**Assignment -4**

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**Date: 1 November  2022**

### 1) Download the Dataset

In [4]:

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

```
Mounted at /content/gdrive
```

In [5]:

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

Out[5]:

| | 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 |

### 2) Import required library

In [16]:

```
import pandas as pd
import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
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.callbacks import EarlyStopping
%matplotlib inline
```

### 3) Read dataset and do pre-processing

In [6]:

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

```
<class 'pandas.core.frame.DataFrame'>
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
```

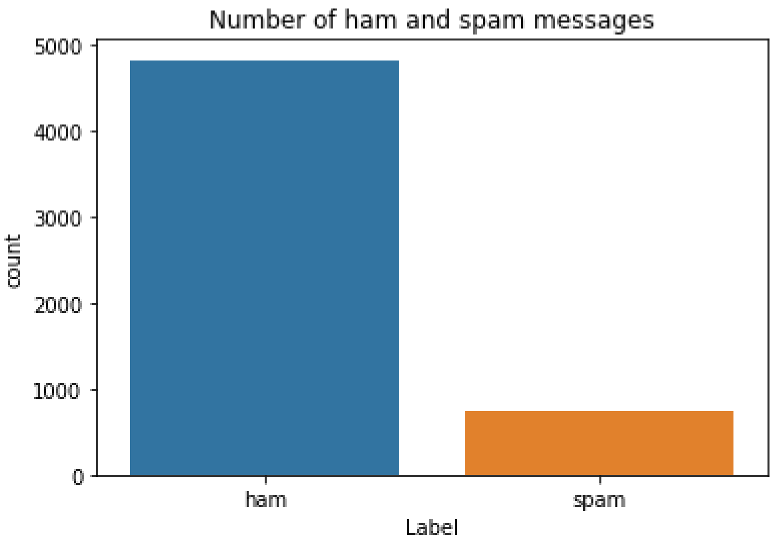
In [7]:

```
sns.countplot(df.v1)
plt.xlabel('Label')
plt.title('Number of ham and spam messages')
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWa
rning: Pass the following variable as a keyword arg: x. From version 0.12,
the only valid positional argument will be `data`, and passing other argum
ents without an explicit keyword will result in an error or misinterpretat
ion.
  FutureWarning
```

Out[7]:

```
Text(0.5, 1.0, 'Number of ham and spam messages')
```



**4) Create Model**

In [8]:

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

In [9]:

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.15)
```

In [17]:

```
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 = tf.keras.utils.pad_sequences(sequences,maxlen=max_len)
```

### 5) Add Layers (LSTM, Dense-(Hidden Layers), Output)

In [18]:

```
def RNN():
    inputs = Input(name='inputs',shape=[max_len])
    layer = Embedding(max_words,50,input_length=max_len)(inputs)
    layer = LSTM(64)(layer)
    layer = Dense(256,name='FC1')(layer)
    layer = Activation('relu')(layer)
    layer = Dropout(0.5)(layer)
    layer = Dense(1,name='out_layer')(layer)
    layer = Activation('sigmoid')(layer)
    model = Model(inputs=inputs,outputs=layer)
    return model
```

### 6) Compile the Model

In [19]:

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

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

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

 lstm (LSTM)                 (None, 64)                29440

 FC1 (Dense)                 (None, 256)               16640

 activation (Activation)     (None, 256)               0

 dropout (Dropout)           (None, 256)               0

 out_layer (Dense)           (None, 1)                 257

 activation_1 (Activation)   (None, 1)                 0

=================================================================
Total params: 96,337
Trainable params: 96,337
Non-trainable params: 0
_________________________________________________________________
```

### 7) Fit the Model

In [20]:

```
model.fit(sequences_matrix,Y_train,batch_size=128,epochs=10,
          validation_split=0.2,callbacks=[EarlyStopping(monitor='val_loss',min_delta=0.
0001)])
```

```
Epoch 1/10
30/30 [==============================] - 12s 305ms/step - loss: 0.3157 - a
ccuracy: 0.8762 - val_loss: 0.1607 - val_accuracy: 0.9747
Epoch 2/10
30/30 [==============================] - 9s 285ms/step - loss: 0.0761 - ac
curacy: 0.9813 - val_loss: 0.0772 - val_accuracy: 0.9778
```

Out[20]:

```
<keras.callbacks.History at 0x7f853b80bd10>
```

### 8) Save and Test The Model

In [22]:

```
test_sequences = tok.texts_to_sequences(X_test)
test_sequences_matrix = tf.keras.utils.pad_sequences(test_sequences,maxlen=max_len)
```

In [23]:

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

```
27/27 [==============================] - 1s 39ms/step - loss: 0.0361 - acc
uracy: 0.9916
```

In [24]:

```
print('Test set\n  Loss: {:0.3f}\n  Accuracy: {:0.3f}'.format(accr[0],accr[1]))
```

```
Test set
  Loss: 0.036
  Accuracy: 0.992
```