Assignment - 4

SMS Spam Classification

Assignment Date	27November 2022
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Maximum Marks	2 Marks

Problem Statement:

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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.

Solution: **Spam Message Classification using LSTM**

Source code and corresponding outputs:

1. Import the Necessary Libraries

In [2]:

```
import numpy as np
import pandas as pd
import os
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
/kaggle/input/sms-spam-collection-dataset/spam.csv
```

2. Reading the .csv dataset

In [3]:
```
data=pd.read_csv("../input/sms-spam-collection-dataset/spam.csv",encoding="latin")
data.head()
```

Out[3]:

	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

In [4]:
```
data.columns
```

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

3. Drop the unnamed Columns

In [5]:
```
data=data.drop(columns=["Unnamed: 2","Unnamed: 3","Unnamed: 4"])
```

4. Renaming Column names sensible

In [6]:
```
data=data.rename(
{
    "v1":"Category",
    "v2":"Message"
},
    axis=1
)
```

In [7]:
```
data.head()
```

Out[7]:

	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...

5. Check for null values in dataset

```
In [8]: data.isnull().sum()
```

```
Out[8]: Category    0
        Message     0
        dtype: int64
```

```
In [9]: data.info()
```

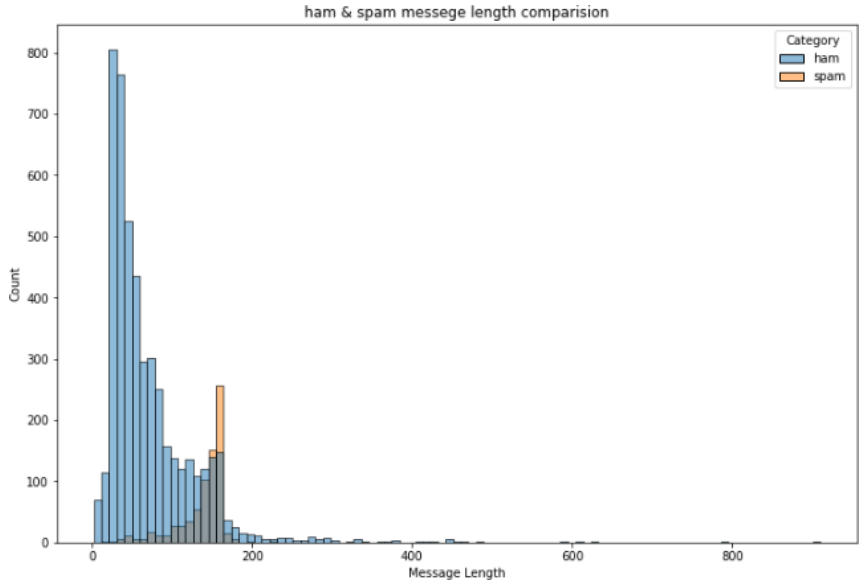
```
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Category  5572 non-null   object
 1   Message   5572 non-null   object
dtypes: object(2)
memory usage: 87.2+ KB
```

6.Creating a new Field to store the Message Lengths

```
In [10]: data["Message Length"]=data["Message"].apply(len)
```

7. Histogram Inference of Message Lengths of Spam and Non-spam messages

```
In [11]: fig=plt.figure(figsize=(12,8))
         sns.histplot(
             x=data["Message Length"],
             hue=data["Category"]
         )
         plt.title("ham & spam messege length comparision")
         plt.show()
```



In [12]:

```
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
```

In [13]:

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

Out[13]:

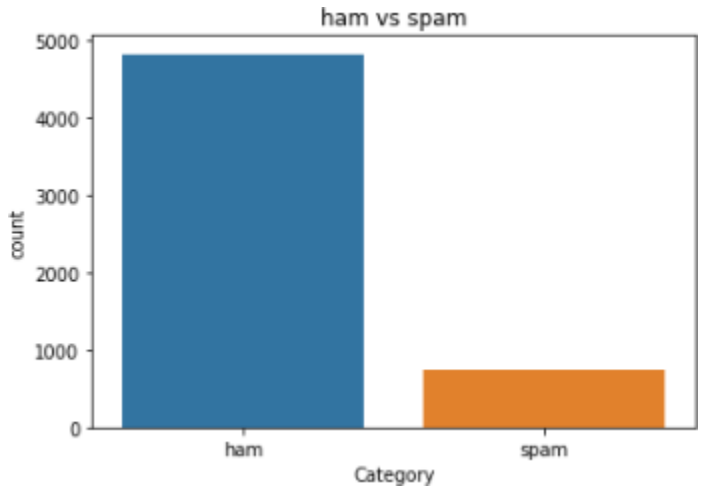
	Category	Message	Message Length
count	5572	5572	5572.000000
unique	2	5169	NaN
top	ham	Sorry, I'll call later	NaN
freq	4825	30	NaN
mean	NaN	NaN	80.118808
std	NaN	NaN	59.690841
min	NaN	NaN	2.000000
25%	NaN	NaN	36.000000
50%	NaN	NaN	61.000000
75%	NaN	NaN	121.000000
max	NaN	NaN	910.000000

8. Visualizing count of messages of Spam and Non Spam

In [14]:
```
data["Category"].value_counts()
```

Out[14]:
```
ham     4825
spam     747
Name: Category, dtype: int64
```

In [15]:
```
sns.countplot(
    data=data,
    x="Category"
)
plt.title("ham vs spam")
plt.show()
```



In [16]:
```
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.
```

9. Undersampling to Genralize Model and Balance Spam and Ham quantities in dataset

In [17]:
```
minority_len=len(data[data["Category"]=="spam"])
majority_len=len(data[data["Category"]=="ham"])
minority_indices=data[data["Category"]=="spam"].index
majority_indices=data[data["Category"]=="ham"].index
random_majority_indices=np.random.choice(
    majority_indices,
    size=minority_len,
    replace=False
)

undersampled_indices=np.concatenate([minority_indices,random_majority_indices])
df=data.loc[undersampled_indices]
df=df.sample(frac=1)
df=df.reset_index()
df=df.drop(
    columns=["index"],
)
```

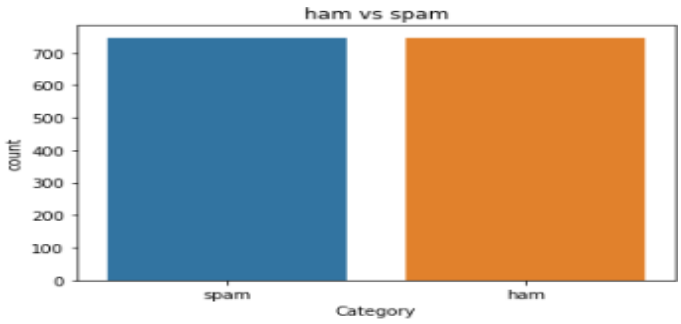
In [18]:
```
df.shape
```

Out[18]: (1494, 3)

In [19]:
```
df["Category"].value_counts()
```

Out[19]:
```
ham     747
spam    747
Name: Category, dtype: int64
```

In [20]:
```
sns.countplot(
    data=df,
    x="Category"
)
plt.title("ham vs spam")
plt.show()
```



Display the head of new **df**

In [21]:
```
df.head()
```

Out[21]:

	Category	Message	Message Length
0	spam	FREE>Ringtone! Reply REAL or POLY eg REAL1 1. ...	158
1	spam	URGENT! We are trying to contact U Todays draw...	157
2	ham	Ok ill send you with in <DECIMAL> ok.	45
3	ham	Oh just getting even with u.... u?	34
4	spam	A link to your picture has been sent. You can ...	96

10. Binary Encoding of Spam and Ham Categories

In [22]:
```
df["Label"]=df["Category"].map(
    {
        "ham":0,
        "spam":1
    }
)
```

In [23]:
```
df.head()
```

Out[23]:

	Category	Message	Message Length	Label
0	spam	FREE>Ringtone! Reply REAL or POLY eg REAL1 1. ...	158	1
1	spam	URGENT! We are trying to contact U Todays draw...	157	1
2	ham	Ok ill send you with in <DECIMAL> ok.	45	0
3	ham	Oh just getting even with u.... u?	34	0
4	spam	A link to your picture has been sent. You can ...	96	1

11. Import Necessary Libraries to perform Word Tokenization

In [24]:
```
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer

stemmer=PorterStemmer()
```

In [25]:
```
corpus=[]
for message in df["Message"]:
    message=re.sub("[^a-zA-Z]"," ",message)
    message=message.lower()
    message=message.split()
    message=[stemmer.stem(words)
             for words in message
              if words not in set(stopwords.words("english"))
             ]
    message=" ".join(message)
    corpus.append(message)
```

12. Perform One Hot on Corpus

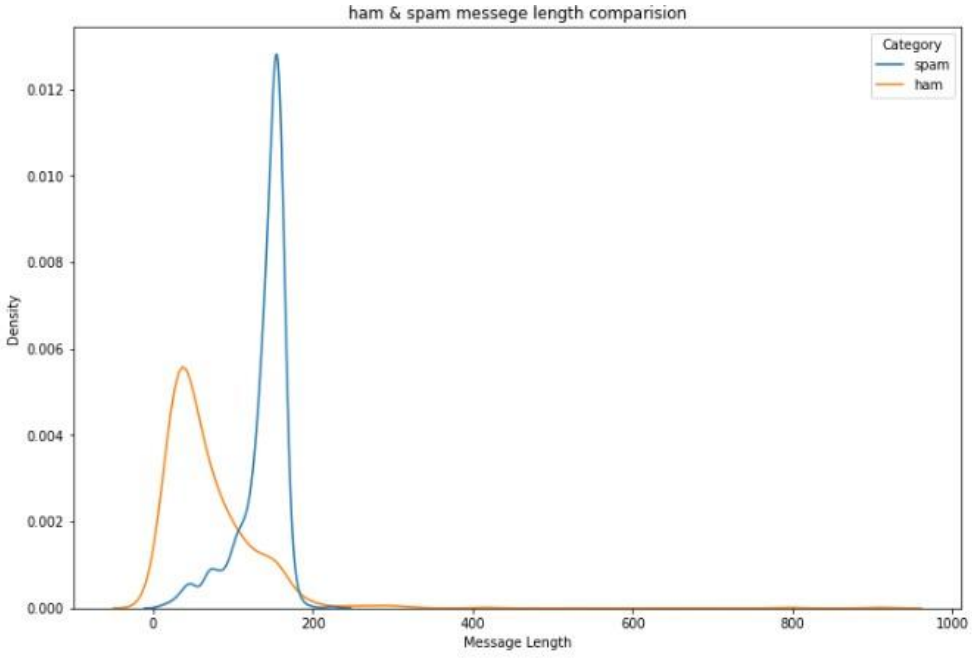
In [26]:
```
from tensorflow.keras.preprocessing.text import one_hot
vocab_size=10000

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

In [27]:
```
df["Message Length"].describe()
```

Out[27]:
```
count    1494.000000
mean      104.491299
std        60.362332
min         2.000000
25%        49.000000
50%       114.000000
75%       153.000000
max       910.000000
Name: Message Length, dtype: float64
```

In [28]:
```
fig=plt.figure(figsize=(12,8))
sns.kdeplot(
    x=df["Message Length"],
    hue=df["Category"]
)
plt.title("ham & spam messege length comparision")
plt.show()
```



In [29]:
```
from tensorflow.keras.preprocessing.sequence import pad_sequences
sentence_len=200
embedded_doc=pad_sequences(
    oneHot_doc,
    maxlen=sentence_len,
    padding="pre"
)
```

In [30]:
```
extract_features=pd.DataFrame(
    data=embedded_doc
)
target=df["Label"]
```

In [31]:
```
df_final=pd.concat([extract_features,target],axis=1)
```

In [32]:
```
df_final.head()
```

Out[32]:

	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	...	8116	8983	7883	1884	5957	5877	266	1527	5846	1
1	0	0	0	0	0	0	0	0	0	0	...	9989	7682	5710	5519	2447	1240	3994	6950	3655	1
2	0	0	0	0	0	0	0	0	0	0	...	0	0	3310	6099	7761	9276	4679	2205	3310	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	8194	7945	3841	266	266	0
4	0	0	0	0	0	0	0	0	0	0	...	5677	7440	8481	9975	2366	4841	4320	4320	4672	1

5 rows × 201 columns

13. Splitting Dependent and Independent Variables

In [33]:
```
X=df_final.drop("Label",axis=1)
y=df_final["Label"]
```

14. Train, test and Validation Split

In [34]:
```
from sklearn.model_selection import train_test_split
```

In [35]:
```
X_trainval,X_test,y_trainval,y_test=train_test_split(
    X,
    y,
    random_state=42,
    test_size=0.15
)
```

In [36]:
```
X_train,X_val,y_train,y_val=train_test_split(
    X_trainval,
    y_trainval,
    random_state=42,
    test_size=0.15
)
```

15. Building a Sequential Model

In [37]:
```
from tensorflow.keras.layers import LSTM
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Embedding
from tensorflow.keras.models import Sequential
```

In [38]:
```
model=Sequential()
```

In [39]:
```
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.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 200, 100)          1000000
_________________________________________________________________
lstm (LSTM)                  (None, 128)               117248
_________________________________________________________________
dense (Dense)                (None, 1)                 129
=================================================================
Total params: 1,117,377
Trainable params: 1,117,377
Non-trainable params: 0
_________________________________________________________________
```

In [40]:
```
from tensorflow.keras.optimizers import Adam
model.compile(
    optimizer=Adam(
    learning_rate=0.001
    ),
    loss="binary_crossentropy",
    metrics=["accuracy"]
)
```

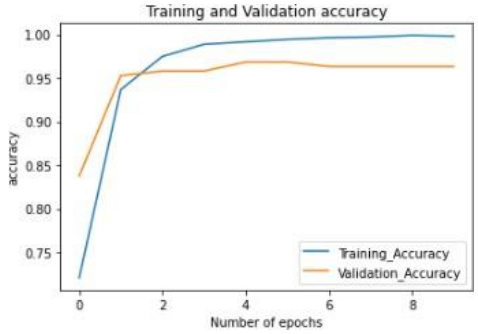
16. Model Fitting

In [41]:
```
history=model.fit(
    X_train,
    y_train,
    validation_data=(
        X_val,
        y_val
    ),
    epochs=10
)
```

```
Epoch 1/10
34/34 [==============================] - 24s 633ms/step - loss: 0.6324 - accuracy: 0.6331 - val_loss: 0.4218 - val_accuracy: 0.8377
Epoch 2/10
34/34 [==============================] - 21s 608ms/step - loss: 0.3045 - accuracy: 0.9257 - val_loss: 0.1631 - val_accuracy: 0.9529
Epoch 3/10
34/34 [==============================] - 21s 609ms/step - loss: 0.1046 - accuracy: 0.9689 - val_loss: 0.1231 - val_accuracy: 0.9581
Epoch 4/10
34/34 [==============================] - 21s 621ms/step - loss: 0.0465 - accuracy: 0.9880 - val_loss: 0.1293 - val_accuracy: 0.9581
Epoch 5/10
34/34 [==============================] - 21s 613ms/step - loss: 0.0342 - accuracy: 0.9895 - val_loss: 0.1252 - val_accuracy: 0.9686
Epoch 6/10
34/34 [==============================] - 21s 615ms/step - loss: 0.0179 - accuracy: 0.9951 - val_loss: 0.1366 - val_accuracy: 0.9686
Epoch 7/10
34/34 [==============================] - 21s 614ms/step - loss: 0.0121 - accuracy: 0.9968 - val_loss: 0.1314 - val_accuracy: 0.9634
Epoch 8/10
34/34 [==============================] - 21s 619ms/step - loss: 0.0222 - accuracy: 0.9944 - val_loss: 0.1479 - val_accuracy: 0.9634
Epoch 9/10
34/34 [==============================] - 21s 614ms/step - loss: 0.0077 - accuracy: 0.9989 - val_loss: 0.1624 - val_accuracy: 0.9634
Epoch 10/10
34/34 [==============================] - 21s 614ms/step - loss: 0.0077 - accuracy: 0.9976 - val_loss: 0.1751 - val_accuracy: 0.9634
```

In [42]:
```
metrics = pd.DataFrame(history.history)
metrics.rename(columns = {'loss': 'Training_Loss', 'accuracy': 'Training_Accuracy', 'val_loss': 'Validation_Loss', 'val_accuracy': 'Validation_Accurac
def plot_graph_acc(var1, var2, string):
    metrics[[var1, var2]].plot()
    plt.title('Training and Validation ' + string)
    plt.xlabel ('Number of epochs')
    plt.ylabel(string)
    plt.legend([var1, var2])
```

In [43]:
```
plot_graph_acc('Training_Accuracy', 'Validation_Accuracy', 'accuracy')
```



17. Save and Test the Model

In [44]:
```
y_pred=model.predict(X_test)
y_pred=(y_pred>0.5)
```

In [45]:
```
model.save('Spam_SMS_classifier.h5')
```

18. Evaluating the Model

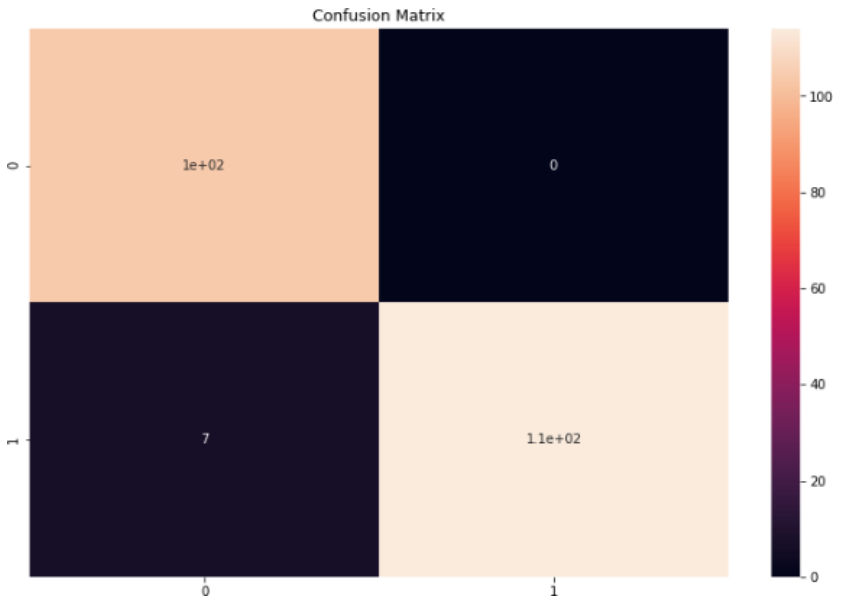
In [46]:
```
from sklearn.metrics import accuracy_score,confusion_matrix
```

In [47]:
```
score=accuracy_score(y_test,y_pred)
print("Test Score:{:.2f}%".format(score*100))
```

```
Test Score:96.89%
```

In [48]:
```
cm=confusion_matrix(y_test,y_pred)
fig=plt.figure(figsize=(12,8))
sns.heatmap(
    cm,
    annot=True,
)
plt.title("Confusion Matrix")
cm
```

Out[48]:
```
array([[104,   0],
       [  7, 114]])
```



19. Function to Test the Model on a Random message

In [62]:
```
def classify_message(model,message):
    for sentences in message:
        sentences=nltk.sent_tokenize(message)
        for sentence in sentences:
            words=re.sub("[^a-zA-Z]"," ",sentence)
            if words not in set(stopwords.words('english')):
                word=nltk.word_tokenize(words)
                word=" ".join(word)
    oneHot=[one_hot(word,n=vocab_size)]
    text=pad_sequences(oneHot,maxlen=sentence_len,padding="pre")
    predict=model.predict(text)
    if predict>0.5:
        print("It is a spam")
        print("predict score: ", predict[0][0])
    else:
        print("It is not a spam")
        print("predict score: ", predict[0][0])
```

In [80]:
```
message1="I am having my Tests right now. Will call back as soon as possible! Till then be safe wherever you are. Be Alert of any hazard"
message2="Your Rs.8850 welcome bonus is ready to be credited. Download Junglee Rummy now. Claim Bonus on your first deposit prize pool"
```

In [81]:
```
classify_message(model,message1)
```

```
It is not a spam
predict score:  0.037389785
```

In [82]:
```
classify_message(model,message2)
```

```
It is a spam
predict score:  0.9936712
```