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1D Convolutional Neural Network for Stock Market Prediction using Tensorflow.js

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Abstract:- Stock also known as equity or shares is a type of security that signifies ownership in a corporation and represents a claim on part of the corporations assets and earnings whereas a stock market or share market is the aggregation of buyers and sellers of stocks. Stock Exchange is defined as a process where the stock brokers can buy as well as sell the shares, bonds or other securities. Many companies regardless of their domains or sectors make their stocks or shares available through Stock Market. Such type of an exchange deals with concentration and a focused mind as the entire process is dealing with valuable assets of a person. Thus to ease the process of stock exchange many stock brokers use the act of predicting the stock prices i.e. trying to determine the whether the financial instruments of a company will go up or down in their values. Prediction is done by fundamental analysis and technical analysis and now using Machine Learning Concepts. In this project we propose a Convolutional Neural Network for predicting the stock price in order to make profit.

Keywords:- *Stock, Stock Market, Stock Exchange, Machine Learning, Deep Learning, Neural Network, Prediction/Forecasting, Time Series Prediction, Convolutional Neural Network, JavaScript, Tensorflow.js*

I. INTRODUCTION

The accessibility of a basic computing machine all over the world lead to development of various applications and many other innovations like the Internet, providing the gen- eral public with various functionalities which make use the resources available mainly the data or information required for execution, these all developments or inventions contributed towards the age of Big Data. The term Big Data usually is used to refer to large amount of data that cannot be handled by any relational type of database systems and is not necessarily structured in nature. The art of Machine learning is where we use this available data in order to extract useful information that can be used for benefit. Machine learning is a combination of statistics, computer science and artificial intelligence and is used for predictive analysis or learning. Various methods and algorithms were developed in this approach where we allow a machine to learn from the data available at hand and then use the learnings in order to predict or forecast other data. One of its application can be found in finance where analysts use machine learning methods in order to determine the stock market conditions and accordingly make investments. Stock is a share or a certain hold upon the assets of an organization which has a certain value or price associated with it whereas a stock market is a place where these shares or equity are made available for the general public to either buy or sell them. In this entire process of stock exchange, the principal thing that is focused upon is the profit that the person can make which happens when the price of a share holded by the person goes higher than the price for which it was purchased and thus selling the share becomes beneficial for the person. Thus, it makes a suitable base for using a any prediction algorithm or method of machine learning to operate upon and make more accurate predictions regarding, which stocks to be invested into. The most notable method used in stock market prediction is that of a neural network. Neural network is part of research field termed as Deep Learning which is interchangeably used with machine learning. However deep learning makes use of these neural networks for prediction or classification. A neural network is a computing system that is made in a way to mimic the working of a human brain.

II. 1D CONVOLUTIONAL NEURAL NETWORK

Convolutional neural network(CNN) is a deep learning algorithm which processes primarily images but also numerical data to find patterns. CNN are also referred as ConvNets and have little processing requirements than other classification algorithms. When we speak of CNN, primarily we think of image classification where CNN is feed with images and trains on these images using the conventional techniques of Convolution, Pooling and Flattening and then tries to classify a new image from the features that it has learned. Use of filters help in capturing the spatial information. Main aim of CNN is to reduce complexity of image by keeping the most relevant features that are good for prediction. This is the most common application of a Convolutional Neural Network, however in our research we use a more niche approach where we train a CNN using raw data i.e. a one-dimensional data and try to improve this approach by tuning the network to work with such data but more on that later.

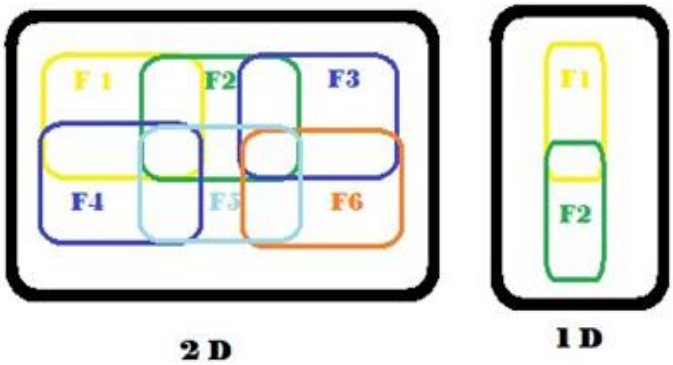

Fig. 1:- Filters in 1D CNN

Lets first start with how a simple Convolutional Neural Network works, as stated previously a CNN will follow the following three stages,

- Convolution: The objective of the Convolution Operation is to extract the high-level features such as edges, from the input image. ConvNets need not be limited to only one Convolutional Layer. Conventionally, the first Convolutional Layer is responsible for capturing the Low-Level features such as edges, color, gradient orien- tation, etc. With added layers, the architecture adapts to the High-Level features as well, giving us a network which has the wholesome understanding of images in the dataset. This results into a matrix referred to as Feature Maps since images themselves are represented as a 3-channel RGB matrix where each cell of matrix represents a numeric color code.
- Pooling: Similar to the Convolutional Layer, the Pooling layer is responsible for reducing the spatial size of the Convolved Feature. This is to decrease the computa- tional power required to process the data through dimen- sionality reduction. It is useful for extracting dominant features which are rotational and positional invariant, thus maintaining the process of effectively training of the model.
- Flattening: In this we literally flatten our pooled feature map into a column. Reason we do this is that we're going to need to insert this data into an artificial neural network which is a fully connected layer.

III. TENSORFLOW.JS

TensorFlow.js, an open-source library you can use to define, train, and run machine learning models entirely in the browser, using Javascript and a high-level layers API. ML running in the browser means that from a users perspective, theres no need to install any libraries or drivers. Just open a webpage, and your program is ready to run. In addition, its ready to run with GPU acceleration. TensorFlow.js automatically supports WebGL, and will accelerate your code behind the scenes when a GPU is available. Users may also open your webpage from a mobile device, in which case your model can take advantage of sensor data, say from a gyroscope or accelerometer.If youre developing with TensorFlow.js, here are three workflows you can consider.

- You can import an existing, pre-trained model for inference. If you have an existing TensorFlow or Keras model youve previously trained offline, you can convert into TensorFlow.js format, and load it into the browser for inference.
- You can re-train an imported model. As in the Pac-Man demo above, you can use transfer learning to augment an existing model trained offline using a small amount of data collected in the browser using a technique called Image Retraining. This is one way to train an accurate model quickly, using only a small amount of data.
- Author models directly in browser. You can also use TensorFlow.js to define, train, and run models entirely in the browser using Javascript and a high-level layers API. If youre familiar with Keras, the high-level layers API should feel familiar.

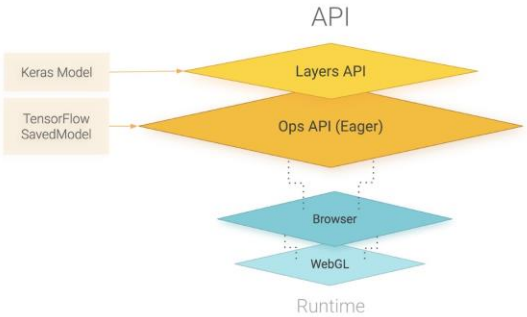

Fig. 2:- Tensorflow.js Overview

The layers API were using here supports all of the Keras layers found in the examples directory (including Dense, CNN, LSTM, and so on). TensorFlow.js also includes a low-level API (previously deeplearn.js) and support for Eager execution.Eager execution provides an imperative interface to TensorFlow (similiar to NumPy). When you enable eager execution, TensorFlow operations execute immediately; you do not execute a pre-constructed graph with Session.run().

IV. METHODOLOGY

In this way a general CNN approach works, now lets dive in our approach for predicting the stock price. Firstly, we define a architecture for our Convolutional Neural Network which is show in the Figure 3. Since we have to deal with raw stock data, we will make use of a one dimensional CNN approach. Lets first define the abstract working of our approach, in this we accept the stock data through an API and then process this data in order to work with one feature i.e. 'Close Price'. The 'Close Price' of stock is the price at which the stock was closed on that day, using this price we can estimate whether or not we can invest in that stock, so we conclude that we need to perform regression instead of performing classification for our problem statement. Stock data comes with many features such as 'Open Price', 'High Price', 'Low Price' etc, however we select 'Close Price' since we want to predict the next day 'Close Price' and is technically the most useful feature for predicting stock growth. But at the same time we can train other neural networks with the remaining features but we move further by using the former as stock price today is dependent on stock price from before. Now the stock data consists of 'Close' of one year(1y) for a company, we use a window size of 7 days for prediction and shape our data in a way that we provide 7 days 'Close' and predict the 8th day 'Close'. Our CNN will have three important layers(Convolution, Pooling, Flatten) each performing a specific task.

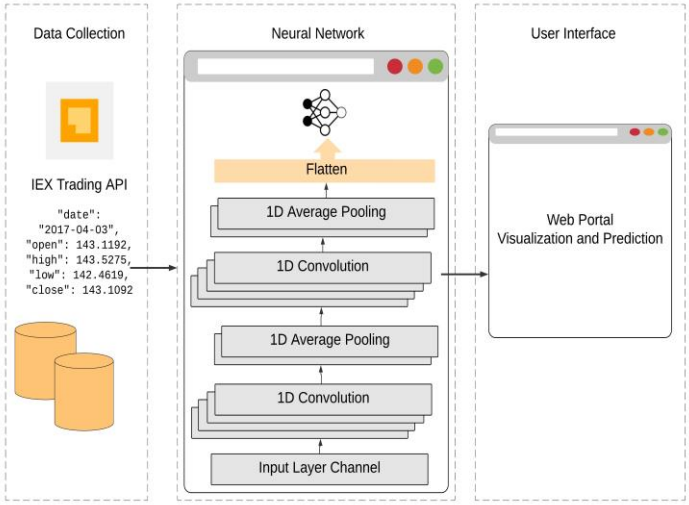

Fig. 3:- Architectural Overview

V. RESULTS

The experiment was carried out by various hyper-parameter tuning. Table 2 show the hyper-parameter used for obtaining the better working CNN model. The parameters for which the mean squared error was miniumum are: Epoch:100 , Convo- lutional Layer1: 128 , Convolutional Layer 2:128 , Activation Function:ReLu , Dense Layer:64 , Optimizer:adam , Mean squared Error:0.001699912128970027

Epochs	Convolution Layer 1	Convolution Layer 2	Activation	Dense Layer	Optimizer	Mean Square Error
100	128	64	ReLU	64	adam	0.0017142153810709715
100	128	64	ReLU	32	adam	0.0017365275416523218
100	128	64	ReLu	128	adam	0.0019843776244670153
100	128	128	ReLu	64	adam	0.001699912128970027
100	128	128	Leaky ReLu	64	adam	0.0018775983480736613
100	128	64	Leaky ReLU	64	adam	0.0021379212848842144
100	128	128	ReLU	64	SGD	0.004025740083307028
100	128	128	ReLU	64	RMSprop	0.0030872575007379055
100	128	128	ReLU	64	AdaGrad	0.00392830278724432
150	128	128	ReLU	64	adam	0.0017893507611006498

Table 1:- Hyper-Parameter Tuning Table

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Table 2 show the stock price of Apple over a period of 10 days. The stock value is predicted by considering the past value of closing price.

Date	Actual Value	Predicted Value
01-04-2019	1206.45	1206.631104
02-04-2019	198.1868	198.5832977
03-04-2019	198.1071	199.6781921
04-04-2019	198.4658	200.2553406
05-04-2019	198.4857	200.2797546
08-04-2019	202.3508	200.0500336
09-04-2019	203.078	199.9963989
10-04-2019	203.7454	200.5020752
11-04-2019	206.6841	201.6365356
12-04-2019	203.3653	203.0935516

Table 2:- Stock Value of Apple

VI. CONCLUSION

By the use of available model training techniques like Con- volutional neural network, it is possible to predict the future trends in stock market. It is possible to utilize the features discussed which are highs, lows of the day, dollar , Fibonacci retracement, market cap etc to develop a hybrid system for the prediction of financial status of a company accurately. We restrict our model with respect to the activation function used, which is ReLU and Sigmoid that are most popularly used and advantageous over other activation functions. These activation function will be powered by the 3 hidden layers of the Convolutional Neural Network.It is important to design the system accordingly by which the accuracy and performance can be increased with less computational complexity.

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