Assignment -4
Python Programming

Assignment Date	13 November 2022
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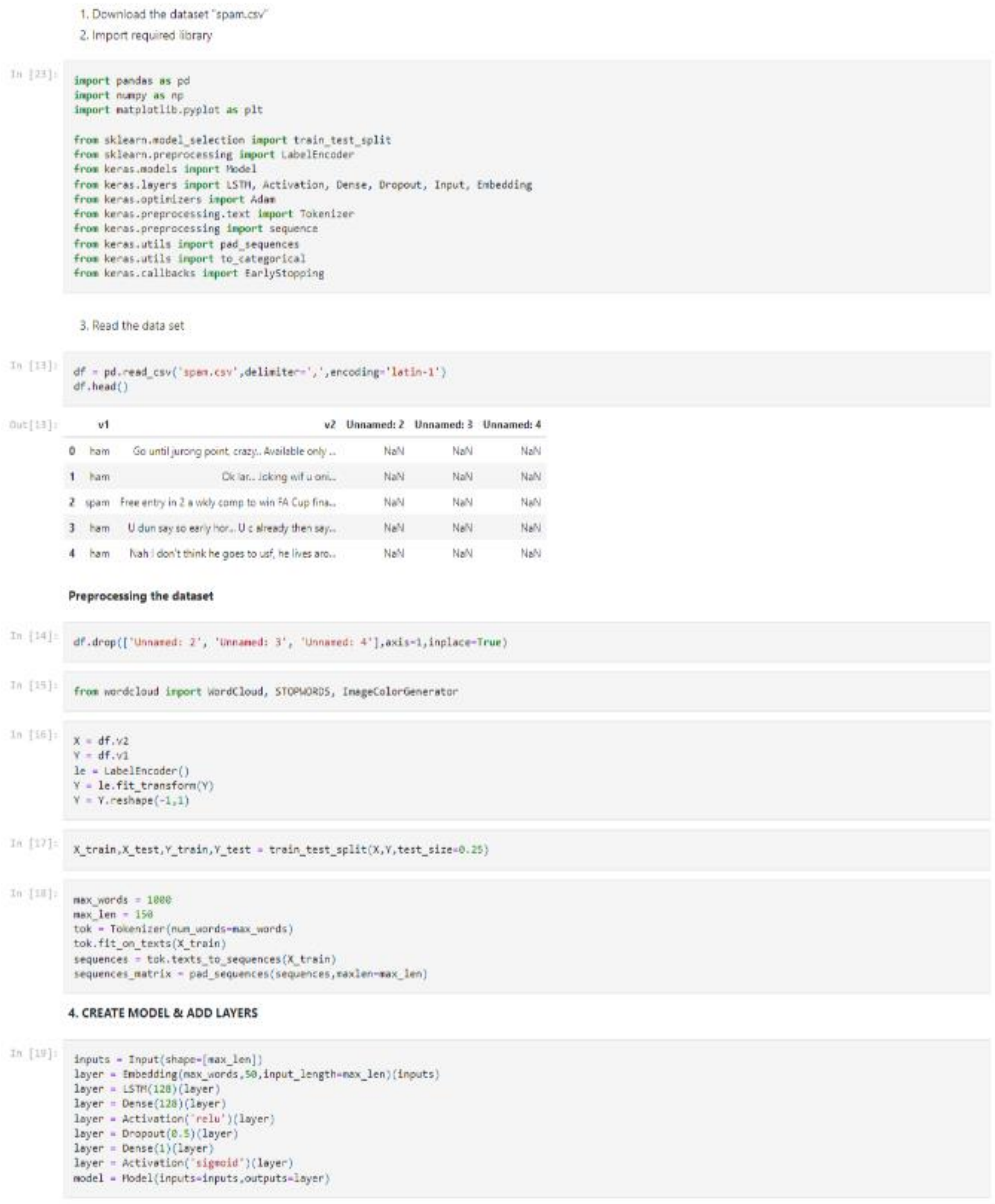
Maximum Marks	2 Marks



1. Download the dataset "spam.csv"
2. Import required library

In [23]:
```python
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
```

3. Read the data set

In [13]:
```python
df = pd.read_csv('spam.csv',delimiter=',',encoding='latin-1')
df.head()
```

Out[13]:

	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

Preprocessing the dataset

In [14]:
```python
df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True)
```

In [15]:
```python
from wordcloud import WordCloud, STOPWORDS, ImageColorGenerator
```

In [16]:
```python
X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)
```

In [17]:
```python
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.25)
```

In [18]:
```python
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)
```

4. CREATE MODEL & ADD LAYERS

In [19]:
```python
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)
```

In [20]:

```
model.summary()
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 150)]             0

 embedding (Embedding)       (None, 150, 50)           50000

 lstm (LSTM)                 (None, 128)               91648

 dense (Dense)               (None, 128)               16512

 activation (Activation)     (None, 128)               0

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 1)                 129

 activation_1 (Activation)   (None, 1)                 0

=================================================================
Total params: 158,289
Trainable params: 158,289
Non-trainable params: 0
_________________________________________________________________
```

5.Compile the Model

In [24]:

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

6.FIT THE MODEL

In [25]:

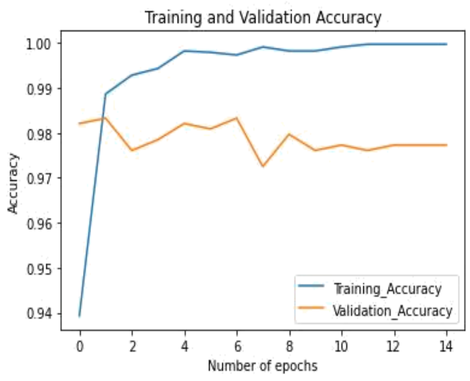
```
history = model.fit(sequences_matrix,Y_train,batch_size=20,epochs=15,
          validation_split=0.2)
```

```
Epoch 1/15
168/168 [==============================] - 35s 189ms/step - loss: 0.1840 - accuracy: 0.9393 - val_loss: 0.0674 - val_accuracy: 0.9821
Epoch 2/15
168/168 [==============================] - 33s 196ms/step - loss: 0.0379 - accuracy: 0.9886 - val_loss: 0.0608 - val_accuracy: 0.9833
Epoch 3/15
168/168 [==============================] - 31s 184ms/step - loss: 0.0189 - accuracy: 0.9928 - val_loss: 0.0805 - val_accuracy: 0.9761
Epoch 4/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0180 - accuracy: 0.9943 - val_loss: 0.0821 - val_accuracy: 0.9785
Epoch 5/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0082 - accuracy: 0.9982 - val_loss: 0.0990 - val_accuracy: 0.9821
Epoch 6/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0062 - accuracy: 0.9979 - val_loss: 0.1117 - val_accuracy: 0.9809
Epoch 7/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0069 - accuracy: 0.9973 - val_loss: 0.1254 - val_accuracy: 0.9833
Epoch 8/15
168/168 [==============================] - 33s 198ms/step - loss: 0.0044 - accuracy: 0.9991 - val_loss: 0.1335 - val_accuracy: 0.9725
Epoch 9/15
168/168 [==============================] - 31s 186ms/step - loss: 0.0097 - accuracy: 0.9982 - val_loss: 0.1148 - val_accuracy: 0.9797
Epoch 10/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0051 - accuracy: 0.9982 - val_loss: 0.1406 - val_accuracy: 0.9761
Epoch 11/15
168/168 [==============================] - 31s 186ms/step - loss: 0.0041 - accuracy: 0.9991 - val_loss: 0.1406 - val_accuracy: 0.9773
Epoch 12/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0025 - accuracy: 0.9997 - val_loss: 0.1444 - val_accuracy: 0.9761
Epoch 13/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0022 - accuracy: 0.9997 - val_loss: 0.1363 - val_accuracy: 0.9773
Epoch 14/15
168/168 [==============================] - 33s 197ms/step - loss: 0.0016 - accuracy: 0.9997 - val_loss: 0.1514 - val_accuracy: 0.9773
Epoch 15/15
168/168 [==============================] - 31s 187ms/step - loss: 0.0022 - accuracy: 0.9997 - val_loss: 0.1462 - val_accuracy: 0.9773
```

In [26]:

```
metrics = pd.DataFrame(history.history)
metrics.rename(columns = {'loss': 'Training_Loss', 'accuracy': 'Training_Accuracy', 'val_loss': 'Validation_Loss', 'val_accuracy': 'Validation_Accurac
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])
```

In [30]:
```
plot_graphs1('Training_Accuracy', 'Validation_Accuracy', 'Accuracy')
```



7. SAVE THE MODEL

In [33]:
```
model.save('A4Spam_sms_classifier.h5')
```

8.TEST THE MODEL

In [34]:
```
test_sequences = tok.texts_to_sequences(X_test)
test_sequences_matrix = pad_sequences(test_sequences,maxlen=max_len)
```

In [35]:
```
accuracy1 = model.evaluate(test_sequences_matrix,Y_test)
```

```
44/44 [==============================] - 4s 80ms/step - loss: 0.1045 - accuracy: 0.9864
```

In [40]:
```
print(' loss: {:0.4f}'.format(accuracy1[0]))
print(' Accuracy: {:0.4f}'.format(accuracy1[1]))
```

```
 loss: 0.1045
 Accuracy: 0.9864
```