In [0]:

```
```

DEEP LEARNING ASSIGNMENT 3

LSTM AIRLINE DATASET (PROBLEM 3)

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IMPORTING ALL THE LIBRARIES

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import math
from sklearn.preprocessing import OneHotEncoder
from sklearn.metrics import accuracy_score
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
from statsmodels.tools.eval_measures import rmse
from keras.preprocessing.sequence import TimeseriesGenerator
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import LSTM
from keras.layers import Dropout
import warnings
warnings.filterwarnings("ignore")
import time
from sklearn.metrics import mean_squared_error
import statistics
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from tensorflow.keras.models import Sequential
from sklearn.preprocessing import MinMaxScaler
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19: F
utureWarning: pandas.util.testing is deprecated. Use the functions in the
public API at pandas.testing instead.
  import pandas.util.testing as tm
Using TensorFlow backend.
```

In [2]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, c
all drive.mount("/content/drive", force_remount=True).
```

READING DATASET

In [0]:

```
#data = pd.read_csv('drive/My Drive/Airlines.csv')# reading data here
```

In [0]:

```
data = pd.read_csv('Airlines.csv')# reading data here
```

In [4]:

```
print(data)#-------------------------------CHECKING DATA
```

```
       Month  Passengers
0    1949-01         112
1    1949-02         118
2    1949-03         132
3    1949-04         129
4    1949-05         121
..       ...         ...
139  1960-08         606
140  1960-09         508
141  1960-10         461
142  1960-11         390
143  1960-12         432

[144 rows x 2 columns]
```

New Section

In [0]:

```

```

In [5]:

```
data#---------------DATA IS IN PANDAS DATAFRAME
```

Out[5]:

	Month	Passengers
0	1949-01	112
1	1949-02	118
2	1949-03	132
3	1949-04	129
4	1949-05	121
...	...	...
139	1960-08	606
140	1960-09	508
141	1960-10	461
142	1960-11	390
143	1960-12	432

144 rows × 2 columns

In [0]:

```
X = data.Passengers#----------------GETTING ONLY PASSENGER DATA HERE STORING IT IN X
```

In [0]:

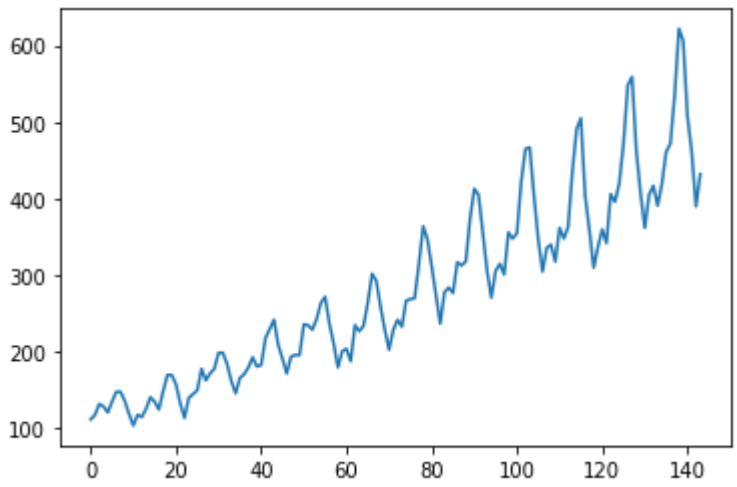
```
X = np.array(X).reshape(-1,1)#-------------------RESHAPING X
```

In [8]:

```
plt.plot(X)#------------------PLOTTING THE VALUES ON GRAPH
```

Out[8]:

```
[<matplotlib.lines.Line2D at 0x7f05ace72748>]
```



In [0]:

```
```

In [0]:

```
Data_scale = MinMaxScaler()#--------------------USING MINMAX SCALER HERE TO GET VALUES
 BETWEEN 0 AND 1
X = Data_scale.fit_transform(X)
```

In [0]:

```
Data = X
```

In [0]:

```
Train, Test = train_test_split(Data,test_size=0.7,shuffle=False)#----------------SPLIT
TING DATA WITHOUT SHUFFLE
```

In [0]:

```
train_size = Train.size#-----------------------DEFINING SIZE AND OF THE DATASET
test_size = Test.size
```

In [0]:

```
X_train = Train[0:train_size-1]#-------------------------SETTING UP TRAINING FEATURES
 AND LABELS
Y_train = Train[1:train_size]
```

In [0]:

```
X_test = Test[0:test_size-1]#--------------------SETTING UP TESTING FEATURES AND LABELS
Y_test = Test[1:test_size]
```

In [15]:

```
Y_train
```

Out[15]:

```
array([[0.02702703],
       [0.05405405],
       [0.04826255],
       [0.03281853],
       [0.05984556],
       [0.08494208],
       [0.08494208],
       [0.06177606],
       [0.02895753],
       [0.        ],
       [0.02702703],
       [0.02123552],
       [0.04247104],
       [0.07142857],
       [0.05984556],
       [0.04054054],
       [0.08687259],
       [0.12741313],
       [0.12741313],
       [0.1042471 ],
       [0.05598456],
       [0.01930502],
       [0.06949807],
       [0.07915058],
       [0.08880309],
       [0.14285714],
       [0.11389961],
       [0.13127413],
       [0.14285714],
       [0.18339768],
       [0.18339768],
       [0.15444015],
       [0.11196911],
       [0.08108108],
       [0.11969112],
       [0.12934363],
       [0.14671815],
       [0.17181467],
       [0.14864865],
       [0.15250965],
       [0.22007722],
       [0.24324324]])
```

In [16]:

```
X_train
```

Out[16]:

```
array([[0.01544402],
       [0.02702703],
       [0.05405405],
       [0.04826255],
       [0.03281853],
       [0.05984556],
       [0.08494208],
       [0.08494208],
       [0.06177606],
       [0.02895753],
       [0.        ],
       [0.02702703],
       [0.02123552],
       [0.04247104],
       [0.07142857],
       [0.05984556],
       [0.04054054],
       [0.08687259],
       [0.12741313],
       [0.12741313],
       [0.1042471 ],
       [0.05598456],
       [0.01930502],
       [0.06949807],
       [0.07915058],
       [0.08880309],
       [0.14285714],
       [0.11389961],
       [0.13127413],
       [0.14285714],
       [0.18339768],
       [0.18339768],
       [0.15444015],
       [0.11196911],
       [0.08108108],
       [0.11969112],
       [0.12934363],
       [0.14671815],
       [0.17181467],
       [0.14864865],
       [0.15250965],
       [0.22007722]])
```

In [0]:

```
X_train = X_train.reshape(X_train.shape[0],X_train.shape[1], 1)#--------------------RESHAPING THE DIMESIONS TO FIT INTO LSTM
X_test = X_test.reshape(X_test.shape[0],X_test.shape[1], 1)
```

BUILDING LSTM MODEL BELOW

In [0]:

```
model = Sequential()
model.add(LSTM(5, input_shape = (1, 1)))
model.add(Dense(1))
model.compile(loss = 'mean_squared_error', optimizer = 'adam')
```

In [19]:

```
model.summary()#----------------------PARAMETERS OF LSTM
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm (LSTM)                  (None, 5)                 140
_________________________________________________________________
dense (Dense)                (None, 1)                 6
=================================================================
Total params: 146
Trainable params: 146
Non-trainable params: 0
_________________________________________________________________
```

In [20]:

```
model.fit(X_train, Y_train, epochs=50, batch_size=1)#----------------------------TRAINI
NG STARTS  HERE
```

```
Epoch 1/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0073
Epoch 2/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0034
Epoch 3/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0028
Epoch 4/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0027
Epoch 5/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0026
Epoch 6/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0025
Epoch 7/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0025
Epoch 8/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0024
Epoch 9/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0024
Epoch 10/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0024
Epoch 11/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0023
Epoch 12/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0022
Epoch 13/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0021
Epoch 14/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0021
Epoch 15/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0021
Epoch 16/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0020
Epoch 17/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0020
Epoch 18/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0019
Epoch 19/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0019
Epoch 20/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0017
Epoch 21/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0017
Epoch 22/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0016
Epoch 23/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0016
Epoch 24/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0015
Epoch 25/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0015
Epoch 26/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0014
Epoch 27/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0014
Epoch 28/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0013
Epoch 29/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0013
Epoch 30/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0013
Epoch 31/50
```

```
42/42 [==============================] - 0s 2ms/step - loss: 0.0012
Epoch 32/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0012
Epoch 33/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0012
Epoch 34/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0011
Epoch 35/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0011
Epoch 36/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0011
Epoch 37/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0010
Epoch 38/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0010
Epoch 39/50
42/42 [==============================] - 0s 2ms/step - loss: 0.0010
Epoch 40/50
42/42 [==============================] - 0s 2ms/step - loss: 9.6490e-04
Epoch 41/50
42/42 [==============================] - 0s 2ms/step - loss: 9.5334e-04
Epoch 42/50
42/42 [==============================] - 0s 2ms/step - loss: 9.2907e-04
Epoch 43/50
42/42 [==============================] - 0s 2ms/step - loss: 9.1923e-04
Epoch 44/50
42/42 [==============================] - 0s 2ms/step - loss: 9.1599e-04
Epoch 45/50
42/42 [==============================] - 0s 2ms/step - loss: 8.9395e-04
Epoch 46/50
42/42 [==============================] - 0s 2ms/step - loss: 8.8569e-04
Epoch 47/50
42/42 [==============================] - 0s 2ms/step - loss: 8.8273e-04
Epoch 48/50
42/42 [==============================] - 0s 2ms/step - loss: 8.9683e-04
Epoch 49/50
42/42 [==============================] - 0s 2ms/step - loss: 8.8650e-04
Epoch 50/50
42/42 [==============================] - 0s 2ms/step - loss: 8.6327e-04
```

Out[20]:

```
<tensorflow.python.keras.callbacks.History at 0x7f05a655f2b0>
```

In [0]:

```
Predicted_Y = model.predict(X_test)#--------------------GETTING PREDICTED VALUE
```

In [0]:

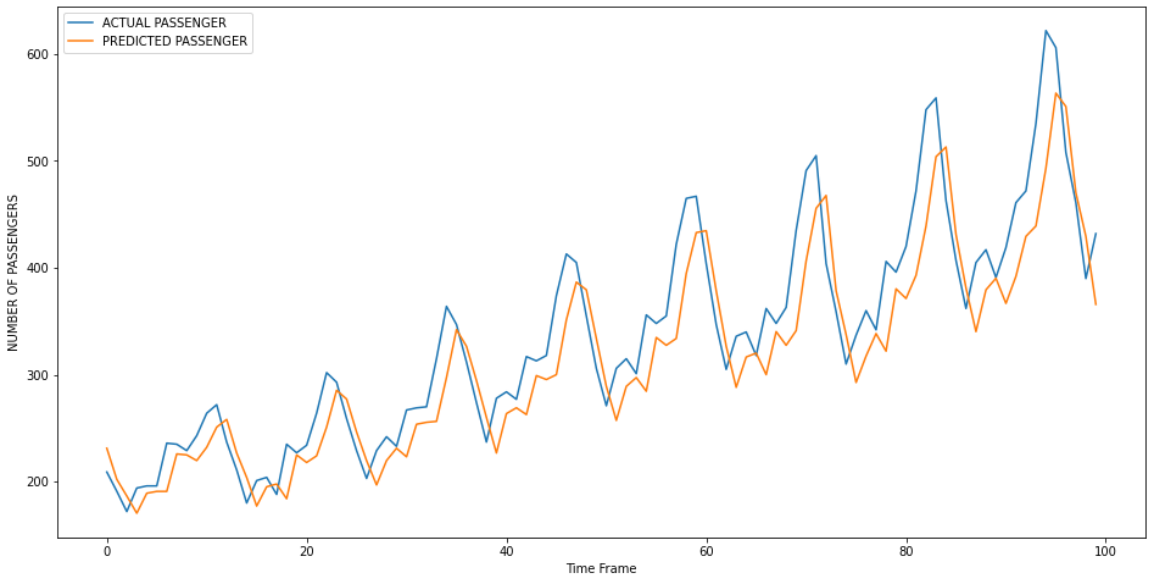
```
Predicted_Y = Data_scale.inverse_transform(Predicted_Y)#------------GETTING INVERSE
```

In [0]:

```
Y_test = np.array(Y_test)
Y_test = Y_test.reshape(-1, 1)
Y_test = Data_scale.inverse_transform(Y_test)
```

In [24]:

```
#-------------------------COMPARING THE ORIGNAL AND PREDICTED MODEL BELOW
plt.figure(figsize=(16,8))
plt.plot(Y_test, label = 'ACTUAL PASSENGER')
plt.plot(Predicted_Y, label = 'PREDICTED PASSENGER')
plt.ylabel('NUMBER OF PASSENGERS')
plt.xlabel('Time Frame')
plt.legend()
plt.show()
```



In [25]:

```
testScore = math.sqrt(mean_squared_error(Y_test, Predicted_Y))#------------------THE F
INAL TESTING RMSE COMES HERE without min max scaling
print('Test Score: %.2f RMSE' % (testScore))
```

```
Test Score: 43.80 RMSE
```

In [26]:

```
Y_test = Data_scale.fit_transform(Y_test)
Predicted_Y = Data_scale.fit_transform(Predicted_Y)
testScore = math.sqrt(mean_squared_error(Y_test, Predicted_Y))#------------------THE F
INAL TESTING RMSE COMES HERE after min max scaling
print('Test Score: %.2f RMSE' % (testScore))
```

```
Test Score: 0.09 RMSE
```

In [0]:

```

```