In [64]:

```
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[64]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance
0	1	15634602	Hargrave	619	France	Female	42	2	0.00
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86
2	3	15619304	Onio	502	France	Female	42	8	159660.80
3	4	15701354	Boni	699	France	Female	39	1	0.00
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82

In [65]:

```
df.shape
```

Out[65]:

```
(10000, 14)
```

In [66]:

```
df.columns
```

Out[66]:

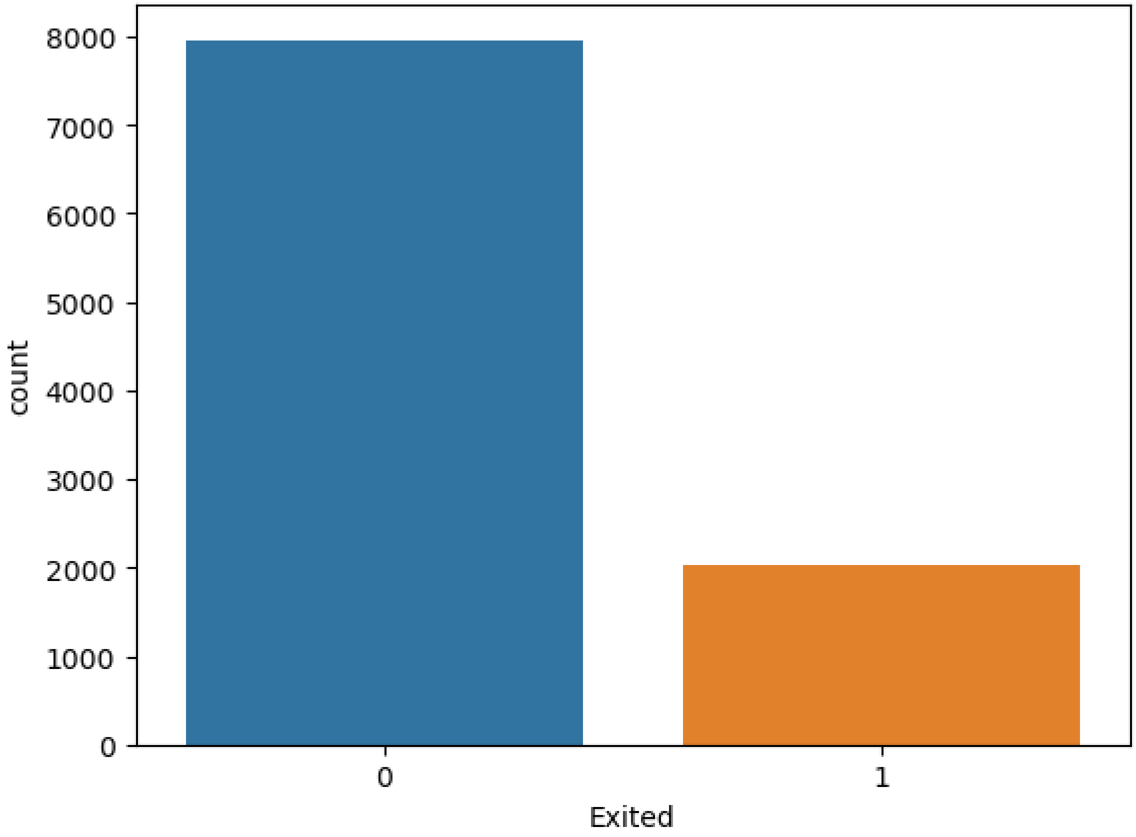
```
Index(['RowNumber', 'CustomerId', 'Surname', 'CreditScore', 'Geography',
       'Gender', 'Age', 'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard', 'IsActiveMember', 'EstimatedSalary',
       'Exited'],
      dtype='object')
```

In [67]:

```
# input data
x=df[['CreditScore','Age', 'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard','IsAct
# output data
y=df[ 'Exited']
```

In [68]:

```
sns.countplot(x=y);
```



In [69]:
```
y.value_counts()
```

Out[69]:
```
0       7963
1       2037
Name: Exited, dtype: int64
```

In [70]:
```
# Normalise
from sklearn.preprocessing import StandardScaler
```

In [71]:
```
Scaler =StandardScaler()
```

In [72]:
```
x_scaled=Scaler.fit_transform(x)
```

In [73]:
```
x_scaled
```

Out[73]:
```
array([[-0.32622142,  0.29351742, -1.04175968, ...,  0.64609167,
         0.97024255,  0.02188649],
       [-0.44003595,  0.19816383, -1.38753759, ..., -1.54776799,
         0.97024255,  0.21653375],
       [-1.53679418,  0.29351742,  1.03290776, ...,  0.64609167,
        -1.03067011,  0.2406869 ],
       ...,
       [ 0.60498839, -0.27860412,  0.68712986, ..., -1.54776799,
         0.97024255, -1.00864308],
       [ 1.25683526,  0.29351742, -0.69598177, ...,  0.64609167,
        -1.03067011, -0.12523071],
       [ 1.46377078, -1.04143285, -0.35020386, ...,  0.64609167,
        -1.03067011, -1.07636976]])
```

In [75]:
```
from sklearn.model_selection import train_test_split
```

In [76]:
```
x_train,x_test,y_train,y_test =train_test_split(x_scaled,y,random_state=0,test_siz
```

In [77]:
```
x.shape
```

Out[77]:

```
(10000, 8)
```

In [78]:

```
x_train.shape
```

Out[78]:

```
(7500, 8)
```

In [79]:

```
x_test.shape
```

Out[79]:

```
(2500, 8)
```

In [80]:

```
from sklearn.neural_network import MLPClassifier
```

In [81]:

```
ann= MLPClassifier(hidden_layer_sizes=(100,100,100),random_state = 0, max_iter=100
```

In [82]:

```
ann.fit(x_train,y_train)
```

Out[82]:

```
▾ MLPClassifier
MLPClassifier(hidden_layer_sizes=(100, 100, 100), max_iter=100, random_st ate=0)
```

In [83]:

```
y_pred = ann.predict(x_test)
```

In [84]:

```
from sklearn.metrics import ConfusionMatrixDisplay,classification_report,accuracy_s
```

In [85]:

```
y_test.value_counts()
```

Out[85]:

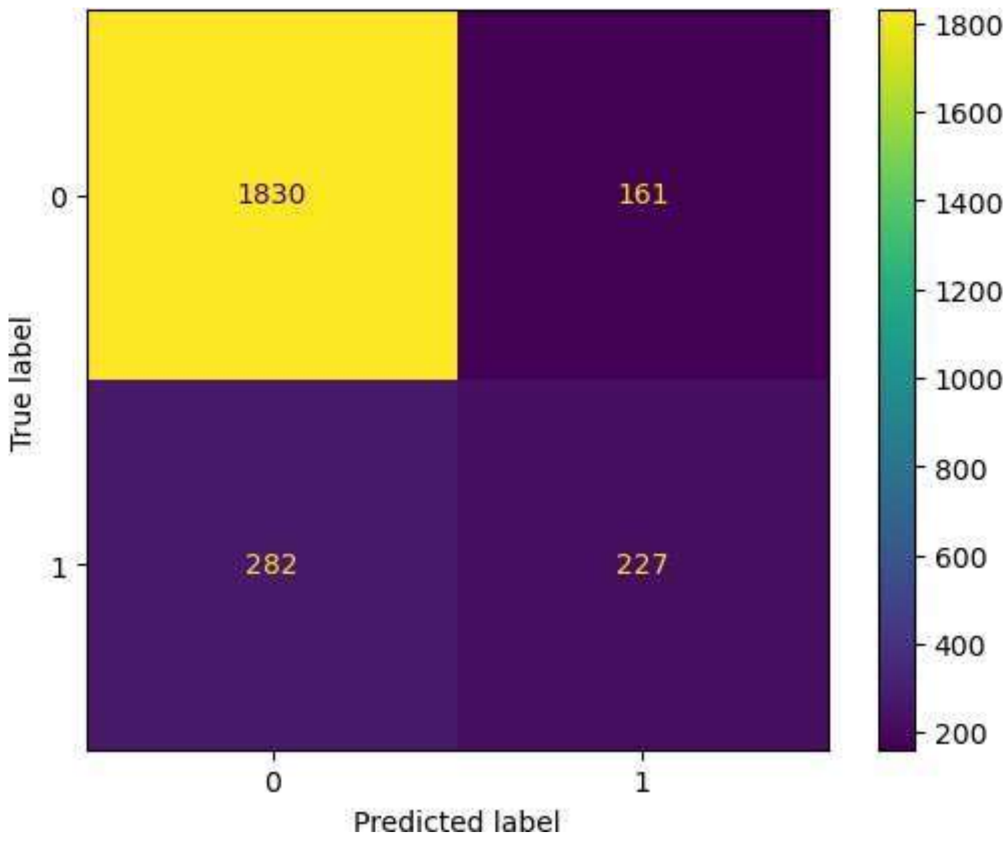
```
0    1991
1     509
Name: Exited, dtype: int64
```

In [86]:

```
ConfusionMatrixDisplay.from_predictions(y_test,y_pred)
```

Out[86]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x139fa9f38b0>
```



In [87]:

```
accuracy_score(y_test,y_pred)
```

Out[87]:

```
0.8228
```

In [88]:

```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.87      0.92      0.89      1991
           1       0.59      0.45      0.51       509

    accuracy                           0.82      2500
   macro avg       0.73      0.68      0.70      2500
weighted avg       0.81      0.82      0.81      2500
```

In [89]:

```
!pip install imbalanced-learn
```

```
Requirement already satisfied: imbalanced-learn in c:\users\owner\anaconda3\lib\si te-packages (0.10.1)
Requirement already satisfied: joblib>=1.1.1 in c:\users\owner\anaconda3\lib\site-
packages (from imbalanced-learn) (1.1.1)
Requirement already satisfied: scipy>=1.3.2 in c:\users\owner\anaconda3\lib\site-p ackages (from imbalanced-
learn) (1.10.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\owner\anaconda3\li
b\site-packages (from imbalanced-learn) (2.2.0)
Requirement already satisfied: numpy>=1.17.3 in c:\users\owner\anaconda3\lib\site- packages (from
imbalanced-learn) (1.23.5)
Requirement already satisfied: scikit-learn>=1.0.2 in c:\users\owner\anaconda3\lib
\site-packages (from imbalanced-learn) (1.2.1)
```

In [90]:

```
from imblearn.over_sampling import RandomOverSampler
```

In [91]:

```
ros = RandomOverSampler (random_state =0)
```

In [92]:
```
x_res,y_res = ros.fit_resample(x,y)
```

In [93]:
```
y_res.value_counts()
```

Out[93]:
```
1       7963
0       7963
Name: Exited, dtype: int64
```

In [94]:
```
# Normalise
from sklearn.preprocessing import StandardScaler
```

In [95]:
```
Scaler =StandardScaler()
```

In [96]:
```
x_scaled=Scaler.fit_transform(x_res)
```

In [97]:
```
x_scaled
```

Out[97]:
```
array([[-0.29877723,  0.08418894, -1.01840607, ...,  0.6512495 ,
         1.08223556,  0.00817382],
       [-0.4103938 , -0.01032629, -1.36135608, ..., -1.53550983,
         1.08223556,  0.20261687],
       [-1.48597169,  0.08418894,  1.03929402, ...,  0.6512495 ,
        -0.92401325,  0.22674468],
       ...,
       [-0.84671313,  1.02934128,  0.01044398, ...,  0.6512495 ,
        -0.92401325,  1.28878188],
       [-0.96847667,  0.65128034, -0.67545605, ..., -1.53550983,
         1.08223556, -1.21851316],
       [-1.5874413 ,  0.74579558,  1.03929402, ...,  0.6512495 ,
         1.08223556,  1.42417217]])
```

In [98]:
```
from sklearn.model_selection import train_test_split
```

In [99]:
```
x_train,x_test,y_train,y_test   =train_test_split(x_scaled,y_res,random_state=0,test
```

In [100...
```
x_res.shape
```

Out[100]:
```
(15926, 8)
```

In [101...
```
from sklearn.neural_network import MLPClassifier
```

In [102...
```
ann= MLPClassifier(hidden_layer_sizes=(100,100,100),random_state = 0, max_iter=100
```

In [103...
```
ann.fit(x_train,y_train)
```

Out[103]:

▾ MLPClassifier

```
MLPClassifier(hidden_layer_sizes=(100, 100, 100), max_iter=100, random_st ate=0)
```

In [104...
```
y_pred = ann.predict(x_test)
```

In [105...
```
from  sklearn.metrics import  ConfusionMatrixDisplay,classification_report,accuracy_s
```

In [106...
```
y_test.value_counts()
```

Out[106]:

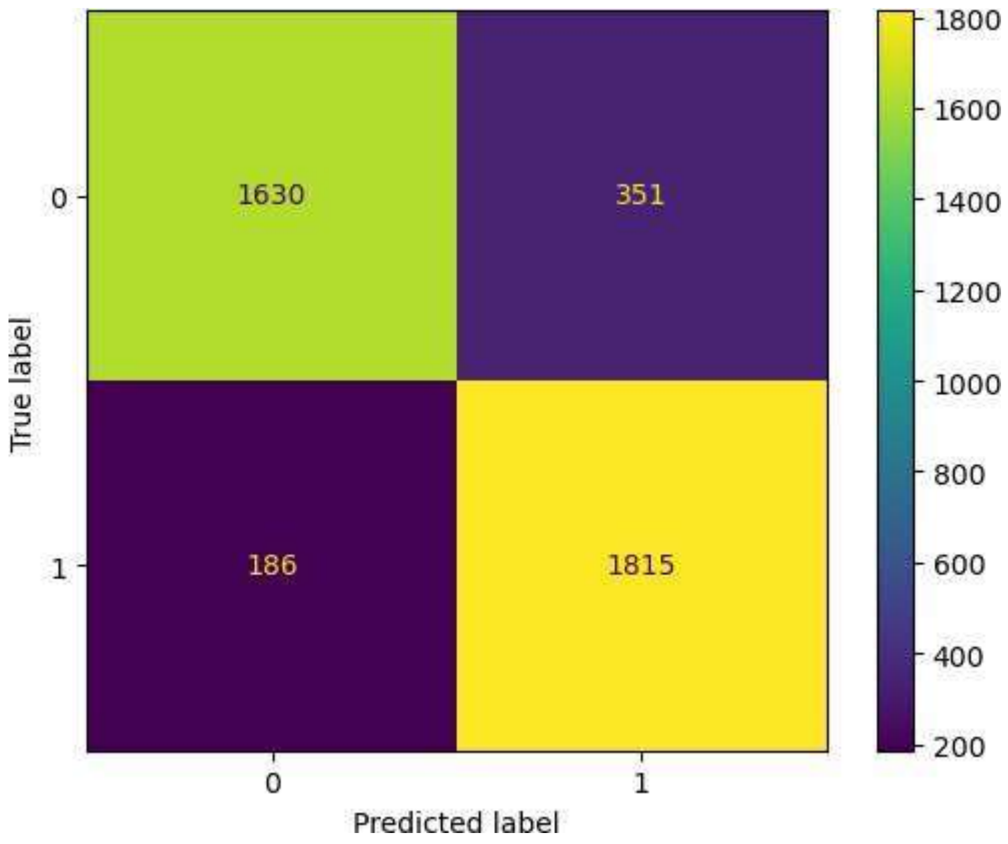
```
1      2001
0      1981
Name: Exited, dtype: int64
```

In [107...

```
ConfusionMatrixDisplay.from_predictions(y_test,y_pred)
```

Out[107]:

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay  at  0x139fa836860>
```



```
accuracy_score(y_test,y_pred)
```

In [108...

```
0.865143144148669
```

Out[108]:

In [109...

```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.90      0.82      0.86      1981
           1       0.84      0.91      0.87      2001

    accuracy                           0.87      3982
   macro avg       0.87      0.86      0.86      3982
weighted avg       0.87      0.87      0.86      3982
```

In [ ]: