DeepTrade AI: Multi-Model Stock Prediction with NLP & Automated Trading

Project Overview:

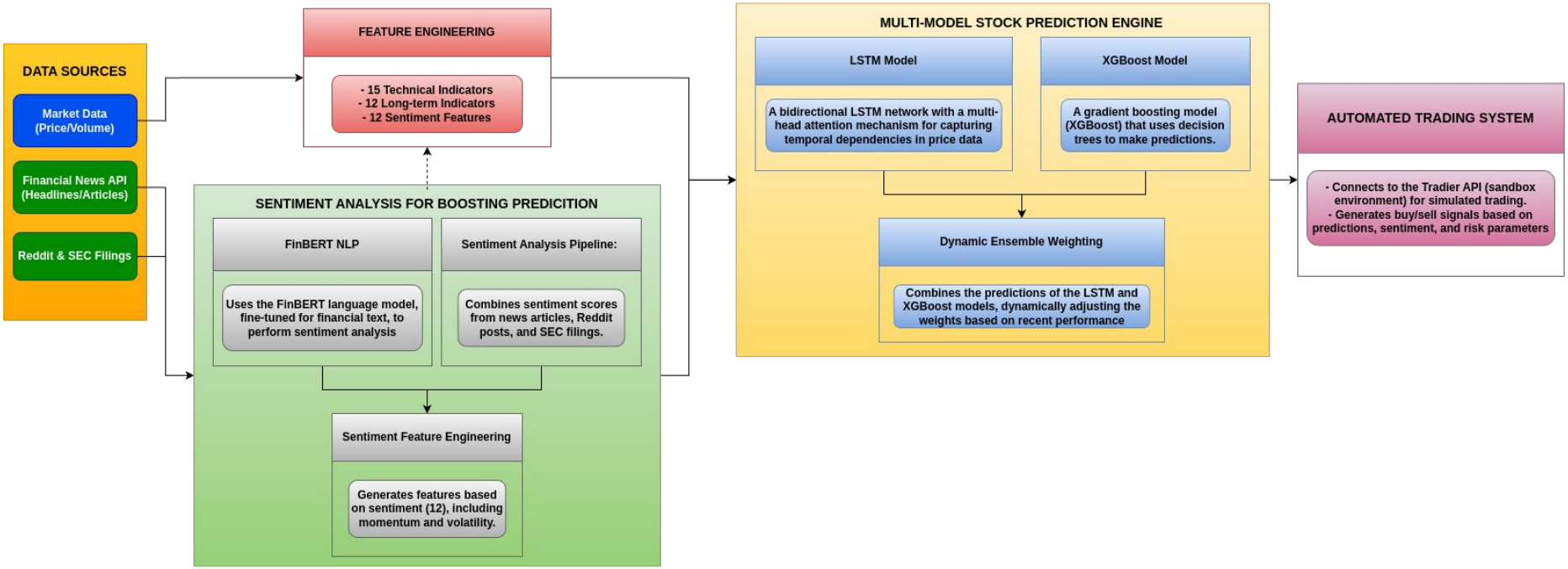
An end-to-end automated stock trading system that combines machine learning price prediction with NLP-based sentiment analysis. The system features a bidirectional LSTM with attention mechanism and XGBoost ensemble for multi-timeframe price forecasting, and integrates FinBERT for real-time sentiment analysis of financial news, Reddit posts, and SEC filings. The architecture employs dynamic model weighting, comprehensive risk management controls, and simulated execution through the Tradier API, achieving 55-65% directional accuracy and a 58.5% win rate in paper trading.

GitHub Repository: DeepTrade-AI

Key Technologies and Skills Used:

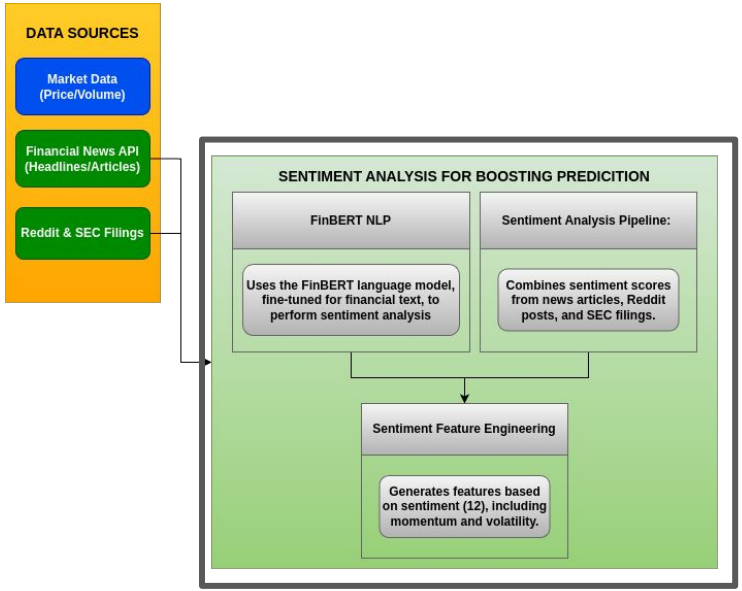
Languages & Frameworks: Python, PyTorch, TensorFlow, CUDA, Scikit-learn, Pandas, NumPy, Hugging Face Transformers
Machine Learning: Gradient Boosting (XGBoost), Feature Engineering, Regression, Time Series Forecasting
Deep Learning: LSTM Networks (Bidirectional, Attention), Model Ensembling, Model Training & Hyperparameter Optimization
Cloud Computing: AWS SageMaker (for distributed model training and hyperparameter optimization)
Natural Language Processing (NLP): FinBERT, Sentiment Analysis, Text Processing, Financial Text Mining

Pipeline:

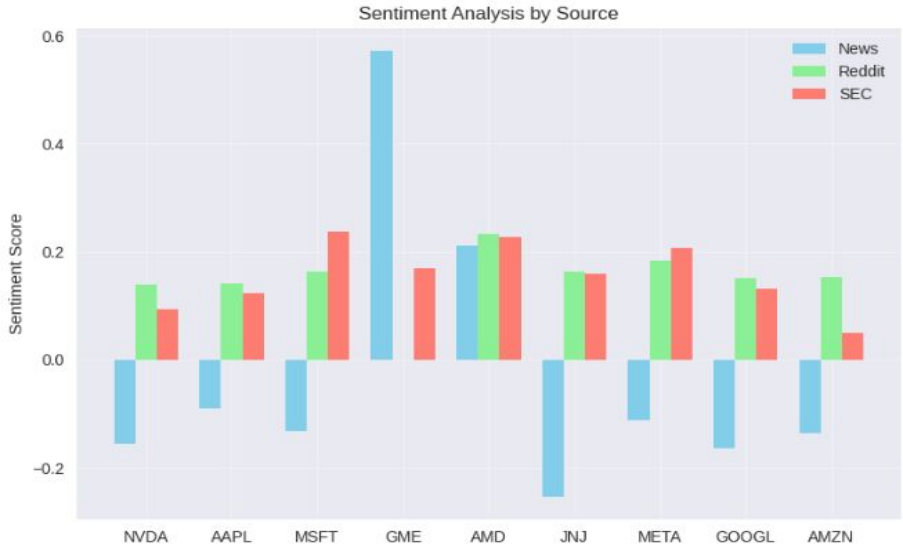


System Architecture and Data Flow

Multi-Source Sentiment Analysis:



System Architecture and Data Flow

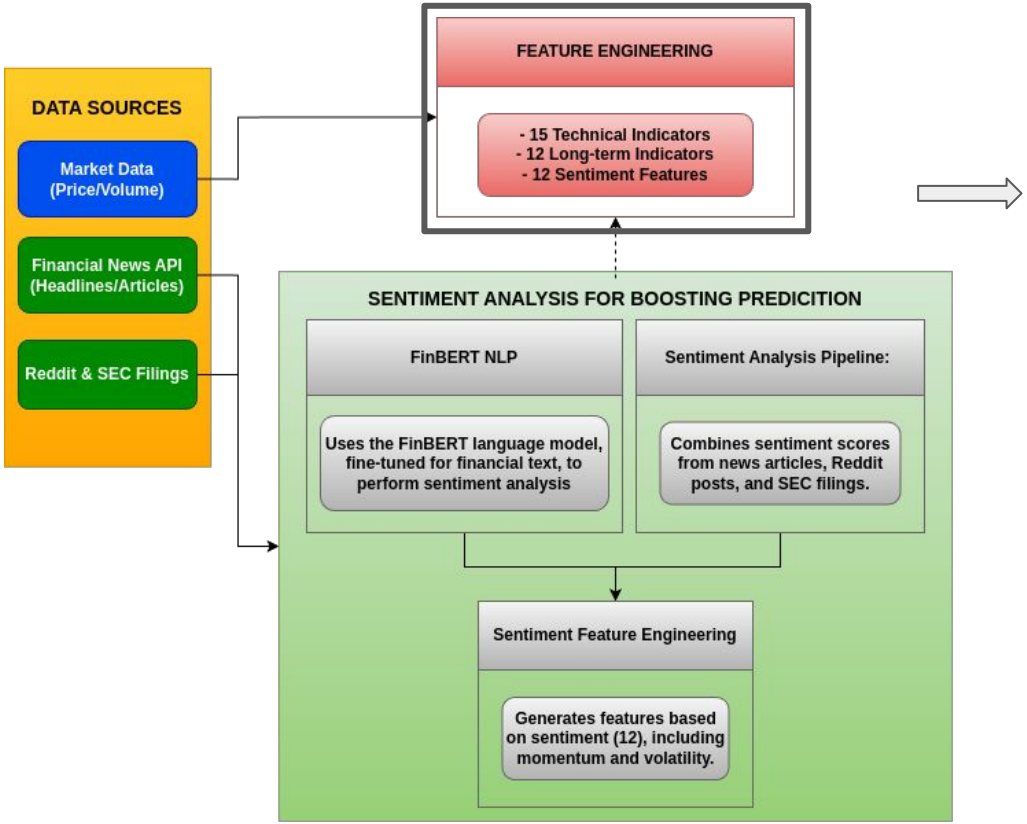


Sentiment scores for selected stocks; Positive values indicate positive sentiment, negative values indicate negative sentiment, and values near zero indicate neutral sentiment

Key Details:

- Tokenization: "Converts text data into numerical representations for the FinBERT model."
- 3-class Classification: "Classifies sentiment as positive, negative, or neutral."
- Multi-Source Weighted Integration: Financial News (40%)/Reddit(30%)/SEC(30%)

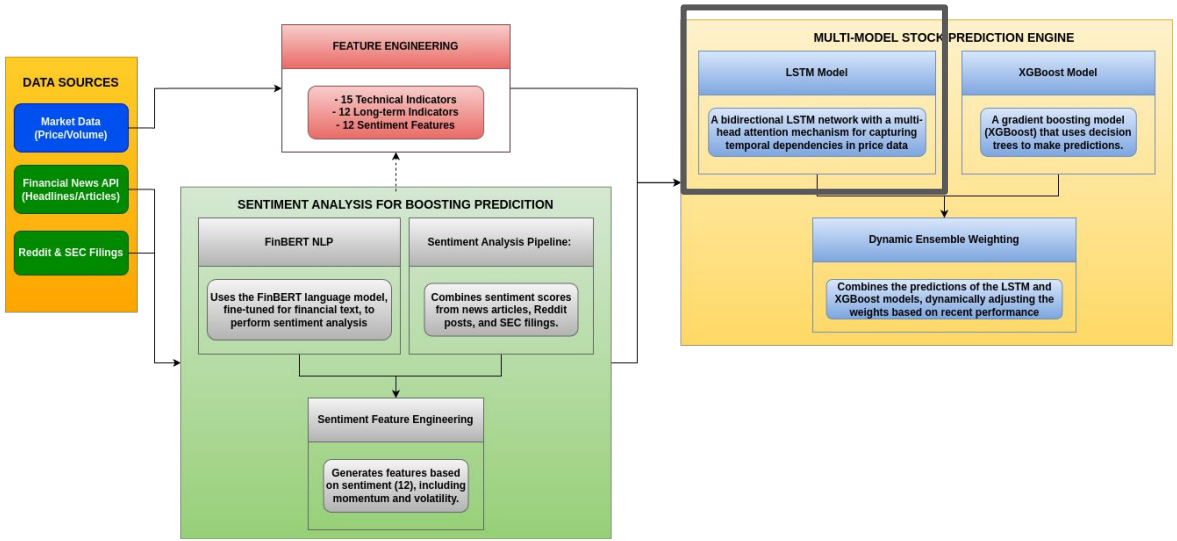
Feature Engineering:



System Architecture and Data Flow

The prediction models utilize a comprehensive set of 39 features, encompassing technical indicators, long-term trend indicators, and sentiment-derived features. This rich feature set provides a holistic view of market dynamics, enabling the models to capture complex relationships and patterns

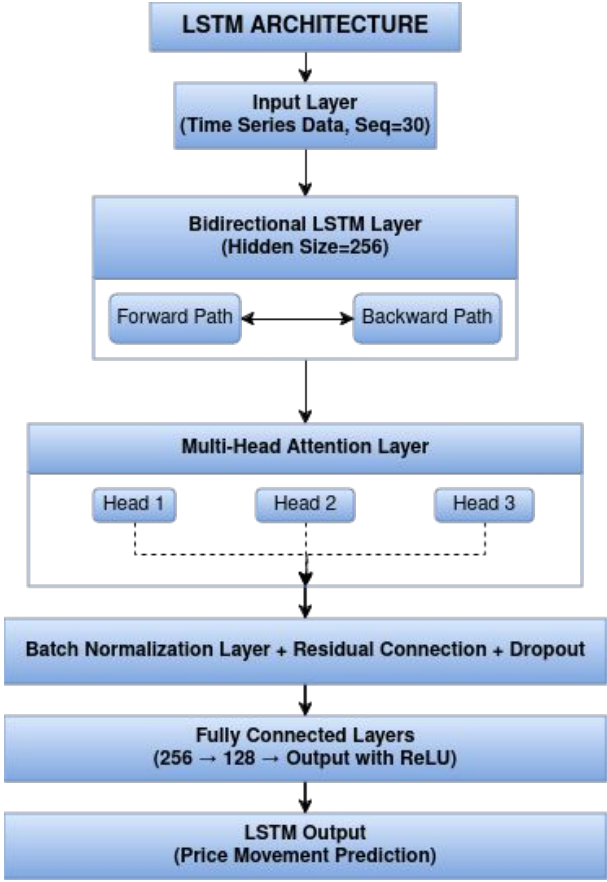
LSTM for Price Prediction



System Architecture and Data Flow

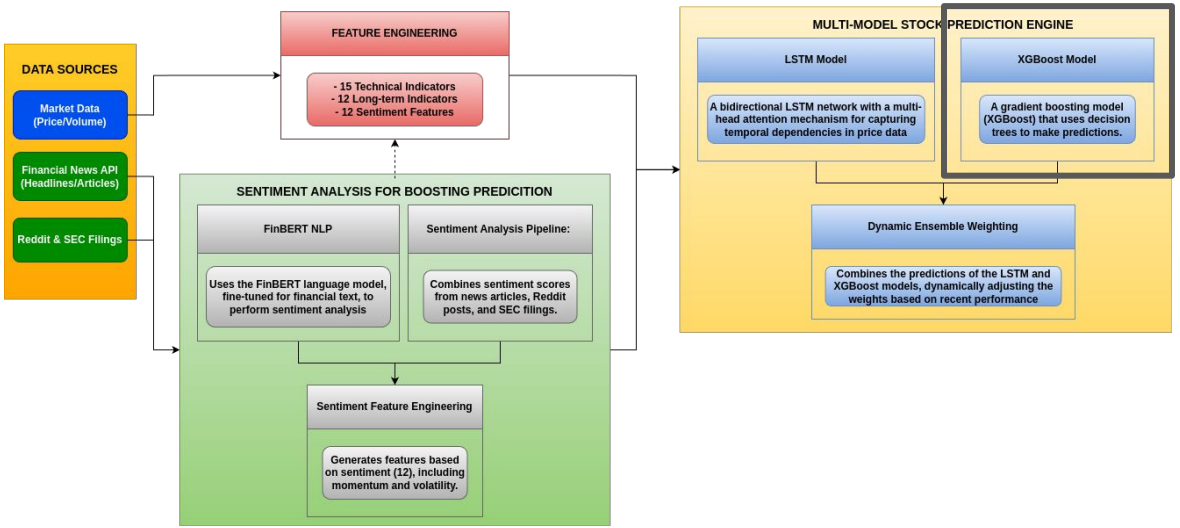
LSTM Neural Network:

- Bidirectional LSTM: The network processes the input sequence in both forward and backward directions, allowing it to learn from past and future context.
- Multi-Head Attention: This mechanism allows the model to focus on different parts of the input sequence that are most relevant for prediction. The model uses 3 attention heads.
- Batch Normalization: Batch normalization layers are used after each LSTM layer to improve training stability and speed.



LSTM Model Architecture

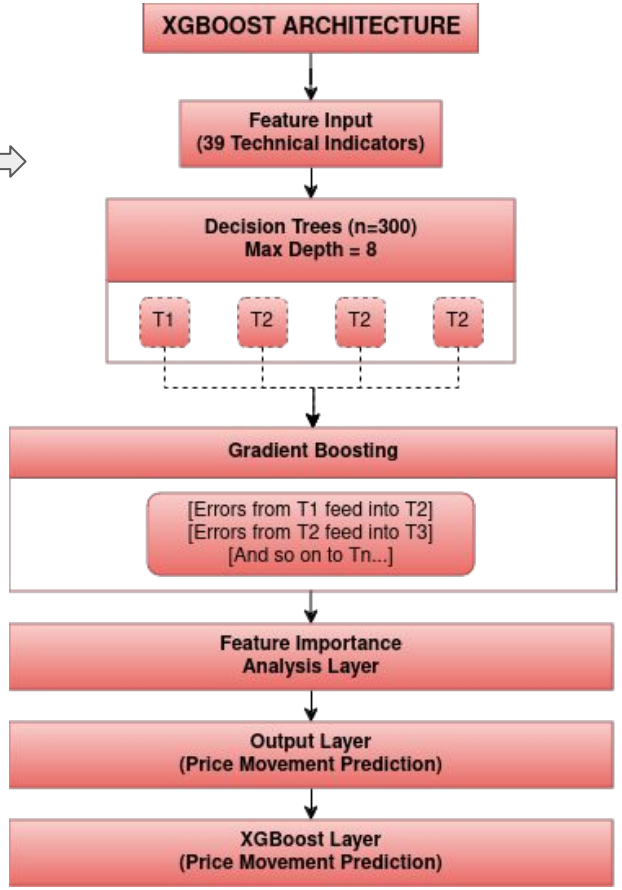
XGBoost for Price Prediction



System Architecture and Data Flow

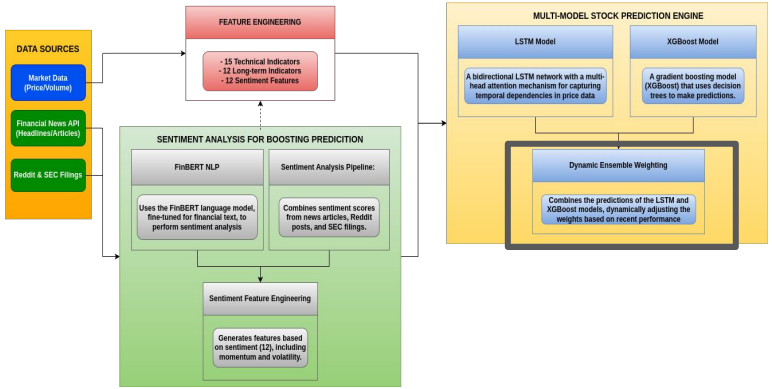
XGBoost Ensemble:

- Gradient boosting with 300 decision trees
- Feature engineering including 39 market indicators
- Min child weight:3, Subsample:0.8, Max depth:8



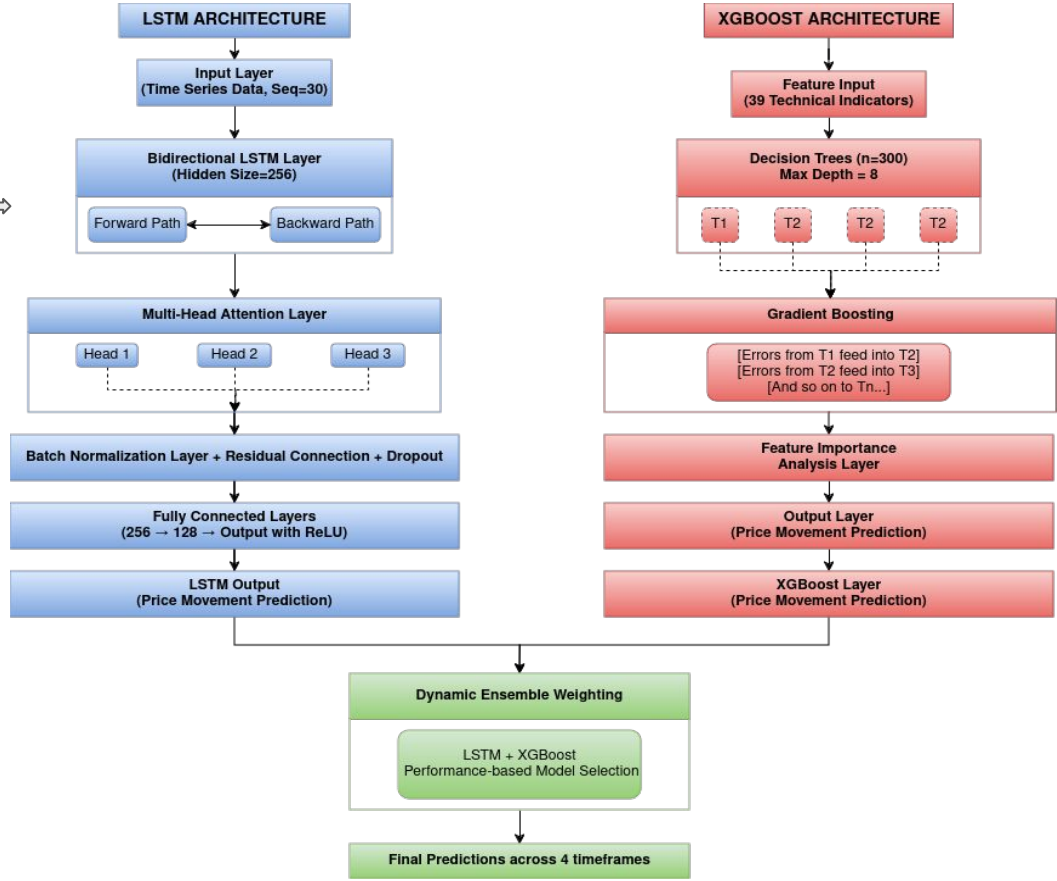
XGBoost Model Architecture

LSTM-XGBoost Ensemble for Price Prediction



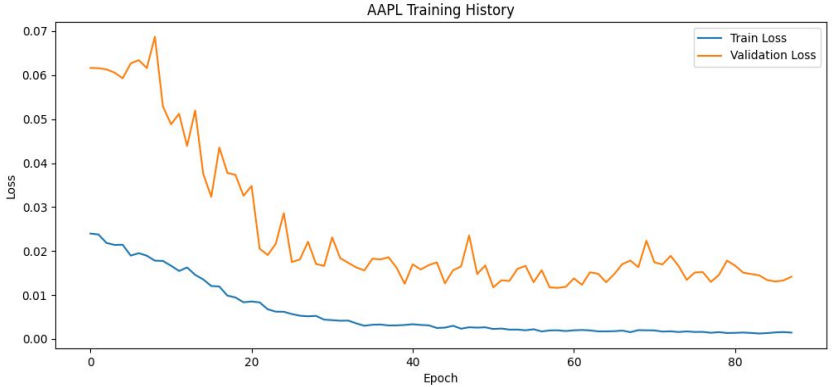
System Architecture and Data Flow

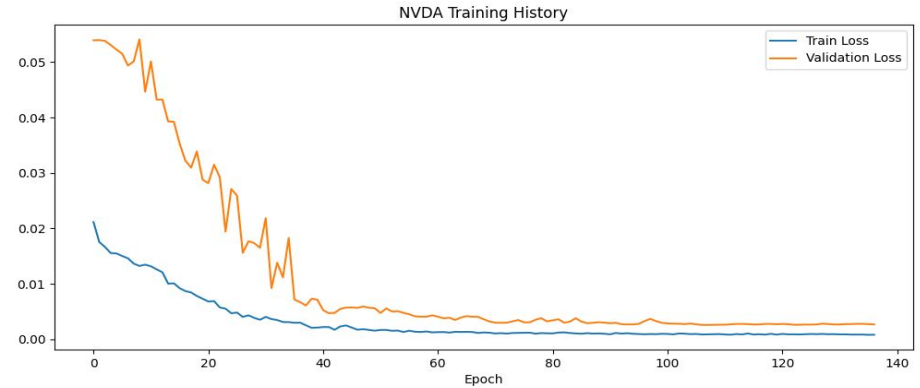
The trained ensemble model achieves a directional accuracy of 55-65% across multiple timeframes (5min, 15min, 30min, 1h) and a mean absolute error of 0.3-0.4% on normalized returns for multiple stocks.



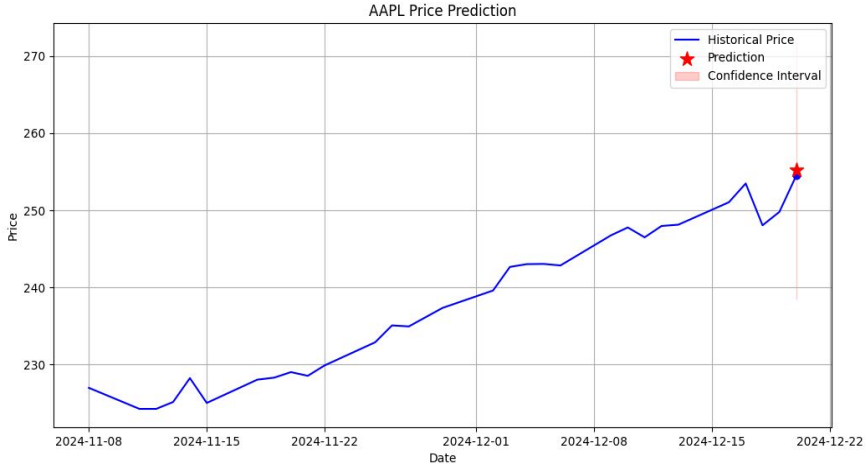
LSTM-XGBoost Ensemble Architecture

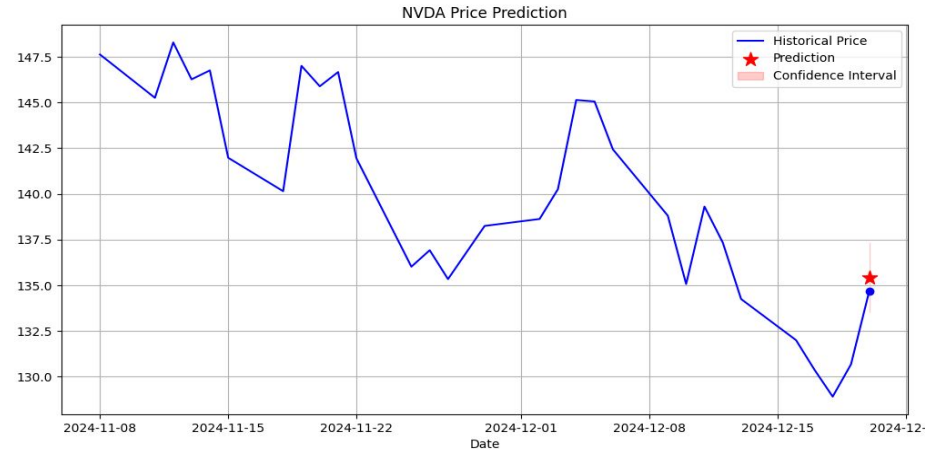
LSTM-XGBoost Ensemble Model Prediction Results with Examples





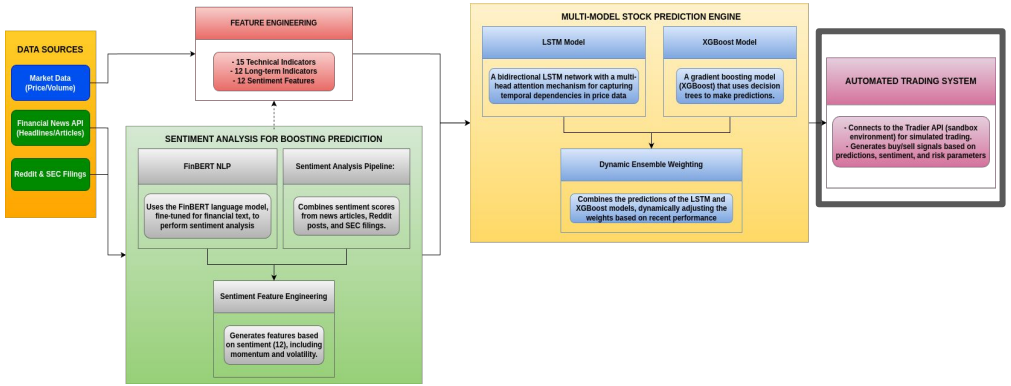
Training Convergences





Price Predictions

Automated Trading System: Real-World Implementation



System Architecture and Data Flow

Trading Strategy Integration:

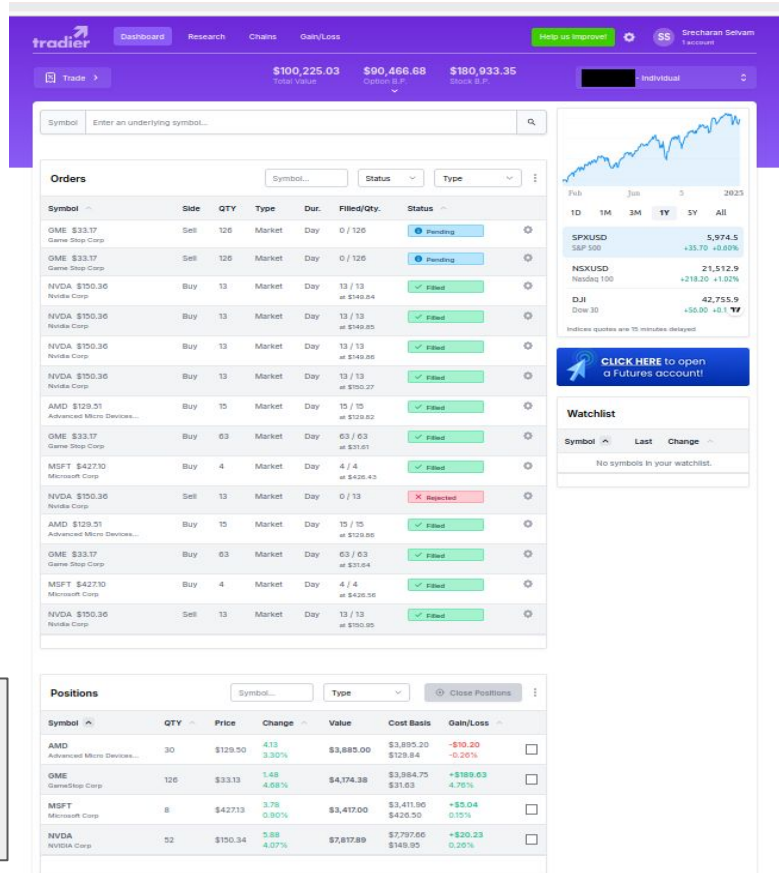
- Entry conditions: Positive directional accuracy in 5/15/30min timeframes.
- Exit conditions: Negative directional forecast

Risk Management Framework:

- Risk per trade: 1% of capital
- Stop-loss: 1.5%, Take-profit: 3%

System Validation:

- Win rate: 58.5% across 9 major stocks
- +0.32% net return



Screenshot of the Tradier paper trading interface, showing successful execution of trades (01/06/2025)