Classify the email using the binary classification method. Email Spam detection has two states:

a) Normal State – Not Spam, b) Abnormal State – Spam.

Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance

Dataset link: The emails.csv dataset on the Kaggle

https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv

The csv file contains 5172 rows, each row for each email. There are 3002 columns. The first column indicates Email name.

The name has been set with numbers and not recipients' name to protect privacy.

The last column has the labels for prediction : 1 for spam, 0 for not spam. The remaining 3000 columns are the 3000 most ##common words in all the emails, after excluding the non-alphabetical characters/words. For each row, the count of each ##word(column) in that email(row) is stored in the respective cells. Thus, information regarding all 5172 emails are stored in a ##compact dataframe rather than as separate text files.

1)Preprocessing removing null values if any and Training testing split

In [1]:

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

```
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
from sklearn.model_selection import train_test_split

from sklearn import metrics
df=pd.read_csv("C:\\Users\\Owner\\Desktop\\Machine Learning BE\\Practical\\Practica
df.head()
```

Out[1]:

	Email No.	the	to	ect	and	for	of	a	you	hou	...	connevey	jay	valued	lay	infrastructu
0	Email 1	0	0	1	0	0	0	2	0	0	...	0	0	0	0	
1	Email 2	8	13	24	6	6	2	102	1	27	...	0	0	0	0	
2	Email 3	0	0	1	0	0	0	8	0	0	...	0	0	0	0	
3	Email 4	0	5	22	0	5	1	51	2	10	...	0	0	0	0	
4	Email 5	7	6	17	1	5	2	57	0	9	...	0	0	0	0	

5 rows × 3002 columns

In [2]:
```
df.shape
```

Out[2]:
```
(5172, 3002)
```

In [3]:
```
df.columns
```

Out[3]:
```
Index(['Email No.', 'the', 'to', 'ect', 'and', 'for', 'of', 'a', 'you', 'hou',
       ...
       'connevey', 'jay', 'valued', 'lay', 'infrastructure', 'military',
       'allowing', 'ff', 'dry', 'Prediction'],
      dtype='object', length=3002)
```

In [4]:
```
##input data
X=df.drop(['Email No.','Prediction'],axis=1)
##output data
y = df['Prediction']
```

In [ ]:

In [5]:
```
X.shape
```

Out[5]:
```
(5172, 3000)
```

In [6]:
```
X.info
X.dtypes
```

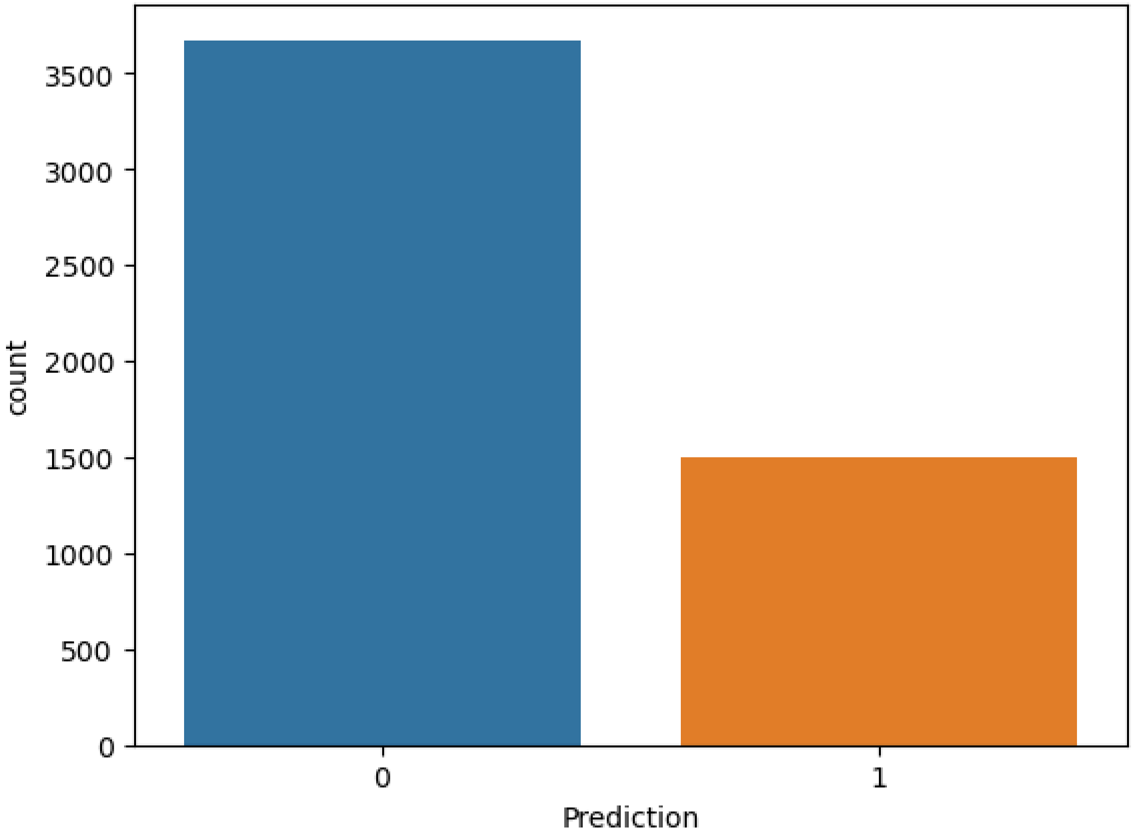
Out[6]:
```
the                 int64
to                  int64
ect                 int64
and                 int64
for                 int64
                    ...
infrastructure      int64
military            int64
allowing            int64
ff                  int64
dry                 int64
Length: 3000, dtype: object
```

In [7]:
```
y.value_counts()
```

Out[7]:
```
0    3672
1    1500
Name: Prediction, dtype: int64
```

In [8]:
```
sns.countplot(x=y)
```

Out[8]:
```
<Axes: xlabel='Prediction', ylabel='count'>
```



In [55]:
```
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
X_scaled = scaler.fit_transform(X)
```

In [56]:
```
X_scaled
```

Out[56]:
```
array([[0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.03809524, 0.09848485, 0.06705539, ..., 0.        , 0.00877193,
        0.        ],
       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.        ],
       ...,
       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.        ],
       [0.00952381, 0.0530303 , 0.        , ..., 0.        , 0.00877193,
        0.        ],
       [0.1047619 , 0.18181818, 0.01166181, ..., 0.        , 0.        ,
        0.        ]])
```

In [59]:
```
# split into train and test
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size = 0.25,
```

In [60]:
```
X_scaled.shape
```

Out[60]:
```
(5172, 3000)
```

In [61]:
```
X_train.shape
```

Out[61]:
```
(3879, 3000)
```

In [62]:
```
X_test.shape
```

Out[62]:
```
(1293, 3000)
```

2)Apply KNN Classifier

In [64]:
```
##import the class
from sklearn.neighbors import KNeighborsClassifier
##create thee object
knn = KNeighborsClassifier(n_neighbors=7)
```

In [65]:
```
#Train the model
knn.fit(X_train, y_train)
```

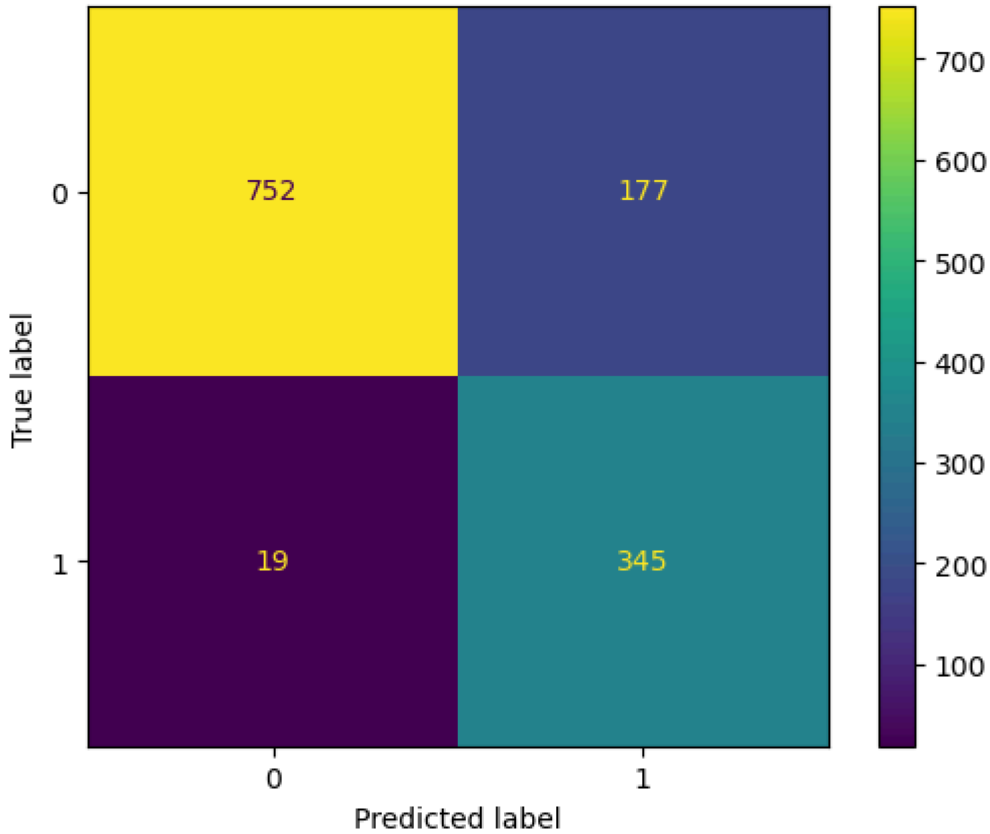
Out[65]:
```
▾ KNeighborsClassifier
KNeighborsClassifier(n_neighbors=7)
```

In [71]:
```
##predict on test data
y_pred = knn.predict(X_test)
```

In [80]:
```
print("Prediction",y_pred)
print("KNN accuracy = ",accuracy_score(y_test,y_pred))
print("Confusion matrix",metrics.confusion_matrix(y_test,y_pred))
```

```
Prediction [1 0 0 ... 1 0 1]
KNN accuracy =  0.848414539829853
Confusion matrix [[752 177]
 [ 19 345]]
```

In [83]:
```
##import the evaluation metrics
from sklearn.metrics import ConfusionMatrixDisplay, accuracy_score
from sklearn.metrics import classification_report
```

In [84]:
```
ConfusionMatrixDisplay.from_predictions(y_test,y_pred)
```
Out[84]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x161af7fa9e0>
```


In [85]:
```
y_test.value_counts()
```
Out[85]:
```
0    929
1    364
Name: Prediction, dtype: int64
```
In [88]:
```
accuracy_score(y_test, y_pred)
print(classification_report(y_test,y_pred))
```
```
              precision    recall  f1-score   support

           0       0.98      0.81      0.88       929
           1       0.66      0.95      0.78       364

    accuracy                           0.85      1293
   macro avg       0.82      0.88      0.83      1293
weighted avg       0.89      0.85      0.85      1293
```

3)Apply SVM Classifier

In [104…
```
from sklearn.svm import SVC
svm=SVC(kernel='sigmoid')
svm.fit(X_train, y_train)
```
Out[104]:
```
▾ SVC
SVC(kernel='sigmoid')
```

In [105…

```python
# predict
y_pred = svm.predict(X_test)
print("SVM accuracy = ",accuracy_score(y_test,y_pred))
```

```
SVM accuracy =  0.839907192575406
```

In [ ]:

```python
#linear=0.9767981438515081
#rbf= 0.9450889404485692
#polynomial= 0.7548337200309359
#sigmoid =0.839907192575406
```