Assignment4_Dev_Bank_LBBL

July 30, 2022

1 Stock Price Prediction of LBLL

1.1 Import the Required Libraries

[1]:
```
import warnings
warnings.filterwarnings('ignore')
```

[2]:
```
import pandas as pd
from keras import Sequential
from keras.layers import GRU, LSTM, SimpleRNN,  Dense, Dropout
from sklearn.model_selection import train_test_split
import numpy as np
from sklearn.metrics import accuracy_score, mean_absolute_error,␣
 ↪mean_squared_error
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plt
```

```
2022-07-30 05:13:12.061456: W
tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load
dynamic library 'libcudart.so.11.0'; dlerror: libcudart.so.11.0: cannot open
shared object file: No such file or directory
2022-07-30 05:13:12.061495: I tensorflow/stream_executor/cuda/cudart_stub.cc:29]
Ignore above cudart dlerror if you do not have a GPU set up on your machine.
```

1.2 Load Data

[3]:
```
lbbl_df = pd.read_csv("data/LBBL.csv")
lbbl_df.shape
```

[3]:
```
(1877, 8)
```

[4]:
```
lbbl_df.head()
```

[4]:

	S.N.	Date	Total Transactions	Total Traded Shares	\
0	1	2021-12-29	196	37355.0	
1	2	2021-12-28	293	55587.0	
2	3	2021-12-27	407	86428.0	
3	4	2021-12-26	375	79223.0	

```
4     5  2021-12-23                 403              74536.0

   Total Traded Amount  Max. Price  Min. Price  Close Price
0           16232734.3       445.7       427.0        430.2
1           24245227.0       448.0       422.0        437.0
2           37957307.7       461.0       427.0        429.9
3           36089623.0       465.0       446.0        453.0
4           34006761.4       468.0       441.1        451.0
```

1.3 Renaming the Columns

[5]:
```
lbbl_df.columns = ['SN', 'Date', 'TTrans', 'TTS','TTA', 'MaxPrice', 'MinPrice',␣
↪'ClosePrice']
```

[6]:
```
lbbl_df.head()
```

[6]:

	SN	Date	TTrans	TTS	TTA	MaxPrice	MinPrice	ClosePrice
0	1	2021-12-29	196	37355.0	16232734.3	445.7	427.0	430.2
1	2	2021-12-28	293	55587.0	24245227.0	448.0	422.0	437.0
2	3	2021-12-27	407	86428.0	37957307.7	461.0	427.0	429.9
3	4	2021-12-26	375	79223.0	36089623.0	465.0	446.0	453.0
4	5	2021-12-23	403	74536.0	34006761.4	468.0	441.1	451.0

[7]:
```
lbbl_df.shape
```

[7]:
```
(1877, 8)
```

Converting the Date into Panda's Date Time

[8]:
```
lbbl_df['Date'] = pd.to_datetime(lbbl_df['Date'])
```

1.4 Sorting the Date by Date in Ascending Order

[9]:
```
lbbl_df=lbbl_df.sort_values(by='Date')
```

1.5 Setting Features and Target Column

[10]:
```
features = ['Date','ClosePrice']
```

[11]:
```
X = lbbl_df[features]
```

[12]:
```
X.set_index("Date",inplace=True)
```

1.6 Splitting the Data Into Training, Validation and Test Set

[13]:
```
X_train_split, X_test_split = train_test_split(X, train_size=0.8,shuffle=False)
X_test_split, X_valid_split = train_test_split(X_test_split, train_size=0.
↪5,shuffle=False)
```

1.7 Fucntion to slice data to Predict next day's closing price by looking into previous 5 day's data

[14]:
```
def SliceData(data,step):
    X,Y = [],[]
    for i in range(len(data)-step):
        X.append(data[i:(i+step),])
        Y.append(data[(i+step),])
    return np.array(X),np.array(Y)
```

1.8 Normalizing the Data Using Standard Scalar

[15]:
```
std_scalar = StandardScaler()
X_train = std_scalar.fit_transform(X_train_split)
X_valid = std_scalar.fit_transform(X_valid_split)
X_test = std_scalar.fit_transform(X_test_split)
```

1.9 Getting the Sliced Data

[16]:
```
steps = 5
X_train,y_train = SliceData(X_train,steps)
X_test,y_test = SliceData(X_test,steps)
X_valid,y_valid = SliceData(X_valid,steps)
```

1.10 Building the RNN Model

[17]:
```
RNN_Model = Sequential()
RNN_Model.add(SimpleRNN(50,input_shape=(steps,1),return_sequences=True ))
RNN_Model.add(Dropout(0.5))
RNN_Model.add(SimpleRNN(50))
RNN_Model.add(Dropout(0.5))
RNN_Model.add(Dense(50))
RNN_Model.compile(optimizer='adam',loss='mean_squared_error', metrics=['mae'])
```

```
2022-07-30 05:13:14.661463: W
tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load
dynamic library 'libcuda.so.1'; dlerror: libcuda.so.1: cannot open shared object
file: No such file or directory
2022-07-30 05:13:14.661532: W
tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit:
```

```
UNKNOWN ERROR (303)
2022-07-30 05:13:14.661565: I
tensorflow/stream_executor/cuda/cuda_diagnostics.cc:156] kernel driver does not
appear to be running on this host (xenon-Inspiron-3442):
/proc/driver/nvidia/version does not exist
2022-07-30 05:13:14.661966: I tensorflow/core/platform/cpu_feature_guard.cc:151]
This TensorFlow binary is optimized with oneAPI Deep Neural Network Library
(oneDNN) to use the following CPU instructions in performance-critical
operations:  AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate
compiler flags.
```

[18]:
```
RNN_Model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 simple_rnn (SimpleRNN)      (None, 5, 50)             2600

 dropout (Dropout)           (None, 5, 50)             0

 simple_rnn_1 (SimpleRNN)    (None, 50)                5050

 dropout_1 (Dropout)         (None, 50)                0

 dense (Dense)               (None, 50)                2550

=================================================================
Total params: 10,200
Trainable params: 10,200
Non-trainable params: 0
_________________________________________________________________
```

1.11 Building LSTM Model

[19]:
```
LSTM_Model = Sequential()
LSTM_Model.add(LSTM(50,input_shape=(steps,1),return_sequences=True ))
LSTM_Model.add(Dropout(0.5))
LSTM_Model.add(LSTM(50))
LSTM_Model.add(Dropout(0.5))
LSTM_Model.add(Dense(50))
LSTM_Model.compile(optimizer='adam',loss='mean_squared_error', metrics=['mae'])
```

[20]:
```
LSTM_Model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
```

```
 Layer (type)                 Output Shape              Param #
=================================================================
 lstm (LSTM)                  (None, 5, 50)             10400

 dropout_2 (Dropout)          (None, 5, 50)             0

 lstm_1 (LSTM)                (None, 50)                20200

 dropout_3 (Dropout)          (None, 50)                0

 dense_1 (Dense)              (None, 50)                2550

=================================================================
Total params: 33,150
Trainable params: 33,150
Non-trainable params: 0
_________________________________________________________________
```

1.12 Fitting the RNN Model

[21]:
```
RNN_History = RNN_Model.fit(X_train,y_train,epochs=100,batch_size =␣
↪50,validation_data=(X_valid,y_valid),shuffle=False,
                    verbose = 2)
```

```
Epoch 1/100
30/30 - 3s - loss: 1.0524 - mae: 0.6914 - val_loss: 0.3640 - val_mae: 0.4768 -
3s/epoch - 86ms/step
Epoch 2/100
30/30 - 0s - loss: 0.6069 - mae: 0.5161 - val_loss: 0.2064 - val_mae: 0.3568 -
179ms/epoch - 6ms/step
Epoch 3/100
30/30 - 0s - loss: 0.4353 - mae: 0.4373 - val_loss: 0.1949 - val_mae: 0.3505 -
177ms/epoch - 6ms/step
Epoch 4/100
30/30 - 0s - loss: 0.3702 - mae: 0.4073 - val_loss: 0.1735 - val_mae: 0.3328 -
169ms/epoch - 6ms/step
Epoch 5/100
30/30 - 0s - loss: 0.3258 - mae: 0.3792 - val_loss: 0.1375 - val_mae: 0.2954 -
171ms/epoch - 6ms/step
Epoch 6/100
30/30 - 0s - loss: 0.2902 - mae: 0.3597 - val_loss: 0.1453 - val_mae: 0.3037 -
171ms/epoch - 6ms/step
Epoch 7/100
30/30 - 0s - loss: 0.2701 - mae: 0.3388 - val_loss: 0.1040 - val_mae: 0.2553 -
165ms/epoch - 5ms/step
Epoch 8/100
30/30 - 0s - loss: 0.2334 - mae: 0.3168 - val_loss: 0.0894 - val_mae: 0.2379 -
170ms/epoch - 6ms/step
```

```
Epoch 9/100
30/30 - 0s - loss: 0.1983 - mae: 0.2946 - val_loss: 0.0790 - val_mae: 0.2253 -
172ms/epoch - 6ms/step
Epoch 10/100
30/30 - 0s - loss: 0.1922 - mae: 0.2869 - val_loss: 0.0850 - val_mae: 0.2349 -
166ms/epoch - 6ms/step
Epoch 11/100
30/30 - 0s - loss: 0.1691 - mae: 0.2774 - val_loss: 0.0833 - val_mae: 0.2326 -
164ms/epoch - 5ms/step
Epoch 12/100
30/30 - 0s - loss: 0.1727 - mae: 0.2735 - val_loss: 0.0739 - val_mae: 0.2189 -
169ms/epoch - 6ms/step
Epoch 13/100
30/30 - 0s - loss: 0.1638 - mae: 0.2670 - val_loss: 0.0773 - val_mae: 0.2260 -
226ms/epoch - 8ms/step
Epoch 14/100
30/30 - 0s - loss: 0.1450 - mae: 0.2551 - val_loss: 0.0657 - val_mae: 0.2083 -
221ms/epoch - 7ms/step
Epoch 15/100
30/30 - 0s - loss: 0.1349 - mae: 0.2469 - val_loss: 0.0590 - val_mae: 0.1971 -
159ms/epoch - 5ms/step
Epoch 16/100
30/30 - 0s - loss: 0.1307 - mae: 0.2401 - val_loss: 0.0489 - val_mae: 0.1807 -
177ms/epoch - 6ms/step
Epoch 17/100
30/30 - 0s - loss: 0.1212 - mae: 0.2302 - val_loss: 0.0463 - val_mae: 0.1757 -
223ms/epoch - 7ms/step
Epoch 18/100
30/30 - 0s - loss: 0.1203 - mae: 0.2302 - val_loss: 0.0524 - val_mae: 0.1857 -
206ms/epoch - 7ms/step
Epoch 19/100
30/30 - 0s - loss: 0.1244 - mae: 0.2293 - val_loss: 0.0520 - val_mae: 0.1853 -
169ms/epoch - 6ms/step
Epoch 20/100
30/30 - 0s - loss: 0.1192 - mae: 0.2285 - val_loss: 0.0527 - val_mae: 0.1861 -
166ms/epoch - 6ms/step
Epoch 21/100
30/30 - 0s - loss: 0.1121 - mae: 0.2251 - val_loss: 0.0529 - val_mae: 0.1865 -
180ms/epoch - 6ms/step
Epoch 22/100
30/30 - 0s - loss: 0.1117 - mae: 0.2250 - val_loss: 0.0563 - val_mae: 0.1918 -
231ms/epoch - 8ms/step
Epoch 23/100
30/30 - 0s - loss: 0.1105 - mae: 0.2225 - val_loss: 0.0590 - val_mae: 0.1969 -
192ms/epoch - 6ms/step
Epoch 24/100
30/30 - 0s - loss: 0.1044 - mae: 0.2188 - val_loss: 0.0500 - val_mae: 0.1809 -
219ms/epoch - 7ms/step
```

```
Epoch 25/100
30/30 - 0s - loss: 0.0985 - mae: 0.2122 - val_loss: 0.0521 - val_mae: 0.1854 -
203ms/epoch - 7ms/step
Epoch 26/100
30/30 - 0s - loss: 0.0982 - mae: 0.2113 - val_loss: 0.0568 - val_mae: 0.1931 -
263ms/epoch - 9ms/step
Epoch 27/100
30/30 - 0s - loss: 0.0970 - mae: 0.2129 - val_loss: 0.0539 - val_mae: 0.1880 -
171ms/epoch - 6ms/step
Epoch 28/100
30/30 - 0s - loss: 0.0970 - mae: 0.2062 - val_loss: 0.0470 - val_mae: 0.1751 -
163ms/epoch - 5ms/step
Epoch 29/100
30/30 - 0s - loss: 0.0928 - mae: 0.2092 - val_loss: 0.0625 - val_mae: 0.2025 -
215ms/epoch - 7ms/step
Epoch 30/100
30/30 - 0s - loss: 0.0989 - mae: 0.2117 - val_loss: 0.0677 - val_mae: 0.2116 -
181ms/epoch - 6ms/step
Epoch 31/100
30/30 - 0s - loss: 0.0975 - mae: 0.2123 - val_loss: 0.0659 - val_mae: 0.2075 -
166ms/epoch - 6ms/step
Epoch 32/100
30/30 - 0s - loss: 0.0869 - mae: 0.1989 - val_loss: 0.0517 - val_mae: 0.1842 -
162ms/epoch - 5ms/step
Epoch 33/100
30/30 - 0s - loss: 0.0873 - mae: 0.1978 - val_loss: 0.0463 - val_mae: 0.1746 -
164ms/epoch - 5ms/step
Epoch 34/100
30/30 - 0s - loss: 0.0843 - mae: 0.1942 - val_loss: 0.0536 - val_mae: 0.1874 -
169ms/epoch - 6ms/step
Epoch 35/100
30/30 - 0s - loss: 0.0892 - mae: 0.2026 - val_loss: 0.0585 - val_mae: 0.1964 -
170ms/epoch - 6ms/step
Epoch 36/100
30/30 - 0s - loss: 0.0933 - mae: 0.2061 - val_loss: 0.0704 - val_mae: 0.2170 -
168ms/epoch - 6ms/step
Epoch 37/100
30/30 - 0s - loss: 0.0881 - mae: 0.2033 - val_loss: 0.0595 - val_mae: 0.1973 -
162ms/epoch - 5ms/step
Epoch 38/100
30/30 - 0s - loss: 0.0796 - mae: 0.1891 - val_loss: 0.0458 - val_mae: 0.1744 -
163ms/epoch - 5ms/step
Epoch 39/100
30/30 - 0s - loss: 0.0816 - mae: 0.1944 - val_loss: 0.0537 - val_mae: 0.1883 -
166ms/epoch - 6ms/step
Epoch 40/100
30/30 - 0s - loss: 0.0894 - mae: 0.1988 - val_loss: 0.0534 - val_mae: 0.1885 -
174ms/epoch - 6ms/step
```

```
Epoch 41/100
30/30 - 0s - loss: 0.0817 - mae: 0.1921 - val_loss: 0.0613 - val_mae: 0.2010 -
165ms/epoch - 6ms/step
Epoch 42/100
30/30 - 0s - loss: 0.0876 - mae: 0.1981 - val_loss: 0.0762 - val_mae: 0.2250 -
168ms/epoch - 6ms/step
Epoch 43/100
30/30 - 0s - loss: 0.0916 - mae: 0.1999 - val_loss: 0.0610 - val_mae: 0.2009 -
189ms/epoch - 6ms/step
Epoch 44/100
30/30 - 0s - loss: 0.0807 - mae: 0.1948 - val_loss: 0.0639 - val_mae: 0.2050 -
217ms/epoch - 7ms/step
Epoch 45/100
30/30 - 0s - loss: 0.0845 - mae: 0.1966 - val_loss: 0.0696 - val_mae: 0.2147 -
167ms/epoch - 6ms/step
Epoch 46/100
30/30 - 0s - loss: 0.0860 - mae: 0.2001 - val_loss: 0.0662 - val_mae: 0.2098 -
187ms/epoch - 6ms/step
Epoch 47/100
30/30 - 0s - loss: 0.0847 - mae: 0.1958 - val_loss: 0.0735 - val_mae: 0.2213 -
205ms/epoch - 7ms/step
Epoch 48/100
30/30 - 0s - loss: 0.0788 - mae: 0.1897 - val_loss: 0.0608 - val_mae: 0.1995 -
195ms/epoch - 7ms/step
Epoch 49/100
30/30 - 0s - loss: 0.0768 - mae: 0.1885 - val_loss: 0.0604 - val_mae: 0.1983 -
200ms/epoch - 7ms/step
Epoch 50/100
30/30 - 0s - loss: 0.0847 - mae: 0.1968 - val_loss: 0.0563 - val_mae: 0.1936 -
219ms/epoch - 7ms/step
Epoch 51/100
30/30 - 0s - loss: 0.0772 - mae: 0.1865 - val_loss: 0.0523 - val_mae: 0.1847 -
189ms/epoch - 6ms/step
Epoch 52/100
30/30 - 0s - loss: 0.0769 - mae: 0.1803 - val_loss: 0.0457 - val_mae: 0.1739 -
163ms/epoch - 5ms/step
Epoch 53/100
30/30 - 0s - loss: 0.0727 - mae: 0.1801 - val_loss: 0.0453 - val_mae: 0.1721 -
201ms/epoch - 7ms/step
Epoch 54/100
30/30 - 0s - loss: 0.0723 - mae: 0.1802 - val_loss: 0.0584 - val_mae: 0.1978 -
192ms/epoch - 6ms/step
Epoch 55/100
30/30 - 0s - loss: 0.0834 - mae: 0.1943 - val_loss: 0.0628 - val_mae: 0.2052 -
165ms/epoch - 5ms/step
Epoch 56/100
30/30 - 0s - loss: 0.0745 - mae: 0.1828 - val_loss: 0.0556 - val_mae: 0.1924 -
199ms/epoch - 7ms/step
```

```
Epoch 57/100
30/30 - 0s - loss: 0.0717 - mae: 0.1824 - val_loss: 0.0618 - val_mae: 0.2041 -
222ms/epoch - 7ms/step
Epoch 58/100
30/30 - 0s - loss: 0.0818 - mae: 0.1918 - val_loss: 0.0628 - val_mae: 0.2041 -
179ms/epoch - 6ms/step
Epoch 59/100
30/30 - 0s - loss: 0.0812 - mae: 0.1897 - val_loss: 0.0666 - val_mae: 0.2118 -
213ms/epoch - 7ms/step
Epoch 60/100
30/30 - 0s - loss: 0.0736 - mae: 0.1830 - val_loss: 0.0577 - val_mae: 0.1948 -
177ms/epoch - 6ms/step
Epoch 61/100
30/30 - 0s - loss: 0.0776 - mae: 0.1824 - val_loss: 0.0580 - val_mae: 0.1962 -
182ms/epoch - 6ms/step
Epoch 62/100
30/30 - 0s - loss: 0.0670 - mae: 0.1729 - val_loss: 0.0559 - val_mae: 0.1912 -
186ms/epoch - 6ms/step
Epoch 63/100
30/30 - 0s - loss: 0.0729 - mae: 0.1843 - val_loss: 0.0645 - val_mae: 0.2077 -
169ms/epoch - 6ms/step
Epoch 64/100
30/30 - 0s - loss: 0.0795 - mae: 0.1944 - val_loss: 0.0623 - val_mae: 0.2041 -
246ms/epoch - 8ms/step
Epoch 65/100
30/30 - 0s - loss: 0.0736 - mae: 0.1801 - val_loss: 0.0564 - val_mae: 0.1947 -
237ms/epoch - 8ms/step
Epoch 66/100
30/30 - 0s - loss: 0.0733 - mae: 0.1832 - val_loss: 0.0497 - val_mae: 0.1829 -
177ms/epoch - 6ms/step
Epoch 67/100
30/30 - 0s - loss: 0.0697 - mae: 0.1774 - val_loss: 0.0554 - val_mae: 0.1925 -
159ms/epoch - 5ms/step
Epoch 68/100
30/30 - 0s - loss: 0.0697 - mae: 0.1768 - val_loss: 0.0457 - val_mae: 0.1745 -
157ms/epoch - 5ms/step
Epoch 69/100
30/30 - 0s - loss: 0.0692 - mae: 0.1756 - val_loss: 0.0494 - val_mae: 0.1821 -
161ms/epoch - 5ms/step
Epoch 70/100
30/30 - 0s - loss: 0.0637 - mae: 0.1680 - val_loss: 0.0420 - val_mae: 0.1670 -
159ms/epoch - 5ms/step
Epoch 71/100
30/30 - 0s - loss: 0.0635 - mae: 0.1701 - val_loss: 0.0376 - val_mae: 0.1578 -
160ms/epoch - 5ms/step
Epoch 72/100
30/30 - 0s - loss: 0.0673 - mae: 0.1686 - val_loss: 0.0378 - val_mae: 0.1581 -
165ms/epoch - 6ms/step
```

```
Epoch 73/100
30/30 - 0s - loss: 0.0658 - mae: 0.1647 - val_loss: 0.0413 - val_mae: 0.1652 -
160ms/epoch - 5ms/step
Epoch 74/100
30/30 - 0s - loss: 0.0649 - mae: 0.1702 - val_loss: 0.0437 - val_mae: 0.1698 -
156ms/epoch - 5ms/step
Epoch 75/100
30/30 - 0s - loss: 0.0614 - mae: 0.1625 - val_loss: 0.0469 - val_mae: 0.1756 -
157ms/epoch - 5ms/step
Epoch 76/100
30/30 - 0s - loss: 0.0664 - mae: 0.1696 - val_loss: 0.0455 - val_mae: 0.1739 -
175ms/epoch - 6ms/step
Epoch 77/100
30/30 - 0s - loss: 0.0612 - mae: 0.1652 - val_loss: 0.0463 - val_mae: 0.1744 -
175ms/epoch - 6ms/step
Epoch 78/100
30/30 - 0s - loss: 0.0634 - mae: 0.1696 - val_loss: 0.0499 - val_mae: 0.1822 -
168ms/epoch - 6ms/step
Epoch 79/100
30/30 - 0s - loss: 0.0652 - mae: 0.1724 - val_loss: 0.0543 - val_mae: 0.1909 -
335ms/epoch - 11ms/step
Epoch 80/100
30/30 - 0s - loss: 0.0658 - mae: 0.1750 - val_loss: 0.0566 - val_mae: 0.1932 -
177ms/epoch - 6ms/step
Epoch 81/100
30/30 - 0s - loss: 0.0704 - mae: 0.1727 - val_loss: 0.0504 - val_mae: 0.1828 -
159ms/epoch - 5ms/step
Epoch 82/100
30/30 - 0s - loss: 0.0616 - mae: 0.1647 - val_loss: 0.0505 - val_mae: 0.1827 -
218ms/epoch - 7ms/step
Epoch 83/100
30/30 - 0s - loss: 0.0678 - mae: 0.1773 - val_loss: 0.0680 - val_mae: 0.2112 -
201ms/epoch - 7ms/step
Epoch 84/100
30/30 - 0s - loss: 0.0636 - mae: 0.1733 - val_loss: 0.0571 - val_mae: 0.1935 -
159ms/epoch - 5ms/step
Epoch 85/100
30/30 - 0s - loss: 0.0632 - mae: 0.1717 - val_loss: 0.0631 - val_mae: 0.2025 -
196ms/epoch - 7ms/step
Epoch 86/100
30/30 - 0s - loss: 0.0683 - mae: 0.1812 - val_loss: 0.0639 - val_mae: 0.2047 -
197ms/epoch - 7ms/step
Epoch 87/100
30/30 - 0s - loss: 0.0728 - mae: 0.1812 - val_loss: 0.0696 - val_mae: 0.2137 -
194ms/epoch - 6ms/step
Epoch 88/100
30/30 - 0s - loss: 0.0723 - mae: 0.1778 - val_loss: 0.0696 - val_mae: 0.2128 -
165ms/epoch - 5ms/step
```

```
Epoch 89/100
30/30 - 0s - loss: 0.0692 - mae: 0.1807 - val_loss: 0.0716 - val_mae: 0.2159 -
297ms/epoch - 10ms/step
Epoch 90/100
30/30 - 0s - loss: 0.0687 - mae: 0.1772 - val_loss: 0.0637 - val_mae: 0.2047 -
384ms/epoch - 13ms/step
Epoch 91/100
30/30 - 0s - loss: 0.0732 - mae: 0.1824 - val_loss: 0.0740 - val_mae: 0.2191 -
240ms/epoch - 8ms/step
Epoch 92/100
30/30 - 0s - loss: 0.0749 - mae: 0.1866 - val_loss: 0.0760 - val_mae: 0.2263 -
334ms/epoch - 11ms/step
Epoch 93/100
30/30 - 0s - loss: 0.0716 - mae: 0.1825 - val_loss: 0.0753 - val_mae: 0.2200 -
178ms/epoch - 6ms/step
Epoch 94/100
30/30 - 0s - loss: 0.0729 - mae: 0.1823 - val_loss: 0.0599 - val_mae: 0.1998 -
314ms/epoch - 10ms/step
Epoch 95/100
30/30 - 0s - loss: 0.0687 - mae: 0.1776 - val_loss: 0.0609 - val_mae: 0.1980 -
178ms/epoch - 6ms/step
Epoch 96/100
30/30 - 0s - loss: 0.0714 - mae: 0.1796 - val_loss: 0.0663 - val_mae: 0.2099 -
164ms/epoch - 5ms/step
Epoch 97/100
30/30 - 0s - loss: 0.0651 - mae: 0.1780 - val_loss: 0.0596 - val_mae: 0.1982 -
159ms/epoch - 5ms/step
Epoch 98/100
30/30 - 0s - loss: 0.0714 - mae: 0.1767 - val_loss: 0.0506 - val_mae: 0.1834 -
167ms/epoch - 6ms/step
Epoch 99/100
30/30 - 0s - loss: 0.0712 - mae: 0.1781 - val_loss: 0.0473 - val_mae: 0.1783 -
170ms/epoch - 6ms/step
Epoch 100/100
30/30 - 0s - loss: 0.0624 - mae: 0.1684 - val_loss: 0.0385 - val_mae: 0.1605 -
161ms/epoch - 5ms/step
```

[22]:
```
LSTM_History = LSTM_Model.fit(X_train,y_train,epochs=100,batch_size =␣
↪50,validation_data=(X_valid,y_valid),shuffle=False,
                    verbose = 2)
```

```
Epoch 1/100
30/30 - 6s - loss: 0.9566 - mae: 0.7277 - val_loss: 0.7364 - val_mae: 0.7396 -
6s/epoch - 190ms/step
Epoch 2/100
30/30 - 0s - loss: 0.6934 - mae: 0.5664 - val_loss: 0.2728 - val_mae: 0.4135 -
283ms/epoch - 9ms/step
Epoch 3/100
```

```
30/30 - 0s - loss: 0.3847 - mae: 0.4055 - val_loss: 0.1676 - val_mae: 0.3280 -
358ms/epoch - 12ms/step
Epoch 4/100
30/30 - 0s - loss: 0.2639 - mae: 0.3316 - val_loss: 0.1400 - val_mae: 0.2979 -
388ms/epoch - 13ms/step
Epoch 5/100
30/30 - 0s - loss: 0.2232 - mae: 0.3083 - val_loss: 0.1230 - val_mae: 0.2776 -
316ms/epoch - 11ms/step
Epoch 6/100
30/30 - 0s - loss: 0.1844 - mae: 0.2795 - val_loss: 0.1167 - val_mae: 0.2708 -
286ms/epoch - 10ms/step
Epoch 7/100
30/30 - 0s - loss: 0.1689 - mae: 0.2736 - val_loss: 0.1097 - val_mae: 0.2606 -
295ms/epoch - 10ms/step
Epoch 8/100
30/30 - 0s - loss: 0.1600 - mae: 0.2655 - val_loss: 0.0981 - val_mae: 0.2445 -
343ms/epoch - 11ms/step
Epoch 9/100
30/30 - 0s - loss: 0.1365 - mae: 0.2443 - val_loss: 0.0934 - val_mae: 0.2381 -
366ms/epoch - 12ms/step
Epoch 10/100
30/30 - 0s - loss: 0.1257 - mae: 0.2340 - val_loss: 0.0867 - val_mae: 0.2268 -
378ms/epoch - 13ms/step
Epoch 11/100
30/30 - 0s - loss: 0.1140 - mae: 0.2227 - val_loss: 0.0817 - val_mae: 0.2180 -
317ms/epoch - 11ms/step
Epoch 12/100
30/30 - 0s - loss: 0.1069 - mae: 0.2169 - val_loss: 0.0781 - val_mae: 0.2120 -
375ms/epoch - 13ms/step
Epoch 13/100
30/30 - 0s - loss: 0.0977 - mae: 0.2060 - val_loss: 0.0739 - val_mae: 0.2001 -
370ms/epoch - 12ms/step
Epoch 14/100
30/30 - 0s - loss: 0.0933 - mae: 0.2001 - val_loss: 0.0730 - val_mae: 0.2022 -
323ms/epoch - 11ms/step
Epoch 15/100
30/30 - 0s - loss: 0.0913 - mae: 0.1979 - val_loss: 0.0738 - val_mae: 0.2064 -
358ms/epoch - 12ms/step
Epoch 16/100
30/30 - 0s - loss: 0.0849 - mae: 0.1942 - val_loss: 0.0679 - val_mae: 0.1856 -
324ms/epoch - 11ms/step
Epoch 17/100
30/30 - 0s - loss: 0.0898 - mae: 0.1962 - val_loss: 0.0667 - val_mae: 0.1849 -
316ms/epoch - 11ms/step
Epoch 18/100
30/30 - 0s - loss: 0.0855 - mae: 0.1957 - val_loss: 0.0776 - val_mae: 0.2174 -
288ms/epoch - 10ms/step
Epoch 19/100
```

```
30/30 - 0s - loss: 0.0916 - mae: 0.1992 - val_loss: 0.0688 - val_mae: 0.1862 -
293ms/epoch - 10ms/step
Epoch 20/100
30/30 - 0s - loss: 0.0838 - mae: 0.1913 - val_loss: 0.0667 - val_mae: 0.1930 -
291ms/epoch - 10ms/step
Epoch 21/100
30/30 - 0s - loss: 0.0768 - mae: 0.1853 - val_loss: 0.0643 - val_mae: 0.1803 -
286ms/epoch - 10ms/step
Epoch 22/100
30/30 - 0s - loss: 0.0791 - mae: 0.1846 - val_loss: 0.0690 - val_mae: 0.2009 -
290ms/epoch - 10ms/step
Epoch 23/100
30/30 - 0s - loss: 0.0862 - mae: 0.1916 - val_loss: 0.0730 - val_mae: 0.2089 -
420ms/epoch - 14ms/step
Epoch 24/100
30/30 - 0s - loss: 0.0893 - mae: 0.2005 - val_loss: 0.0928 - val_mae: 0.2465 -
300ms/epoch - 10ms/step
Epoch 25/100
30/30 - 0s - loss: 0.0929 - mae: 0.2035 - val_loss: 0.0631 - val_mae: 0.1766 -
303ms/epoch - 10ms/step
Epoch 26/100
30/30 - 0s - loss: 0.0782 - mae: 0.1821 - val_loss: 0.0629 - val_mae: 0.1778 -
428ms/epoch - 14ms/step
Epoch 27/100
30/30 - 0s - loss: 0.0745 - mae: 0.1800 - val_loss: 0.0650 - val_mae: 0.1950 -
439ms/epoch - 15ms/step
Epoch 28/100
30/30 - 0s - loss: 0.0754 - mae: 0.1826 - val_loss: 0.0653 - val_mae: 0.1949 -
354ms/epoch - 12ms/step
Epoch 29/100
30/30 - 0s - loss: 0.0782 - mae: 0.1845 - val_loss: 0.0592 - val_mae: 0.1687 -
368ms/epoch - 12ms/step
Epoch 30/100
30/30 - 0s - loss: 0.0737 - mae: 0.1773 - val_loss: 0.0714 - val_mae: 0.2101 -
301ms/epoch - 10ms/step
Epoch 31/100
30/30 - 0s - loss: 0.0827 - mae: 0.1859 - val_loss: 0.0630 - val_mae: 0.1840 -
324ms/epoch - 11ms/step
Epoch 32/100
30/30 - 0s - loss: 0.0803 - mae: 0.1897 - val_loss: 0.0900 - val_mae: 0.2393 -
498ms/epoch - 17ms/step
Epoch 33/100
30/30 - 1s - loss: 0.0858 - mae: 0.1965 - val_loss: 0.0585 - val_mae: 0.1677 -
572ms/epoch - 19ms/step
Epoch 34/100
30/30 - 0s - loss: 0.0744 - mae: 0.1809 - val_loss: 0.0813 - val_mae: 0.2269 -
401ms/epoch - 13ms/step
Epoch 35/100
```

```
30/30 - 0s - loss: 0.0853 - mae: 0.1942 - val_loss: 0.0677 - val_mae: 0.1984 -
356ms/epoch - 12ms/step
Epoch 36/100
30/30 - 0s - loss: 0.0784 - mae: 0.1869 - val_loss: 0.0847 - val_mae: 0.2310 -
343ms/epoch - 11ms/step
Epoch 37/100
30/30 - 0s - loss: 0.0867 - mae: 0.1978 - val_loss: 0.0602 - val_mae: 0.1768 -
426ms/epoch - 14ms/step
Epoch 38/100
30/30 - 0s - loss: 0.0725 - mae: 0.1786 - val_loss: 0.0785 - val_mae: 0.2232 -
345ms/epoch - 11ms/step
Epoch 39/100
30/30 - 0s - loss: 0.0849 - mae: 0.1987 - val_loss: 0.0559 - val_mae: 0.1659 -
311ms/epoch - 10ms/step
Epoch 40/100
30/30 - 0s - loss: 0.0696 - mae: 0.1775 - val_loss: 0.0720 - val_mae: 0.2147 -
430ms/epoch - 14ms/step
Epoch 41/100
30/30 - 0s - loss: 0.0711 - mae: 0.1778 - val_loss: 0.0563 - val_mae: 0.1717 -
296ms/epoch - 10ms/step
Epoch 42/100
30/30 - 0s - loss: 0.0679 - mae: 0.1715 - val_loss: 0.0653 - val_mae: 0.2027 -
398ms/epoch - 13ms/step
Epoch 43/100
30/30 - 0s - loss: 0.0722 - mae: 0.1788 - val_loss: 0.0655 - val_mae: 0.1968 -
392ms/epoch - 13ms/step
Epoch 44/100
30/30 - 0s - loss: 0.0705 - mae: 0.1807 - val_loss: 0.0989 - val_mae: 0.2490 -
296ms/epoch - 10ms/step
Epoch 45/100
30/30 - 0s - loss: 0.0916 - mae: 0.2116 - val_loss: 0.0615 - val_mae: 0.1841 -
305ms/epoch - 10ms/step
Epoch 46/100
30/30 - 0s - loss: 0.0672 - mae: 0.1711 - val_loss: 0.0571 - val_mae: 0.1886 -
346ms/epoch - 12ms/step
Epoch 47/100
30/30 - 0s - loss: 0.0734 - mae: 0.1786 - val_loss: 0.0532 - val_mae: 0.1707 -
444ms/epoch - 15ms/step
Epoch 48/100
30/30 - 0s - loss: 0.0701 - mae: 0.1736 - val_loss: 0.0629 - val_mae: 0.1982 -
368ms/epoch - 12ms/step
Epoch 49/100
30/30 - 0s - loss: 0.0729 - mae: 0.1743 - val_loss: 0.0500 - val_mae: 0.1583 -
443ms/epoch - 15ms/step
Epoch 50/100
30/30 - 0s - loss: 0.0611 - mae: 0.1640 - val_loss: 0.0513 - val_mae: 0.1761 -
327ms/epoch - 11ms/step
Epoch 51/100
```

```
30/30 - 0s - loss: 0.0683 - mae: 0.1705 - val_loss: 0.0494 - val_mae: 0.1590 -
336ms/epoch - 11ms/step
Epoch 52/100
30/30 - 1s - loss: 0.0620 - mae: 0.1649 - val_loss: 0.0808 - val_mae: 0.2255 -
506ms/epoch - 17ms/step
Epoch 53/100
30/30 - 0s - loss: 0.0778 - mae: 0.1882 - val_loss: 0.0590 - val_mae: 0.1833 -
362ms/epoch - 12ms/step
Epoch 54/100
30/30 - 0s - loss: 0.0648 - mae: 0.1650 - val_loss: 0.0687 - val_mae: 0.2087 -
430ms/epoch - 14ms/step
Epoch 55/100
30/30 - 0s - loss: 0.0763 - mae: 0.1869 - val_loss: 0.0575 - val_mae: 0.1816 -
440ms/epoch - 15ms/step
Epoch 56/100
30/30 - 0s - loss: 0.0654 - mae: 0.1689 - val_loss: 0.0679 - val_mae: 0.2076 -
458ms/epoch - 15ms/step
Epoch 57/100
30/30 - 0s - loss: 0.0717 - mae: 0.1820 - val_loss: 0.0499 - val_mae: 0.1620 -
411ms/epoch - 14ms/step
Epoch 58/100
30/30 - 0s - loss: 0.0607 - mae: 0.1587 - val_loss: 0.0621 - val_mae: 0.1984 -
313ms/epoch - 10ms/step
Epoch 59/100
30/30 - 0s - loss: 0.0704 - mae: 0.1759 - val_loss: 0.0488 - val_mae: 0.1616 -
305ms/epoch - 10ms/step
Epoch 60/100
30/30 - 0s - loss: 0.0579 - mae: 0.1545 - val_loss: 0.0512 - val_mae: 0.1809 -
313ms/epoch - 10ms/step
Epoch 61/100
30/30 - 0s - loss: 0.0609 - mae: 0.1624 - val_loss: 0.0506 - val_mae: 0.1711 -
320ms/epoch - 11ms/step
Epoch 62/100
30/30 - 0s - loss: 0.0579 - mae: 0.1557 - val_loss: 0.0505 - val_mae: 0.1788 -
310ms/epoch - 10ms/step
Epoch 63/100
30/30 - 0s - loss: 0.0641 - mae: 0.1657 - val_loss: 0.0428 - val_mae: 0.1443 -
307ms/epoch - 10ms/step
Epoch 64/100
30/30 - 0s - loss: 0.0612 - mae: 0.1581 - val_loss: 0.0463 - val_mae: 0.1687 -
343ms/epoch - 11ms/step
Epoch 65/100
30/30 - 0s - loss: 0.0624 - mae: 0.1633 - val_loss: 0.0410 - val_mae: 0.1456 -
321ms/epoch - 11ms/step
Epoch 66/100
30/30 - 0s - loss: 0.0552 - mae: 0.1535 - val_loss: 0.0451 - val_mae: 0.1644 -
310ms/epoch - 10ms/step
Epoch 67/100
```

```
30/30 - 0s - loss: 0.0562 - mae: 0.1548 - val_loss: 0.0382 - val_mae: 0.1381 -
305ms/epoch - 10ms/step
Epoch 68/100
30/30 - 0s - loss: 0.0562 - mae: 0.1529 - val_loss: 0.0410 - val_mae: 0.1509 -
298ms/epoch - 10ms/step
Epoch 69/100
30/30 - 0s - loss: 0.0614 - mae: 0.1660 - val_loss: 0.0636 - val_mae: 0.2006 -
303ms/epoch - 10ms/step
Epoch 70/100
30/30 - 0s - loss: 0.0740 - mae: 0.1836 - val_loss: 0.0422 - val_mae: 0.1444 -
310ms/epoch - 10ms/step
Epoch 71/100
30/30 - 0s - loss: 0.0522 - mae: 0.1495 - val_loss: 0.0448 - val_mae: 0.1700 -
308ms/epoch - 10ms/step
Epoch 72/100
30/30 - 0s - loss: 0.0582 - mae: 0.1548 - val_loss: 0.0437 - val_mae: 0.1581 -
307ms/epoch - 10ms/step
Epoch 73/100
30/30 - 0s - loss: 0.0552 - mae: 0.1534 - val_loss: 0.0450 - val_mae: 0.1699 -
309ms/epoch - 10ms/step
Epoch 74/100
30/30 - 0s - loss: 0.0581 - mae: 0.1592 - val_loss: 0.0389 - val_mae: 0.1420 -
300ms/epoch - 10ms/step
Epoch 75/100
30/30 - 0s - loss: 0.0639 - mae: 0.1682 - val_loss: 0.0675 - val_mae: 0.2102 -
301ms/epoch - 10ms/step
Epoch 76/100
30/30 - 0s - loss: 0.0706 - mae: 0.1816 - val_loss: 0.0454 - val_mae: 0.1586 -
308ms/epoch - 10ms/step
Epoch 77/100
30/30 - 0s - loss: 0.0573 - mae: 0.1554 - val_loss: 0.0424 - val_mae: 0.1639 -
298ms/epoch - 10ms/step
Epoch 78/100
30/30 - 0s - loss: 0.0660 - mae: 0.1671 - val_loss: 0.0702 - val_mae: 0.2094 -
301ms/epoch - 10ms/step
Epoch 79/100
30/30 - 0s - loss: 0.0727 - mae: 0.1822 - val_loss: 0.0895 - val_mae: 0.2323 -
294ms/epoch - 10ms/step
Epoch 80/100
30/30 - 0s - loss: 0.0924 - mae: 0.2171 - val_loss: 0.0537 - val_mae: 0.1768 -
300ms/epoch - 10ms/step
Epoch 81/100
30/30 - 0s - loss: 0.0634 - mae: 0.1627 - val_loss: 0.0569 - val_mae: 0.1897 -
294ms/epoch - 10ms/step
Epoch 82/100
30/30 - 0s - loss: 0.0699 - mae: 0.1745 - val_loss: 0.0364 - val_mae: 0.1332 -
313ms/epoch - 10ms/step
Epoch 83/100
```

```
30/30 - 0s - loss: 0.0574 - mae: 0.1555 - val_loss: 0.0338 - val_mae: 0.1285 -
313ms/epoch - 10ms/step
Epoch 84/100
30/30 - 0s - loss: 0.0559 - mae: 0.1582 - val_loss: 0.0447 - val_mae: 0.1693 -
299ms/epoch - 10ms/step
Epoch 85/100
30/30 - 0s - loss: 0.0603 - mae: 0.1632 - val_loss: 0.0352 - val_mae: 0.1344 -
306ms/epoch - 10ms/step
Epoch 86/100
30/30 - 0s - loss: 0.0511 - mae: 0.1456 - val_loss: 0.0328 - val_mae: 0.1312 -
302ms/epoch - 10ms/step
Epoch 87/100
30/30 - 0s - loss: 0.0479 - mae: 0.1438 - val_loss: 0.0329 - val_mae: 0.1354 -
299ms/epoch - 10ms/step
Epoch 88/100
30/30 - 0s - loss: 0.0484 - mae: 0.1425 - val_loss: 0.0324 - val_mae: 0.1296 -
326ms/epoch - 11ms/step
Epoch 89/100
30/30 - 0s - loss: 0.0523 - mae: 0.1465 - val_loss: 0.0351 - val_mae: 0.1457 -
303ms/epoch - 10ms/step
Epoch 90/100
30/30 - 0s - loss: 0.0548 - mae: 0.1491 - val_loss: 0.0341 - val_mae: 0.1331 -
293ms/epoch - 10ms/step
Epoch 91/100
30/30 - 0s - loss: 0.0482 - mae: 0.1436 - val_loss: 0.0389 - val_mae: 0.1567 -
294ms/epoch - 10ms/step
Epoch 92/100
30/30 - 0s - loss: 0.0584 - mae: 0.1596 - val_loss: 0.0334 - val_mae: 0.1321 -
310ms/epoch - 10ms/step
Epoch 93/100
30/30 - 0s - loss: 0.0483 - mae: 0.1443 - val_loss: 0.0330 - val_mae: 0.1377 -
311ms/epoch - 10ms/step
Epoch 94/100
30/30 - 0s - loss: 0.0516 - mae: 0.1494 - val_loss: 0.0317 - val_mae: 0.1271 -
302ms/epoch - 10ms/step
Epoch 95/100
30/30 - 0s - loss: 0.0475 - mae: 0.1417 - val_loss: 0.0305 - val_mae: 0.1270 -
293ms/epoch - 10ms/step
Epoch 96/100
30/30 - 0s - loss: 0.0531 - mae: 0.1462 - val_loss: 0.0313 - val_mae: 0.1314 -
314ms/epoch - 10ms/step
Epoch 97/100
30/30 - 0s - loss: 0.0496 - mae: 0.1430 - val_loss: 0.0307 - val_mae: 0.1274 -
292ms/epoch - 10ms/step
Epoch 98/100
30/30 - 0s - loss: 0.0472 - mae: 0.1392 - val_loss: 0.0305 - val_mae: 0.1292 -
296ms/epoch - 10ms/step
Epoch 99/100
```

```
30/30 - 0s - loss: 0.0488 - mae: 0.1438 - val_loss: 0.0324 - val_mae: 0.1365 -
326ms/epoch - 11ms/step
Epoch 100/100
30/30 - 0s - loss: 0.0486 - mae: 0.1429 - val_loss: 0.0305 - val_mae: 0.1260 -
285ms/epoch - 9ms/step
```

1.13 Make Predictions

[23]:
```
RNN_Predictions = RNN_Model.predict(X_test)
LSTM_predictions = LSTM_Model.predict(X_test)
```

1.14 Inverse Transform the Values

[24]:
```
RNN_act_prd = std_scalar.inverse_transform(RNN_Predictions)
LSTM_act_prd = std_scalar.inverse_transform(LSTM_predictions)
```

1.15 Evalation Metrics (RMSE and MAE)

[25]:
```
print("### RNN Model ###")
Y_test_res_RNN = std_scalar.inverse_transform(y_test)
pre_RNN = RNN_act_prd[:,:1]

rmse=np.sqrt(np.mean(((pre_RNN- Y_test_res_RNN)**2)))
print(f"RMSE {rmse}"  )

print(f"MAE {mean_absolute_error(Y_test_res_RNN, pre_RNN)}")
```

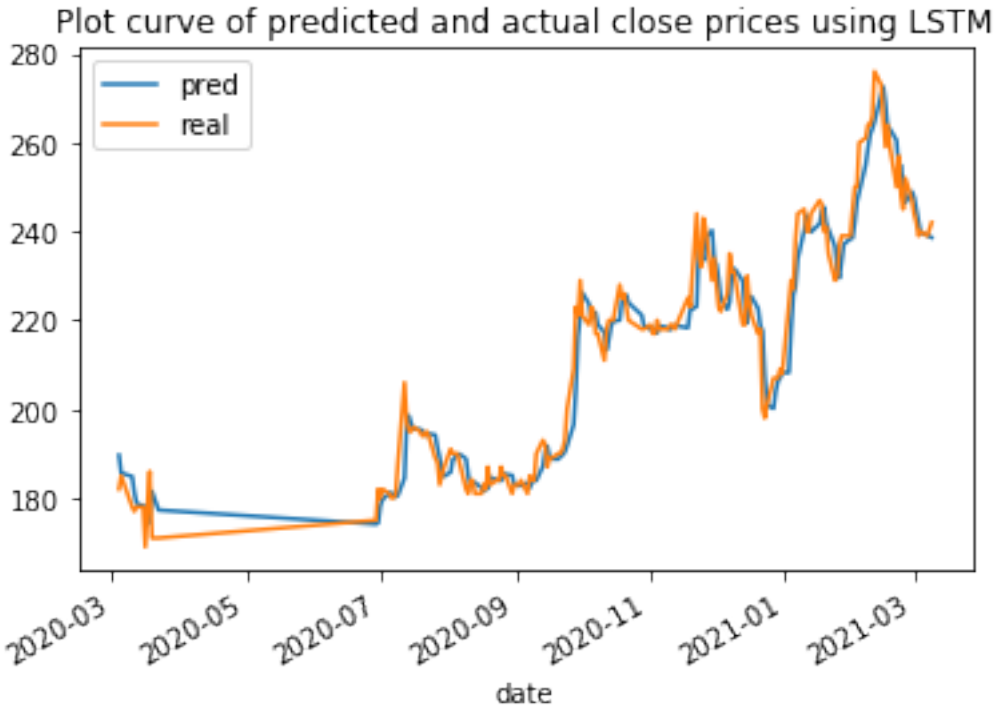
```
### RNN Model ###
RMSE 6.4697278074282405
MAE 5.187774324677681
```

[26]:
```
print("### LSTM Model ###")
Y_test_res_LSTM = std_scalar.inverse_transform(y_test)
pre_LSTM = LSTM_act_prd[:,:1]

rmse=np.sqrt(np.mean(((pre_LSTM- Y_test_res_LSTM)**2)))
print(f"RMSE {rmse}"  )

print(f"MAE {mean_absolute_error(Y_test_res_LSTM, pre_LSTM)}")
```

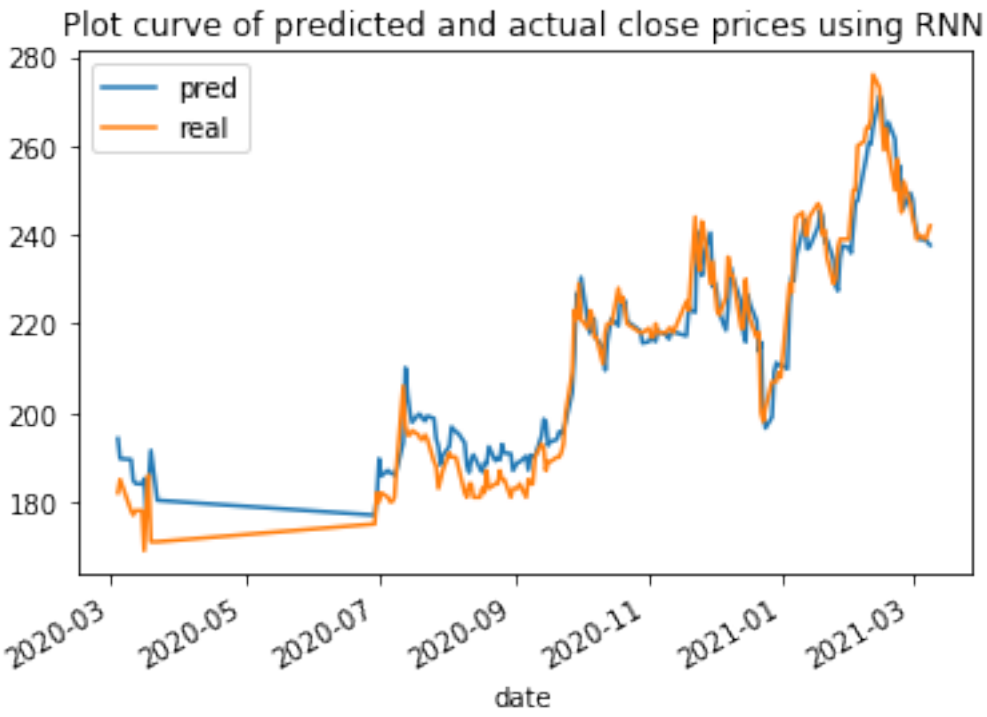
```
### LSTM Model ###
RMSE 5.652457303598954
MAE 3.958984041474556
```

[27]:
```
plot =pd.DataFrame()
plot["pred"]=list(map(float, pre_LSTM))
plot["real"]=list(map(float, Y_test_res_LSTM))
```

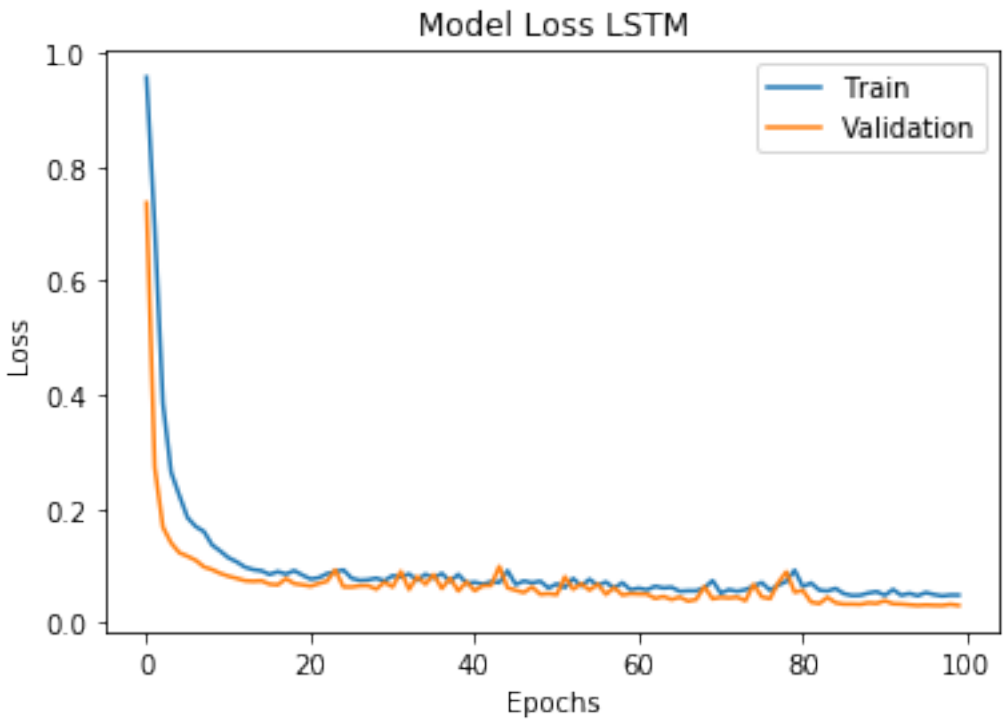
```
plot["date"]=X_test_split.index[:-steps]
plot.plot(kind="line", x="date", title="Plot curve of predicted and actual␣
 ↪close prices using LSTM")
plt.show()
```



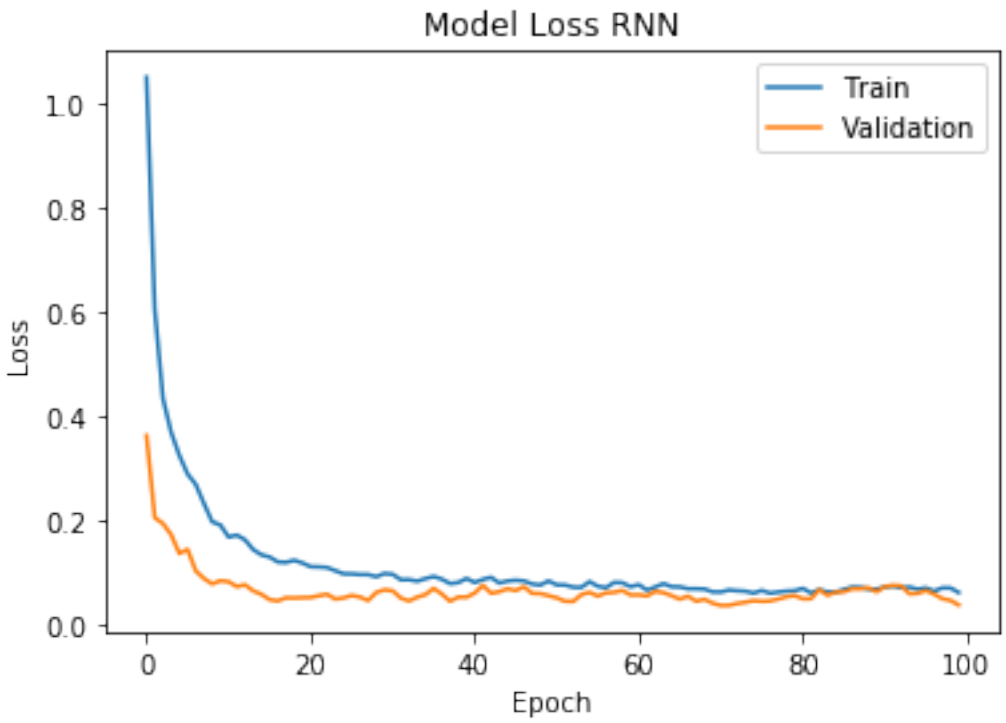
[28]:
```
plot =pd.DataFrame()
plot["pred"]=list(map(float, pre_RNN))
plot["real"]=list(map(float, Y_test_res_RNN))
plot["date"]=X_test_split.index[:-steps]
plot.plot(kind="line", x="date", title="Plot curve of predicted and actual␣
 ↪close prices using RNN")
plt.show()
```



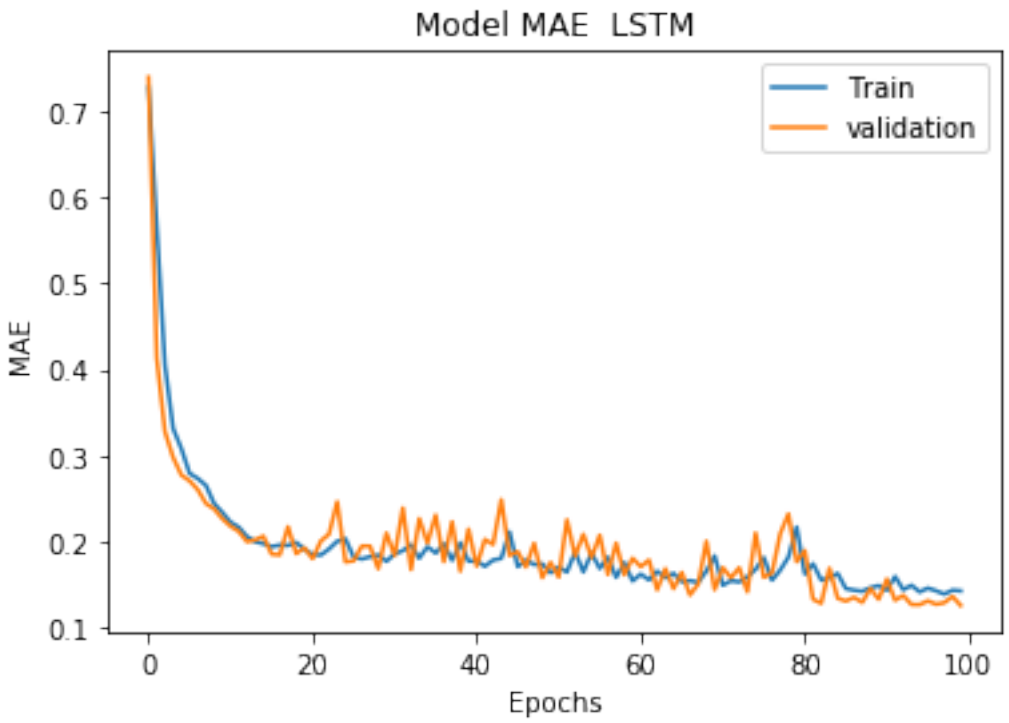
[29]:
```
plt.plot(LSTM_History.history['loss'])
plt.plot(LSTM_History.history['val_loss'])
plt.title('Model Loss LSTM')
plt.ylabel('Loss')
plt.xlabel('Epochs')
plt.legend(['Train', 'Validation'], loc='upper right')
plt.show()
```



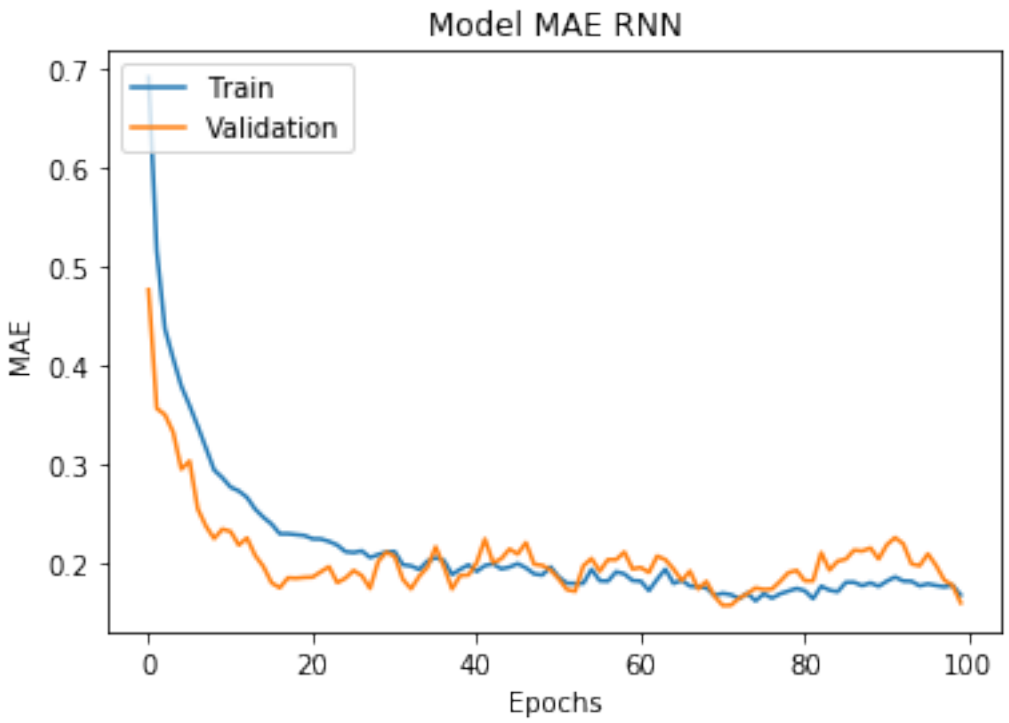
[30]:
```
plt.plot(RNN_History.history['loss'])
plt.plot(RNN_History.history['val_loss'])
plt.title('Model Loss RNN')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Validation'], loc='upper right')
plt.show()
```



[31]:
```
plt.plot(LSTM_History.history['mae'])
plt.plot(LSTM_History.history['val_mae'])
plt.title('Model MAE  LSTM')
plt.ylabel('MAE')
plt.xlabel('Epochs')
plt.legend(['Train', 'validation'], loc='upper right')
plt.show()
```



[32]:
```
plt.plot(RNN_History.history['mae'])
plt.plot(RNN_History.history['val_mae'])
plt.title('Model MAE RNN')
plt.ylabel('MAE')
plt.xlabel('Epochs')
plt.legend(['Train', 'Validation'], loc='upper left')
plt.show()
```



1.16 Conclusion

1. For LBBL Bank LSTM and RNN Models used for Stock Price Prediction
2. The Error is Low for LSTM Model

[ ]: