

**Assignment -4**  
**SMS SPAM Classification**

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**Question-1.** Import required library

**Solution:**

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
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 Adam
from keras.preprocessing.text import Tokenizer
from keras.preprocessing import sequence
from keras.utils import pad_sequences
from keras.utils import to_categorical
from keras.callbacks import EarlyStopping
```

**Question-2.** Read the Dataset

**Solution:**

```
df = pd.read_csv('spam.csv',delimiter=',',encoding='latin-1')
df.head()
```

	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

### Question-3. Preprocessing the Dataset

#### Solution:

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

```
from wordcloud import WordCloud, STOPWORDS, ImageColorGenerator
```

```
X = df.v2
```

```
Y = df.v1
```

```
le = LabelEncoder()
```

```
Y = le.fit_transform(Y)
```

```
Y = Y.reshape(-1,1)
```

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.25)
```

```
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 = pad_sequences(sequences,maxlen=max_len)
```

### Question-4.Create Model

#### Solution:

```
inputs = Input(shape=[max_len])
```

```
layer = Embedding(max_words,50,input_length=max_len)(inputs)
```

```
layer = LSTM(128)(layer)
```

```
layer = Dense(128)(layer)
```

```

layer = Activation('relu')(layer)
layer = Dropout(0.5)(layer)
layer = Dense(1)(layer)
layer = Activation('sigmoid')(layer)
model = Model(inputs=inputs,outputs=layer)

```

**Question-5.** Add Layers (LSTM, Dense-(Hidden Layers), Output)

**Solution:**

```
model.summary()
```

Model: "model\_1"

Layer (type)	Output Shape	Param #
=====		
input_2 (InputLayer)	[(None, 150)]	0
embedding_1 (Embedding)	(None, 150, 50)	50000
lstm_1 (LSTM)	(None, 128)	91648
dense_2 (Dense)	(None, 128)	16512
activation_2 (Activation)	(None, 128)	0
dropout_1 (Dropout)	(None, 128)	0
dense_3 (Dense)	(None, 1)	129
activation_3 (Activation)	(None, 1)	0
=====		
Total params: 158,289		
Trainable params: 158,289		
Non-trainable params: 0		
=====		

### Question-6.Compile the Model

#### Solution:

```
model.compile(loss='binary_crossentropy',optimizer=Adam(),metrics=['accuracy'])
```

### Question-7. Fit the Model

#### Solution:

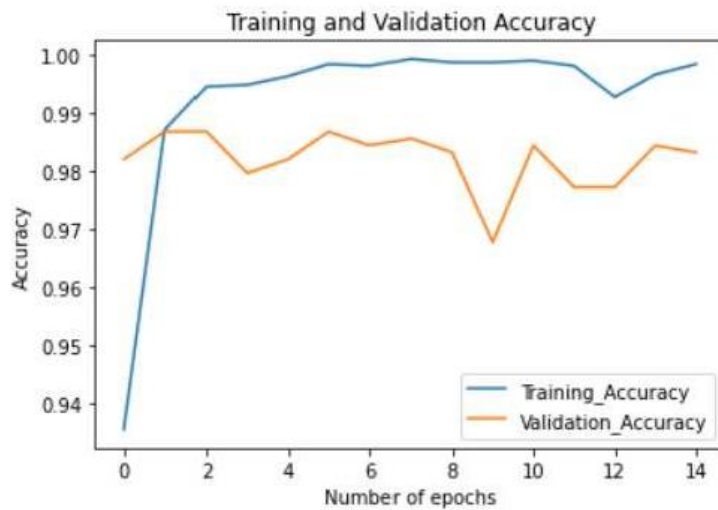
```
history = model.fit(sequences_matrix,Y_train,batch_size=20,epochs=15,  
                    validation_split=0.2)
```

```
Epoch 1/15  
168/168 [=====] - 34s 190ms/step - loss: 0.1980 - accuracy: 0.9354 - val_loss: 0.0649 - val_accuracy: 0.9821  
Epoch 2/15  
168/168 [=====] - 31s 185ms/step - loss: 0.0416 - accuracy: 0.9871 - val_loss: 0.0513 - val_accuracy: 0.9868  
Epoch 3/15  
168/168 [=====] - 31s 186ms/step - loss: 0.0217 - accuracy: 0.9946 - val_loss: 0.0613 - val_accuracy: 0.9868  
Epoch 4/15  
168/168 [=====] - 33s 198ms/step - loss: 0.0155 - accuracy: 0.9949 - val_loss: 0.0779 - val_accuracy: 0.9797  
Epoch 5/15  
168/168 [=====] - 32s 188ms/step - loss: 0.0132 - accuracy: 0.9964 - val_loss: 0.0661 - val_accuracy: 0.9821  
Epoch 6/15  
168/168 [=====] - 32s 190ms/step - loss: 0.0065 - accuracy: 0.9985 - val_loss: 0.0772 - val_accuracy: 0.9868  
Epoch 7/15  
168/168 [=====] - 32s 192ms/step - loss: 0.0057 - accuracy: 0.9982 - val_loss: 0.0811 - val_accuracy: 0.9844  
Epoch 8/15  
168/168 [=====] - 32s 191ms/step - loss: 0.0045 - accuracy: 0.9994 - val_loss: 0.0877 - val_accuracy: 0.9856  
Epoch 9/15  
168/168 [=====] - 32s 189ms/step - loss: 0.0046 - accuracy: 0.9988 - val_loss: 0.1282 - val_accuracy: 0.9833  
Epoch 10/15  
168/168 [=====] - 32s 188ms/step - loss: 0.0066 - accuracy: 0.9988 - val_loss: 0.1191 - val_accuracy: 0.9677  
Epoch 11/15  
168/168 [=====] - 33s 194ms/step - loss: 0.0036 - accuracy: 0.9991 - val_loss: 0.1149 - val_accuracy: 0.9844  
Epoch 12/15  
168/168 [=====] - 31s 186ms/step - loss: 0.0131 - accuracy: 0.9982 - val_loss: 0.1019 - val_accuracy: 0.9773  
Epoch 13/15  
168/168 [=====] - 31s 187ms/step - loss: 0.0251 - accuracy: 0.9928 - val_loss: 0.1015 - val_accuracy: 0.9773  
Epoch 14/15  
168/168 [=====] - 31s 187ms/step - loss: 0.0081 - accuracy: 0.9967 - val_loss: 0.1005 - val_accuracy: 0.9844  
Epoch 15/15  
168/168 [=====] - 32s 188ms/step - loss: 0.0048 - accuracy: 0.9985 - val_loss: 0.0985 - val_accuracy: 0.9833
```

```
metrics = pd.DataFrame(history.history)  
metrics.rename(columns = {'loss': 'Training_Loss', 'accuracy': 'Training_Accuracy', 'val_loss': 'Validation_Loss', 'val_accuracy': 'Validation_Accuracy'}, inplace = True)  
def plot_graphs1(var1, var2, string):  
    metrics[[var1, var2]].plot()
```

```
plt.title('Training and Validation ' + string)
plt.xlabel('Number of epochs')
plt.ylabel(string)
plt.legend([var1, var2])
```

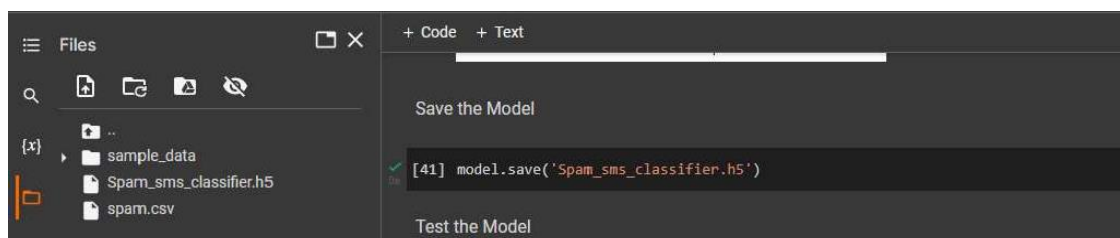
```
plot_graphs1('Training_Accuracy', 'Validation_Accuracy', 'Accuracy')
```



**Question-8.** Save The Model

**Solution:**

```
model.save('Spam_sms_classifier.h5')
```



**Question-9.** Test The Model

**Solution:**

```
test_sequences = tok.texts_to_sequences(X_test)
```

```
test_sequences_matrix = pad_sequences(test_sequences,maxlen=max_len)
```

```
accuracy1 = model.evaluate(test_sequences_matrix,Y_test)
```

```
44/44 [=====] - 4s 82ms/step - loss: 0.1061 - accuracy: 0.9828
```

```
print(' loss: {:.4f}'.format(accuracy1[0]))
```

```
print(' Accuracy: {:.4f}'.format(accuracy1[1]))
```

```
loss: 0.1061
```

```
Accuracy: 0.9828
```