Assignment 4

ADTA 5560.701 - Recurrent Neural Networks for Sequence Data

PART I: Request GCP Free Credit Coupon and Redeem It

A screenshot of a computer

Description automatically generated

PART II: Write the Project Report

1. Introduction

This report uses historical market data to implement a deep learning solution for predicting Apple Inc. (AAPL) stock prices. The implementation utilizes a stacked LSTM architecture, which is well-suited for capturing long-term dependencies in time series data such as stock prices. The model's design incorporates multiple LSTM layers with dropout regularization to enhance generalization capabilities and prevent overfitting.

This project aimed to build, train, and test an LSTM neural network for time series prediction using historical stock market data. The implementation leverages modern deep learning frameworks including TensorFlow and Keras, demonstrating the practical application of recurrent neural networks in financial forecasting.

2. Methodology

2.1 Data Collection and Preprocessing

Data Source and Timeline:

* Stock: Apple Inc. (AAPL)
* Time Period: January 1, 2014 - June 30, 2019
* Total Duration: 5.5 years of trading data
* Source: Yahoo! Finance historical data

Data Characteristics:

* Daily trading data, including open, high, low, close prices, and volume
* Approximately 1,380 trading days (excluding weekends and holidays)
* Captures multiple market cycles and significant company events

**3. Model Architecture**

The LSTM model implements a deep architecture with multiple stacked layers:

1. First LSTM Layer (lstm\_3)
   * Units: 50
   * Input sequence handling
   * Parameters: 10,400
2. First Dropout Layer (dropout\_2)
   * Dropout rate applied for regularization
   * Output shape: (None, 60, 50)
3. Second LSTM Layer (lstm\_4)
   * Units: 50
   * Parameters: 20,200
   * Maintains temporal information
4. Second Dropout Layer (dropout\_3)
   * Additional regularization
   * Output shape: (None, 60, 50)
5. Third LSTM Layer (lstm\_5)
   * Units: 50
   * Parameters: 20,200
   * Final sequence processing
6. Dense Layer (dense\_1)
   * Units: 1
   * Parameters: 51
   * Final prediction output

Total Model Parameters: 50,851 (198.64 KB)

* Trainable parameters: 50,851
* Non-trainable parameters: 0

This architecture follows a deep LSTM design with regularization through dropout layers. This helps prevent overfitting while maintaining the model's ability to capture complex temporal patterns in the Apple stock price data.

3. Results Analysis

3.1 Model Performance

* Model shows higher accuracy in sustained trends
* Predictions closely track actual prices in the latter part of the dataset
* Some smoothing of extreme price movements, which is expected in LSTM predictions
* Maintained reliability across different market conditions

A blue line graph with numbers

Description automatically generated

4. Time Series Forecasting with RNN LSTM Neural Network

A graph with blue lines and orange lines

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**Forecast Analysis**

The model's performance can be analyzed across three distinct components:

**1. Historical Data (Blue Line)**

* Spans from 2014 to 2019
* Shows clear upward trend from $15 to peak of ~$55
* Exhibits varying levels of volatility
* Contains multiple price cycles and patterns

**2. Model Predictions (Orange Line)**

* Closely tracks historical price movements
* Particularly accurate in trending periods
* Successfully captures major price levels
* Shows slight smoothing of extreme volatility

**3. Future Forecast (Green Line)**

* Projects significant downward trend
* Starting from ~$45 level
* Forecasts decline to ~$22 level
* Shows increasing uncertainty with time horizon