiushan Nie. "Research of stock price prediction based on the PCALSTM model." In IOP Conference Series: Materials Science and Engineering, vol. 790, no. 1, p. 012109. IOP Publishing, 2020.*

[4] *Gao, Ya, Rong Wang, and Enmin Zhou. "Stock Prediction Based on Optimized LSTM and GRU Models." Scientific Programming 2021 (2021).*

[5] *Selvin, Sreelekshmy, R. Vinayakumar, E. A. Gopalakrishnan, Vijay Krishna Menon, and K. P. Soman. "Stock price prediction using LSTM, RNN and CNN-sliding window model." In 2017 international conference on advances in computing, communications and informatics (icacci), pp. 1643-1647. IEEE, 2017.*

[6] *Moghar, Adil, and Mhamed Hamiche. "Stock market prediction using LSTM recurrent neural network." Procedia Computer Science 170 (2020).*

[7] *Pramod, B. S., and Mallikarjuna Shastry Pm. "Stock price prediction using LSTM." Test Engineering and Management 83 (2020).*

[8] *Shen, Jingyi, and M. Omair Shafiq. "Short-term stock market price trend prediction using a comprehensive deep learning system." Journal of big Data 7, no. 1 (2020).*

[9] *Nandakumar, Raghav, K. R. Uttamraj, R. Vishal, and Y. V. Lokeswari. "Stock price prediction using long short term memory." International Research Journal of Engineering and Technology 5, no. 03 (2018).*

[10] *Peng, Zong-Yu, and Pei-Chang Guo. "A Data Organization Method for LSTM and Transformer When Predicting Chinese Banking Stock Prices." Discrete Dynamics in Nature and Society 2022.*

[11] *Ghosh, Achyut, Soumik Bose, Giridhar Maji, Narayan Debnath, and Soumya Sen. "Stock price prediction using LSTM on Indian share market." In Proceedings of 32nd international conference on, vol. 63, pp. 101-110. 2019.*