ARTIFICIAL INTELLIGENCE IN FINANCE

Machine Learning to Predict Stock Prices

Utilizing a Keras LSTM model to forecast stock trends

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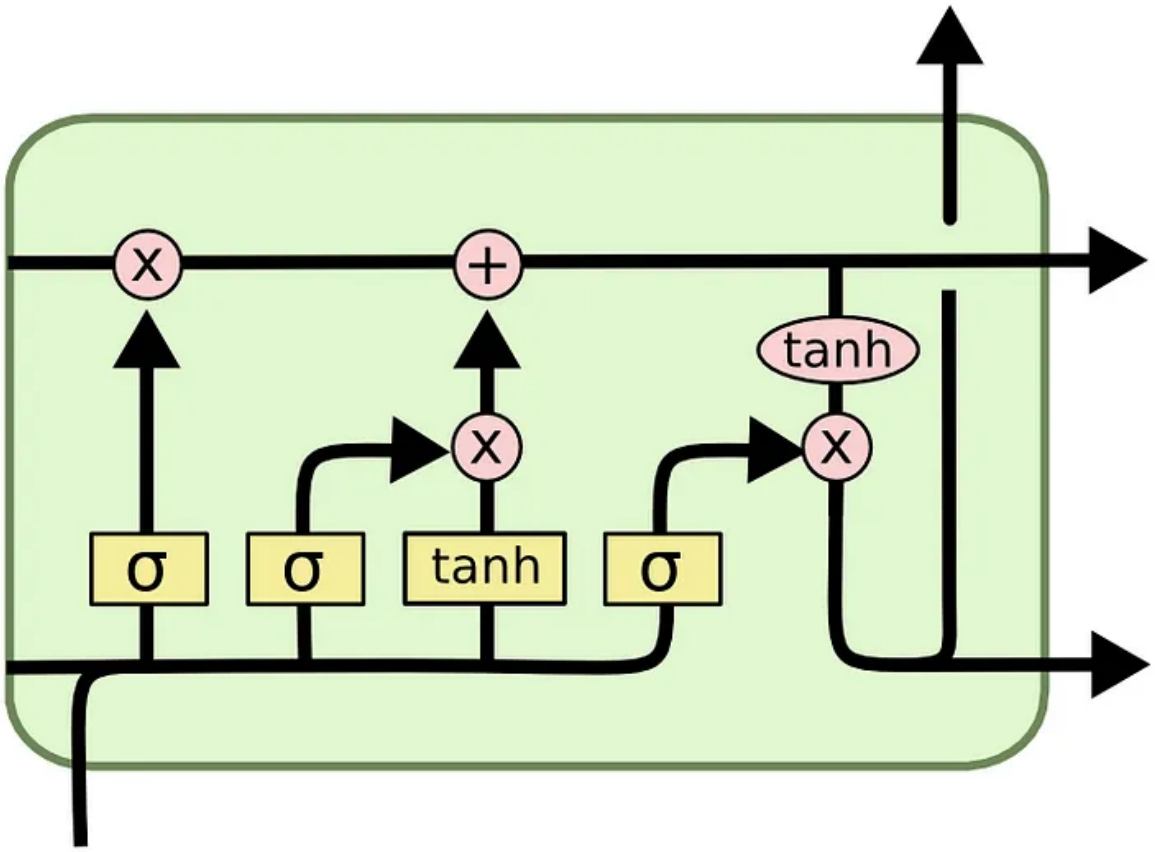
Published in Towards Data Science · 5 min read · Dec 25, 2019

As financial institutions begin to embrace artificial intelligence, machine learning is increasingly utilized to help make trading decisions. Although there is an abundance of stock data for machine learning models to train on, a high noise to signal ratio and the multitude of factors that affect stock prices are among the several reasons that predicting the market difficult. At the same time, these models don't need to reach high levels of accuracy because even 60% accuracy can deliver solid returns. One method for predicting stock prices is using a long short-term memory neural network (LSTM) for times series forecasting.

LSTM: A Brief Explanation



LSTM diagram (source)

LSTMs are an improved version of recurrent neural networks (RNNs). RNNs are analogous to human learning. When humans think, we don't start our thinking from scratch each second. For example, in the sentence "Bob plays basketball", we know that Bob is the person who plays basketball because we retain information about past words while reading sentences. Similarly, RNNs are networks with loops in them, which allow them to use past information before arriving at a final output. However, RNNs can only connect recent previous information and cannot connect information as the time gap grows. This is where LSTMs come into play; LSTMs are a type of RNN that remember information over long periods of time, making them better suited for predicting stock prices. For a technical explanation of LSTMs click here.

Imports/Initial Data

To begin our project, we import numpy for making scientific computations, pandas for loading and modifying datasets, and matplotlib for plotting graphs.

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

After making the necessary imports, we load data on Tata Global Beverage's past stock prices. From the data, we select the values of the first and second columns ("Open" and "High" respectively) as our training dataset. The "Open" column represents the opening price for shares that day and the "High" column represents the highest price shares reached that day.

```
url =
'https://raw.githubusercontent.com/mwitiderrick/stockprice/master/NSE
-TATAGLOBAL.csv'

dataset_train = pd.read_csv(url)

training_set = dataset_train.iloc[:, 1:2].values
```

To get a look at the dataset we're using, we can check the head, which shows us the first five rows of our dataset.

```
dataset_train.head()
```

	Date	Open	High	Low	Last	Close	Total Trade Quantity	Turnover (Lacs)
0	2018-09-28	234.05	235.95	230.20	233.50	233.75	3069914	7162.35
1	2018-09-27	234.55	236.80	231.10	233.80	233.25	5082859	11859.95
2	2018-09-26	240.00	240.00	232.50	235.00	234.25	2240909	5248.60
3	2018-09-25	233.30	236.75	232.00	236.25	236.10	2349368	5503.90
4	2018-09-24	233.55	239.20	230.75	234.00	233.30	3423509	7999.55

"Low" represents the lowest share price for the day, "Last" represents the price at which the last transaction for a share went through. "Close" represents the price shares ended at for the day.

Data Normalization

Normalization is changing the values of numeric columns in the dataset to a common scale, which helps the performance of our model. To scale the

training dataset we use Scikit-Learn's MinMaxScaler with numbers between zero and one.

```
from sklearn.preprocessing import MinMaxScaler
sc = MinMaxScaler(feature_range=(0,1))
training_set_scaled = sc.fit_transform(training_set)
```

Incorporating Timesteps Into Data

We should input our data in the form of a 3D array to the LSTM model. First, we create data in 60 timesteps before using numpy to convert it into an array. Finally, we convert the data into a 3D array with X_train samples, 60 timestamps, and one feature at each step.

```
X_train = []
y_train = []
for i in range(60, 2035):
X_train.append(training_set_scaled[i-60:i, 0])
y_train.append(training_set_scaled[i, 0])
X_train, y_train = np.array(X_train), np.array(y_train)
X_train = np.reshape(X_train, (X_train.shape[0], X_train.shape[1],
1))
```

Creating the LSTM Model

Before we can develop the LSTM, we have to make a few imports from Keras: Sequential for initializing the neural network, LSTM to add the LSTM layer, Dropout for preventing overfitting with dropout layers, and Dense to add a densely connected neural network layer.

```
from keras.models import Sequential
from keras.layers import LSTM
from keras.layers import Dropout
from keras.layers import Dense
```

The LSTM layer is added with the following arguments: 50 units is the dimensionality of the output space, return_sequences=True is necessary for stacking LSTM layers so the consequent LSTM layer has a three-dimensional sequence input, and input_shape is the shape of the training dataset.

Specifying 0.2 in the Dropout layer means that 20% of the layers will be dropped. Following the LSTM and Dropout layers, we add the Dense layer that specifies an output of one unit. To compile our model we use the Adam optimizer and set the loss as the mean_squared_error. After that, we fit the model to run for 100 epochs (the epochs are the number of times the learning algorithm will work through the entire training set) with a batch size of 32.

```
model = Sequential()
model.add(LSTM(units=50,return_sequences=True,input_shape=
(X_train.shape[1], 1)))
model.add(Dropout(0.2))
model.add(LSTM(units=50,return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(units=50,return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(units=50))
model.add(Dropout(0.2))
model.add(Dense(units=1))
```

```
model.compile(optimizer='adam',loss='mean_squared_error')

model.fit(X_train,y_train,epochs=100,batch_size=32)
```

Making Predictions on the Test Set

We start off by importing the test set

```
url =
'https://raw.githubusercontent.com/mwitiderrick/stockprice/master/tat
atest.csv'

dataset_test = pd.read_csv(url)

real_stock_price = dataset_test.iloc[:, 1:2].values
```

Before predicting future stock prices, we have to modify the test set (notice similarities to the edits we made to the training set): merge the training set

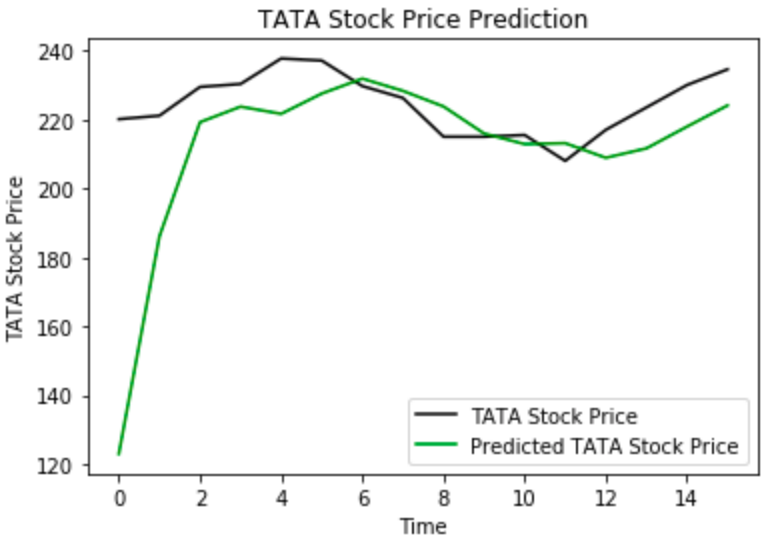

```
dataset_total = pd.concat((dataset_train['Open'],
dataset_test['Open']), axis = 0)

inputs = dataset_total[len(dataset_total) - len(dataset_test) -
60:].values

inputs = inputs.reshape(-1,1)

inputs = sc.transform(inputs)

X_test = []

for i in range(60, 76):

X_test.append(inputs[i-60:i, 0])

X_test = np.array(X_test)

X_test = np.reshape(X_test, (X_test.shape[0], X_test.shape[1], 1))
```

```
predicted_stock_price = model.predict(X_test)

predicted_stock_price = sc.inverse_transform(predicted_stock_price)
```

Plotting the Results

After all these steps, we can use matplotlib to visualize the result of our predicted stock price and the actual stock price.

```
plt.plot(real_stock_price, color = 'black', label = 'TATA Stock
Price')

plt.plot(predicted_stock_price, color = 'green', label = 'Predicted
TATA Stock Price')

plt.title('TATA Stock Price Prediction')

plt.xlabel('Time')

plt.ylabel('TATA Stock Price')

plt.legend()

plt.show()
```



While the exact price points from our predicted price weren't always close to the actual price, our model did still indicate overall trends such as going up or down. This project teaches us the LSTMs can be somewhat effective in times series forecasting.

Click here for the entire code

References

[1] Derrick Mwiti, Data and Notebook for the Stock Price Prediction Tutorial(2018), Github

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I'm Roshan, a 16 year old passionate about the intersection of artificial intelligence and finance. For a broad view of AI in finance, check out this article: https://becominghuman.ai/artificial-intelligence-and-its-application-in-finance-9f1e0588e777.

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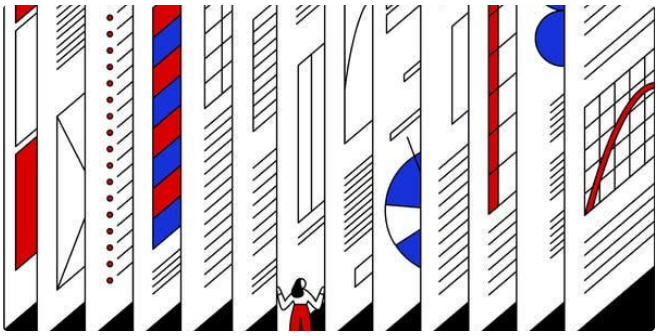

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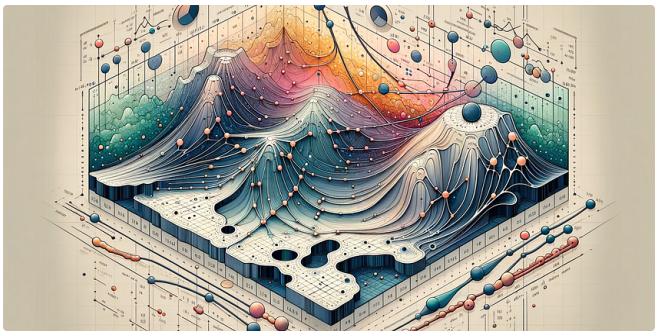

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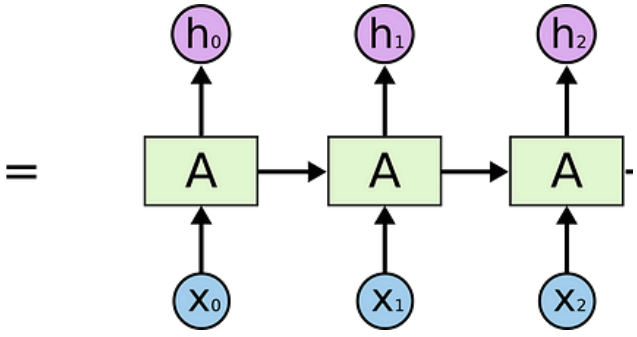

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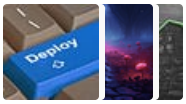

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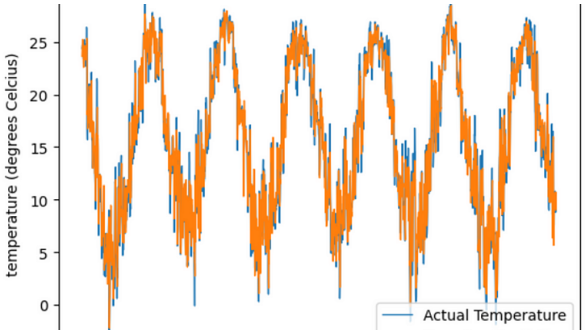

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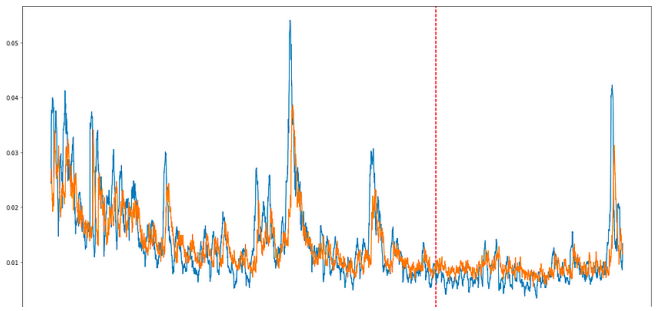

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