Libraries and classes

In [1]:

```
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import ConfusionMatrixDisplay, accuracy_score
from sklearn.metrics import classification_report
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
df = pd.read_csv("emails.csv")
```

In [3]:

```
df.head()
```

Out[3]:

	Email No.	the	to	ect	and	for	of	a	you	hou	...	connevey	jay	valued	lay	infrastru
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 [4]:

```
df.isnull().sum()
```

Out[4]:

```
Email No.     0
the           0
to            0
ect           0
and           0
             ..
military      0
allowing      0
ff            0
dry           0
Prediction    0
Length: 3002, dtype: int64
```

In [5]:

```
X = df.iloc[:,1:3001]
X
```

Out[5]:

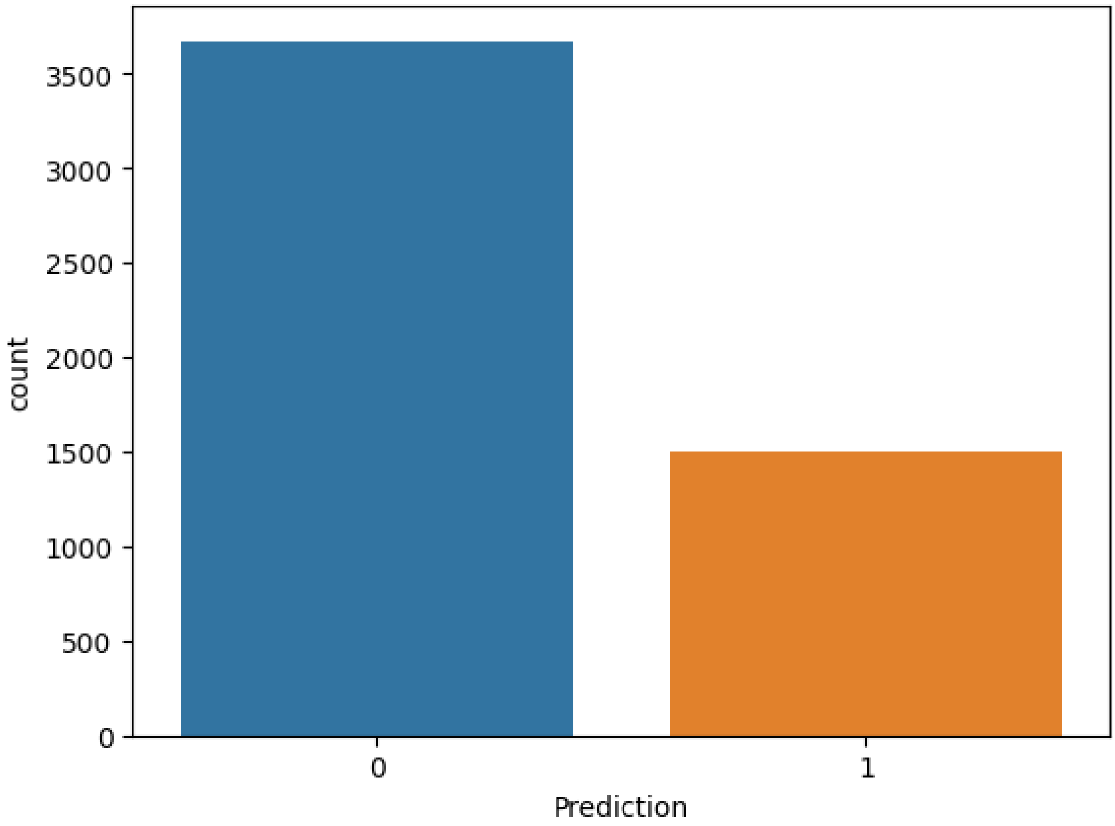
```
      the  to  ect  and  for  of    a  you  hou  in  ...  enhancements  connevey  jay
   0    0   0    1    0    0   0    2    0    0   0  ...             0         0    0
   1    8  13   24    6    6   2  102    1   27  18  ...             0         0    0
   2    0   0    1    0    0   0    8    0    0   4  ...             0         0    0
   3    0   5   22    0    5   1   51    2   10   1  ...             0         0    0
   4    7   6   17    1    5   2   57    0    9   3  ...             0         0    0
 ...  ...  ...  ...  ...  ... ...  ...  ...  ... ...  ...           ...       ...  ...
5167    2   2    2    3    0   0   32    0    0   5  ...             0         0    0
5168   35  27   11    2    6   5  151    4    3  23  ...             0         0    0
5169    0   0    1    1    0   0   11    0    0   1  ...             0         0    0
5170    2   7    1    0    2   1   28    2    0   8  ...             0         0    0
```

Count plot of y

In [6]:

```
x=df.drop(["Email No.","Prediction"],axis=1)
y=df["Prediction"]
print(y)
print(x.shape)
print(sns.countplot(x=y))
print(y.value_counts())
```

```
0       0
1       0
2       0
3       0
4       0
       ..
5167    0
5168    0
5169    1
5170    1
5171    0
Name: Prediction, Length: 5172, dtype: int64
(5172, 3000)
AxesSubplot(0.125,0.11;0.775x0.77)
0    3672
1    1500
Name: Prediction, dtype: int64
```



Scaling of values using min-max scaling technique

In [7]:
```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler()
x_scaled=scaler.fit_transform(x)
x_scaled
```

Out[7]:
```
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 [8]:
```
Y = df.iloc[:,-1].values
Y
```

Out[8]:
```
array([0, 0, 0, ..., 1, 1, 0], dtype=int64)
```

Spliting of dataset in train and test dataset

In [9]:
```
x_train,x_test,y_train,y_test = train_test_split(x_scaled,y,random_state=0,
print(x_scaled.shape)
print(x_train.shape)
print(x_test.shape)
```

```
(5172, 3000)
(3879, 3000)
(1293, 3000)
```

Model training using KNN algo.

In [10]:
```
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(x_train, y_train)
```

Out[10]:
```
▾ KNeighborsClassifier

KNeighborsClassifier()
```

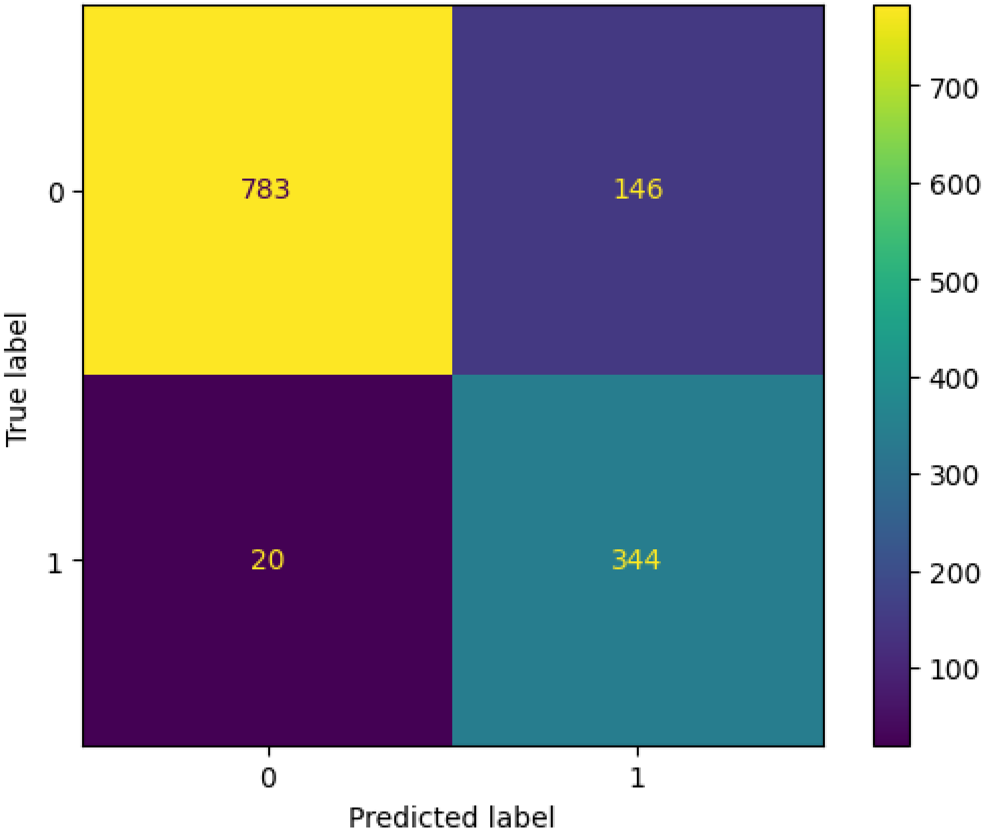
In [11]:
```
y_pred=knn.predict(x_test)
print(y_pred)
```

```
[1 0 0 ... 1 0 1]
```

Performance measure of model

In [12]:
```
ConfusionMatrixDisplay.from_predictions(y_test,y_pred)
```

Out[12]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x2889d9
f9420>
```



In [13]:
```
y_test.value_counts()
```

Out[13]:
```
0    929
1    364
Name: Prediction, dtype: int64
```

In [14]:
```
accuracy_score(y_test,y_pred)
```

Out[14]:
```
0.871616395978345
```

In [15]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.98      0.84      0.90       929
           1       0.70      0.95      0.81       364

    accuracy                           0.87      1293
   macro avg       0.84      0.89      0.85      1293
weighted avg       0.90      0.87      0.88      1293
```

In [16]:

```
error=[]
for k in range(1,41):
    knn=KNeighborsClassifier(n_neighbors=5)
    knn.fit(x_train,y_train)
    pred=knn.predict(x_test)
    error.append(np.mean(pred!=y_test))
error
```

Out[16]:

```
[0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508,
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 0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508,
 0.12838360402165508]
```

Support vector machine model

In [17]:

```
svc = SVC(C=1.0,kernel='rbf',gamma='auto')
# C here is the regularization parameter. Here, L2 penalty is used(default)
# As C increases, model overfits.
# Kernel here is the radial basis function kernel.
# gamma (only used for rbf kernel) : As gamma increases, model overfits.
svc.fit(x_train,y_train)
y_pred2 = svc.predict(x_test)
print("Accuracy Score for SVC : ", accuracy_score(y_pred,y_test))
```

```
Accuracy Score for SVC :  0.871616395978345
```

In [18]:

```
svc = SVC(C=1.0,kernel='linear',gamma='auto')

svc.fit(x_train,y_train)
y_pred2 = svc.predict(x_test)
print("Accuracy Score for SVC : ", accuracy_score(y_pred,y_test))
```

```
Accuracy Score for SVC :  0.871616395978345
```

In [19]:

```
svc = SVC(C=1.0,kernel='poly',gamma='auto')

svc.fit(x_train,y_train)
y_pred2 = svc.predict(x_test)
print("Accuracy Score for SVC : ", accuracy_score(y_pred,y_test))
```

```
Accuracy Score for SVC :  0.871616395978345
```