**Predict Stock Prices with LSTM**

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**Abstract**

There are a lot of complicated financial indicators and also the fluctuation of the stock market is highly volatile. However, as the technology is getting advanced, the opportunity to gain a steady fortune from the stock market is increased and it also helps experts to find out the most informative indicators to make a better prediction. The prediction of the market value is of great importance to help in maximizing the profit of stock trade while keeping the risk low.

Long Short-Term memory is one of the most successful RNNs architectures. LSTM introduces the memory cell, a unit of computation that replaces traditional artificial neurons in the hidden layer of the network. With these memory cells, networks are able to effectively associate memories and input remote in time, hence suit to grasp the structure of data dynamically over time with high prediction capacity.

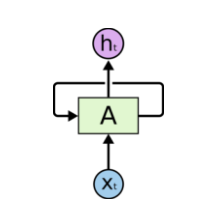
We are trying to predict stock closing price based on LSTMs. We collected a sample and used it for training and validation purposes for the model.

**Methodology**

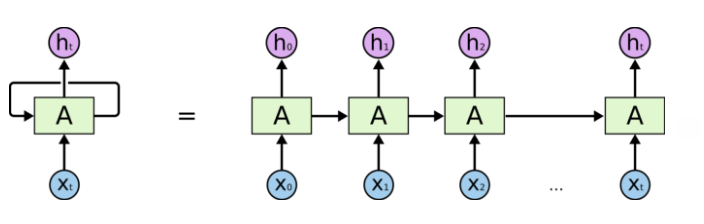
Various types of neural networks can be developed by the combination of variegated factors such as network topology, training method etc. In this experiment we are using Long Short-Term Memory. We are also going to compare LSTM to other popular methodology – GRU (Gated Recurrent Unit).

LSTM

LSTM is a neural network which can be used to predict process at any particular point, which traditional neural network cannot really handle. They are networks with loops:



In this diagram, neural network A takes as input xt and produces output ht. Loop makes it possible to pass information from one state of the network to the next step. Next steps are actually similar to their predecessors, and you can assume that you receive input xt and producing output ht at every step:



Above diagram represents unrolled version of a particular neural network A.

**Experiment**

For our project we have followed these steps:

1. Downloaded daily closing prices for stocks both form NYSE and NASDAQ for the period between 1/1/2000 and 12/31/2016.
2. We have implemented LSTM and GRU neural networks in order to predict stock prices
3. We have also used sentiment analysis of stocks based on TwitStocks
4. Other supporting functions in Python like plotting results were also implemented
5. Watson Conversation Services were used in order to interact with users with the help of Python SDK
6. All interaction with code and users is held in Jupyter Notebook

Data includes following fields:

1. Date
2. Ticker (name of the stock)
3. Closing price

We have preprocessed the data based on user input. For example, if user wants to make prediction for MSFT (Microsoft) stock, we have parsed data to include only MSFT results. Neural Networks are sensitive to the input data. So, we had to rescale data in order to achieve reasonable output

Stage 1: Raw Data:

In this stage, the dataset consisting of S&P 500 companies is used for prediction of future stock prices

Stage 2: Data Preprocessing:

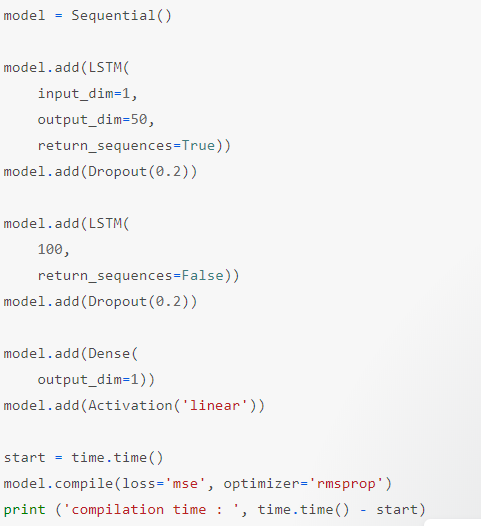
The pre-processing stage involves

1. Data discretization: Part of the data reduction but with importance, especially for numerical data.
2. Data transformation: Normalization
3. Data cleaning: Fill in missing values.
4. Data integration: Integration of data files.

Stage 3: Feature Extraction

In this layer, only the features which are to be fed to the neural network are chosen. We will choose the feature from Date, open, high, low, close and volume.

The code for the Neural Network implemented in Keras is shown below:



**References**

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