Tesla Stock Price Prediction using RNN and LSTM

1. Problem Statement

The goal of this project is to develop deep learning models (SimpleRNN and LSTM) to predict Tesla's stock closing price using historical data.

Stock prices are sequential data, and RNNs (especially LSTMs) are well-suited for such time-series forecasting problems.

We'll use 'Close' price as the target for our models and compare the prediction performance of RNN and LSTM architectures.

2. Data Preprocessing

- The dataset contains daily Tesla stock data with features such as Date, Open, High, Low, Close, Adj Close, and Volume.
- We focus on the 'Close' price.
- The data is scaled using MinMaxScaler to bring it into [0,1] range for better convergence during training.
- A sliding window of 60 days is used to create time-series sequences where 60 previous days are used to predict the 61st day's closing price.

3. Model Development

- Two models are developed using Keras Sequential API:
  a) SimpleRNN with 50 units, Dropout(0.2), and Dense(1) output.
  b) LSTM with 50 units, Dropout(0.2), and Dense(1) output.
- Mean Squared Error (MSE) is used as the loss function.
- Adam optimizer is used to optimize the models.
- EarlyStopping and ModelCheckpoint are used to prevent overfitting and save the best-performing models.

4. Model Evaluation

- The best models are loaded from the saved checkpoints.
- Predictions are made on the test set.

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- The predicted values are inverse-transformed to original price scale.
- A plot is generated comparing actual vs predicted prices for both models.
- MSE is calculated for both models for performance comparison.

5. Results & Insights

- Both models were able to capture the overall trend of the stock prices.
- LSTM generally showed better performance due to its ability to capture long-term dependencies.
- SimpleRNN is faster but may not handle long sequences as effectively as LSTM.
- Improvements could include using more features (technical indicators, sentiment analysis) or experimenting with other time-series models like GRU or Transformers.

6. Business Use Cases

- Automated Trading: Predict trends to make real-time buy/sell decisions.
- Financial Forecasting: Support long-term investment strategies.
- Risk Management: Help hedge portfolios against predicted downturns.
- Corporate Strategy: Compare with competitors or forecast company valuation metrics.