Stock Market Trend Prediction using Dueling Deep Q-Network

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ABSTRACT
The goal of the project is to develop a new technique to predict the stock trend, Because the stock market is so important to acountry's economic prosperity, anticipating changes in market behavior has become crucial to shareholders stock market is one of the popular ways to earn the passive income, A successful prediction of stocks future price is challenging because it could either give significant profit or significant loss for the investors. Prediction plays a vital role in the investment of stocks, so, we can maximize the profit, if the system takes the right action, there are many works on stock prediction using supervised learning, but they are not accurate, so to maximize the profit, we use dueling deep Q-learning, which helps to select the best action at a best particular state.

Keywords
Reinforcement learning, Q-learning, stock market, deep Q-network, double deep Q-network, dueling deep Q-network

1. INTRODUCTION
The stock market prediction has always attracted the attention of many researchers and investors due to high returns and risks The stock market is called a share market or equity market, Stock market is a place where public listed companies are traded, The stock market refers to the collection of markets and exchanges where regular activities of buying, selling, means partial ownership of a company which means, if a buyer buys a share in a particular company, then he has a share on companies future profit or loss.

The stock market serves two important purposes. The first is to provide capital to companies that they can use to fund and expand their businesses. Another purpose of the stock market is to serve the investors, it provides an opportunity for the investors to invest their money, and purchase shares in public traded companies, to gain profits.

The successful prediction of the stock will be great for the stock market institutions. Prediction of the stock market is a challenging task, due to the fluctuating nature of the stock, so prediction plays a vital role in the investment, it is very foolish to sell our stocks at a lower price and buy the stocks at a higher price. One of the main challenge in stock market prediction is accuracy most of the previous attempts to predict the stock market was unsuccessful, this motivated us to select this project. Stock market prediction needs a lot of experience and knowledge in the field of stock market which is impossible for a normal person, so our main aim is to build a model to predict the stock market, so that the trader can decide whether to buy the stock or sell the stocks or to hold the stocks of a particular company, to gain the maximum profit using Q-learning.

2. LITERATURE SURVEY
2.1 HMM
Poonam Somani, Shreyas talele, surajsawant in [1] proposed a predicting method to provide a better accuracy using hidden Markov model, they used stock indices of ICIC, SBI, IDBI. The input parameters are open, high, low, close values of the day shares are taken, and the model accuracy is tasted using MAPE value, the MAPE value for stocks were as follows ICIC-2.1, SBI-1.7, IDBI-2.3.

Aditya gupa and Bhuwan Dhingra in [3] proposed a method to predict the next day closing price using Hidden Markov Model, four different stock companies are taken into consideration viz.TATA Steel, Apple inc., IBM Corporation and Dell inc, the input parameters were open, close, high, and low. The model was trained for a period of seven months, and then the effectiveness of the model is tested using Mean Absolute Percentage Error(MAPE). the MAPE value is observed as TATA Steel-1.560, apple inc-1.510, dell-0.824

3. ARTIFICIAL NEURAL NETWORK:
Kumar Abhishek, Anusha Khairwa, Tej Pratap, Surya Prakash in [2] has proposed a model for stock price prediction using artificial neural network, they used Microsoft corporation dataset, the input parameters are open, high, low, adj. close, and volume and close as output parameters for predicting stock price, backpropagation algorithm is used for training, the training functions are trainlm and traingdx in our experiment, Mean Square Error (MSE) is used to find the accuracy of the proposed system, accuracy of the network in case of trainlm was 99% and MSE is 0.00650, in case of traingdx the accuracy of the network was 98% and MSE is 0.0430.

3.1 Support Vector Machine
Fangqiong Luo, Jiansheng Wu, and Kesong Yan in [6] proposed a novel method for the prediction of shanghai stock exchange (SSE) index using SVM regression combination model (SVR-CM) linear regression with non linear regression, linear is used to extract linear features and whereas non non linear regression used to extract non linear features, finally SVM regression was used to combine all the output results, to indicate the effectiveness of the proposed system Mean Absolute percentage error (MAPE), root mean square error(RMSE) and trend accuracy is used. It was found that SVM-CM has good learning ability and forecasting capability.

3.2 GAN
Ricardo Alberto Carrillo Romero in [4] proposed a model to predict whether the price would increase one day after our sample period, input parameters open, high, low, close, and volume, used GAN with a convolutional neural network(CNN) as a discriminator and multi-layer perceptron

as a generator to forecast the closing price of stocks, the accuracy of the model of the proposed model is observed as 72.68%. the author trained a baseline with other models like ARIMA model, a long short-term memory (LSTM), a deep LSTM model, and a generative adversarial network(GAN) to develop this task. All these models were predicted with near or above 60% accuracy.

3.3 Recurrent Neural Network

Dr. N V Ganapathi Raju, Satya Sri Sugandha Padullaparti, Sai Preetham Reddy Allam in[5] proposed a model for stock trading decision prediction using a recursive neural network which incorporates Long Short Term Memory (LSTM), the data set consists of day wise prices of stocks Apple, Microsoft, Intel, IBM and Oracle, the dataset has information like index(date), High, Low, open stock price, close stock price, the volume of stock sold, adjusted closing stock price. The proposed algorithm gives 72% accuracy

4. PROPOSED METHODS

4.1 Dueling Deep Q Network

Dueling deep Q network is a reinforcement learning algorithm A Dueling deep q Network is a type of Q-Network it has two streams to separately estimate state-value and the advantages for each action. Both streams share a common convolutional feature learning module. The two streams are combined via a special aggregating layer to produce an estimate of the state-action value function. In dueling deep Q networks employ a neural network to approximate the Q-value function in deep Q-learning. The state is provided as input, and the Q-value of all potential actions is returned as output.

$$Q(S,a)= V(S) +A(S,a)$$

5. DATASET

The new data set has total 961 records in that 70% is given as training data set and 30% is given as testing data set input to the algorithms. The algorithms classify the data and detect the dengue prevalence.The parameters are is open, high, low, close, and volume.Data set is taken from the alpha ventage.

6. MODEL OVERVIEW

Figure 1. describes the proposed model for detection of dengue prevalence that consists of Pre-processing, Classification and Evaluation phases which are explained below,

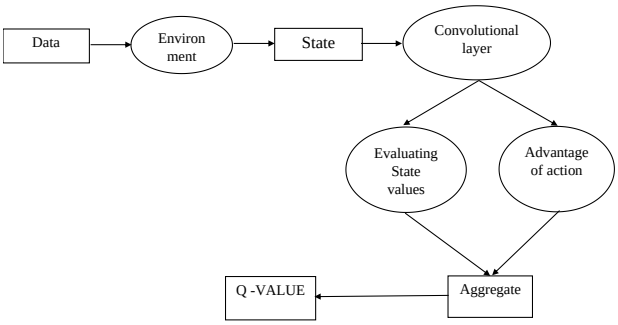

Fig1: System Architecture.

7. RESULTS AND DISCUSSION

In this section, the results of the experiment and their significance are discussed based on the following graph,

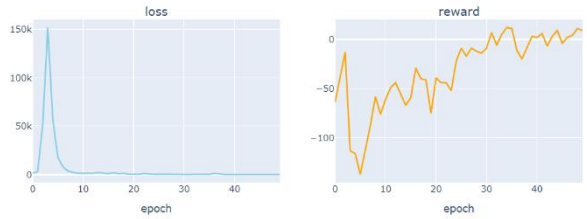

Figure 2. Loss and Rewards for using Deep Q learning

From the above figure 2, we can say that the reward is 14 and the loss is 11. This means that the loss is reduced while the reward is enhanced.

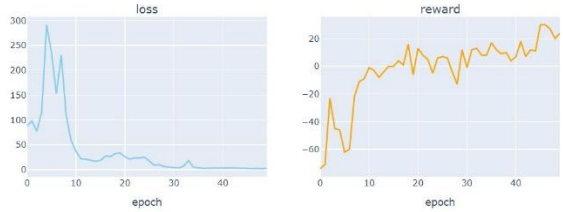

Figure 3. Loss and rewards for using double deep Q learning

From the above figure 3, we can say that the reward is 20.2 and the loss is 9.10 here we can see that the loss is reduced and the reward is increased than the deep Q-learning.

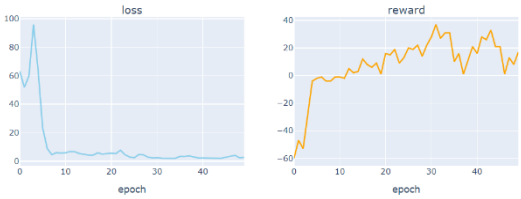

Figure 4. Loss and rewards for using Dueling deep Q learning

From the above figure 4, we can say that the reward is 20.2 and the loss is 9.10 here we can see that the loss is reduced and the reward is increased than the double deep Q-learning.

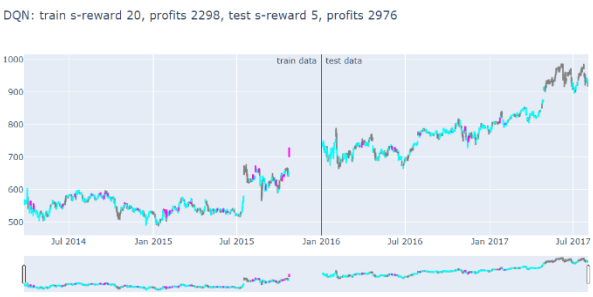

Figure 5. Rewards and profits of training and testing data of deep Q learning

From the figure 5 we can see that The training and testing data from the data set is split in half for training and half for testing. It was discovered that the training reward is 20 and the profit is 2298, whereas the test reward is 5 and the profit is 2976.

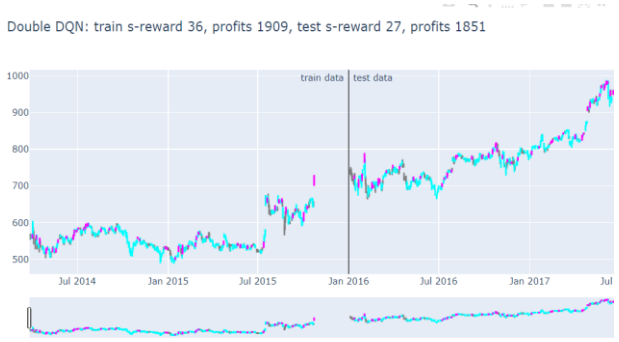

Figure 6. Rewards and Profits of training and testing data of double deep Q learning

From the figure 6 we can see that The training and testing data from the data set is split in half for training and half for testing. It was discovered that the training reward is 36 and the profit is 1909, whereas the test reward is 27 and the profit is 1851.

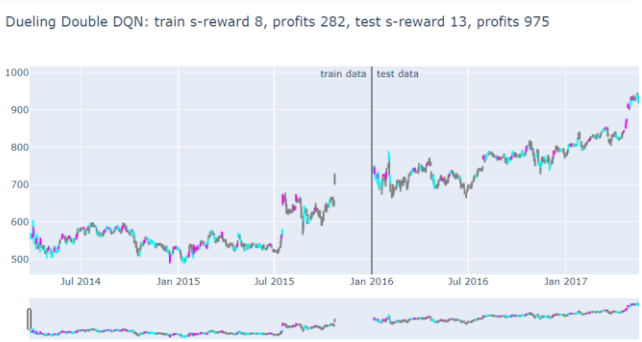

Figure 7. Rewards and Profits of training and testing data of Dueling deep Q learning

From the figure 7, we can see that The training and testing data from the data set is split in half for training and half for testing. It was discovered that the training reward is 8 and the profit is 282, whereas the test reward is 13 and the profit is 975

7.1 Evaluation Metrics

Table: Evaluation Matrics

ALGORITHMS	REWARDS	LOSS	MEAN SQUARE ERROR	MEAN ABSOLUTE ERROR
Deep Q-network	14	11	1.98	1.92
Double deep Q-network	20.2	9.10	1.25	1.22
Dueling deep Q-network	29.4	2.90	0.4	0.6

8. CONCLUSION

In this study proposed a dueling deep q-network for stock market trend prediction and compared the accuracy of dueling deep q network with the existing deep Q network and double deep Q network, mean square error and mean absolute error is used for evaluating the performance of the system, the mean square error for the deep Q-network is 1.82, double deep Q network is 1.21, dueling deep Q-network is 0.41 and mean absolute error for deep Q-network is 1.98, double deep Q network is 1.26, dueling deep Q -network is 0.82, soheredueling deep Q-network will give more accuracy than deep Q-network and double deep Q-network.

9. FUTURE SCOPE

The project's future scope might include the usage of data connected to sentiment analysis, such as Twitter trends or current news, as parameters that would eventually generate better accuracy.

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