J002 ASSIGNMENT NLP

SPAM DETECTION

Importing Libraries

In [1]:

```
# Basic Libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Text preprocessing
import nltk as nltk
from nltk.corpus import stopwords
from string import punctuation
from nltk.tokenize import word_tokenize
from nltk.stem import LancasterStemmer
from string import punctuation
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import LancasterStemmer
from sklearn.feature_extraction.text import TfidfVectorizer

# Model Building
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import LinearSVC
import xgboost as xgb
from sklearn.metrics import accuracy_score,confusion_matrix,classification_rep
ort
```

Reading and viewing the data

In [2]:

```
data = pd.read_csv('/Users/home/Downloads/spam.csv',encoding="ISO-8859-1")
```

In [3]:

```
data
```

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
...	...	...	...	...	...
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

5572 rows × 5 columns

1. Exploratory Data Analysis and preprocessing :

1. Data shape and variable datatypes

In [4]:

```
data.shape
```

Out[4]:

```
(5572, 5)
```

In [5]:

```
data.dtypes
```

Out[5]:

```
v1             object
v2             object
Unnamed: 2     object
Unnamed: 3     object
Unnamed: 4     object
dtype: object
```

2. Handling null values

In [6]:

```
data.isnull().sum()
```

Out[6]:

```
v1                0
v2                0
Unnamed: 2     5522
Unnamed: 3     5560
Unnamed: 4     5566
dtype: int64
```

The columns Unnamed: 2, Unnamed: 3 and Unnamed: 4 have null values

In [7]:

```
data.isnull().sum()*100/data.shape[0]
```

Out[7]:

```
v1              0.000000
v2              0.000000
Unnamed: 2     99.102656
Unnamed: 3     99.784637
Unnamed: 4     99.892319
dtype: float64
```

The columns Unnamed: 2, Unnamed: 3 and Unnamed: 4 have null values greater than 99% so we drop them

In [8]:

```
data=data.drop(data.columns[[2,3,4]],axis=1)
```

The new data now looks like:

In [9]:

```
data
```

Out[9]:

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

5572 rows × 2 columns

Column v1 is the outcome and v2 is the predictor so we rename them to X and Y

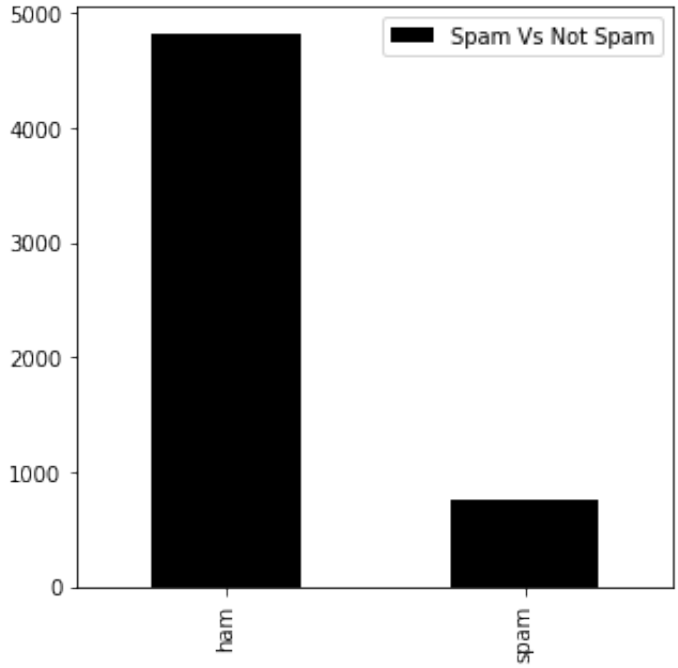
In [10]:

```
data.columns = ['Y' , 'X']
```

4. Checking the distribution of the target variable

In [11]:

```
plt.figure(figsize=(5,5))
data['Y'].value_counts().plot(kind='bar',color='black',label='Spam Vs Not Spam
')
plt.legend();
```



5. Preprocessing 1 - identifying stopwords, punctuations and creating a corpus

In [12]:

```
trashitems = list(stopwords.words('english'))+list(punctuation)
stemmer = LancasterStemmer()
corpus = data['X'].tolist()
```

In [13]:

```
corpus[0]
```

Out[13]:

```
'Go until jurong point, crazy.. Available only in bugis n great wo
rld la e buffet... Cine there got amore wat...'
```

In [14]:

```
len(corpus)
```

Out[14]:

```
5572
```

5. Preprocessing 2 - Modifying the corpus

In [15]:

```
final_corpus = []
for i in range(len(corpus)):
    word = word_tokenize(corpus[i].lower())
    word = [stemmer.stem(y) for y in word if y not in trashitems]
    j = " ".join(word)
    final_corpus.append(j)
```

5. Preprocessing 3 - TF IDF Vectorization

In [16]:

```
x=data['X']
y=data['Y']
```

In [17]:

```
tfidf = TfidfVectorizer()
vector = tfidf.fit_transform(x)
x = vector.toarray()
x
```

Out[17]:

```
array([[0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       ...,
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.]])
```

2. Model building

1. Train test split (80:20)

In [18]:

```
x_train,x_test,y_train,y_test=train_test_split(x,y,random_state=0,test_size=0.2)
```

2. Model building 1 - Multinomial Naive Bayes

In [19]:

```
mnb = MultinomialNB()
mnb.fit(x_train,y_train)
```

Out[19]:

```
MultinomialNB(alpha=1.0, class_prior=None, fit_prior=True)
```

2. Model prediction 1 - Multinomial Naive Bayes

In [20]:

```
ypredmnb = mnb.predict(x_train)
ypredmnb
```

Out[20]:

```
array(['ham', 'ham', 'ham', ..., 'ham', 'ham', 'ham'], dtype='<U4'
)
```

2. Model evaluation 1 - Multinomial Naive Bayes

2.1. Accuracy score

In [21]:

```
print(accuracy_score(y_train,ypredmnb)*100, '%')
```

```
96.99349338119812 %
```

2.2. Confusion Matrix

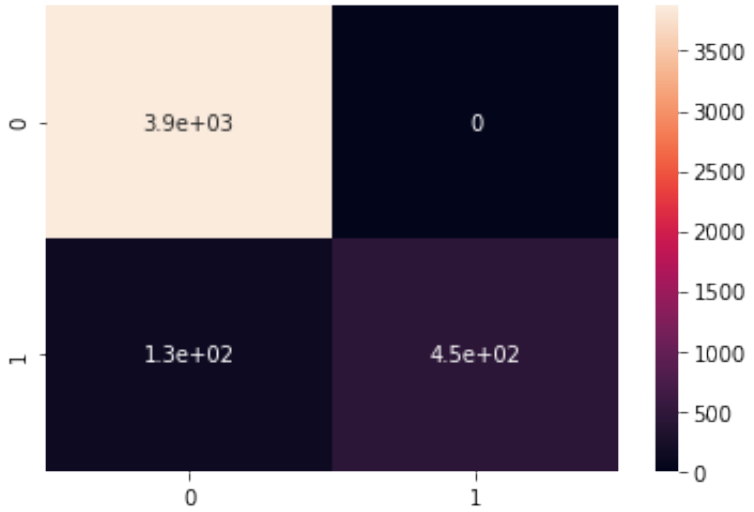
In [22]:

```
cnf_mnb = confusion_matrix(y_train,ypredmnb)
print(cnf_mnb)
```

```
[[3876    0]
 [ 134  447]]
```

In [23]:

```
sns.heatmap(cnf_mnb, annot=True);
```



2.3. Classification report

In [24]:

```
print(classification_report(y_train,ypredmnb))
```

```
              precision    recall  f1-score   support

         ham       0.97      1.00      0.98      3876
        spam       1.00      0.77      0.87       581

    accuracy                           0.97      4457
   macro avg       0.98      0.88      0.93      4457
weighted avg       0.97      0.97      0.97      4457
```

3. Model building 2 - Linear Support Vector Classifier

In [25]:

```
svc = LinearSVC().fit(x_train,y_train)
```

3. Model prediction 2 - Linear Support Vector Classifier

In [26]:

```
ypred_svc = svc.predict(x_train)
```

3. Model evaluation 2 - Linear Support Vector Classifier

3.1. Accuracy score

In [27]:

```
print(accuracy_score(y_train,ypred_svc)*100, '%')
```

```
99.95512676688355 %
```

3.2. Confusion Matrix

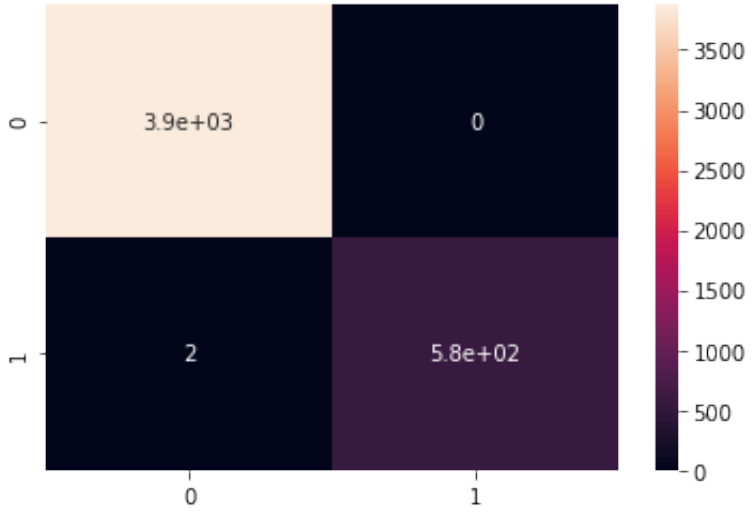
In [28]:

```
cnf_svc = confusion_matrix(y_train,ypred_svc)
print(cnf_svc)
```

```
[[3876    0]
 [   2  579]]
```

In [29]:

```
sns.heatmap(cnf_svc, annot=True);
```



3.3. Classification report

In [30]:

```
print(classification_report(y_train,ypred_svc))
```

```
              precision    recall  f1-score   support

         ham       1.00      1.00      1.00      3876
        spam       1.00      1.00      1.00       581

    accuracy                           1.00      4457
   macro avg       1.00      1.00      1.00      4457
weighted avg       1.00      1.00      1.00      4457
```

4. Model building 3 - XG Boost

In [31]:

```
clf = xgb.XGBClassifier()
clf.fit(x_train, y_train)
```

Out[31]:

```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=
1,
              colsample_bynode=1, colsample_bytree=1, gamma=0, gpu
_id=-1,
              importance_type='gain', interaction_constraints='',
              learning_rate=0.300000012, max_delta_step=0, max_dep
th=6,
              min_child_weight=1, missing=nan, monotone_constraint
s='()',
              n_estimators=100, n_jobs=0, num_parallel_tree=1,
              objective='binary:logistic', random_state=0, reg_alp
ha=0,
              reg_lambda=1, scale_pos_weight=1, subsample=1,
              tree_method='exact', validate_parameters=1, verbosit
y=None)
```

4. Model prediction 3 - XG Boost

In [32]:

```
ypred_xgb = clf.predict(x_train)
ypred_xgb
```

Out[32]:

```
array(['ham', 'ham', 'ham', ..., 'ham', 'ham', 'ham'], dtype=objec
t)
```

4. Model evaluation 3 - XG Boost

4.1. Accuracy score

In [33]:

```
print(accuracy_score(y_train,ypred_xgb))
```

```
0.99798070450976
```

4.2. Confusion matrix

In [34]:

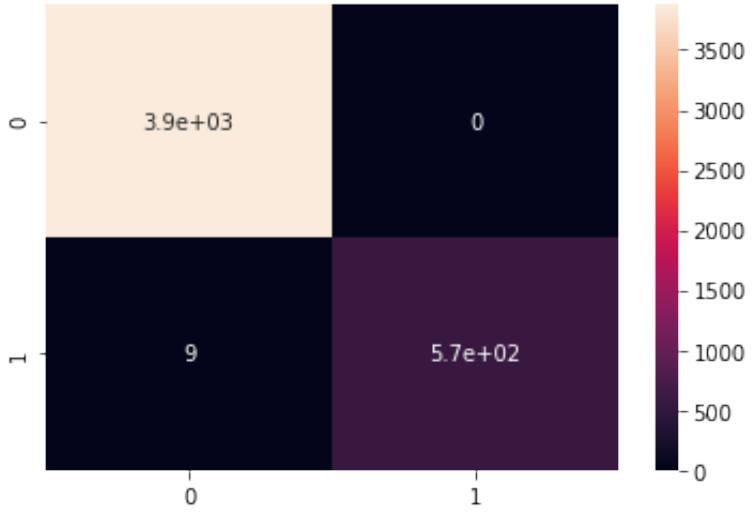
```
cnf_xgb = confusion_matrix(y_train,ypred_xgb)
cnf_xgb
```

Out[34]:

```
array([[3876,    0],
       [   9,  572]])
```

In [35]:

```
sns.heatmap(cnf_xgb, annot=True);
```



4.3. Classification report

In [36]:

```
print(classification_report(y_train,ypred_xgb))
```

```
              precision    recall  f1-score   support

         ham       1.00      1.00      1.00      3876
        spam       1.00      0.98      0.99       581

    accuracy                           1.00      4457
   macro avg       1.00      0.99      1.00      4457
weighted avg       1.00      1.00      1.00      4457
```

In [ ]: