***SMS SPAM Classification***

### 1)Import required library

In [ ]:

```
import pandas as pd
import numpy as np
from keras import utils
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
%matplotlib inline
```

### 2) i) Read dataset

In [ ]:

```
!unzip "/content/drive/MyDrive/Colab Notebooks/spam.zip"
```

```
Archive:  /content/drive/MyDrive/Colab Notebooks/spam.zip
  inflating: spam.csv
```

In [ ]:

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

Out[ ]:

| | 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 |
| ... | ... | ... | ... | ... | ... |
| 5567 | spam | This is the 2nd time we have tried 2 contact u... | NaN | NaN | NaN |
| 5568 | ham | Will Ì_ b going to esplanade fr home? | NaN | NaN | NaN |
| 5569 | ham | Pity, * was in mood for that. So...any other s... | NaN | NaN | NaN |
| 5570 | ham | The guy did some bitching but I acted like i'd... | NaN | NaN | NaN |
| 5571 | ham | Rofl. Its true to its name | NaN | NaN | NaN |

5572 rows × 5 columns

### 2) ii)Pre-processing

In [ ]:

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

```
df  # Drop the columns that are not requried for the neural network.
```

Out[ ]:

| | v1 | v2 |
|---|---|---|
| 0 | ham | Go until jurong point, crazy.. Available only ... |
| 1 | ham | Ok lar... Joking wif u oni... |
| 2 | spam | Free entry in 2 a wkly comp to win FA Cup fina... |
| 3 | ham | U dun say so early hor... U c already then say... |
| 4 | ham | Nah I don't think he goes to usf, he lives aro... |
| ... | ... | ... |
| 5567 | spam | This is the 2nd time we have tried 2 contact u... |
| 5568 | ham | Will Ì_ b going to esplanade fr home? |
| 5569 | ham | Pity, * was in mood for that. So...any other s... |
| 5570 | ham | The guy did some bitching but I acted like i'd... |
| 5571 | ham | Rofl. Its true to its name |

**5572 rows × 2 columns**

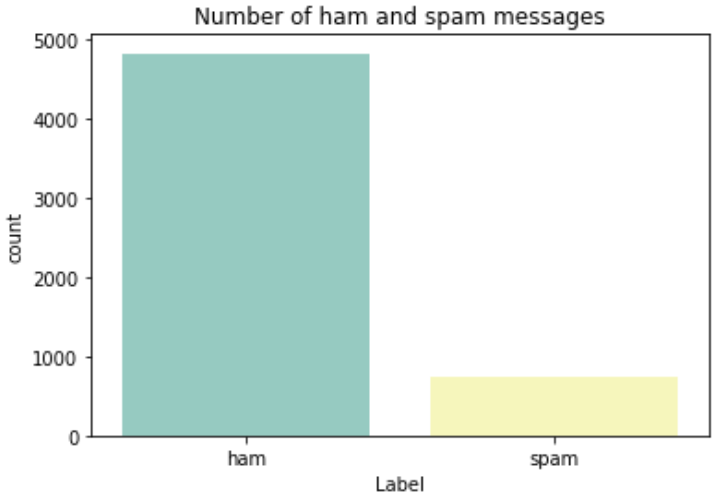
In [ ]:

```
sns.countplot(df.v1,palette='Set3')
plt.xlabel('Label')
plt.title('Number of ham and spam messages')
```

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

Out[ ]:

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




In [ ]:

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

In [ ]:

```
# Split into training and test data.
```

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

In [ ]:

```
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 = utils.pad_sequences(sequences,maxlen=max_len) # Padding the words to g
et equal length for all words in a sentence
```

In [ ]:

```
sequences_matrix.shape
```

Out[ ]:

```
(4736, 150)
```

In [ ]:

```
sequences_matrix.ndim
```

Out[ ]:

```
2
```

In [ ]:

```
sequences_matrix = np.reshape(sequences_matrix,(4736,150,1))
sequences_matrix.ndim #3d shape verification to proceed to RNN LSTM
```

Out[ ]:

```
3
```

#### 4) Create Model for RNN

In [ ]:

```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import LSTM
from keras.layers import Embedding
```

In [ ]:

```
model = Sequential()
```

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

In [ ]:

```
model.add(Embedding(max_words,50,input_length=max_len))
model.add(LSTM(units=64,input_shape = (sequences_matrix.shape[1],1),return_sequences=Tru
e))
model.add(LSTM(units=64,return_sequences=True))
model.add(LSTM(units=64,return_sequences=True))
model.add(LSTM(units=64))
model.add(Dense(units = 256,activation = 'relu'))
model.add(Dense(units = 1,activation = 'sigmoid'))
```

#### 6)Compile the Model

In [ ]:

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

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 150, 50)           50000

 lstm (LSTM)                 (None, 150, 64)           29440

 lstm_1 (LSTM)               (None, 150, 64)           33024

 lstm_2 (LSTM)               (None, 150, 64)           33024

 lstm_3 (LSTM)               (None, 64)                33024

 dense (Dense)               (None, 256)               16640

 dense_1 (Dense)             (None, 1)                 257

 embedding_1 (Embedding)     (None, 1, 50)             50000

 lstm_4 (LSTM)               (None, 1, 64)             29440

 lstm_5 (LSTM)               (None, 1, 64)             33024

 lstm_6 (LSTM)               (None, 1, 64)             33024

 lstm_7 (LSTM)               (None, 64)                33024

 dense_2 (Dense)             (None, 256)               16640

 dense_3 (Dense)             (None, 1)                 257

=================================================================
Total params: 390,818
Trainable params: 390,818
Non-trainable params: 0
_________________________________________________________________
```

**7)Fit the model on the training data.**

In [ ]:

```
X = model.fit(sequences_matrix,Y_train,batch_size=128,epochs=5,validation_split=0.2)
X
```

```
Epoch 1/5
30/30 [==============================] - 45s 1s/step - loss: 0.4416 - accuracy: 0.8432 -
val_loss: 0.2616 - val_accuracy: 0.8903
Epoch 2/5
30/30 [==============================] - 31s 1s/step - loss: 0.1363 - accuracy: 0.9591 -
val_loss: 0.0683 - val_accuracy: 0.9778
Epoch 3/5
30/30 [==============================] - 33s 1s/step - loss: 0.0556 - accuracy: 0.9826 -
val_loss: 0.0633 - val_accuracy: 0.9821
Epoch 4/5
30/30 [==============================] - 34s 1s/step - loss: 0.0369 - accuracy: 0.9894 -
val_loss: 0.0773 - val_accuracy: 0.9821
Epoch 5/5
30/30 [==============================] - 32s 1s/step - loss: 0.0275 - accuracy: 0.9926 -
val_loss: 0.0833 - val_accuracy: 0.9821
```

Out[ ]:

```
<keras.callbacks.History at 0x7f0e3ddf3c10>
```

**8)Save the model**

In [ ]:

```
model.save
```

Out[ ]:

Out[ ]:

```
<bound method Model.save of <keras.engine.sequential.Sequential object at 0x7f0e42439910>
>
```

**9)Evaluate the model on test set data.**

In [ ]:

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

In [ ]:

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

```
27/27 [==============================] - 6s 84ms/step - loss: 0.1020 - accuracy: 0.9701
```

In [ ]:

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

```
Test set
  Loss: 0.102
  Accuracy: 0.970
```

In [ ]:

```

```