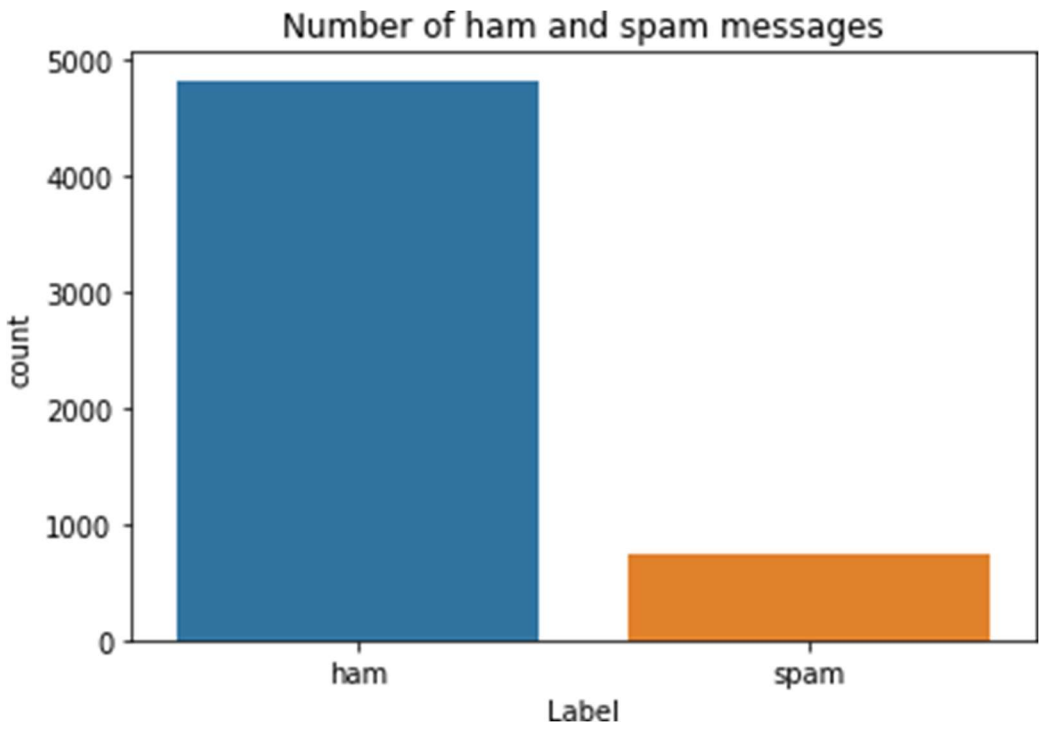
ASSIGNMENT-4

```
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')

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: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or misinterpretation.
  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
)
```

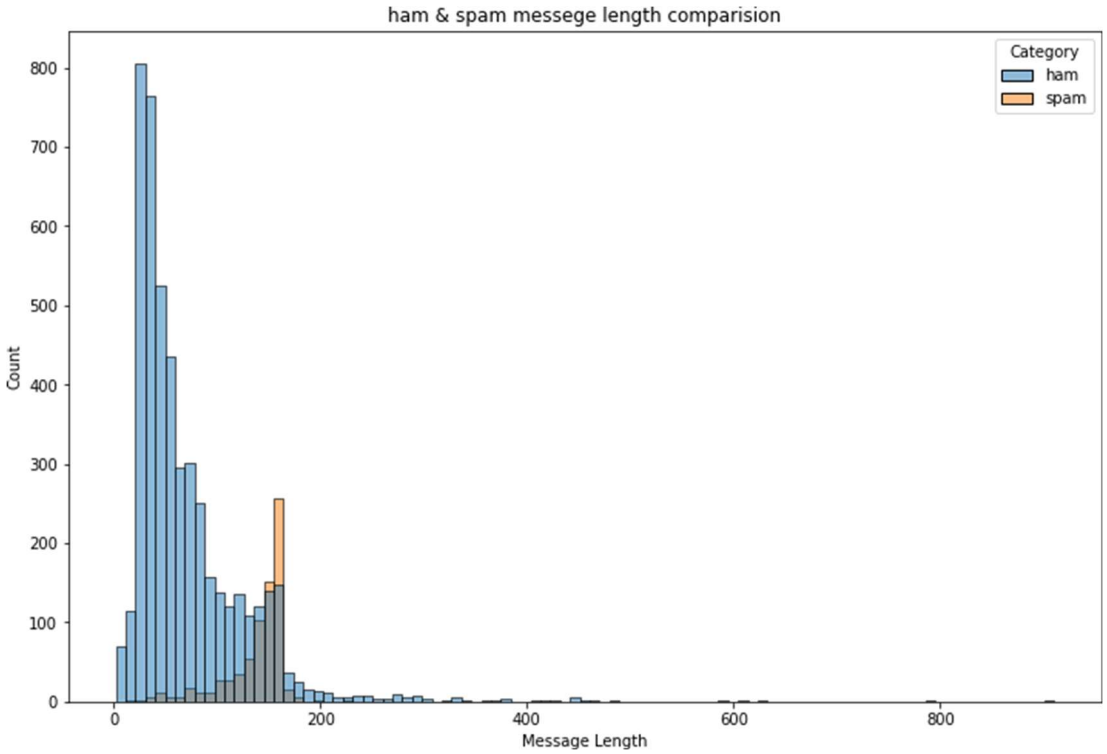
```
df.info()
```

```
<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
```

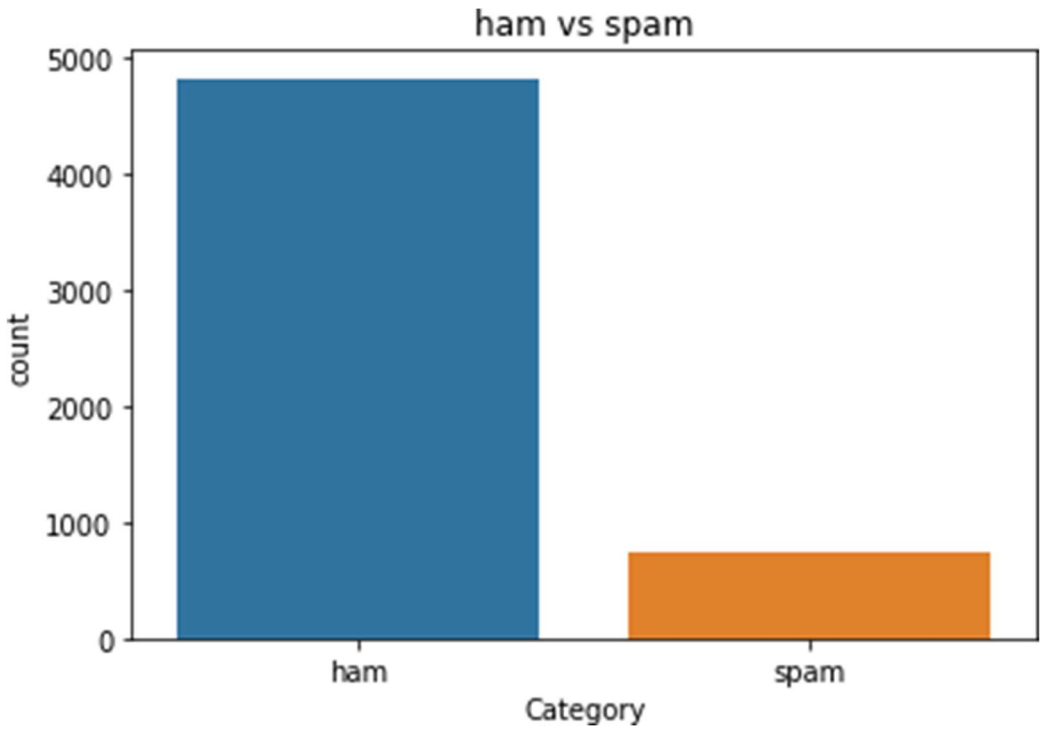
```
data.describe(include="all")
```

	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,
```

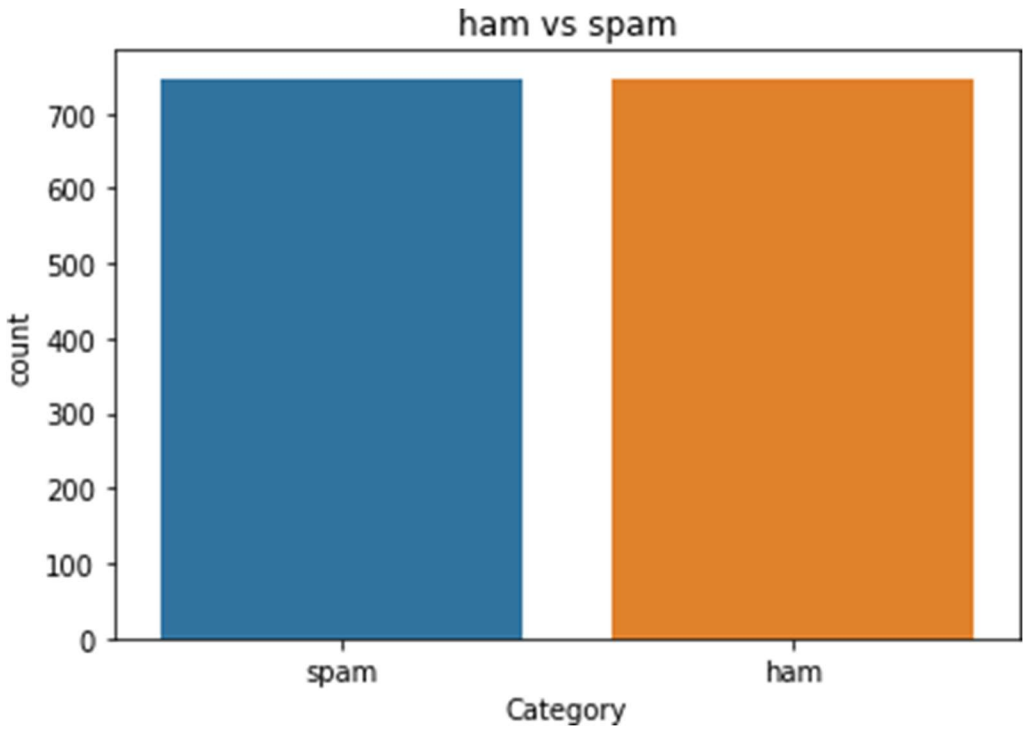
```
        replace=False
)

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

	Message Length
0	162
1	70
2	200
3	83
4	149

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

```
    }
)

df.head()
```

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

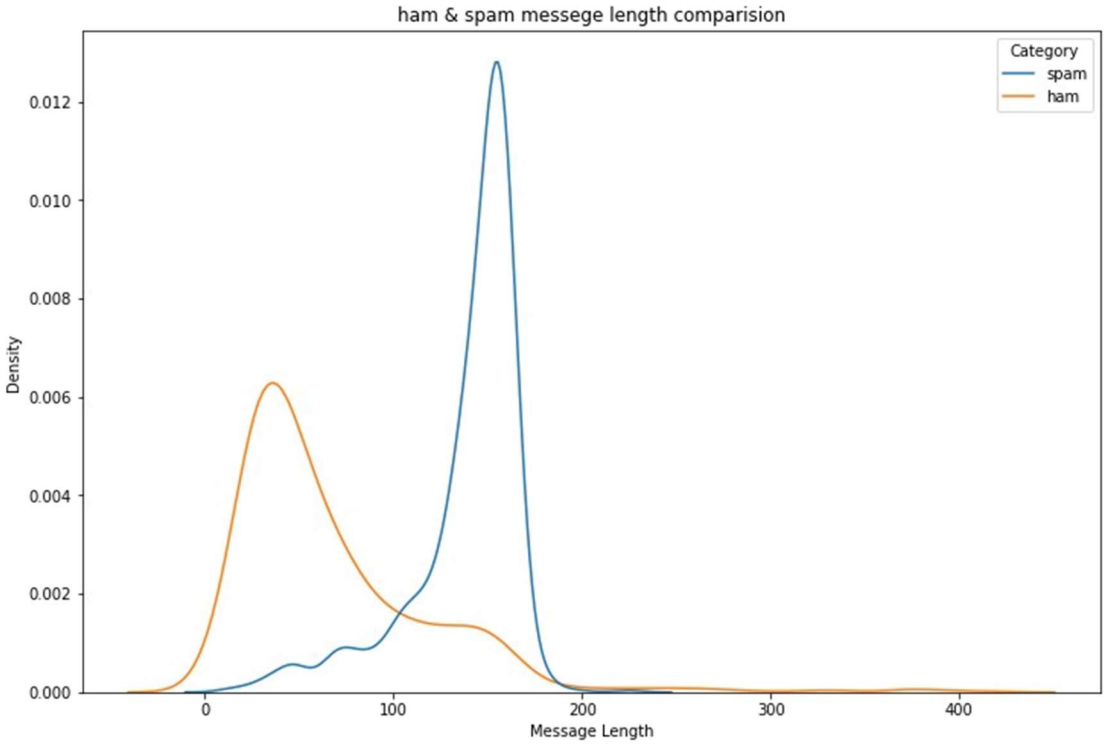
	Message Length	Label
0	162	1
1	70	0
2	200	0
3	83	0
4	149	1

```
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  194
195  196  \
0  NaN NaN       Na NaN NaN NaN NaN NaN NaN NaN  ...   NaN  NaN   Na   Na
NaN NaN          N                                          N    N
   NaN
1  NaN NaN       Na NaN NaN NaN NaN NaN NaN NaN  ...   NaN  NaN   Na   Na
NaN NaN          N                                          N    N
   NaN           Na NaN NaN NaN NaN NaN NaN NaN  ...   NaN  NaN   Na   Na
2  NaN NaN          N                                          N    N
NaN NaN          Na NaN NaN NaN NaN NaN NaN NaN  ...   NaN  NaN   Na   Na
   NaN
3  NaN NaN
NaN NaN
   NaN
4  NaN NaN
NaN NaN
   NaN

    197  198  199   Label
      0  NaN  NaN       1
         NaN
      1  NaN  NaN       0
         NaN
      2  NaN  NaN       0
         NaN
      3  NaN  NaN       0
         NaN
      4  NaN  NaN       1
         NaN

[5 rows x 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