Step 1- Reading and Understanding Data

Importing Libraries

```
# import required libraries for dataframe and visualization
import pandas as pd
import numpy as np
from pathlib import Path
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.metrics import accuracy_score, confusion_matrix, roc_curve, roc_auc_score
import nltk
from nltk.corpus import stopwords
from collections import Counter

%matplotlib inline

import warnings
warnings.filterwarnings('ignore')
```

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```
nltk.download('stopwords')
```

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

```
# load data
df = pd.read_csv('/content/spam.csv',  encoding='latin-1')
df.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
		U dun say so early hor... U c already then			

```
# Drop unnecessary columns from the DataFrame

columns_to_drop = ["Unnamed: 2", "Unnamed: 3", "Unnamed: 4"]
df.drop(columns=columns_to_drop, inplace=True)
df.head()
```

	v1	v2
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...

```
df.shape
```

```
(5572, 2)
```

```
# data information
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
```

```
 0   v1      5572 non-null   object
 1   v2      5572 non-null   object
dtypes: object(2)
memory usage: 87.2+ KB
```

```
# Finding the count of null values
df.isnull().sum()
```

```
v1    0
v2    0
dtype: int64
```

No null values in the dataset

```
# RENAMING THE COLUMNS
df.columns = ['category', 'message']
df.head()
```

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	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...

```
#lets make another column i.e the length of the sms
len_msg=[]
for i in df['message']:
    len_msg.append(len(i))
```

```
df['msg_length']=len_msg
df.head()
```

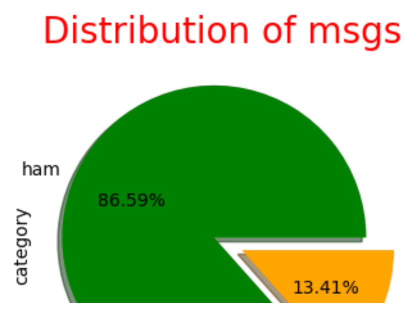
	category	message	msg_length
0	ham	Go until jurong point, crazy.. Available only ...	111
1	ham	Ok lar... Joking wif u oni...	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155
3	ham	U dun say so early hor... U c already then say...	49
4	ham	Nah I don't think he goes to usf, he lives aro...	61

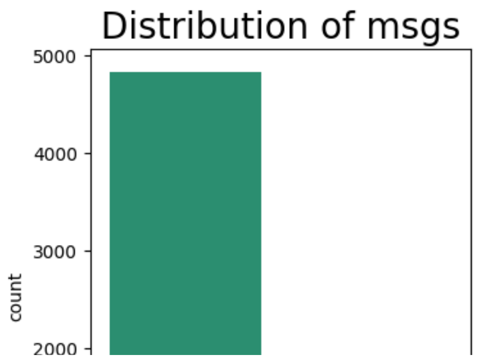
Step2 : Visualizing and Data Cleaning

```
plt.figure(figsize=(13,5))

custom_colors = ['green', 'orange']
ax =plt.subplot(1,3,1)
ax= df['category'].value_counts().plot.pie(explode=[0.1, 0.1],autopct='%1.2f%%', colors = custom_colors, shadow=True);
ax.set_title(label = "Distribution of msgs ", fontsize = 20, color= 'Red');

ax = plt.subplot(1,3,3)
ax = sns.countplot(x='category', data=df, width=0.1)
plt.title("Distribution of msgs", fontsize=20)
sns.countplot(data=df, x='category', palette = "Dark2")
plt.xlabel('Category')
plt.show()
```





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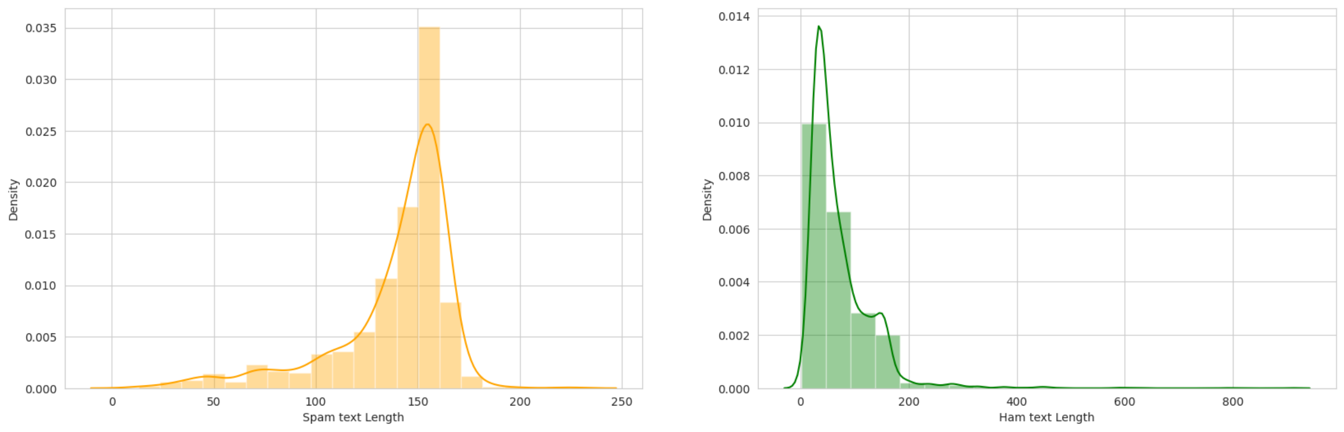
```
sns.set_style('whitegrid')

f, ax = plt.subplots(1, 2, figsize = (20, 6))

sns.distplot(df[df['category']=='spam']['msg_length'], bins = 20, color = 'orange', ax = ax[0])
ax[0].set_xlabel("Spam text Length")

sns.distplot(df[df['category']=='ham']['msg_length'], bins = 20,color='green', ax = ax[1])
ax[1].set_xlabel("Ham text Length")


plt.show()
```

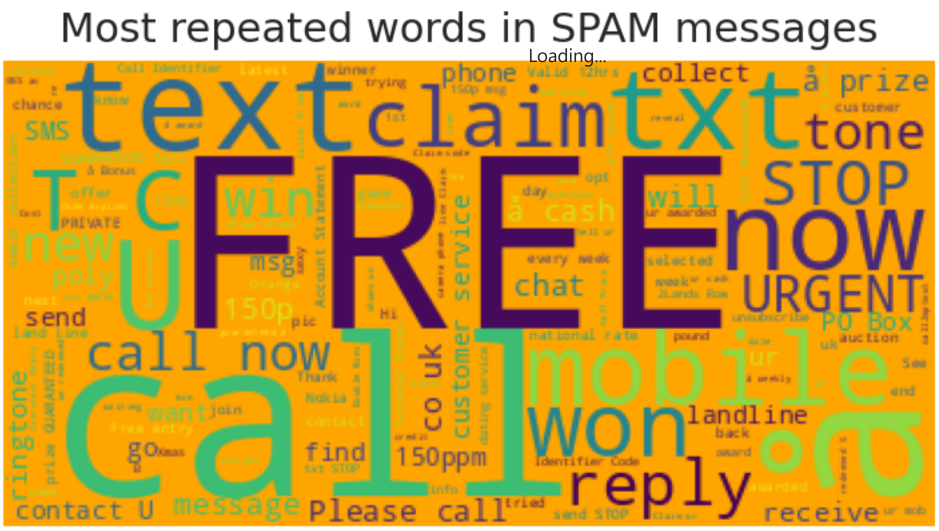


Step 3: Tokenization and Tokens visualization

```
from wordcloud import WordCloud


wc = WordCloud(background_color='white', max_words=200 )
wc.generate(' '.join(text for text in df.loc[df['category'] == 'ham', 'message']))
plt.figure(figsize=(9,5), facecolor='k')
plt.title('Most repeated words in HAM messages', color= 'white', fontdict={'size': 22, 'verticalalignment': 'bottom'})
plt.imshow(wc)
plt.axis("off")
plt.show()
```

```
wc = WordCloud(background_color='orange', max_words=200)
wc.generate(' '.join(text for text in df.loc[df['category'] == 'spam', 'message']))
plt.figure(figsize=(9,5))
plt.title('Most repeated words in SPAM messages',
          fontdict={'size': 22,  'verticalalignment': 'bottom'})
plt.imshow(wc)
plt.axis("off")
plt.show()
```



Step 4 : Data Preparation & Target encoding

```
from sklearn.preprocessing import LabelEncoder

le = LabelEncoder()
le.fit(df['category'])

df['category_encoded'] = le.transform(df['category'])
df.head()
```

	category	message	msg_length	category_encoded
0	ham	Go until jurong point, crazy.. Available only ...	111	0
1	ham	Ok lar... Joking wif u oni...	29	0
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155	1
3	ham	U dun say so early hor... U c already then say...	49	0
4	ham	Nah I don't think he goes to usf, he lives aro...	61	0

```
# Separate the feature (message) and target (category) data

X = df["message"]
Y = df["category_encoded"]
```

Splitting the data into training data & Test data

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size = 0.2, random_state = 42)
print(X.shape, X_train.shape, X_test.shape)
```

```
    (5572,) (4457,) (1115,)
```

```
# Convert Y_train and Y_test to integer type
Y_train = Y_train.astype("int")
Y_test = Y_test.astype("int")
```

```
print(X_train)
```

```
1978    No I'm in the same boat. Still here at my moms...
3989    (Bank of Granite issues Strong-Buy) EXPLOSIVE ...
3935       They r giving a second chance to rahul dengra.
4078       O i played smash bros  &lt;#&gt;  religiously.
4086    PRIVATE! Your 2003 Account Statement for 07973...
                              ...
3772    I came hostel. I m going to sleep. Plz call me...
5191                               Sorry, I'll call later
5226        Prabha..i'm soryda..realy..frm heart i'm sory
5390                           Nt joking seriously i told
860                    In work now. Going have in few min.
Name: message, Length: 4457, dtype: object
```

Step 5:Feature Extraction

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Model Training : Logistic Regression

```
# Initialize TF-IDF Vectorizer
feature_extraction = TfidfVectorizer(min_df=1, stop_words="english", lowercase=True)
```

```
# Feature extraction for training and testing data
X_train_features = feature_extraction.fit_transform(X_train)
X_test_features = feature_extraction.transform(X_test)
```

```
# training the Logistic Regression model with training data

model = LogisticRegression()
model.fit(X_train_features, Y_train)
```

```
▾ LogisticRegression
LogisticRegression()
```

Accuracy Score

```
# accuracy on training data
X_train_prediction = model.predict(X_train_features)
training_data_accuracy = accuracy_score(Y_train, X_train_prediction)
print('Accuracy score of training data : ', training_data_accuracy)
```

```
Accuracy score of training data :  0.9694862014808167
```

```
# accuracy on test data
X_test_prediction = model.predict(X_test_features)
```

```
test_data_accuracy = accuracy_score(Y_test, X_test_prediction)
print('Accuracy score of test data : ', test_data_accuracy)
```

```
Accuracy score of test data :  0.9524663677130045
```

```
# Calculate and print Root Mean Square Error(RMSE)
from sklearn.metrics import mean_squared_error
mse = mean_squared_error(Y_test, X_test_prediction)
rmse = np.sqrt(mse)
print("RMSE value: {:.4f}".format(rmse))
```

```
RMSE value: 0.2180
```

```
 #Make predictions on the training data
predict_train_data=model.predict(X_train_features)
```

```
#Model Evaluation
from sklearn.metrics import accuracy_score,confusion_matrix
accuracy_train_data=accuracy_score(Y_train,predict_train_data)
print("Accuracy on training data: ",accuracy_train_data)
```

```
Accuracy on training data:  0.9694862014808167
```

```
# Make predictions on the testing data
predict_test_data=model.predict(X_test_features)
```

```
#Model Evaluation
accuracy_test_data=accuracy_score(Y_test,predict_test_data)
print("acuuracy on test data: ",accuracy_test_data)

     acuuracy on test data:  0.9524663677130045
```

Step 6 : Model testing

Test the model with few randon messages

```
new_msg=["Need to talk to you.. call me "]
new_data_features=feature_extraction.transform(new_msg)
prediction=model.predict(new_data_features)
print(prediction)


if(prediction[0]==1):
    print("SPAM Message")
else:
    print("HAM Message")

     [0]
     HAM Message
```

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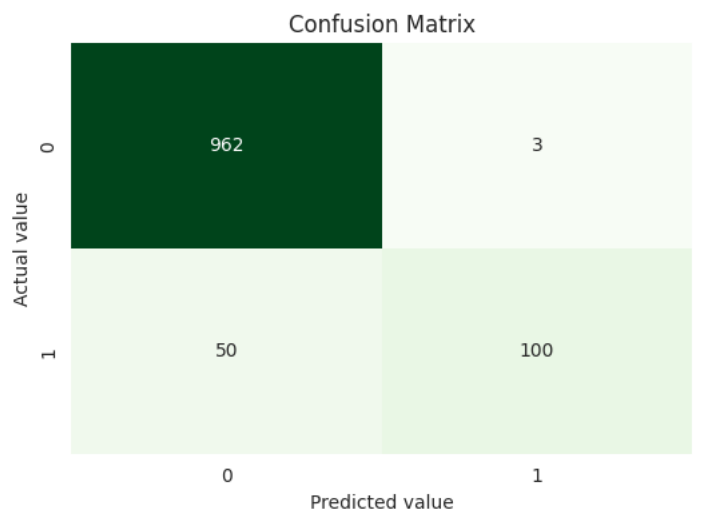
```
new_msg=["Free entry in 2 a wkly comp to win FA Cup fina"]
new_data_features=feature_extraction.transform(new_msg)
prediction=model.predict(new_data_features)
print(prediction)


if(prediction[0]==1):
    print("SPAM Message")
else:
    print("HAM Message")


     [1]
     SPAM Message
```

Confusion Matrix

```
conf_matrix=confusion_matrix(Y_test,predict_test_data)
plt.figure(figsize=(6,4))
sns.heatmap(conf_matrix,annot=True,fmt="d",cmap="Greens",cbar=False)
plt.xlabel("Predicted value")
plt.ylabel("Actual value")
plt.title("Confusion Matrix")
plt.show()
```



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