

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='latin-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()
```

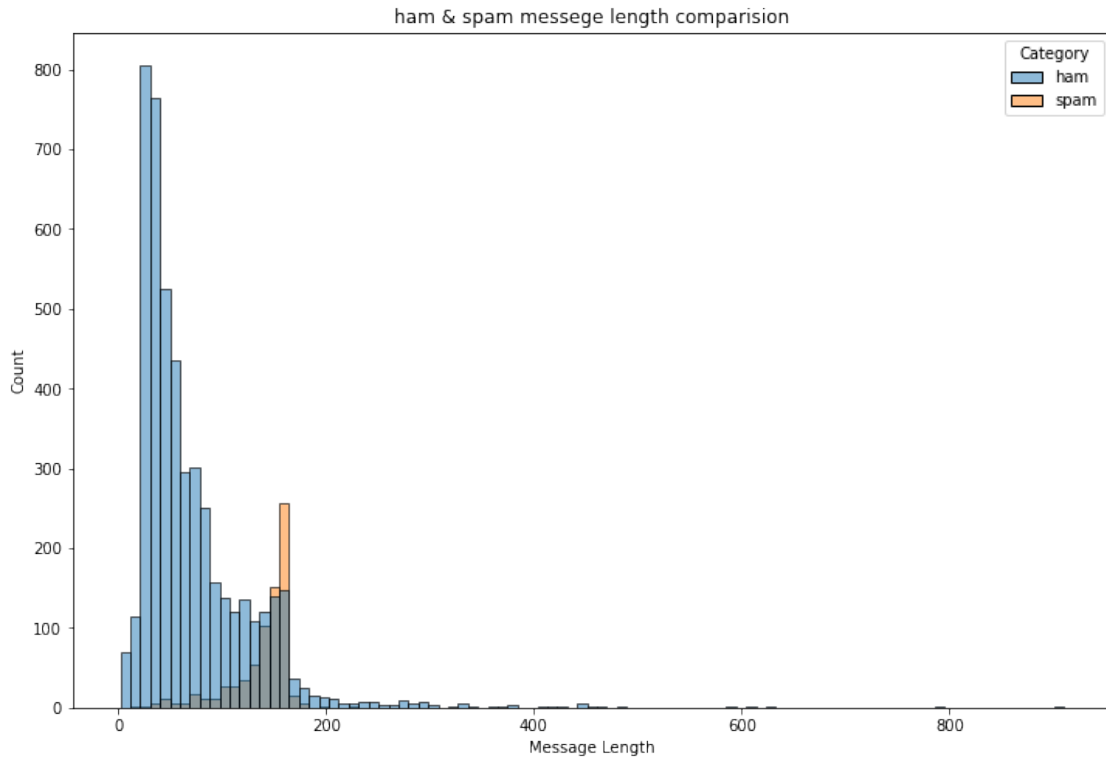
```
Category      0  
Message       0  
dtype: int64
```

```
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
```

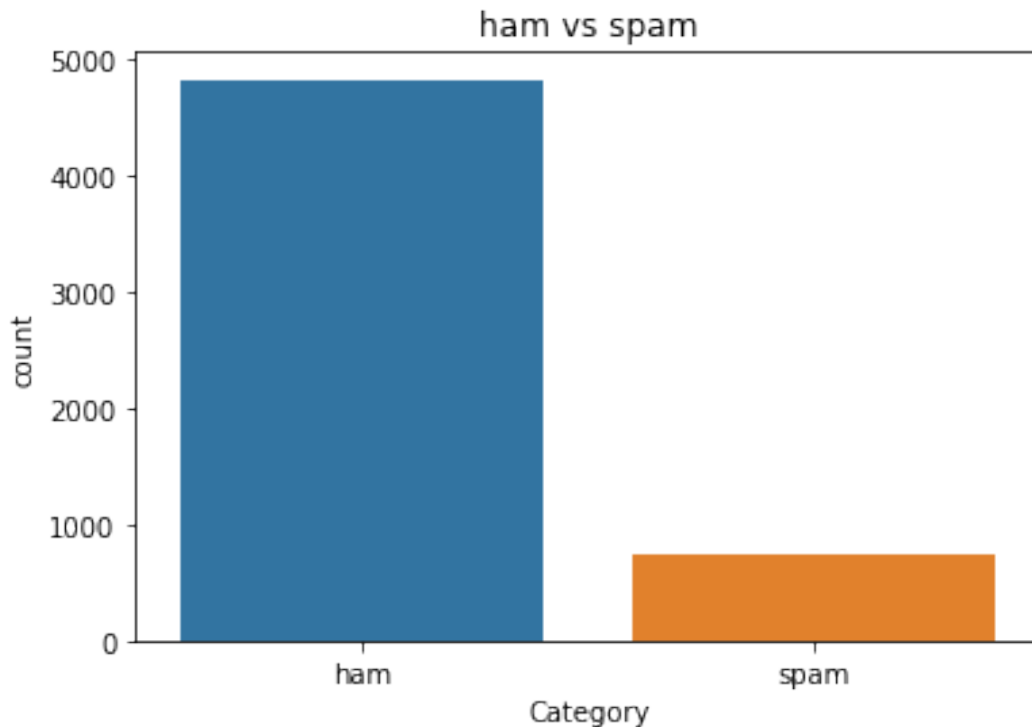
```
data.describe(include="all")
```

| | 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()

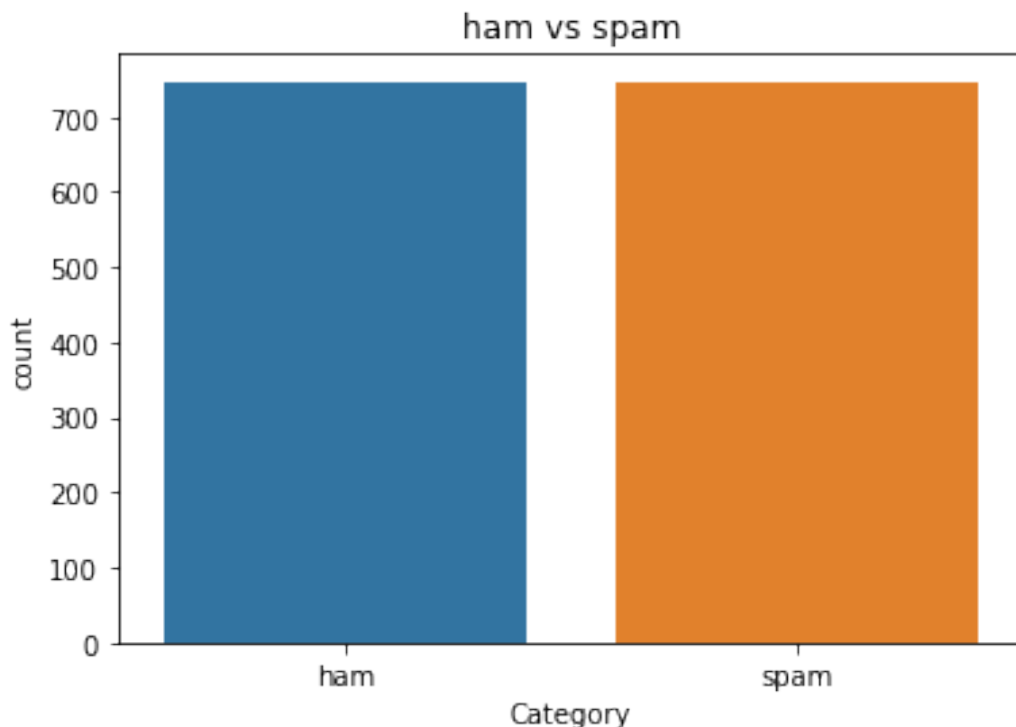
#drop the older index
df=df.drop(
    columns=["index"],
)

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

#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 |
|---|----------|---|---------|
| 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

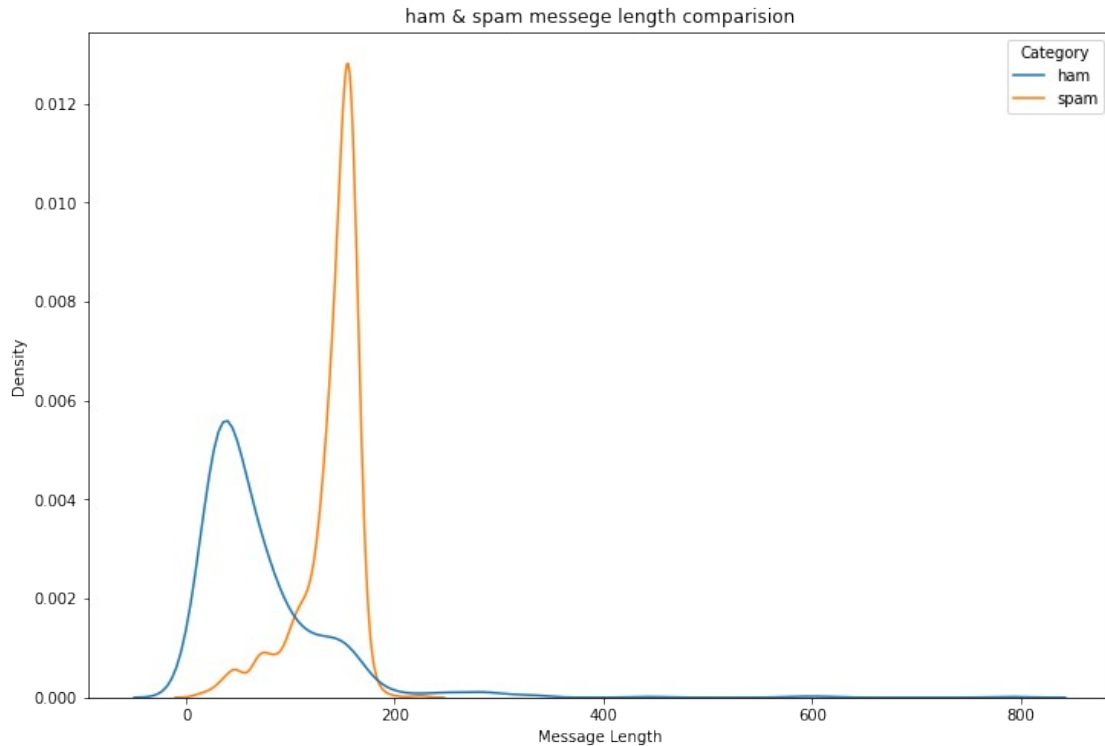
oneHot_doc=[one_hot(words,n=vocab_size)
            for words in corpus
            ]

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

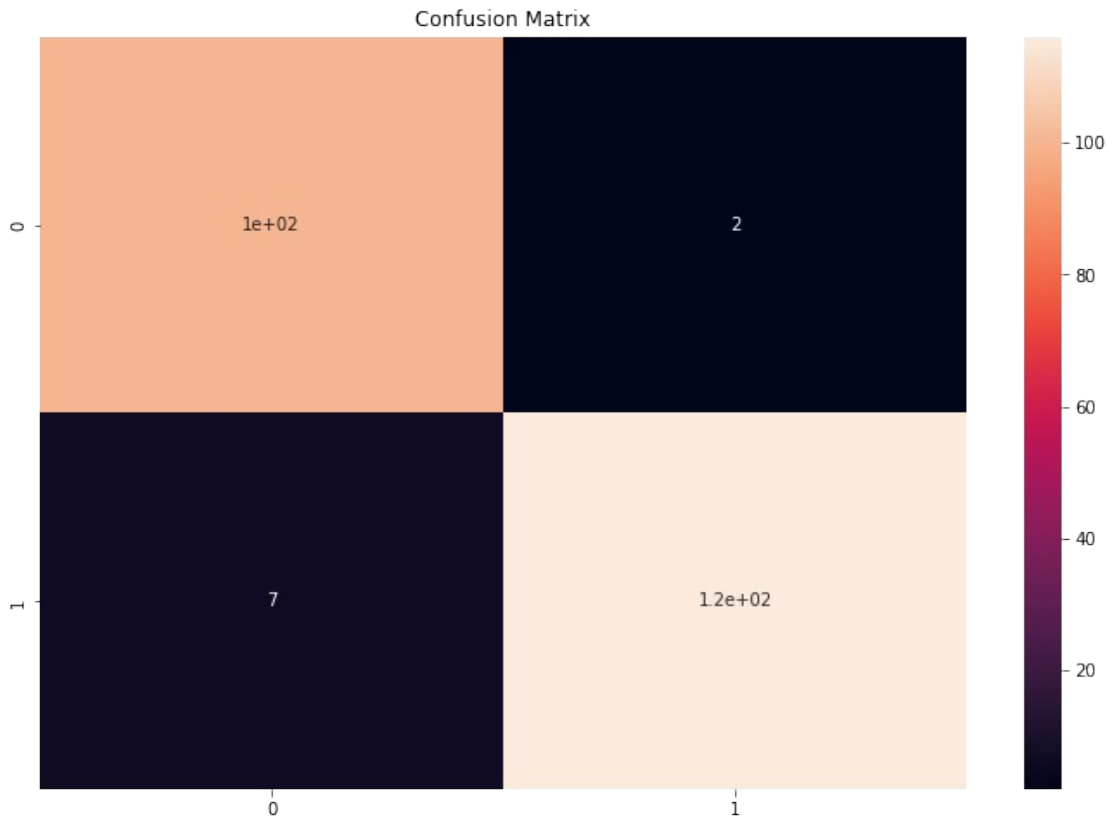
score=accuracy_score(y_test,y_pred)
print("Test Score:{:.2f}%".format(score*100))

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=nlk.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=nlk.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
```