



A Review of Machine Learning Algorithms for Cryptocurrency Price Prediction

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Abstract: In this paper we have discussed different machine learning algorithms used for prediction purpose. We have compared algorithms like SVM, logistic regression, decision tree, linear regression, LSTM, GRU. In this the process of this algorithm have been explained with the help of diagrams wherever needed. As every algorithm has its limitation which makes it to be used till certain limit only. These algorithms are been classified on different parameters like accuracy and many more. The main goal of this paper is to get an idea of machine learning algorithms and try to explain it in a simplified manner.

Keywords –Machine learning algorithms, accuracy, LSTM, GRU, Linear regression, decision tree, logistic regression.

I. INTRODUCTION

In this paper we have studied different types of machine learning algorithms like SVM, LSTM, linear regression, decision tree and GRU. We have discussed working accuracy and applications of algorithms. There are many algorithms of machine learning used for purpose of prediction. The algorithms we discussed in this paper are mostly used for classification and regression. We have discussed each and every algorithm mentioned in the paper in detail and simple manner. Prediction of crypto currency is difficult because of its high volatility. The algorithms are explained well with the use of figures wherever necessary. Every algorithm has its different accuracy as every algorithm have its pros and cons which makes the accuracy varying. The data set used also plays and important role in improving accuracy. The data used in the model should be pre-processed as only data needed should be taken in consideration.

II. LITERATURE SURVEY

T.Awoke et al, [1], In this paper they have compared two different Deep learning models i.e LSTM and GRU which have been efficient for forecasting bitcoin prediction. LSTM was mainly designed to overcome the problem of remembering information. As in this LSTM it remembers information for long period of time. GRU is similar to LSTM as it is new version of RNN(recurrent neural network). GRU has basically two gates i.e reset gate in this it decides how much information that is past to be remembered. And another gate is update gate in this it decides the information that is to be thrown away and the updated information to be added. The process starts with the data preparation stage. As preparing data is the first crucial stage in machine learning. As dataset prepared can impact the accuracy of the model. The dataset consist of daily price value that is been extracted from online site known as kaggle. This dataset has seven different attributes they re as opening price, high prices price and closing price and also the market cap of publicly traded outstanding shares. The model was trained on the LSTM and GRU. To find the accuracy we measure it on RMSE (root mean square value) and MAPE(mean absolute percentage error). In this we observed that LSTM takes greater compilation time than GRU model and it was also clearly seen that GRU is converging faster and steady. Lastly it concluded that LSTM and GRU both are capable for long term dependencies. In this they have compared two basic Deep learning models. However it needs further investigation considering different parameter in addition to previous.

Mohammed Mudassir [2], The paper is related to prediction on crypto currency which is bitcoin as it is most popular crypto currency and also not having third party intervention of any country so there is no tax and any one from any where from the world can invest in this currency. In his paper they have talked about prediction not only one time frame but multiply days like one, seventh, thirty, ninetieth day. For this they have used different machine learning models like SVM, ANN, SANN and LSTM. The process starts with data gathering, data cleaning, data scaling . In this the 80% data was assigned for training and 20% data was assigned for validation. After this they select certain features that will help in prediction. The results shows that it is possible to forecast bitcoin price with low errors, while it is harder to predict the fall and rise.

Lekkala Sreenath Reddy [3], In this paper, we proposed to foresee the Bitcoin cost precisely thinking about different boundaries that influence the Bitcoin esteem. By social affair data from various reference papers and applying progressively ,I tracked down the benefits and weaknesses of bitcoin value forecast. Every single paper has its own arrangement of approaches of bitcoin value expectation. Many papers has exact cost however some other don't, yet the time intricacy is higher in those forecasts, so to lessen the time intricacy here in this paper we utilize a calculation connected to man-made reasoning named LASSO(least outright shrinkage determination administrator. Different papers utilized various calculations like SVM(support vector machine),coinmarkupcap, Quandl, GLM, CNN(Convolutional Neural Networks)and RNN(Recurrent neural organizations) and so forth which don't live it up administration, however in LASSO finding of the outcomes from a bigger information base is speedy and fast..so for this reason we draw a correlation between different calculations and the LASSO calculation, this study paper assists the forthcoming scientists with having an effect in the their papers

Nor Azizah Hitam [4], ML is important for Artificial Intelligence that can make future forecastings in view of the past experience. Strategies has been proposed to develop models including ML calculations like Neural Networks (NN), Support Vector Machines (SVM) and Deep Learning. This paper presents a similar exhibition of Machine Learning calculations for digital money determining. In particular, this paper focuses on determining of time series information. SVM enjoys a few upper hands over different models in determining, and past examination uncovered that SVM gives an outcome that is nearly or near genuine outcome yet likewise work on the exactness of the actual outcome. Notwithstanding, ongoing exploration has showed that because of little scope of tests and information control by lacking proof and expert analyzers, by and large status and precision pace of the gauging should be worked on in additional investigations. Along these lines, progressed research on the exactness pace of the estimated cost must be finished.

Saad Ali Alahmari [5], The rising benefit potential in virtual cash has made estimating the cost of digital money an interesting subject of study. Various examinations have effectively been led to anticipate future costs of a particular virtual money utilizing a AI model. Be that as it may, not very many have zeroed in on utilizing various portions of a "Backing Vector Regression" (SVR) model. This study applies the Linear, Polynomial and "Spiral Basis Function"(RBF) bits to foresee the costs of the three significant digital forms of money, Bitcoin, XRP and Ethereum, utilizing a bivariate time series strategy utilizing the digital currency (day by day Closed Price) as the constant subordinate variable and the "Morgan Stanley Capital International" (MSCI) World List (MSCI-WI) and the (day by day Closed Price) as the indicator variable.

Ho et al [6], In this paper they have tried to help people to invest their money in crypto currency as everybody wants to invest money at good place and want to see their money grown.to do this they have taken help of two models of machine learning that are Linear regression and LSTM. So the process starts with the data collection in this part of data collection the main objective is to gather the most significant, rich in content and reliable data for statistical purpose. In this firstly we have to trim the data it is necessary because we want only those feature that can contribute to our prediction and remove those features which can create noise in our final output. To do this segregation they have used some predefined python libraries which help in identify important features for system. The model used in this system for prediction is LSTM an linear regression. linear regression is used to find the relation between the independent variable and dependent variable. This relationship helps in predicting future outcomes .In LSTM as it is better known for overcoming the vanishing gradient problem and can remember information for long period of time. By studying two models they found that LSTM has more accuracy then the linear regression. Hence this conclusion can differ by taking other parameters in consideration as crypto is more volatile and is affected by different parameters

Lokesh Vaddi et al [7], In this paper, they have explaining several approaches for crypto currencies like Bitcoin price prediction were investigated. They compared the results accuracy of prediction with two machine Learning and deep Learning model 1) Linear Regression, Linear Regression with Features, Linear Regression consider the previous performance crypto currency data as input and analysis that data give the output and 2) Recurrent Neural Networks with LSTM cells. The research contribution of this technique is that we predicted a numerical value of price instead of performing binary classification, as well as used multiple features to train the model. The LSTM method performed notably better than the other approaches, and they believe that further research on using Neural Networks for time-series prediction is very promising to financial data analytics and other fields. LSTM model, as well as the autonomous agent-based on it, can be further enhanced with sentiment analysis. Historical sentiments from Twitter, the number of search queries from Wikipedia and Google, and other metrics reflecting the public interest in Bitcoin can be used to influence the weights during model.

Karunya Rathan, [8], Crypto-currency like Bitcoin is additional widespread recently among investors within the projected work, it's studied to forecast the Bitcoin value exactly considering completely different parameters that influence the Bitcoin value. This study initial handles, it's known {the value| the worth| the value} trend on day by day changes within the Bitcoin value whereas it offers information regarding Bitcoin price trends. The dataset until current date is smitten open, high, low and shut value details of Bitcoin price. Exploiting the dataset machine learning module is introduced for prediction of value values. The aim of this work is to derive the accuracy of Bitcoin prediction victimisation completely different machine learning rule and compare their accuracy. Experiment results square measure compared for call tree and regression model. In this paper they select Bitcoin crypto. Bitcoin is a booming crypto-currency market, and various researches have been studied in fields of economics and price prediction. In they proposed work, Bitcoin dataset is considered from 2011 to till date price and applied machine learning models such as Decision Tree and Linear regression models. Also the price forecast for five days is done using Decision Tree and Linear regression models. The proposed learning method suggest the best algorithm to choose and adopt for crypto currency prediction problem. The experimental study results show that linear regression outperforms the other by high accuracy on price prediction.

Neha mangla [9], In this paper, they tried to estimate the Bitcoin price precisely taking into consideration various parameters that affect the Bitcoin value. In our work, we pointed to understand and identify daily changes in the Bitcoin market while obtaining insight into most appropriate features surrounding Bitcoin price. We will predict the daily price change with highest possible accuracy. The market capitalization of publicly traded crypto currencies is currently above 230 billion dollars . These characteristics are outlined in the following subsection; the underlying details of Bitcoin, as they are described in depth in the cited papers. they considered previous Bitcoin transaction in which price and timestamps are the attributes used to predict the bitcoin price for future. They used four methods for price predictions such as Logistic regression, Support vector machine, ARIMA and RNN. Among the four methods, ARIMA has performs well for next days predictions but performs poor for longer terms like given last few days price predict next 5-7 days prices. RNN perform consistently upto 6 days. Logistic regression-based model's assumptions were not violated, it is only able to classify accurately if a separable hyperplane exists

Thearasak Phaladisailoed [10], In this paper Bitcoin is a new currency that is recognized as a creative payment network. The operating system functions independently of a central structure or bank. Bitcoin is managed by the developed network. Bitcoin's open source code structure allows it to be uncontrolled and uncontrollable by an individual. The use of bitcoin requires virtual wallet. Verification of all payments is secured using public key encryption. Machine learning has also been employed directly for crypto currency price prediction For example, the creators in add to the Bitcoin determining writing by testing auto-backward incorporated moving normal (ARIMA) and neural organization auto-relapse (NNAR) models to figure the day by day value development dependent on the authentic value focuses. Also the creator in presents a Neural Network system to give a profound AI answer for the digital currency value expectation issue. The system is acknowledged in three moments with a Multi-layer Perceptron (MLP), a basic Recurrent Neural Network (RNN) and a Long Short Term Memory (LSTM), which can learn long conditions. Conversely, our forecast model as well as considering the web-based media impact, additionally utilizes web based figuring out how to ceaselessly gain from its errors and work on itself simultaneously.

Jifeng Sun, [11], In this paper There are two of the most common metrics used to measure accuracy for continuous variables, Mean Squared Error (MSE) and R-Square (R²). The MSE and R² of all our implemented models while table 2 shows the calculated time of all our implemented models. Whereas, the calculated time that Huber regression use is much less than LSTM and GRU. Therefore, this research aims to discover the most efficient and highest accuracy model to predict Bitcoin's prices from various machine learning algorithms. By using 1-hour

interval exchange rate in USD from January 1, 2012 to January 8, 2018 via the Kaggle website, some different regression models with scikit-learn and Keras libraries had experimented. This research uses two libraries; scikit-learn and Keras for analyzing data in order to create machine learning models.

Shubhankar Mohapatra [12], In this paper we give a clever constant and versatile cryptographic money value expectation stage dependent on Twitter feelings. The integrative and secluded stage adapts to the three previously mentioned difficulties in more than one way. Right off the bat, it gives a Spark-based engineering which handles the huge volume of approaching information in a steady and shortcoming lenient way. Besides, the proposed stage offers a methodology that upholds feeling examination dependent on VADER which can react to a lot of normal language handling inquiries progressively. Thirdly, the stage upholds a prescient methodology dependent on web based learning in which an AI model adjusts its loads to adapt to new costs and opinions. At long last, the stage is particular and integrative as in it consolidates these various answers for give novel realtime apparatus backing to bitcoin value expectation that is more adaptable, information rich, and proactive, and can assist with speeding up dynamic, reveal new freedoms and give more 978-1-7281-0858-2/19/\$31.00 .A digital money is an advanced cash intended to fill in as a mechanism of trade that utilizes solid cryptography to get monetary exchanges, control the formation of extra units, and confirm the exchange of resources. They depend on decentralized frameworks based on block-chain innovation, an appropriated record implemented by a unique organization of PCs . The originally decentralized digital currency, Bitcoin, was delivered as open-source programming in 2009. After this delivery, roughly 4000 altcoins (other digital currencies) have been delivered. As of August 2019, the complete market capitalization of digital currencies is \$258 billion, where Bitcoin alone has a market capitalization of \$179 billion.

III. PREDICTION TECHNIQUES

There are many Machine Learning prediction techniques and algorithms here we have studied and explained some important techniques. These techniques can be used to predict/forecast future price and data price for example we take data from dependent sources like stock price, bitcoin price and can predict their future using this algorithm to do this we use various python libraries like matplotlib for better view of graph and understanding the prediction

2.1 SVM

This algorithm is used for classification and regression. The labelled data is used to build the model.

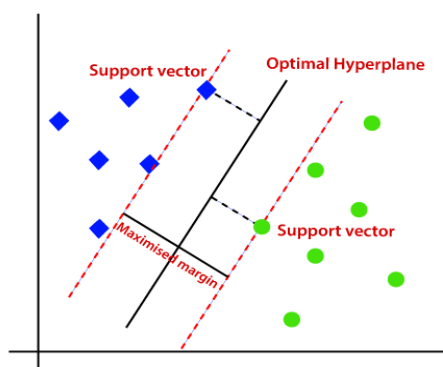


Fig 1 : SVM Classification

As shown in above figure the data is divided using a line called decision boundary or hyperplane. The SVM finds an optimal hyper-plane to separate two classes of patterns [5]. The distance between the opposite support vector is defined as margin. The classified data which is nearest to the hyperplane is called as support vectors. SVM supports both linear and non-linear type of models. When the data is separated by line it is called as linear separable data and we can apply linear support vector to this linear separable data. The data which is not separated by line is known as non-linear data. The solution for separating a non-linear data is by firstly transforming LD(low Dimension) feature space to HD(High Dimension)feature space using kernel and thereafter the data can be classified .

2.2 Logistic Regression

logistic regression is used when the data is in categorical form .The logistic regression works on the following sigmoid function equation.

$$Y = 1 / 1 + e^{-z} \quad (1)$$

The sigmoid function is used to convert the independent variable into expression of probability which ranges from 0 to 1 with respect to the dependent variable . The curve you see in figure is sigmoid curve as shown in below diagram

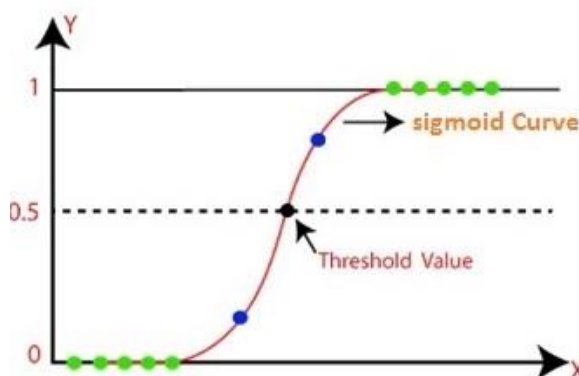


Fig 2: Logistic regression

The data set used in logistic regression should be free from missing values .Zero means there is no such possibility of occurrence and one means there is a possibility of occurrence. the data points which are near to one will be related to certain class having occurrence and the data points which are near to zero will be related to certain class having no such occurrence. If the data points falls on the threshold line this data points are un-classifiable as the data points will be on threshold line is rare condition. Examples of model which can use logistic regression are fraud detection, spam mail detection ,disease diagnosis.

2.3 Decision Tree

Decision Tree is a Supervised Learning Algorithm.[14] Decision Trees use as classification and also It can use regression the Technique of Classification the role Decision Trees is a classifier. Decision Trees is like a tree structure, in decision tree have a main root and there are two sub branches that is Decision node and Leaf Node. Decision Node test the data and Leaf Node is classification the data and value. In this strategy we split our crypto currency dataset into two sets internal nodes in Decision Tree indicate test and leaf node are decisions made after subsequent processing.

In this step follows the work of decision tree

- Place the dataset in root of tree
- Split the dataset into two parts train and test set. every sub set contain similar information with similar feature.
- Above steps repeat on till end of tree.
- The end of tree we got leaf node

In decision tree class label any record prediction start from the root of tree. the data and compared with root of attributes with next record attributes. this is follow to continue to next node.

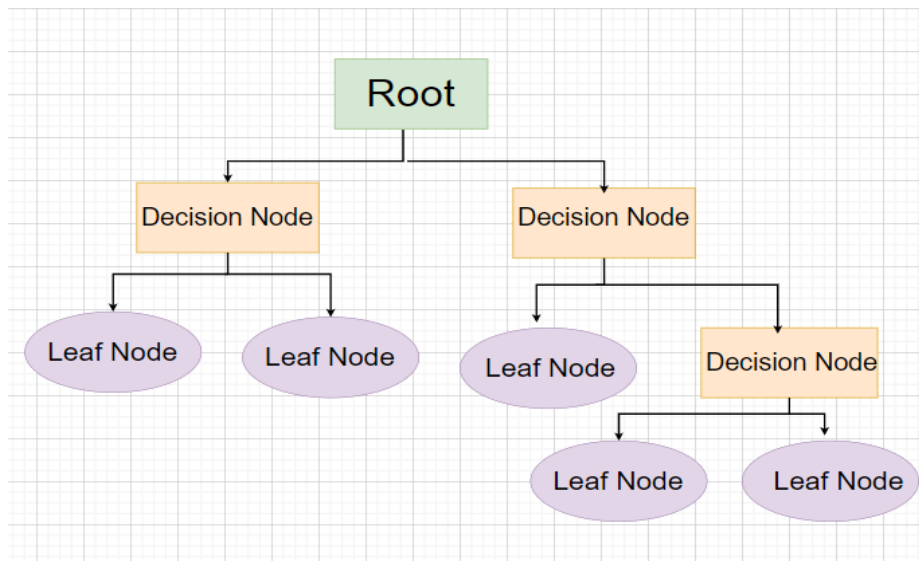


Fig 3: Decision tree working

2.4 Linear regression

Linear regression is a Supervised Learning Algorithms. Linear regression is easiest and popular Machine Learning algorithms. In basic of regression,[15] It is a statistical method that is used for predictive analysis. Linear regression is a predictive model used for finding the linear relationship between a dependent variable and one or more independent variable. In regression model, the subject of prediction of Y and product value plotted in X frame is a straight line. In implementation part used latest version of python and scikit-learn, pandas, matplotlib others python library.

Linear regression line is represented in the form of

Formula: - $Y=a*X+b$ (2)

- Y-Dependent Variable x
- a-slope x
- X-Independent Variable x
- b-Intercept

The best fit regression line to the data the error rate between the predicted and true values can be minimized.

Linear Regression is classified into two types. One of it is Simple Linear Regression, and the second type of regression is Multiple Linear Regression.

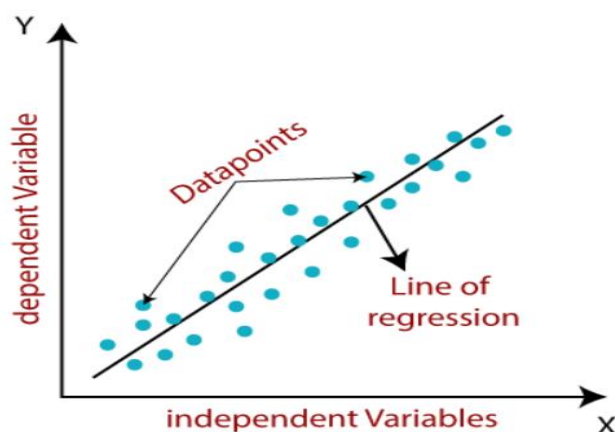


Fig 4: Linear regression working

2.5 LSTM

The long short-term memory network it is a simple problem of disappearing parents in the RNN. [9]It is type of RNN that is used to profound learning, it is a very large a architecture can be trained it's enables the network to learn long terms trust LSTM call contains forget. It LSTM enables the network study more about many times procedure by managing a more steady error and remember gates that give to allow the cell to decided which is information to block or transmit based on in deep strength and is important. As a final result weak signal that parents the prevent from disappearing a block. The performance can be RNN and LSTM network is based to determine the models efficiency. They are firstly useful with sequential data because each neuron. Access the our internal memory the keep input from previous input

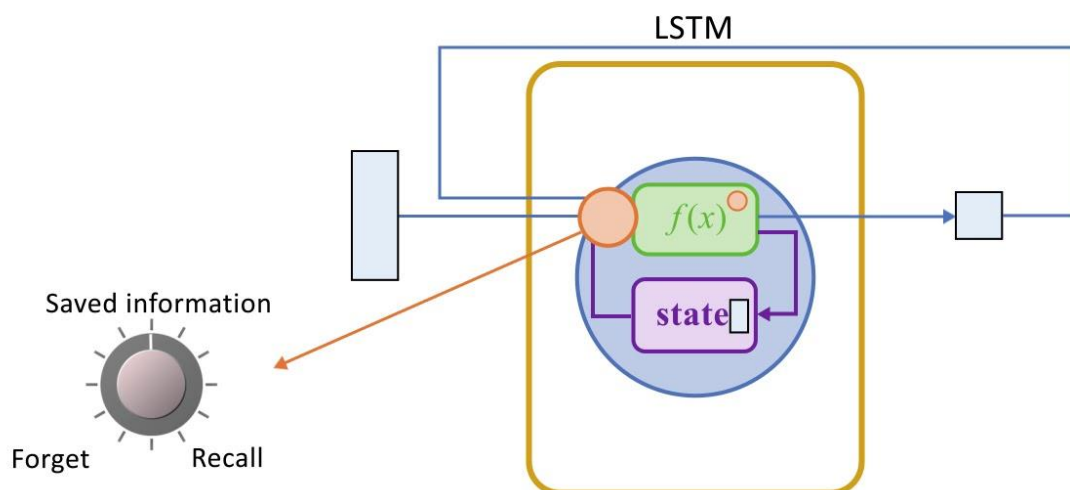


Fig 5: Architecture of LSTM

The information earlier in the sequence may be important LSTM are a type of recurrent network which one network the reuse the output from the previous step like all neural network the node a perform calculations using the input and return the value in a recurrent network. This output is them used along with the next elements as the input for next step and so on in LSTM.

2.6 GRU

A gated recurrent unit as its name involved is a variant of RNN, architecture and use this mechanism to control and manage the flow of information between all in neural network. It is similar to the ones in LSTMs which solve some exploding gradient problems of traditional RNNs. This is its responsibility for regulating the information to be kept or discarded at each time step and specify how to gate work. We develop the method for boat detection using a machine learning model applied to a system for altering nearby person of approaching boats to decrease imitation cause by a boat noise. Output time sequence showed that the LSTM-RNN model results were more similar than the other results to ground truth labelled time sequence. The output performance of the GRU-RNN model was between that of the LSTM-RNN and CNN model. We develop a boat detector performance of the GRU-RNN, evaluation values were accuracy and F-measure for the training performance.

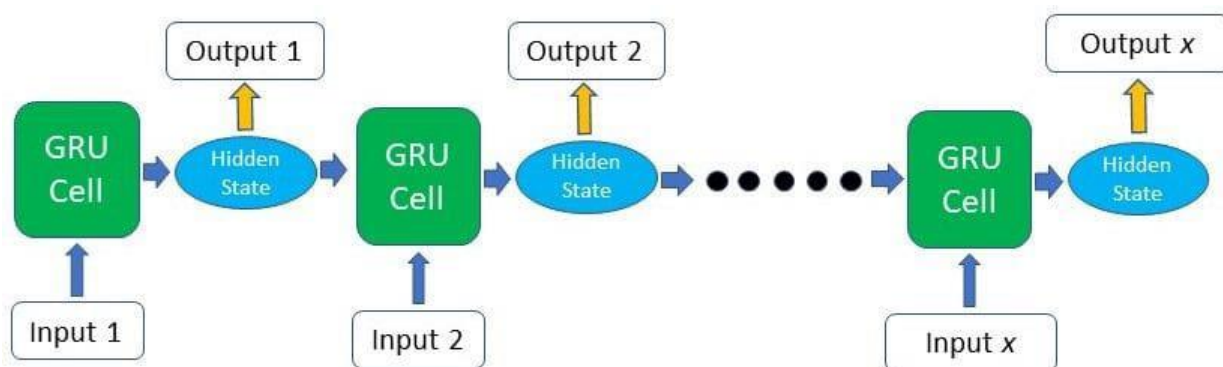


Fig 6: GRUs follows same flow as typical RNN

Other ways it's internal gating mechanism the GRU function just like an RNN, where sequential input data is reduce by the GRU call at each time step along with the memories or know as hidden state the state in the refer in the RNN cell together with the next input data in sequential memory.

IV. ANALYSIS

We have seen various algorithms from which we have concluded that LSTM algorithm has the highest percentage of accuracy and SVM have the lowest percent of accuracy as shown in table below.

Table 1: Performance measures of various classifiers

No	Algorithms	Accuracy
1	SVM	51%
2	Logistic regression	50-55%
3	Decision Tree	65-78%
4	Linear regression	68%
5	LSTM	80.74%
6	GRU	71%

V. CONCLUSION

In this paper we have seen machine learning algorithms which can be used for prediction purpose. prediction is measured on how good percent of accuracy the algorithm can give. So we have seen that LSTM algorithm has the highest percent of accuracy Thereafter GRU has the second most highest percent of accuracy and the lowest accuracy we can get is by SVM which is almost 51%. At last we have concluded that LSTM is best algorithm for prediction purpose.

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