MAHENDRA ENGINEERING COLLEGE FOR WOMEN
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```
#libraries
import pandas as pd
import numpy as npp
import matplotlib.pyplot as plt
%matplotlib inline
#load dataset
df = pd.read_csv(r"/content/Churn_Modelling.csv")
df.head(10)
```

| | RowNumber | CustomerId | Surname | CreditScore | Geography | Gender | Age |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 15634602 | Hargrave | 619 | France | Female | 42 |
| 1 | 2 | 15647311 | Hill | 608 | Spain | Female | 41 |
| 2 | 3 | 15619304 | Onio | 502 | France | Female | 42 |
| 3 | 4 | 15701354 | Boni | 699 | France | Female | 39 |
| 4 | 5 | 15737888 | Mitchell | 850 | Spain | Female | 43 |
| 5 | 6 | 15574012 | Chu | 645 | Spain | Male | 44 |
| 6 | 7 | 15592531 | Bartlett | 822 | France | Male | 50 |
| 7 | 8 | 15656148 | Obinna | 376 | Germany | Female | 29 |
| 8 | 9 | 15792365 | He | 501 | France | Male | 44 |
| 9 | 10 | 15592389 | H? | 684 | France | Male | 27 |

| | Tenure | Balance | NumOfProducts | HasCrCard | IsActiveMember | EstimatedSalary | Exited |
|---|---|---|---|---|---|---|---|
| 0 | 2 | 0.00 | 1 | 1 | 1 | 101348.88 | 1 |
| 1 | 1 | 83807.86 | 1 | 0 | 1 | 112542.58 | 0 |
| 2 | 8 | 159660.80 | 3 | 1 | 0 | 113931.57 | 1 |
| 3 | 1 | 0.00 | 2 | 0 | 0 | | |
| 4 | 2 | 125510.82 | 1 | 1 | 1 | | |
| 5 | 8 | 113755.78 | 2 | 1 | 0 | | |
| 6 | 7 | 0.00 | 2 | 1 | 1 | | |
| 7 | 4 | 115046.74 | 4 | 1 | 0 | | |
| 8 | 4 | 142051.07 | 2 | 0 | 1 | | |
| 9 | 2 | 134603.88 | 1 | 1 | 1 | | |

```
3       93826.63       0
4       79084.10       0
5      149756.71       1
6       10062.80       0
7      119346.88       1
8       74940.50       0
9       71725.73       0
```

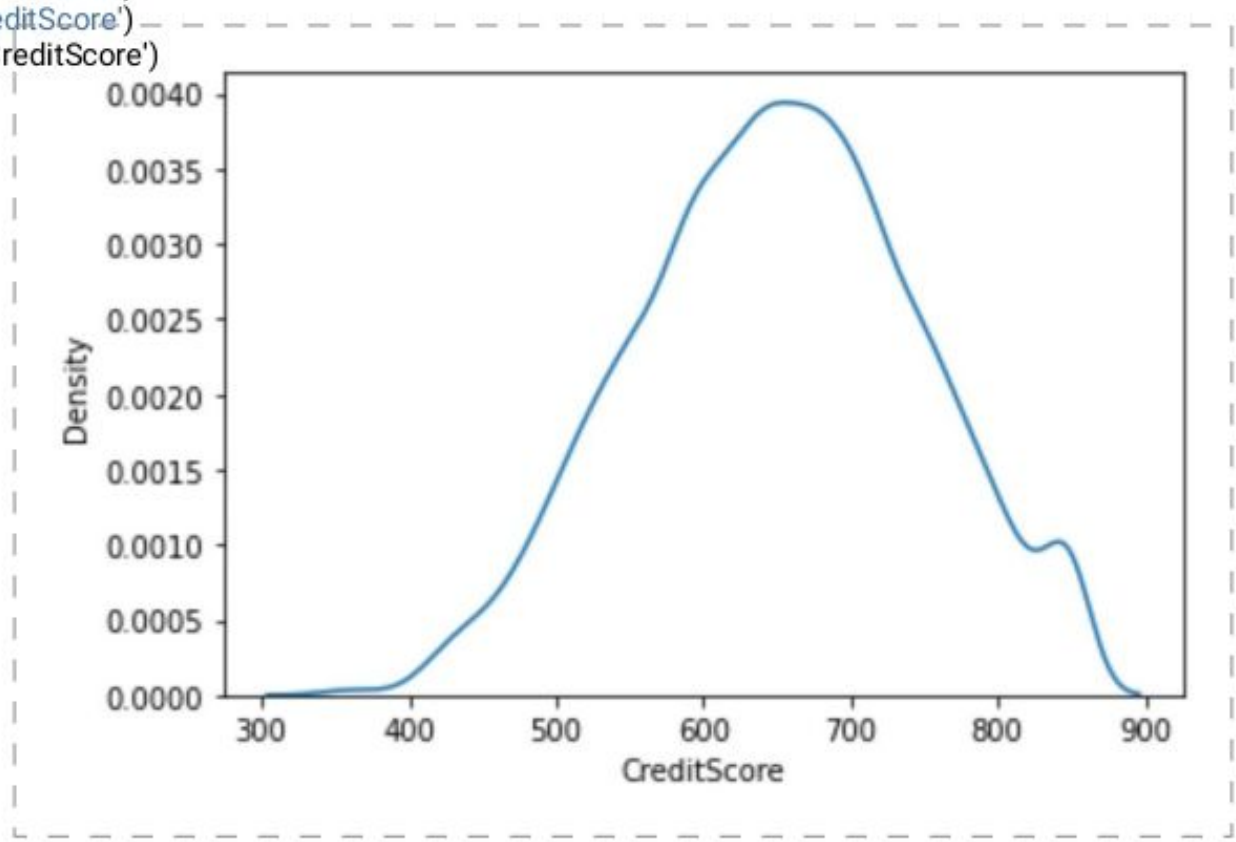
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   RowNumber       10000 non-null  int64  
 1   CustomerId      10000 non-null  int64  
 2   Surname         10000 non-null  object 
 3   CreditScore     10000 non-null  int64  
 4   Geography       10000 non-null  object 
 5   Gender          10000 non-null  object 
 6   Age             10000 non-null  int64  
 7   Tenure          10000 non-null  int64  
 8   Balance         10000 non-null  float64
 9   NumOfProducts   10000 non-null  int64  
 10  HasCrCard       10000 non-null  int64  
 11  IsActiveMember  10000 non-null  int64  
 12  EstimatedSalary  10000 non-null  float64
 13  Exited          10000 non-null  int64  
dtypes: float64(2), int64(9), object(3)
memory usage: 1.1+ MB
```

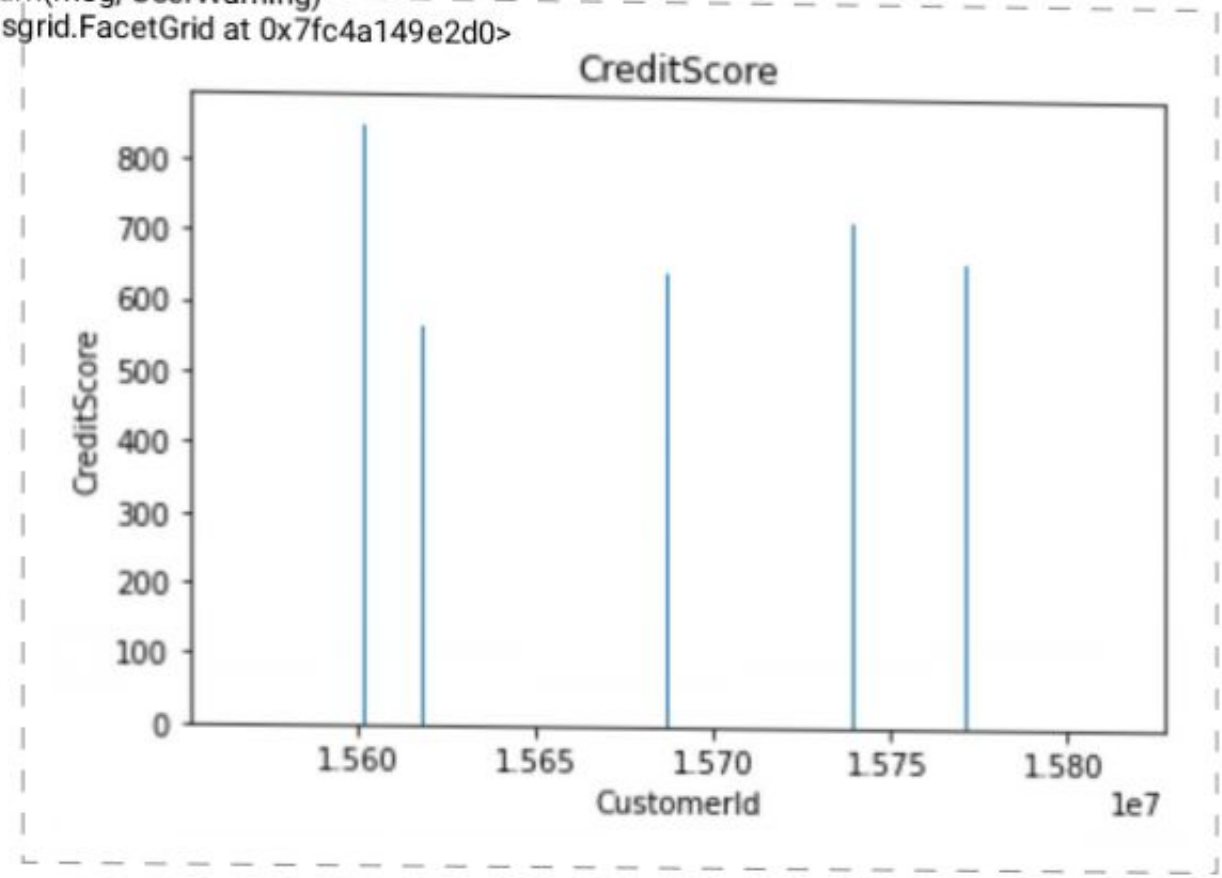
```
#Visualizations
#Univariate Analysis
import seaborn as sns
sns.kdeplot(df['CreditScore'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fc4a0cd2790>
```

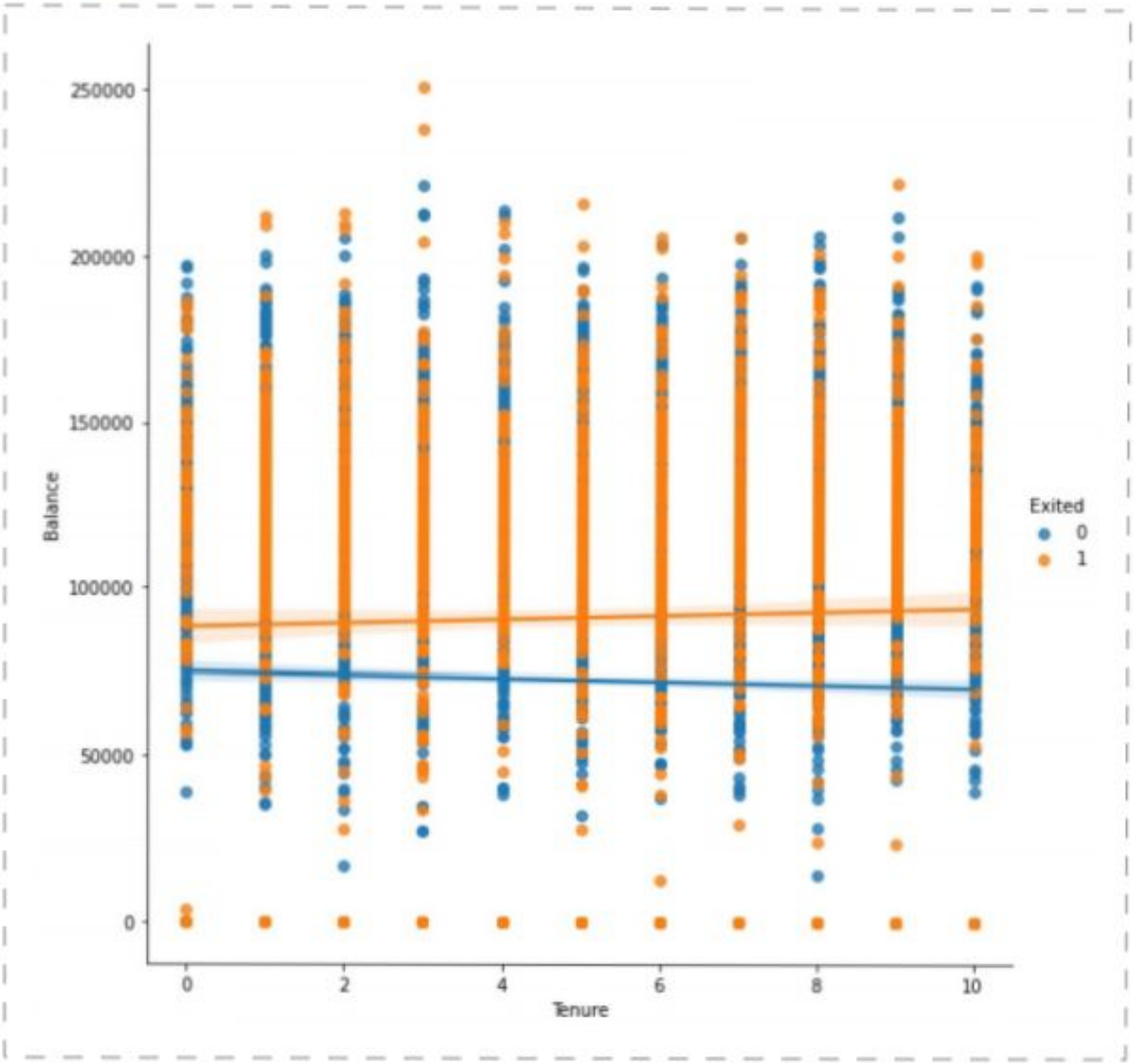
```
#Bi - Variate Analysis
plt.bar(df.CustomerId, df.CreditScore)
plt.title('CreditScore')
plt.xlabel('CustomerId')
plt.ylabel('CreditScore')
Text(0, 0.5, 'CreditScore')
```



```
sns.lmplot(x='Tenure', y='Balance', data=df ,hue='Exited',size=8)
/usr/local/lib/python3.7/dist-packages/seaborn/regression.py:581:
UserWarning: The `size` parameter has been renamed to `height`; please
update your code.
  warnings.warn(msg, UserWarning)
<seaborn.axisgrid.FacetGrid at 0x7fc4a149e2d0>
```



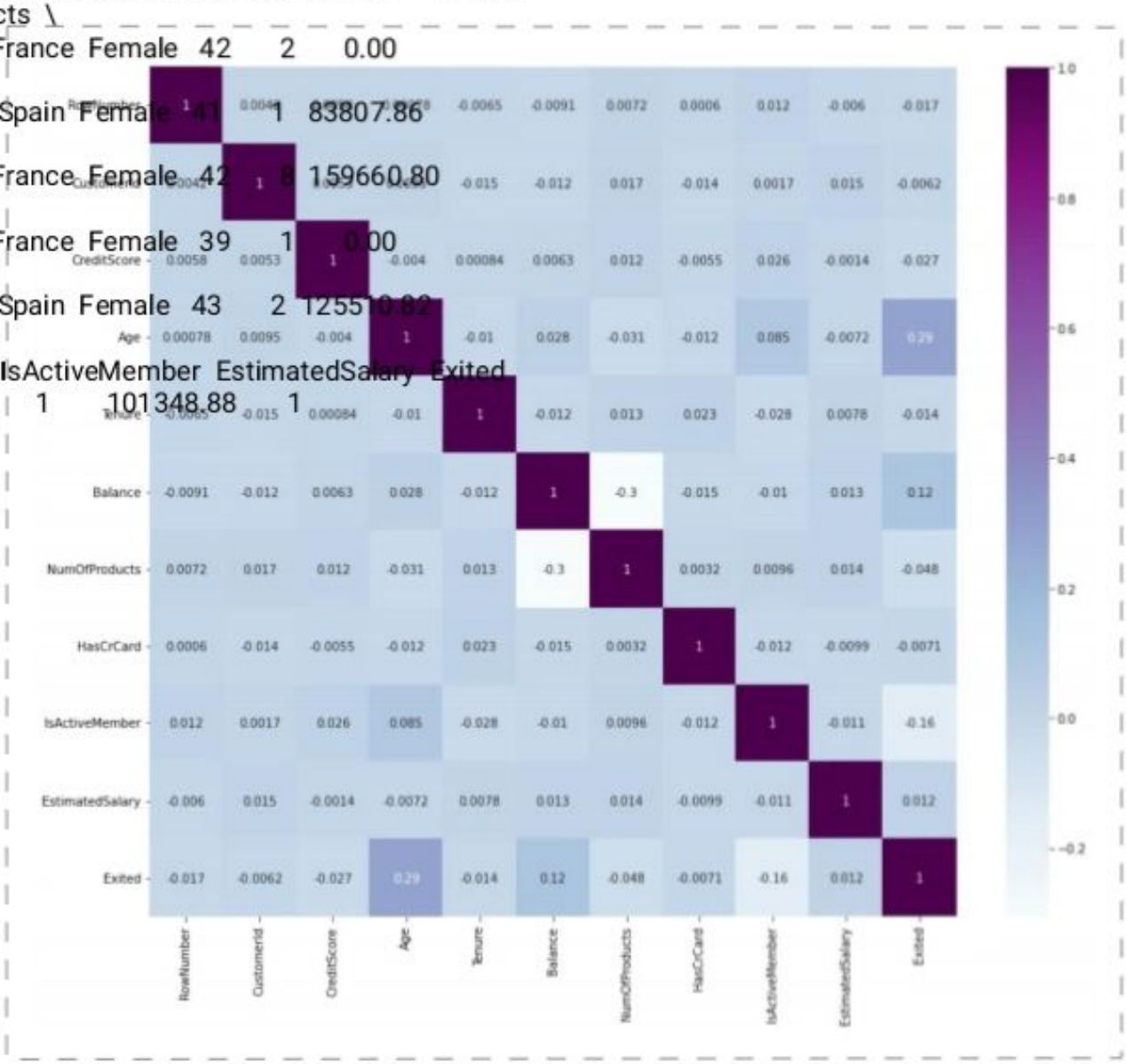
```
#Multi - Variate Analysis
ax =
df[["CreditScore","Age","Tenure","Balance"]].plot(figsize=(80,40))
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5));
```



```
df.isnull().sum()
RowNumber        0
CustomerId       0
Surname          0
CreditScore      0
Geography        0
Gender           0
Age              0
Tenure           0
Balance          0
NumOfProducts    0
HasCrCard        0
IsActiveMember   0
EstimatedSalary  0
Exited           0
dtype: int64
plt.figure(figsize=(15,13))
sns.heatmap(df.corr(),annot=True,cmap='BuPu')
plt.show()
```

```
df.drop(['RowNumber', 'CustomerId','Surname'],axis=1,inplace=True)

df.head()
  CreditScore Geography  Gender  Age  Tenure   Balance
NumOfProducts \
0         619    France  Female   42       2      0.00
1
1         608     Spain  Female   41       1  83807.86
1
2         502    France  Female   42       8 159660.80
3
3         699    France  Female   39       1      0.00
2
4         850     Spain  Female   43       2 125510.82
1
  HasCrCard  IsActiveMember  EstimatedSalary  Exited
0         1               1        101348.88       1
```



```
1       0           1       112542.58       0
2       1           0       113931.57       1
3       0           0       93826.63        0
4       1           1       79084.10        0
df.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 11 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   CreditScore     10000 non-null  int64
 1   Geography       10000 non-null  object
 2   Gender          10000 non-null  object
 3   Age             10000 non-null  int64
 4   Tenure          10000 non-null  int64
 5   Balance         10000 non-null  float64
 6   NumOfProducts   10000 non-null  int64
 7   HasCrCard       10000 non-null  int64
 8   IsActiveMember  10000 non-null  int64
 9   EstimatedSalary 10000 non-null  float64
 10  Exited          10000 non-null  int64
dtypes: float64(2), int64(7), object(2)
memory usage: 859.5+ KB
df["Geography"].unique()
array(['France', 'Spain', 'Germany'], dtype=object)

df["Gender"].unique()
array(['Female', 'Male'], dtype=object)

geo=pd.get_dummies(df["Geography"],drop_first=False)

geo.head()
   France  Germany  Spain
0       1        0      0
1       0        0      1
2       1        0      0
3       1        0      0
4       0        0      1
gen=pd.get_dummies(df["Gender"],drop_first=False)
df=pd.concat([df, geo,gen], axis=1)

df
     CreditScore Geography  Gender  Age  Tenure   Balance
NumOfProducts  \
```

```
0         619   France  Female  42     2       0.00
1
1         608    Spain  Female  41     1   83807.86
1
2         502   France  Female  42     8  159660.80
3
3         699   France  Female  39     1       0.00
2
4         850    Spain  Female  43     2  125510.82
1
...       ...     ...     ... ...    ...       ...
...
9995      771   France    Male  39     5       0.00
2
9996      516   France    Male  35    10   57369.61
1
9997      709   France  Female  36     7       0.00
1
9998      772  Germany    Male  42     3   75075.31
2
9999      792   France  Female  28     4  130142.79
1
   HasCrCard  IsActiveMember  EstimatedSalary  Exited  France
Germany \
0          1               1        101348.88       1       1
0
1          0               1        112542.58       0       0
0
2          1               0        113931.57       1       1
0
3          0               0         93826.63       0       1
0
4          1               1         79084.10       0       0
0
...      ...             ...              ...     ...     ...
...
9995       1               0         96270.64       0       1
0
9996       1               1        101699.77       0       1
0
9997       0               1         42085.58       1       1
0
9998       1               0         92888.52       1       0
1
9999       1               0         38190.78       0       1
0
   Spain  Female  Male
0      0       1     0
```

```
1       1    1   0
2       0    1   0
3       0    1   0
4       1    1   0
...   ...  ...  ...
9995    0    0   1
9996    0    0   1
9997    0    1   0
9998    0    0   1
9999    0    1   0
[10000 rows x 16 columns]
```

```
df.drop(["Geography","Gender"], axis=1, inplace=True)
```

```
df.head()
```

```
   CreditScore  Age  Tenure   Balance  NumOfProducts  HasCrCard  \
0          619   42       2      0.00              1          1
1          608   41       1  83807.86              1          0
2          502   42       8 159660.80              3          1
3          699   39       1      0.00              2          0
4          850   43       2 125510.82              1          1
   IsActiveMember  EstimatedSalary  Exited  France  Germany  Spain
Female  \
0               1        101348.88       1       1        0      0
1
1               1        112542.58       0       0        0      1
1
2               0        113931.57       1       1        0      0
1
3               0         93826.63       0       1        0      0
1
4               1         79084.10       0       0        0      1
1
   Male
0     0
1     0
2     0
3     0
4     0
```

```
x=df.drop('Exited',axis=1)
```

```
x
```

```
     CreditScore  Age  Tenure   Balance  NumOfProducts  HasCrCard  \
0           619   42       2      0.00              1          1
1           608   41       1  83807.86              1          0
```

```
2          502   42       8  159660.80              3          1
3          699   39       1       0.00              2          0
4          850   43       2  125510.82              1          1
...        ...  ...     ...        ...            ...        ...
9995       771   39       5       0.00              2          1
9996       516   35      10   57369.61              1          1
9997       709   36       7       0.00              1          0
9998       772   42       3   75075.31              2          1
9999       792   28       4  130142.79              1          1
      IsActiveMember  EstimatedSalary  France  Germany  Spain  Female
Male
0                  1        101348.88       1        0      0       1
0
1                  1        112542.58       0        0      1       1
0
2                  0        113931.57       1        0      0       1
0
3                  0         93826.63       1        0      0       1
0
4                  1         79084.10       0        0      1       1
0
...              ...              ...     ...      ...    ...     ...
...
9995               0         96270.64       1        0      0       0
1
9996               1        101699.77       1        0      0       0
1
9997               1         42085.58       1        0      0       1
0
9998               0         92888.52       0        1      0       0
1
9999               0         38190.78       1        0      0       1
0
[10000 rows x 13 columns]
y=df['Exited']

y
0       1
1       0
2       1
3       0
4       0
       ..
9995    0
9996    0
9997    1
9998    1
```

```
9999    0
Name: Exited, Length: 10000, dtype: int64
df.shape
(10000, 14)
x.shape
(10000, 13)
y.shape
(10000,)
from sklearn.model_selection import train_test_split
x_train,x_test, y_train,y_test = train_test_split(x,y,
test_size=0.2,random_state=0)
x_train.shape
(8000, 13)
x_test.shape
(2000, 13)
y_test.shape
(2000,)
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()
x_train = sc.fit_transform(x_train)

x_train
array([[ 0.16958176, -0.46460796,  0.00666099, ...,  1.74309049,
         1.09168714, -1.09168714],
       [-2.30455945,  0.30102557, -1.37744033, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-1.19119591, -0.94312892, -1.031415  , ..., -0.57369368,
         1.09168714, -1.09168714],
       ...,
       [ 0.9015152 , -0.36890377,  0.00666099, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-0.62420521, -0.08179119,  1.39076231, ...,  1.74309049,
         1.09168714, -1.09168714],
       [-0.28401079,  0.87525072, -1.37744033, ..., -0.57369368,
         1.09168714, -1.09168714]])
x_test = sc.transform(x_test)
```

x_test

```
array([[-0.55204276, -0.36890377,  1.04473698, ..., -0.57369368,
         1.09168714, -1.09168714],
       [-1.31490297,  0.10961719, -1.031415  , ..., -0.57369368,
         1.09168714, -1.09168714],
       [ 0.57162971,  0.30102557,  1.04473698, ...,  1.74309049,
         1.09168714, -1.09168714],
       ...,
       [-0.74791227, -0.27319958, -1.37744033, ...,  1.74309049,
        -0.91601335,  0.91601335],
       [-0.00566991, -0.46460796, -0.33936434, ..., -0.57369368,
        -0.91601335,  0.91601335],
       [-0.79945688, -0.84742473,  1.04473698, ..., -0.57369368,
        -0.91601335,  0.91601335]])
```