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**DA 420**

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**KNOWLEDGED BASED ARTICLE:**

**Stock Price Prediction**

**Overview:**

As common a project this may be, stock prediction has proven itself time and time again as one of the fundamental examples of machine learning and time series analysis. However, in this project I have managed to do not only the prediction with an LTSM model (Long Short-Term Memory Model), but also an integration of using real time data on the daily for making decisions on whether a stock is a buy or a sell for that given day’s market opening.

This works with three main parts and will be explained further in this article: Our main program that handles a user’s budget, a ticker portion that handles web scraping and data cleaning, and a ML prediction portion that handles the LTSM and outputting the desired results (buy or sell).

To preface, this is a little different from the project proposed as I did mention an auto-trading function, which should not be too hard to implement. But for the sake of brevity and purpose, we will not be including that portion, with the largest reason being that *I would have needed to open a brokerage account and deposit over 10,000 dollars to day trade without restrictions* **(Webull, 2021)***.* I did also mention the option of paper trading in my proposal. Within a couple hours of digging around, I would have had to apply and wait for the API and the API keys to use a pre-existing system.

With all our little disclaimers out of the way, without further ado, we will get into the grit of the project.

**[Portion 1] Ticker.py :**

As mentioned before, I wanted to go into this knowing that this program could work wherever, whenever. What does that mean? Well, you guessed it, real time data. Without getting permissions and submitting forms and waiting for approval of APIs I opted for an easier more illegal solution, (*disclaimer: not for financial use or financial advice*), web scraping.

Now this is a topic I have explored on my own and done in some of my past classes, so it was familiar to me. I made a function as a part of this program to get our desired data off the yahoo finance site, in their category *trending tickers* **(Yahoo Trending Stocks, 2021)***.*

Text

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In the function created, trending\_ticker(), we use beautiful soup , a data scraping library, to perform our data gathering. Some previous knowledge of how HTML is needed to physically look through the website for the relevant tags for identifying our data **(Real-Python, 2021)**. I found that everything relevant was under ‘aria-label’ and I proceeded to append the correct data to their specific arrays.

I used pandas in the very end to attach the data together which you will be able to see in *the figure below.*

Text

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I had to do some data cleaning at the very end since the web.DataReader() I was using later does not recognize crypto or tickers that are too recent. In addition to that, a removal of small volume trades was removed.

To make a point, we are only focused on those stocks with *large quantities of volume* flowing in and out through the day, so I also filtered for stocks that only have volumes greater than 100 million to give our options a little more room for profit on percentage changes daily **(Mitchell, 2020).**

With all of that said, a final return was made to return the data set we wanted. And now, we can move onto the next portion main().

**[Portion 2] main.py**

Moving onto our second program we have a relatively short program that takes the input of the user in terms of an investment amount. This returns a further filtered data frame (with stock prices never exceeding the max amount of money the user inputs) of the stock symbols and information required for our ML model later.

A picture containing table

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This was but a very short but necessary inclusion as I wanted to separate where the user would input their desired investments.

**[Portion 3] algo.py**

Whew! We got all that data cleaning out of the way, now what? The next and last part covers the main grit of the project where I will be explaining exactly what LTSM is, how it works in time series analysis, and how it is relevant to this stock prediction project.

Before we get to the actual predictions I will be explaining what LSTMs are. LSTM, Long-Short Term Memory networks/models, are designed for applications where the inputs are in ordered sequence where the information earlier may be important. While commonly used in language prediction and the auto-predict text on your phone where it predicts the next word you are going to type for sentence completion, concepts can be applied similarly in time series as the information from earlier is important **(Brownlee, 2020)**.

LSTMs are a type of recurrent network (RNN), which are networks that reuse part of the input from a previous step in the next step. As shown below, RNNs use other nodes in a particular sequence to influence outputs on later nodes (computational unit that takes inputs and outputs and connects to different nodes) **(Colah, 2015)**.

A picture containing text, clock

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*Taken From: https://lionbridge.ai/articles/difference-between-cnn-and-rnn/*

Each of these A nodes are recurrent but they all have an internal state (memory space), which can be retrieved over many times, Both the input the output and the internal state are used in the main function ran in the node, leading to an updatable memory space **(Colah, 2015)**. In addition to all of this, the nodes also have gates that are mainly influenced based on an input performing a forgetting and recalling function for the previous or current node.

Similar gates are used to perform changes on the current state itself and the output, allowing for a myriad of different outputs depending on a given / past situation **(Ganegedara, 2020)**. Even though this may be complex to digest, it provides our network with the ability to learn complex patterns and interdependencies of the data.

Now that we have some knowledge on what LTSM is, we can jump straight into the program.

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First, we will import all necessary libraries for this program. We have some portions from sklearn, TensorFlow, and your classic pandas, NumPy, and matplotlib for graphing later.

Now before we get further into writing the model, we will have to gather some further data for training once more. We will use Yahoo again along with the data reader to grab time, dates, and closing prices to continue with further predictions.

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As you can see a call on MinMaxScaler (sklearn) and reshape (NumPy formatting for arrays) was used to restructure and put the data on a more manageable scale, for us between 0 and 1 **(TensorFlow, 2021)**. We will limit our prediction days to 60 even though we have data dating back all the way to 2012, and appending that to our two training sets x and y\_train (binary classification, x being our inputs, y being our expected outcomes) based off of the length of scaled data and our prediction days **(Brownlee, 2020)**.

Graphical user interface, text

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Now comes time to write our model. The model created above is based off a standard model and includes 50 LSTM blocks (hence units 50) and with 1 visible layer of input. We have a series of dropouts that drops out units of invisible and visible data, that addresses overfitting in a neural network. Our dense layer provides and feeds the layer of outputs to the individual nodes. Our compile method provides an optimizer of sorts in this case the commonly used ‘adam’ optimizer with a loss of mean squared error. There is no need to go into detail of why we use compile, all we need to know is that it is a necessary argument required to train **(Colah, 2015)**.

Furthermore, we finally train by using model fit, which takes our x\_train, y\_train (inputs, expected outputs) and specify some standardizations in ML. A batch-size (number of samples ran before the model update) is 32 as standard, and our epochs (number of complete passthroughs of our training set) 5 (*usually 25)* is used for the brevity and speed of the code **(TensorFlow, 2021)**.

Text

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A similar process is run for testing the model accuracy against our close values from the original dataset we obtained from Yahoo **(Ganegedara, 2020)**. At the very end we use more concurrent data, from (1/1/2021) to our current date for the actual prediction putting it into the same model from before.

Text

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Chart, histogram

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Here is a simple plot we can write that shows our predicted vs actual prices for the models above.

With that done now we can use the following code based on our model to project ourselves one day in the future by adding in the necessary inputs and adding 1 to the last day predicted on.

Graphical user interface, text, application

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All that is now left to do is gather the data together for a reasonable looking output and prediction. What is the real question? Well but of course it is whether we buy or sell the stock. I put some simple Boolean logic code below and some print statements to decipher our outputs findings.

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Continuing below is an output of everything that this program outputs.

Graphical user interface

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Chart

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Text, letter

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As you can see, we have our desired graphical outputs along with the stock predictions. The simple print statements at the end tell us whether we should buy or sell, if the predicted price is lower than the actual price sell it, if the price predicted is higher buy it. A very simplistic way of determining whether we buy a stock. Of course, we could go into more detail and make this a whole lot more complex with financial knowledge, identifying day-trading patterns (bullish-pennant, inverse neck, and shoulder, etc.) that would be way too complex to implement for this project (**Mitchell, 2020)**.

Initially I was going to add an NLP (Natural Language Processing) Portion as well where I would take data from the Twitter API to determine the sentiment of the stock, but that would influence the run time of this project significantly, so I decided to opt out, not to mention that Twitter never got the credentials back to me for accessing the API.

**Conclusion**

I was able to take data off from the web, organize, and put it into a LSTM Neural Network to get a graphical representation of predictions on a given stock within a certain time frame and the prediction of the price for the next day. This allowed the program to output whether we should buy or sell a given security based on whether the prediction was higher or lower than the actual value. I have learned a lot about Machine Learning and Neural Networks through the process of this course. Although I am not proficient by any means, this is a good takeaway into the applications I can use in the future in tandem with data analysis.

Works Cited

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