1.Introduction

1.1 Background and Motivation

1.2 Research Objective

1.3 Contributions

a) Designing a threshold-based multi-class target variable

b) Feature engineering using technical indicators

c) Neural network model implementation and evaluation

d) Visualization comparing predicted vs actual trends

2. Literature Review ?

Traditional Time-Series Forecasting Models (ARIMA, exponential smoothing, linear regression) compare to Deep Learning in Stock Prediction

3. Data and Feature Engineering

3.1 Data Collection

15 years of daily AAPL stock data (2012–2025) using Yahoo Finance API.

3.2 Feature Construction

Technical indicators: RSI, MACD, ATR, SMA

Rolling volume average

Percent daily returns

3.3 Labeling Strategy

Future n-day cumulative return (n = 5)

Threshold = ±0.3 \* standard deviation

Classification into Down / Neutral / Up

3.4 Data Splitting and Scaling (data processing)

Train/test split: 80/20

Standardization using StandardScaler

4. Model Design and Implementation

4.1 Problem Setup

Supervised multi-class classification  
Inputs: engineered features  
Target: 3-class trend label

4.2 Network Architecture

Input layer: 4 features

Hidden layers: Dense, BatchNorm, LeakyReLU, Dropout

Output: Dense(3), softmax

Optimizer: Adam

Loss: sparse categorical crossentropy

4.3 Training Strategy

Early stopping

Batch size and learning rate

Epochs

5. Experimental Results (Model Performance)

Accuracy, loss

Classification report (Precision, Recall, F1-score)

6. Visualization and Interpretation

6.1 Color-Coded Actual Trend on Price Chart

Historical price plotted with red (Down), blue (Neutral), green (Up) based on real labels.

6.2 Color-Coded Predicted Trend on Price Chart

Plot test data price with model-predicted trend colors.

6.3 Visual Comparison

Side-by-side or overlapping comparison of predicted vs actual trend trajectories.

7. Conclusion and Future Work

7.1 Key Findings

The model captures broad up/down trends well

Neutral state is difficult to classify correctly

7.2 Limitations

Labeling is sensitive to threshold ?

7.3 Future Work

References