# aapl prediction

June 4, 2023

[48]:
```
import yfinance as yf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM
from tensorflow.keras.layers import Dropout
from sklearn.metrics import mean_squared_error, mean_absolute_error
```

[2]:
```
aapl=pd.read_csv("C:/Users/jakey/OneDrive/Documents/personal projects/
 ↪predicting AAPL stock price\AAPL.csv",index_col='Date')
aapl
#10409 days
```

[2]:
```
                  Open        High         Low       Close   Adj Close  \
Date
1980-12-12    0.128348    0.128906    0.128348    0.128348    0.100323
1980-12-15    0.122210    0.122210    0.121652    0.121652    0.095089
1980-12-16    0.113281    0.113281    0.112723    0.112723    0.088110
1980-12-17    0.115513    0.116071    0.115513    0.115513    0.090291
1980-12-18    0.118862    0.119420    0.118862    0.118862    0.092908
…                  …           …           …           …           …
2022-03-18  160.509995  164.479996  159.759995  163.979996  163.979996
2022-03-21  163.509995  166.350006  163.009995  165.380005  165.380005
2022-03-22  165.509995  169.419998  164.910004  168.820007  168.820007
2022-03-23  167.990005  172.639999  167.649994  170.210007  170.210007
2022-03-24  171.059998  174.139999  170.210007  174.070007  174.070007

               Volume
Date
1980-12-12  469033600
1980-12-15  175884800
1980-12-16  105728000
1980-12-17   86441600
1980-12-18   73449600
…                 …
```

```
2022-03-18  123351200
2022-03-21   95811400
2022-03-22   81532000
2022-03-23   98062700
2022-03-24   90018700

[10409 rows x 6 columns]
```

[3]:
```
aapl.describe()
```

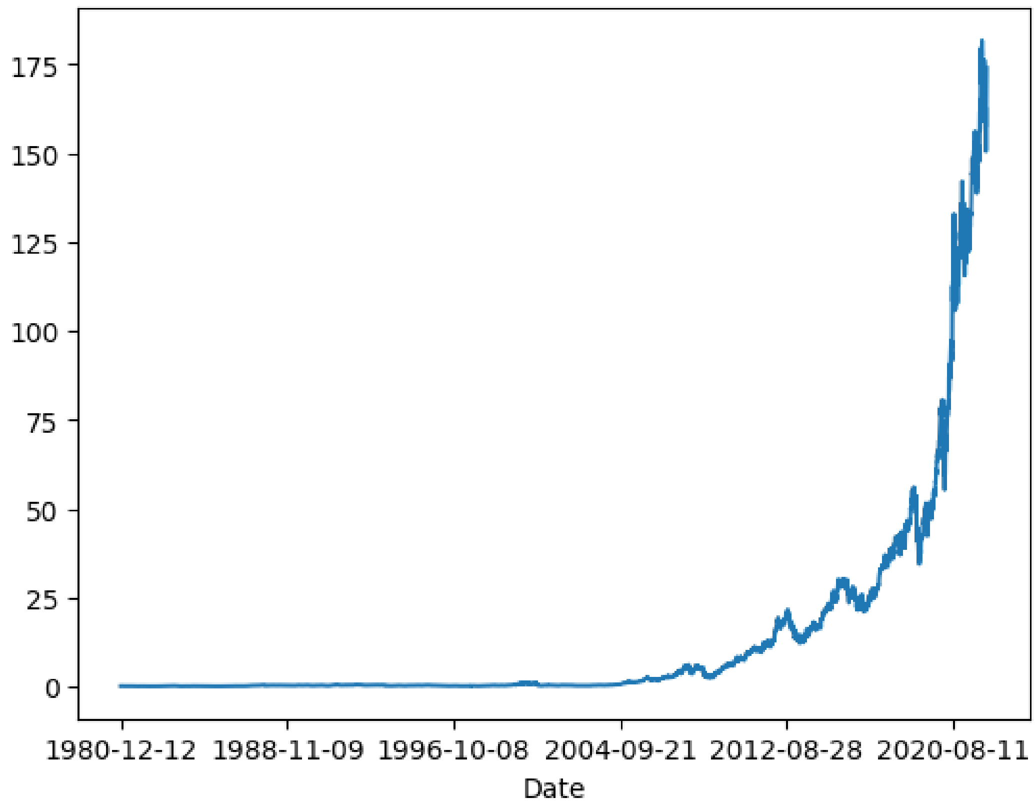
[3]:
```
               Open          High           Low         Close     Adj Close  \
count  10409.000000  10409.000000  10409.000000  10409.000000  10409.000000
mean      13.959910     14.111936     13.809163     13.966757     13.350337
std       30.169244     30.514878     29.835055     30.191696     29.911132
min        0.049665      0.049665      0.049107      0.049107      0.038384
25%        0.281964      0.287946      0.274554      0.281250      0.234799
50%        0.468750      0.477679      0.459821      0.468750      0.386853
75%       14.217857     14.364286     14.043571     14.206071     12.188149
max      182.630005    182.940002    179.119995    182.009995    181.778397

             Volume
count  1.040900e+04
mean   3.321778e+08
std    3.393344e+08
min    0.000000e+00
25%    1.247604e+08
50%    2.199680e+08
75%    4.126108e+08
max    7.421641e+09
```

[4]:
```
#Check for any missing values values
aapl.isnull().values.any()
```

[4]:
```
False
```

[5]:
```
aapl['Adj Close'].plot()
```

[5]:
```
<Axes: xlabel='Date'>
```




[6]:
```
#target variable=dependent variable
target=pd.DataFrame(aapl['Adj Close'])
#feature variables=independent variables
features=['Open','High','Low','Volume']
#Scaling data between 0 and 1 for precision and memory consumption
scaler=MinMaxScaler(feature_range=(0,1))
features_transform=scaler.fit_transform(aapl[features])
feature_transform=pd.
 ↪DataFrame(columns=features,data=features_transform,index=aapl.index)
feature_transform
```

[6]:

| | Open | High | Low | Volume |
|---|---|---|---|---|
| Date | | | | |
| 1980-12-12 | 0.000431 | 0.000433 | 0.000443 | 0.063198 |
| 1980-12-15 | 0.000397 | 0.000397 | 0.000405 | 0.023699 |
| 1980-12-16 | 0.000348 | 0.000348 | 0.000355 | 0.014246 |
| 1980-12-17 | 0.000361 | 0.000363 | 0.000371 | 0.011647 |
| 1980-12-18 | 0.000379 | 0.000381 | 0.000390 | 0.009897 |
| … | … | … | … | … |
| 2022-03-18 | 0.878848 | 0.899065 | 0.891886 | 0.016620 |
| 2022-03-21 | 0.895279 | 0.909290 | 0.910036 | 0.012910 |

```
2022-03-22  0.906233  0.926076  0.920646  0.010986
2022-03-23  0.919816  0.943682  0.935947  0.013213
2022-03-24  0.936631  0.951884  0.950243  0.012129

[10409 rows x 4 columns]
```

[51]:
```python
#Split Training and Test sets with 80/20
test_ratio=.1
training_ratio=1-test_ratio
test_size=int(test_ratio*len(aapl))
training_size=int(training_ratio*len(aapl))
x_train,x_test=feature_transform[:
 ↪training_size],feature_transform[training_size:]
y_train,y_test=target[:training_size],target[training_size:]
train_x,test_x=np.array(x_train),np.array(x_test)
#n x m -> n arrays containing 1 array with m elements
x_train=train_x.reshape(x_train.shape[0],1,x_train.shape[1])
x_test=test_x.reshape(x_test.shape[0],1,x_test.shape[1])
```

[52]:
```python
lstm=Sequential()
lstm.add(LSTM(32,input_shape=(1,train_x.
 ↪shape[1]),activation='relu',return_sequences=False))
lstm.add(Dense(1))
lstm.compile(loss='mean_squared_error',optimizer='adam')
history=lstm.
 ↪fit(x_train,y_train,epochs=100,batch_size=32,verbose=1,shuffle=False)
```

```
Epoch 1/100
293/293 [==============================] - 1s 716us/step - loss: 88.7918
Epoch 2/100
293/293 [==============================] - 0s 680us/step - loss: 76.9560
Epoch 3/100
293/293 [==============================] - 0s 681us/step - loss: 68.5523
Epoch 4/100
293/293 [==============================] - 0s 677us/step - loss: 63.2379
Epoch 5/100
293/293 [==============================] - 0s 685us/step - loss: 58.4186
Epoch 6/100
293/293 [==============================] - 0s 677us/step - loss: 54.8505
Epoch 7/100
293/293 [==============================] - 0s 698us/step - loss: 50.5184
Epoch 8/100
293/293 [==============================] - 0s 683us/step - loss: 46.0803
Epoch 9/100
293/293 [==============================] - 0s 714us/step - loss: 41.1552
Epoch 10/100
293/293 [==============================] - 0s 719us/step - loss: 35.5283
Epoch 11/100
```

```
293/293 [==============================] - 0s 740us/step - loss: 29.3769
Epoch 12/100
293/293 [==============================] - 0s 712us/step - loss: 23.1234
Epoch 13/100
293/293 [==============================] - 0s 711us/step - loss: 17.2399
Epoch 14/100
293/293 [==============================] - 0s 705us/step - loss: 12.1046
Epoch 15/100
293/293 [==============================] - 0s 710us/step - loss: 7.9437
Epoch 16/100
293/293 [==============================] - 0s 698us/step - loss: 4.8293
Epoch 17/100
293/293 [==============================] - 0s 701us/step - loss: 2.6983
Epoch 18/100
293/293 [==============================] - 0s 684us/step - loss: 1.3810
Epoch 19/100
293/293 [==============================] - 0s 701us/step - loss: 0.6531
Epoch 20/100
293/293 [==============================] - 0s 686us/step - loss: 0.2975
Epoch 21/100
293/293 [==============================] - 0s 677us/step - loss: 0.1457
Epoch 22/100
293/293 [==============================] - 0s 683us/step - loss: 0.0900
Epoch 23/100
293/293 [==============================] - 0s 679us/step - loss: 0.0732
Epoch 24/100
293/293 [==============================] - 0s 679us/step - loss: 0.0699
Epoch 25/100
293/293 [==============================] - 0s 672us/step - loss: 0.0704
Epoch 26/100
293/293 [==============================] - 0s 692us/step - loss: 0.0715
Epoch 27/100
293/293 [==============================] - 0s 682us/step - loss: 0.0724
Epoch 28/100
293/293 [==============================] - 0s 711us/step - loss: 0.0729
Epoch 29/100
293/293 [==============================] - 0s 730us/step - loss: 0.0728
Epoch 30/100
293/293 [==============================] - 0s 718us/step - loss: 0.0723
Epoch 31/100
293/293 [==============================] - 0s 698us/step - loss: 0.0712
Epoch 32/100
293/293 [==============================] - 0s 710us/step - loss: 0.0697
Epoch 33/100
293/293 [==============================] - 0s 715us/step - loss: 0.0681
Epoch 34/100
293/293 [==============================] - 0s 687us/step - loss: 0.0666
Epoch 35/100
```

```
293/293 [==============================] - 0s 706us/step - loss: 0.0653
Epoch 36/100
293/293 [==============================] - 0s 684us/step - loss: 0.0643
Epoch 37/100
293/293 [==============================] - 0s 687us/step - loss: 0.0637
Epoch 38/100
293/293 [==============================] - 0s 700us/step - loss: 0.0634
Epoch 39/100
293/293 [==============================] - 0s 688us/step - loss: 0.0633
Epoch 40/100
293/293 [==============================] - 0s 712us/step - loss: 0.0634
Epoch 41/100
293/293 [==============================] - 0s 680us/step - loss: 0.0637
Epoch 42/100
293/293 [==============================] - 0s 688us/step - loss: 0.0640
Epoch 43/100
293/293 [==============================] - 0s 696us/step - loss: 0.0643
Epoch 44/100
293/293 [==============================] - 0s 720us/step - loss: 0.0647
Epoch 45/100
293/293 [==============================] - 0s 701us/step - loss: 0.0652
Epoch 46/100
293/293 [==============================] - 0s 702us/step - loss: 0.0656
Epoch 47/100
293/293 [==============================] - 0s 673us/step - loss: 0.0661
Epoch 48/100
293/293 [==============================] - 0s 687us/step - loss: 0.0666
Epoch 49/100
293/293 [==============================] - 0s 694us/step - loss: 0.0672
Epoch 50/100
293/293 [==============================] - 0s 696us/step - loss: 0.0677
Epoch 51/100
293/293 [==============================] - 0s 699us/step - loss: 0.0684
Epoch 52/100
293/293 [==============================] - 0s 698us/step - loss: 0.0690
Epoch 53/100
293/293 [==============================] - 0s 683us/step - loss: 0.0696
Epoch 54/100
293/293 [==============================] - 0s 670us/step - loss: 0.0702
Epoch 55/100
293/293 [==============================] - 0s 676us/step - loss: 0.0708
Epoch 56/100
293/293 [==============================] - 0s 681us/step - loss: 0.0714
Epoch 57/100
293/293 [==============================] - 0s 671us/step - loss: 0.0719
Epoch 58/100
293/293 [==============================] - 0s 682us/step - loss: 0.0724
Epoch 59/100
```

```
293/293 [==============================] - 0s 692us/step - loss: 0.0729
Epoch 60/100
293/293 [==============================] - 0s 682us/step - loss: 0.0734
Epoch 61/100
293/293 [==============================] - 0s 722us/step - loss: 0.0739
Epoch 62/100
293/293 [==============================] - 0s 708us/step - loss: 0.0743
Epoch 63/100
293/293 [==============================] - 0s 695us/step - loss: 0.0746
Epoch 64/100
293/293 [==============================] - 0s 698us/step - loss: 0.0750
Epoch 65/100
293/293 [==============================] - 0s 685us/step - loss: 0.0753
Epoch 66/100
293/293 [==============================] - 0s 712us/step - loss: 0.0755
Epoch 67/100
293/293 [==============================] - 0s 679us/step - loss: 0.0758
Epoch 68/100
293/293 [==============================] - 0s 698us/step - loss: 0.0760
Epoch 69/100
293/293 [==============================] - 0s 685us/step - loss: 0.0762
Epoch 70/100
293/293 [==============================] - 0s 684us/step - loss: 0.0763
Epoch 71/100
293/293 [==============================] - 0s 699us/step - loss: 0.0764
Epoch 72/100
293/293 [==============================] - 0s 689us/step - loss: 0.0766
Epoch 73/100
293/293 [==============================] - 0s 700us/step - loss: 0.0767
Epoch 74/100
293/293 [==============================] - 0s 710us/step - loss: 0.0767
Epoch 75/100
293/293 [==============================] - 0s 694us/step - loss: 0.0768
Epoch 76/100
293/293 [==============================] - 0s 714us/step - loss: 0.0768
Epoch 77/100
293/293 [==============================] - 0s 688us/step - loss: 0.0769
Epoch 78/100
293/293 [==============================] - 0s 700us/step - loss: 0.0769
Epoch 79/100
293/293 [==============================] - 0s 692us/step - loss: 0.0769
Epoch 80/100
293/293 [==============================] - 0s 704us/step - loss: 0.0769
Epoch 81/100
293/293 [==============================] - 0s 709us/step - loss: 0.0768
Epoch 82/100
293/293 [==============================] - 0s 681us/step - loss: 0.0768
Epoch 83/100
```

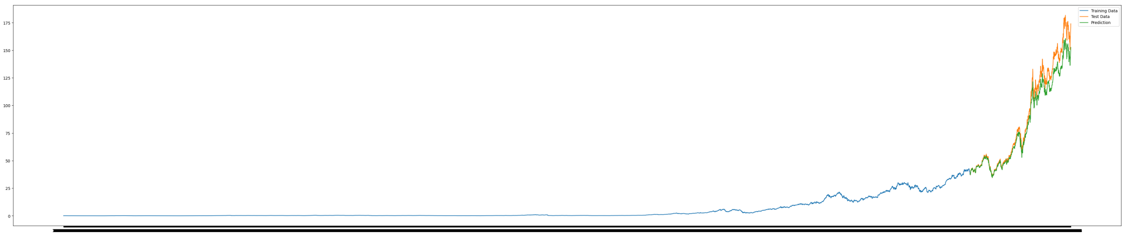
```
293/293 [==============================] - 0s 681us/step - loss: 0.0768
Epoch 84/100
293/293 [==============================] - 0s 697us/step - loss: 0.0767
Epoch 85/100
293/293 [==============================] - 0s 690us/step - loss: 0.0767
Epoch 86/100
293/293 [==============================] - 0s 691us/step - loss: 0.0766
Epoch 87/100
293/293 [==============================] - 0s 704us/step - loss: 0.0766
Epoch 88/100
293/293 [==============================] - 0s 684us/step - loss: 0.0765
Epoch 89/100
293/293 [==============================] - 0s 689us/step - loss: 0.0765
Epoch 90/100
293/293 [==============================] - 0s 699us/step - loss: 0.0764
Epoch 91/100
293/293 [==============================] - 0s 701us/step - loss: 0.0763
Epoch 92/100
293/293 [==============================] - 0s 685us/step - loss: 0.0763
Epoch 93/100
293/293 [==============================] - 0s 679us/step - loss: 0.0762
Epoch 94/100
293/293 [==============================] - 0s 681us/step - loss: 0.0761
Epoch 95/100
293/293 [==============================] - 0s 693us/step - loss: 0.0760
Epoch 96/100
293/293 [==============================] - 0s 713us/step - loss: 0.0760
Epoch 97/100
293/293 [==============================] - 0s 700us/step - loss: 0.0759
Epoch 98/100
293/293 [==============================] - 0s 715us/step - loss: 0.0758
Epoch 99/100
293/293 [==============================] - 0s 712us/step - loss: 0.0757
Epoch 100/100
293/293 [==============================] - 0s 710us/step - loss: 0.0756
```

[55]:
```
y_pred=lstm.predict(x_test)
```

```
33/33 [==============================] - 0s 512us/step
```

[59]:
```
y_test['Predicted']=y_pred
```

[60]:
```
plt.figure(figsize=(50,10))
plt.plot(y_train['Adj Close'],label='Training Data')
plt.plot(y_test['Adj Close'],label='Test Data')
plt.plot(y_test['Predicted'],label='Prediction')
plt.legend()
plt.show()
```



[62]:
```
#more test data=more accuracy
print('The Mean Squared Error: ',mean_squared_error(y_test['Adj Close'].
 ↪values,y_test['Predicted'].values))
print('The Mean Absolute Error: ',mean_absolute_error(y_test['Adj Close'].
 ↪values,y_test['Predicted'].values))
print('The Root Mean Squared Error: ',np.sqrt(mean_squared_error(y_test['Adj␣
 ↪Close'].values,y_test['Predicted'].values)))
```

```
The Mean Squared Error:  76.6663812472651
The Mean Absolute Error:  6.302792272016746
The Root Mean Squared Error:  8.755934059097584
```