**Assignment -4**
Python Programming

| | |
|---|---|
| Assignment Date | 21 October 2022 |
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| Student Roll Number | 311419205021 |
| Maximum Marks | 2 Marks |

# Problem Statement :- SMS SPAM Classification

Problem Statement: Over recent years, as the popularity of mobile phone devices has increased, Short Message Service (SMS) has grown into a multi-billion dollar industry. At the same time, reduction in the cost of messaging services has resulted in growth in unsolicited commercial advertisements (spams) being sent to mobile phones. Due to Spam SMS, Mobile service providers suffer from some sort of financial problems as well as it reduces calling time for users. Unfortunately, if the user accesses such Spam SMS they may face the problem of virus or malware. When SMS arrives at mobile it will disturb mobile user privacy and concentration. It may lead to frustration for the user. So Spam SMS is one of the major issues in the wireless communication world and it grows day by day

- Download the Dataset:- Dataset
- Import required library
- Read dataset and do pre-processing
- Create Model
- Add Layers (LSTM, Dense-(Hidden Layers), Output)
- Compile the Model
- Fit the Model
- Save The Model  Test The Mode

# Solution:

```
import numpy as np  import
pandas as pd  import seaborn
as sns import
matplotlib.pyplot as plt
%matplotlib inline
import re import
nltk
from nltk.corpus import stopwords from
nltk.stem import PorterStemmer
from tensorflow.keras.preprocessing.text import one_hot from
tensorflow.keras.preprocessing.sequence import pad_sequences
from sklearn.model_selection import train_test_split
from tensorflow.keras.layers import LSTM from
tensorflow.keras.layers import Dense from
tensorflow.keras.layers import Embedding
```

from tensorflow.keras.models import Sequential from tensorflow.keras.optimizers import Adam
from sklearn.metrics import accuracy_score,confusion_matrix
data=pd.read_csv("spam.csv",encoding="latin") data.head()

```
[5] data=pd.read_csv("spam.csv",encoding="latin")
    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.columns

```
[6] data.columns

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

data=data.drop(columns=["Unnamed: 2","Unnamed: 3","Unnamed: 4"]) data=data.rename(
{
"v1":"Category",
"v2":"Message"
},
axis=1
)
data.head()

```
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... |

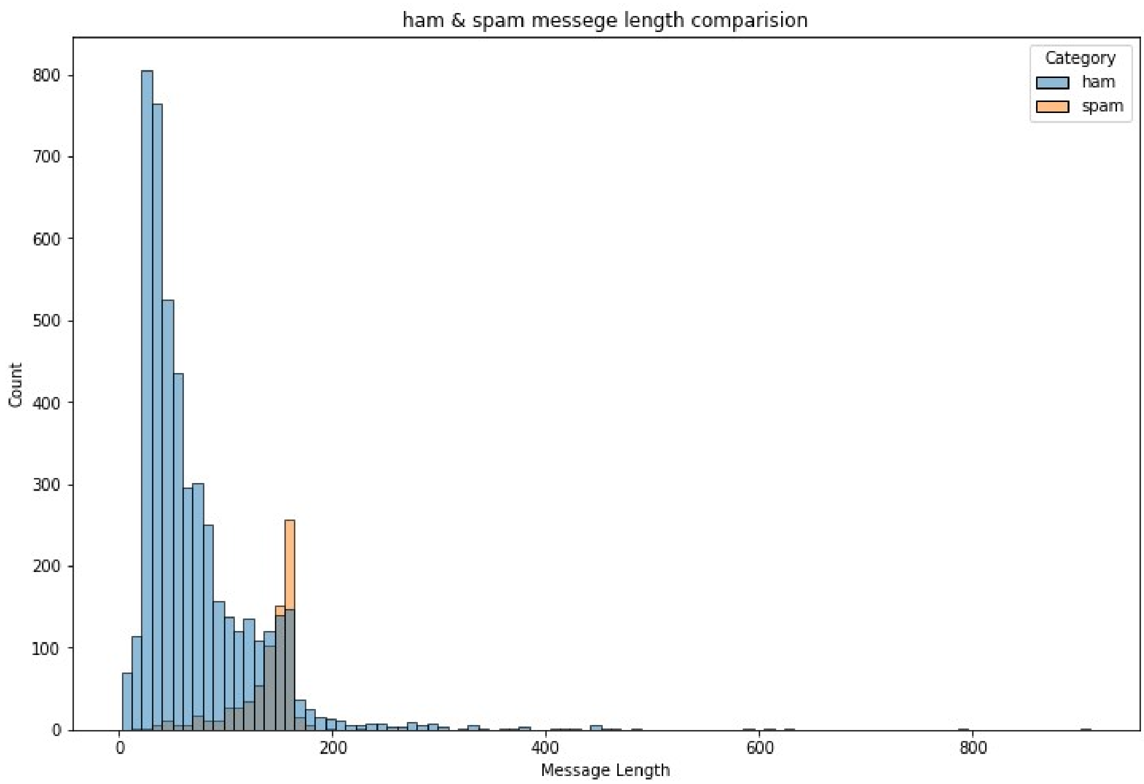
data.isnull().sum()

```
[10] data.isnull().sum()

     Category    0
     Message     0
     dtype: int64
```

data.info()

```
[11] 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()
```



```
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
```

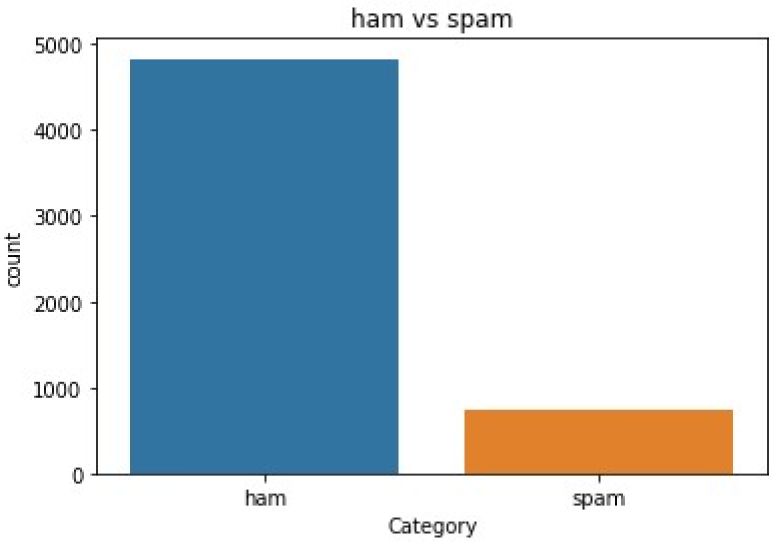
```
data.describe(include="all")
```

| | 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"],
)

The resulting dataframes have **1494** rows and **4** columns

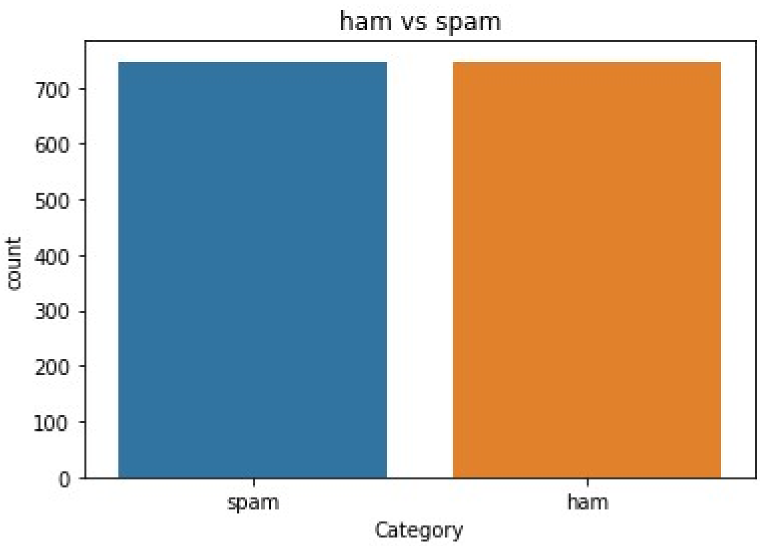
df.shape

```
(1494, 3)
```

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()



Display the head of new **df**

df.head()

```
df.head()
```

| | Category | Message | Message Length |
|---|---|---|---|
| 0 | spam | Congratulations ur awarded either å£500 of CD ... | 152 |
| 1 | spam | Congratulations - Thanks to a good friend U ha... | 158 |
| 2 | ham | You sure your neighbors didnt pick it up | 40 |
| 3 | spam | Urgent UR awarded a complimentary trip to Euro... | 161 |
| 4 | ham | In xam hall boy asked girl Tell me the startin... | 185 |

Created new column **Label** and encode **ham** as **0** and **spam** as **1**

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

df.head()

```
df.head()
```

| | Category | Message | Message Length | Label |
|---|---|---|---|---|
| 0 | spam | Congratulations ur awarded either å£500 of CD ... | 152 | 1 |
| 1 | spam | Congratulations - Thanks to a good friend U ha... | 158 | 1 |
| 2 | ham | You sure your neighbors didnt pick it up | 40 | 0 |
| 3 | spam | Urgent UR awarded a complimentary trip to Euro... | 161 | 1 |
| 4 | ham | In xam hall boy asked girl Tell me the startin... | 185 | 0 |

Import libraries to perform word **tokenization**

stemmer=PorterStemmer()

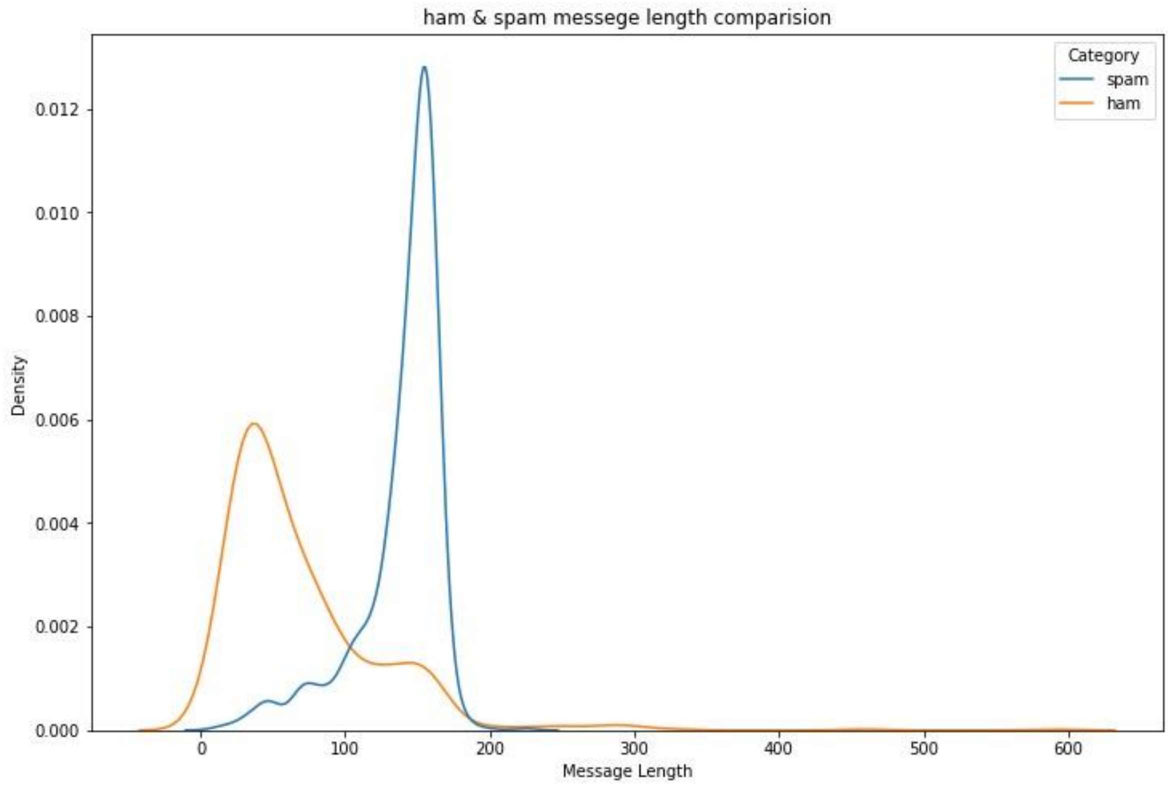
#declare empty list to store tokenized message corpus=[]

#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()

   #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)


vocab_size=10000

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

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

```
count    1494.000000
mean      104.014726
std        56.243274
min         2.000000
25%        49.000000
50%       118.000000
75%       153.000000
max       588.000000
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()
```




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 | 197 | 198 | 199 | Label |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 3170 | 4545 | 4392 | 5141 | 6489 | 5186 | 1607 | 4335 | 3753 | 1 |
| **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 6586 | 3423 | 1639 | 8826 | 3416 | 1739 | 3443 | 9175 | 9588 | 1 |
| **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 0 | 0 | 0 | 0 | 0 | 5964 | 1401 | 4951 | 9927 | 0 |
| **3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 2505 | 3969 | 6586 | 3170 | 5152 | 7631 | 3266 | 3294 | 4399 | 1 |
| **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ... | 8116 | 4652 | 1586 | 9705 | 8789 | 6633 | 8781 | 4430 | 3873 | 0 |

5 rows × 201 columns

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

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=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"
   )
)


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 [==============================] - 24s 532ms/step - loss: 0.4982 - accuracy: 0.7987 - val_loss: 0.2507 - val_accuracy
Epoch 2/10
34/34 [==============================] - 12s 348ms/step - loss: 0.1531 - accuracy: 0.9518 - val_loss: 0.0826 - val_accuracy
Epoch 3/10
34/34 [==============================] - 13s 386ms/step - loss: 0.0559 - accuracy: 0.9824 - val_loss: 0.0450 - val_accuracy
Epoch 4/10
34/34 [==============================] - 12s 343ms/step - loss: 0.0259 - accuracy: 0.9926 - val_loss: 0.0970 - val_accuracy
Epoch 5/10
34/34 [==============================] - 12s 343ms/step - loss: 0.0139 - accuracy: 0.9972 - val_loss: 0.0491 - val_accuracy
Epoch 6/10
34/34 [==============================] - 12s 341ms/step - loss: 0.0085 - accuracy: 0.9981 - val_loss: 0.0863 - val_accuracy
Epoch 7/10
34/34 [==============================] - 12s 340ms/step - loss: 0.0123 - accuracy: 0.9963 - val_loss: 0.0528 - val_accuracy
Epoch 8/10
34/34 [==============================] - 13s 384ms/step - loss: 0.0062 - accuracy: 0.9991 - val_loss: 0.1202 - val_accuracy
Epoch 9/10
34/34 [==============================] - 14s 412ms/step - loss: 0.0159 - accuracy: 0.9981 - val_loss: 0.0561 - val_accuracy
Epoch 10/10
34/34 [==============================] - 11s 337ms/step - loss: 0.0038 - accuracy: 0.9991 - val_loss: 0.0798 - val_accuracy
<keras.callbacks.History at 0x7f5d53dc9b90>
```

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

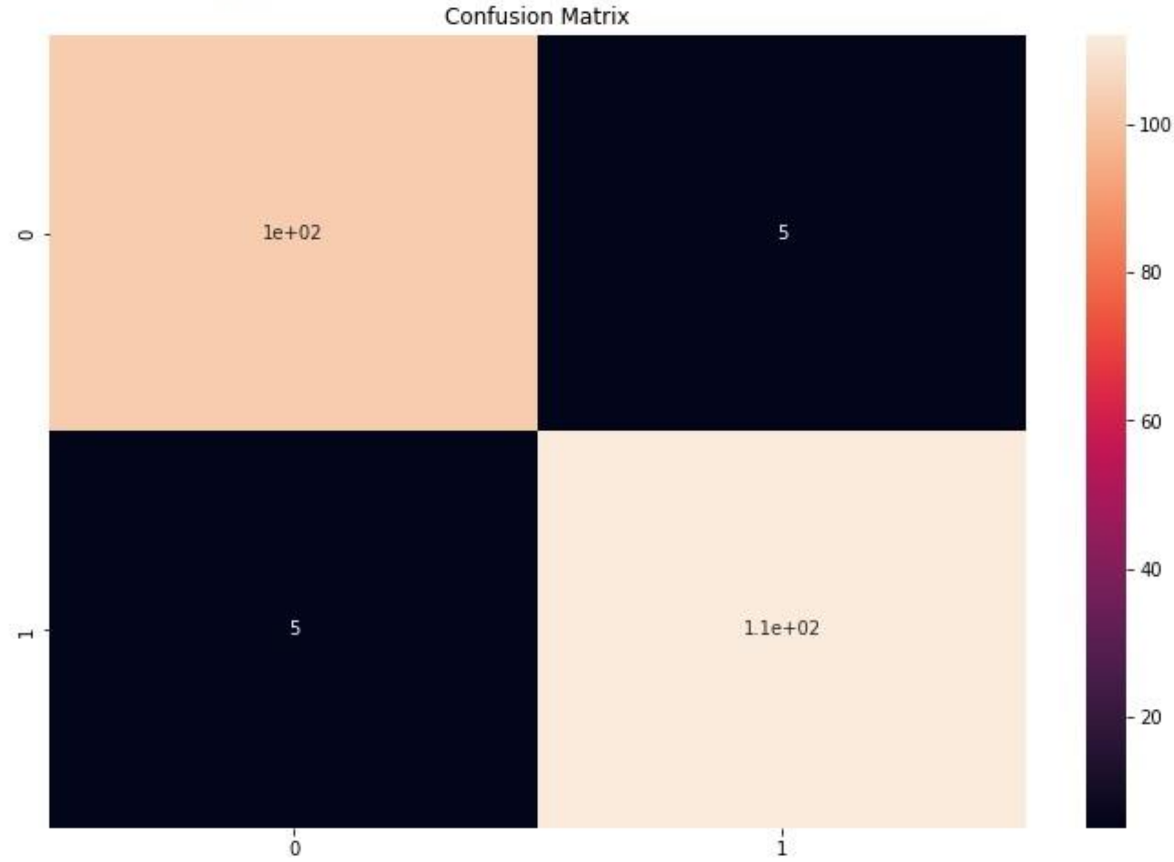
```
8/8 [==============================] - 1s 93ms/step
```

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

```
Test Score:95.56%
```

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

```
array([[103,   5],
       [  5, 112]])
```




```
#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."


classify_message(model,message1)
```

```
1/1 [==============================] - 0s 27ms/step
It is not a spam
```

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

```
1/1 [==============================] - 0s 26ms/step
It is a spam
```