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Performance Comparison of LSTM and SVR Models in Predicting Stock Prices

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Abstract-There were many models developed for predicting random and complicated stock price. Over past years, many researches were taking interest in stock price prediction. Deep learning techniques were used for better predicting of stock prices. In this paper, Long Short-Term Memory (LSTM) and Support Vector Regressor (SVR) model is used to predict Meta, Amazon, Apple, Netflix &Google (MAANG) companies stock prices, we used 6 years data from Dec 2017 to Dec 2022 from which we found that LSTM model provides better accuracy by comparing both results of Root Mean Squared Error (RMSE) & Mean Absolute Error (MAE) values.

Keywords-LSTM (Long Short-Term Memory), SVR (Support Vector Regressor), Stock price prediction, RMSE (Root Mean Squared Error), MAE (Mean Absolute Error), MPE (Mean Percentage Error), MINMAX (Minimization & Maximization Normalization), MAANG (Meta, Amazon, Apple, Netflix, Google).

1 Introduction

Despite its non-linearity and volatility, any economy cannot function without its stock market [1]. Patterns are very challenging to extract the valuable information. Investing in the stock market brings investors together and allows them to buy and sell shares. [2] The supply and demand of stocks will determine the price of their shares. Investment decisions and planning capabilities are empowered for institutions, individuals and develop effective strategies regarding their daily operations and future endeavors. [3] When there are high demand of any stock in market and their availability is less than the price of the stock will highly increase and on the other hand similarly if any stock is highly available in the market and buyers are not enough then stock price will decrease [4] [5].

The prediction of stock prices has been approached in a variety of innovative ways in the past. These approaches have the limitation that they are not sufficiently accurate [6] [7]. We found that LSTM provides better results in term of accuracy.

As soon as training data has been used to develop an accurate model. [8] A fixed-length period of stocks price data will be fed to the model by users and it will be possible to get the prediction for ten days in the future as the output. We predicted stock prices of MAANG companies using LSTM and SVR models and compared results by using error functions. We used dataset of these MAANG companies' duration from Dec 2017 to Dec 2022, from which we took 80:20 training and testing ratio.

2 Techniques used

2.1 LSTM

Long Short-Term Memory (LSTM) was originally developed by Hochreiter and Schmidhuber in 1997 as a special type of Recurrent Neural Network. [9] A type of neural network that does not suffer from vanishing gradients has been rediscovered in recent years in the context of deep learning. On a wide range of problems, it shows outstanding performance[10**]**. A large number of traditional deep learning approaches are being replaced by networks based on LSTMs, which are ideal for prediction and classification of temporal sequences [11]. LSTMs networks are composed of cells (LSTM blocks) linked together.

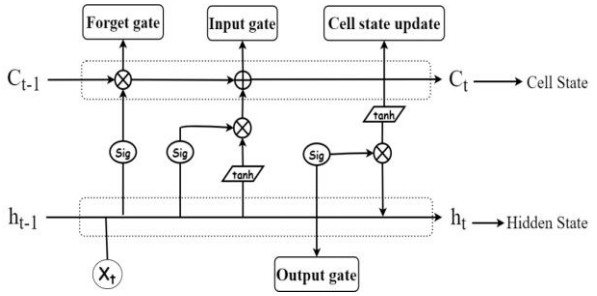

Fig. 1. LSTM Architecture

There are three gates present in LSTM, Input gate, Output gate & Forget gate as shown in Fig.1. A gate in an LSTM is an activation function indicated by a sig-

moid function, meaning that it outputs either 0 or 1. This ‘ ’ sign is point to point multiplication and this ‘ ’ sign is point to point addition of the function.

$\hat{C}_t = \tanh(w_c[h_{t-1}, x_t] + b_c)$
C_t = Forget gate * C_{t-1} + Input gate * $\hat{C}_t$
h_t = Output gate * $\tanh(C^t)$ [12]

The symbol ‘$\hat{C}_t$’ represents the candidate cell state at time stamp. The symbol ‘C_t’ is the new cell state‘C_{t-1}’ is the previous cell state. ‘h_t’ is hidden state at time stamp and ‘h_{t-1}’ is previous hidden state at time stamp. ‘x_t’ is input dataset.

2.2 SVR

Support vectors are used to represent the hyperplane, those samples lie outside the tube boundary and are used for training. A tube's shape is largely determined by the support vectors in SVR, as they are in SVM [13], it is assumed that the test and training data are independent and that their distributions are identical [14]. The visualization can be done as follows:

$$f(x,w) = \sum_{i=1}^{N} x^i w_i \ , w \in R^N, x \in R$$

x_i is the mapping function, w_i is weighted vector.
the Normalization we got,

$$min_w 1/2||w||^2$$

Here, w is normalization vector. Predicted values and Actual values are compared using SVR.

3 Methodology

About Dataset : The MAANG companies stock dataset that was used in this analysis was taken from Yahoo Finance[15]. The dataset contains columns namely Date, Open, Close, Adjacent Close, High, Low & Volume. It includes past 6 years of data from Dec 2017 to Dec 2022. The dataset was divided into 80:20 ratio of training data and testing data and the Close column is used for analysis & prediction.

4 Experimental Analysis

The LSTM technique used in this paper has 9 hidden layers and 100 epochs, while dropout is considered at 0.2. The Adam optimizer & sigmoid activation function is also used with 64 batch size and verbose of 1. These experiments are deployed on Jupyter Notebook with environment setup of python libraries including Scikit-learn [16], NumPy [17], Pandas [18], Keras [19] and Matplotlib [20].

Here we calculated the Root Mean Squared Error (RMSE) with respective formula shown below and we got the values that are written in the table with a comparison of LSTM and SVR of MAANG companies stock data. The RMSE value of Meta stock using LSTM we got 7.04 and whereas for SVR we got 14.61. Similarly, for Amazon stock, we got LSTM 4.90 and for SVR we got 6.05 and for Apple, we got LSTM RMSE value 4.05 and SVR we got 4.18, for Netflix LSTM we got 12.85 and SVR we got 24.14 and for Google we got LSTM RMSE is 3.94 and SVR 3.46, shown in Table 1.

$$RMSE = \sqrt{\sum_{i=1}^{N} \frac{||A(i) - B(i)||^2}{\mathrm{N}}}$$

Where, N is number of data, A(i) is actual measurement and B(i) is corresponding predicted measurement and i is number of iterations done.

Table 1. RMSE of LSTM & SVR

RMSE		
Stock name	**LSTM**	**SVR**
Meta	7.04	14.61
Amazon	4.90	6.05
Apple	4.05	4.18
Netflix	12.85	24.14
Google	3.94	3.46

Here we calculated the Mean Absolute Error (MAE) by the given equation, LSTM and SVR of MAANG companies stock data was analyzed and got the following values shown in Table 2.

$$MAE = \frac{1}{n}\sum ||A(i) - B(i)||$$

Where, n is sample size, A(i) is actual measurement, B(i) is predicted measurement.

Table 2. MAE of LSTM & SVR

MAE		
Stock name	**LSTM**	**SVR**
Meta	5.06	9.56
Amazon	3.46	4.24
Apple	2.82	3.06
Netflix	8.74	16.54
Google	2.59	2.49

Similarly, Mean Percentage Error (MPE) was calculated by the equation below. MAANG companies stock data was analyzed using LSTM and SVR then MPE was calculated, the results compared and shown in the following Table 3.

$$MPE = \frac{100\%}{n}\sum_{t=1}^{n}\left(\frac{a_t - p_t}{a_t}\right)$$

Where, n is number of time period, a_t is actual measurement, p_t is predicted measurement.

Table 3. MPE of LSTM & SVR

MPE		
Stock name	**LSTM**	**SVR**
Meta	0.005	0.007
Amazon	0.008	0.003
Apple	0.009	0.005
Netflix	0.00932	0.00931
Google	0.015	0.001

We also calculated Minimization and Maximization (MINMAX) using the equation below. Finally, the results are provided in the following Table 4.

$$MINMAX = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Table 4. MINMAX of LSTM & SVR

MINMAX		
Stock name	**LSTM**	**SVR**
Meta	0.022	0.042
Amazon	0.028	0.034
Apple	0.027	0.030
Netflix	0.023	0.043
Google	0.027	0.027

In the above tables are the comparisons of MAANG stock price prediction error function using two models, LSTM and SVR, respectively.
Based on the LSTM model, the following graphs show the prediction and actual value of MAANG company stock prices.

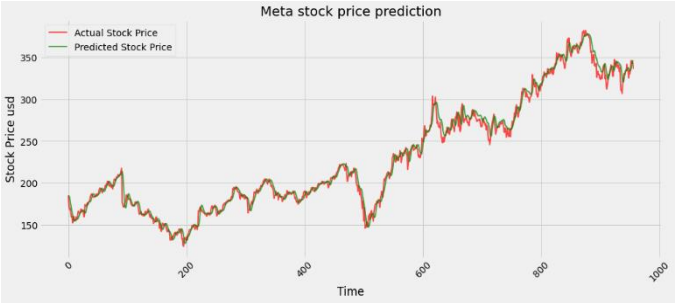

Fig. 2. Meta Stock prediction graph

In Fig. 2 graph red curve shows the actual stock price of the Meta Stock and the green curve shows the predicted stock price of Meta that LSTM model predicts.

Fig. 3. Amazon Stock prediction graph

In Fig. 3 graph green curve shows the predicted Amazon's stock price and the red curve shows the Actual Amazon's stock price.

Fig. 4. Apple Stock prediction graph

In Fig. 4 graph red curve shows the Actual Apple's stock price and the green curve shows the predicted Apple's stock price.

Fig. 5. Netflix Stock prediction graph

In Fig. 5 graph green curve shows the predicted Netflix's stock price and the red curve shows the Actual Netflix's stock price.

Fig. 6. Google Stock prediction graph

In Fig. 6 graph green curve shows the predicted Google's stock price and the red curve shows the Actual Google's stock price.

5 Conclusion and Future Work

In this paper shows the comparison between LSTM (long short-term memory) and SVR (support vector regressor) prediction models on the MAANG Stock price data from Yahoo finance and calculated the RMSE (root mean squared error), MAE (mean absolute error), MPE (mean percentage error) and MINMAX normalization. We found that the LSTM performs better then SVR prediction model, not only for single for every stock data LSTM performs better than SVR. For future work, we can compare ARIMA, SARIMA and ARCH models to achieve the maximum accuracy.

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