Neural Networks for Sentiment Analysis in Cryptocurrency Market

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Introduction

"the question is no longer […] whether investor sentiments affect stock prices but rather how to measure investor sentiments and quantify its effects" – Malcolm Baker

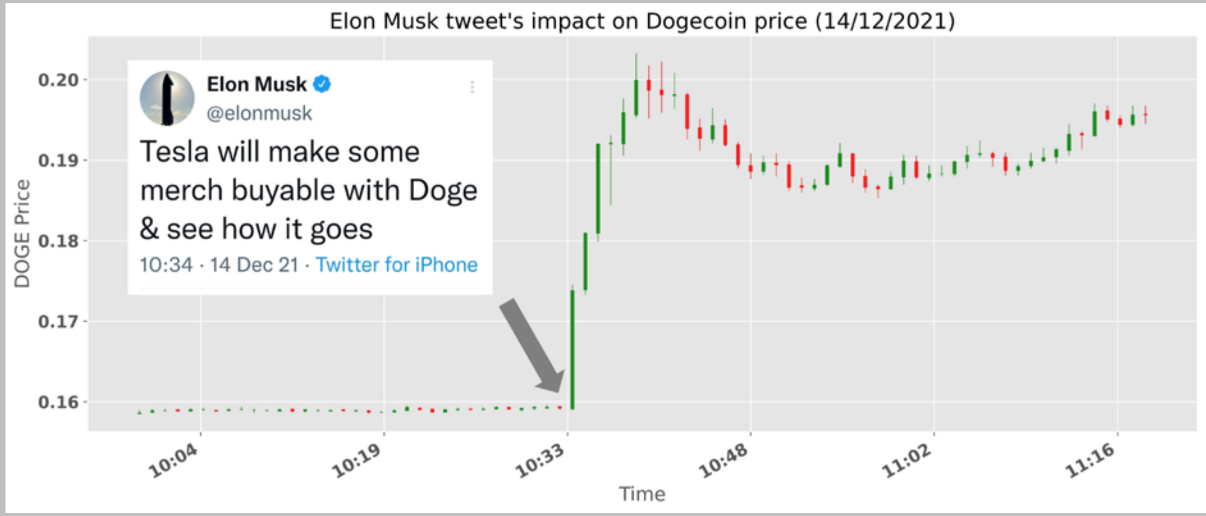
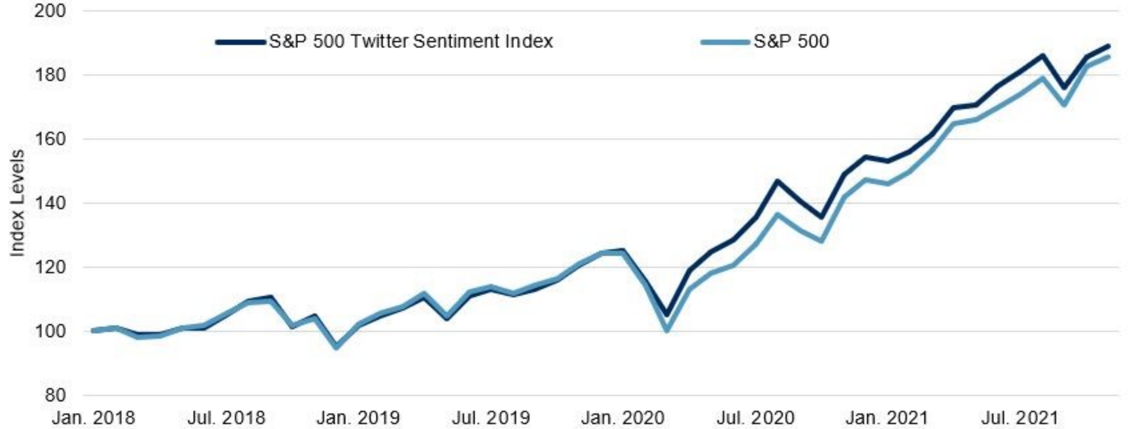


Exhibit 2: Back-Tested Performance of the S&P 500 Twitter Sentiment Index versus the S&P 500

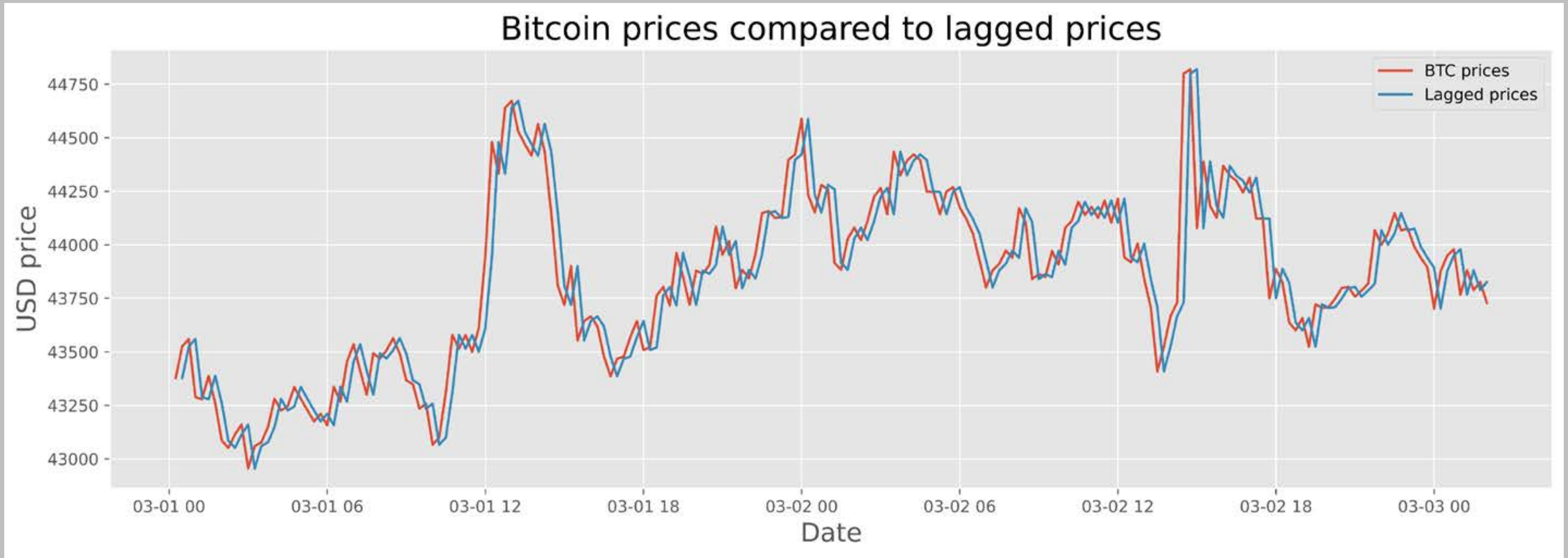


INDEX	RETURN (ANNUALIZED, %)	VOLATILITY (ANNUALIZED, %)	RISK-ADJUSTED RETURN	MAXIMUM DRAWDOWN (%)
S&P 500 Twitter Sentiment Index	18.57	21.24	0.87	-30.54
S&P 500	18.00	21.52	0.84	-33.79

Motivations & Objectives

Autonomous system with:

- **Data collection**
- **Sentiment analysis**
- **Price prediction**
- **Trading strategy**



MSE: 0.3%
Correlation: 0.99

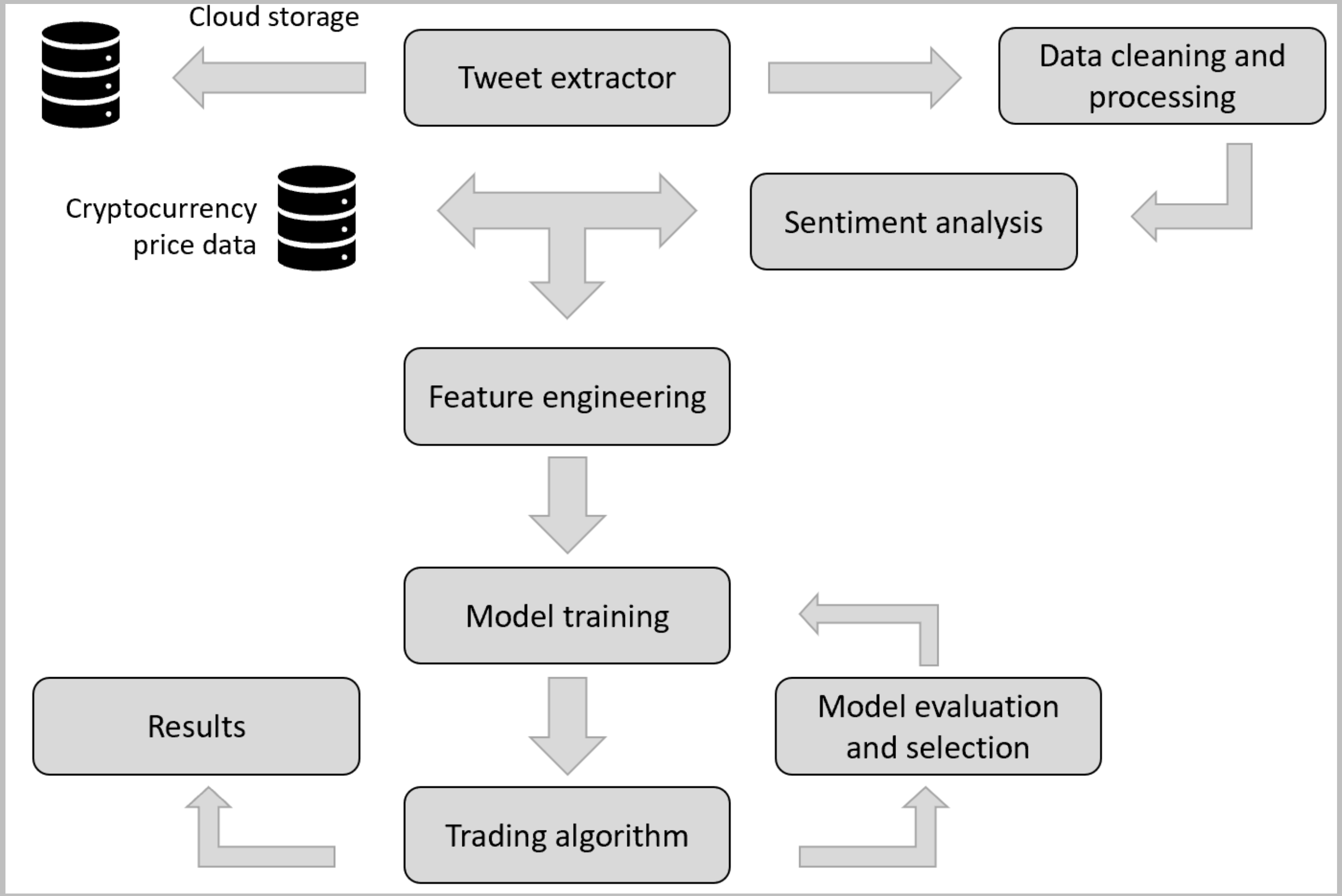
Return on investment using trading strategy: -13% in two days
Accuracy: 44%

System design

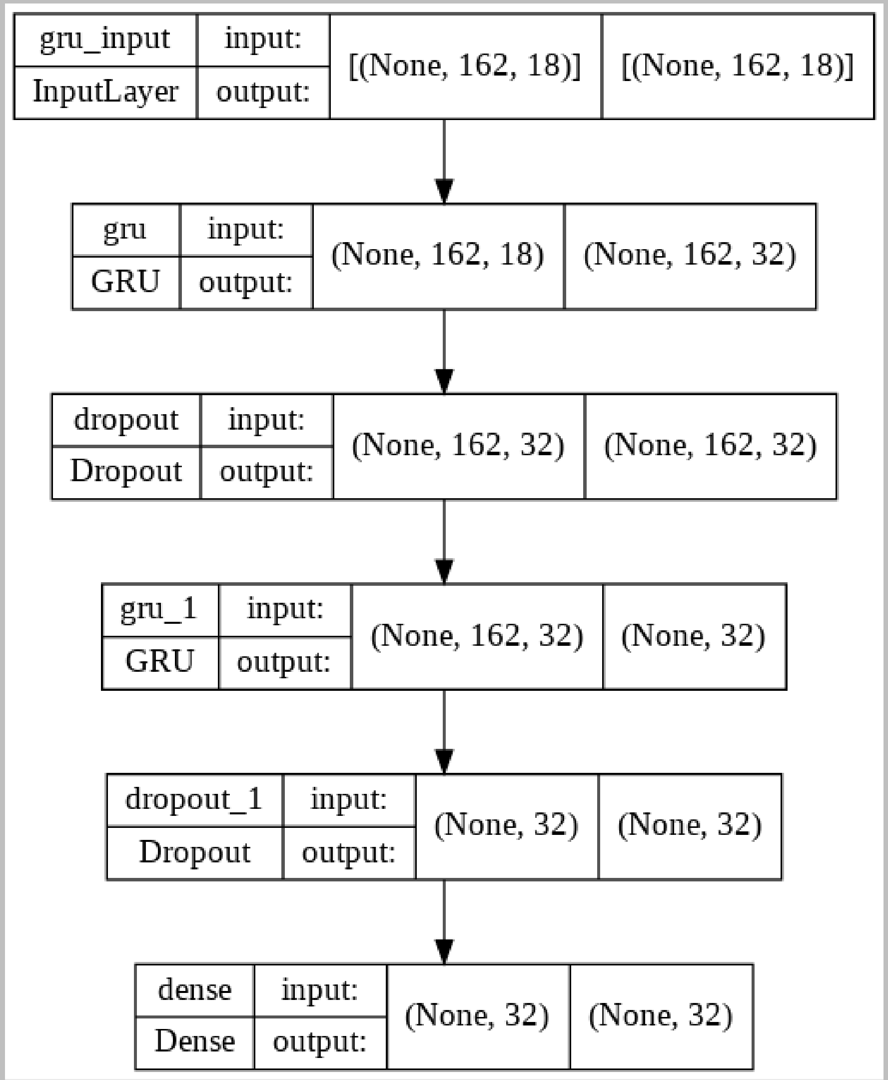
<u>Sentiment features:</u>

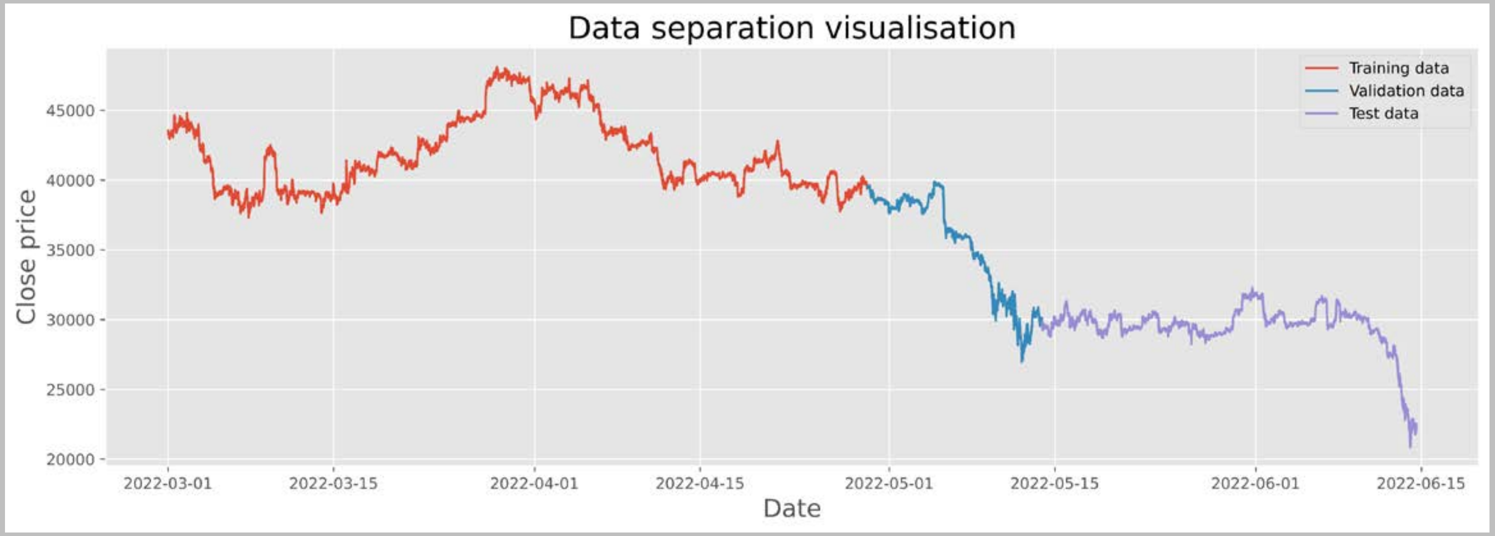
- Number of tweets
- Additive sentiment score
- Mean sentiment score
- Polarity sentiment score
- Number of positive tweets
- Percentage of positive tweets

Raw tweet	ðŸ‡§ðŸ‡· Rio de Janeiro will allow residents to pay property taxes in #Bitcoin & #cryptocurrency beginning in 2023.
Cleaned tweet	rio de janeiro will allow residents to pay property taxes in bitcoin cryptocurrency beginning in 2023



Implementation



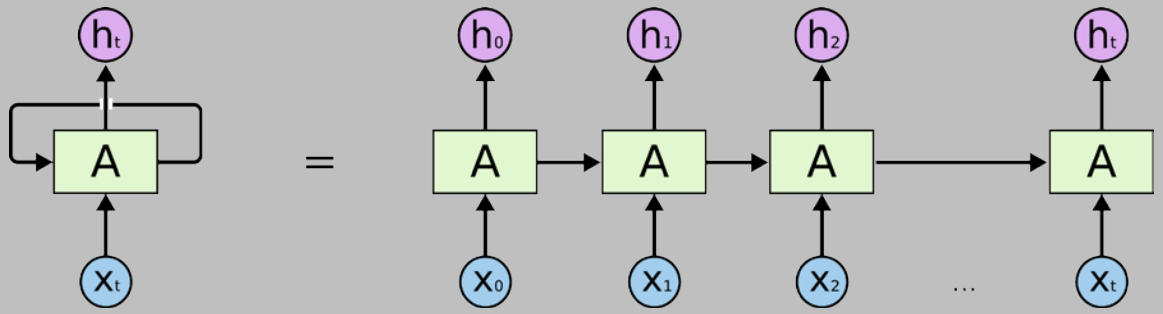


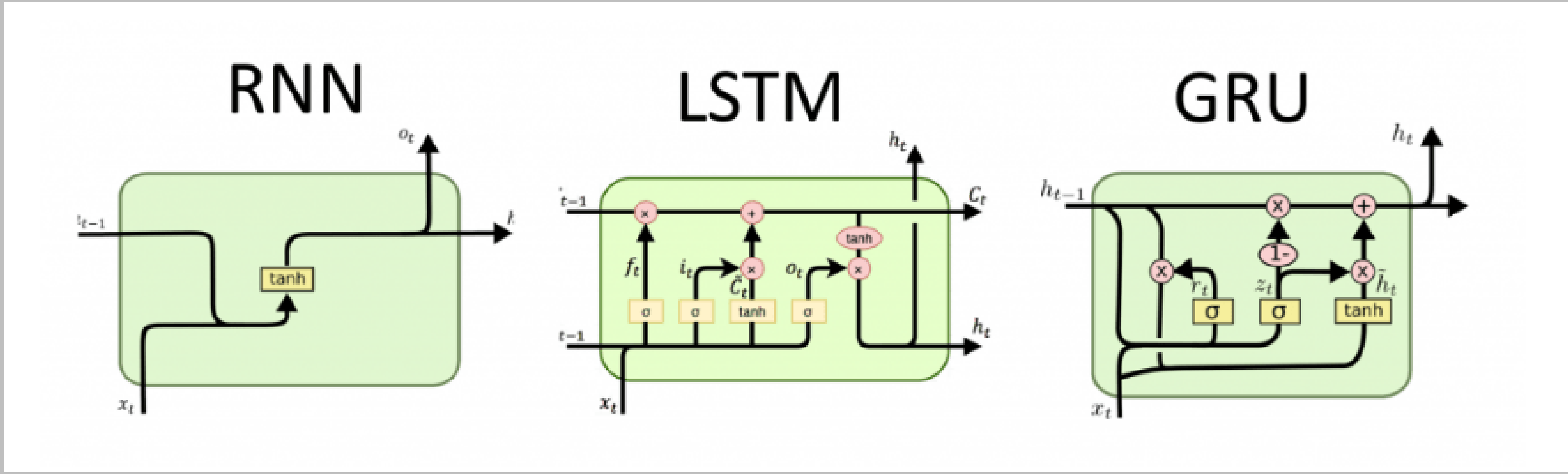
<u>Hyperparameters:</u>

- Sequence length: 24
- Batch size: 32
- Hidden size: 32
- Number of layers: 2
- Dropout rate: 0.1
- Learning rate: 0.01
- Type of model: GRU

Background: Neural networks

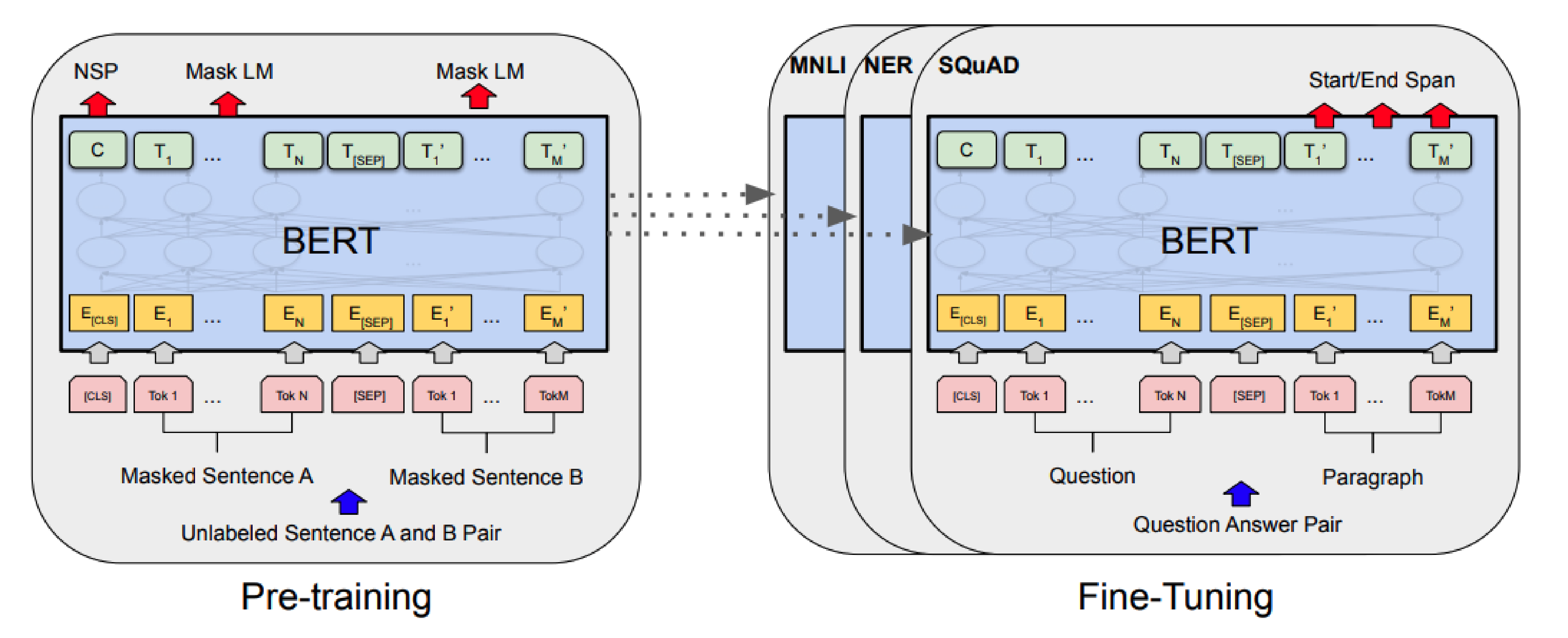
Unrolled recurrent neural network





Background: Sentiment analysis

BERT: Bidirectional Encoder Representations from Transformers – Google, 2018



Background: Performance metrics

Technical Indicators used:

- **Relative Strength Index**
- Stochastic Oscillator
- Williams Percentage Range
- Moving Average Convergence Divergence
- **On Balance Volume**

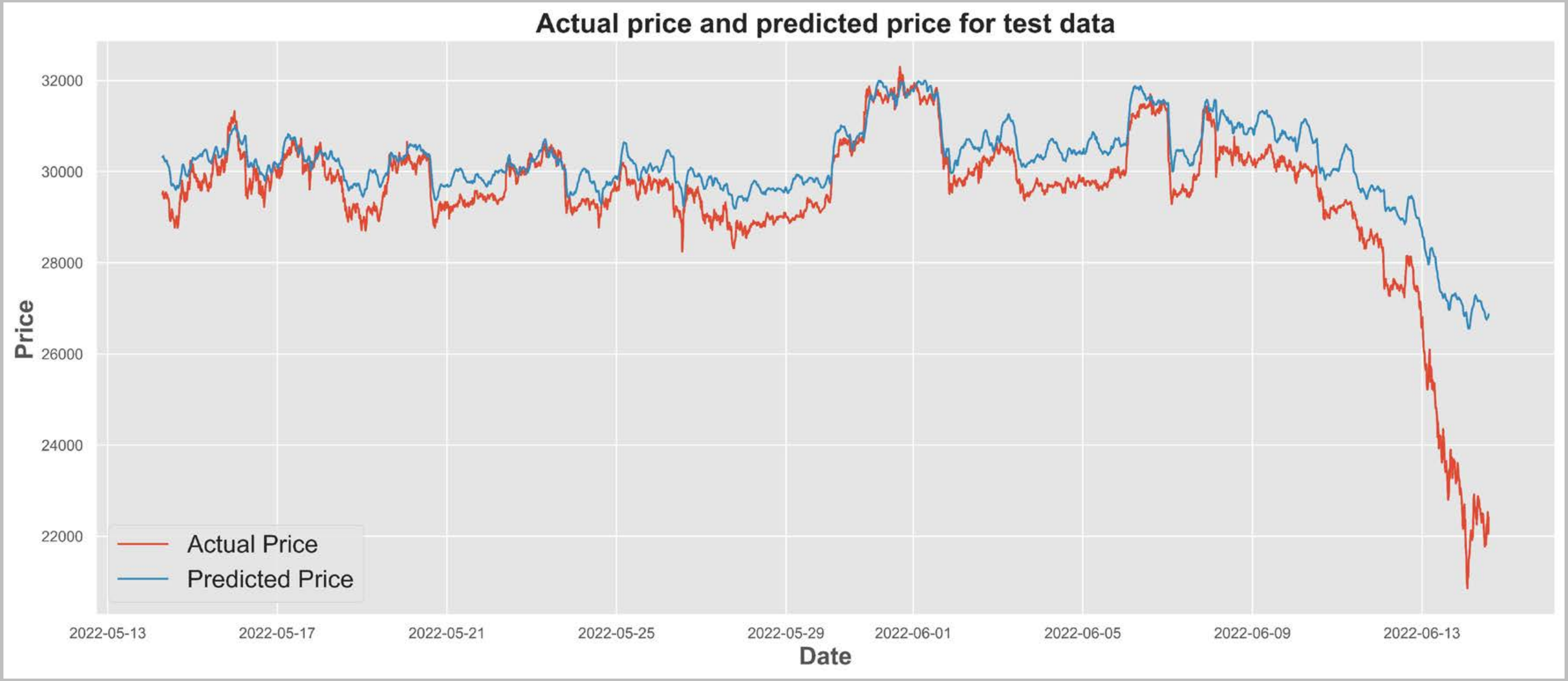
Traditional error metrics:

- **Mean squared error**
- Root mean squared error
- Mean average error
- Mean average percentage error
- **Accuracy**
- F1-score

Financial evaluation metrics:

- **Return on investment**
- **Sharpe ratio**
- Value at risk

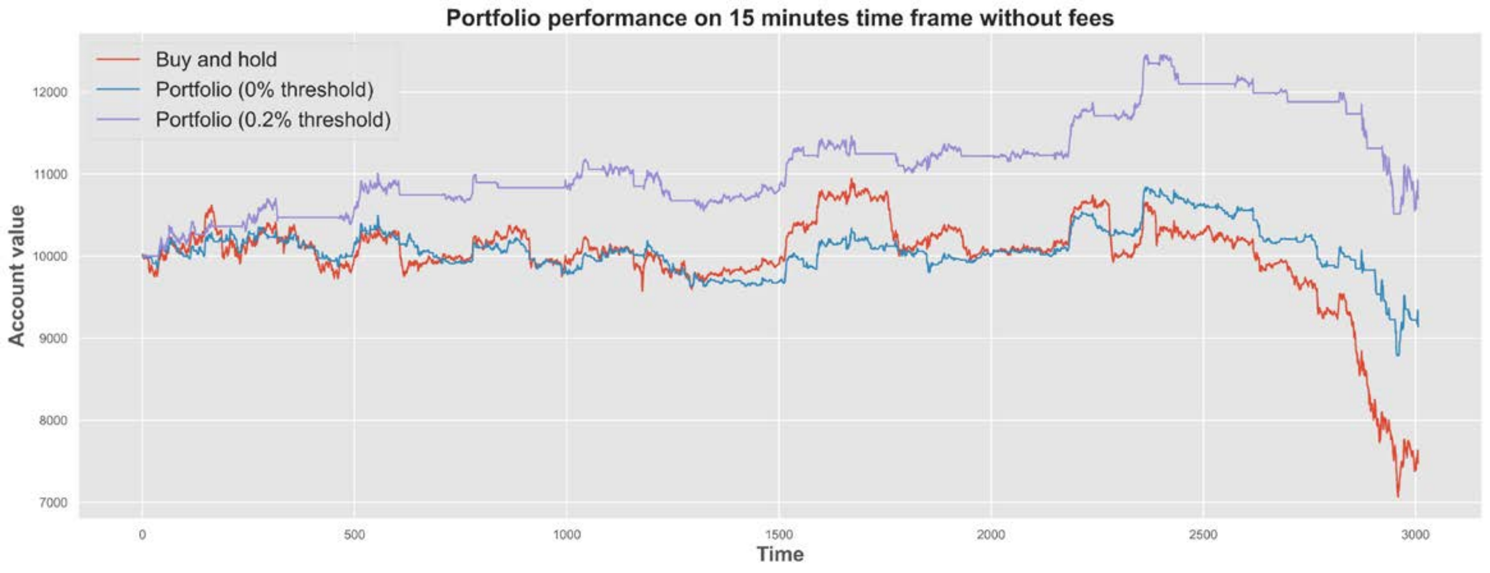
Results



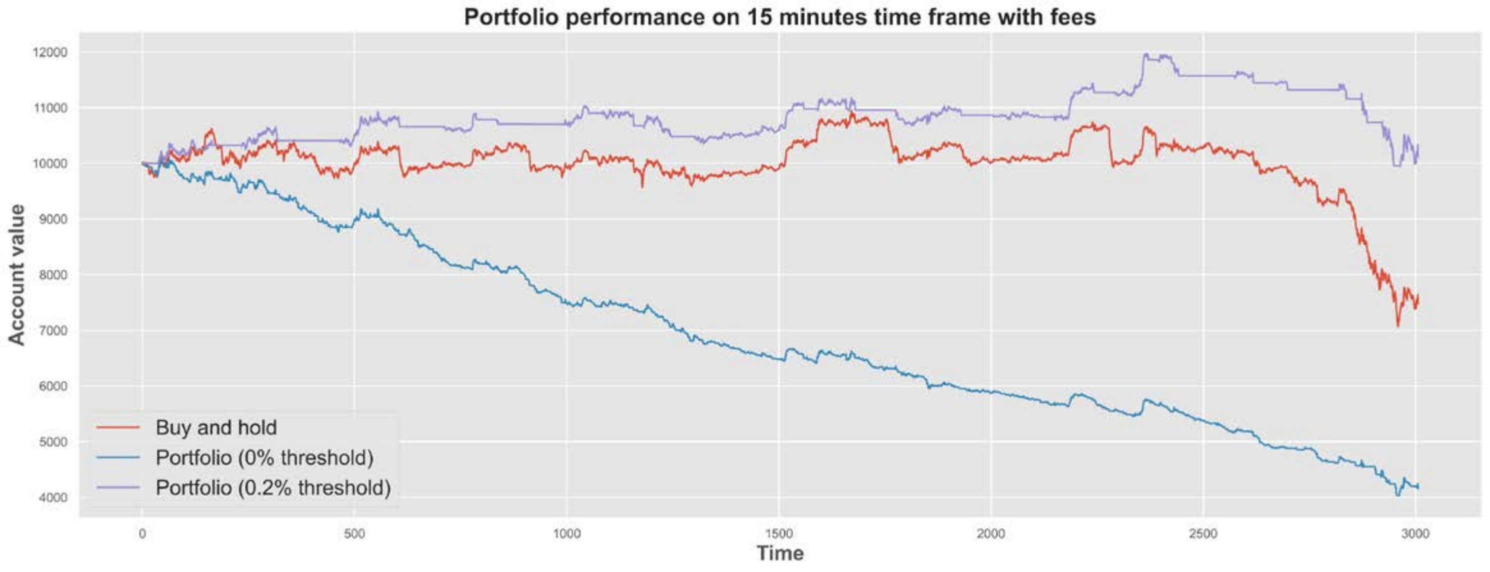
Actual price and predicted price for test data
32000
30000
28000
26000
24000
22000
Price
2022-05-13
2022-05-17
2022-05-21
2022-05-25
2022-05-29
2022-06-01
2022-06-05
2022-06-09
2022-06-13
Date
Actual Price
Predicted Price

Results

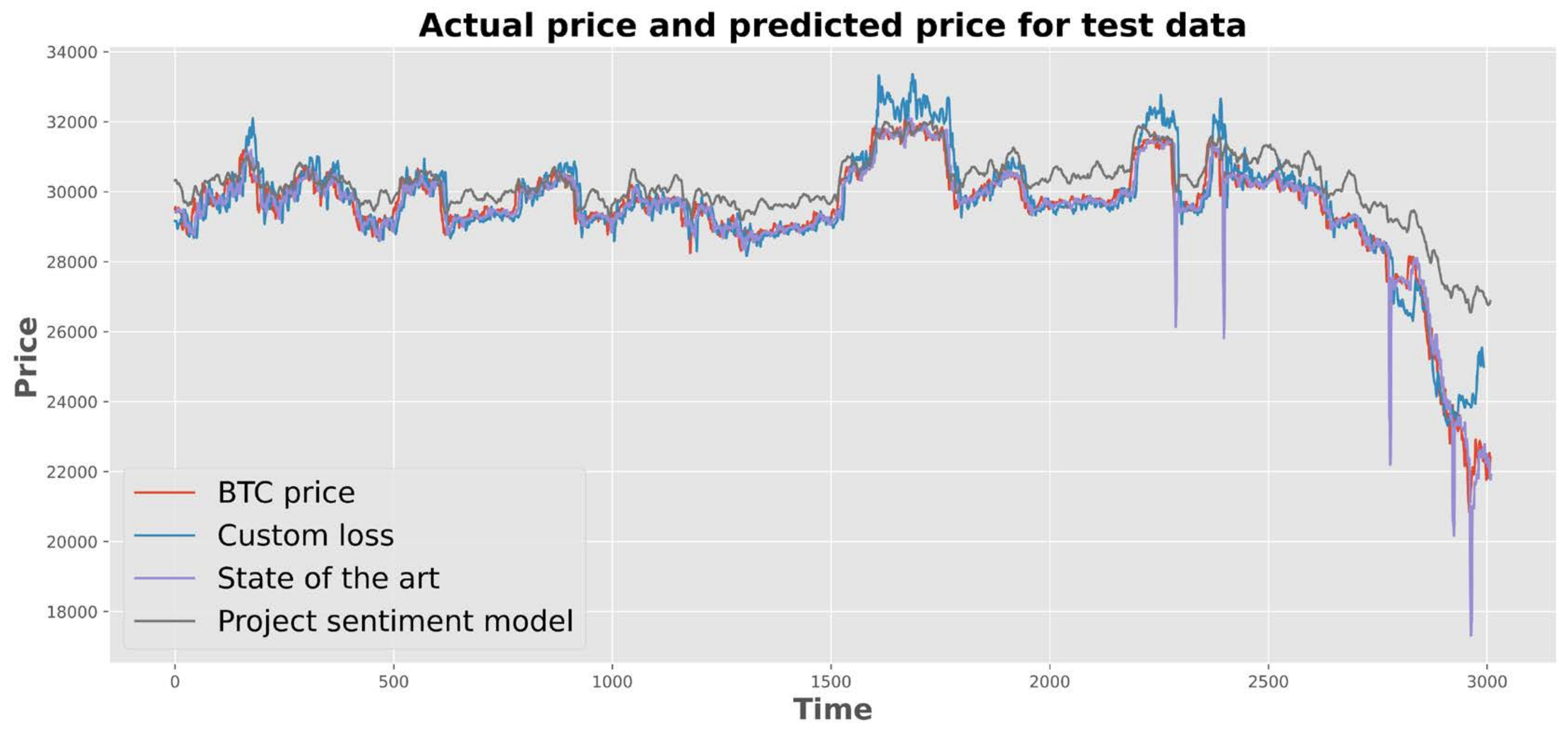
	ROI	Sharpe ratio	Number of trades
Buy and hold	-26%	-0.36	-
0% threshold	-7.1%	-0.17	396
0.2% threshold	+8.6%	+0.16	28



	ROI	Sharpe ratio	Number of trades
Buy and hold	-26%	-0.36	-
0% threshold	-58%	-1.72	396
0.2% threshold	+2.8%	+0.04	28



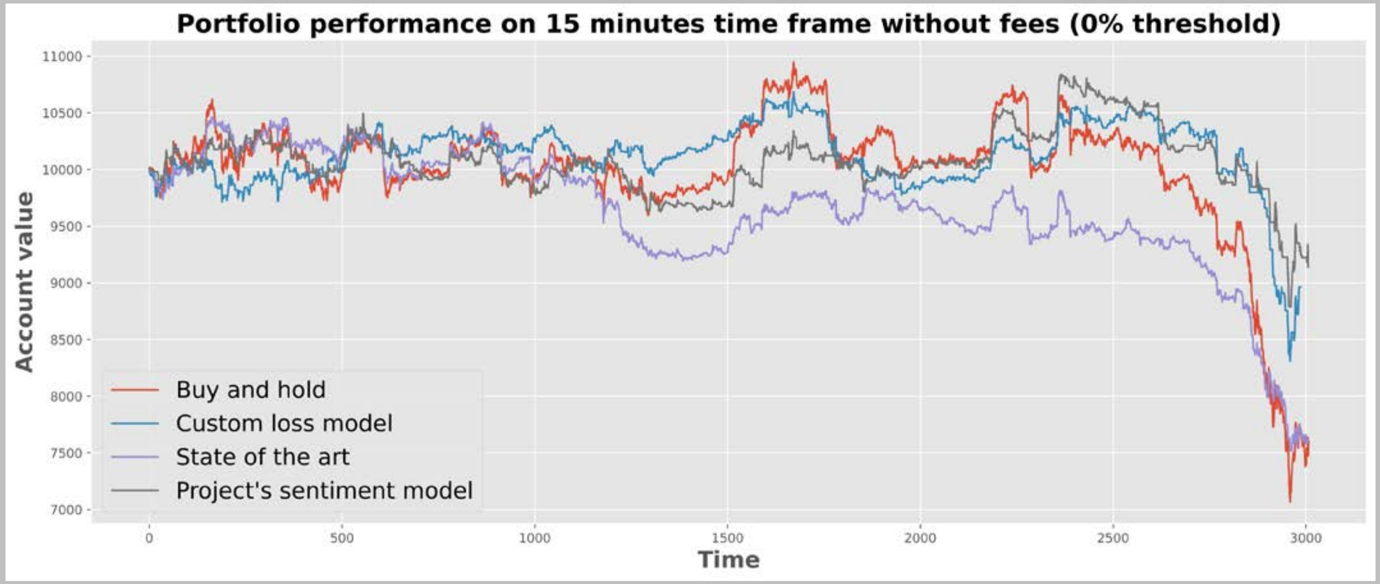
Evaluation to previous methods

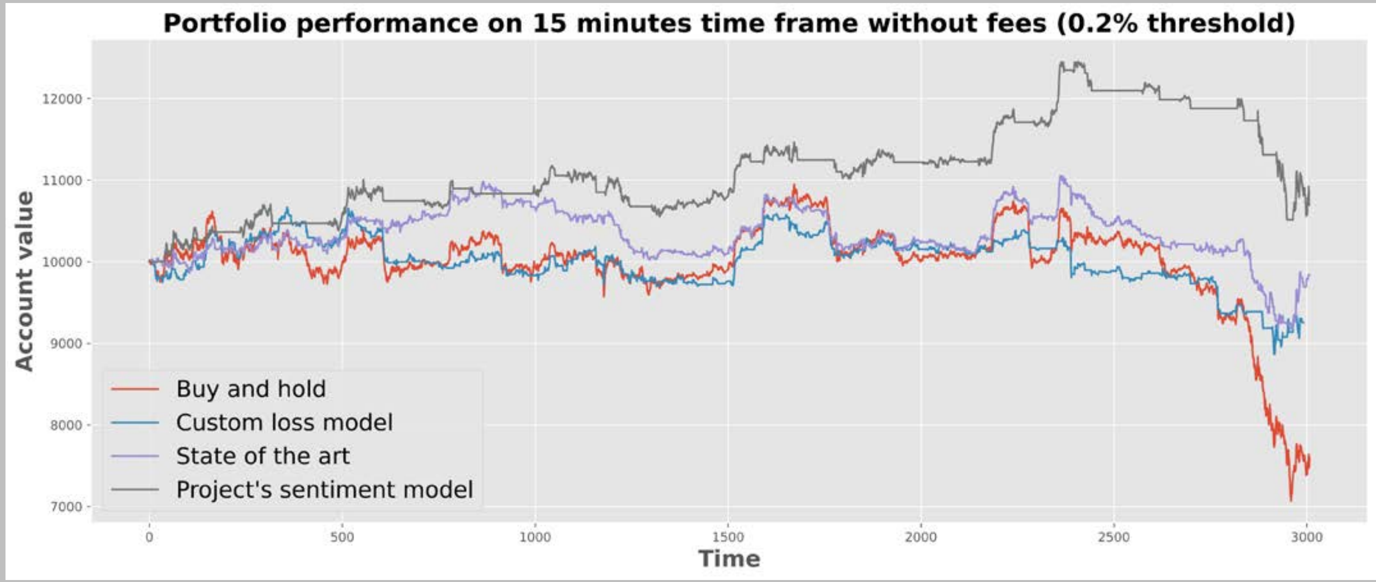


Evaluation to previous methods

Model	0% threshold	0.2% threshold
Custom loss	443	237
State of the art	840	372
Project's sentiment model	396	28

Number of trades made for different models and threshold values





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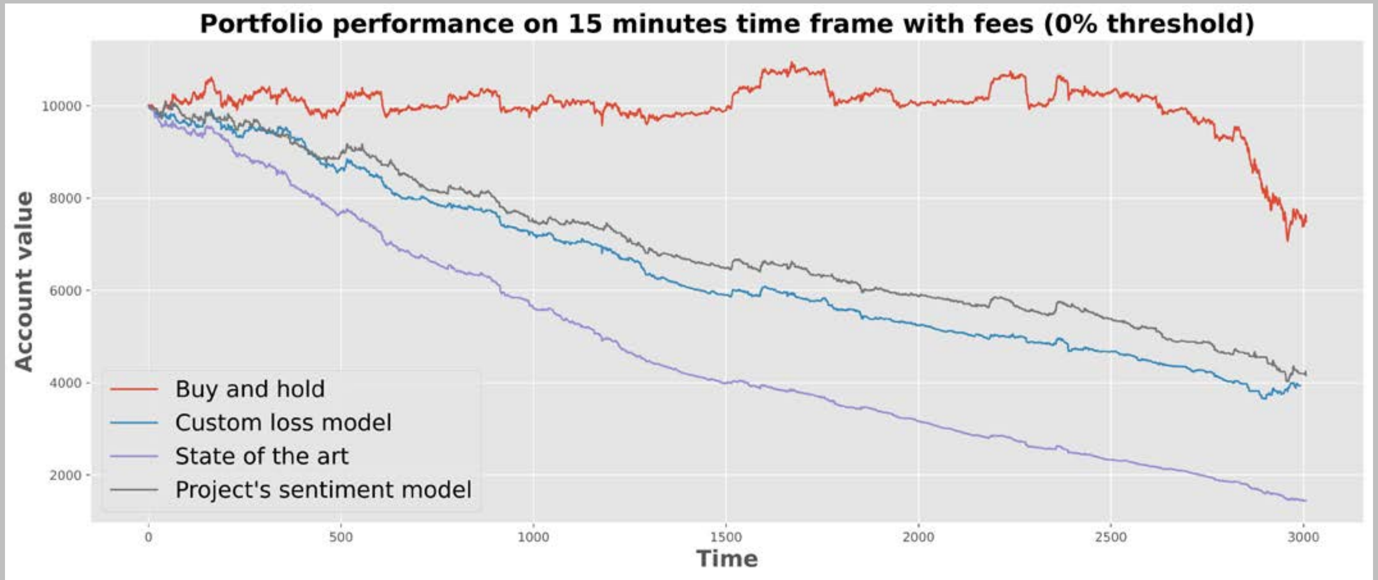
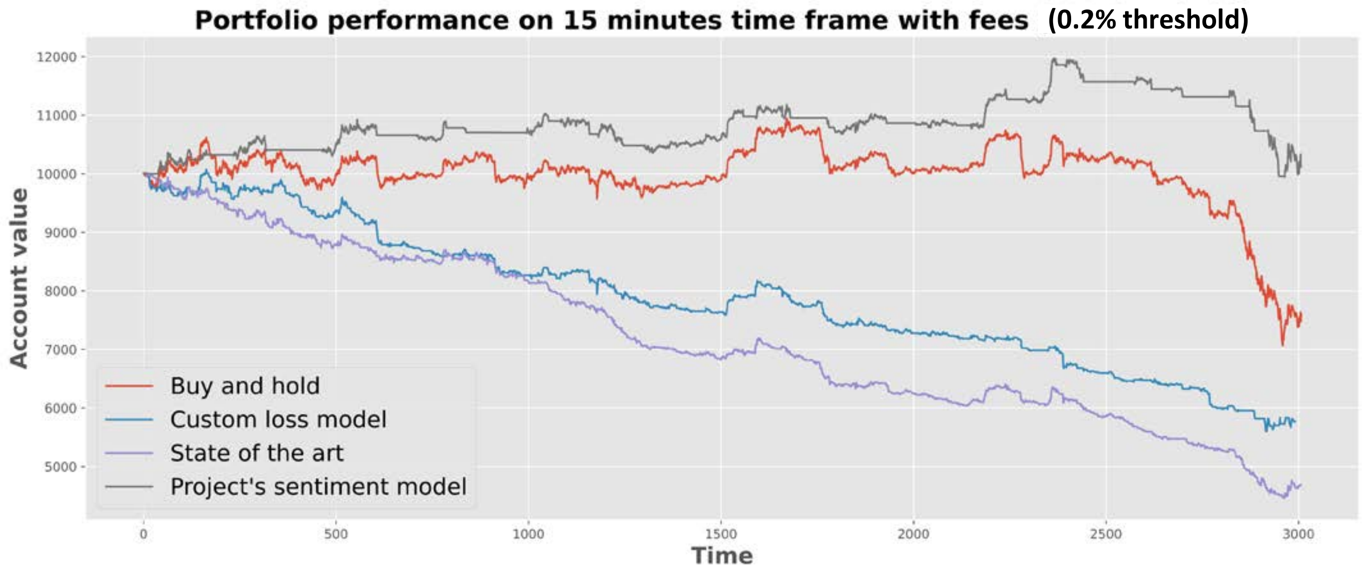
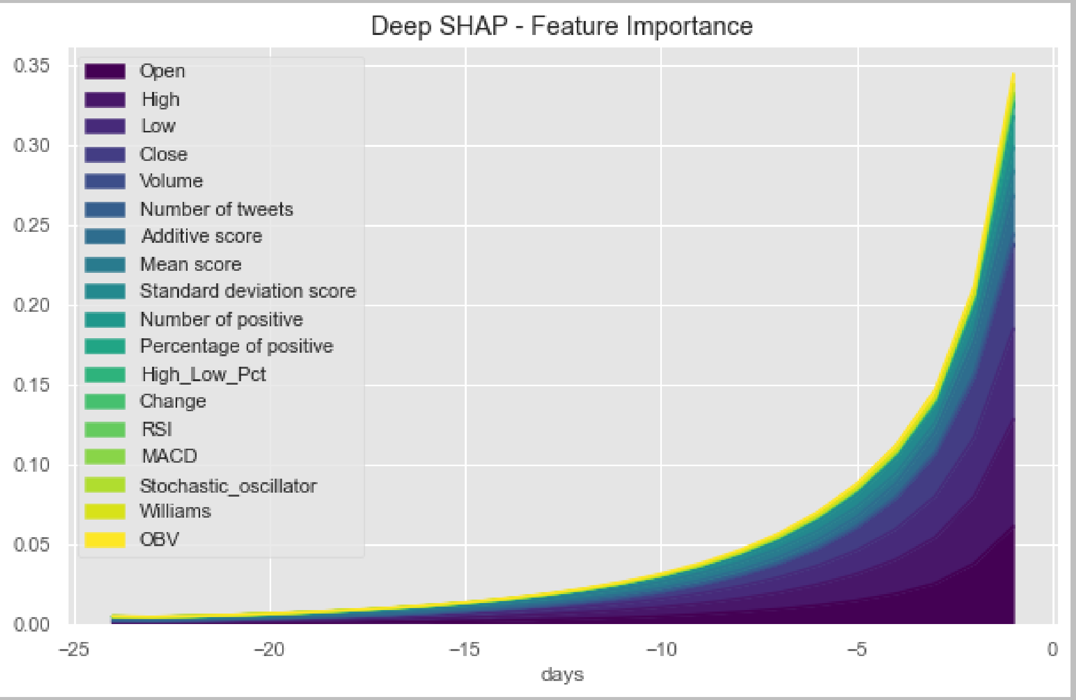
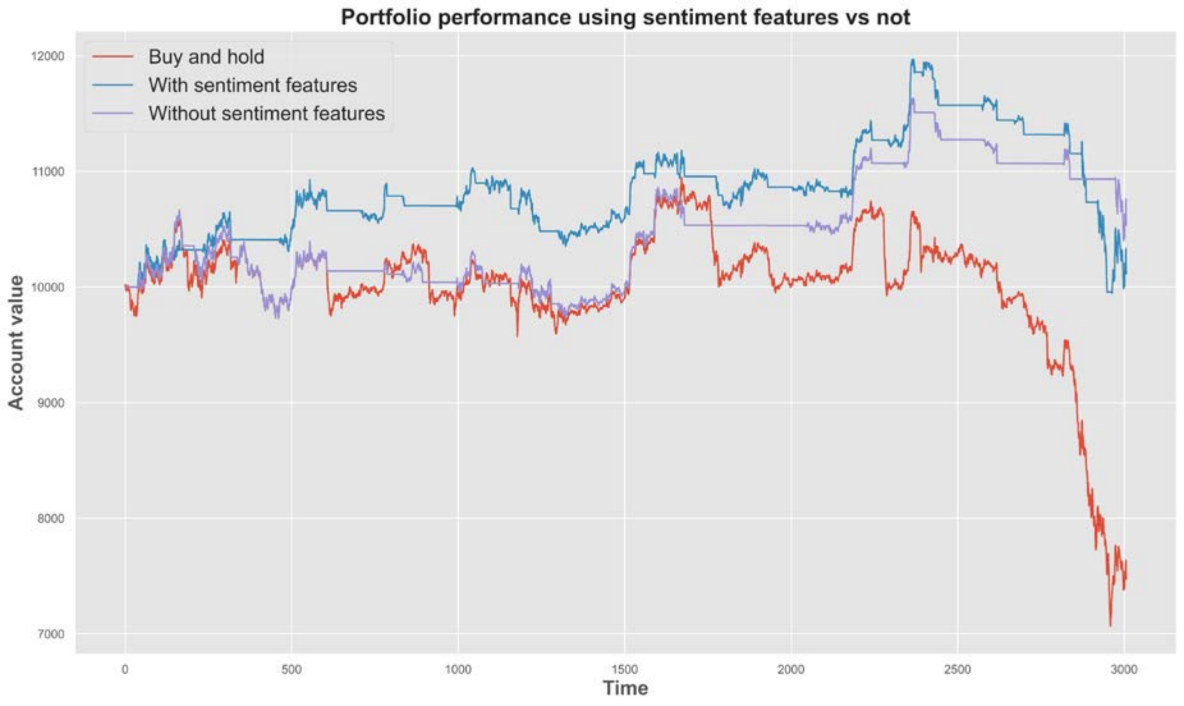




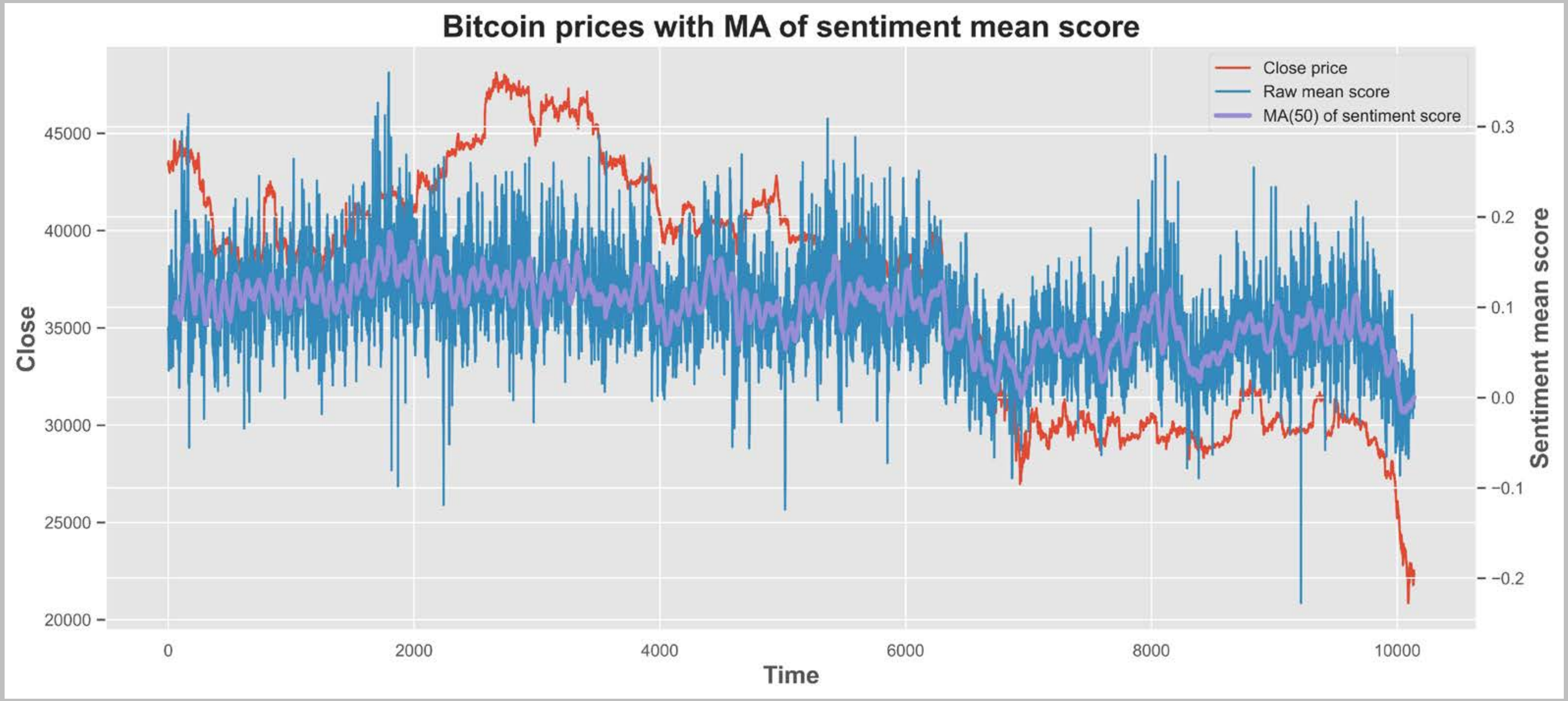
Sentiment importance





Sentiment features total 26%
of the prediction's importance

Conclusion

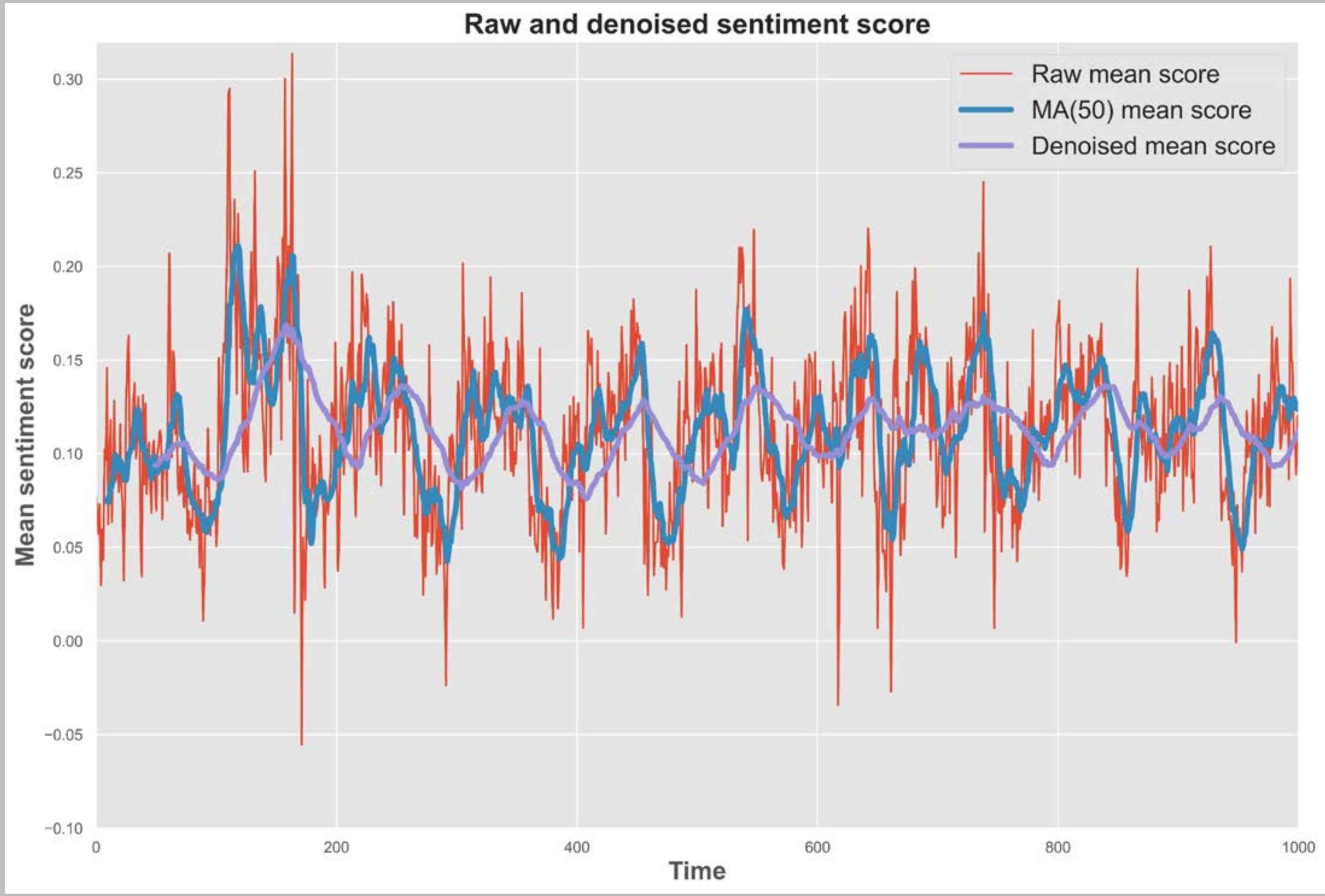


Bitcoin prices with MA of sentiment mean score
Close price
Raw mean score
MA(50) of sentiment score
Close
Sentiment mean score
Time
45000
40000
35000
30000
25000
20000
0
2000
4000
6000
8000
10000
0.3
0.2
0.1
0.0
−0.1
−0.2

Future work

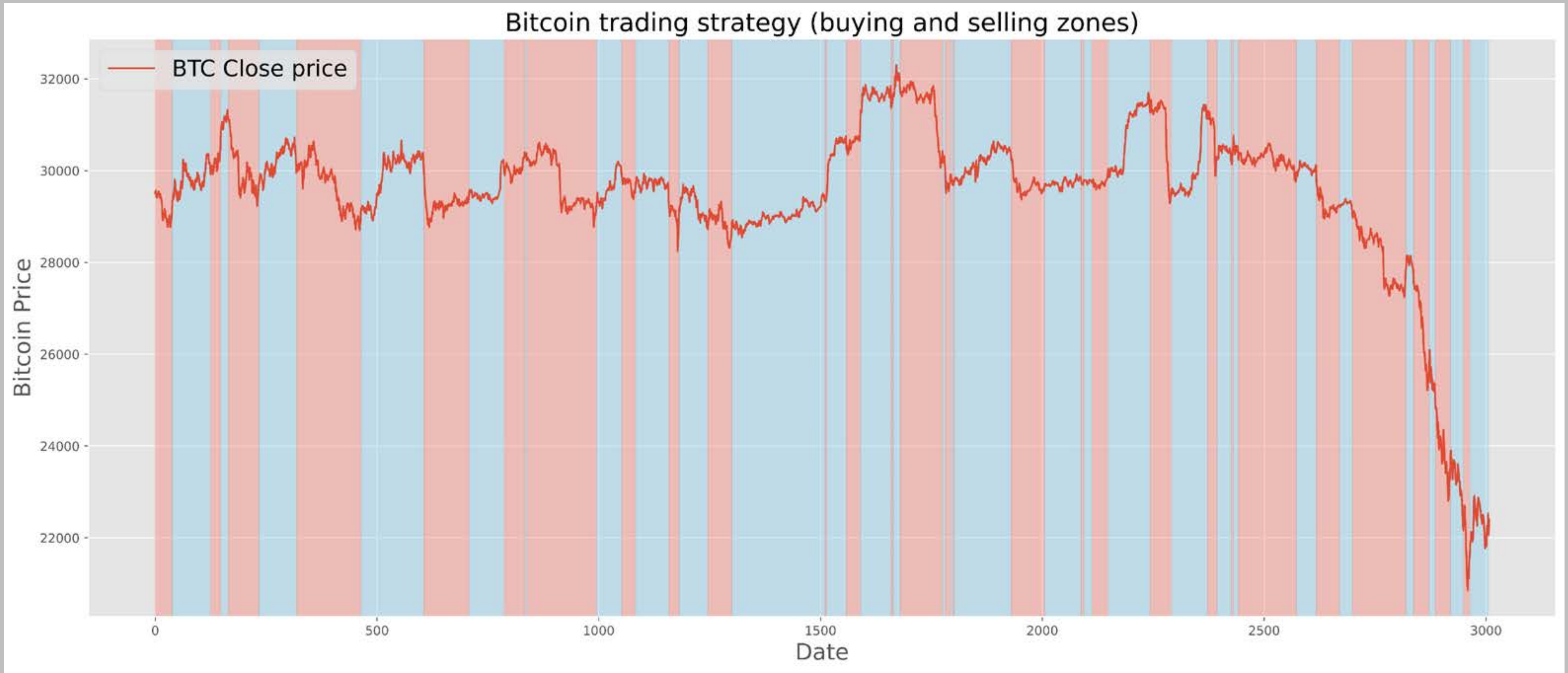
<u>Improvements:</u>

- More robust trading strategy
- Improve quality and quantity of the collected sentiment data
- Denoise sentiment data
- Loss function designed for trading purposes
- Real-time implementation



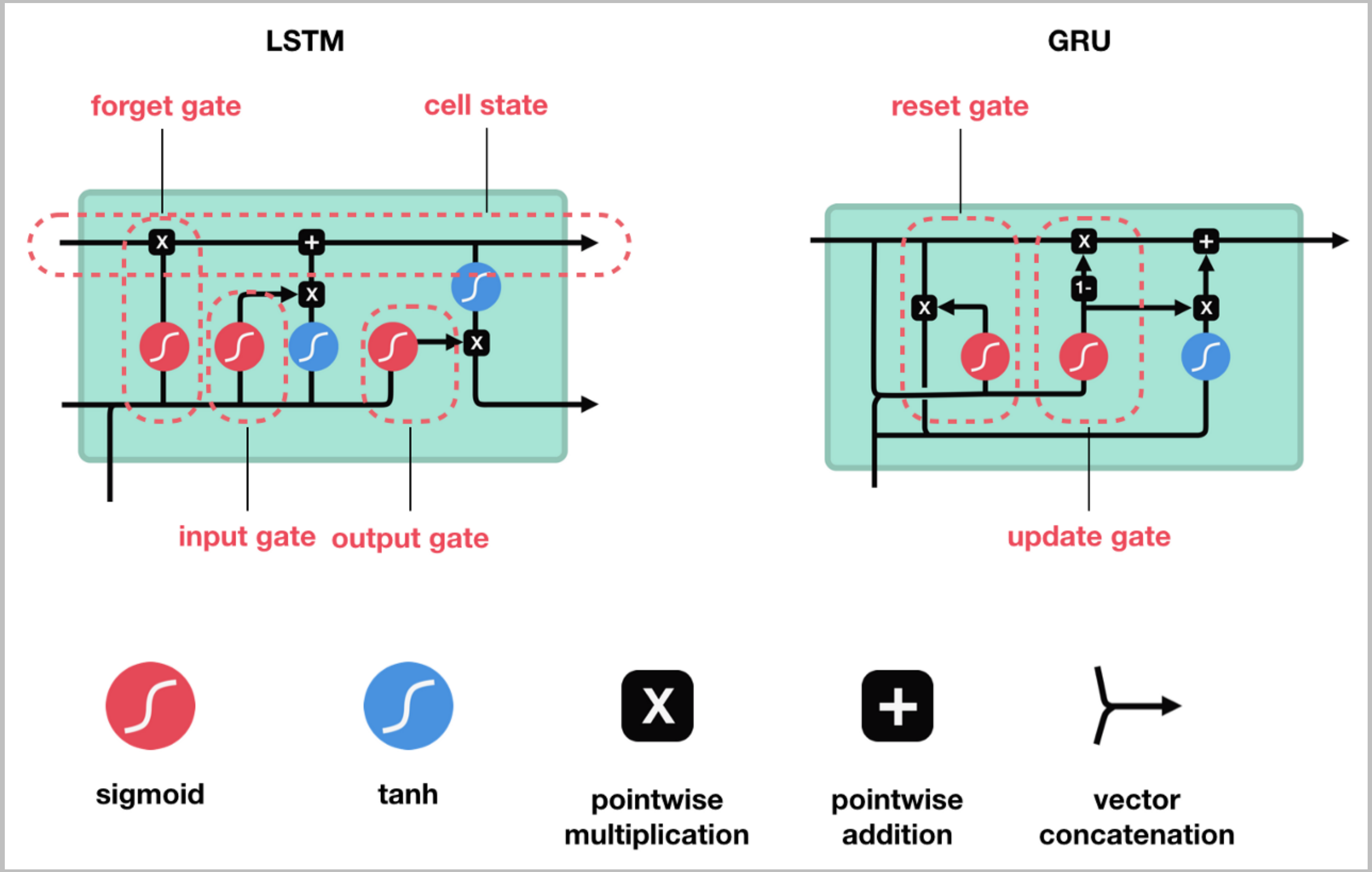
Questions

Code and report available on:
https://github.com/bprovendier/NN-for-Sentiment-Analysis



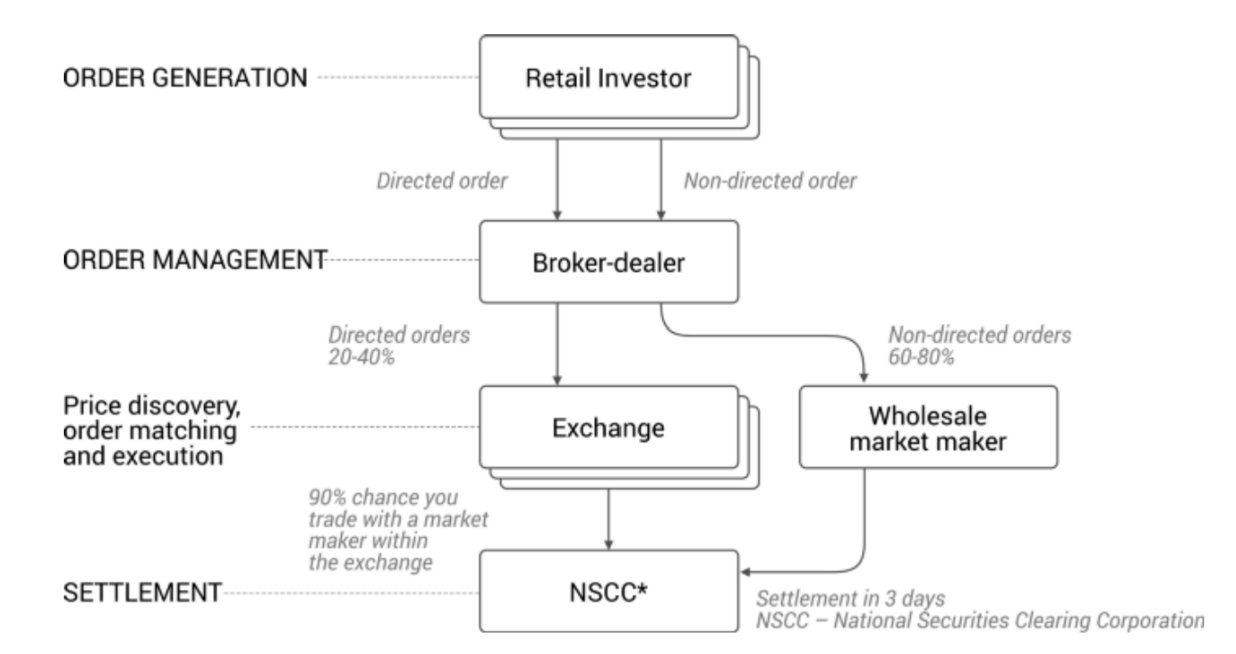
LSTM and GRU architecture

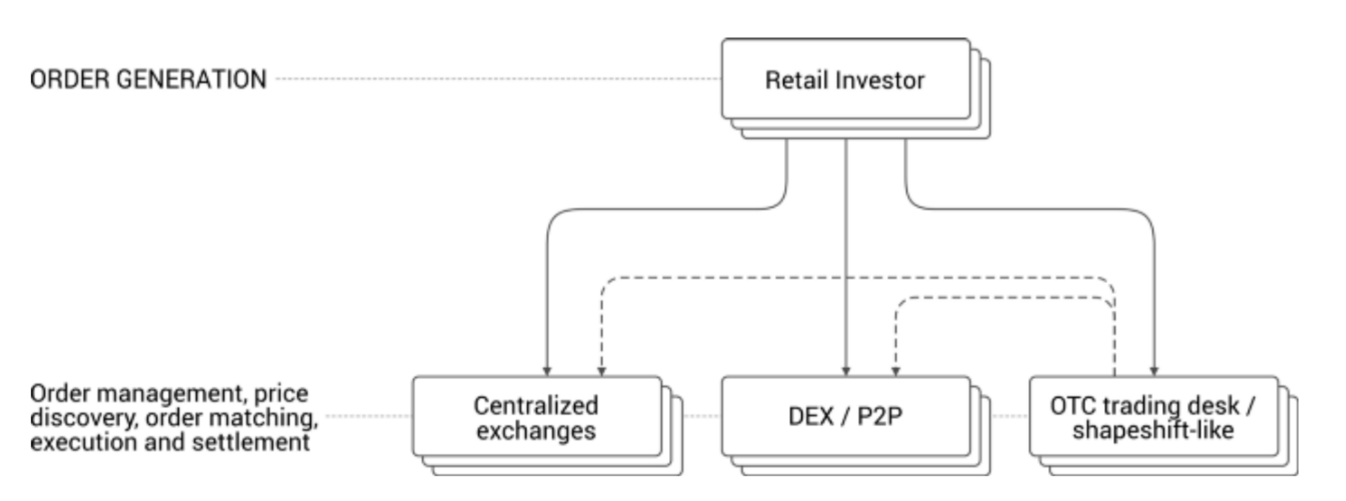
Forget gates (LSTM) and reset gate (GRU) help regulate the learning gradient and get rid of the unnecessary information in order to prevent fast decaying gradient.



Why use crypto?

- Inefficient markets (news travel slower, less participants, and more illiquid)
- More volatile
- No intrinsic value, purely driven by speculation





Hyperparameter selection