In [4]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt #visualizing data
import seaborn as sns
```

In [5]:
```
df= pd.read_csv("Apple.csv") # read data set
```

In [6]:
```
df.shape # count row and column
```

Out[6]:
```
(10468, 7)
```

In [7]:
```
df.head() # top 5 row amd column
```

Out[7]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	12-12-1980	0.128348	0.128906	0.128348	0.128348	0.100178	469033600
1	15-12-1980	0.122210	0.122210	0.121652	0.121652	0.094952	175884800
2	16-12-1980	0.113281	0.113281	0.112723	0.112723	0.087983	105728000
3	17-12-1980	0.115513	0.116071	0.115513	0.115513	0.090160	86441600
4	18-12-1980	0.118862	0.119420	0.118862	0.118862	0.092774	73449600

In [8]:
```
df.info() # check null value
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10468 entries, 0 to 10467
Data columns (total 7 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   Date       10468 non-null  object 
 1   Open       10468 non-null  float64
 2   High       10468 non-null  float64
 3   Low        10468 non-null  float64
 4   Close      10468 non-null  float64
 5   Adj Close  10468 non-null  float64
 6   Volume     10468 non-null  int64  
dtypes: float64(5), int64(1), object(1)
memory usage: 572.6+ KB
```

In [12]:
```
pd.isnull(df).sum() # sum of null value
```

Out[12]:
```
Date         0
Open         0
High         0
Low          0
Close        0
Adj Close    0
Volume       0
dtype: int64
```

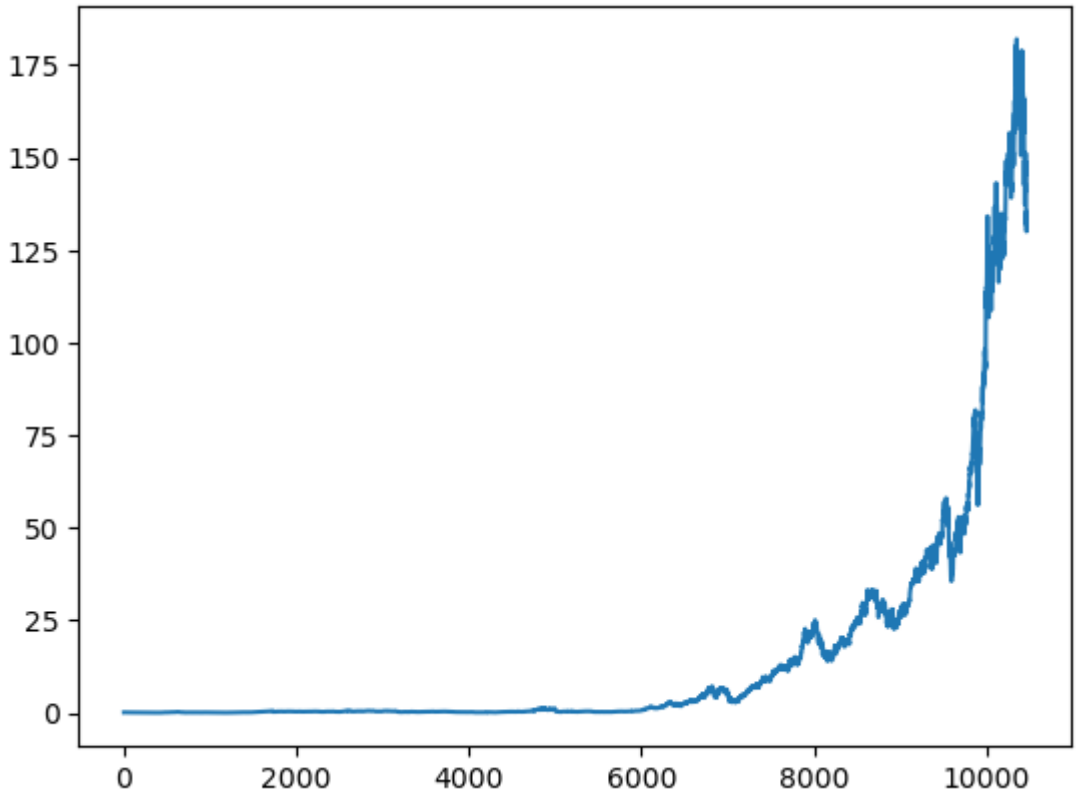
In [13]:
```
df1 = df.reset_index()['Close']
```

In [14]:
```
df1
```

Out[14]:
```
0          0.128348
1          0.121652
2          0.112723
3          0.115513
4          0.118862
             ...
10463    131.880005
10464    132.759995
10465    135.429993
10466    130.059998
10467    131.559998
Name: Close, Length: 10468, dtype: float64
```

In [15]:
```
plt.plot(df1)
```

Out[15]:
```
[<matplotlib.lines.Line2D at 0x2de447b5750>]
```



In [16]:
```
df1
```

Out[16]:
```
0          0.128348
1          0.121652
2          0.112723
3          0.115513
4          0.118862
             ...
10463    131.880005
10464    132.759995
10465    135.429993
10466    130.059998
10467    131.559998
Name: Close, Length: 10468, dtype: float64
```

In [17]:
```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler(feature_range=(0,1))
df1=scaler.fit_transform(np.array(df1).reshape(-1,1))
```

In [18]:
```
print(df1)
```

```
[[4.35483696e-04]
 [3.98684579e-04]
 [3.49613594e-04]
 ...
 [7.44010911e-01]
 [7.14499102e-01]
 [7.22742631e-01]]
```

In [19]:
```
training_size=int(len(df1)*0.65)
test_size=len(df1)-training_size
train_data,test_data=df1[0:training_size,:],df1[training_size:len(df1),:1]
```

In [20]:
```
training_size,test_size
```

Out[20]:
```
(6804, 3664)
```

In [25]:
```
train_data
```

Out[25]:
```
array([[0.00043548],
       [0.00039868],
       [0.00034961],
       ...,
       [0.03359533],
       [0.03404087],
       [0.03510272]])
```

In [26]:
```
import numpy
# convert an array of values into a dataset matrix
def create_dataset(dataset, time_step=1):
 dataX, dataY = [], []
 for i in range(len(dataset)-time_step-1):
        a = dataset[i:(i+time_step), 0]
 dataX.append(a)
 dataY.append(dataset[i + time_step, 0])
 return numpy.array(dataX), numpy.array(dataY)
```

In [27]:
```
# reshape into X=t,t+1,t+2,t+3 and Y=t+4
time_step = 100
X_train, y_train = create_dataset(train_data, time_step)
X_test, ytest = create_dataset(test_data, time_step)
```

In [28]:
```
print(X_train.shape), print(y_train.shape)
```

```
(1, 100)
(1,)
```

Out[28]:
```
(None, None)
```

In [29]:
```
print(X_test.shape), print(ytest.shape)
```

```
(1, 100)
(1,)
```

Out[29]:
```
(None, None)
```

In [31]:
```
# reshape input to be [samples, time steps, features] which is required for LSTM
X_train =X_train.reshape(X_train.shape[0],X_train.shape[1] , 1)
X_test = X_test.reshape(X_test.shape[0],X_test.shape[1] , 1)
```

In [46]:
```
pip install tensorflow
```

```
Requirement already satisfied: tensorflow in c:\users\lenovo\anaconda3\lib\site-pack
ages (2.13.0)
Requirement already satisfied: tensorflow-intel==2.13.0 in c:\users\lenovo\anaconda3
\lib\site-packages (from tensorflow) (2.13.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\lenovo\anaconda3\lib\site-
packages (from tensorflow-intel==2.13.0->tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\lenovo\anaconda3\lib\si
te-packages (from tensorflow-intel==2.13.0->tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.1.21 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorflow-intel==2.13.0->tensorflow) (23.5.26)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorflow-intel==2.13.0->tensorflow) (0.4.0)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorflow-intel==2.13.0->tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in c:\users\lenovo\anaconda3\lib\site-pac
kages (from tensorflow-intel==2.13.0->tensorflow) (3.7.0)
Requirement already satisfied: libclang>=13.0.0 in c:\users\lenovo\anaconda3\lib\sit
e-packages (from tensorflow-intel==2.13.0->tensorflow) (16.0.6)
Requirement already satisfied: numpy<=1.24.3,>=1.22 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorflow-intel==2.13.0->tensorflow) (1.24.3)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\lenovo\anaconda3\lib\si
te-packages (from tensorflow-intel==2.13.0->tensorflow) (3.3.0)
Requirement already satisfied: packaging in c:\users\lenovo\anaconda3\lib\site-packa
ges (from tensorflow-intel==2.13.0->tensorflow) (23.0)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.
4,!=4.21.5,<5.0.0dev,>=3.20.3 in c:\users\lenovo\anaconda3\lib\site-packages (from t
ensorflow-intel==2.13.0->tensorflow) (4.24.3)
Requirement already satisfied: setuptools in c:\users\lenovo\anaconda3\lib\site-pack
ages (from tensorflow-intel==2.13.0->tensorflow) (67.8.0)
Requirement already satisfied: six>=1.12.0 in c:\users\lenovo\anaconda3\lib\site-pac
kages (from tensorflow-intel==2.13.0->tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\lenovo\anaconda3\lib\sit
e-packages (from tensorflow-intel==2.13.0->tensorflow) (2.3.0)
Requirement already satisfied: typing-extensions<4.6.0,>=3.6.6 in c:\users\lenovo\an
aconda3\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (4.5.0)
Requirement already satisfied: wrapt>=1.11.0 in c:\users\lenovo\anaconda3\lib\site-p
ackages (from tensorflow-intel==2.13.0->tensorflow) (1.14.1)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorflow-intel==2.13.0->tensorflow) (1.58.0)
Requirement already satisfied: tensorboard<2.14,>=2.13 in c:\users\lenovo\anaconda3
\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (2.13.0)
Requirement already satisfied: tensorflow-estimator<2.14,>=2.13.0 in c:\users\lenovo
\anaconda3\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (2.13.0)
Requirement already satisfied: keras<2.14,>=2.13.1 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorflow-intel==2.13.0->tensorflow) (2.13.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\users\leno
vo\anaconda3\lib\site-packages (from tensorflow-intel==2.13.0->tensorflow) (0.31.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\users\lenovo\anaconda3\lib\s
ite-packages (from astunparse>=1.6.0->tensorflow-intel==2.13.0->tensorflow) (0.38.4)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\lenovo\anaconda3\li
b\site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow)
(2.23.0)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in c:\users\lenovo\ana
conda3\lib\site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->te
nsorflow) (1.0.0)
Requirement already satisfied: markdown>=2.6.8 in c:\users\lenovo\anaconda3\lib\site
-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (3.4.
1)
Requirement already satisfied: requests<3,>=2.21.0 in c:\users\lenovo\anaconda3\lib
\site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow)
(2.29.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in c:\users\len
ovo\anaconda3\lib\site-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.1
3.0->tensorflow) (0.7.1)
Requirement already satisfied: werkzeug>=1.0.1 in c:\users\lenovo\anaconda3\lib\site
```

```
-packages (from tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (2.2.
3)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\lenovo\anaconda3\l
ib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-in
tel==2.13.0->tensorflow) (5.3.1)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\users\lenovo\anaconda3\li
b\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-int
el==2.13.0->tensorflow) (0.2.8)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\lenovo\anaconda3\lib\site-p
ackages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.1
3.0->tensorflow) (4.9)
Requirement already satisfied: urllib3<2.0 in c:\users\lenovo\anaconda3\lib\site-pac
kages (from google-auth<3,>=1.6.3->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0
->tensorflow) (1.26.16)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\lenovo\anaconda3
\lib\site-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<2.14,>=2.13->te
nsorflow-intel==2.13.0->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\users\lenovo\anaconda3
\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-in
tel==2.13.0->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\lenovo\anaconda3\lib\site-pa
ckages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0-
>tensorflow) (3.4)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\lenovo\anaconda3\lib\s
ite-packages (from requests<3,>=2.21.0->tensorboard<2.14,>=2.13->tensorflow-intel==
2.13.0->tensorflow) (2023.5.7)
Requirement already satisfied: MarkupSafe>=2.1.1 in c:\users\lenovo\anaconda3\lib\si
te-packages (from werkzeug>=1.0.1->tensorboard<2.14,>=2.13->tensorflow-intel==2.13.0
->tensorflow) (2.1.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\users\lenovo\anaconda3\lib
\site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.14,
>=2.13->tensorflow-intel==2.13.0->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\lenovo\anaconda3\lib\site
-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=0.5->tensorboar
d<2.14,>=2.13->tensorflow-intel==2.13.0->tensorflow) (3.2.2)
Note: you may need to restart the kernel to use updated packages.
```

In [47]:
```
### Create the Stacked LSTM model
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM
```

In [48]:
```
model=Sequential()
model.add(LSTM(50,return_sequences=True,input_shape=(100,1)))
model.add(LSTM(50,return_sequences=True))
model.add(LSTM(50))
model.add(Dense(1))
model.compile(loss='mean_squared_error',optimizer='adam')
```

In [49]:
```
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm_6 (LSTM)               (None, 100, 50)           10400

 lstm_7 (LSTM)               (None, 100, 50)           20200

 lstm_8 (LSTM)               (None, 50)                20200

 dense_2 (Dense)             (None, 1)                 51

=================================================================
Total params: 50851 (198.64 KB)
Trainable params: 50851 (198.64 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [53]:
```
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm_6 (LSTM)               (None, 100, 50)           10400

 lstm_7 (LSTM)               (None, 100, 50)           20200

 lstm_8 (LSTM)               (None, 50)                20200

 dense_2 (Dense)             (None, 1)                 51

=================================================================
Total params: 50851 (198.64 KB)
Trainable params: 50851 (198.64 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [56]:
```
model.fit(X_train,y_train,validation_data=(X_test,ytest),epochs=20,batch_size=64,verb
```

```
Epoch 1/20
1/1 [==============================] - 0s 199ms/step - loss: 1.6560e-06 - val_loss:
0.4144
Epoch 2/20
1/1 [==============================] - 0s 161ms/step - loss: 5.6168e-07 - val_loss:
0.4172
Epoch 3/20
1/1 [==============================] - 0s 164ms/step - loss: 6.0174e-06 - val_loss:
0.4193
Epoch 4/20
1/1 [==============================] - 0s 160ms/step - loss: 1.3095e-05 - val_loss:
0.4207
Epoch 5/20
1/1 [==============================] - 0s 180ms/step - loss: 1.7145e-05 - val_loss:
0.4213
Epoch 6/20
1/1 [==============================] - 0s 192ms/step - loss: 1.6172e-05 - val_loss:
0.4213
Epoch 7/20
1/1 [==============================] - 0s 156ms/step - loss: 1.1267e-05 - val_loss:
0.4208
Epoch 8/20
1/1 [==============================] - 0s 164ms/step - loss: 5.3085e-06 - val_loss:
0.4200
Epoch 9/20
1/1 [==============================] - 0s 172ms/step - loss: 1.1034e-06 - val_loss:
0.4192
Epoch 10/20
1/1 [==============================] - 0s 156ms/step - loss: 4.6295e-08 - val_loss:
0.4184
Epoch 11/20
1/1 [==============================] - 0s 176ms/step - loss: 1.7496e-06 - val_loss:
0.4180
Epoch 12/20
1/1 [==============================] - 0s 164ms/step - loss: 4.5741e-06 - val_loss:
0.4180
Epoch 13/20
1/1 [==============================] - 0s 163ms/step - loss: 6.6585e-06 - val_loss:
0.4183
Epoch 14/20
1/1 [==============================] - 0s 154ms/step - loss: 6.8876e-06 - val_loss:
0.4191
Epoch 15/20
1/1 [==============================] - 0s 164ms/step - loss: 5.3151e-06 - val_loss:
0.4201
Epoch 16/20
1/1 [==============================] - 0s 172ms/step - loss: 2.9083e-06 - val_loss:
0.4212
Epoch 17/20
1/1 [==============================] - 0s 188ms/step - loss: 8.7536e-07 - val_loss:
0.4224
Epoch 18/20
1/1 [==============================] - 0s 158ms/step - loss: 1.3839e-08 - val_loss:
0.4235
Epoch 19/20
1/1 [==============================] - 0s 160ms/step - loss: 4.0248e-07 - val_loss:
0.4244
Epoch 20/20
1/1 [==============================] - 0s 156ms/step - loss: 1.5069e-06 - val_loss:
0.4251
```

Out[56]:
```
<keras.src.callbacks.History at 0x2de548bc510>
```

In [57]:
```
### Lets Do the prediction and check performance metrics
train_predict=model.predict(X_train)
test_predict=model.predict(X_test)
```

```
1/1 [==============================] - 2s 2s/step
1/1 [==============================] - 0s 40ms/step
```

In [58]:
```
### Lets Do the prediction and check performance metrics
train_predict=model.predict(X_train)
test_predict=model.predict(X_test)
```

```
1/1 [==============================] - 0s 89ms/step
1/1 [==============================] - 0s 118ms/step
```

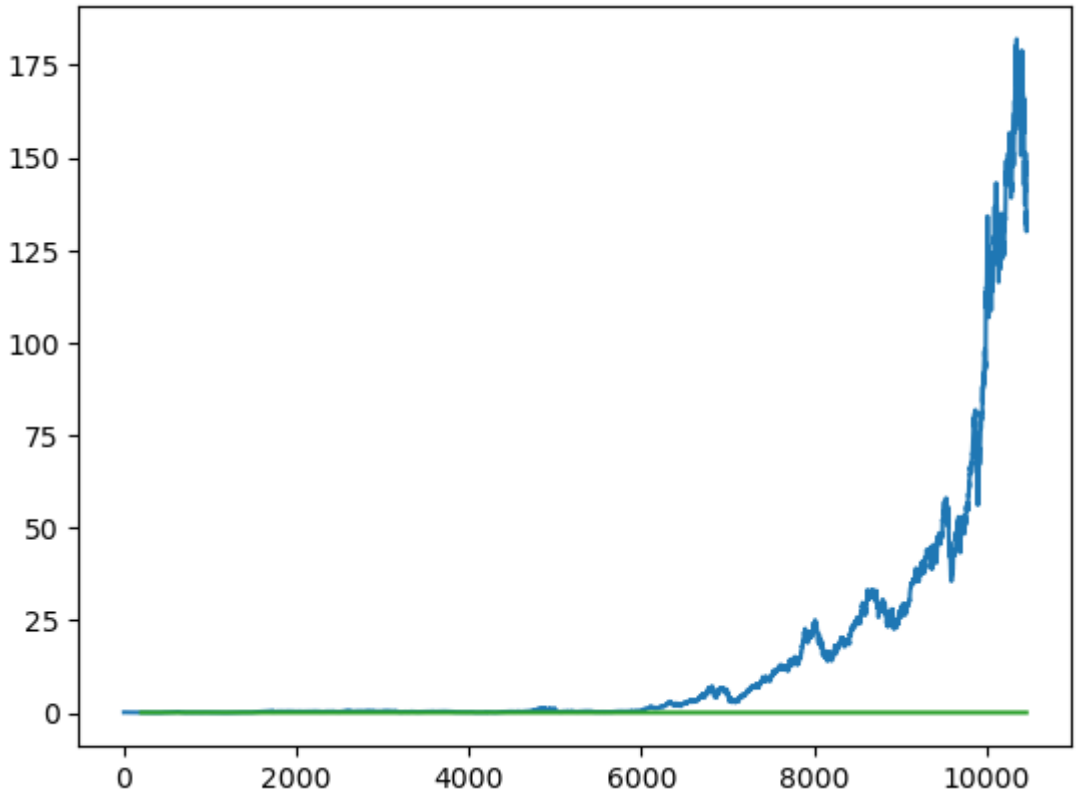
In [59]:
```
import math
from sklearn.metrics import mean_squared_error
math.sqrt(mean_squared_error(y_train,train_predict))
```

Out[59]:
```
0.0015991947025096598
```

In [60]:
```
math.sqrt(mean_squared_error(ytest,test_predict))
```

Out[60]:
```
0.6519634356578323
```

In [61]:
```
### Plotting
# shift train predictions for plotting
look_back=100
trainPredictPlot = numpy.empty_like(df1)
trainPredictPlot[:, :] = np.nan
trainPredictPlot[look_back:len(train_predict)+look_back, :] = train_predict
# shift test predictions for plotting
testPredictPlot = numpy.empty_like(df1)
testPredictPlot[:, :] = numpy.nan
testPredictPlot[len(train_predict)+(look_back*2)+1:len(df1)-1, :] = test_predict
# plot baseline and predictions
plt.plot(scaler.inverse_transform(df1))
plt.plot(trainPredictPlot)
plt.plot(testPredictPlot)
plt.show()
```



In [62]:
```
len(test_data)
```

Out[62]: 3664

In [63]:
```
x_input=test_data[341:].reshape(1,-1)
x_input.shape
```

Out[63]: (1, 3323)

In [64]:
```
temp_input=list(x_input)
temp_input=temp_input[0].tolist()
```

In [65]:
```
temp_input
```

Out[65]:
```
[0.022560776907177983,
 0.023198666737656276,
 0.023326243604614633,
 0.02295136084409524,
 0.022819860056959053,
 0.02356766361790892,
 0.02395432363464834,
 0.023381200469850417,
 0.023628506363411458,
 0.023579440874128946,
 0.024342945611476676,
 0.024048536188722047,
 0.02421144482434049,
 0.024048536188722047,
 0.024291918162105252,
 0.024427348365105798,
 0.024704094651373645,
 0.025652100576690963,
 0.0257777154835604,
```

In [66]:
```
day_new=np.arange(1,101)
day_pred=np.arange(101,131)
```

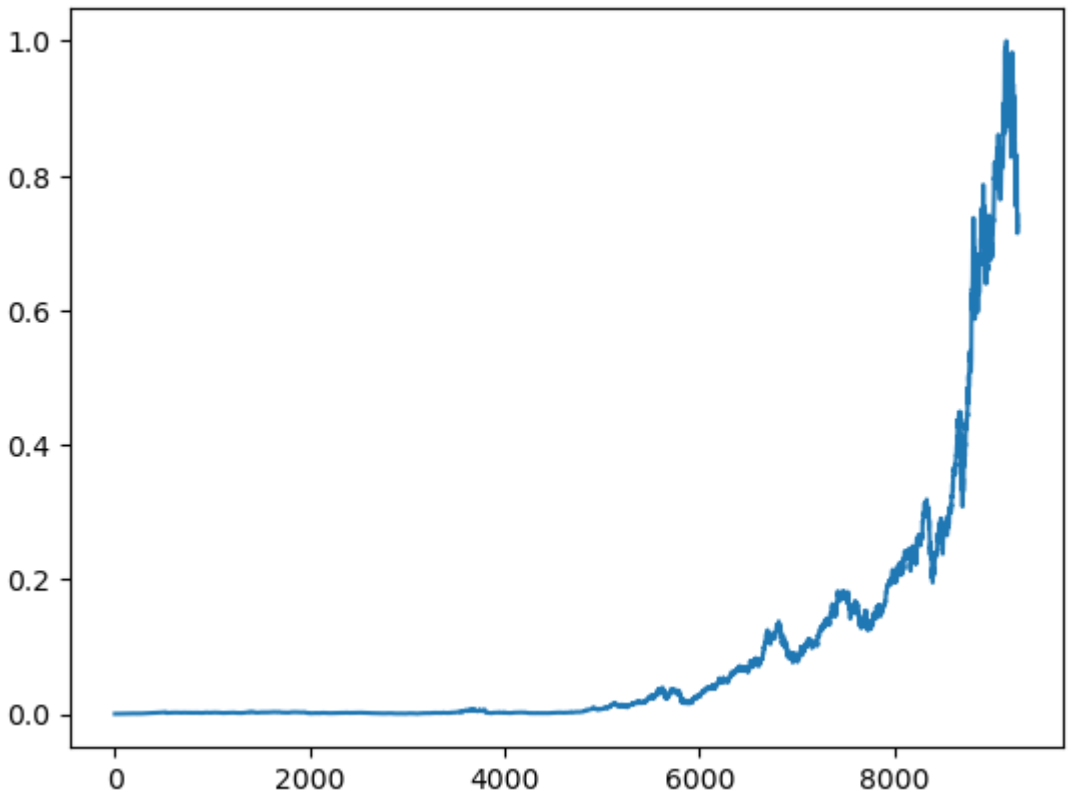
In [67]:
```
import matplotlib.pyplot as plt
```

In [78]:
```
len(df1)
```

Out[78]:
```
10468
```

In [79]:
```
df3=df1.tolist()
plt.plot(df3[1200:])
```

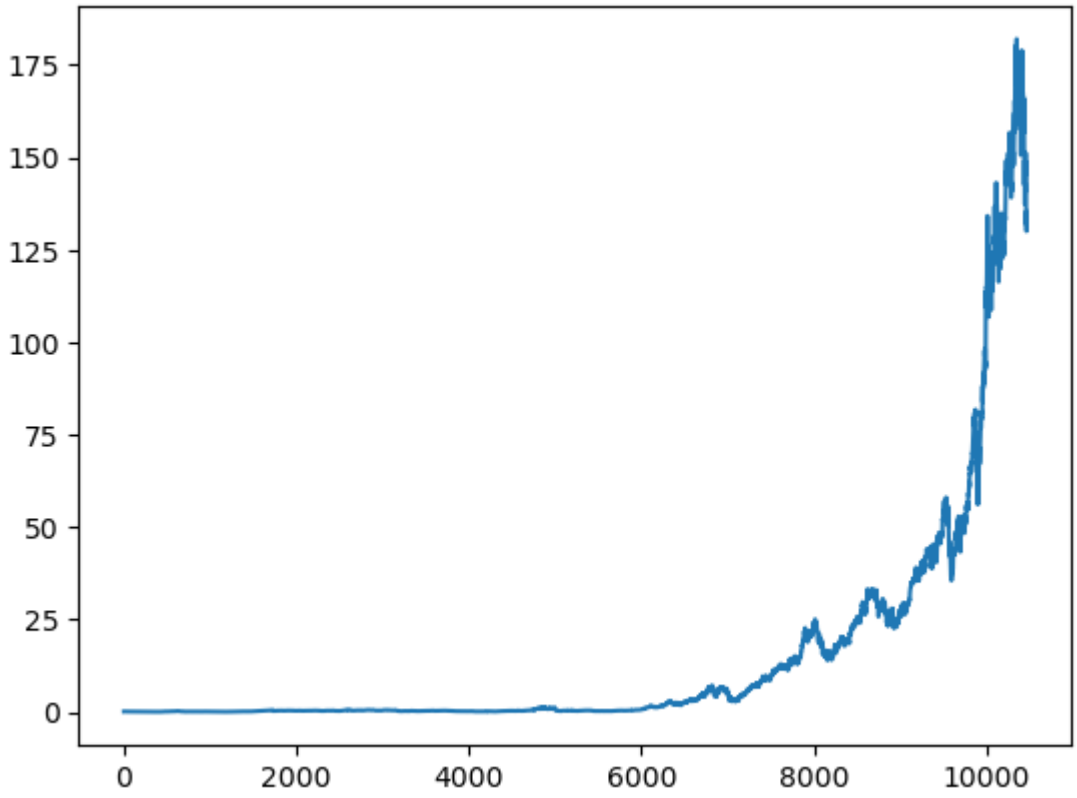
Out[79]:
```
[<matplotlib.lines.Line2D at 0x2de5e794810>]
```



In [80]:
```
df3=scaler.inverse_transform(df3).tolist()
```

In [81]:
```
plt.plot(df3)
```

Out[81]:
```
[<matplotlib.lines.Line2D at 0x2de5e778b10>]
```



In [ ]: