Assignment-4 (SMS SPAM Classification)

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```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

data =
pd.read_csv('/content/sample_data/spam.csv',delimiter=',',encoding='la
tin-1')
data.head()
```

```
     v1                                                  v2 Unnamed: 2
\
0   ham  Go until jurong point, crazy.. Available only ...         NaN

1   ham                      Ok lar... Joking wif u oni...         NaN

2  spam  Free entry in 2 a wkly comp to win FA Cup fina...         NaN

3   ham  U dun say so early hor... U c already then say...         NaN

4   ham  Nah I don't think he goes to usf, he lives aro...         NaN


  Unnamed: 3 Unnamed: 4
0        NaN        NaN
1        NaN        NaN
2        NaN        NaN
3        NaN        NaN
4        NaN        NaN
```

```
data.columns
```

```
Index(['v1', 'v2', 'Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],
dtype='object')
```

```
#drop the unamed columns
data=data.drop(columns=["Unnamed: 2","Unnamed: 3","Unnamed: 4"])

#rename the two relevant columns
data=data.rename(
{
    "v1":"Category",
    "v2":"Message"
},axis=1)
```

```
data.head()
```

```
  Category                                            Message
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...
```

```
#check for null values
data.isnull().sum()
```

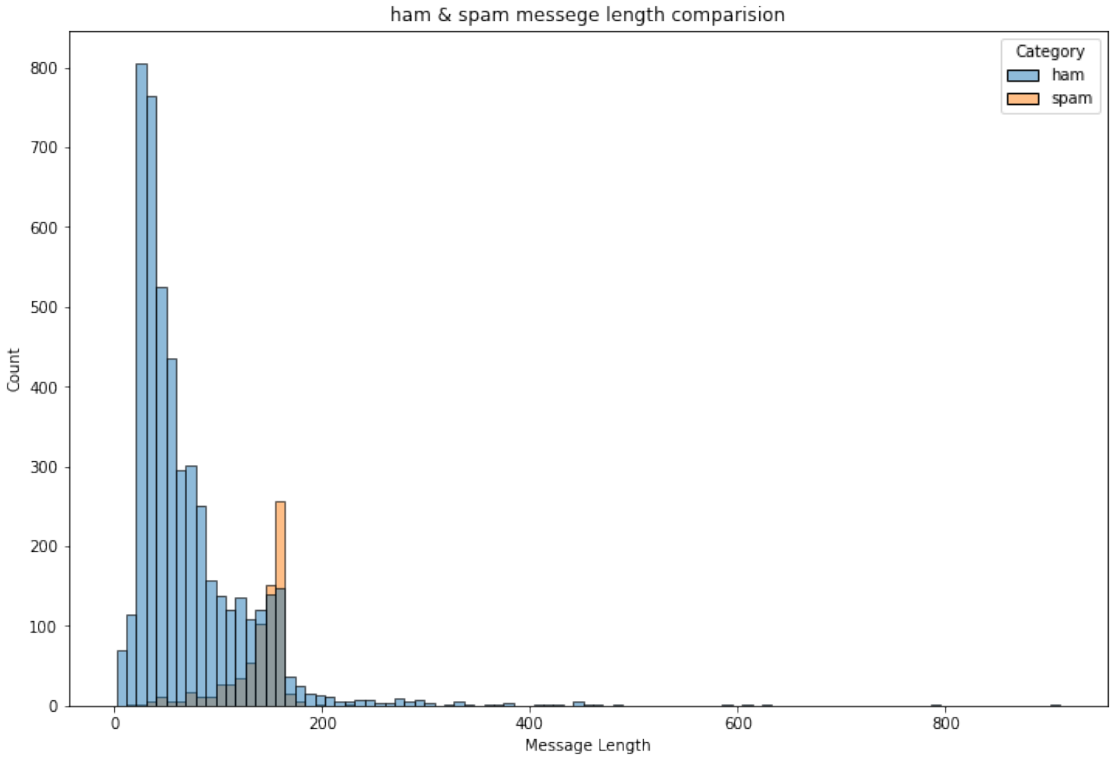
```
Category    0
Message     0
dtype: int64
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   Category  5572 non-null   object
 1   Message   5572 non-null   object
dtypes: object(2)
memory usage: 87.2+ 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()
```




```
#Display the description of length of ham and spam messages seperately
on an individual series.

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
```

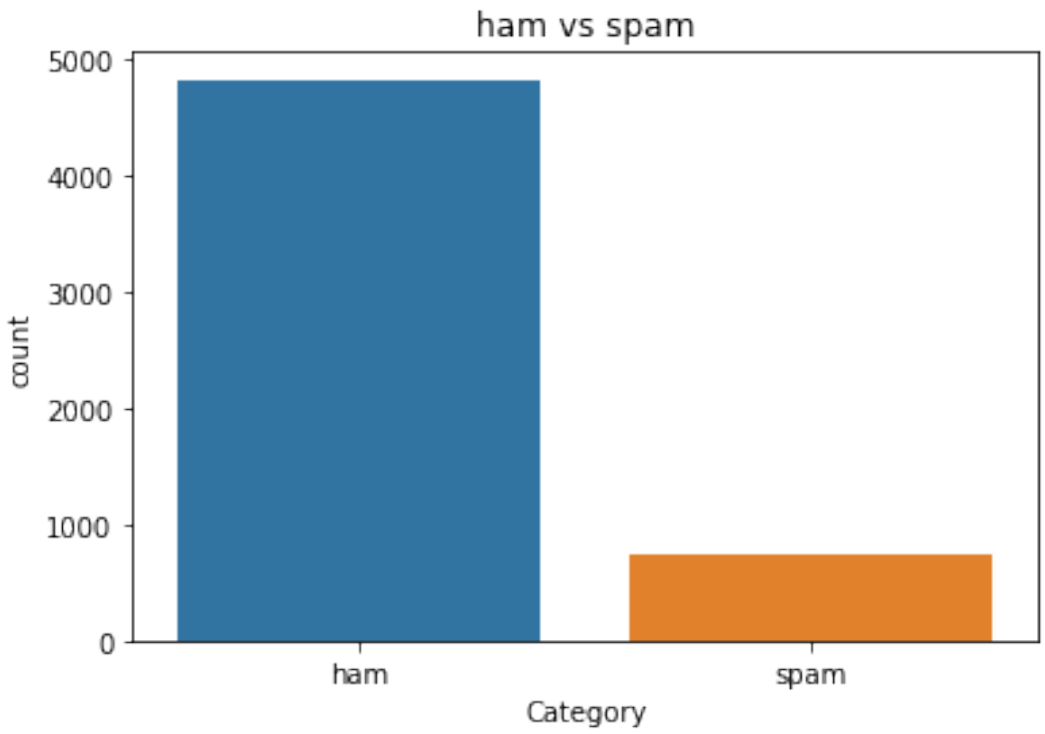
```
data.describe(include="all")
```

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

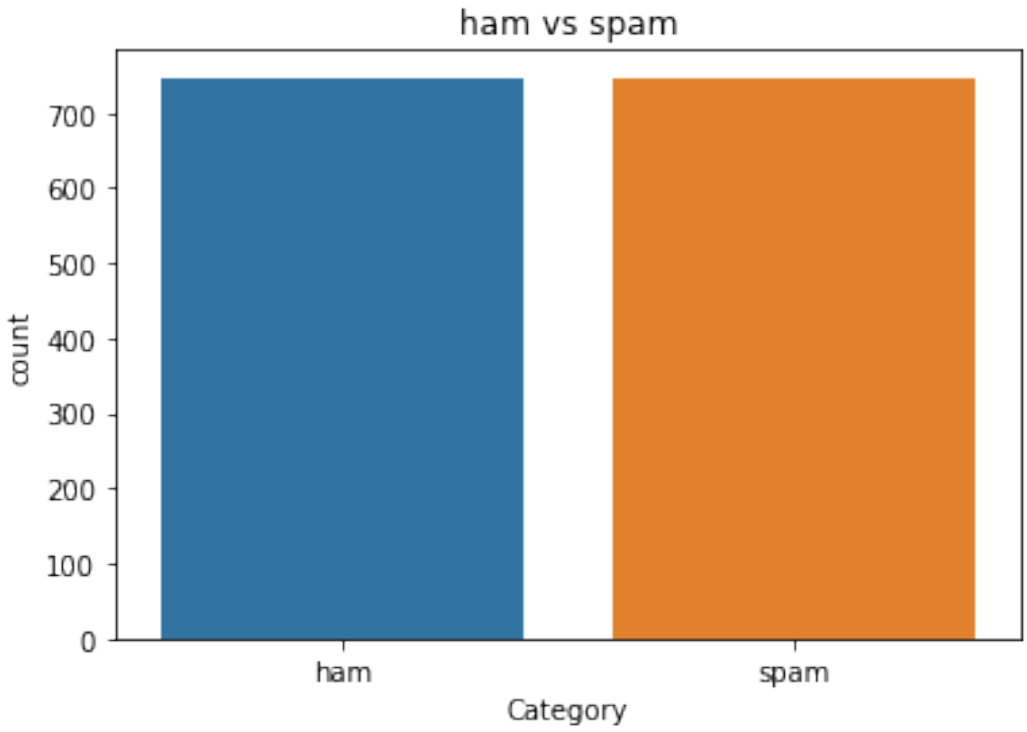
```
    replace=False
)

#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, 3)
```

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

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

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




```
df.head()
```

```
  Category                                            Message  Message
Length
0      ham  Aah! A cuddle would be lush! I'd need lots of ...
87
1      ham            I'm in solihull, | do you want anything?
40
2     spam  Double Mins & 1000 txts on Orange tariffs. Lat...
151
3      ham  No we put party 7 days a week and study lightl...
126
4     spam  URGENT!! Your 4* Costa Del Sol Holiday or å£50...
161
```

```
#Created new column Label and encode ham as 0 and spam as 1
df["Label"]=df["Category"].map(
    {
        "ham":0,
        "spam":1
    }
)
```

```
df.head()
```

```
  Category                                            Message  Message
Length  \
0      ham  Aah! A cuddle would be lush! I'd need lots of ...
```

```
87
1      ham           I'm in solihull, | do you want anything?
40
2     spam  Double Mins & 1000 txts on Orange tariffs. Lat...
151
3      ham  No we put party 7 days a week and study lightl...
126
4     spam  URGENT!! Your 4* Costa Del Sol Holiday or å£50...
161

   Label
0      0
1      0
2      1
3      0
4      1
```

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

stemmer=PorterStemmer()

nltk.download('stopwords')
```

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

True
```

```
#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()

    #perform stemming using PorterStemmer for all non-english-
stopwords
    message=[stemmer.stem(words)
```

```
            for words in message
             if words not in set(stopwords.words("english"))
            ]
    #join the word lists with the whitespace
    message=" ".join(message)

    #append the message in corpus list
    corpus.append(message)
```

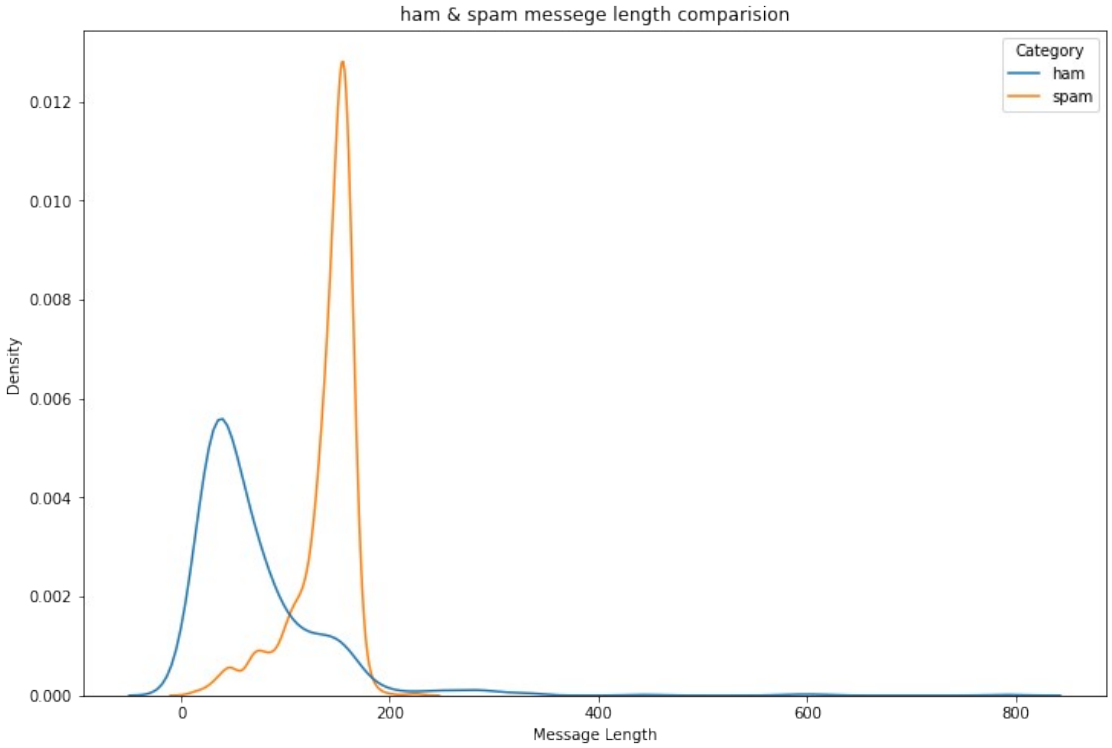
```
from tensorflow.keras.preprocessing.text import one_hot
vocab_size=10000
```

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

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

```
count    1494.000000
mean      105.203481
std        61.166448
min         3.000000
25%        48.000000
50%       118.000000
75%       153.000000
max       790.000000
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  0  0  0  0  0  0  0  0  0  0  ...  2090  1632  4289  7158   478
5808
1  0  0  0  0  0  0  0  0  0  0  ...     0     0     0     0     0
0
2  0  0  0  0  0  0  0  0  0  0  ...  1275   702  1694  4114  4162
3935
3  0  0  0  0  0  0  0  0  0  0  ...  3705  9946  5462  7158  9883
4500
4  0  0  0  0  0  0  0  0  0  0  ...  4753  6414  5018  1953   216
```

```
1175
```

```
    197   198   199  Label
0  6133  8348  4198      0
1  8663  4425  6636      0
2  4162  8536  7201      1
3  8030  8630  2977      0
4  8861  2485  6055      1

[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
)
```

```
from tensorflow.keras.layers import LSTM
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Embedding
from tensorflow.keras.models import Sequential
model=Sequential()
```

```
feature_num=100
model.add(
    Embedding(
        input_dim=vocab_size,
        output_dim=feature_num,
        input_length=sentence_len
    )
)
model.add(
    LSTM(
    units=128
    )
)
```

```
model.add(
```

```
    Dense(
        units=1,
        activation="sigmoid"
    )
)

from tensorflow.keras.optimizers import Adam
model.compile(
    optimizer=Adam(
    learning_rate=0.001
    ),
    loss="binary_crossentropy",
    metrics=["accuracy"]
)

model.fit(
    X_train,
    y_train,
    validation_data=(
        X_val,
        y_val
    ),
    epochs=10
)

Epoch 1/10
34/34 [==============================] - 8s 33ms/step - loss: 0.5258 -
accuracy: 0.7653 - val_loss: 0.3215 - val_accuracy: 0.8691
Epoch 2/10
34/34 [==============================] - 1s 16ms/step - loss: 0.1718 -
accuracy: 0.9453 - val_loss: 0.1003 - val_accuracy: 0.9738
Epoch 3/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0533 -
accuracy: 0.9842 - val_loss: 0.0764 - val_accuracy: 0.9791
Epoch 4/10
34/34 [==============================] - 1s 15ms/step - loss: 0.0254 -
accuracy: 0.9926 - val_loss: 0.0716 - val_accuracy: 0.9843
Epoch 5/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0184 -
accuracy: 0.9954 - val_loss: 0.0728 - val_accuracy: 0.9843
Epoch 6/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0134 -
accuracy: 0.9963 - val_loss: 0.0852 - val_accuracy: 0.9843
Epoch 7/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0150 -
accuracy: 0.9954 - val_loss: 0.0744 - val_accuracy: 0.9791
Epoch 8/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0112 -
accuracy: 0.9972 - val_loss: 0.0657 - val_accuracy: 0.9843
Epoch 9/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0062 -
```

```
accuracy: 0.9981 - val_loss: 0.0732 - val_accuracy: 0.9843
Epoch 10/10
34/34 [==============================] - 1s 16ms/step - loss: 0.0050 -
accuracy: 0.9991 - val_loss: 0.0843 - val_accuracy: 0.9843

<keras.callbacks.History at 0x7fa3263a7850>
```

```
y_pred=model.predict(X_test)
y_pred=(y_pred>0.5)
```

```
8/8 [==============================] - 0s 8ms/step
```

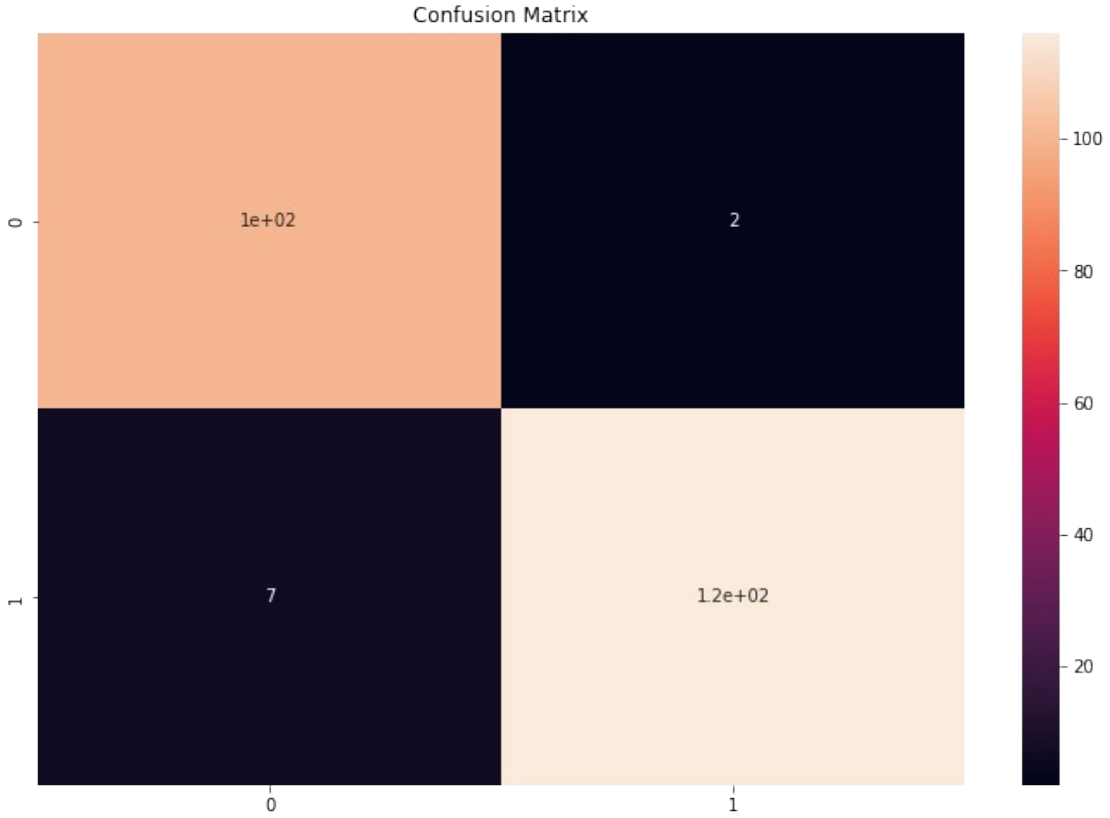
```
from sklearn.metrics import accuracy_score,confusion_matrix
```

```
score=accuracy_score(y_test,y_pred)
print("Test Score:{:.2f}%".format(score*100))
```

```
Test Score:96.00%
```

```
cm=confusion_matrix(y_test,y_pred)
fig=plt.figure(figsize=(12,8))
sns.heatmap(
    cm,
    annot=True,
)
plt.title("Confusion Matrix")
cm
```

```
array([[100,   2],
       [  7, 116]])
```




```
#The function take model and message as parameter
def classify_message(model,message):

    #We will treat message as a paragraphs containing multiple
sentences(lines)
    #we will extract individual lines
    for sentences in message:
        sentences=nltk.sent_tokenize(message)

        #Iterate over individual sentences
        for sentence in sentences:
            #replace all special characters
            words=re.sub("[^a-zA-Z]"," ",sentence)

            #perform word tokenization of all non-english-stopwords
            if words not in set(stopwords.words('english')):
                word=nltk.word_tokenize(words)
                word=" ".join(word)

    #perform one_hot on tokenized word
    oneHot=[one_hot(word,n=vocab_size)]

    #create an embedded documnet using pad_sequences
    #this can be fed to our model
    text=pad_sequences(oneHot,maxlen=sentence_len,padding="pre")
```

```
    #predict the text using model
    predict=model.predict(text)

    #if predict value is greater than 0.5 its a spam
    if predict>0.5:
        print("It is a spam")
    #else the message is not a spam
    else:
        print("It is not a spam")

message1="I am having a bad day and I would like to have a break
today"
message2="This is to inform you had won a lottery and the subscription
will end in a week so call us."

nltk.download('punkt')
```

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

True
```

```
classify_message(model,message1)
```

```
1/1 [==============================] - 0s 21ms/step
It is not a spam
```

```
classify_message(model,message2)
```

```
1/1 [==============================] - 0s 22ms/step
It is a spam
```