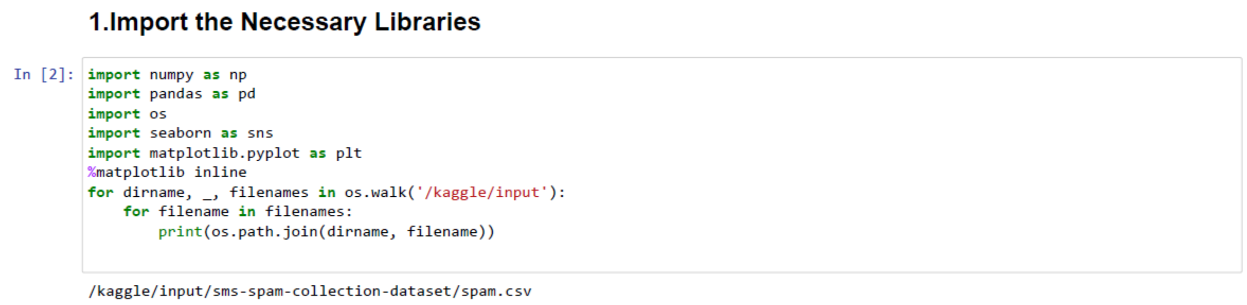
Assignment – 4

SMS Spam Classification

Assignment Date	08 October 2022
Student Name	Yuvaraj S
Student Roll Number	2019504610
Maximum Marks	2 Marks

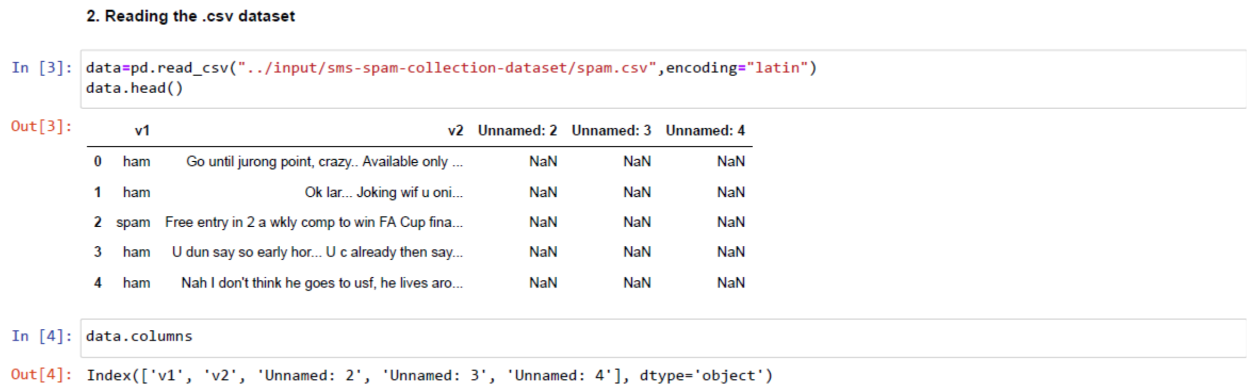
Task - 1: Import the necessary libraries



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

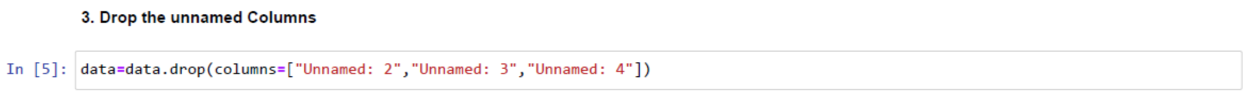
```
In [3]: data=pd.read_csv("../input/sms-spam-collection-dataset/spam.csv",encoding="latin")
        data.head()
```

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')
```

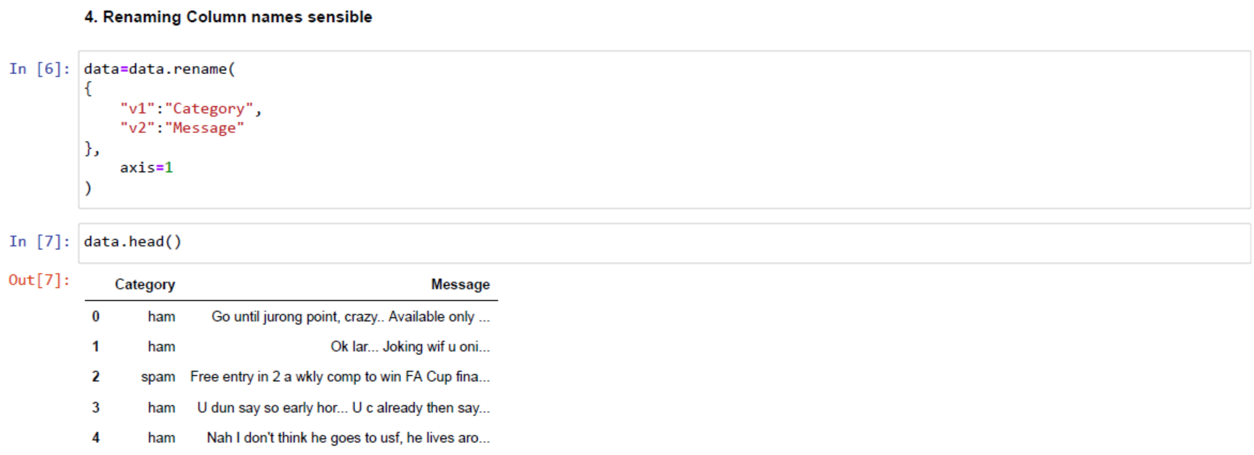
Task - 3: Drop the unnamed columns



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

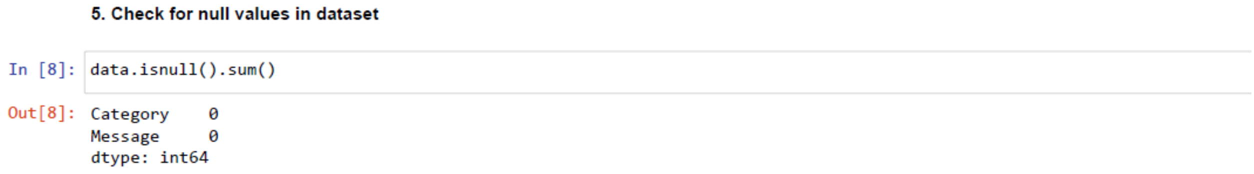
```
In [6]: data=data.rename(
        {
            "v1":"Category",
            "v2":"Message"
        },
            axis=1
        )
```

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

Out[7]:

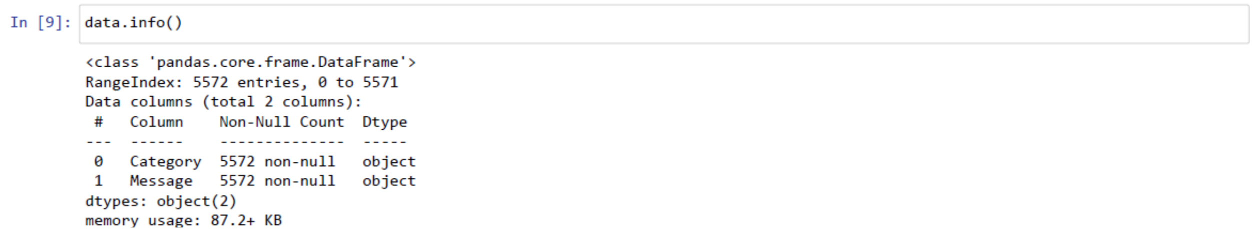
	Category	Message
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

Task – 5: Check for null values in dataset



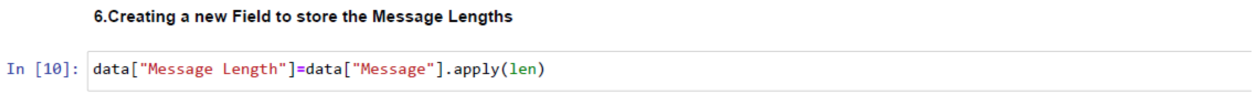
5. Check for null values in dataset

```
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



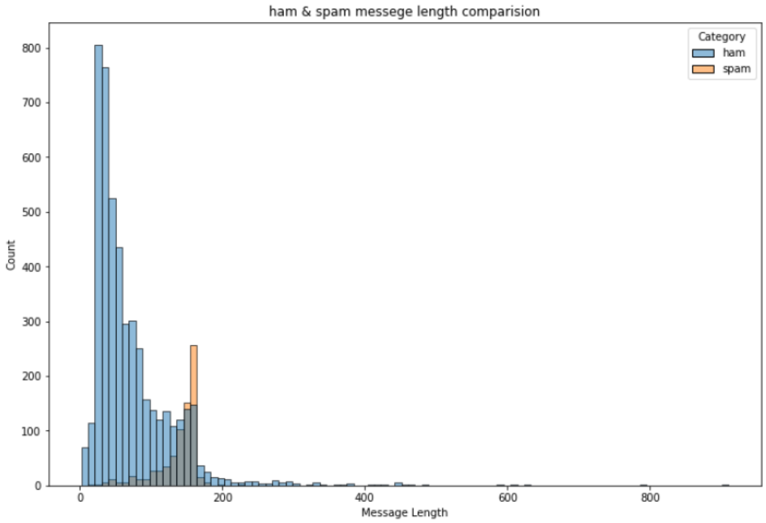
6.Creating a new Field to store the Message Lengths

```
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
```

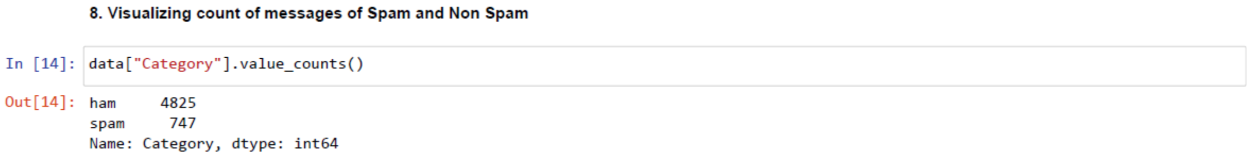
In [13]:

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

Out[13]:

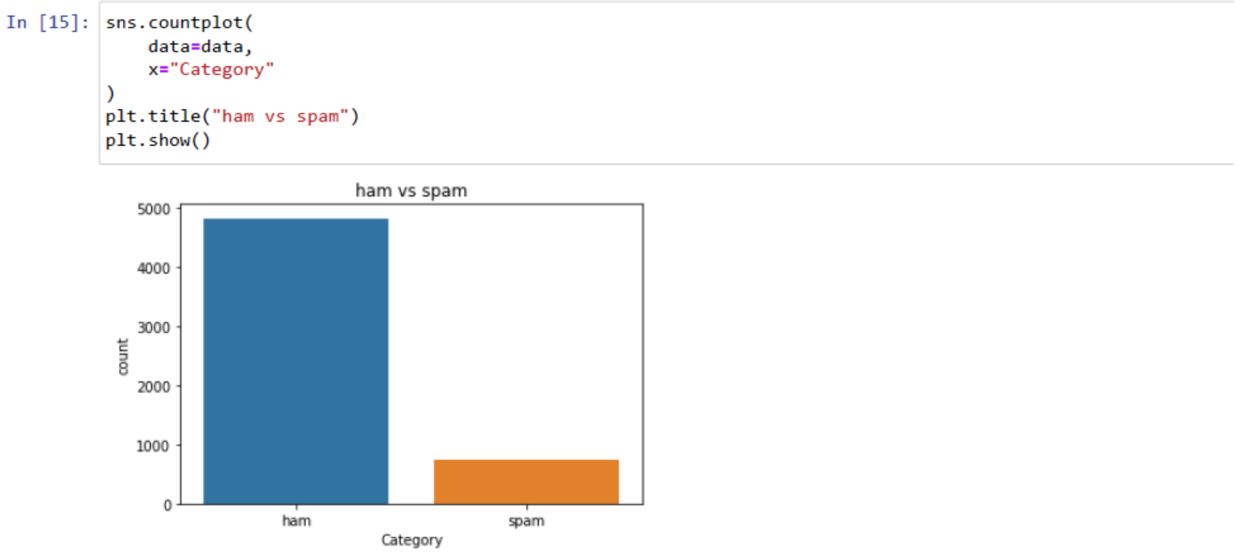
	Category	Message	Message Length
count	5572	5572	5572.000000
unique	2	5169	NaN
top	ham	Sorry, I'll call later	NaN
freq	4825	30	NaN
mean	NaN	NaN	80.118808
std	NaN	NaN	59.690841
min	NaN	NaN	2.000000
25%	NaN	NaN	36.000000
50%	NaN	NaN	61.000000
75%	NaN	NaN	121.000000
max	NaN	NaN	910.000000

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

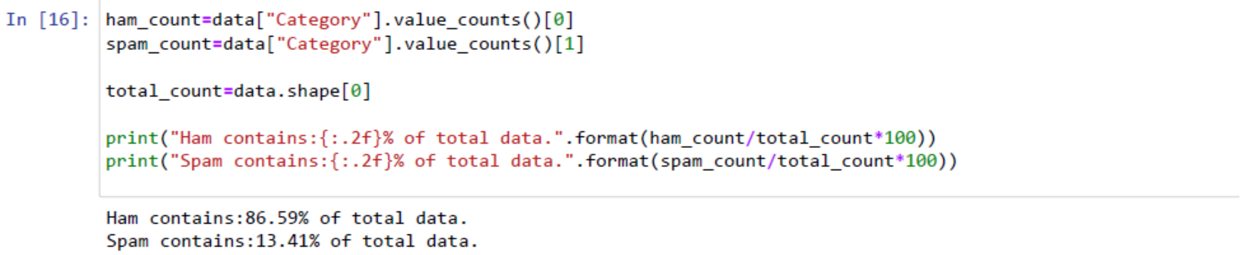


8. Visualizing count of messages of Spam and Non Spam

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

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

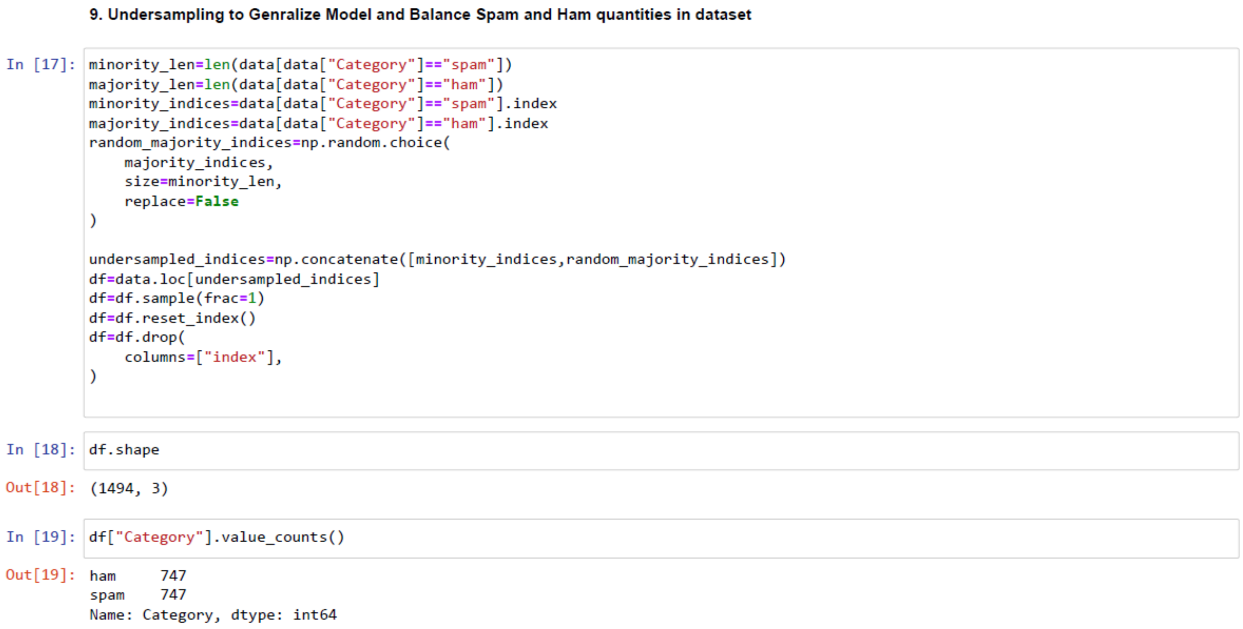


```
In [15]: sns.countplot(
             data=data,
             x="Category"
         )
         plt.title("ham vs spam")
         plt.show()
```



```
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

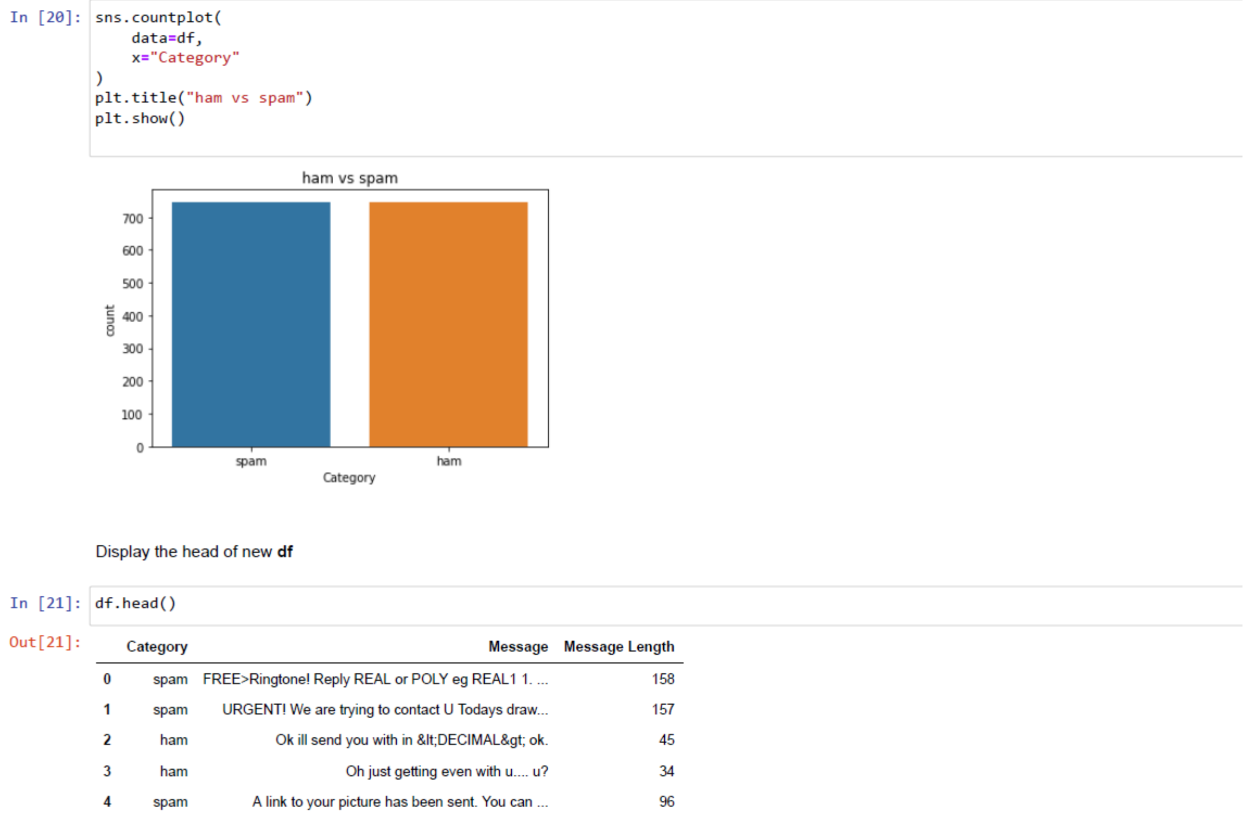
```
In [17]: minority_len=len(data[data["Category"]=="spam"])
         majority_len=len(data[data["Category"]=="ham"])
         minority_indices=data[data["Category"]=="spam"].index
         majority_indices=data[data["Category"]=="ham"].index
         random_majority_indices=np.random.choice(
     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

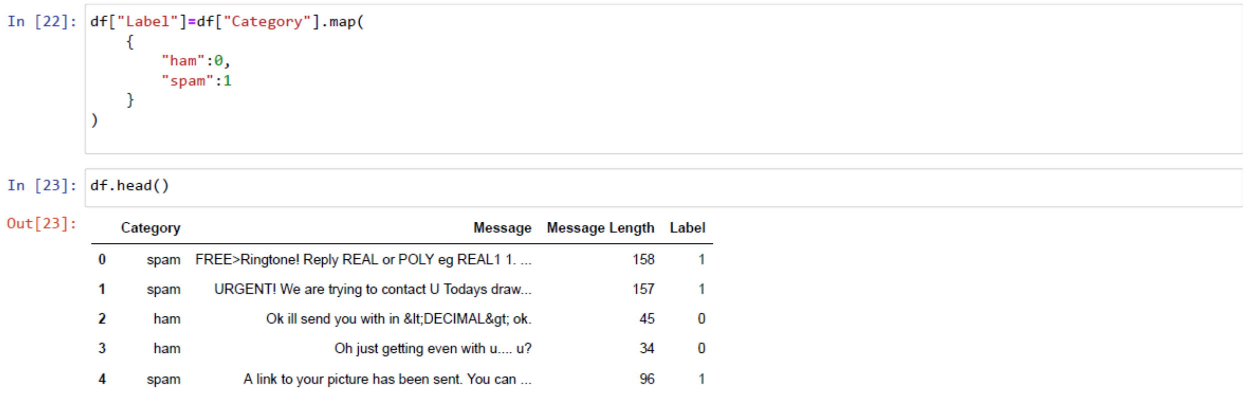
Display the head of new **df**

```
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



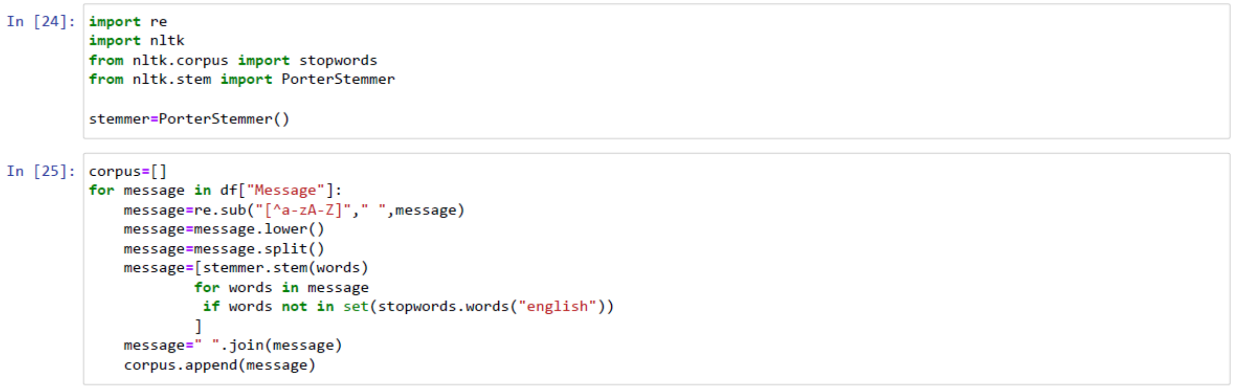
```
In [22]: df["Label"]=df["Category"].map(
             {
                 "ham":0,
                 "spam":1
             }
         )
```

```
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

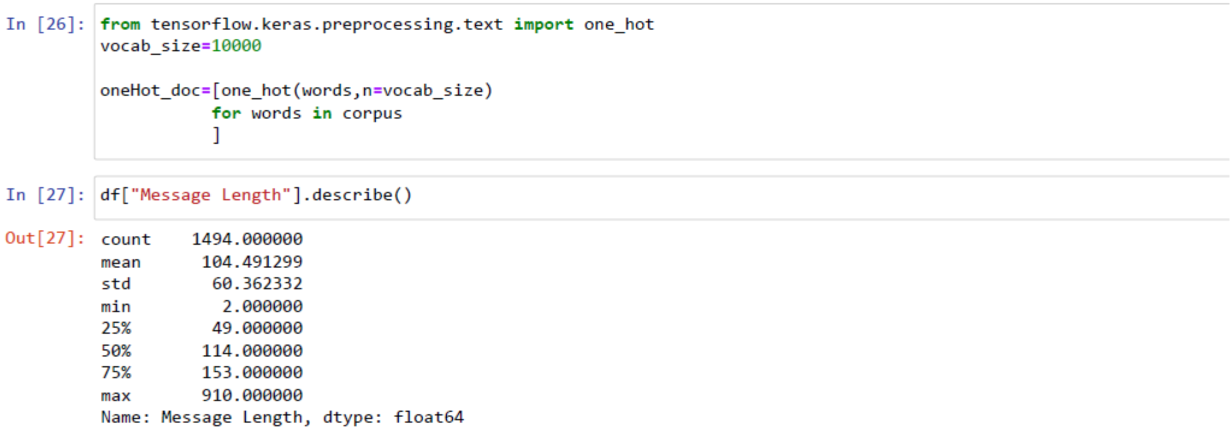
Task – 11: Import Necessary Libraries to perform Word Tokenization



```
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)
```

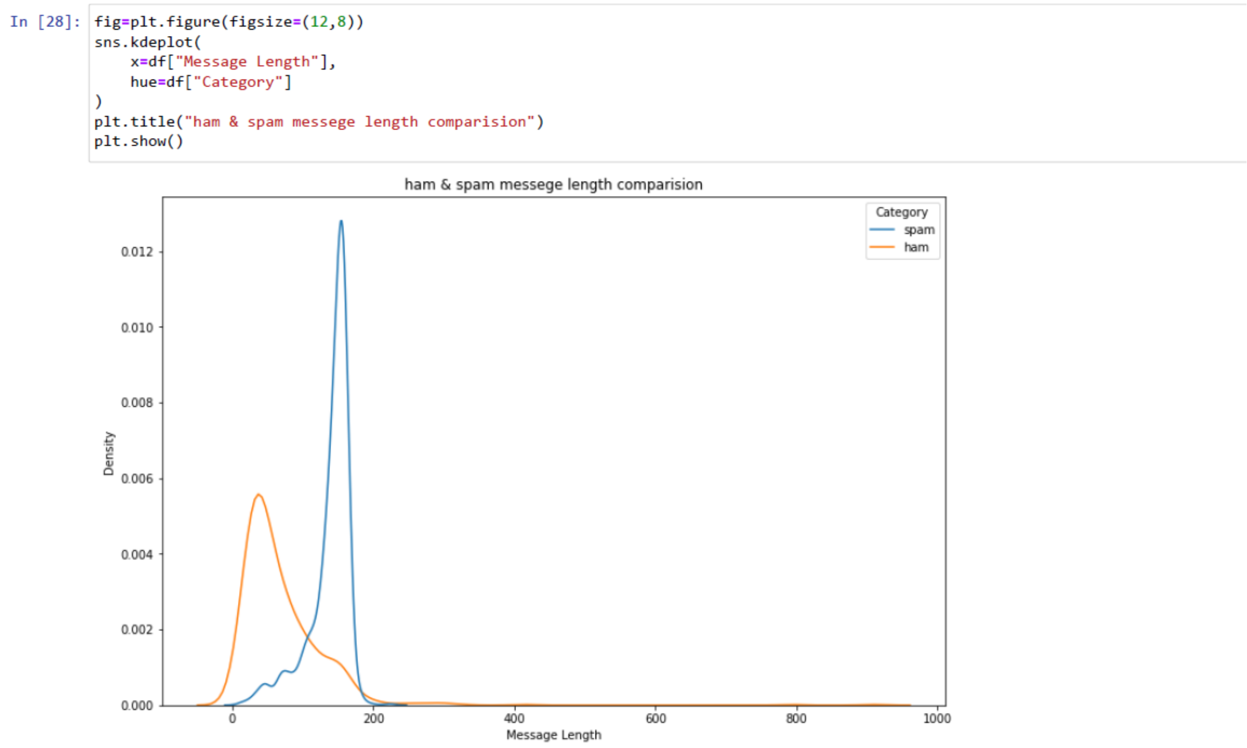
Task – 12: Perform One Hot on Corpus



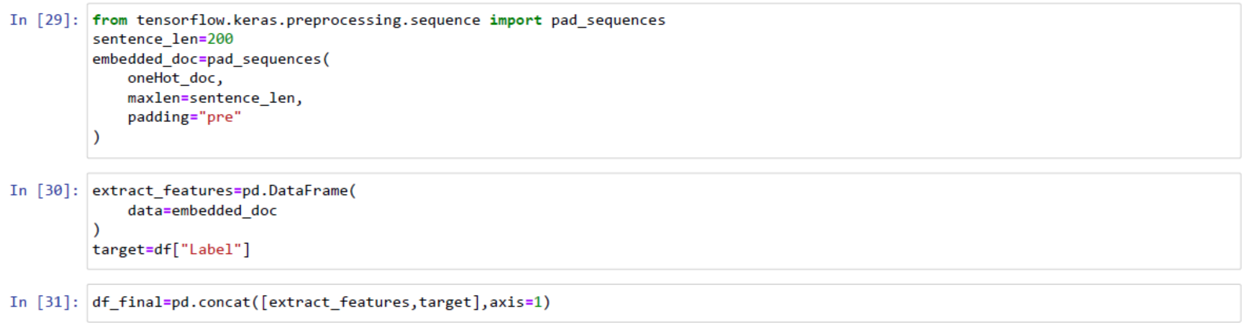
```
In [26]: from tensorflow.keras.preprocessing.text import one_hot
         vocab_size=10000

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

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

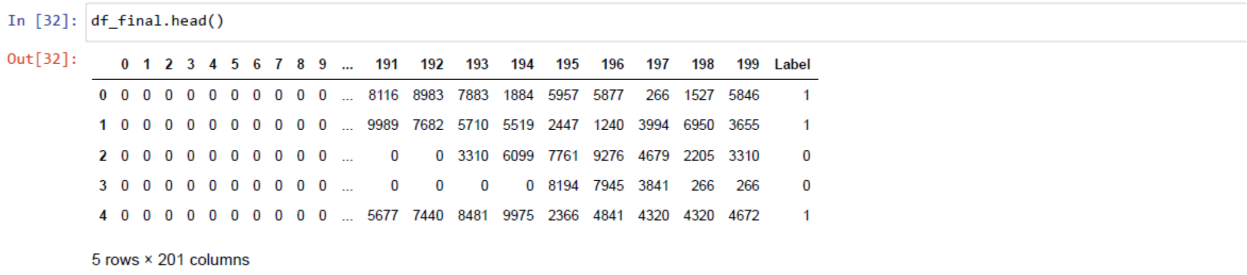
```
Out[27]: count    1494.000000
         mean      104.491299
         std        60.362332
         min         2.000000
         25%        49.000000
         50%       114.000000
         75%       153.000000
         max       910.000000
         Name: Message Length, dtype: float64
```



```
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)
```

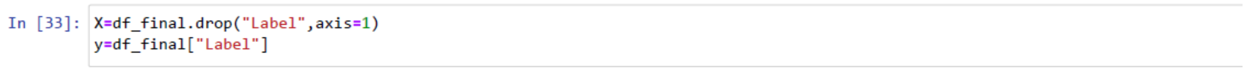


```
In [32]: df_final.head()

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

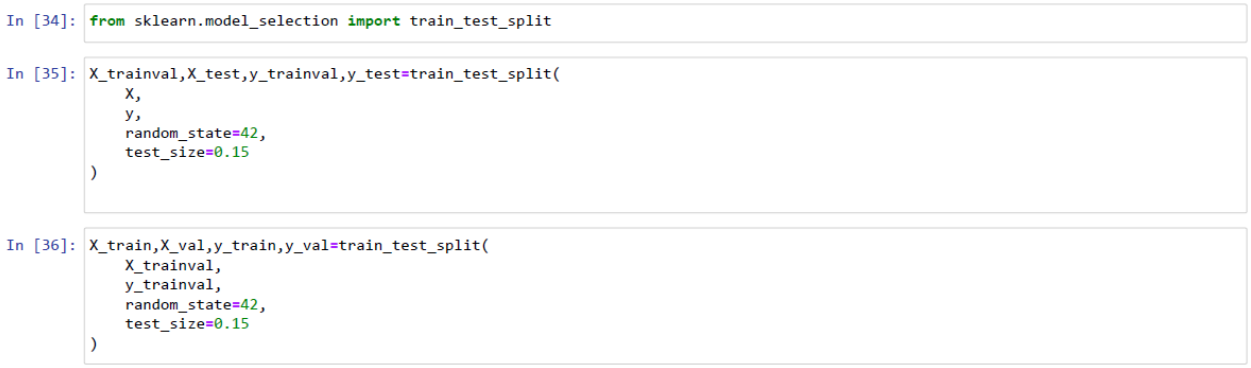
5 rows × 201 columns

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

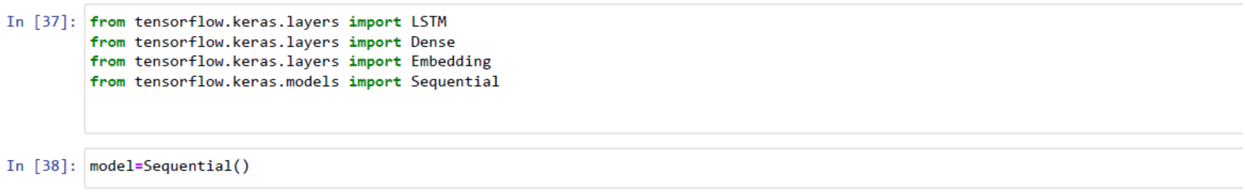


```
In [34]: from sklearn.model_selection import train_test_split
```

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

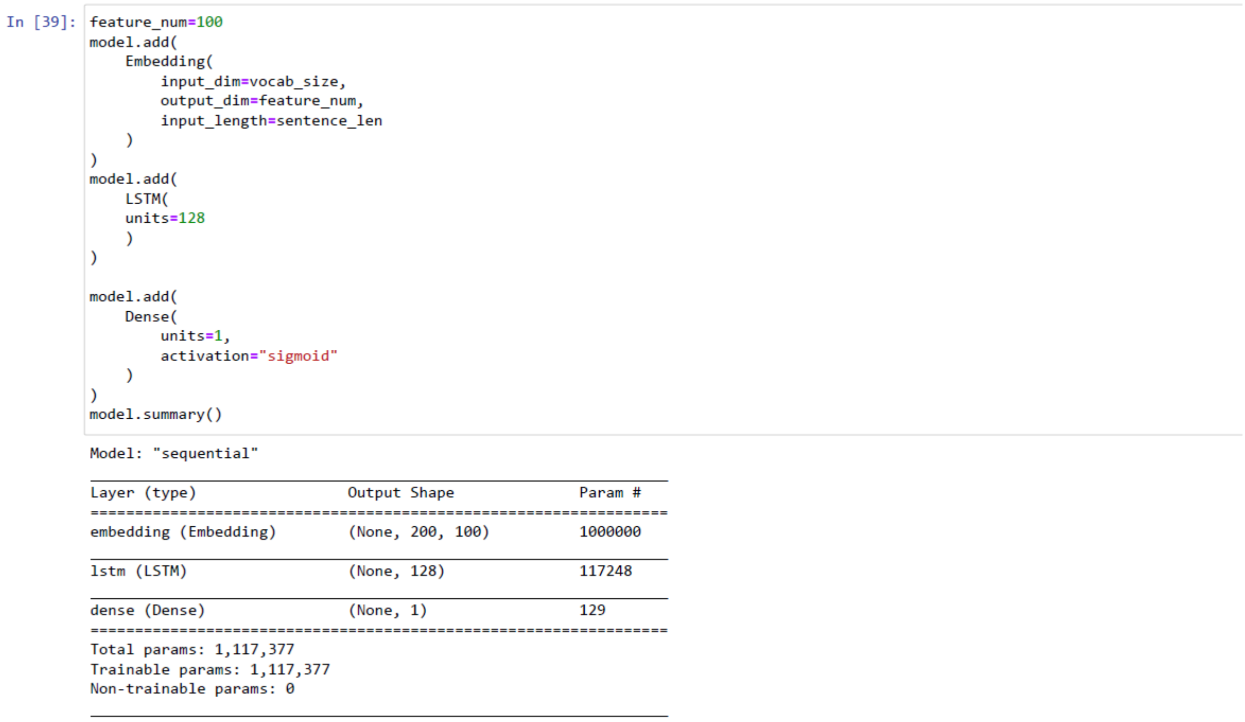
```
In [36]: X_train,X_val,y_train,y_val=train_test_split(
             X_trainval,
             y_trainval,
             random_state=42,
             test_size=0.15
         )
```

Task – 15: Building a Sequential Model

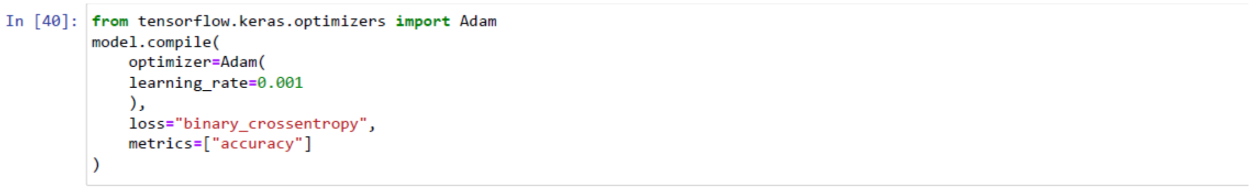


```
In [37]: from tensorflow.keras.layers import LSTM
         from tensorflow.keras.layers import Dense
         from tensorflow.keras.layers import Embedding
         from tensorflow.keras.models import Sequential
```

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

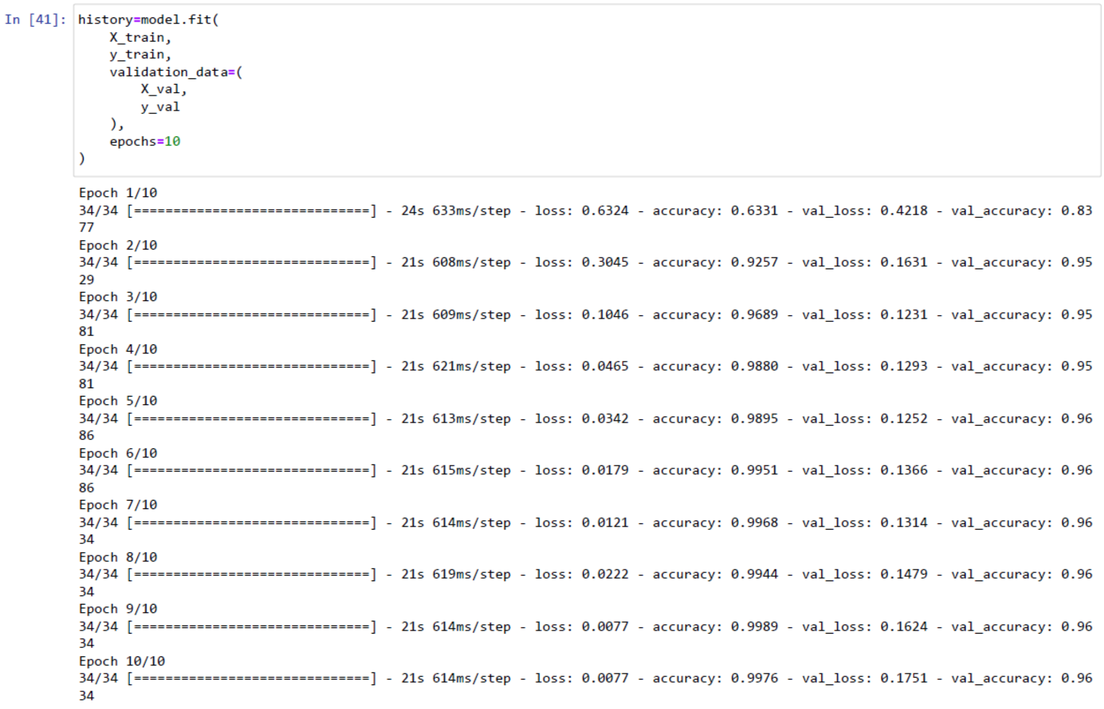


```
In [39]: feature_num=100
         model.add(
             Embedding(
                 input_dim=vocab_size,
                 output_dim=feature_num,
                 input_length=sentence_len
             )
         )
         model.add(
             LSTM(
             units=128
             )
         )

         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
         _________________________________________________________________
```

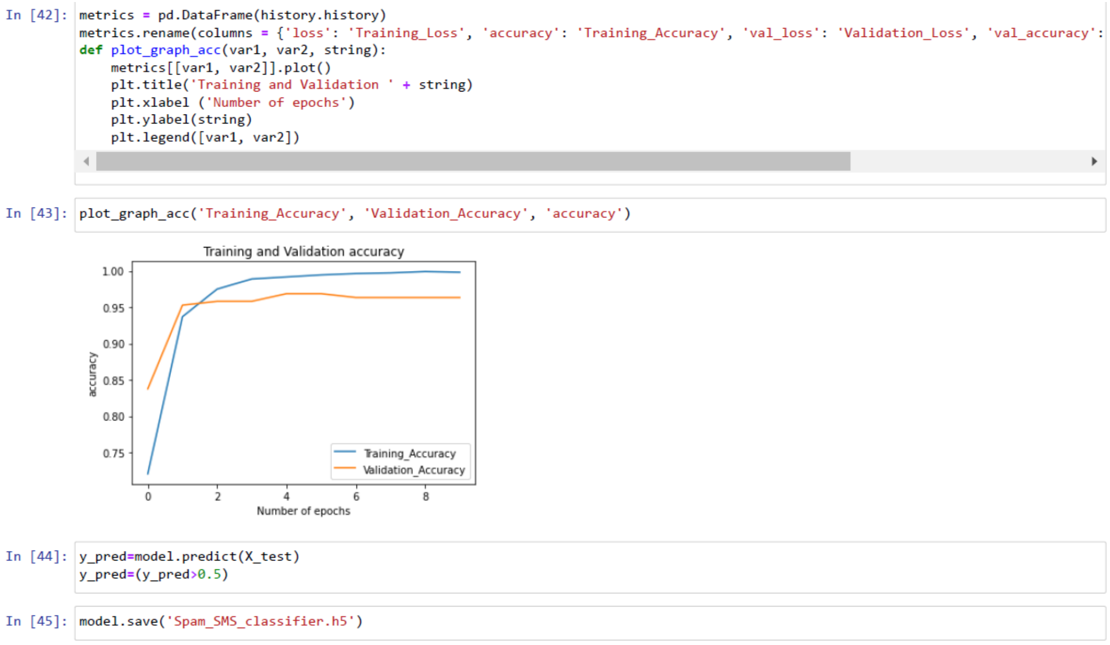


```
In [40]: from tensorflow.keras.optimizers import Adam
         model.compile(
             optimizer=Adam(
             learning_rate=0.001
             ),
             loss="binary_crossentropy",
             metrics=["accuracy"]
         )
```

Task – 16: Model Fitting



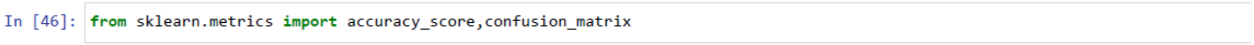
```
In [41]: history=model.fit(
             X_train,
             y_train,
             validation_data=(
                 X_val,
                 y_val
             ),
             epochs=10
         )

         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
```



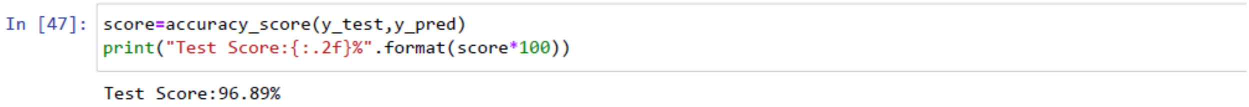
```
In [42]: metrics = pd.DataFrame(history.history)
         metrics.rename(columns = {'loss': 'Training_Loss', 'accuracy': 'Training_Accuracy', 'val_loss': 'Validation_Loss', 'val_accuracy':
         def plot_graph_acc(var1, var2, string):
             metrics[[var1, var2]].plot()
             plt.title('Training 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')
```

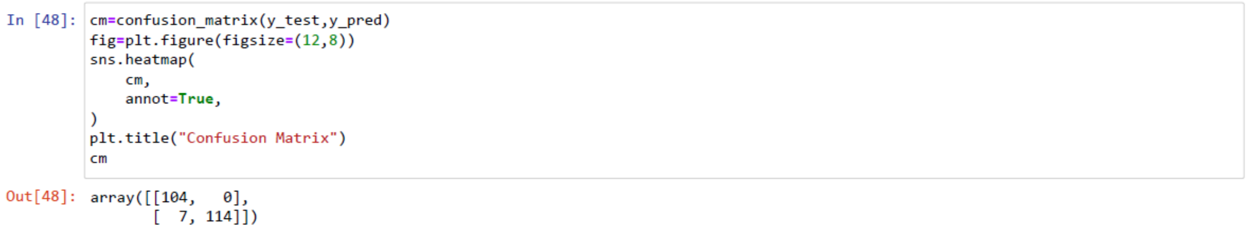
Task – 16: Evaluating the Model



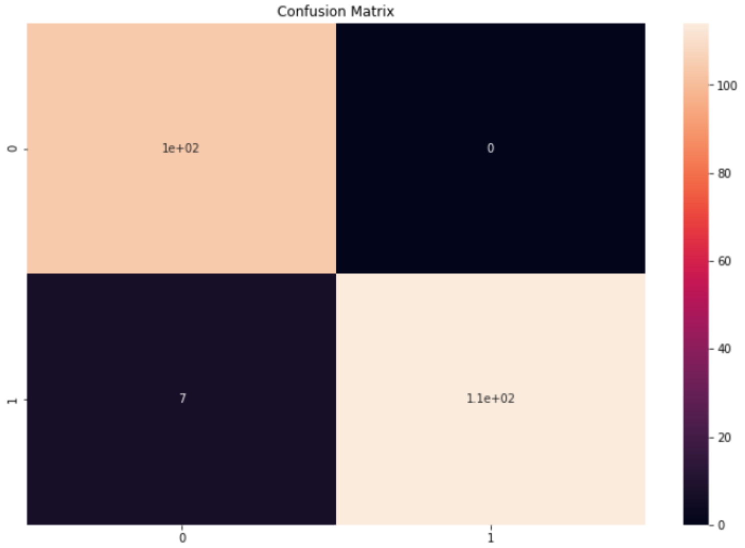
```
In [46]: from sklearn.metrics import accuracy_score,confusion_matrix
```



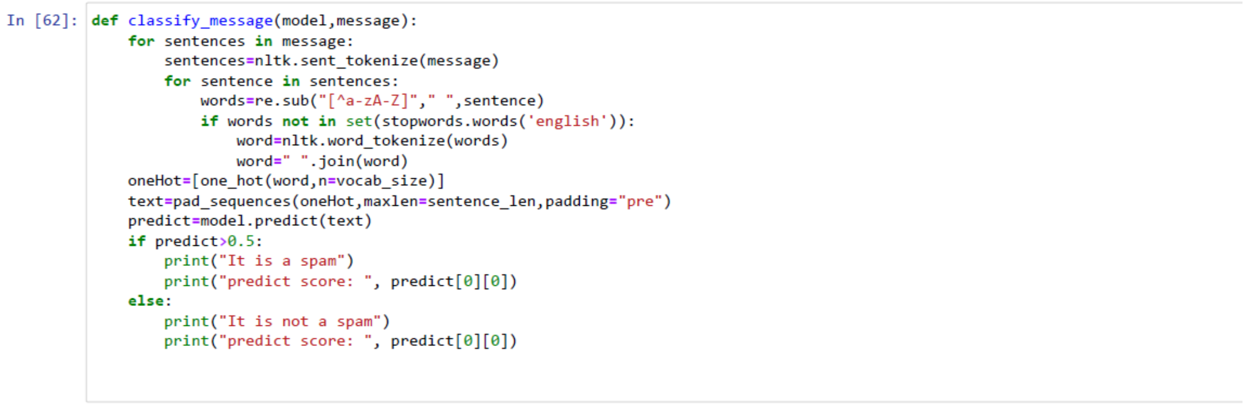
```
In [47]: score=accuracy_score(y_test,y_pred)
         print("Test Score:{:.2f}%".format(score*100))

         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
```