```
import pandas as pd
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
```

```
from tensorflow.keras.preprocessing.sequence import pad_sequences
```

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

```
---------------------------------------------------------------------------
FileNotFoundError                         Traceback (most recent call last)
<ipython-input-5-b43e29bce5ab> in <module>
----> 1 df = pd.read_csv('spam.csv',delimiter=',',encoding='latin-1')
      2 df.head()
```

7 frames

```
/usr/local/lib/python3.7/dist-packages/pandas/io/common.py in get_handle(path_or_buf,
storage_options)
    705                 encoding=ioargs.encoding,
    706                 errors=errors,
--> 707                 newline="",
    708             )
    709         else:

FileNotFoundError: [Errno 2] No such file or directory: 'spam.csv'
```

SEARCH STACK OVERFLOW

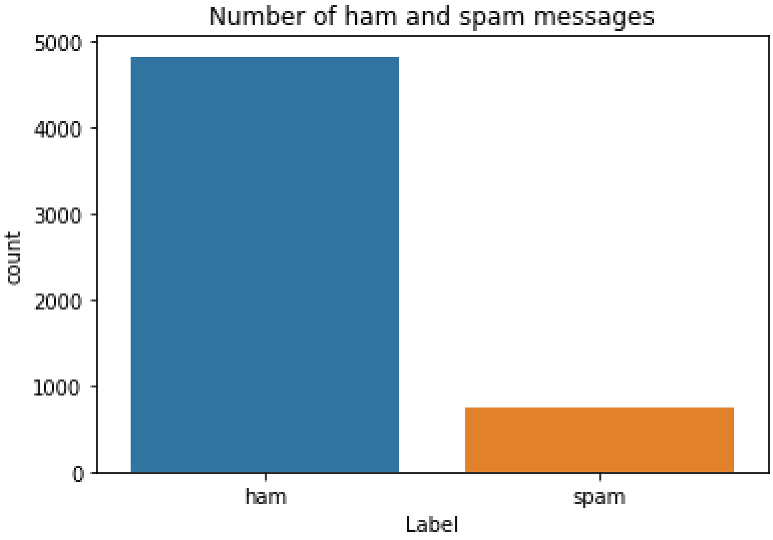
```
df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True)
df.info()
```

```
<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
```

```
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: 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)
```

```
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)
```

```
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

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
_________________________________________________________________
```

```
df.columns
```

```
Index(['v1', 'v2', 'Count'], dtype='object')
```

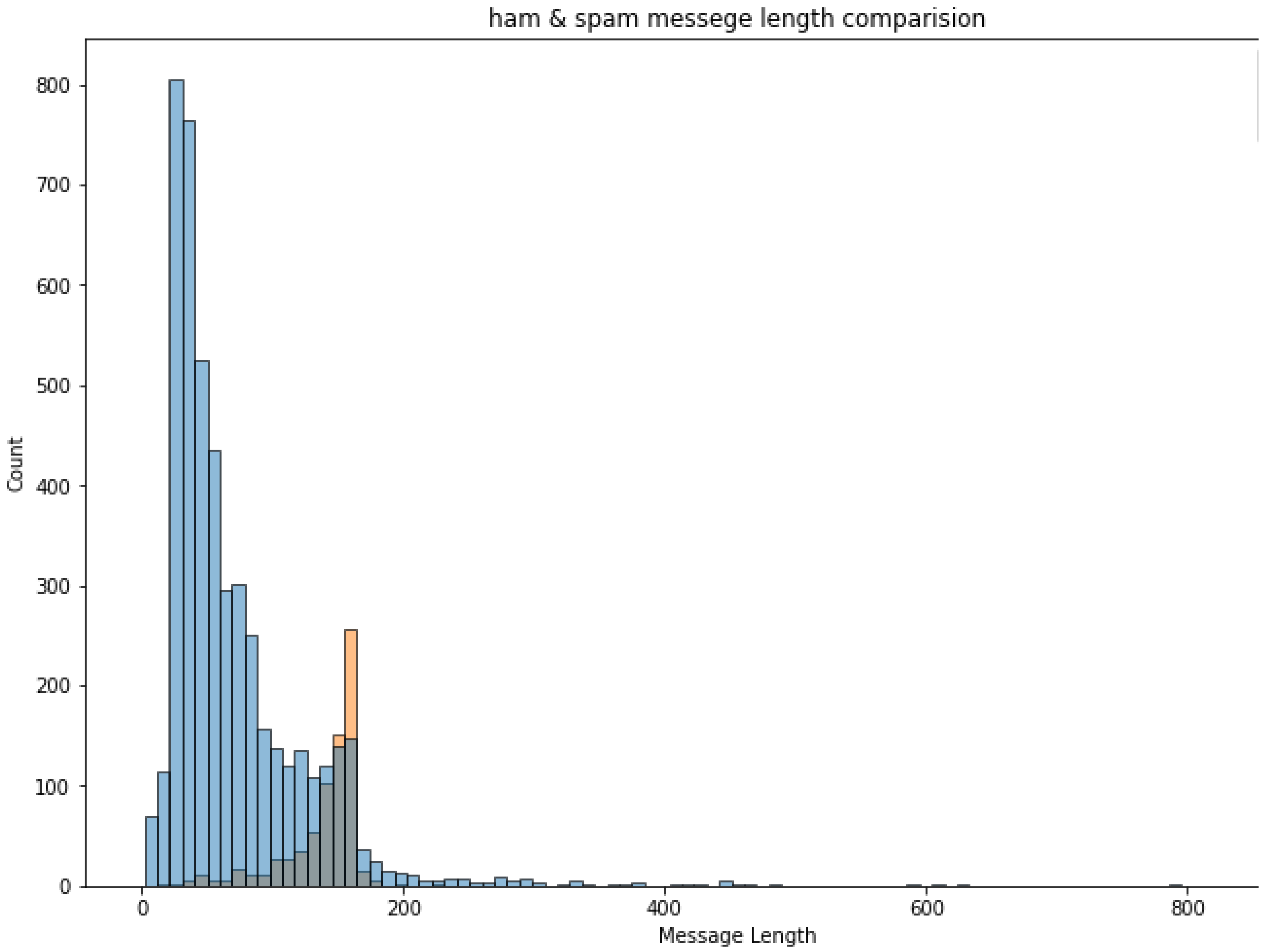
```
data=df.rename(
{
    "v1":"Category",
    "v2":"Message"
},
    axis=1
)
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 5572 entries, 1211 to 3623
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   v1      5572 non-null   object
 1   v2      5572 non-null   object
 2   Count   5572 non-null   int64 
dtypes: int64(1), object(2)
memory usage: 174.1+ KB
```

```
data["Message Length"]=data["Message"].apply(len)
```

```
fig=plt.figure(figsize=(12,8))
sns.histplot(
    x=data["Message Length"],
    hue=data["Category"]
)
plt.title("ham & spam messege length comparision")
plt.show()
```



```
ham_desc=data[data["Category"]=="ham"]["Message Length"].describe()
spam_desc=data[data["Category"]=="spam"]["Message Length"].describe()

print("Ham Messege Length Description:\n",ham_desc)
print("************************************")
print("Spam Message Length Description:\n",spam_desc)
```

```
Ham Messege Length Description:
 count    4825.000000
mean       71.023627
std        58.016023
min         2.000000
25%        33.000000
50%        52.000000
75%        92.000000
max       910.000000
Name: Message Length, dtype: float64
************************************
Spam Message Length Description:
 count    747.000000
mean     138.866131
std       29.183082
min       13.000000
25%      132.500000
50%      149.000000
75%      157.000000
max      224.000000
Name: Message Length, dtype: float64
```

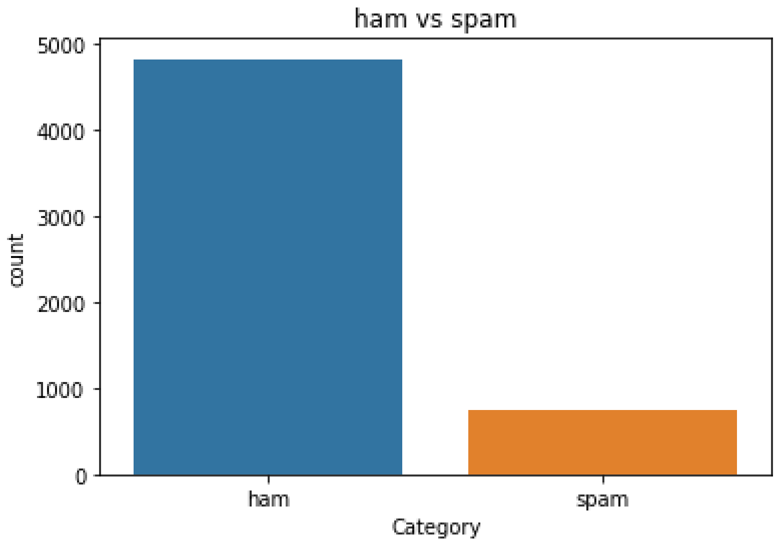
```
data.describe(include="all")
```

	Category	Message	Count	Message Length
count	5572	5572	5572.0	5572.000000
unique	2	5169	NaN	NaN
top	ham	Sorry, I'll call later	NaN	NaN
freq	4825	30	NaN	NaN
mean	NaN	NaN	0.0	80.118808
std	NaN	NaN	0.0	59.690841
min	NaN	NaN	0.0	2.000000
25%	NaN	NaN	0.0	36.000000
50%	NaN	NaN	0.0	61.000000
75%	NaN	NaN	0.0	121.000000
max	NaN	NaN	0.0	910.000000

```
data["Category"].value_counts()
```

```
ham     4825
spam     747
Name: Category, dtype: int64
```

```
sns.countplot(
    data=data,
    x="Category"
)
plt.title("ham vs spam")
plt.show()
```



```
ham_count=data["Category"].value_counts()[0]
spam_count=data["Category"].value_counts()[1]

total_count=data.shape[0]

print("Ham contains:{:.2f}% of total data.".format(ham_count/total_count*100))
print("Spam contains:{:.2f}% of total data.".format(spam_count/total_count*100))
```

```
Ham contains:86.59% of total data.
Spam contains:13.41% of total data.
```

```
#compute the length of majority & minority class
minority_len=len(data[data["Category"]=="spam"])
majority_len=len(data[data["Category"]=="ham"])

#store the indices of majority and minority class
minority_indices=data[data["Category"]=="spam"].index
majority_indices=data[data["Category"]=="ham"].index

#generate new majority indices from the total majority_indices
#with size equal to minority class length so we obtain equivalent number of indices length
random_majority_indices=np.random.choice(
    majority_indices,
    size=minority_len,
    replace=False
)

#concatenate the two indices to obtain indices of new dataframe
undersampled_indices=np.concatenate([minority_indices,random_majority_indices])

#create df using new indices
df=data.loc[undersampled_indices]
```

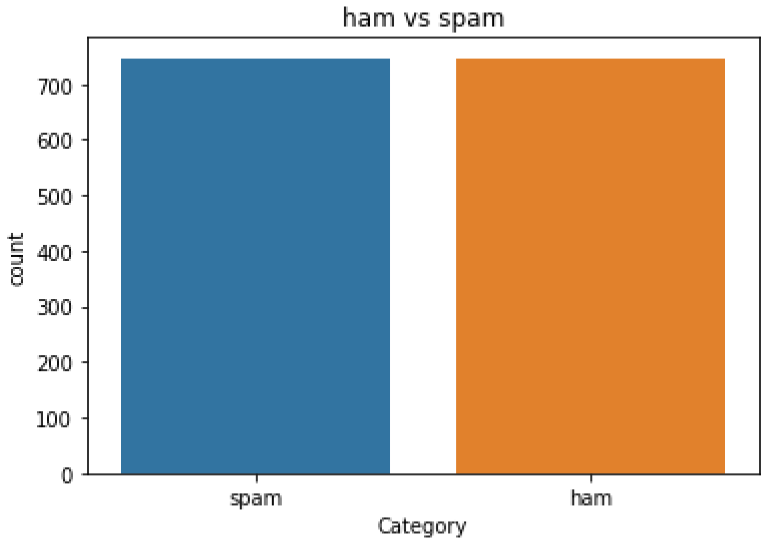
```
#shuffle the sample
df=df.sample(frac=1)

#reset the index as its all mixed
df=df.reset_index()

#drop the older index
df=df.drop(
    columns=["index"],
)

df.shape
```

```
(1494, 4)
```

```
df["Category"].value_counts()
```

```
spam    747
ham     747
Name: Category, dtype: int64
```

```
sns.countplot(
    data=df,
    x="Category"
)
plt.title("ham vs spam")
plt.show()
```



```
df.head()
```

	Category	Message	Count	Message Length
0	spam	Eerie Nokia tones 4u, rply TONE TITLE to 8007 ...	0	162

```
df["Label"]=df["Category"].map(
    {
        "ham":0,
        "spam":1
    }
)
```

```
df.head()
```

	Category	Message	Count	Message Length	Label
0	spam	Eerie Nokia tones 4u, rply TONE TITLE to 8007 ...	0	162	1
1	ham	That sucks. I'll go over so u can do my hair. ...	0	70	0
2	ham	says that he's quitting at least5times a day ...	0	200	0
3	ham	Hey. For me there is no leave on friday. Wait ...	0	83	0
4	spam	Please call our customer service representativ...	0	149	1

```
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer

stemmer=PorterStemmer()


#declare empty list to store tokenized message
corpus=[]

#iterate through the df["Message"]
for message in df["Message"]:

    #replace every special characters, numbers etc.. with whitespace of message
    #It will help retain only letter/alphabets
    message=re.sub("[^a-zA-Z]"," ",message)

    #convert every letters to its lowercase
    message=message.lower()

    #split the word into individual word list
    message=message.split()
```

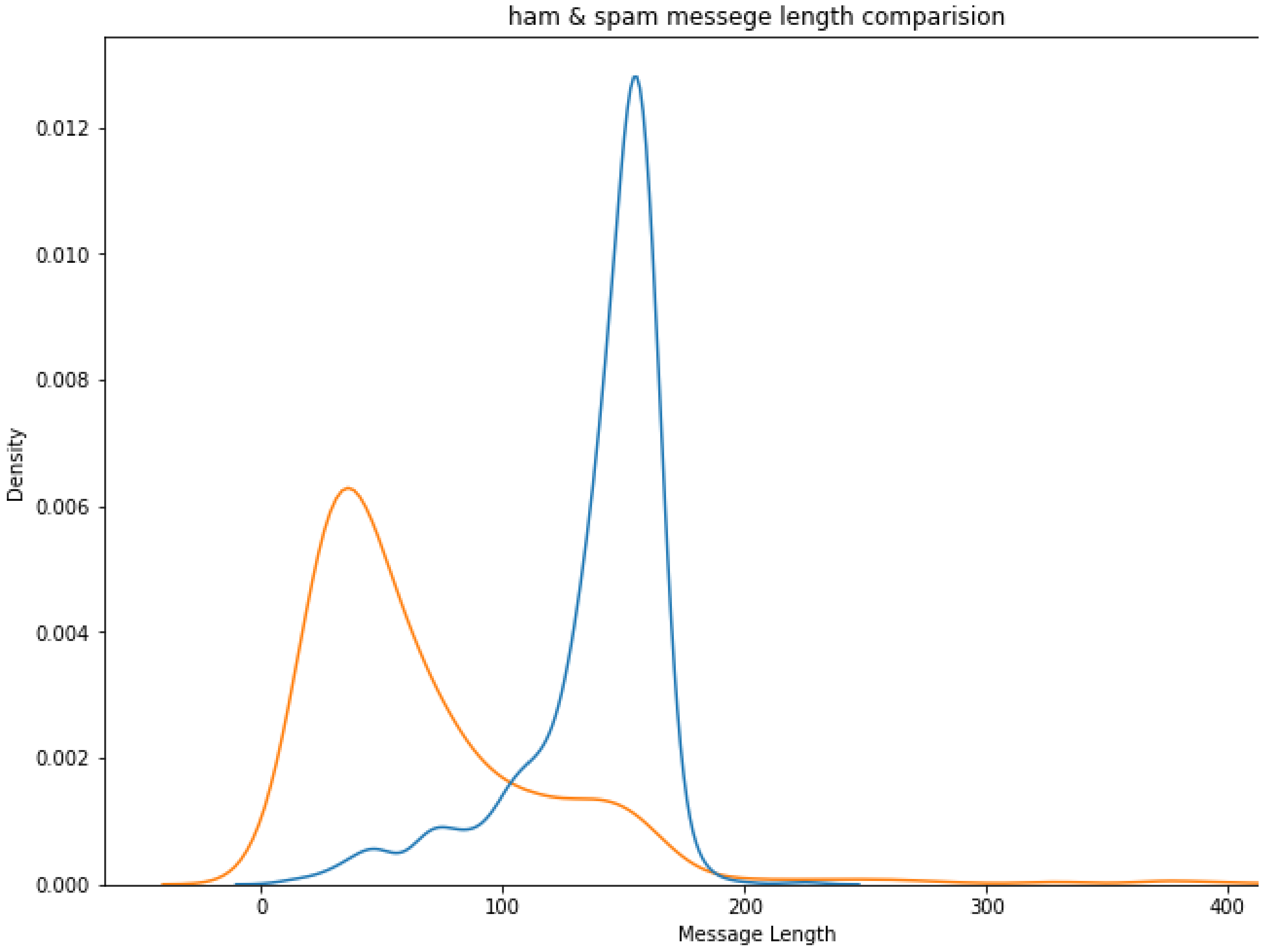
```
from tensorflow.keras.preprocessing.text import one_hot
vocab_size=10000
```

```
oneHot_doc=[one_hot(words,n=vocab_size)
           for words in corpus
           ]
```

```
df["Message Length"].describe()
```

```
count    1494.000000
mean      103.384873
std        55.635473
min         2.000000
25%        48.000000
50%       115.000000
75%       152.750000
max       408.000000
Name: Message Length, dtype: float64
```

```
fig=plt.figure(figsize=(12,8))
sns.kdeplot(
    x=df["Message Length"],
    hue=df["Category"]
)
plt.title("ham & spam messege length comparision")
plt.show()
```



```
from tensorflow.keras.preprocessing.sequence import pad_sequences
sentence_len=200
```

```
embedded_doc=pad_sequences(
    oneHot_doc,
    maxlen=sentence_len,
    padding="pre"
)
```

```
extract_features=pd.DataFrame(
    data=embedded_doc
)
target=df["Label"]
```

```
df_final=pd.concat([extract_features,target],axis=1)
```

```
df_final.head()
```

```
     0    1    2    3    4    5    6    7    8    9  ...  191  192  193  19
0  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  ...  NaN  NaN  NaN  Na
1  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  ...  NaN  NaN  NaN  Na
2  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  ...  NaN  NaN  NaN  Na
3  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  ...  NaN  NaN  NaN  Na
4  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  NaN  ...  NaN  NaN  NaN  Na

5 rows × 201 columns
```

```
X=df_final.drop("Label",axis=1)
y=df_final["Label"]
```

```
from sklearn.model_selection import train_test_split
```

```
X_trainval,X_test,y_trainval,y_test=train_test_split(
    X,
    y,
    random_state=42,
    test_size=0.15
)
```

```
X_train,X_val,y_train,y_val=train_test_split(
    X_trainval,
    y_trainval,
    random_state=42,
    test_size=0.15
)
```

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

```
Model: "model_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 inputs (InputLayer)         [(None, 150)]             0         
                                                                 
 embedding_4 (Embedding)     (None, 150, 50)           50000     
                                                                 
 lstm_4 (LSTM)               (None, 64)                29440     
                                                                 
 FC1 (Dense)                 (None, 256)               16640     
                                                                 
 activation_6 (Activation)   (None, 256)               0         
                                                                 
 dropout_3 (Dropout)         (None, 256)               0         
                                                                 
 out_layer (Dense)           (None, 1)                 257       
                                                                 
 activation_7 (Activation)   (None, 1)                 0         
                                                                 
=================================================================
Total params: 96,337
Trainable params: 96,337
Non-trainable params: 0
_________________________________________________________________
```