A STOCK WEB-APPLICATION WITH PRICE PREDICTION USING LSTM AND ALGORITHMIC TRADING

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*Abstract*— The prediction of a stock market web application that may serve as an early recommendation system for short-term investors and as an early financial distress warning system for long-term shareholders. Forecasting accuracy is the most important factor in selecting any forecasting methods. Research efforts in improving the accuracy of forecasting models are increasing since the last decade. The appropriate stock selections those are suitable for investment is a very difficult task. The key factor for each investor is to earn maximum profits on their investments. We used deep learning and more precisely one of the most famous recurrent neural networks : LSTM, in order to perform stock market prediction. Since it is necessary to mention that stock market prediction is not an easy task since the prediction part could be divided into two : fundamental analysis (sales, earning, profits, etc.) and technical analysis (historical price, VWAP, etc.). This means numerous factors could affect the stock price trends, but here we used only time series forecasting using the historical price of a given stock. We used Long Short Term Memory, a commonly used RNN. Considering the type of data that we will be feeding our model and the ability of a RNN to allow information to persist unlike standard feed forward neural networks ( they could only process single data points e.g. images ), an LSTM is the best fit for these type of problems. LSTM could easily process an entire sequence of data and it introduces the memory cell, which make the network able to effectively associate memories and input remote in time. In this example we fed our model with a set of sequences that will help predict a given price using time steps. The final predicted model will be displayed in a web-application, so this will be user-friendly.

Keywords—stock market, LSTM, price prediction, algo-trading

# Introduction

The stock market is a vast array of investors and traders who buy and sell stock, pushing the price up or down. The prices of stocks are governed by the principles of demand and supply, and the ultimate goal of buying shares is to make money by buying stocks in companies whose perceived value (i.e., share price) is expected to rise. Stock markets are closely linked with the world of economics —the rise and fall of share prices can be traced back to some Key Performance Indicators (KPI's). The five most commonly used KPI's are the opening stock price (`Open'), end-of-day price (`Close'), intraday low price (`Low'), intra-day peak price (`High'), and total volume of stocks traded during the day (`Volume'). Economics and stock prices are mainly reliant upon subjective perceptions about the stock market. It is near impossible to predict stock prices to the T, owing to the volatility of factors that play a major role in the movement of prices. However, it is possible to make an educated estimate of prices. Stock prices never vary in isolation: the movement of one tends to have an avalanche effect on several other stocks as well. This aspect of stock price movement can be used as an important tool to predict the prices of many stocks at once. Due to the sheer volume of money involved and number of transactions that take place every minute, there comes a trade-off between the accuracy and the volume of predictions made; as such, most stock prediction systems are implemented in a distributed, parallelized fashion. These are some of the considerations and challenges faced in stock market analysis.

# LITERATURE REVIEW

## Explainable Deep Convolutional Networks

In this paper, Gramian Angular Summation Field (GASF) – Convolutional Neural Network (CNN) model is used to find the candlestick patterns and their model was able to find 8 major candlestick patterns with 90% accuracy. They’ve used EUR/USD 1-minute open, high, low, and close price data to produce their empirical results. The training data is from January 1, 2010 to January 1, 2016. The testing data is from January 2, 2016 to January 1, 2018. There are eight patterns and each label includes 1500 data. If the pattern does not belong to any one of the eight patterns, we set that kind of patterns as the label 0 and there are 3000 samples in this category. [5] But the drawback in this paper’s method is that the working of the model is not confirmed using analytical method yet.

## Stock Price Prediction Using Long Short Term Memory

In this paper, a stock price prediction model using LSTM has been constructed and has been tested with 1 small-cap, 2 medium-cap, 2 large-cap companies to predict their end of the day stock price. The drawback in this system is that it can only predict the end of the day stock price and not for cumulative days.

## Stock Price Prediction Using Long Short Term Memory

In this paper, ANN has been primarily used to predict the price of a stock. They’ve used two different markets NSE and NYSE to test their model. MARUTI, HCL, AXIS BANK has been chosen to test the algorithm from NSE and Chesapak Energy (CHK) and Bank of America (BAC) have been chosen to test their algorithm from NYSE. The model discussed in the paper has worked properly for these stocks but in certain cases, other models like CNN have outperformed the chosen model. So, a hybrid model is not taken into account in this paper.

## The Application of Stock Index Price Prediction with Neural Network

In this paper, various techniques such as Multi-Layer Perceptron (MLP), Long Short Term Memory (LSTM) and Convolutional Neural Network (CNN) have been used to predict the stock price prediction of market indices. Three indices namely S&P 500, NIKKEI 225, and CSI 300 have been chosen and the closing prices of these indices haven been predicted. The model used in this paper has been very less accurate to less developed financial markets such as CSI 300. Also, their model uses as time step 20 which will take a long time if it is to be predicted for a longer interval.

## Stock Price Prediction Using Artificial Neural Networks

In this paper, the prediction has been done only for a single company INFRATEL using the past 400 days intraday closing price. Past 60 days data has been used for training LSTM and ANN models whereas 400 days data is used for training ARIMA and using neural networks. From the results, it’s been concluded that ANN models have been more efficient in predicting the stock price. The drawback of this system is that the price prediction for cumulative days is not done here.

# Stock Price Prediction

## Algorithm [5]

**Input:** Historical stock price data  
**Output:** Prediction for stock prices based on stock price variation

1. Start
2. Stock data is taken and stored in a numpy array of 3 dimensions using MinMaxScalar.
3. The data is split into testing set and training set.
4. LSTM neural network structure is build.
5. Train the constructed network on the data
6. Use the output of the last layer as prediction of the next time step.
7. Repeat steps 5 and 6 until optimal convergence is reached.
8. Obtain predictions by providing test data as input to the network.
9. Evaluate accuracy by comparing predictions made with actual data.
10. End.

Dataset is taken from the stock data of a particular company from the Symbol that is entered by the user. The data set contains information like previous closing, opening, high, low, volume of the stocks of that company. From these datasets, we extract only 65% of data; this data will be used to train the model. Using this trained set of data, predicting the next 10 days stock market price of that company can be accomplished. This closing price of stock is given preference as investors have to take decision on buying with only the stock closing value.

## LSTM – An Overview [5]

LSTM's are a special subset of RNN’s that can capture context-specific temporal dependencies for long periods of time. Each LSTM neuron is a memory cell that can store other information i.e., it maintains its own cell state. While neurons in normal RNN’s merely take in their previous hidden state and the current input to output a new hidden state, an LSTM neuron also takes in its old cell state and outputs its new cell state. An LSTM memory cell, as depicted in Figure 1, has the following three components, or gates: [5]

1. Forget gate: the forget gate decides when specific portions of the cell state are to be replaced with more recent information. It outputs values close to 1 for parts of the cell state that should be retained, and zero for values that should be neglected.
2. Input gate : based on the input (i.e., previous output o(t-1), input x(t), and previous cell state c(t- 1)), this section of the network learns the conditions under which any information should be stored (or updated) in the cell state
3. Output gate: depending on the input and cell state, this portion decides what information is propagated forward (i.e., output o(t) and cell state c(t)) to the next node in the network.

Thus, LSTM networks are ideal for exploring how variation in one stock's price can affect the prices of several other stocks over a long period of time. They can also decide (in a dynamic fashion) for how long information about specific past trends in stock price movement needs to be retained in order to more accurately predict future trends in the variation of stock prices.

## Obtaining dataset and pre-processing

Stock Data for various scrips were obtained from Yahoo Finance which provides an API to fetch the following data:

1. Date of the observation.
2. Opening price of the stock.
3. High: highest intra-day price reached by the stock.
4. Low: lowest intra-day price reached by the stock.
5. Volume: number of shares or contracts bought and sold in the market during the day.
6. Open Int. i.e., Open Interest: how many futures contracts are currently outstanding in the market.

The above data was then transformed into a format suitable for use with our prediction model by performing the following steps: [5]

1. Transformation of time-series data into input-output components for supervised learning.
2. Scaling the data to the [-1, +1] range.

## Construction of prediction model

The input data is split into training and test datasets; our LSTM model will be fit on the training dataset, and the accuracy of the fit will be evaluated on the test dataset. The LSTM network (Figure 2) is constructed with one input layer having five neurons, 'n' hidden layers (with 'm' LSTM memory cells per layer), and one output layer (with one neuron). After fitting the model on the training dataset, hyper-parameter tuning is done using the validation set to choose the optimal values of parameters such as the number of hidden layers 'n', number of neurons 'm' per hidden layer, batch size, etc. [5]

# Buy and sell signals

When an investor decides to buy or sell a particular stock, he must get the best price. To achieve that, our web-application provides buy and sell signals using Moving Averages for all stocks in the Indian Stock Exchange. We construct a simple moving average window for 10 days and 60 days. When the 10-day moving average crosses the 60-day moving average, we indicate a buy signal. When the 60-day moving average crosses the 10-day moving average, we indicate a sell signal. This strategy is followed by traders all over the world. However, the moving average window may vary from trader to trader according to their strategy.

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