```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [ ]:

```
data=pd.read_excel("/content/Crude Oil Prices Daily.xlsx")
```

In [ ]:

```
data.isnull().any()
```

Out[ ]:

```
Date             False
Closing Value     True
dtype: bool
```

In [ ]:

```
data.isnull().sum()
```

Out[ ]:

```
Date             0
Closing Value    7
dtype: int64
```

In [ ]:

```
data.dropna(axis=0,inplace=True)
```

In [ ]:

```
data.isnull().sum()
```

Out[ ]:

```
Date             0
Closing Value    0
dtype: int64
```

In [ ]:

```
data_oil=data.reset_index()['Closing Value']
data_oil
```

Out[ ]:

```
0       25.56
1       26.00
2       26.53
3       25.85
4       25.87
        ...
8211    73.89
8212    74.19
8213    73.05
8214    73.78
8215    73.93
Name: Closing Value, Length: 8216, dtype: float64
```

In [ ]:

```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler(feature_range=(0,1))
data_oil=scaler.fit_transform(np.array(data_oil).reshape(-1,1))
```

In [ ]:

```
data_oil
```

Out[ ]:

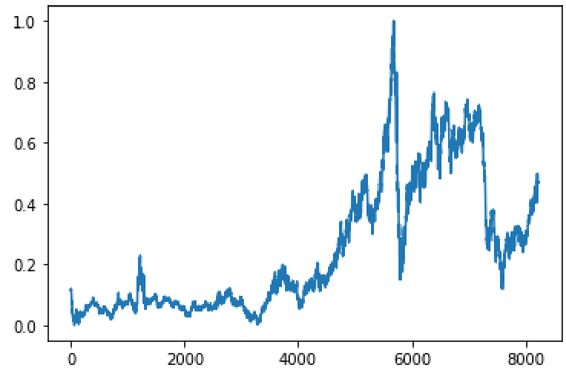
```
array([[0.11335703],
       [0.11661484],
       [0.12053902],
       ...,
       [0.46497853],
       [0.47038353],
       [0.47149415]])
```

In [ ]:

```
plt.plot(data_oil)
```

Out[ ]:

```
[]
```



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

In [ ]:

```
training_size,test_size
```

Out[ ]:

```
(5340, 2876)
```

In [ ]:

```
train_data.shape
```

Out[ ]:

```
(5340, 1)
```

In [ ]:

```
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 np.array(dataX),np.array(dataY)
```

In [ ]:

```
time_step=10
x_train,y_train=create_dataset(train_data,time_step)
x_test,y_test=create_dataset(test_data,time_step)
```

In [ ]:

```
print(x_train.shape),print(y_train.shape)
```

```
(5329, 10)
(5329,)
```

Out[ ]:

```
(None, None)
```

In [ ]:

```
print(x_test.shape),print(y_test.shape)
```

```
(2865, 10)
(2865,)
```

Out[ ]:

```
(None, None)
```

In [ ]:

```
x_train
```

Out[ ]:

```
array([[0.11335703, 0.11661484, 0.12053902, ..., 0.10980305, 0.1089886 ,
        0.11054346],
       [0.11661484, 0.12053902, 0.11550422, ..., 0.1089886 , 0.11054346,
        0.10165852],
       [0.12053902, 0.11550422, 0.1156523 , ..., 0.11054346, 0.10165852,
        0.09906708],
       ...,
       [0.36731823, 0.35176958, 0.36080261, ..., 0.36391234, 0.37042796,
        0.37042796],
       [0.35176958, 0.36080261, 0.35354657, ..., 0.37042796, 0.37042796,
        0.37879461],
       [0.36080261, 0.35354657, 0.35295424, ..., 0.37042796, 0.37879461,
        0.37916482]])
```

In [ ]:

```
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 [ ]:

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM
```

In [ ]:

```
model=Sequential()
```

In [ ]:

```
model.add(LSTM(50,return_sequences=True,input_shape=(10,1)))
model.add(LSTM(50,return_sequences=True))
model.add(LSTM(50))
```

In [ ]:

```
model.add(Dense(1))
```

In [ ]:

```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm (LSTM)                 (None, 10, 50)            10400

 lstm_1 (LSTM)               (None, 10, 50)            20200

 lstm_2 (LSTM)               (None, 50)                20200

 dense (Dense)               (None, 1)                 51

=================================================================
Total params: 50,851
Trainable params: 50,851
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:

```
model.compile(loss='mean_squared_error',optimizer='adam')
```

In [ ]:

```
model.fit(x_train,y_train,validation_data=(x_test,y_test),epochs=3,batch_si
ze=64,verbose=1)
```

```
Epoch 1/3
84/84 [==============================] - 6s 25ms/step - loss: 0.0017 - val_
loss: 0.0011
Epoch 2/3
84/84 [==============================] - 1s 16ms/step - loss: 1.2375e-04 -
val_loss: 7.8338e-04
Epoch 3/3
84/84 [==============================] - 1s 16ms/step - loss: 1.2058e-04 -
val_loss: 7.5010e-04
```

Out[ ]:

In [ ]:

```
##Transformback to original form
train_predict=scaler.inverse_transform(train_data)
test_predict=scaler.inverse_transform(test_data)
### Calculate RMSE performance metrics
import math
from sklearn.metrics import mean_squared_error
math.sqrt(mean_squared_error(train_data,train_predict))
```

Out[ ]:

```
29.347830443269938
```

In [ ]:

```
from tensorflow.keras.models import load_model
```

In [ ]:

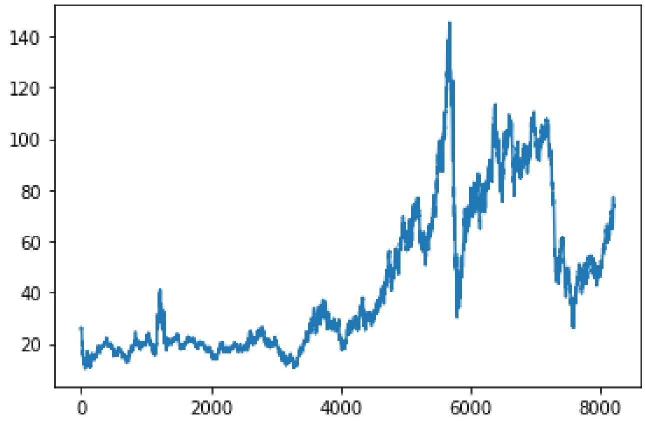
```
model.save("crude_oil.hs")
```

```
WARNING:absl:Found untraced functions such as lstm_cell_layer_call_fn, lstm
_cell_layer_call_and_return_conditional_losses, lstm_cell_1_layer_call_fn,
lstm_cell_1_layer_call_and_return_conditional_losses, lstm_cell_2_layer_cal
l_fn while saving (showing 5 of 6). These functions will not be directly ca
llable after loading.
WARNING:absl: has the same name 'LSTMCell' as a built-in Keras object. Cons
ider renaming  to avoid naming conflicts when loading with `tf.keras.models
.load_model`. If renaming is not possible, pass the object in the `custom_o
bjects` parameter of the load function.
WARNING:absl: has the same name 'LSTMCell' as a built-in Keras object. Cons
ider renaming  to avoid naming conflicts when loading with `tf.keras.models
.load_model`. If renaming is not possible, pass the object in the `custom_o
bjects` parameter of the load function.
WARNING:absl: has the same name 'LSTMCell' as a built-in Keras object. Cons
ider renaming  to avoid naming conflicts when loading with `tf.keras.models
.load_model`. If renaming is not possible, pass the object in the `custom_o
bjects` parameter of the load function.
```

In [ ]:

```
### Plotting
look_back=10
trainpredictPlot = np.empty_like(data_oil)
```

```
trainpredictPlot[:, :]= np.nan
trainpredictPlot[look_back:len(train_predict)+look_back, :] = train_predict
# shift test predictions for plotting
testPredictplot = np.empty_like(data_oil)
testPredictplot[:,: ] = np.nan
testPredictplot[look_back:len(test_predict)+look_back, :] = test_predict
# plot baseline and predictions
plt.plot(scaler.inverse_transform(data_oil))
plt.show()
```



```
len(test_data)
```

Out[ ]:

```
2876
```

In [ ]:

```
x_input=test_data[2866:].reshape(1,-1)
x_input.shape
```

Out[ ]:

```
(1, 10)
```

In [ ]:

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

In [ ]:

```
temp_input
```

Out[ ]:

```
[0.44172960165852215,
 0.48111950244335855,
 0.49726047682511476,
 0.4679401747371539,
 0.4729749740855915,
 0.47119798608026064,
 0.47341922108692425,
 0.4649785280616022,
 0.4703835332444839,
 0.47149415074781587]
```

In [ ]:

```
lst_output=[]
n_steps=10
i=0
while(i<10):
    if(len(temp_input)>10):
#print(temp_input)
       x_input=np.array(temp_input[1:])
       print("{} day input {}".format(i,x_input))
       x_input=x_input.reshape(1,-1)
       x_input = x_input.reshape((1, n_steps, 1)) #print(x_input)
       yhat = model.predict(x_input, verbose=0)
       print("{} day output {}".format(i,yhat))
       temp_input.extend(yhat[0].tolist())
       temp_input=temp_input[1:] #print(temp_input)
       lst_output.extend(yhat.tolist())
       i=i+1
    else:
       x_input = x_input.reshape((1, n_steps,1))
       yhat = model.predict(x_input, verbose=0)
       print(yhat[0])
       temp_input.extend(yhat[0].tolist())
       print(len(temp_input))
       lst_output.extend(yhat.tolist())
       i=i+1
```

```
[0.47442466]
11
1 day input [0.4811195  0.49726048 0.46794017 0.47297497 0.47119799 0.47341
922
 0.46497853 0.47038353 0.47149415 0.47442466]
1 day output [[0.47781762]]
2 day input [0.49726048 0.46794017 0.47297497 0.47119799 0.47341922 0.46497
853
 0.47038353 0.47149415 0.47442466 0.47781762]
2 day output [[0.47653615]]
3 day input [0.46794017 0.47297497 0.47119799 0.47341922 0.46497853 0.47038
353
 0.47149415 0.47442466 0.47781762 0.47653615]
3 day output [[0.47364426]]
4 day input [0.47297497 0.47119799 0.47341922 0.46497853 0.47038353 0.47149
415
 0.47442466 0.47781762 0.47653615 0.47364426]
4 day output [[0.47442248]]
5 day input [0.47119799 0.47341922 0.46497853 0.47038353 0.47149415 0.47442
466
 0.47781762 0.47653615 0.47364426 0.47442248]
5 day output [[0.47467044]]
6 day input [0.47341922 0.46497853 0.47038353 0.47149415 0.47442466 0.47781
762
 0.47653615 0.47364426 0.47442248 0.47467044]
6 day output [[0.47518066]]
7 day input [0.46497853 0.47038353 0.47149415 0.47442466 0.47781762 0.47653
615
 0.47364426 0.47442248 0.47467044 0.47518066]
7 day output [[0.47546706]]
8 day input [0.47038353 0.47149415 0.47442466 0.47781762 0.47653615 0.47364
426
 0.47442248 0.47467044 0.47518066 0.47546706]
8 day output [[0.4767432]]
9 day input [0.47149415 0.47442466 0.47781762 0.47653615 0.47364426 0.47442
248
```

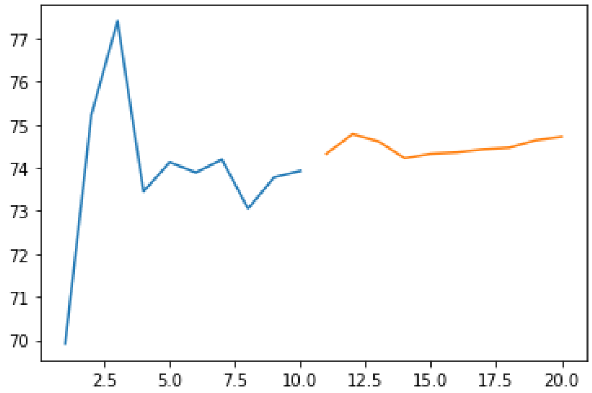
```
 0.47467044 0.47518066 0.47546706 0.47674319]
9 day output [[0.47736228]]
```

In [ ]:

```
day_new=np.arange(1,11)
day_pred=np.arange(11,21)
len(data_oil)
plt.plot(day_new, scaler.inverse_transform(data_oil[8206:]))
plt.plot(day_pred, scaler.inverse_transform(lst_output))
```

Out[ ]:

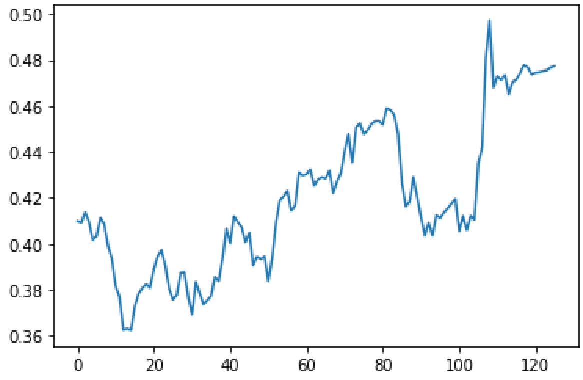
```
[]
```



```
df3=data_oil.tolist()
df3.extend(lst_output)
plt.plot(df3[8100:])
```

Out[ ]:

```
[]
```



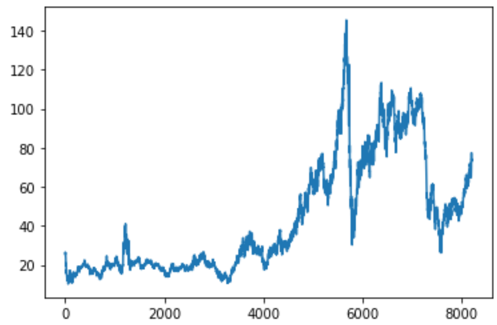
```
df3=scaler.inverse_transform(df3).tolist()
```

In [ ]:

```
plt.plot(scaler.inverse_transform(data_oil))
```

Out[ ]:

```
[]
```


140
120
100
80
60
40
20
0
2000
4000
6000
8000