Stock Market Prediction with Deep Learning

DHANANI NIKUNJKUMAR, *REG NO. 2111709*

Abstract—For evaluating financial text data, machine learning has become a very useful method.Stock price forecasting from financial news,recurrent neural networks with character-level language model pre-training for both intraday and interday stock market forecasting.

1 Introduction

The study of text data, such as news releases and commentary on events, is one key source of market information and is routinely used and evaluated by investors. Predicting stock market behaviour is an area of strong attraction for both academic researchers and industry practitioners alike. Financial news disseminates fresh information to a large number of market players, and trading tactics that respond quickly to new information are crucial. The majority of approaches to analysing financial text data are based on bag-of-words, noun phrase, and/or named entity feature extraction combined with manual feature selection. However, the ability of these methods to extract meaningful information from the data is limited because much information about the structure of the text is lost in the process.

The trend for extracting features from text data has shifted away from manual feature engineering, and there has been a resurgence of interest in neural networks due to their power for learning useful representations directly from data. While deep learning has had great success in learning representations from text data, successful applications of deep learning in textual analysis of financial news have been few, despite the fact that its applicability has been demonstrated.In a text classification task, the most informative representation of the data is still an unsolved problem. Text classification has been proposed using a variety of different neural network architectures.

2 Event-based Trading

Algorithmic trading has been a popular investment strategy in recent years. This, in conjunction with machine learning and natural language processing, allows for the use of unstructured text data as a source of data for investing strategies. Tetlock (2007) employed sentiment analysis to investigate the relationship between sentiment in news articles and market prices, indicating that media pessimism may have an impact on both market prices and trading volume.Many feature selection-based algorithms have been proposed in the literature for direct stock price forecasting, as evidenced by news articles.

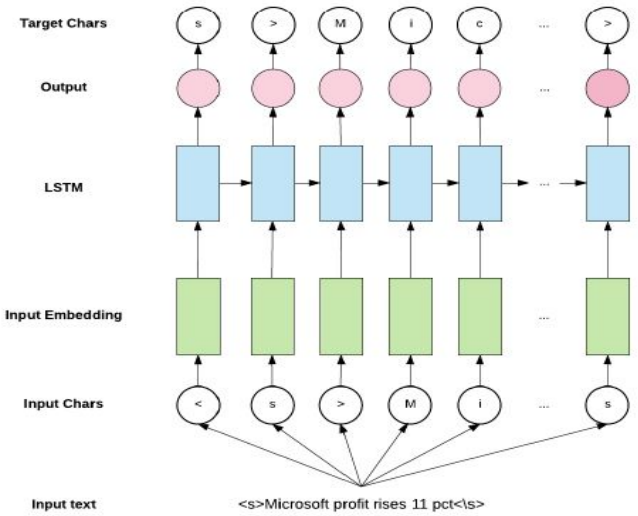
3 Model design and Training Details

In this paper we have a twopart model. The first builds a representation for the input, which for us is the characterlevel language model. The second is the recurrent neural network used for the prediction, a classifier that takes the input and predicts whether the price will rise or fall in the chosen timeframe. Both models process text as a sequence of UTF-8 encoded bytes.

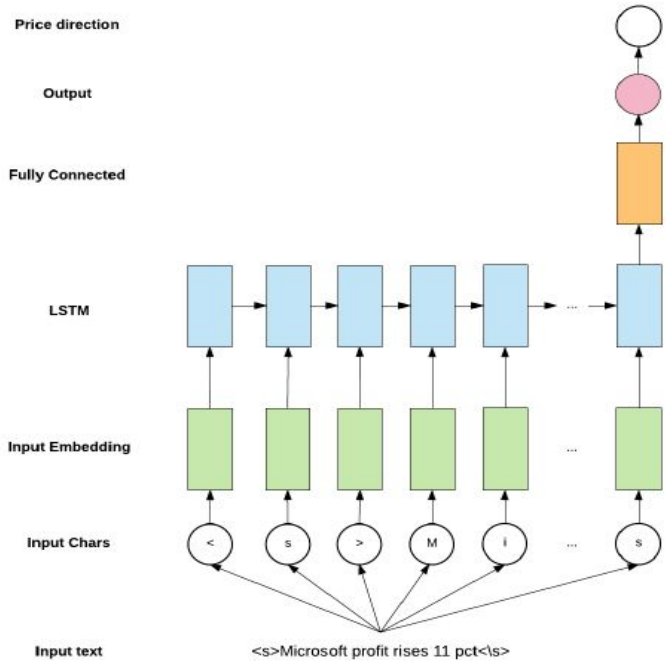
4 Experiments

From October 2006 to November 2013, we tested our model using a collection of financial news gathered from Reuters and Bloomberg. Ding et al. made this dataset public (2014). We used the timestamp for the news release to filter the news that only contained the name of one firm from the Samp;P 500 index and ran our experiments on forecasting whether the last price after one hour would be greater than the first price after the news release.

The author compare the model.For the other work using the same dataset (Ding et al., 2015; Vargas et al., 2017), we give the results from the respective papers; we use the same experimental setup as they did. These models do not have intraday results, as the authors of those papers did not have stock data at more finegrained intervals than daily.



(a) Language model



(b) Stock price prediction

Figure 1: (a) Network architecture for the language model. In each step the output of the LSTM layer predicts the probability distribution of the next character. (b) Networks architecture for the stock prediction network. Only at the final processing of the text the output of the LSTM is used to predict the direction of the stock price.

5 Results and Discussion

The quality of the representations learned by the character language model is examined first. We were curious how effectively our model would be able to reproduce the information dependencies inherent in the data, such as the time of events and currency information, given that it was trained entirely on a dataset of financial news. The language model seems to be able to replicate these dependencies.When it comes to analysing the impact of news announcements on stock prices, there haven't always been the instruments to analyse large amounts of text. It is now possible to look empirically at how long it takes knowledge to be integrated by measuring how predictable stock prices are as a function of news announcements, thanks to deep learning and online availability of stock prices at fine-grained intervals.

6 Conclusion

This research demonstrated how to anticipate the stock market using solely financial news as predictors using a simple LSTM neural network with character level embeddings. Our findings imply that character level embeddings are both promising and competitive with more complex models that incorporate technical indicators and event extraction approaches in addition to news articles.

Furthermore, while previous research has shown that including the news's body text performs worse than just the headline, there may be useful information to be extracted from the body text, perhaps along the lines of Pang and Lee (2004), who improve sentiment analysis results by snipping out irrelevant text using a graph-theoretic minimum cut approach.

References

[1] Johan Bollen, HuinaMao, and Xiaojun Zeng. 2011. Twitter mood predicts the stock market. Journal of Computational Science 2(1):1–8.

[2] W. Edwards. 1968. Conservatism in human information processing. In B. Kleinmutz, editor, Formal Representation of Human Judgement, Wiley, New York.

[3] Eugene Fama. 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. Journal of Finance 25:383–417.

[4] Burton G Malkiel. 2003. The efficient market hypothesis and its critics. The Journal of Economic Perspectives 17(1):59–82.

[5] Tomas Mikolov, Kai Chen, Greg Corrado, and Jerey Dean. 2013a. Efficient estimation of word representations in vector space. CoRR abs/1301.3781. http://arxiv.org/abs/1301.3781.

[6] Thien Hai Nguyen, Kiyoaki Shirai, and Julien Velcin. 2015. Sentiment analysis on social media for stock movement prediction. Expert Systems with Applications 42(24):9603–9611.