National College of Ireland

Configuration Manual

MSc Research Project
MSc in Artificial Intelligence

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MSc Project Submission Sheet

School of Computing

Student Name:	DHEERAJ GOPALKRISHNA
Student ID:	24135739
Programm:	MSc in Artificial Intelligence **Year:** 2025
Module:	Research Thesis Practicum (2)
Lecturer:	Anu Sahani
Submission Due Date:	11-12-2025
Project Title:	A Meta-MACD Approach: Evaluating ARIMA-LSTM Generated MACD Signals for Optimizing Trade Entries in the S&P 500 Index
Word Count:	1058 **Page Count: 13**

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
ALL internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

Signature:	DHEERAJ GOPALKRISHNA
Date:	11-12-2025

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Configuration Manual

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Introduction

The current configuration manual is a detailed account of the overall process of installation, testing, evaluation, and replication of all experimental programs in order to execute the research process under the title of A Meta-MACD Approach: Evaluating ARIMA-LSTM-Generated MACD Signals to Optimize Trade Entries in the S&P 500 Index. The project involves a hybrid forecasting pipeline, i.e. a combination of ARIMA as a linear time-series analysis with LSTM as a non-linear sequence learning model to enable the generation of more specific MACD-based trading signals based on the predicted price movement rather than the actual history of the movement alone and with the help of Transformer model to identify Support-Resistance levels.

System Requirements

Before proceeding, ensure your local development environment meets the following requirements:

- **Software Requirements:** Windows 10.
- **Hardware Requirements**: Intel i7 13th Gen, 16gb RAM, 6gb NVIDIA RTA 4050 Graphics, 1 TB SSD.
- **Python:** Python 3.10+ - Primary programming language for model development, preprocessing, visualization, and backtesting.
- **Python Libraries:**
    1. Pandas – For loading OHLCV data, cleaning, time-series operations, and feature engineering.
    2. NumPy – Numerical computations and array handling.
    3. TensorFlow / Keras – ML library
    4. Scikit-learn : Scalers
    5. Matplotlib – General plotting (price series, MACD, prediction charts).
    6. Seaborn – Statistical visualizations.
    7. mplfinance –To plot candlestick charts with MACD overlays.
    8. Yahoo Finance (yfinance) – For historical S&P 500 data (close, open, volume).
    9. Talib – To derive and calculate technical indicators

- **Statsmodels:** ARIMA.
- **Deep Learning Models:** LSTM, Standard Transformer.
- **VS Code –** For writing Python scripts and project modules.
- **CPU-based system** for model and general training**.**
- **Microsoft Excel** – For storing model outputs, predicted signals, and MACD comparisons and dataset analysis.
- **Microsoft Word** – For writing research report and configuration manual.

Initial Setup and Configuration

Dataset is present in the following path :

- sp500_sr_data.csv – contains support/resistance level that the Transformer model in trained on.
- Source of data: yfinance library. Data from 2000 to 2025.

The python script relies on certain parameters being correctly configured in ***globals.py*** file.

Data Configuration:

1. Dataset will be updated if ***download_data*** is **True**. If **False,** local data is used**.**
2. Custom years of data to be downloaded is set in ***stock_data_years*** to the number of years. Recommended years is atleast 10.

Model Configuration:

1. ***future_days*** = number of future days to be predicted by ARIMA and LSTM models and to detect support and resistance levels by Transformer model. Recommended value is 10.
2. ***lstm_memory_steps*** = batch size to be processed by LSTM model**.** Recommended value is 10.
3. ***lstm_epochs*** = Epoch count of LSTM model**.** Recommended value is 50.
4. ***lstm_neurons*** = number of hidden layers of LSTM model**.** Recommended value is 64.
5. ***tns_nhead*** = number of attention heads of Transformer model**.** Recommended value is 8.
6. ***tns_num_layers*** = number of hidden layers of Transformer model**.** Recommended value is 4.
7. ***tns_batch_size*** = batch size to be processed by Transformer model**.** Recommended value is 32.
8. ***tns_learning_rate*** = learning rate of Transformer model**.** Recommended value is 0.0001.
9. ***tns_epochs*** = Epoch count of Transformer model**.** Recommended value is 50.

Dataset Configuration:

If fresh data is downloaded using the yfinance libraries, support, resistance levels , 9day EMA-50d EMA crossover and Close Price-20day EMA Crossover parameters are manually marked and updated in binary values in the dataset file ***sp500_sr_data.csv*** for the new dates downloaded. Available binary data are for the dates ranging from ***2005-11-07*** to ***2025-12-05***.

Transformer model uses this custom data to effectively identify support and resistance levels.

The main.py Master Script

Major operations are conducted from the main.py script. Thus, this script contents are modularized into different files and is a main execution file which is the entry point of the project.

Usage:

- Command Prompt or Visual Studio Code opened.
- Navigated to the path of the file ***main.py*** of the project.
- Ran, ***python main.py*** in the console.

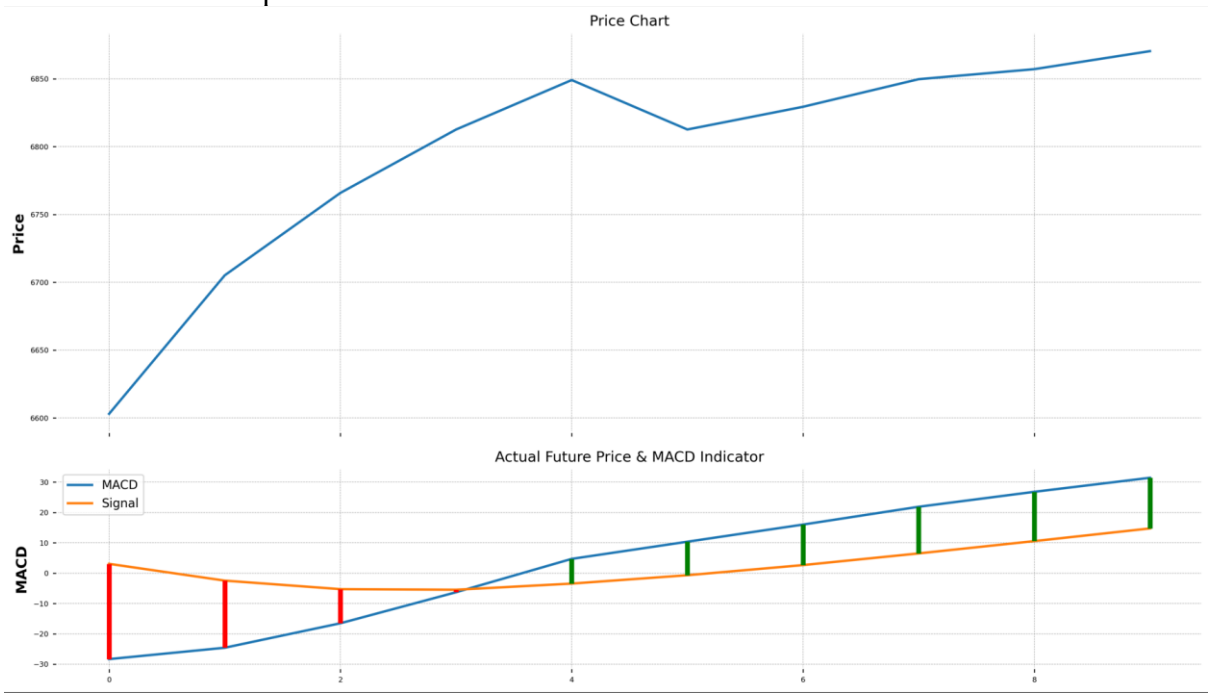
Project Structure Overview

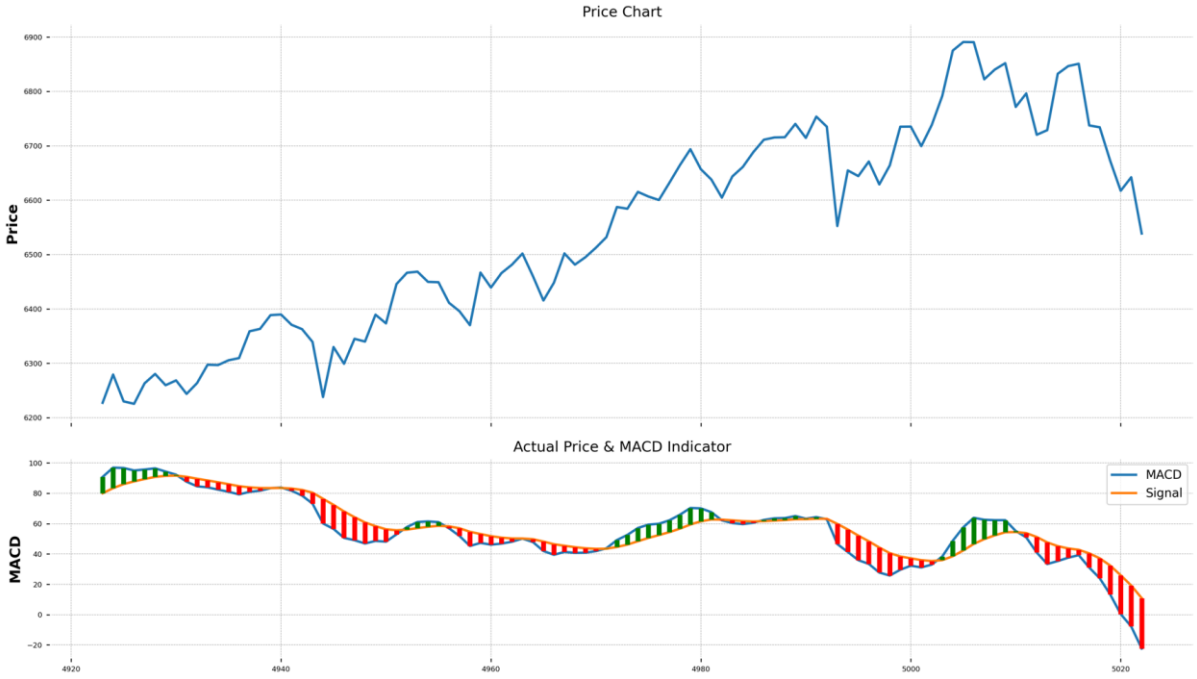
The project is organized into several key directories and files:

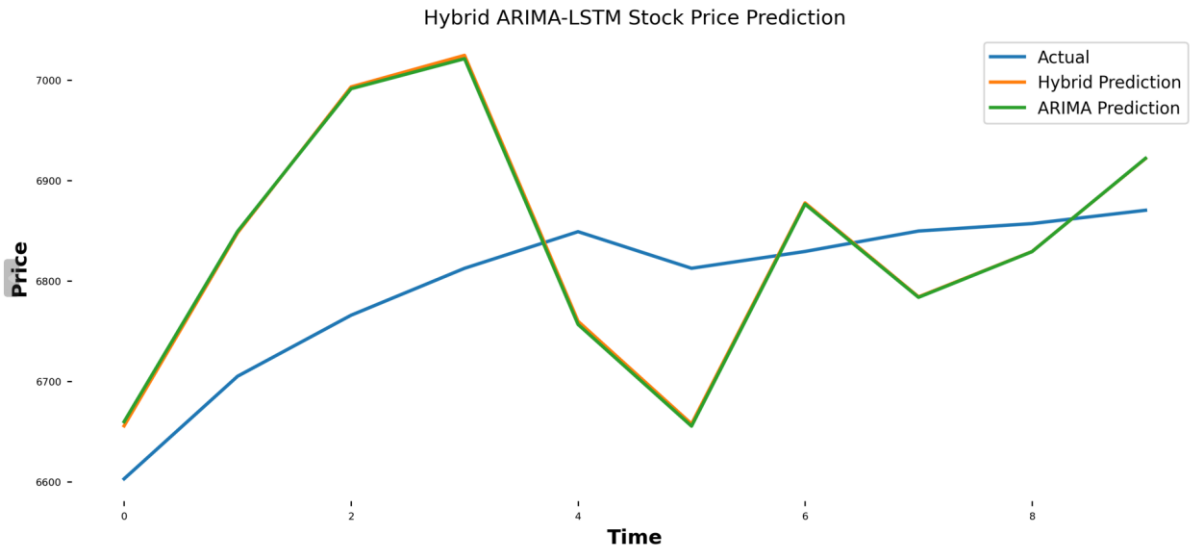
```
/src      # Main directory that contains source code with sub directories.
├── reports/     # Contains evaluation reports, computed and derived data.
├── visualizations/     # Contains all the visual graphs generated during execution.
├── datasets/     # Contains the dataset for ARIMA, LSTM and Transformer models.
├── main.py      # Master script runner for all operations
├── globals.py          # Global configuration file
├── data_preprocessing.py      # Script for preprocessing and postprocessing of data
├── models.py          # Script containing implementation of ARIMA and LSTM models
├── identify_sr_levels.py      # Script implementing Transformer model to identify SR levels
├── plots.py            # Script implementing methods for graphical visualizations
├── utilities.py          # Script containing utility methods
└── ... (test files)
```

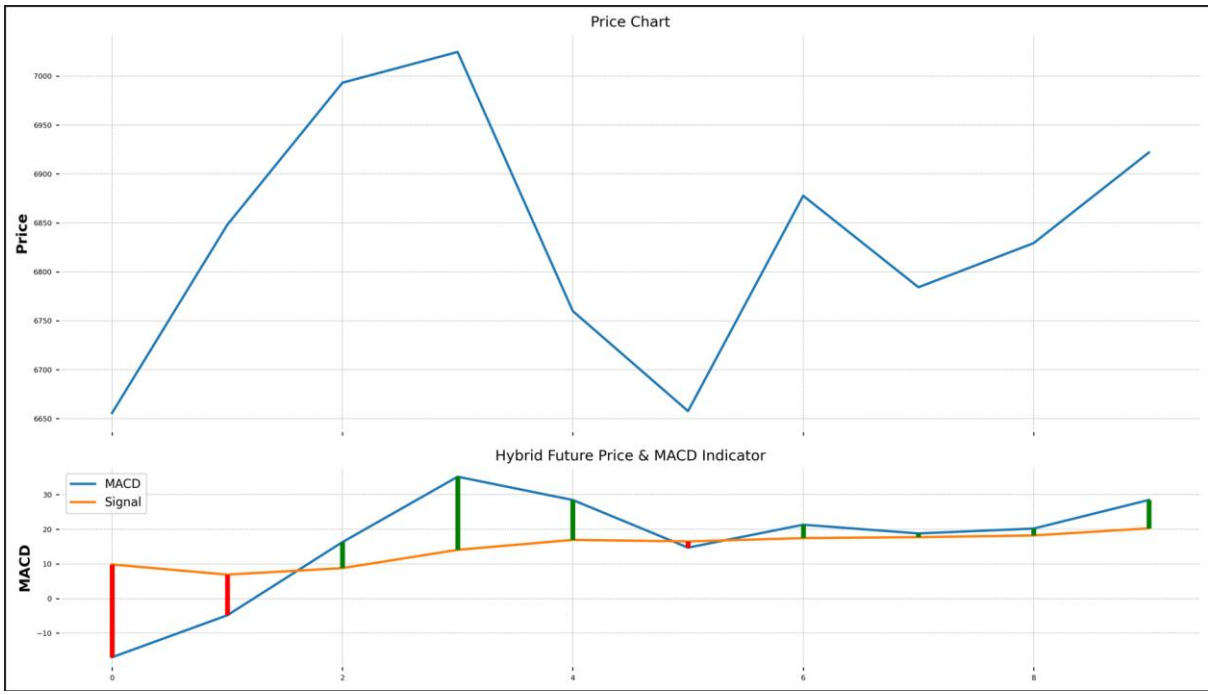
Conclusion

ARIMA-LSTM Graphs




Price Chart
Price
6900
6800
6700
6600
6500
6400
6300
6200
Actual Price & MACD Indicator
MACD
100
80
60
40
20
0
−20
4920
4940
4960
4980
5000
5020
MACD
Signal


Hybrid ARIMA-LSTM Stock Price Prediction
Actual
Hybrid Prediction
ARIMA Prediction
Price
7000
6900
6800
6700
6600
0
2
4
6
8
Time

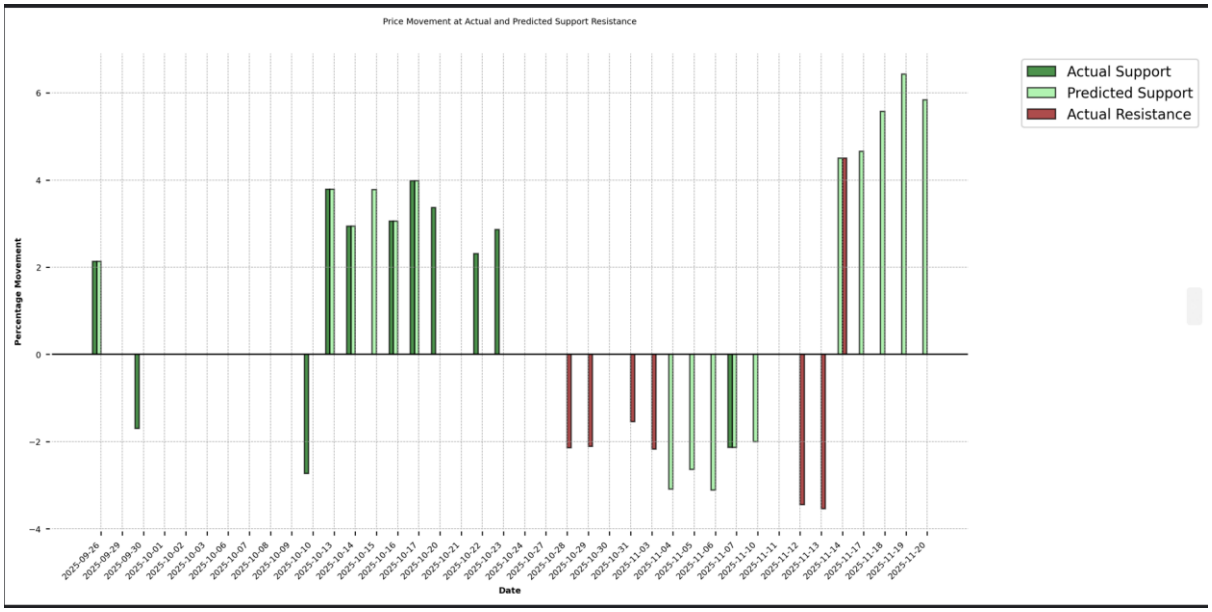

Price Chart
Price
Hybrid Future Price & MACD Indicator
MACD
Signal
MACD

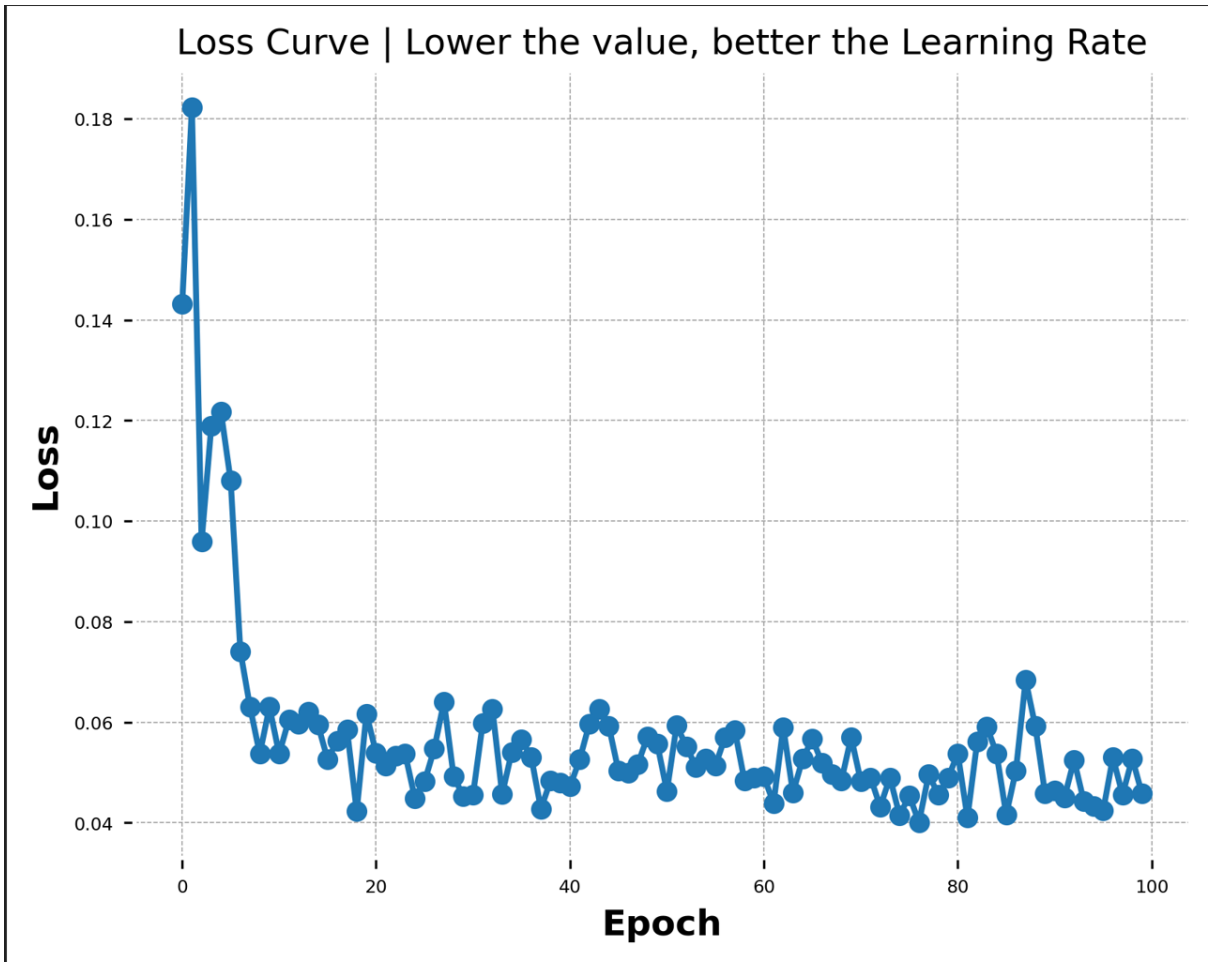

Hybrid ARIMA-LSTM Stock Price Prediction
Actual
Hybrid Prediction
ARIMA Prediction
Price
Time

Historical Data

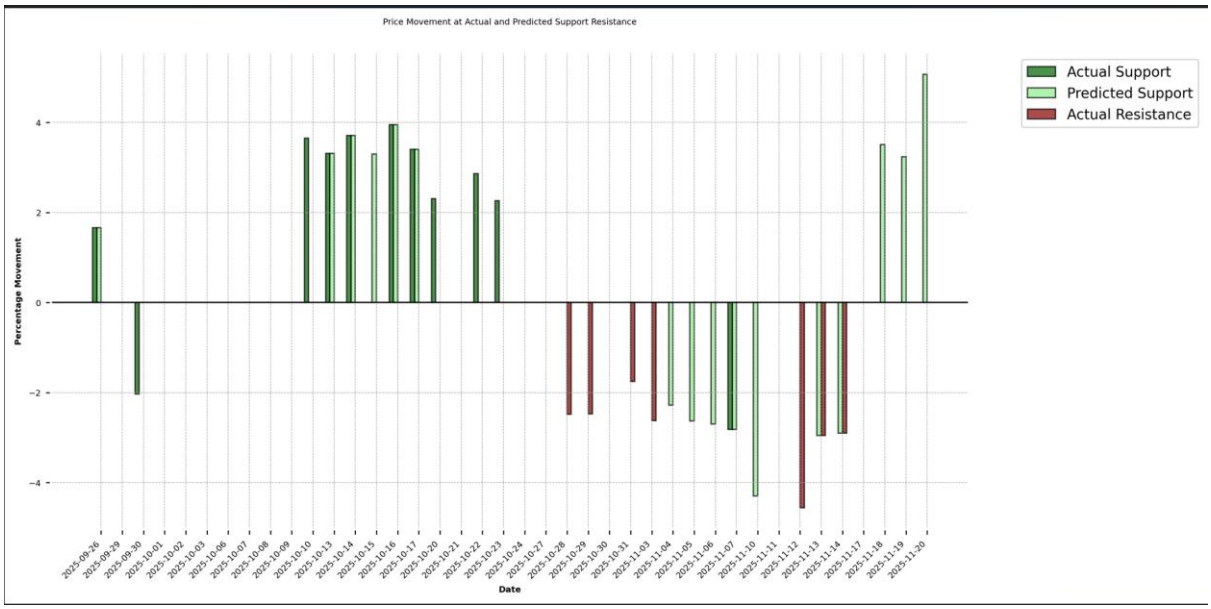

SP500 data from 2022 to 2023
Previous
Price
MACD
Volume


SP500 data from 2021 to 2022
Price
MACD
Volume


Price Movement at Actual and Predicted Support Resistance
Actual Support
Predicted Support
Actual Resistance
Percentage Movement
Date

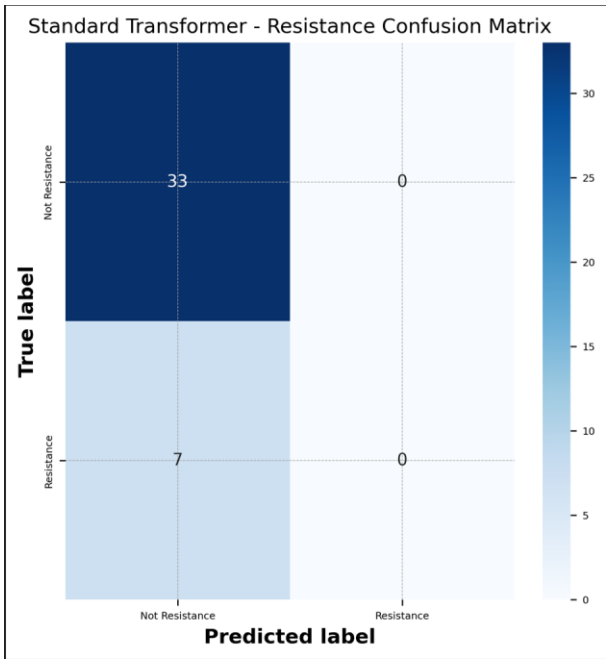

Loss Curve | Lower the value, better the Learning Rate
Loss
Epoch
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0
20
40
60
80
100

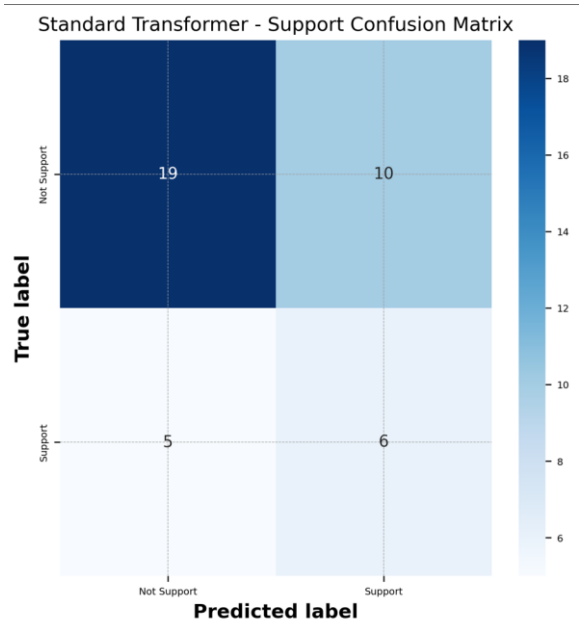

SP500 Predicted Data from past 40 days
(Support - Green | Resistance - Red | Pred Support - Blue | Pred Resistance - Black)
Price
Volume
MACD


Price Movement at Actual and Predicted Support Resistance
Actual Support
Predicted Support
Actual Resistance
Percentage Movement
Date


SP500 data from 2024 to 2025
Price
MACD
Volume


SP500 data from 2022 to 2023
Price
MACD
Volume


Standard Transformer - Resistance Confusion Matrix
True label
Predicted label
Not Resistance
Resistance
33
0
7
0


Standard Transformer - Support Confusion Matrix
True label
Predicted label
Not Support
Support
19
10
5
6


SP500 Chart with 9Day EMA (Orange) & 20Day EMA (Purple) from 2005 to 2010
Price
Volume 10^6


SP500 Chart with 9Day EMA (Orange) & 20Day EMA (Purple) from 2020 to 2025
Price
Volume 10^6