Assignment -4

Python Programming

SMS SPAM Classification

Assignment Date	27 October 2022
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Student Roll Number	912419104019
Project	AI BASED DISCOURSEFOR BANKING INDUSTRY
Maximum Marks	2 Marks

Question-1:

Download the dataset: dataset

Solution:

from google.colab import drive
drive.mount('/content/drive')

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

Question-2:

Import required library

Solution:

import csv
import tensorflow as tf
import pandas as pd
import numpy as np
import seaborn as sns
import re
import matplotlib.pyplot as plt

```
import csv
import tensorflow as tf
import pandas as pd
import numpy as np
import seaborn as sns
import re
import matplotlib.pyplot as plt
```

from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.text import one_hot
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Embedding

from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score,confusion_matrix

```
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.text import one_hot
from tensorflow.keras.preprocessing.sequence import pad_sequences
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from tensorflow.keras.layers import LSTM
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Embedding
from tensorflow.keras.optimizers import Adam
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score,confusion_matrix
```

import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
STOPWORDS = set(stopwords.words('english'))

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nltk.download('stopwords')
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
STOPWORDS = set(stopwords.words('english'))
```

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

Question-3:

Read dataset and do pre-processing

Solution:

data=pd.read_csv("/content/drive/MyDrive/spam.csv",encoding="latin")
data.head()

```
data=pd.read_csv("/content/drive/MyDrive/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.tail()

```
data.tail()
```

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
5567	spam	This is the 2nd time we have tried 2 contact u...	NaN	NaN	NaN
5568	ham	Will Ì_ b going to esplanade fr home?	NaN	NaN	NaN
5569	ham	Pity, * was in mood for that. So...any other s...	NaN	NaN	NaN
5570	ham	The guy did some bitching but I acted like i'd...	NaN	NaN	NaN
5571	ham	Rofl. Its true to its name	NaN	NaN	NaN

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

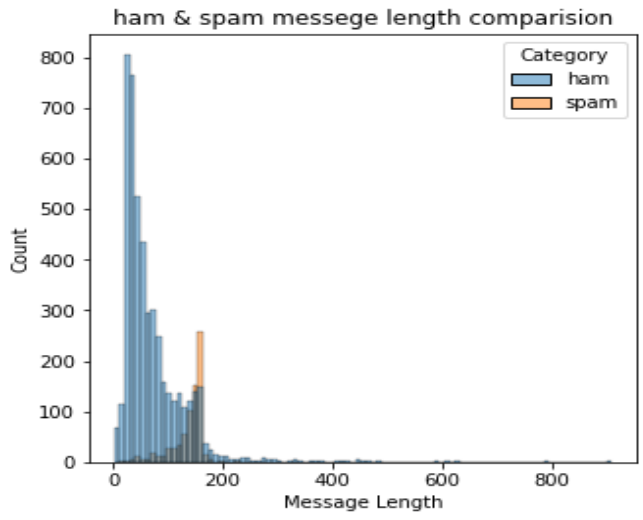
```
data=data.drop(columns=["Unnamed: 2","Unnamed: 3","Unnamed: 4"])
```

```
data=data.rename({"v1":"Category","v2":"Message"},axis=1)
data.isnull().sum()
```

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

data["Message Length"]=data["Message"].apply(len)
fig=plt.figure(figsize=(5,5))
sns.histplot(x=data["Message Length"],hue=data["Category"])
plt.title("ham & spam messege length comparision")
plt.show()

```
data["Message Length"]=data["Message"].apply(len)
fig=plt.figure(figsize=(5,5))
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_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
```

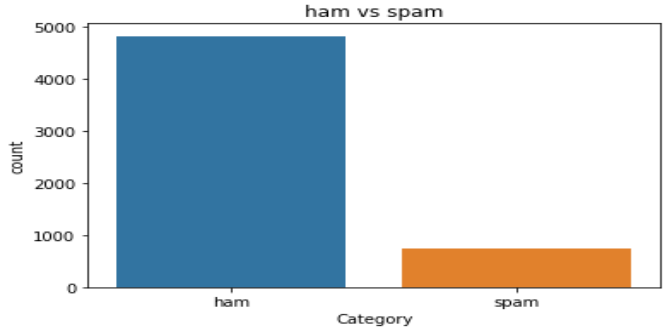
data["Category"].value_counts()

```
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()

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



nltk.download('punkt')

```
nltk.download('punkt')
```

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

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_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"],)

```
#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)

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df=data.loc[undersampled_indices]

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#reset the index as its all mixed
df=df.reset_index()

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

df.shape

```
df.shape
```

```
(1494, 3)
```

df["Category"].value_counts()

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

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

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

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

```
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)

```
#declare empty list to store tokenized message
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#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
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    message=message.lower()
    #split the word into individual word list
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    #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
]

```
vocab_size=10000
oneHot_doc=[one_hot(words,n=vocab_size)
           for words in corpus
           ]
```

df["Message Length"].describe()

```
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```

```
count    1494.000000
mean      104.854083
std        54.568061
min         2.000000
25%        49.000000
50%       121.000000
75%       153.000000
max       384.000000
Name: Message Length, dtype: float64
```

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

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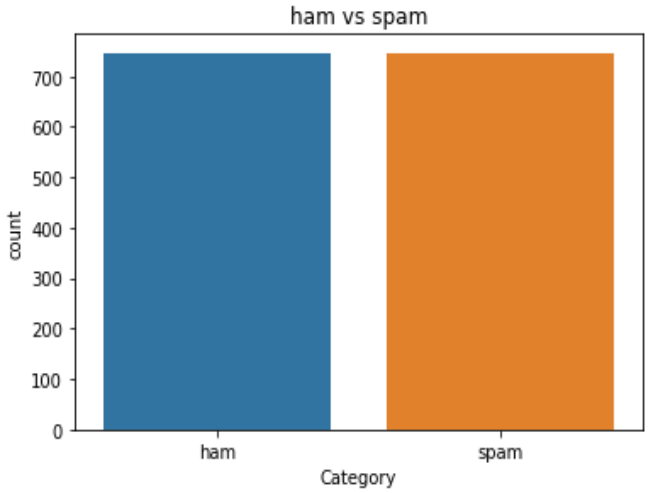
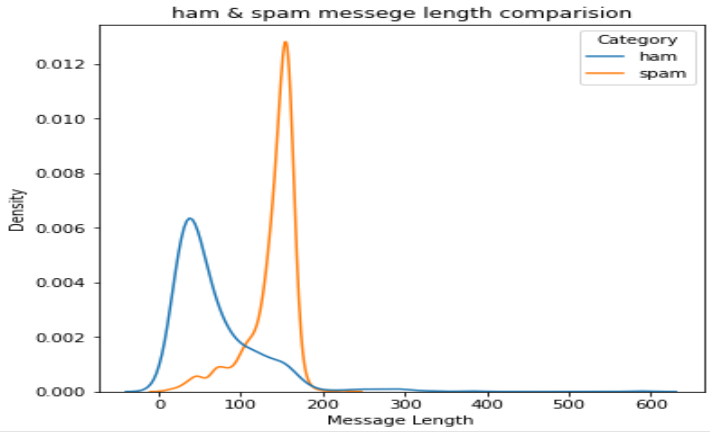
```



fig=plt.figure(figsize=(8,8))
sns.kdeplot(x=df["Message Length"],hue=df["Category"])
plt.title("ham & spam messege length comparision")
plt.show()

```
fig=plt.figure(figsize=(6,6))
sns.kdeplot(x=df["Message Length"],hue=df["Category"])
plt.title("ham & spam messege length comparision")
plt.show()
```



Question-4:

Create Model

Solution:

sentence_len=200
embedded_doc=pad_sequences(oneHot_doc,maxlen=sentence_len,
padding="pre")
extract_features=pd.DataFrame(data=embedded_doc)
target=df["Label"]

```
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()

```
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	...	5450	4116	2084	2812	4142	3508	3923	1083	3977	0
1	0	0	0	0	0	0	0	0	0	0	...	9690	5007	7762	2201	1591	7220	8834	8928	9982	1
2	0	0	0	0	0	0	0	0	0	0	...	9690	5597	8440	2828	2407	501	5007	7876	49	1
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	8591	9792	9019	8030	0
4	0	0	0	0	0	0	0	0	0	0	...	723	7860	3229	8287	1594	2017	7094	3874	3180	1

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()

```
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()
```

Question-5:

Add Layers (LSTM, Dense-(Hidden Layers), Output)

Solution:

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"))

```
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"))
```

Question-6:

Compile the Model

Solution:

model.compile(optimizer=Adam(learning_rate=0.001),loss="binary_crossentropy",metrics=["accuracy"])

```
model.compile(optimizer=Adam(learning_rate=0.001),loss="binary_crossentropy",metrics=["accuracy"])
```

Question-7:

Fit the Model

Solution:

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

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

```
Epoch 1/10
34/34 [==============================] - 17s 381ms/step - loss: 0.5160 - accuracy: 0.7301 - val_loss: 0.3182 - val_accuracy: 0.8848
Epoch 2/10
34/34 [==============================] - 12s 343ms/step - loss: 0.1638 - accuracy: 0.9462 - val_loss: 0.1194 - val_accuracy: 0.9686
Epoch 3/10
34/34 [==============================] - 14s 416ms/step - loss: 0.0582 - accuracy: 0.9814 - val_loss: 0.0819 - val_accuracy: 0.9791
Epoch 4/10
34/34 [==============================] - 12s 344ms/step - loss: 0.0298 - accuracy: 0.9889 - val_loss: 0.0839 - val_accuracy: 0.9738
Epoch 5/10
34/34 [==============================] - 14s 414ms/step - loss: 0.0201 - accuracy: 0.9963 - val_loss: 0.0990 - val_accuracy: 0.9529
Epoch 6/10
34/34 [==============================] - 14s 429ms/step - loss: 0.0121 - accuracy: 0.9944 - val_loss: 0.1043 - val_accuracy: 0.9686
Epoch 7/10
34/34 [==============================] - 12s 344ms/step - loss: 0.0581 - accuracy: 0.9889 - val_loss: 0.1537 - val_accuracy: 0.9476
Epoch 8/10
34/34 [==============================] - 13s 394ms/step - loss: 0.0211 - accuracy: 0.9981 - val_loss: 0.0900 - val_accuracy: 0.9686
Epoch 9/10
34/34 [==============================] - 16s 487ms/step - loss: 0.0074 - accuracy: 0.9981 - val_loss: 0.0828 - val_accuracy: 0.9738
Epoch 10/10
34/34 [==============================] - 14s 391ms/step - loss: 0.0054 - accuracy: 0.9991 - val_loss: 0.0872 - val_accuracy: 0.9686
<keras.callbacks.History at 0x7fb7399dc7d0>
```

Question-8:

Save The Model

Solution:

model.save('sms_classifier.h5')

```
model.save('sms_classifier.h5')
```

Question-9:

Test The Model

Solution:

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

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

```
8/8 [==============================] - 1s 96ms/step
```

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

```
Test Score:96.00%
```

```
#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")
```

```
#The function take model and message as parameter
def classify_message(model,message):
    #We will treat message as a paragraphs containing multiple sentences(lines)
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    for sentences in message:
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        #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)
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    oneHot=[one_hot(word,n=vocab_size)]
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    predict=model.predict(text)
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    if predict>0.5:
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    #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."

```
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)

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

```
1/1 [==============================] - 0s 105ms/step
It is not a spam
```

classify_message(model,message2)

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

```
1/1 [==============================] - 0s 33ms/step
It is not a spam
```