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	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
```

```
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()
```

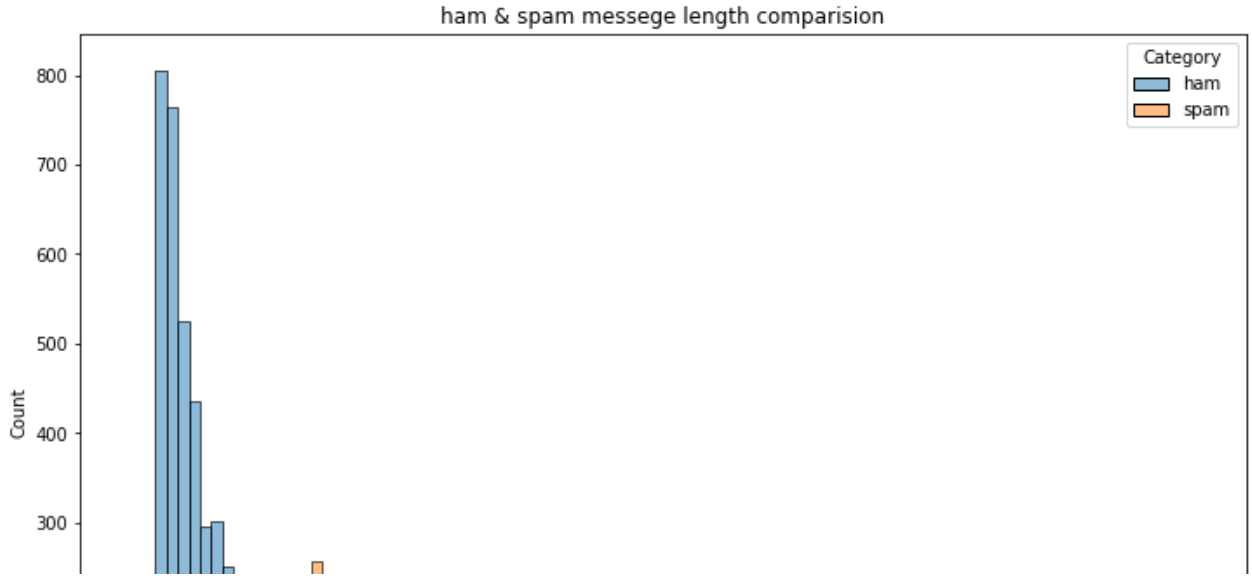
```
Category    0
Message     0
dtype: int64
```

```
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 serie

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
```

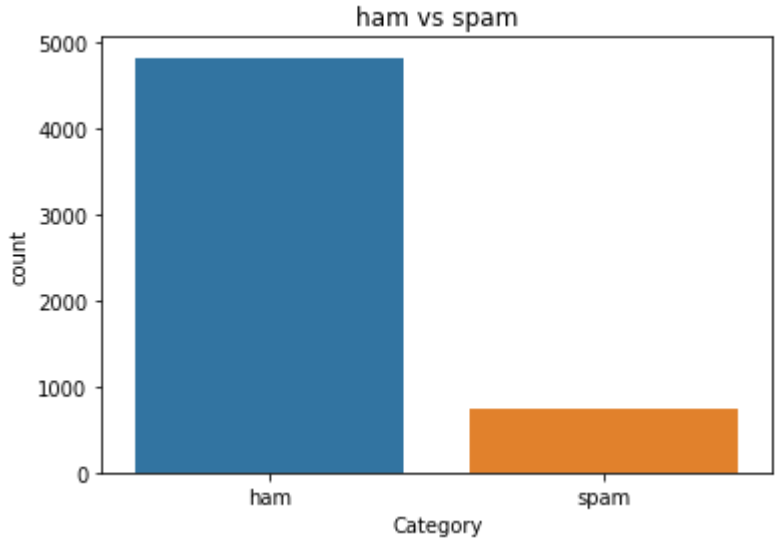
```
data.describe(include="all")
```

	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

```
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"],
)
```

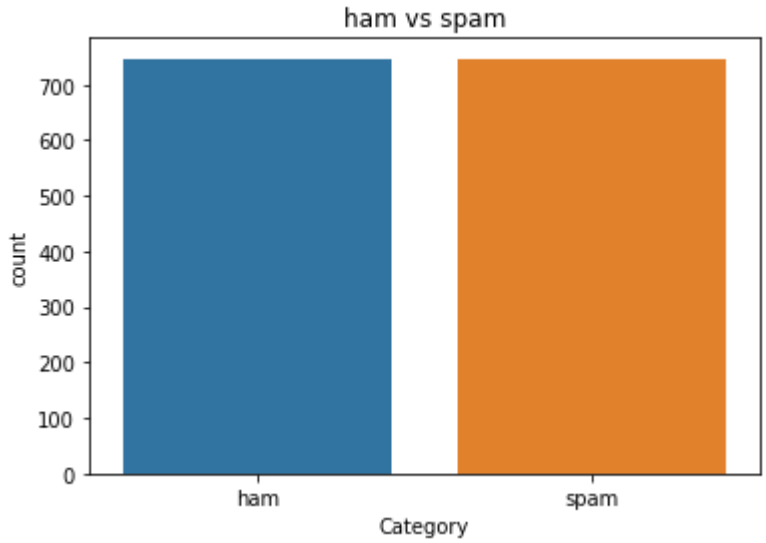
```
df.shape
```

```
(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	Label
0	ham	Aah! A cuddle would be lush! I'd need lots of ...	87	0
1	ham	I'm in solihull, | do you want anything?	40	0
2	spam	Double Mins & 1000 txts on Orange tariffs. Lat...	151	1
3	ham	No we put party 7 days a week and study lightl...	126	0

```
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)
```

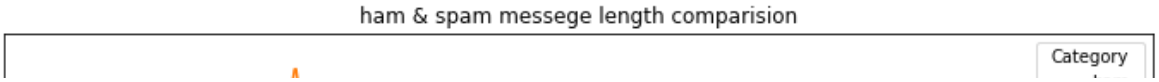
```
from tensorflow.keras.preprocessing.text import one_hot
vocab_size=10000

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	197	19
0	0	0	0	0	0	0	0	0	0	0	...	2090	1632	4289	7158	478	5808	6133	834
1	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	8663	442
2	0	0	0	0	0	0	0	0	0	0	...	1275	702	1694	4114	4162	3935	4162	853
3	0	0	0	0	0	0	0	0	0	0	...	3705	9946	5462	7158	9883	4500	8030	863
4	0	0	0	0	0	0	0	0	0	0	...	4753	6414	5018	1953	216	1175	8861	248

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
    )


    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
 Epoch 2/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.1718 - accuracy: 0.9453
 Epoch 3/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0533 - accuracy: 0.9842
 Epoch 4/10
 34/34 [==============================] - 1s 15ms/step - loss: 0.0254 - accuracy: 0.9926
 Epoch 5/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0184 - accuracy: 0.9954
 Epoch 6/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0134 - accuracy: 0.9963
 Epoch 7/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0150 - accuracy: 0.9954
 Epoch 8/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0112 - accuracy: 0.9972
 Epoch 9/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0062 - accuracy: 0.9981
 Epoch 10/10
 34/34 [==============================] - 1s 16ms/step - loss: 0.0050 - accuracy: 0.9991
 <keras.callbacks.History at 0x7fa3263a7850>
```

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

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

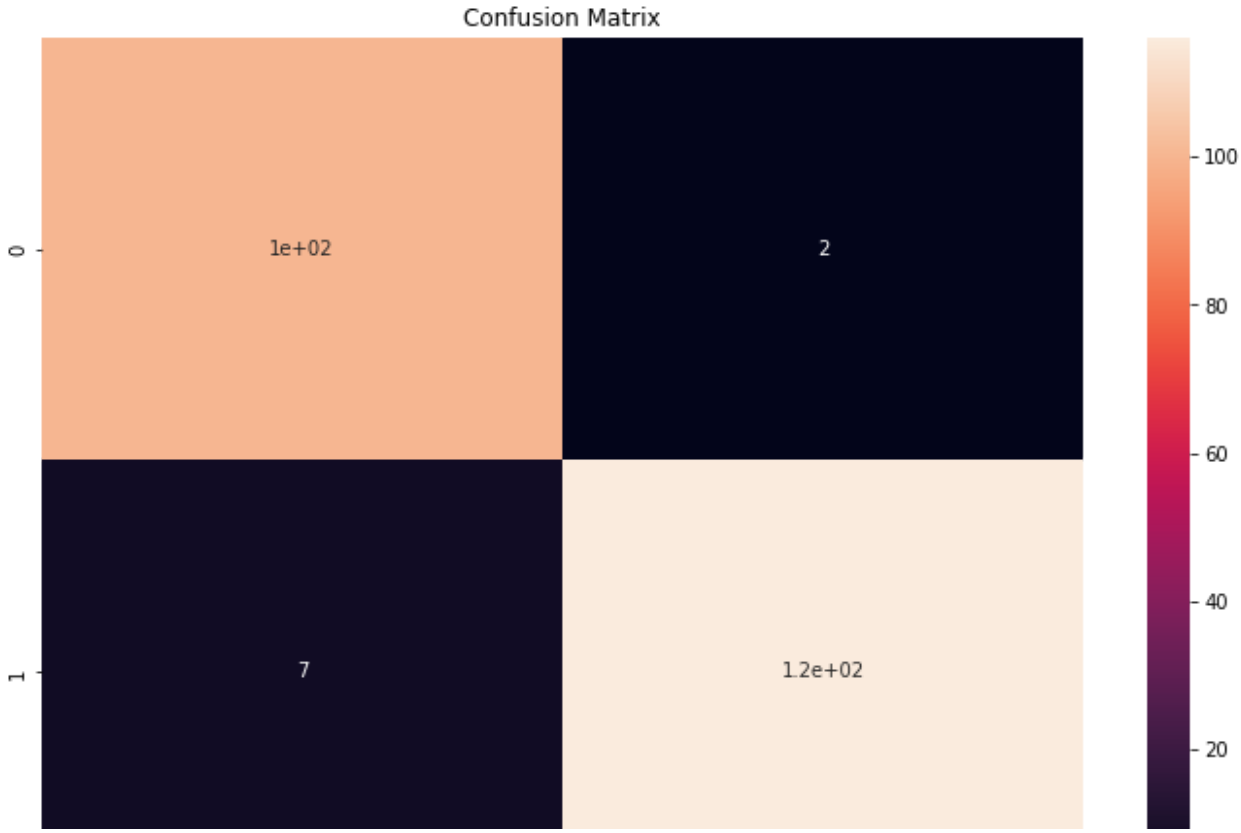
```
from sklearn.metrics import accuracy_score,confusion_matrix
```

```
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


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
```