GPT-BASED SENTIMENT ANALYSIS FOR PREDICTING DOW JONES TRENDS

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Introduction

Our Model

Overview: This project leverages GPT-based sentiment analysis to predict trends in the Dow Jones Industrial Average (DJIA).

Objective: Establish a correlation between public sentiment (derived from historical news headlines) and stock market movements.

Previous Solutions:

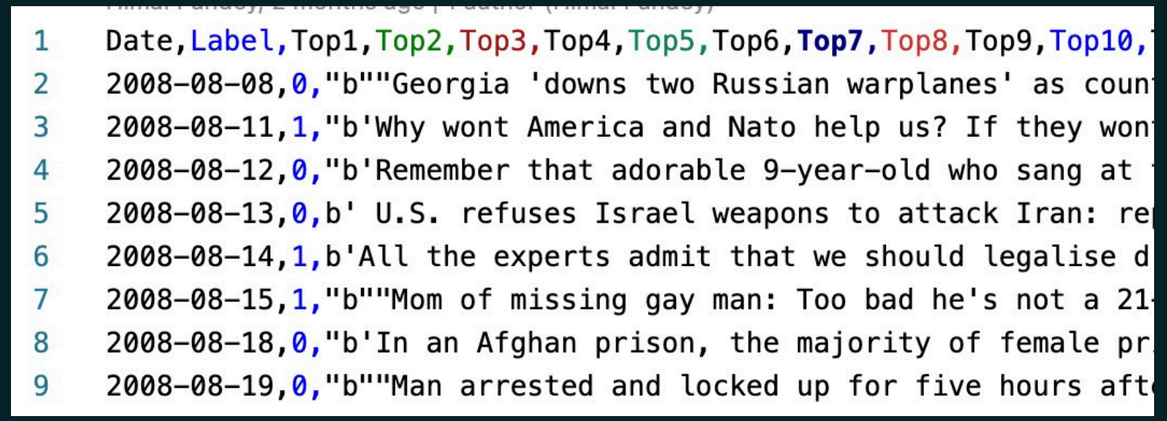
- **Bollen, Mao, and Zeng (2011):**
  - **Correlated public mood from Twitter with DJIA.**
  - **Tools: OpinionFinder, GPOMS.**
  - **Improved DJIA prediction accuracy to 86.7% with "Calm" mood dimension.**

- **Li et al. (2014):**
  - Analyzed financial news sentiment on stock returns.
  - Used sentiment dictionaries.
  - Sentiment analysis models outperformed traditional models.

Dataset and Proposed Method

Dataset

- News Data: Reddit WorldNews Channel (June 8, 2008 - July 1, 2016), top 25 headlines per date.
- Stock Data: Yahoo Finance DJIA metrics (same period), includes Date, Open, High, Low, Close, Volume, Adj Close.



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1  Date,Label,Top1,Top2,Top3,Top4,Top5,Top6,Top7,Top8,Top9,Top10,
2  2008-08-08,0,"b""Georgia 'downs two Russian warplanes' as coun
3  2008-08-11,1,"b'Why wont America and Nato help us? If they won
4  2008-08-12,0,"b'Remember that adorable 9-year-old who sang at
5  2008-08-13,0,b' U.S. refuses Israel weapons to attack Iran: re
6  2008-08-14,1,b'All the experts admit that we should legalise d
7  2008-08-15,1,"b""Mom of missing gay man: Too bad he's not a 21
8  2008-08-18,0,"b'In an Afghan prison, the majority of female pr
9  2008-08-19,0,"b""Man arrested and locked up for five hours aft
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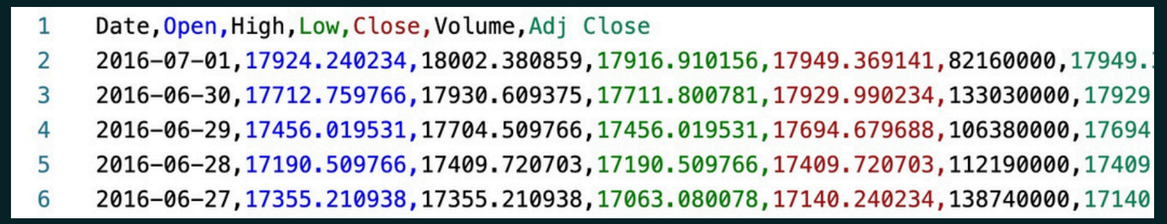

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1  Date,Open,High,Low,Close,Volume,Adj Close
2  2016-07-01,17924.240234,18002.380859,17916.910156,17949.369141,82160000,17949.
3  2016-06-30,17712.759766,17930.609375,17711.800781,17929.990234,133030000,17929
4  2016-06-29,17456.019531,17704.509766,17456.019531,17694.679688,106380000,17694
5  2016-06-28,17190.509766,17409.720703,17190.509766,17409.720703,112190000,17409
6  2016-06-27,17355.210938,17355.210938,17063.080078,17140.240234,138740000,17140
```

Dataset and Proposed Method

Proposed Method

- Data Preprocessing:
  - Merged DJIA and news headline datasets.
  - Labeled data for trend predictions.
  - Created NewsDataset class for data handling.

- Model Implementation:
  - GPT-2 Model: For sentiment analysis of news headlines.
  - BERT Model: Integrates DJIA price info for enhanced accuracy.

Combined Headlines Dataset:

	Date	Combined_Headlines	Label
0	2016-07-01	A 117-year-old woman in Mexico City finally re...	1
1	2016-06-30	Jamaica proposes marijuana dispensers for tour...	1
2	2016-06-29	Explosion At Airport In Istanbul Yemeni former...	1
3	2016-06-28	2,500 Scientists To Australia: If You Want To ...	1
4	2016-06-27	Barclays and RBS shares suspended from trading...	0

Merged Dataset:

	Date	Open	High	Low	Close	\
0	2016-07-01	17924.240234	18002.380859	17916.910156	17949.369141	
1	2016-06-30	17712.759766	17930.609375	17711.800781	17929.990234	
2	2016-06-29	17456.019531	17704.509766	17456.019531	17694.679688	
3	2016-06-28	17190.509766	17409.720703	17190.509766	17409.720703	
4	2016-06-27	17355.210938	17355.210938	17063.080078	17140.240234	

	Volume	Adj Close	Combined_Headlines
0	82160000	17949.369141	A 117-year-old woman in Mexico City finally re...
1	133030000	17929.990234	Jamaica proposes marijuana dispensers for tour...
2	106380000	17694.679688	Explosion At Airport In Istanbul Yemeni former...
3	112190000	17409.720703	2,500 Scientists To Australia: If You Want To ...
4	138740000	17140.240234	Barclays and RBS shares suspended from trading...

	Label
0	1
1	1
2	1
3	1
4	0

Training, Evaluation, and Results

Training and Evaluation

- Model Training: Used AdamW optimizer, learning rate scheduler.
- Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, Confusion Matrix, ROC Curve, AUC.

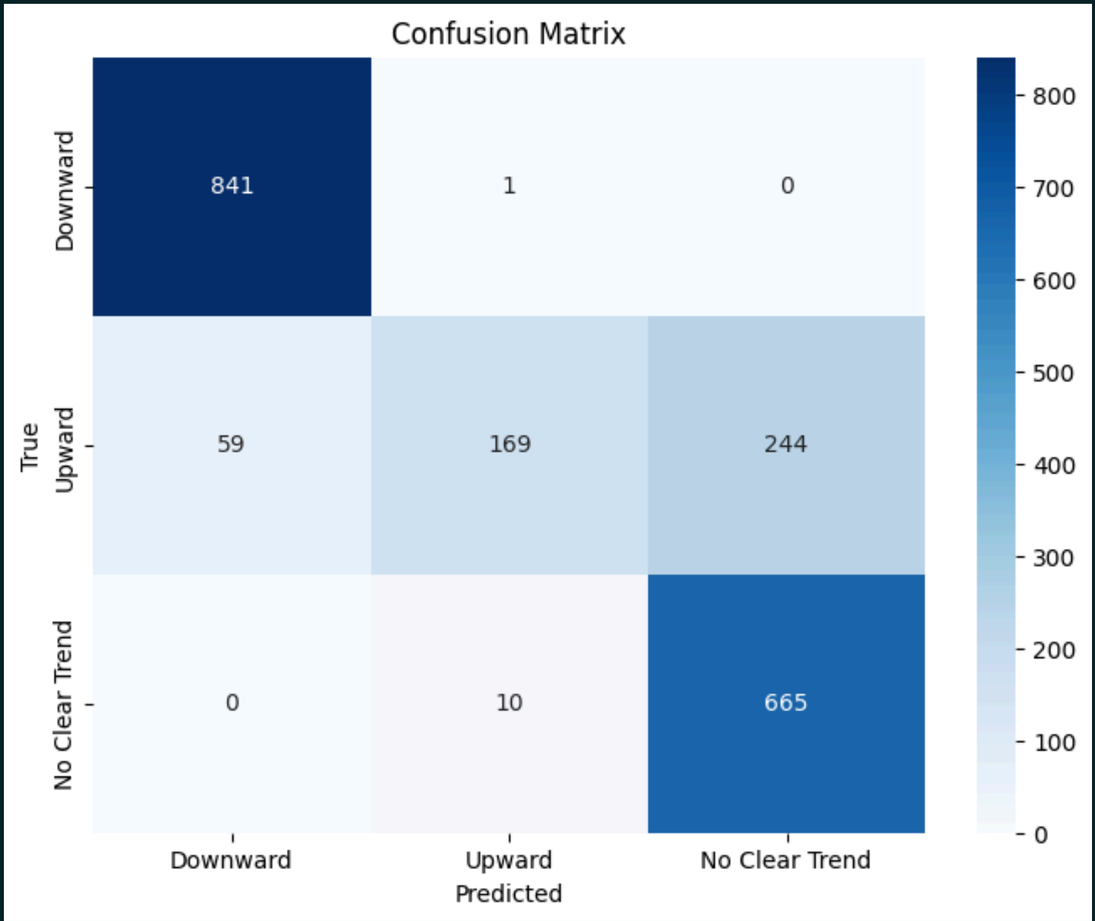
Results

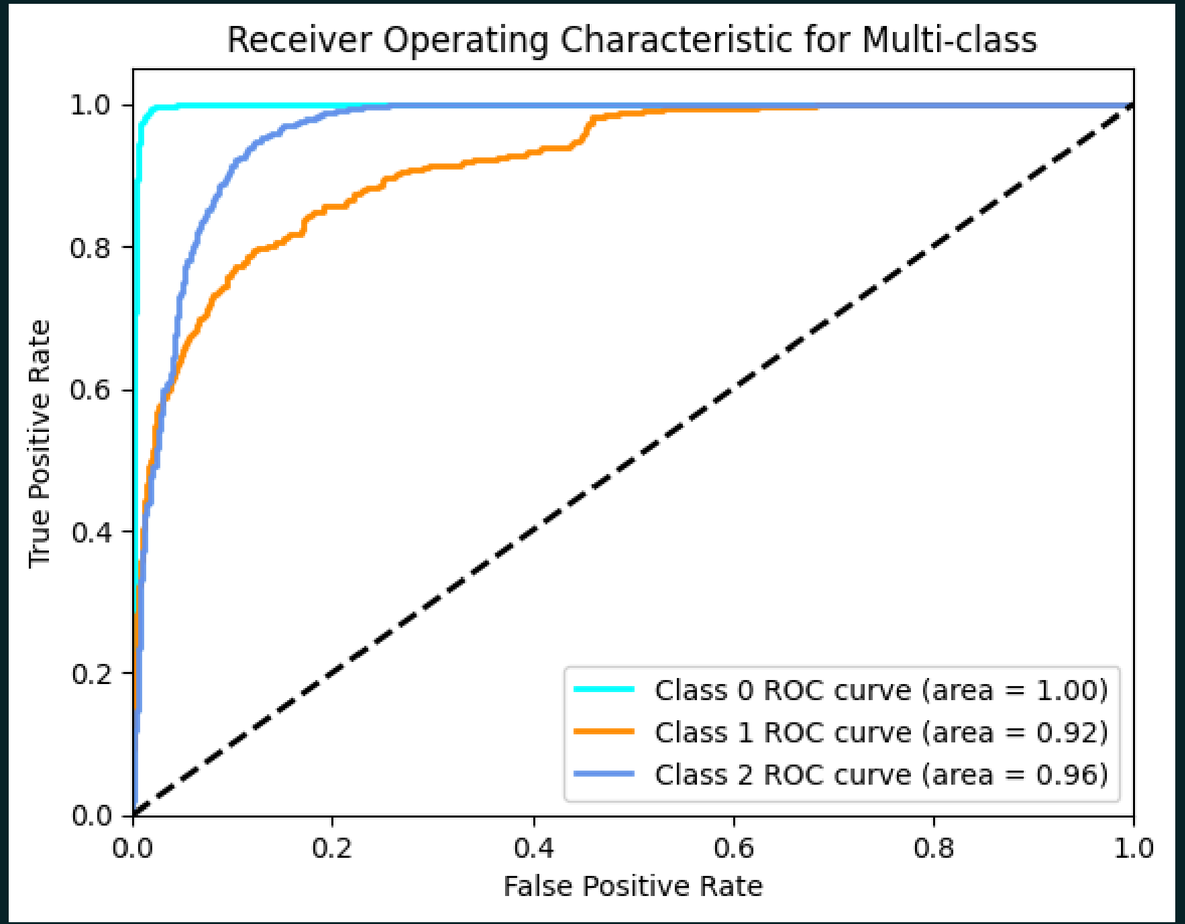
- Training Accuracy: 80.34% by 10th epoch.
- Validation Accuracy: 81.25% by 10th epoch.
- Confusion Matrix: High precision for 'Downward' trends, struggles with 'Upward' and 'No Clear Trend.'

Insights

- High precision in 'Downward' predictions.
- Lower precision for 'Upward' trends due to ambiguous positive sentiment.
- Balanced overall performance.

Training, Evaluation, and Results





Future Work and Conclusion

Future Work

- Fine-Tuning: Additional data, hyperparameter adjustments, different model architectures.
- Feature Expansion: Include other financial indicators, alternative data sources like social media sentiment, economic reports, financial news.

Conclusion

- GPT-based sentiment analysis shows potential in financial prediction.
- Continued advancements in NLP and machine learning will enhance model accuracy and reliability.

References

- Bollen, J., Mao, H., & Zeng, X. (2011). Twitter mood predicts the stock market. Journal of Computational Science.
- Li, X., et al. (2014). News impact on stock price return via sentiment analysis. Knowledge-Based Systems.