Assignment – 2

SMS Spam Classification

Assignment Date	08 October 2022
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Maximum Marks	2 Marks

Task - 1: Import the necessary libraries

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
```

Task - 2: Reading the .csv dataset

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')
```

Task - 3: Drop the unnamed columns

3. Drop the unnamed Columns

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

Task – 4: Renaming Column names sensible

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...

Task – 5: Check for null values in dataset

5. Check for null values in dataset

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

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

In [9]:
```
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
```

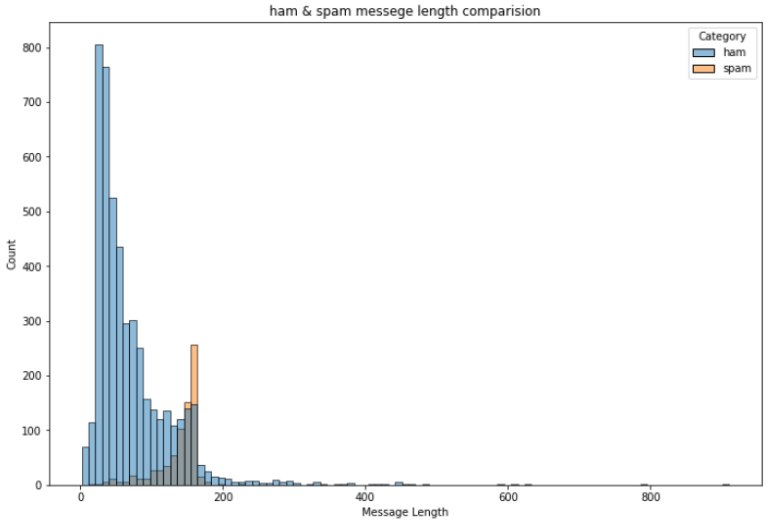
Task – 6: Creating a new field to store the Message Lengths

6.Creating a new Field to store the Message Lengths

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

Task – 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

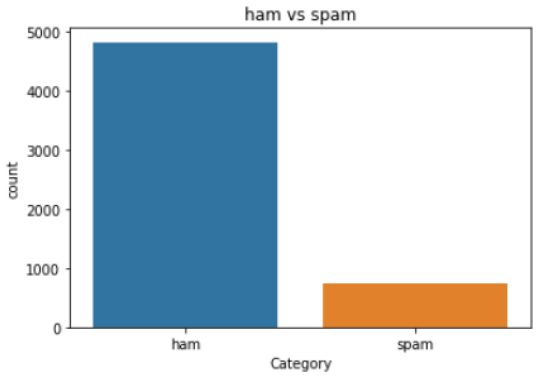
Task – 8: Visualizing count of messages of Spam and Non Spam

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.
```

Task – 9: Undersampling to Genralize Model and Balance Spam and Ham quantities in dataset

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"],
)
```

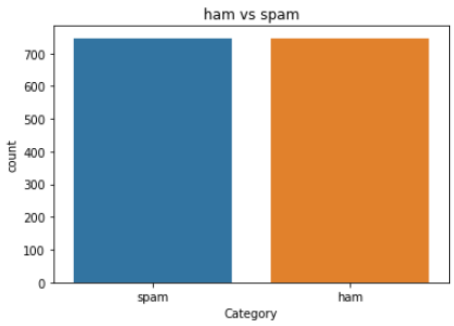
In [18]:
```
df.shape
```

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

Task – 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

Task – 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)
```

Task – 12: Perform One Hot on Corpus

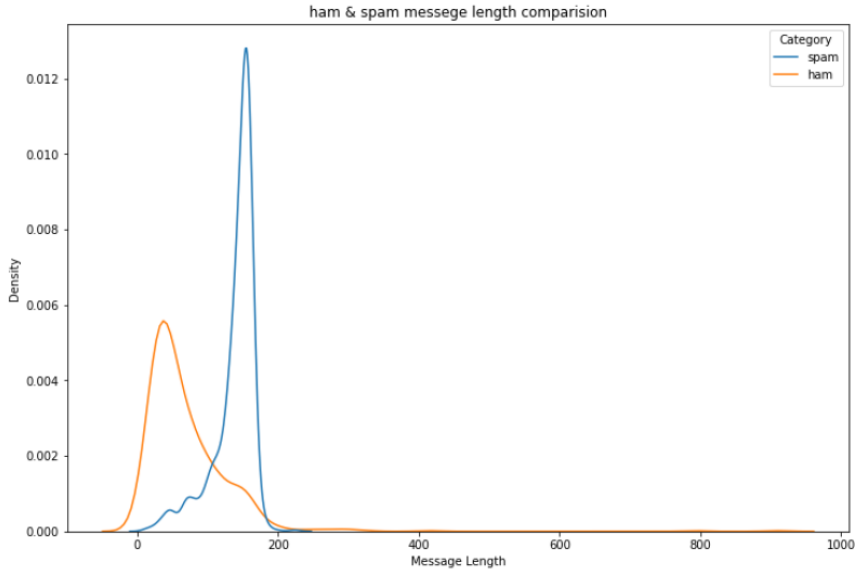
In [26]:
```
from tensorflow.keras.preprocessing.text import one_hot
vocab_size=10000

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

Task – 13: Splitting Dependent and Independent Variables

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

Task – 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
)
```

Task – 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"]
)
```

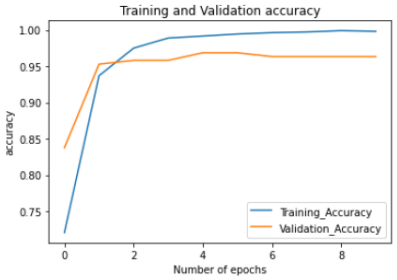
Task – 16: Model Fitting

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: 0.83
77
Epoch 2/10
34/34 [==============================] - 21s 608ms/step - loss: 0.3045 - accuracy: 0.9257 - val_loss: 0.1631 - val_accuracy: 0.95
29
Epoch 3/10
34/34 [==============================] - 21s 609ms/step - loss: 0.1046 - accuracy: 0.9689 - val_loss: 0.1231 - val_accuracy: 0.95
81
Epoch 4/10
34/34 [==============================] - 21s 621ms/step - loss: 0.0465 - accuracy: 0.9880 - val_loss: 0.1293 - val_accuracy: 0.95
81
Epoch 5/10
34/34 [==============================] - 21s 613ms/step - loss: 0.0342 - accuracy: 0.9895 - val_loss: 0.1252 - val_accuracy: 0.96
86
Epoch 6/10
34/34 [==============================] - 21s 615ms/step - loss: 0.0179 - accuracy: 0.9951 - val_loss: 0.1366 - val_accuracy: 0.96
86
Epoch 7/10
34/34 [==============================] - 21s 614ms/step - loss: 0.0121 - accuracy: 0.9968 - val_loss: 0.1314 - val_accuracy: 0.96
34
Epoch 8/10
34/34 [==============================] - 21s 619ms/step - loss: 0.0222 - accuracy: 0.9944 - val_loss: 0.1479 - val_accuracy: 0.96
34
Epoch 9/10
34/34 [==============================] - 21s 614ms/step - loss: 0.0077 - accuracy: 0.9989 - val_loss: 0.1624 - val_accuracy: 0.96
34
Epoch 10/10
34/34 [==============================] - 21s 614ms/step - loss: 0.0077 - accuracy: 0.9976 - val_loss: 0.1751 - val_accuracy: 0.96
34
```

In [42]:
```
metrics = pd.DataFrame(history.history)
metrics.rename(columns = {'loss': 'Training_Loss', 'accuracy': 'Training_Accuracy', 'val_loss': 'Validation_Loss', 'val_accuracy':
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')
```



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

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

Task – 16: Evaluating the Model

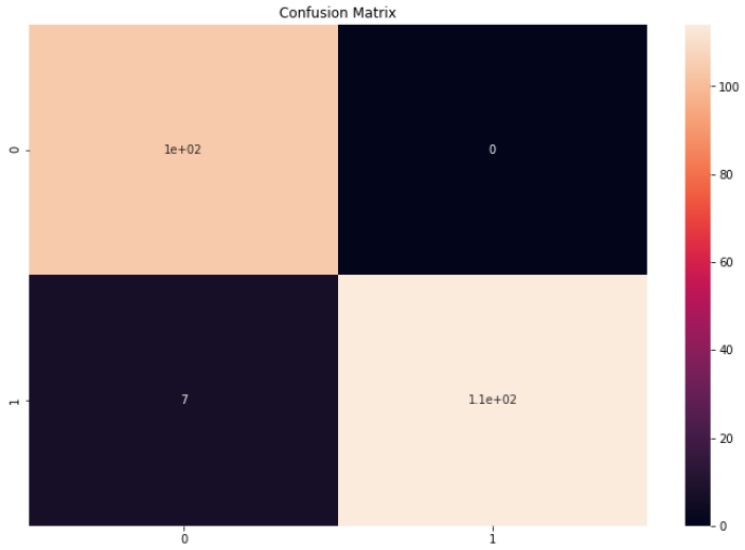
In [46]:
```
from sklearn.metrics import accuracy_score,confusion_matrix
```

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]])
```



Task – 18: 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
message2="Your Rs.8850 welcome bonus is ready to be credited. Download Junglee Rummy now. Claim Bonus on your first deposit prize
```

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
```