Applications of Deep Learning in stock market prediction

Introduction

In this article, I will go into a deep dive on the recent progress that has been made in the usage of deep learning in the stock market. This article will focus on the works from the article "Applications of Deep Learning in stock market prediction: recent progress" by Weiwei Jiang of the Department of Electronic Engineering, Tsinghua University. The article focuses on the usage of deep learning to predict the stock market using the concepts that have been tried so far.

Stock market prediction is a classic problem that everyone has tried to solve for many years. With the explosion of computing power, people now have the ability to use machine learning and deep learning techniques to predict the market. With this statement the market assumes that the market is efficient; efficient market hypothesis (emh). This would allow us to use traditional machine learning to be able to predict that market, but due to the inefficiencies in the market this is not possible.

The focus of the survey would be on the latest emerging deep learning, which would include neural networks. As mentioned earlier, due to the significant increase in computing power, we can use GPU's, CPU's and all available resources to be able to process the large amounts of data. This has led to a rapid development of prediction models, making prediction easier every time.

Topics covered in the article are

- Summary of the latest progress of applying deep learning topics and techniques to stock market prediction over the last three years
- General workflow of stock market prediction based on the studies
- Implementation and reproducibility
- Future directions of works

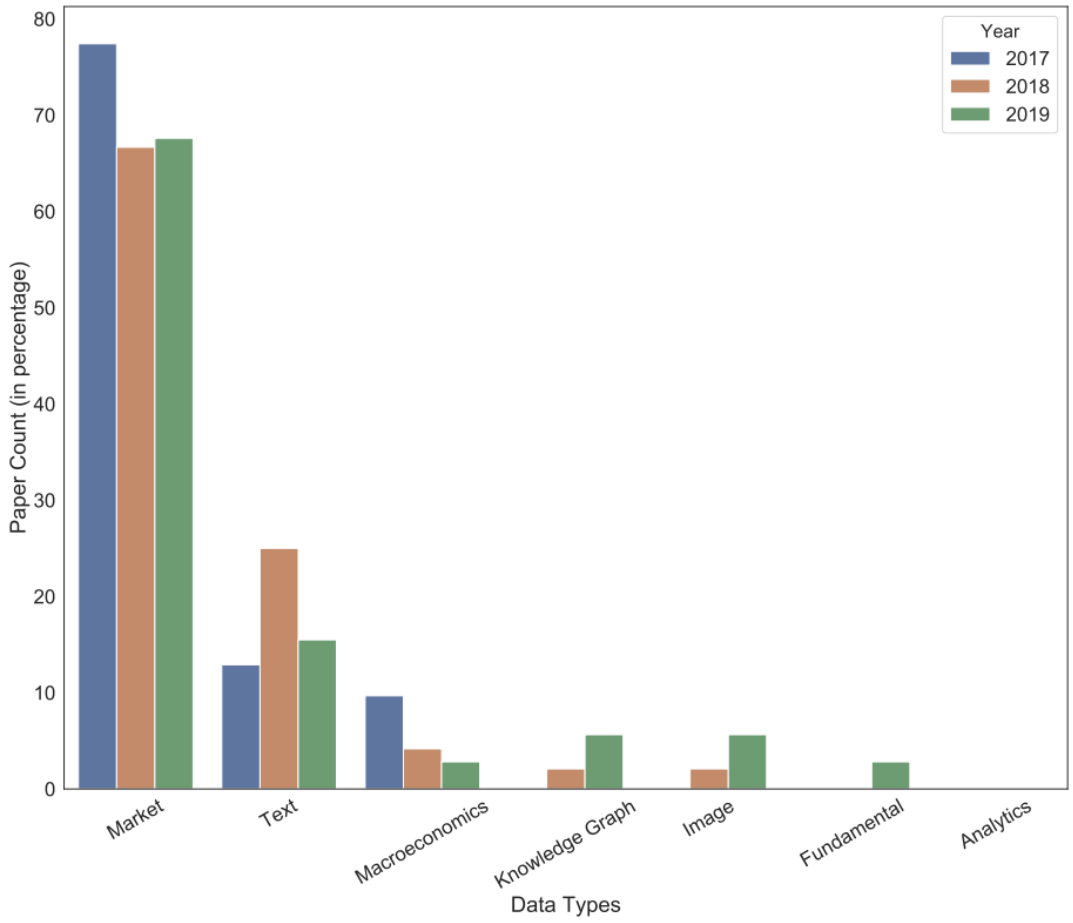
Workflow

The works of any paper starts off with the raw data. This data needs to have the historical prices of the different stock markets. The larger the amount of data that can be collected the better it was, due to the assumption that the stock market follows historical patterns.

The types of data that would be collected in each of the papers includes

- Market data: Open, high, low, close trading prices of stocks, trading volume. These values will be used as the input, and the expected output will also be these values for a time period in the future
- Text Data: Social media, news, web searches, alternative data sources. These values would be looked at using NLP techniques.
- Macroeconomics data: economic data for a country, region, or sector. Items would include Consumer price Index, Gross Domestic product, and other factors that might affect a company.

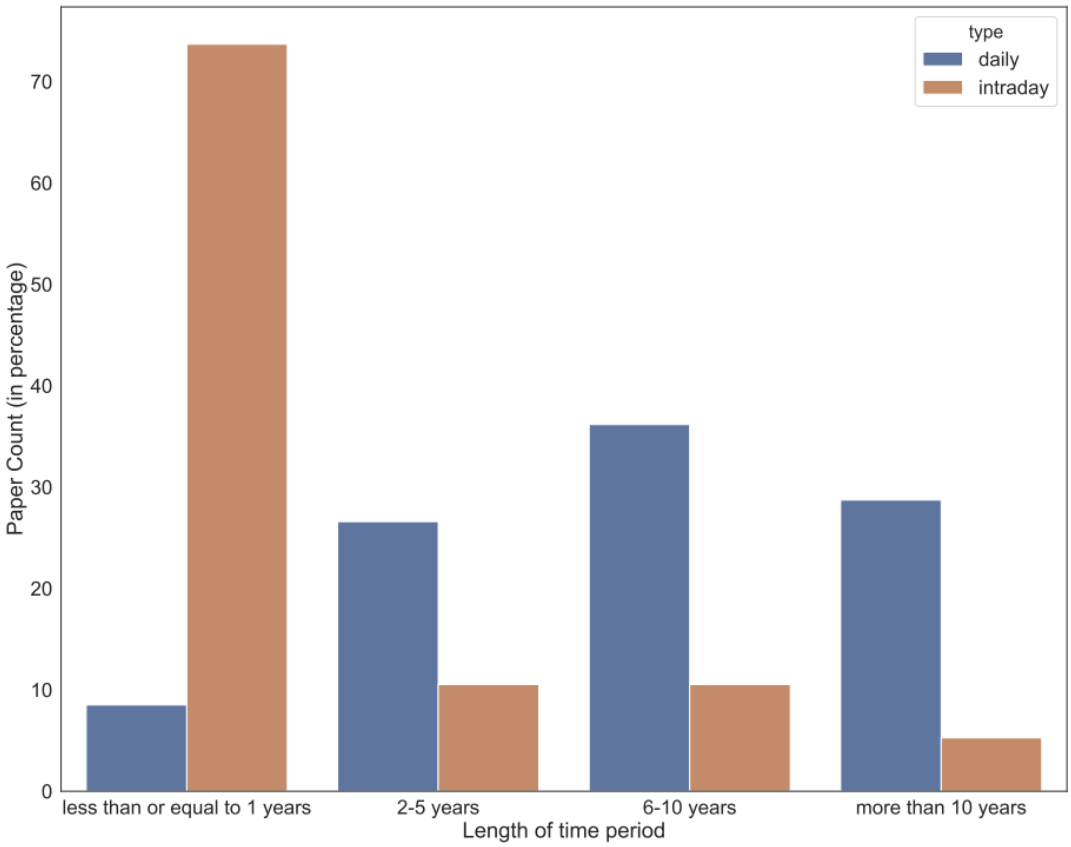
- Knowledge graph data: Relationship between different companies and different markets, an example of this would be a grocery chain in the united states vs a grocery chain in the United Kingdom.
- Image data: Using satellite images to determine the activity over a factory. For example the number of vehicles in the parking lot of a Walmart shows the success of the store or not.
- Fundamental Data: Accounting data, profit statements from the company. This would be the filling such as the 10k in the united states.
- Analytics Data: Reports created by trades, predicting the value of the stock. Data that analysts create. Rating the stock as a buy or sell.



The articles try to capture as many of the data points as possible, almost all the articles focus on the market data, looking at text as the next option, macroeconomics, knowledge image and fundamentals in last. Analytics data is completely ignored in each of the years that data was collected from.

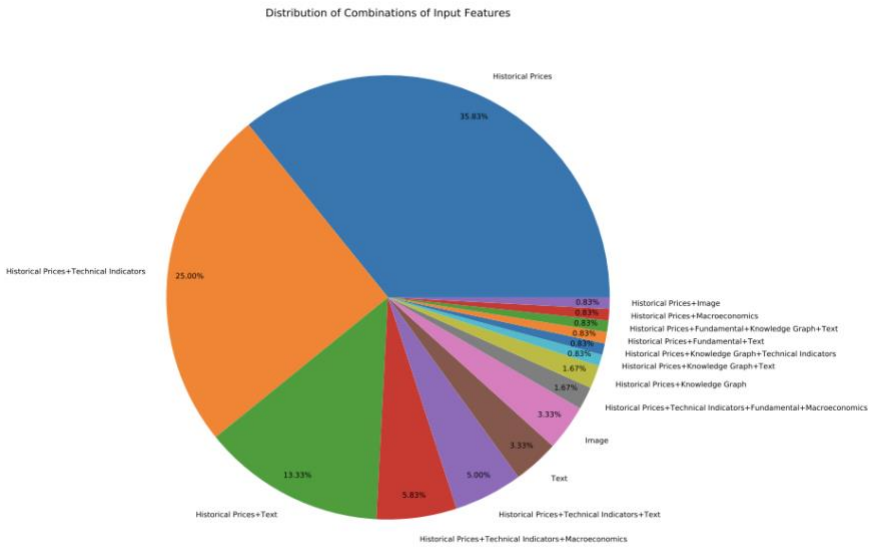
Most of the collected data is less than 1 year, while we also see data from 2-5 years, 6-10 years, and more than 10 years. The information is usually for the daily stock price, and few

articles focus on intraday data. Data collected only for the first year would generally be focused on intraday values.

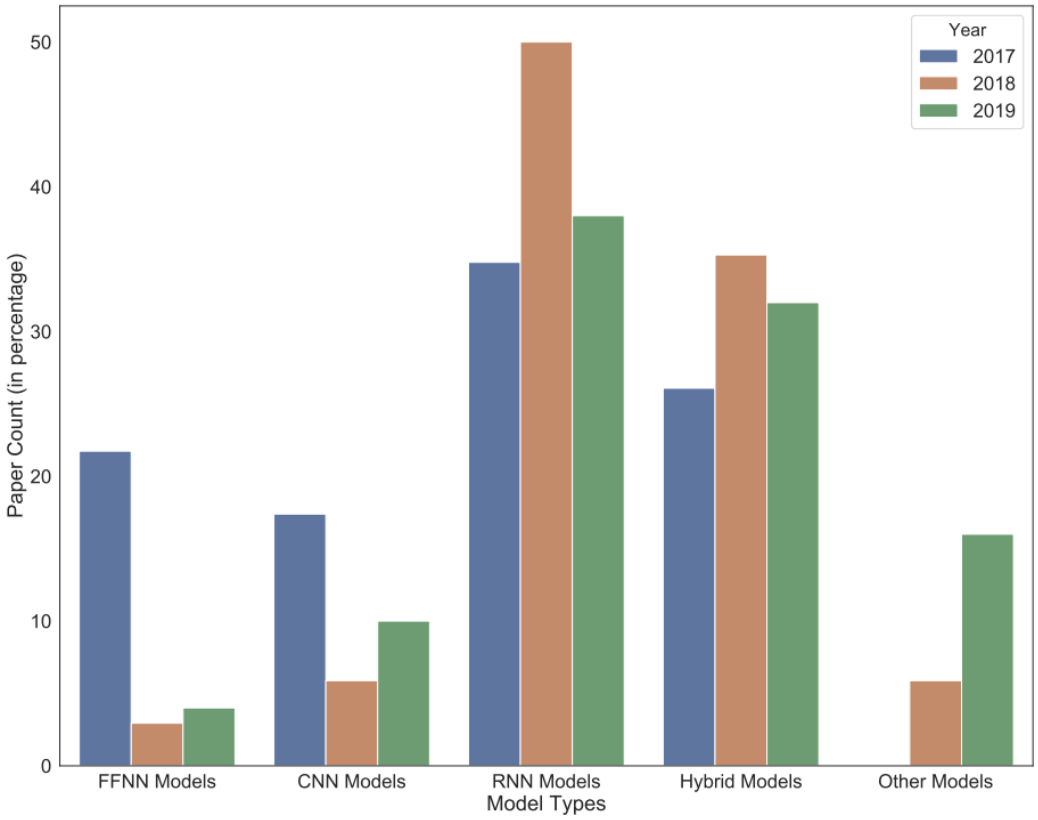


Using the collected data, we would now need to focus on feature extraction. Our focus would be on proven technologies such as moving average and moving average convergence/divergence (MACD). We would also focus on extracting features based on public events. This is because a lot of stock market activity can occur during an public event. For example, during the holidays people tend to go on vacation. This time period would be near the end of December, during this time we see the stock prices of travel related sectors start to increase. From our text data, we would start extracting sentiment and cataloging those based on the companies that they relate to.

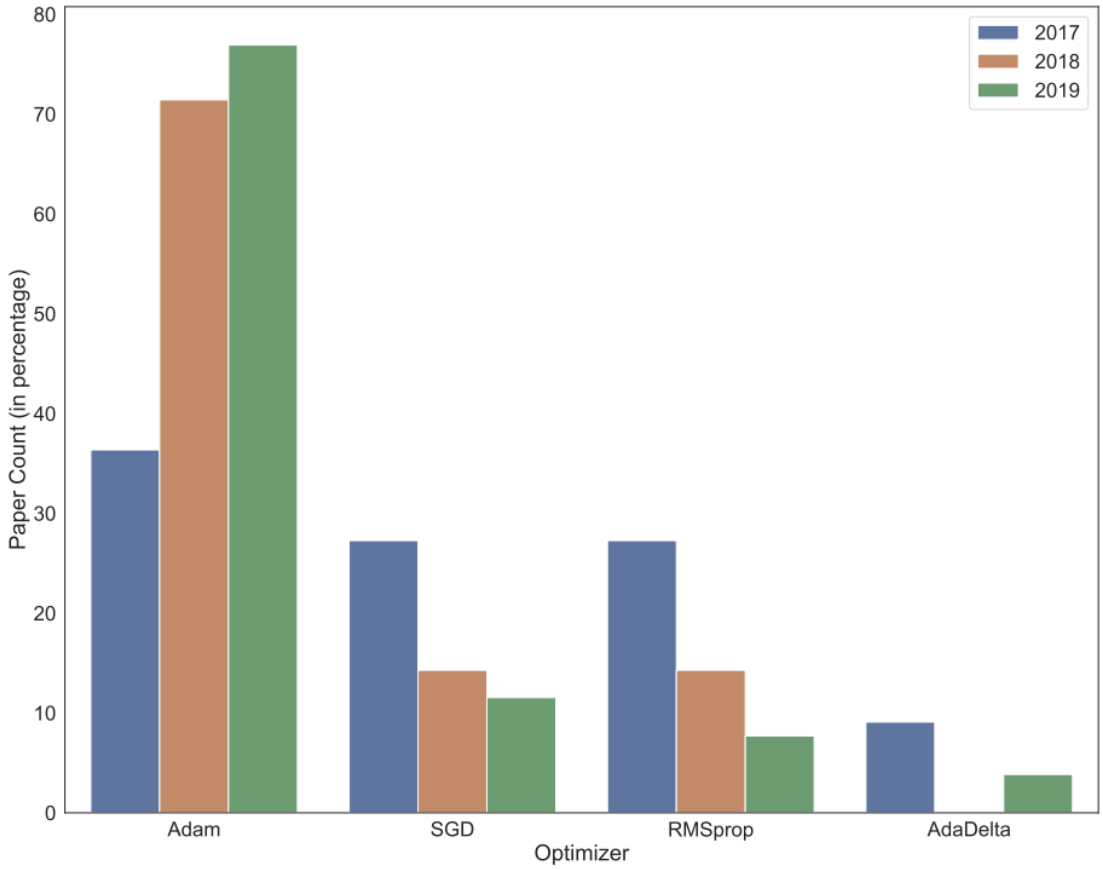
The following graph from the article shows the feature extraction from the inputs



The processing techniques that were used included, Bag-of-features, bag-of-words, cycle embeddings with attention mechanism, complete ensemble empirical mode decomposition with adaptive noise, empirical mode decomposition, moving average, momentum, neural bag-of-features, principal component analysis, rough set, relative strength index, simple moving average, sub-mode coordinate algorithm, wavelet transform, 2 directional PCA.



The focus on deep learning focused on feedforward neural networks, where the network connections between nodes do not form a cycle. Convolutional neural networks, to procession two dimensional images. Recurrent neural networks, connections with the nodes do form a cycle along with a temporal sequence.



Conclusion

What we learned was that a lot of work still needs to be completed in the prediction of the stock market using machine learning and neural networks. The performance of some of the models was much higher than what was expected.

The amount of data required to predict the stock market is still very large and people need to find ways to reduce the number of data points that are required. We also learned that the deep learning models do not perform as well as the machine learning models. So how do we combine the two to build a more robust system to predict the stock market. Even though some of the paper went over them combining two models, they did not achieve that significant of a result. Over the course of the fifty-four articles that the author of the survey went over, we were brought up to date with the usage of machine learning and deep learning in the stock market.

We can use this data point to build upon the works of the author and implement our own stock market prediction tool. We can also utilize some of the tools that the papers used such as keras, tensorflow, pytourch, Theano, and scikit learn.