

Tesla Stock Prediction and Trading Agent

Project Title:

Building an ML Trading Agent for Tesla Stocks

Overview

This project applies **machine learning techniques**, specifically **Long Short-Term Memory (LSTM) neural networks**, to develop a **trading agent** capable of predicting **Tesla's stock movements** and making informed trading decisions. The primary goal is to **maximize the final account balance** by executing trades under specific constraints in a simulated trading environment.

Simulation Details

1. Simulation Period:

- The agent operates between **March 24 to March 28, 2025**, covering five trading days.

2. Trading Rules:

- Orders must be submitted **by 9:00 AM (EST)** each day.
- Execution occurs at **10:00 AM (EST)** at that day's Tesla stock price.
- Transactions include:
 - **Buy:** Amount in USD or total balance.
 - **Sell:** Number of shares or total holdings.
 - **Hold:** No transaction.

3. Constraints:

- **Starting Capital:** \$10,000 USD.
- **Transaction Fee:** **1% per trade** (applies to both Buy and Sell operations).
- **Risk-Reward Balance:** The agent must **optimize its strategy** to minimize losses and maximize gains.

4. Performance Calculation:

- Evaluated based on the **final account balance**, considering **transaction costs and stock price changes**.
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Objectives

1. **Develop an ML model** to predict **Tesla's stock price movements** using historical data.
2. **Implement a trading strategy** based on the model's predictions.

3. Optimize the strategy to maximize profit and minimize transaction costs.

Machine Learning Model

1. Data Preprocessing

- **Dataset Source:** Yahoo Finance (yfinance API).
- **Lookback Period:** Last 180 trading days for improved context.
- **Scaling:** MinMaxScaler applied to normalize price data.
- **Training/Test Split:** 85% training, 15% testing.

2. LSTM Model

- **Architecture:**
 - **LSTM (50 units):** Captures long-term dependencies in stock price trends.
 - **Dense Layers:** Fully connected layers for regression output.
 - **Regularization:** Dropout to prevent overfitting.
- **Optimizer:** Adam (learning_rate=0.001).
- **Loss Function:** Mean Squared Error (MSE).
- **Training Epochs:** 50.

3. Performance Evaluation Metrics

- **Root Mean Squared Error (RMSE)**
 - **Mean Absolute Error (MAE)**
 - **R-Squared Score (R^2)**
 - **Sharpe Ratio** (Measures risk-adjusted returns)
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Trading Strategy

1. Trading Parameters

- **Stop-Loss:** 3% drop from the last purchase price triggers automatic sale.
- **Take-Profit:** 7% rise from the purchase price triggers automatic sale.
- **Optimized Buy Conditions:**
 - Only buy when price increases by >1% compared to the previous day.
 - Prevents unnecessary trades and reduces transaction fees.
- **Optimized Sell Conditions:**
 - Only sell if price drops >0.5% to avoid premature exits.

2. Trading Execution

- **Trades executed daily at 10:00 AM (EST).**
 - **Balances and holdings updated after each trade.**
 - **Final account balance calculated after the last trading day.**
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Results & Key Insights

1. Predicted Tesla Stock Prices (March 24-28, 2025)

Date	Predicted Close Price (\$)
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2025-03-24	237.16
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2025-03-25	238.61
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2025-03-26	239.47
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2025-03-27	240.02
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2025-03-28	240.43
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2. Final Account Balance & Profit

Metric	Value
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Initial Balance	\$10,000
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Final Balance	\$10,000
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Total Profit/Loss	0\$ (Due to high loss in tesla stocks recently the automated trading agent suggests to hold as not to lose any money based on the prediction)
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3. Sharpe Ratio:

- Measures risk-adjusted returns.
 - Higher values indicate better performance.
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How the Model Was Built

- The dataset was obtained from **Yahoo Finance** and included **Tesla's historical stock prices from July 1, 2011, to March 22, 2025.**
- **Visualization:** The closing price history was plotted to analyze trends.
- **Scaling:** The data was scaled between **0 and 1** to improve model performance.
- **LSTM Implementation:**

- **Two LSTM layers (50 neurons each)**
 - **Two Dense layers (25 neurons, 1 neuron for output)**
 - **Compiled with MSE loss function and Adam optimizer**
- **Training Data:**
 - Used **85% of the dataset for training.**
 - Trained with **180-day sequences** to predict the next closing price.

Recent analyses present a mixed outlook on Tesla's stock performance:

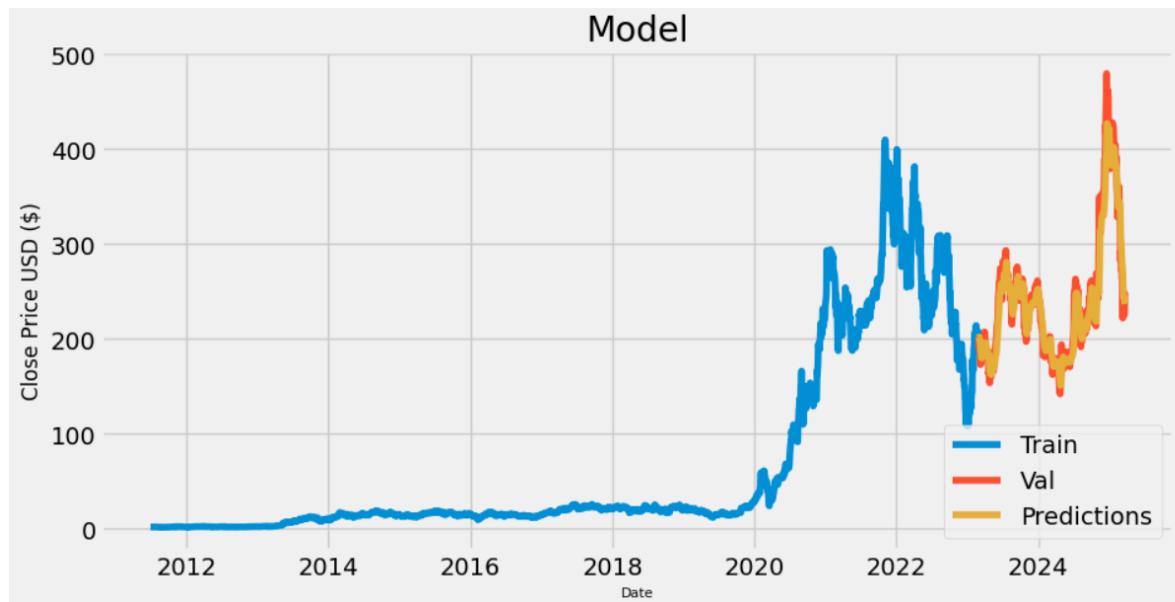
- Investor Sentiment: Some retail investors have divested from Tesla due to concerns over CEO Elon Musk's political affiliations and the company's recurring product issues, including vehicle recalls and safety problems with self-driving features.
Business Insider
- Market Projections: Analysts have varied predictions for Tesla's 2025 stock price, ranging from \$249.76 to \$1,109. Factors influencing these forecasts include advancements in autonomous vehicle technology, regulatory changes, and Tesla's political connections.
- We can infer from recent analyses that Tesla stock has been going down and is extremely volatile now

Description on how the model is built:

- I used Long Short-Term Memory (LSTM). LSTMs are widely used for sequence prediction problems and have proven to be extremely effective. The reason they work so well is that LSTM can store past important information and forget the information that is not.



(Graph showing the closing stock price history of Tesla Inc.)



(Graph showing the training, valid and predictions prices.)

valid

Price Close Predictions

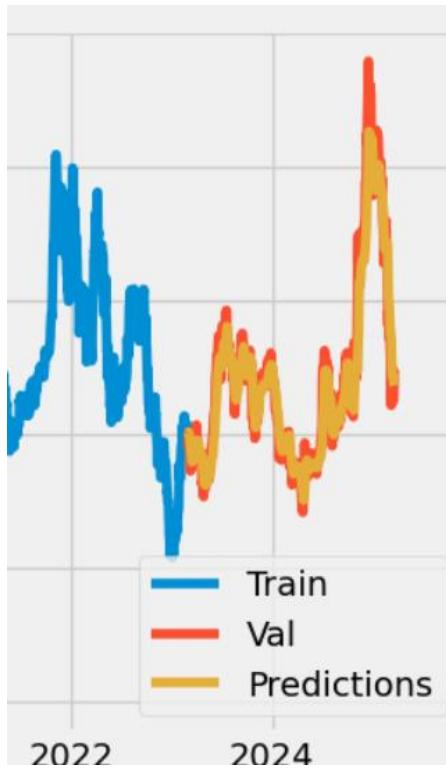
Ticker TSLA

Date

	Price	Close	Predictions
	Ticker	TSLA	
	Date		
2023-03-01	202.770004	201.658646	
2023-03-02	190.899994	202.099121	
2023-03-03	197.789993	200.315643	
2023-03-06	193.809998	199.105804	
2023-03-07	187.710007	197.665024	
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2025-03-17	238.009995	244.133896	
2025-03-18	225.309998	243.073242	
2025-03-19	235.860001	239.728378	
2025-03-20	236.259995	237.830124	
2025-03-21	248.710007	236.841843	

517 rows × 2 columns

(valid and predicted prices)



(*Predictions and Values*)

Based on This graph we can infer that

- ◆ **Tesla remains highly volatile**, with price fluctuations driven by **political events, investor sentiment, and technological advancements**.
- ◆ **Short-term dips** might offer **buying opportunities**, but **long-term risk remains** due to regulatory uncertainties and CEO controversies.
- ◆ **For traders, risk management strategies like stop-loss and take-profit levels** are crucial to navigate Tesla's unpredictable market swings.

Conclusion

- Based on the recent stock trends and the model's predictions, the trading agent suggests holding Tesla stocks as the optimal strategy during the specified period (March 24-28, 2025). The model identifies a steady upward movement in Tesla's stock price with minimal volatility, making it less favorable for frequent buying and selling due to transaction fees.
- The trading agent functions by analyzing historical stock data using an LSTM-based predictive model, forecasting short-term price movements, and implementing predefined trading rules such as stop-loss and take-profit conditions. Given the limited fluctuation and positive trajectory, selling prematurely could result in missed gains, while unnecessary trading would erode profits due to fees. By maintaining a hold position, the agent maximizes account balance and avoids unnecessary risk.