Importing required libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from keras_preprocessing.sequence import pad_sequences
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.sequence import pad_sequences
from keras.utils import to_categorical
from keras.callbacks import EarlyStopping
import nltk
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from nltk.stem import WordNetLemmatizer
import re
%matplotlib inline
```

Reading Dataset

```
data = pd.read_csv("/content/spam.csv", encoding="ISO-8859-1")
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   v1          5572 non-null   object
```

```
 1   v2          5572 non-null   object
 2   Unnamed: 2  50 non-null     object
 3   Unnamed: 3  12 non-null     object
 4   Unnamed: 4  6 non-null      object
dtypes: object(5)
memory usage: 217.8+ KB
```

```
data.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

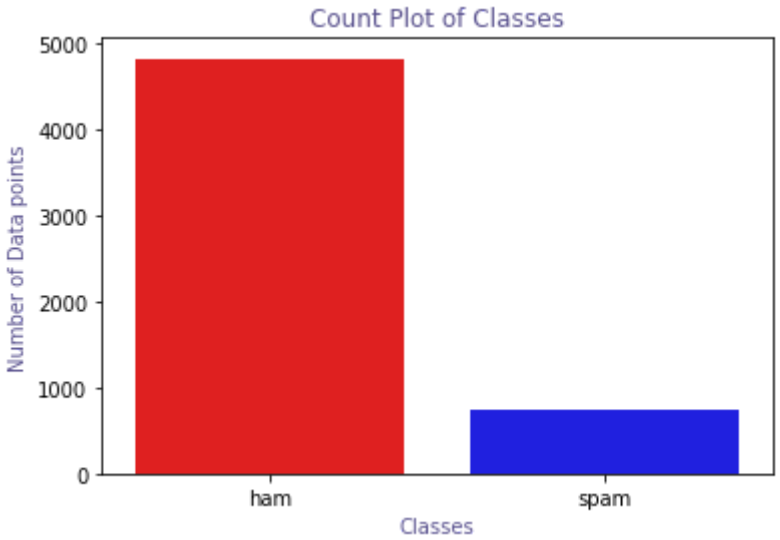
Data Preprocessing

```
df = data.drop(data[["Unnamed: 2","Unnamed: 3","Unnamed: 4"]], axis=1)
df.rename(columns = {"v1":"Target", "v2":"Text"}, inplace = True)
df
```

	Target	Text
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...
...	...	...

```
plt.figure(figsize=(6,4))
fg = sns.countplot(x= df["Target"], palette= ["red", "blue"] )
fg.set_title("Count Plot of Classes", color="#58508d")
fg.set_xlabel("Classes", color="#58508d")
fg.set_ylabel("Number of Data points", color="#58508d")
```

```
Text(0, 0.5, 'Number of Data points')
```




```
nltk.download('punkt')
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
True
```

```
df["No_of_Characters"] = df["Text"].apply(len)
df["No_of_Words"]=df.apply(lambda row: nltk.word_tokenize(row["Text"]), axis=1).apply(len)
df["No_of_sentence"]=df.apply(lambda row: nltk.sent_tokenize(row["Text"]), axis=1).apply(len)
df.describe().T
```

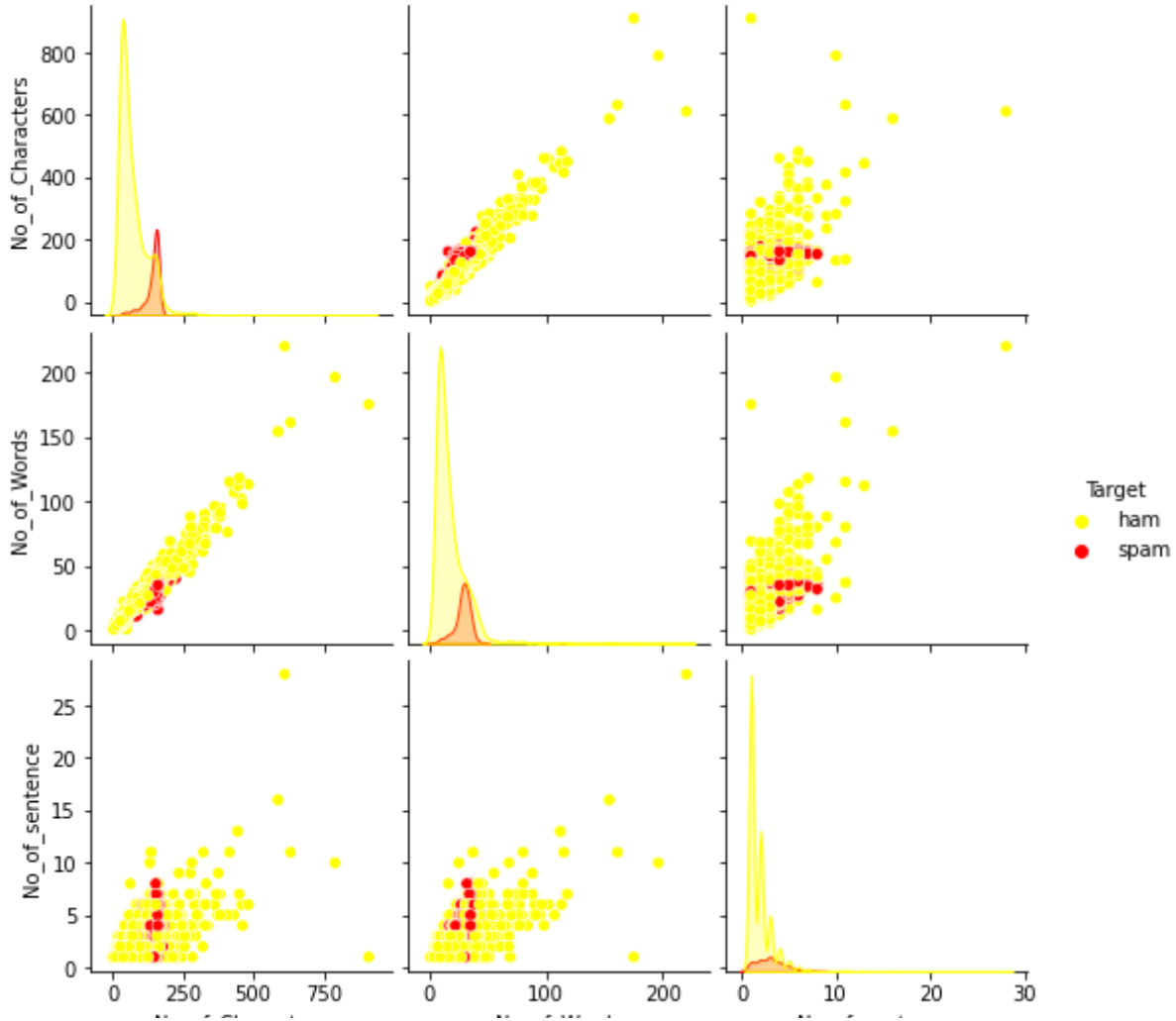
	count	mean	std	min	25%	50%	75%	max
No_of_Characters	5572.0	80.118808	59.690841	2.0	36.0	61.0	121.0	910.0
No_of_Words	5572.0	18.695621	13.742587	1.0	9.0	15.0	27.0	220.0
No_of_sentence	5572.0	1.970747	1.417778	1.0	1.0	1.0	2.0	28.0

```
df.head()
```

	Target	Text	No_of_Characters	No_of_Words	No_of_sentence
0	ham	Go until jurong point, crazy.. Available only ...	111	24	2
1	ham	Ok lar... Joking wif u oni...	29	8	2
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155	37	2
3	ham	U dun say so early hor... U c already then say...	49	13	1
4	ham	Nah I don't think he goes to usf, he lives aro...	61	15	1

```
plt.figure(figsize=(18,12))
fg = sns.pairplot(data=df, hue="Target",palette=["yellow","red"])
plt.show(fg)
```

```
<Figure size 1296x864 with 0 Axes>
```




```
def Clean(Text):
    sms = re.sub('[^a-zA-Z]', ' ', Text)       #Replacing all non-alphabetic characters with a space
    sms = sms.lower()      #converting to lowecase
    sms = sms.split()
    sms = ' '.join(sms)
    return sms
df["Clean_Text"] = df["Text"].apply(Clean)
```

```
df["Tokenize_Text"]=df.apply(lambda row: nltk.word_tokenize(row["Clean_Text"]), axis=1)
```

```
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
True
```

```
def remove_stopwords(text):
    stop_words = set(stopwords.words("english"))
    filtered_text = [word for word in text if word not in stop_words]
    return filtered_text
```

```
df["Nostopword_Text"] = df["Tokenize_Text"].apply(remove_stopwords)
```

```
nltk.download('wordnet')
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
True
```

```
nltk.download('omw-1.4')
```

```
[nltk_data] Downloading package omw-1.4 to /root/nltk_data...
True
```

```
lemmatizer = WordNetLemmatizer()
```

```
def lemmatize_word(text):
    lemmas = [lemmatizer.lemmatize(word, pos ='v') for word in text]
    return lemmas
```

```
df["Lemmatized_Text"] = df["Nostopword_Text"].apply(lemmatize_word)
```

```
corpus= []
for i in df["Lemmatized_Text"]:
    msg = ' '.join([row for row in i])
    corpus.append(msg)
corpus[:5]
```

```
['go jurong point crazy available bugis n great world la e buffet cine get amore wat',
 'ok lar joke wif u oni',
 'free entry wkly comp win fa cup final tkts st may text fa receive entry question std txt rate c apply',
 'u dun say early hor u c already say',
 'nah think go usf live around though']
```

```
df.tail()
```

	Target	Text	No_of_Characters	No_of_Words	No_of_sentence	Clean_Text	Tokenize_Text	Nostopword_Text	Lemmatiz

Model building

5567	spam	we have	161	35	4	have tried	time, we, have	contact, u, u	con

```
X = df.Clean_Text
Y = df.Target
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)
```

		fr home?				fr home	fr, home]	home]	

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

		in mood				mood for	[pity, was, 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 = pad_sequences(sequences,maxlen=max_len)
```

		but ! ...				i acted like i	but. i. acted....	interested. buvin...	s

Layers

```
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
```

Compiling

```
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
_________________________________________________________________
```

Fill model

```
model.fit(sequences_matrix,Y_train,batch_size=128,epochs=15,validation_split=0.2,callbacks=[EarlyStopping(monitor='val_loss',min_delt
```

```
Epoch 1/15
30/30 [==============================] - 8s 268ms/step - loss: 0.0380 - accuracy: 0.9889 - val_loss: 0.0600 - val_accuracy: 0.9
Epoch 2/15
30/30 [==============================] - 8s 266ms/step - loss: 0.0290 - accuracy: 0.9908 - val_loss: 0.0611 - val_accuracy: 0.9
<keras.callbacks.History at 0x7fd1b9419b10>
```

Save model

```
model.save('lstm_model')
```

```
WARNING:absl:Found untraced functions such as lstm_cell_layer_call_fn, lstm_cell_layer_call_and_return_conditional_losses while
```

Test model

```
test_sequences = tok.texts_to_sequences(X_test)
test_sequences_matrix = pad_sequences(test_sequences,maxlen=max_len)
accr = model.evaluate(test_sequences_matrix,Y_test)
```

```
27/27 [==============================] - 1s 23ms/step - loss: 0.0567 - accuracy: 0.9833
```

✓ 0s completed at 10:37 AM