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Name: Saniya Mansuri Rollno: 20CO071
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Recurrent neural network (RNN) Use the Google stock prices dataset and design a time series analysis and prediction system using RNN.

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.preprocessing import MinMaxScaler
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Dropout
```

```
dataset_train = pd.read_csv('Google_Stock_Price_Train.csv')
```

```
dataset_train.head()
```

	Date	Open	High	Low	Close	Volume
0	1/3/2012	325.25	332.83	324.97	663.59	7,380,500
1	1/4/2012	331.27	333.87	329.08	666.45	5,749,400
2	1/5/2012	329.83	330.75	326.89	657.21	6,590,300
3	1/6/2012	328.34	328.77	323.68	648.24	5,405,900
4	1/9/2012	322.04	322.29	309.46	620.76	11,688,800

```
training_set = dataset_train.iloc[:, 1: 2].values
```

```
training_set.shape
```

```
(1258, 1)
```

```
sc = MinMaxScaler(feature_range = (0, 1))
#fit: get min/max of train data
training_set_scaled = sc.fit_transform(training_set)
```

```
X_train = []
y_train = []
for i in range(60, len(training_set_scaled)):
 X_train.append(training_set_scaled[i-60: i, 0])
 y_train.append(training_set_scaled[i, 0])
X_train, y_train = np.array(X_train), np.array(y_train)
```

```
X_train.shape
```

```
(1198, 60)
```

```
y_train.shape
```

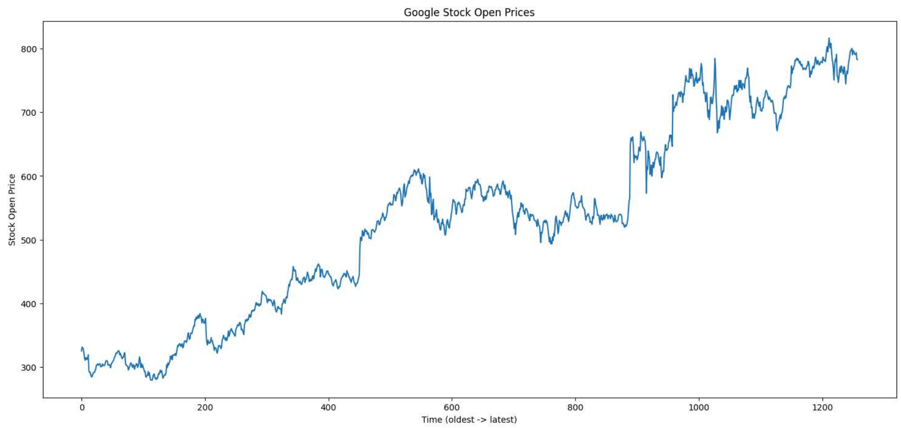
```
(1198,)
```

```
X_train = np.reshape(X_train, newshape =
 (X_train.shape[0], X_train.shape[1], 1))
```

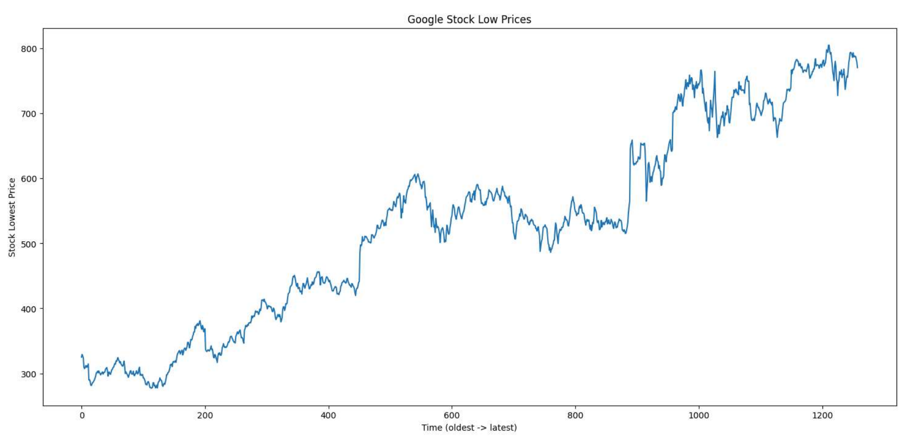
```
X_train.shape
```

```
(1198, 60, 1)
```

```
plt.figure(figsize=(18, 8))
plt.plot(dataset_train['Open'])
plt.title("Google Stock Open Prices")
plt.xlabel("Time (oldest -> latest)")
plt.ylabel("Stock Open Price")
plt.show()
```




```
plt.figure(figsize=(18, 8))
plt.plot(dataset_train['Low'])
plt.title("Google Stock Low Prices")
plt.xlabel("Time (oldest -> latest)")
plt.ylabel("Stock Lowest Price")
plt.show()
```



```
regressor = Sequential()
#add 1st lstm layer
regressor.add(LSTM(units = 50, return_sequences = True, input_shape = (X_train.shape[1], 1)))
regressor.add(Dropout(rate = 0.2))
##add 2nd lstm layer: 50 neurons
regressor.add(LSTM(units = 50, return_sequences = True))
regressor.add(Dropout(rate = 0.2))
##add 3rd lstm layer
regressor.add(LSTM(units = 50, return_sequences = True))
regressor.add(Dropout(rate = 0.2))
##add 4th lstm layer
regressor.add(LSTM(units = 50, return_sequences = False))
regressor.add(Dropout(rate = 0.2))
##add output layer
regressor.add(Dense(units = 1))
```

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

```
regressor.fit(x = X_train, y = y_train, batch_size = 32, epochs = 100)
```

```
Epoch 1/100
38/38 [==============================] - 14s 102ms/step - loss: 0.0367
Epoch 2/100
38/38 [==============================] - 4s 102ms/step - loss: 0.0058
Epoch 3/100
38/38 [==============================] - 5s 129ms/step - loss: 0.0051
Epoch 4/100
38/38 [==============================] - 4s 101ms/step - loss: 0.0052
Epoch 5/100
38/38 [==============================] - 4s 102ms/step - loss: 0.0047
Epoch 6/100
38/38 [==============================] - 5s 128ms/step - loss: 0.0053
Epoch 7/100
38/38 [==============================] - 4s 101ms/step - loss: 0.0048
Epoch 8/100
38/38 [==============================] - 5s 128ms/step - loss: 0.0051
Epoch 9/100
38/38 [==============================] - 6s 150ms/step - loss: 0.0046
Epoch 10/100
38/38 [==============================] - 4s 102ms/step - loss: 0.0043
Epoch 11/100
38/38 [==============================] - 5s 123ms/step - loss: 0.0052
Epoch 12/100
38/38 [==============================] - 5s 142ms/step - loss: 0.0042
Epoch 13/100
38/38 [==============================] - 4s 101ms/step - loss: 0.0038
Epoch 14/100
38/38 [==============================] - 5s 128ms/step - loss: 0.0037
Epoch 15/100
38/38 [==============================] - 4s 103ms/step - loss: 0.0040
Epoch 16/100
38/38 [==============================] - 5s 131ms/step - loss: 0.0039
Epoch 17/100
38/38 [==============================] - 5s 130ms/step - loss: 0.0047
Epoch 18/100
38/38 [==============================] - 4s 102ms/step - loss: 0.0039
Epoch 19/100
38/38 [==============================] - 4s 103ms/step - loss: 0.0036
Epoch 20/100
38/38 [==============================] - 5s 127ms/step - loss: 0.0038
Epoch 21/100
38/38 [==============================] - 5s 120ms/step - loss: 0.0036
Epoch 22/100
38/38 [==============================] - 4s 118ms/step - loss: 0.0035
Epoch 23/100
38/38 [==============================] - 4s 111ms/step - loss: 0.0036
Epoch 24/100
38/38 [==============================] - 6s 152ms/step - loss: 0.0036
Epoch 25/100
38/38 [==============================] - 7s 181ms/step - loss: 0.0032
Epoch 26/100
38/38 [==============================] - 4s 101ms/step - loss: 0.0032
Epoch 27/100
38/38 [==============================] - 7s 194ms/step - loss: 0.0031
Epoch 28/100
38/38 [==============================] - 4s 101ms/step - loss: 0.0031
Epoch 29/100
38/38 [==============================] - 4s 102ms/step - loss: 0.0030
```

```
dataset_test = pd.read_csv('Google_Stock_Price_Test.csv')
```

```
dataset_test.head()
```

	Date	Open	High	Low	Close	Volume
0	1/3/2017	778.81	789.63	775.80	786.14	1,657,300
1	1/4/2017	788.36	791.34	783.16	786.90	1,073,000
2	1/5/2017	786.08	794.48	785.02	794.02	1,335,200
3	1/6/2017	795.26	807.90	792.20	806.15	1,640,200
4	1/9/2017	806.40	809.97	802.83	806.65	1,272,400

```
real_stock_price = dataset_test.iloc[:, 1: 2].values
real_stock_price.shape
```

```
(20, 1)
```

```
#vertical concat use 0, horizontal uses 1
dataset_total = pd.concat((dataset_train['Open'], dataset_test['Open']),
 axis = 0)
##use .values to make numpy array
inputs = dataset_total[len(dataset_total) - len(dataset_test) - 60:].values
```

```
#reshape data to only have 1 col
inputs = inputs.reshape(-1, 1)
#scale input
inputs = sc.transform(inputs)
```

```
len(inputs)
```

```
80
```

```
X_test = []
for i in range(60, len(inputs)):
 X_test.append(inputs[i-60:i, 0])
X_test = np.array(X_test)
#add dimension of indicator
X_test = np.reshape(X_test, (X_test.shape[0], X_test.shape[1], 1))
```

```
X_test.shape
```

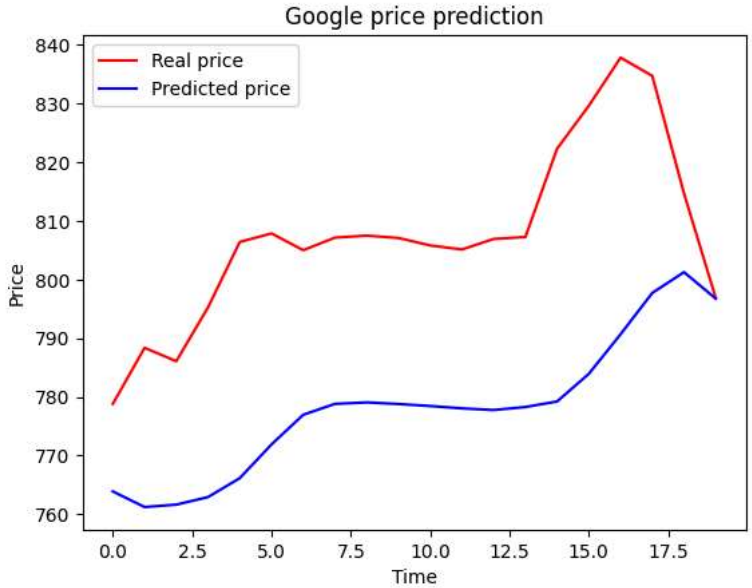
```
(20, 60, 1)
```

```
predicted_stock_price = regressor.predict(X_test)
```

```
1/1 [==============================] - 2s 2s/step
```

```
#inverse the scaled value
predicted_stock_price = sc.inverse_transform(predicted_stock_price)
```

```
##visualize the prediction and real price
plt.plot(real_stock_price, color = 'red', label = 'Real price')
plt.plot(predicted_stock_price, color = 'blue', label = 'Predicted price')
plt.title('Google price prediction')
plt.xlabel('Time')
plt.ylabel('Price')
plt.legend()
plt.show()
```



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