# Stocks Close Price Prediction

Using LSTM

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# Introduction

- Huge increase in interest from the financial sector about Deep Learning applications
- A small edge in this sector can be translated into large gains
- Approached by an Actively Managed Fund
- Active Fund aims to beat the average market index
- Take advantage of small short-term price fluctuations
- Predict the next day Close price of a stock using as predictors the previous day metrics

# Input Data

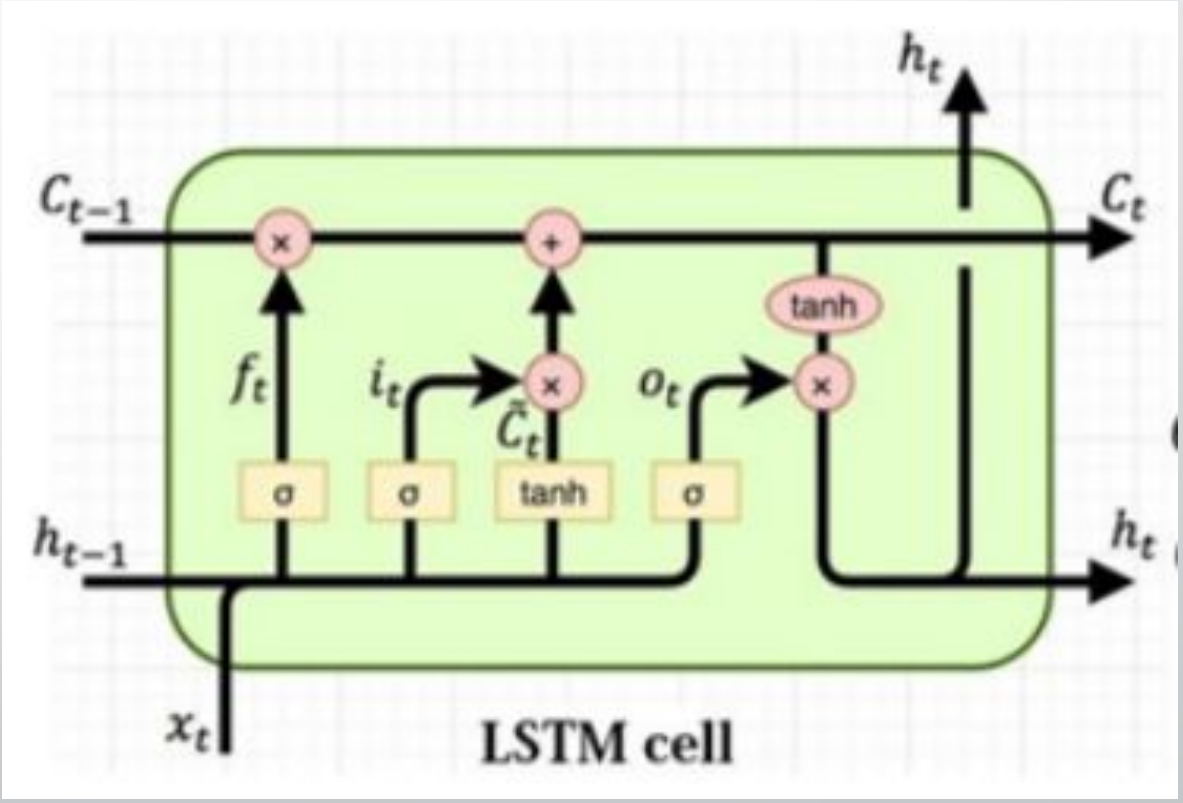
- Historical daily data from companies that are now included in S&P500 from 1980 to 2018
- 25 of those stocks chosen
- Various stages of cleaning and reformatting using Bash and Python
- Transformed using MinMaxScaler to scale and normalize the data into the range [0,1]

# Recurrent Neural Networks

- RNNs are multi-layer type of networks that use internal memory in order to process sequential data
- LSTM is a type of RNN
- LSTM have proved to be one of the most powerful and effective models in processing sequential data
- RNN are suffering from vanishing gradient
- LSTM solve this problem with different approach in its architecture

# LSTM

- Forget Gate
- Input Gate
- Output Gate
- Cell State



# Design & Implementation

- 3 Different Approaches
- We wanted to examine if the previous values are affected the output in a positive or negative way
- 3D Tensors (No. of sequences, length of sequence, No. of features)
- “All-In” (1,n,5)
- “Window” (n,4,1)
- “MLP” (n,1,5)
- Used one stock to train each model
- Then used that model to make predictions on other stocks

# Optimization

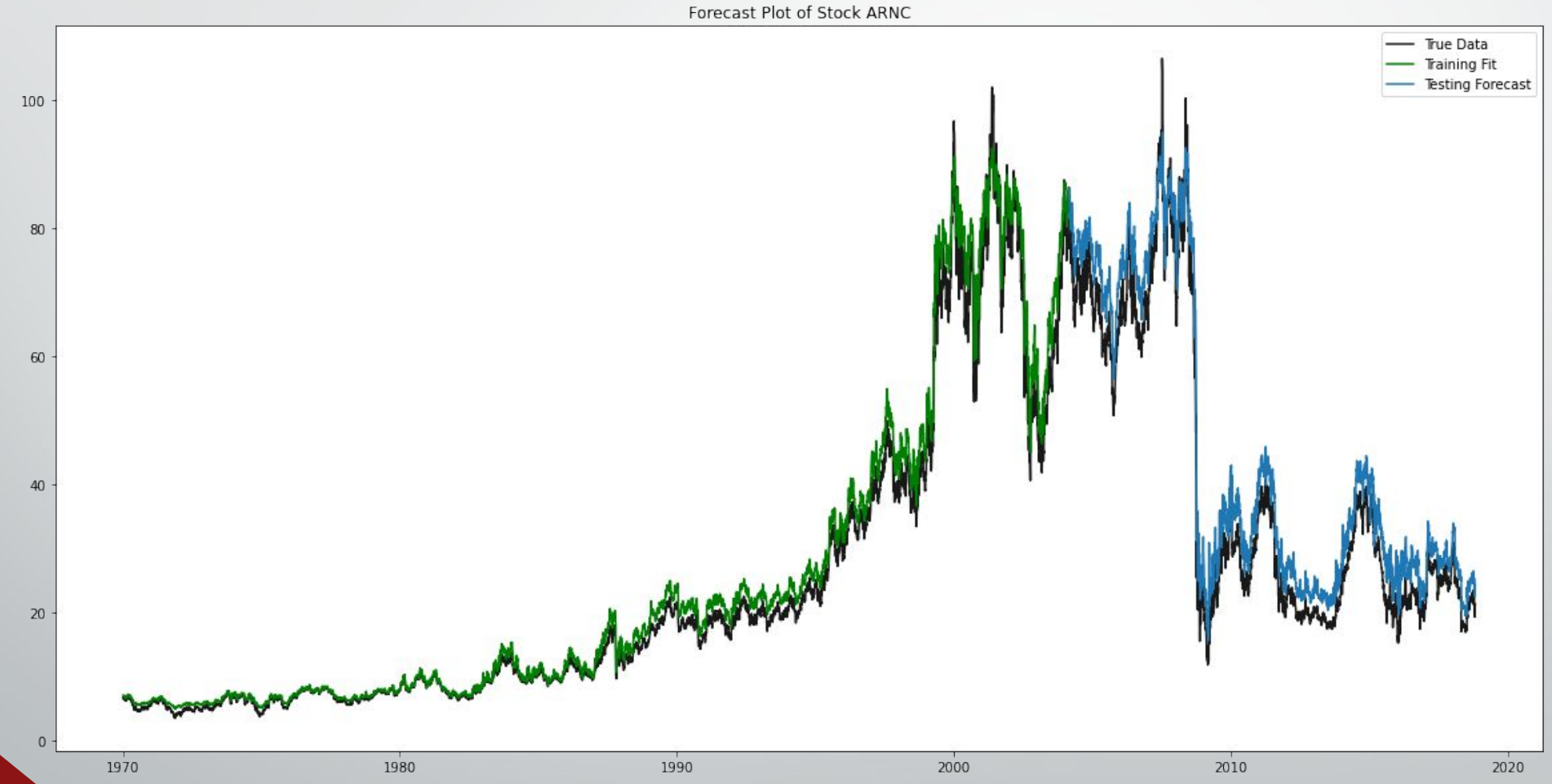
- Hyper-parameters optimized using Talos library using the following for 100 epochs

| | Range Searched | Results |
|---|---|---|
| Number of units of the first LSTM Layer | [8,16,32] | 8 |
| Number of units of the second LSTM Layer | [8,16,32] | 16 |
| Number of units of the third LSTM Layer | [8,16,32] | 32 |
| Dropout | [0,1 0,2] | 0,1 |

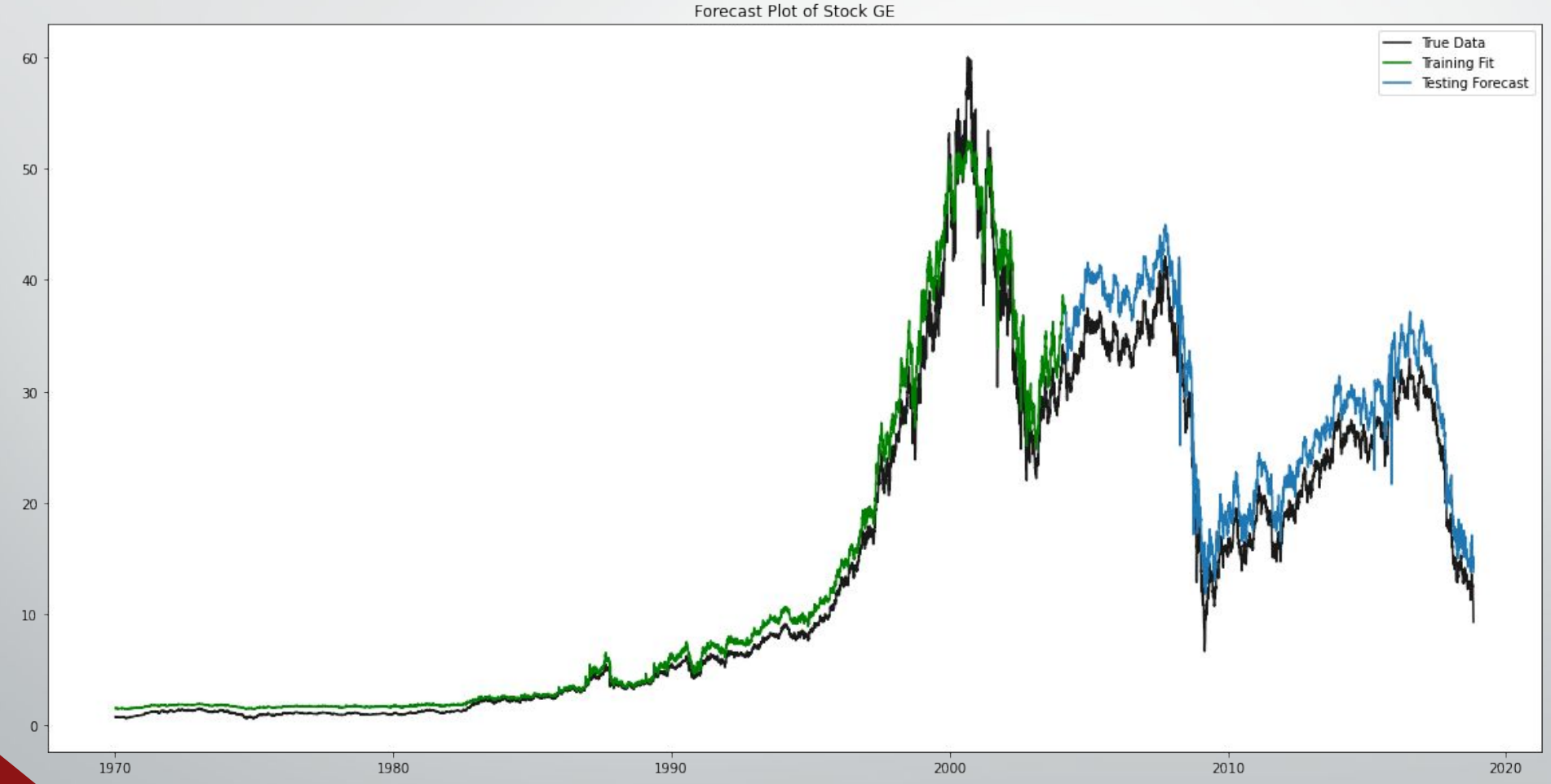
# RMSE

| Stock | MLP | Window | All In |
|---|---|---|---|
| ARNC | **0.0220** | 0.0368 | 0.0488 |
| GE | 0.0609 | **0.0328** | 0.0430 |
| IBM | 0.0524 | 0.0633 | **0.0467** |
| MSFT | 0.0482 | **0.0384** | 0.0420 |
| AAPL | 0.0598 | **0.0365** | 0.0450 |

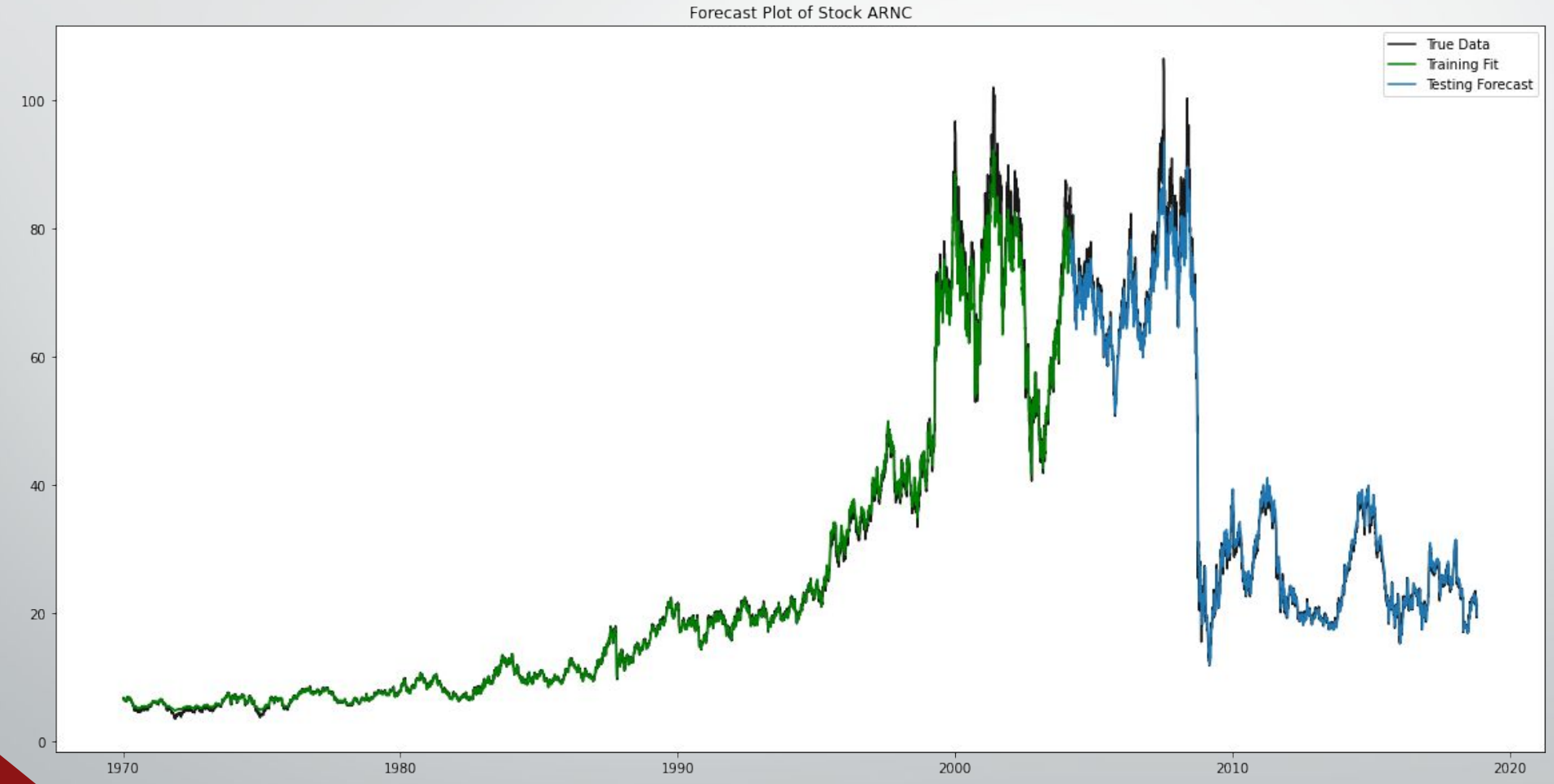
# Results: “MLP” ARNC



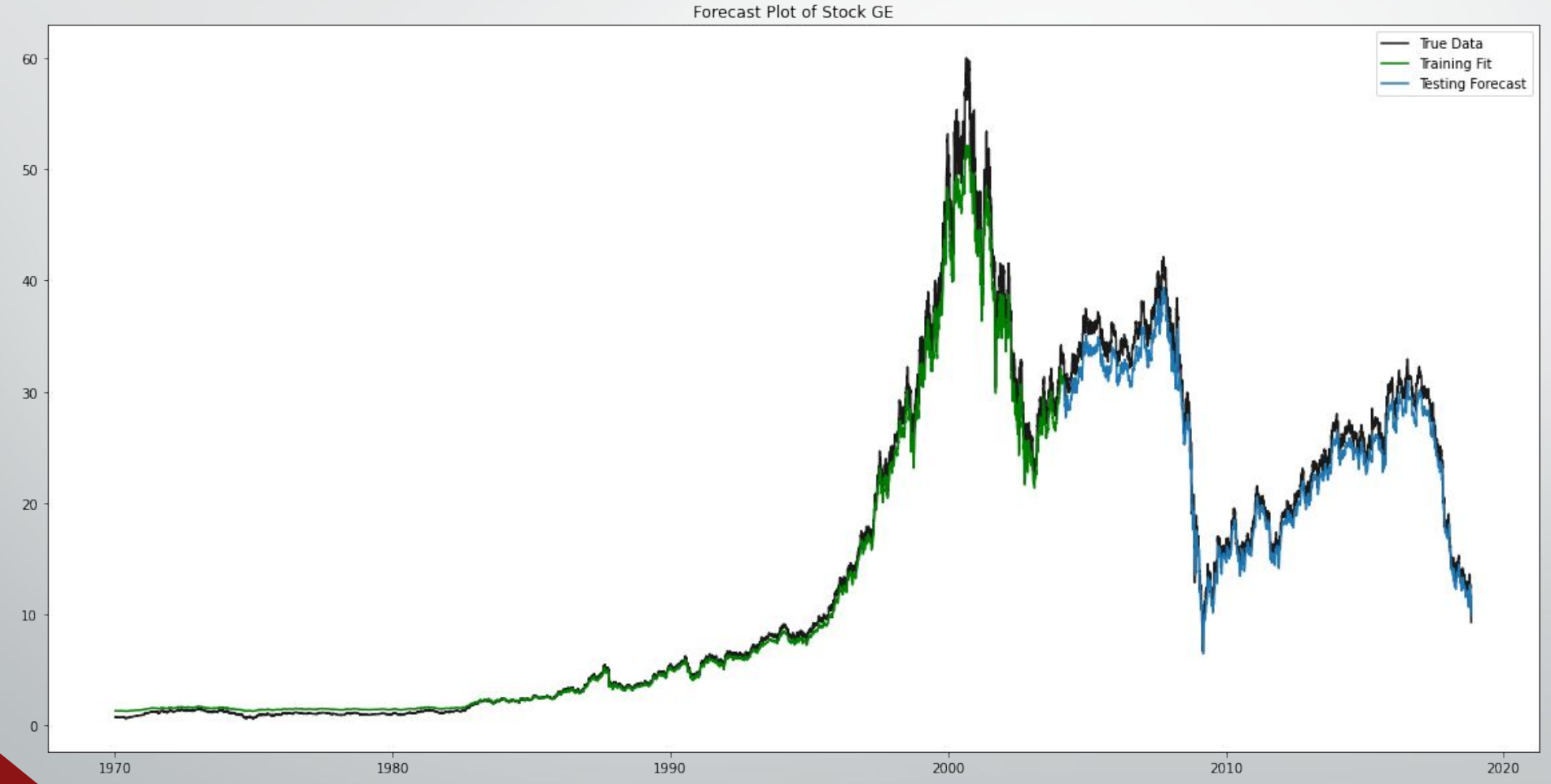
# Results: “MLP” GE



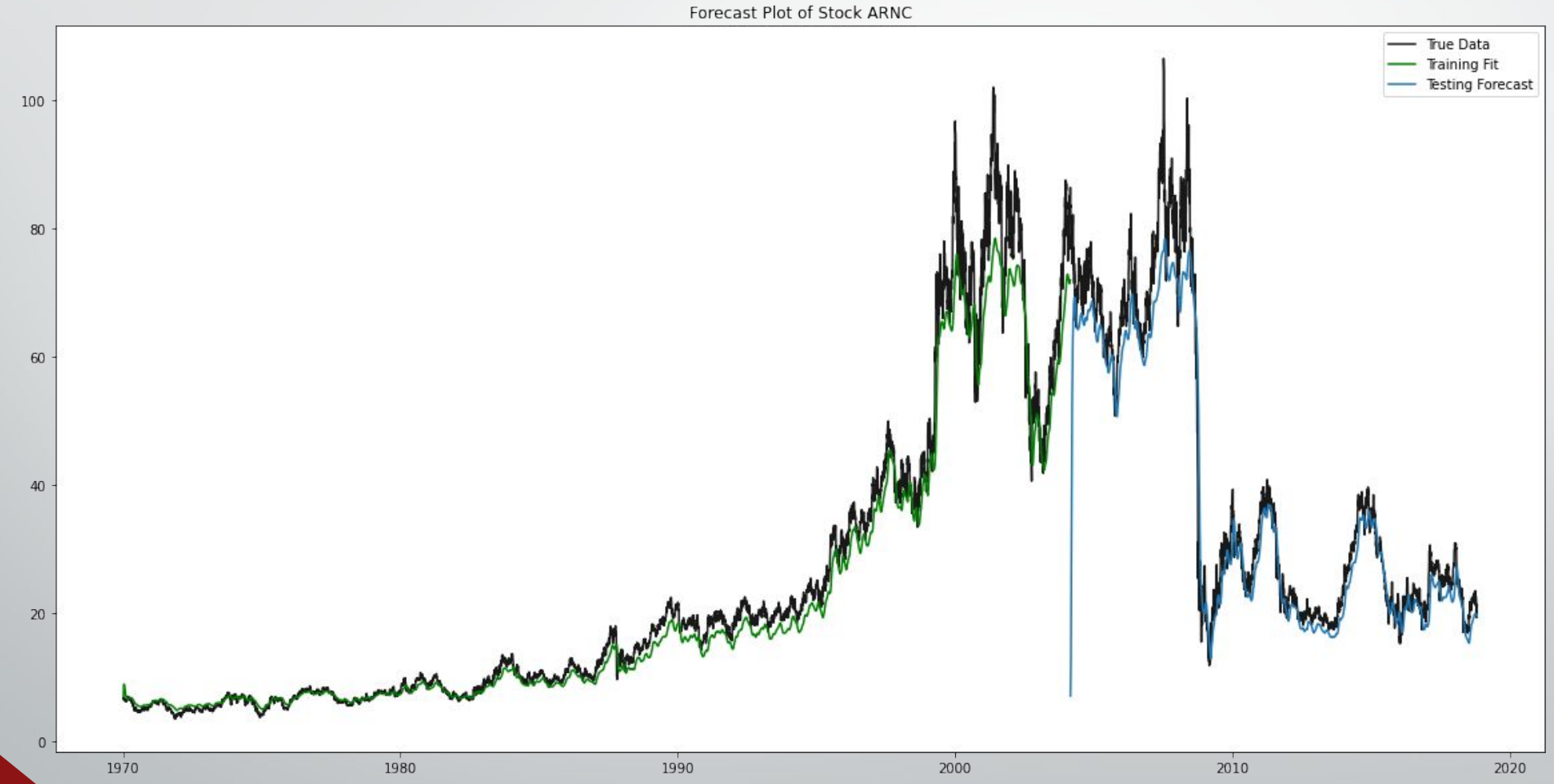
# Results: “Window” ARNC



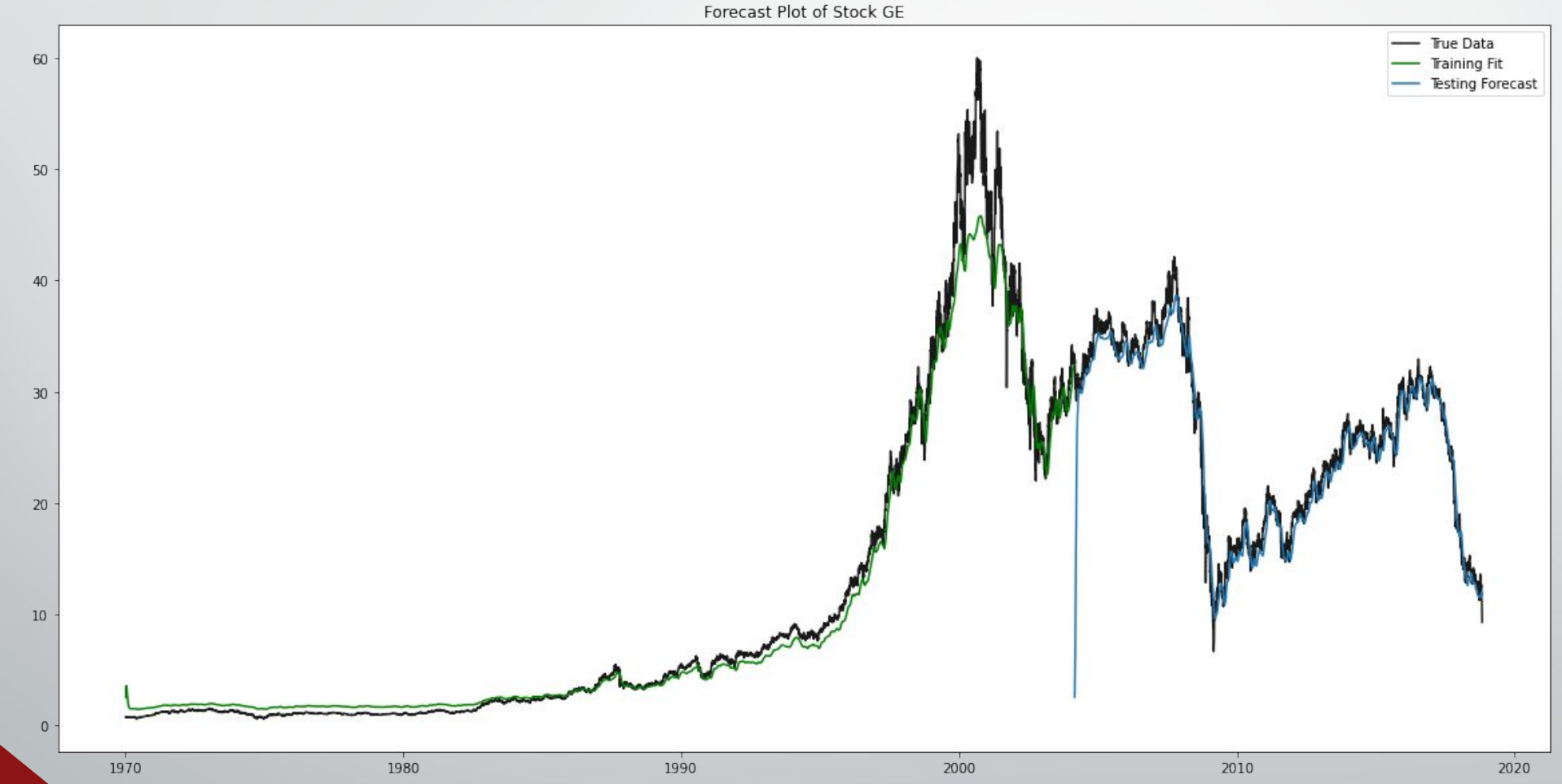
# Results: “Window” GE



# Results: “All-In” ARNC



# Results: “All-In” GE



# Any Questions?