1)Import required library

```
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
```

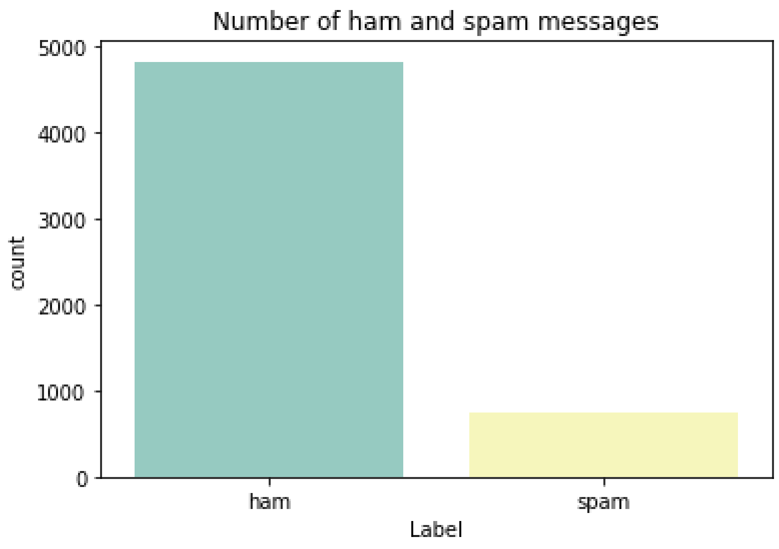
2) i) Read dataset

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

	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

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



```
X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)
# Split into training and test data.
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 = utils.pad_sequences(sequences,maxlen=max_len) # Padding the words to ge
sequences_matrix.shape
(4736, 150)
sequences_matrix.ndim

     2
```

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

     3
```

4) Create Model for RNN

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

```
model = Sequential()
```

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

```
model.add(Embedding(max_words,50,input_length=max_len))
model.add(LSTM(units=64,input_shape = (sequences_matrix.shape[1],1),return_sequences=True
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

```
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

=================================================================
Total params: 195,409
Trainable params: 195,409
Non-trainable params: 0
_________________________________________________________________
```

7)Fit the model on the training data

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

```
Epoch 1/5
30/30 [==============================] - 44s 1s/step - loss: 0.4569 - accuracy: 0.84
Epoch 2/5
30/30 [==============================] - 45s 2s/step - loss: 0.3207 - accuracy: 0.87
```

```
Epoch 3/5
30/30 [==============================] - 33s 1s/step - loss: 0.1115 - accuracy: 0.96
Epoch 4/5
30/30 [==============================] - 33s 1s/step - loss: 0.0487 - accuracy: 0.98
Epoch 5/5
30/30 [==============================] - 34s 1s/step - loss: 0.0375 - accuracy: 0.99
<keras.callbacks.History at 0x7f7332fb3e50>
```

8)Save the model

```
model.save
```

```
<bound method Model.save of <keras.engine.sequential.Sequential object at
0x7f7337435110>>
```

9)Evaluate the model on test set data

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

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

```
27/27 [==============================] - 4s 90ms/step - loss: 0.1111 - accuracy: 0.9
```

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

```
Test set
 Loss: 0.111
 Accuracy: 0.972
```