

ASSIGNMENT – 4  
Python Programming

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## Importing Model building libraries

### Solution :

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from keras.models import Model
from keras.layers import LSTM, Activation, Dense, Dropout, Input,
Embedding
from keras.optimizers import RMSprop
from keras.preprocessing.text import Tokenizer
from keras.preprocessing import sequence
from keras.utils import to_categorical
from keras.models import load_model
```

## Importing NLTK libraries

### Solution :

```
import csv
import tensorflow as tf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
STOPWORDS = set(stopwords.words('english'))
```

## Reading dataset and preprocessing

### Solution:

```
from google.colab import drive
drive.mount('/content/drive')
cd/content/drive/MyDrive/Colab Notebooks
```

```
df =
pd.read_csv('/content/drive/MyDrive/AI_IBM/spam.csv',delimiter=',',encoding='latin-1')
df.head()
```

### Output:

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	ham	Go until jurong point, crazy.. Available only ...	NaN	NaN	NaN
1	ham	Ok lar... Joking wif u oni...	NaN	NaN	NaN
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	NaN	NaN
3	ham	U dun say so early hor... U c already then say...	NaN	NaN	NaN
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	NaN	NaN

### Solution:

```
df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True)
df.info()
```

### Output:

```
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
#   Column  Non-Null Count  Dtype
---  -
0    v1      5572 non-null     object
1    v2      5572 non-null     object
dtypes: object(2)
memory usage: 87.2+ KB
```

### Solution:

```
df.groupby(['v1']).size()
```

### Output:

```
v1
ham    4825
spam    747
dtype: int64
```

### Solution:

```
X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)

# Test and train data split
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.15)
```

```

max_words = 1000
max_len = 150
tok = Tokenizer(num_words=max_words)
tok.fit_on_texts(X_train)
sequences = tok.texts_to_sequences(X_train)
sequences_matrix = sequence.pad_sequences(sequences,maxlen=max_len)

```

## Create Model

### Add layers (LSTM ,Dense-(HiddenLayers),Ouput)

#### Solution:

```

#LSTM model
inputs = Input(name='InputLayer',shape=[max_len])
layer = Embedding(max_words,50,input_length=max_len)(inputs)
layer = LSTM(64)(layer)
layer = Dense(256,name='FullyConnectedLayer1')(layer)
layer = Activation('relu')(layer)
layer = Dropout(0.5)(layer)
layer = Dense(1,name='OutputLayer')(layer)
layer = Activation('sigmoid')(layer)

model = Model(inputs=inputs,outputs=layer)
model.summary()
model.compile(loss='binary_crossentropy',optimizer=RMSprop(),metrics=['accuracy'])

```

#### Output:

Model: "model"

Layer (type)	Output Shape	Param #
InputLayer (InputLayer)	[(None, 150)]	0
embedding (Embedding)	(None, 150, 50)	50000
lstm (LSTM)	(None, 64)	29440
FullyConnectedLayer1 (Dense)	(None, 256)	16640
activation (Activation)	(None, 256)	0
dropout (Dropout)	(None, 256)	0
OutputLayer (Dense)	(None, 1)	257
activation_1 (Activation)	(None, 1)	0
Total params: 96,337		
Trainable params: 96,337		
Non-trainable params: 0		

### Solution:

```
model.fit(sequences_matrix,Y_train,batch_size=128,epochs=25,validation_split=0.2)
```

### Output:

```
Epoch 1/25
30/30 [=====] - 28s 720ms/step - loss: 0.3323 - accuracy: 0.8772 - val_loss: 0.1085 - val_accuracy: 0.9715
Epoch 2/25
30/30 [=====] - 18s 588ms/step - loss: 0.0818 - accuracy: 0.9807 - val_loss: 0.0794 - val_accuracy: 0.9800
Epoch 3/25
30/30 [=====] - 12s 384ms/step - loss: 0.0421 - accuracy: 0.9884 - val_loss: 0.0518 - val_accuracy: 0.9842
Epoch 4/25
30/30 [=====] - 9s 291ms/step - loss: 0.0293 - accuracy: 0.9921 - val_loss: 0.0461 - val_accuracy: 0.9884
Epoch 5/25
30/30 [=====] - 9s 288ms/step - loss: 0.0261 - accuracy: 0.9921 - val_loss: 0.0517 - val_accuracy: 0.9873
Epoch 6/25
30/30 [=====] - 9s 291ms/step - loss: 0.0161 - accuracy: 0.9952 - val_loss: 0.0582 - val_accuracy: 0.9863
Epoch 7/25
30/30 [=====] - 9s 291ms/step - loss: 0.0110 - accuracy: 0.9971 - val_loss: 0.0660 - val_accuracy: 0.9895
Epoch 8/25
30/30 [=====] - 11s 369ms/step - loss: 0.0087 - accuracy: 0.9974 - val_loss: 0.0765 - val_accuracy: 0.9863
Epoch 9/25
30/30 [=====] - 9s 294ms/step - loss: 0.0059 - accuracy: 0.9982 - val_loss: 0.0815 - val_accuracy: 0.9884
Epoch 10/25
30/30 [=====] - 9s 290ms/step - loss: 0.0051 - accuracy: 0.9987 - val_loss: 0.0902 - val_accuracy: 0.9852
Epoch 11/25
30/30 [=====] - 9s 318ms/step - loss: 0.0038 - accuracy: 0.9987 - val_loss: 0.0964 - val_accuracy: 0.9884
Epoch 12/25
30/30 [=====] - 9s 290ms/step - loss: 0.0039 - accuracy: 0.9984 - val_loss: 0.1214 - val_accuracy: 0.9863
Epoch 13/25
30/30 [=====] - 11s 363ms/step - loss: 0.0011 - accuracy: 0.9997 - val_loss: 0.1153 - val_accuracy: 0.9895
Epoch 14/25
30/30 [=====] - 9s 294ms/step - loss: 6.9965e-04 - accuracy: 0.9997 - val_loss: 0.1322 - val_accuracy: 0.9873
Epoch 15/25
30/30 [=====] - 9s 292ms/step - loss: 0.7710 - accuracy: 0.9739 - val_loss: 0.1286 - val_accuracy: 0.9884
Epoch 16/25
30/30 [=====] - 9s 294ms/step - loss: 5.0771e-04 - accuracy: 0.9997 - val_loss: 0.1294 - val_accuracy: 0.9895
Epoch 17/25
30/30 [=====] - 9s 296ms/step - loss: 2.4364e-04 - accuracy: 1.0000 - val_loss: 0.1362 - val_accuracy: 0.9895
Epoch 18/25
30/30 [=====] - 9s 293ms/step - loss: 7.7019e-05 - accuracy: 1.0000 - val_loss: 0.1435 - val_accuracy: 0.9863
Epoch 19/25
30/30 [=====] - 9s 294ms/step - loss: 4.9329e-05 - accuracy: 1.0000 - val_loss: 0.1585 - val_accuracy: 0.9863
Epoch 20/25
30/30 [=====] - 9s 310ms/step - loss: 3.0667e-05 - accuracy: 1.0000 - val_loss: 0.1735 - val_accuracy: 0.9863
Epoch 21/25
30/30 [=====] - 9s 316ms/step - loss: 1.8201e-05 - accuracy: 1.0000 - val_loss: 0.1857 - val_accuracy: 0.9852
Epoch 22/25
30/30 [=====] - 9s 295ms/step - loss: 7.7908e-06 - accuracy: 1.0000 - val_loss: 0.2049 - val_accuracy: 0.9884
Epoch 23/25
30/30 [=====] - 9s 295ms/step - loss: 7.4443e-06 - accuracy: 1.0000 - val_loss: 0.2257 - val_accuracy: 0.9873
Epoch 24/25
30/30 [=====] - 9s 298ms/step - loss: 1.8775e-04 - accuracy: 1.0000 - val_loss: 0.2443 - val_accuracy: 0.9810
Epoch 25/25
30/30 [=====] - 9s 292ms/step - loss: 1.6095e-06 - accuracy: 1.0000 - val_loss: 0.2496 - val_accuracy: 0.9810
```

>>>

### Solution:

```
model.fit_generator(xtrain,
test_sequences = tok.texts_to_sequences(X_test)
test_sequences_matrix = sequence.pad_sequences(test_sequences,maxlen=max_len)

accuracy = model.evaluate(test_sequences_matrix,Y_test)
print('Accuracy: {:.0.3f}'.format(accuracy[1]))
```

### Output:

```
27/27 [=====] - 1s 27ms/step - loss: 0.3614 - accuracy: 0.9833
Accuracy: 0.983
```

