MAHENDRA ENGINEERING COLLEGE FOR
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CLASS:IV YEAR
ECE SUB:IBM(AI)
REG NO:611419106048

```
#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  \
0      2      0.00             1        1            1
1      1   83807.86             1        0            1
2      8  159660.80             3        1            0
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
   EstimatedSalary Exited
0       101348.88      1
1       112542.58      0
2       113931.57      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()
```

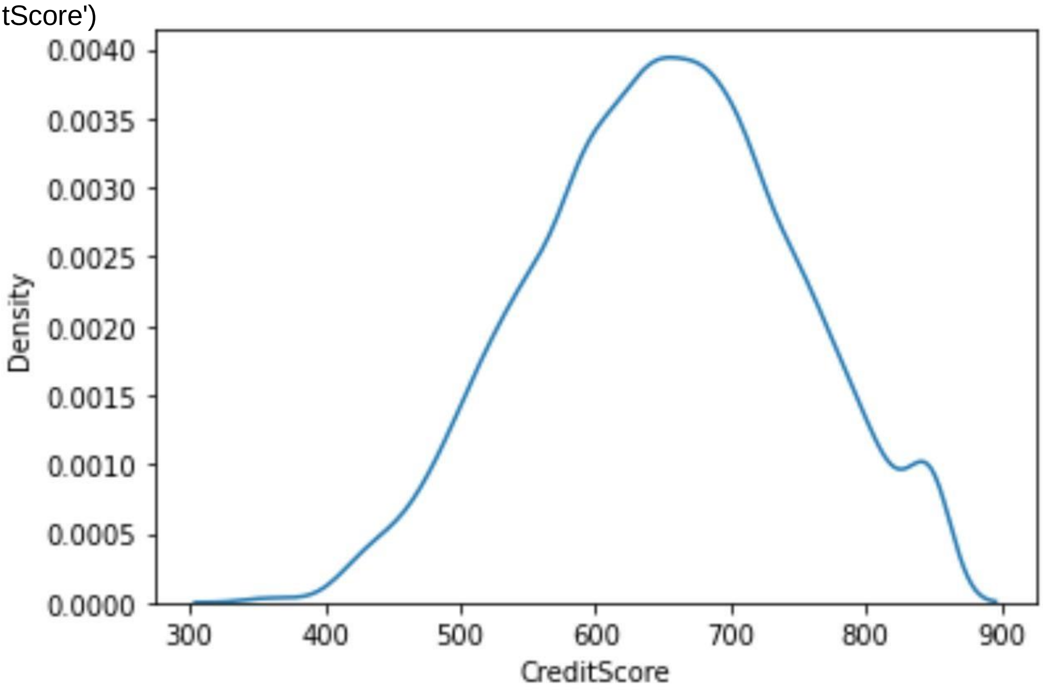
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column          Non-Null Count Dtype
---  ------          -------------- -----
 0   RowNumber        10000 non-null int64
 1   CustomerId       10000 non-null  int64
 2   Surname          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>
```

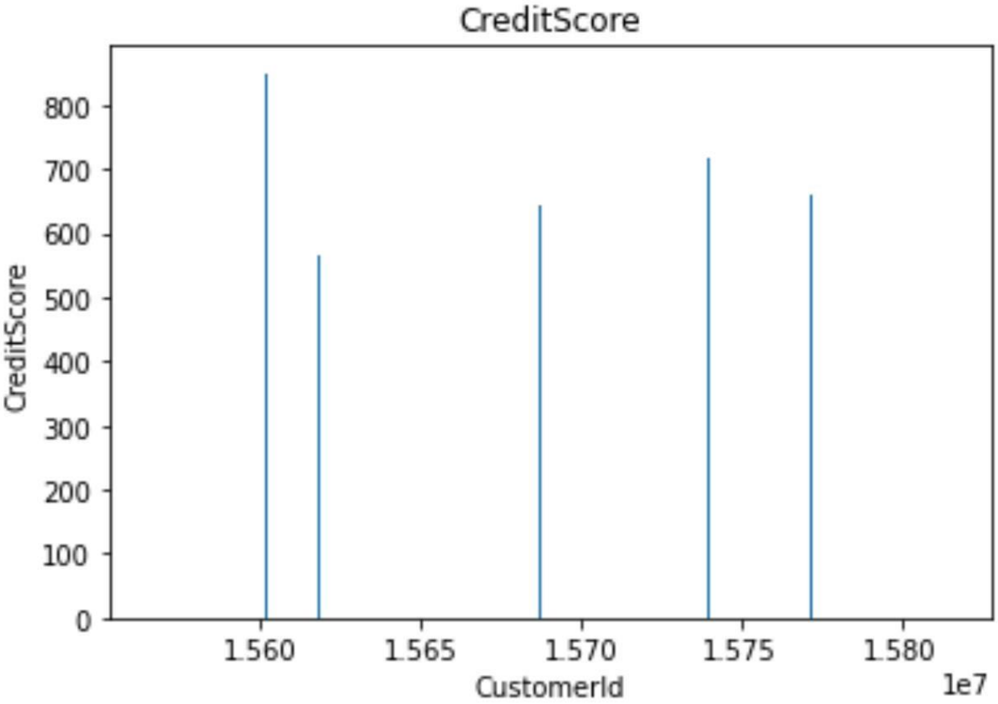
```
#Bi - Variate Analysis
plt.bar(df.CustomerId, df.CreditScore)
plt.title('CreditScore')
plt.xlabel('CustomerId')
plt.ylabel('CreditScore')
```

```
Text(0, 0.5, 'CreditScore')
```

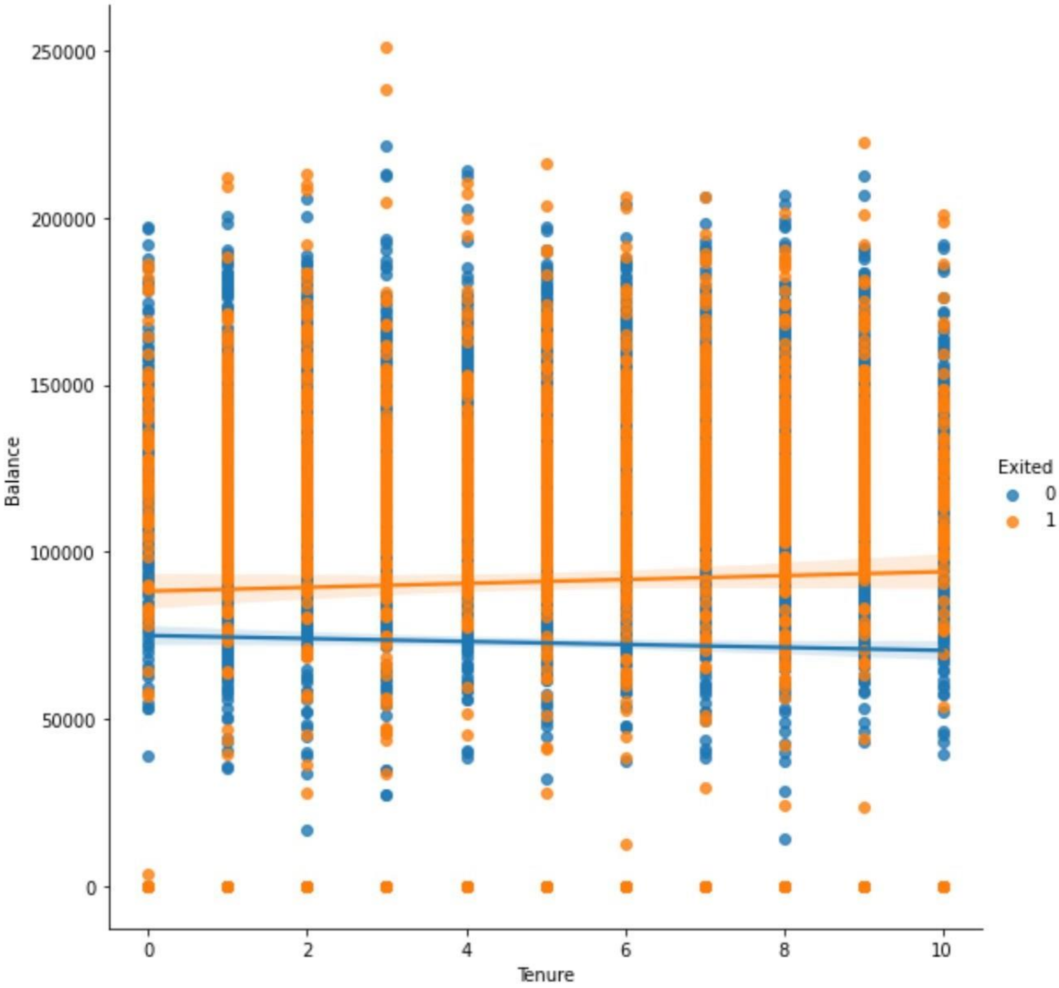


```
sns.lmplot(x='Tenure', y='Balance', data=df ,hue='Exited',size=8)
```

```
/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>
```



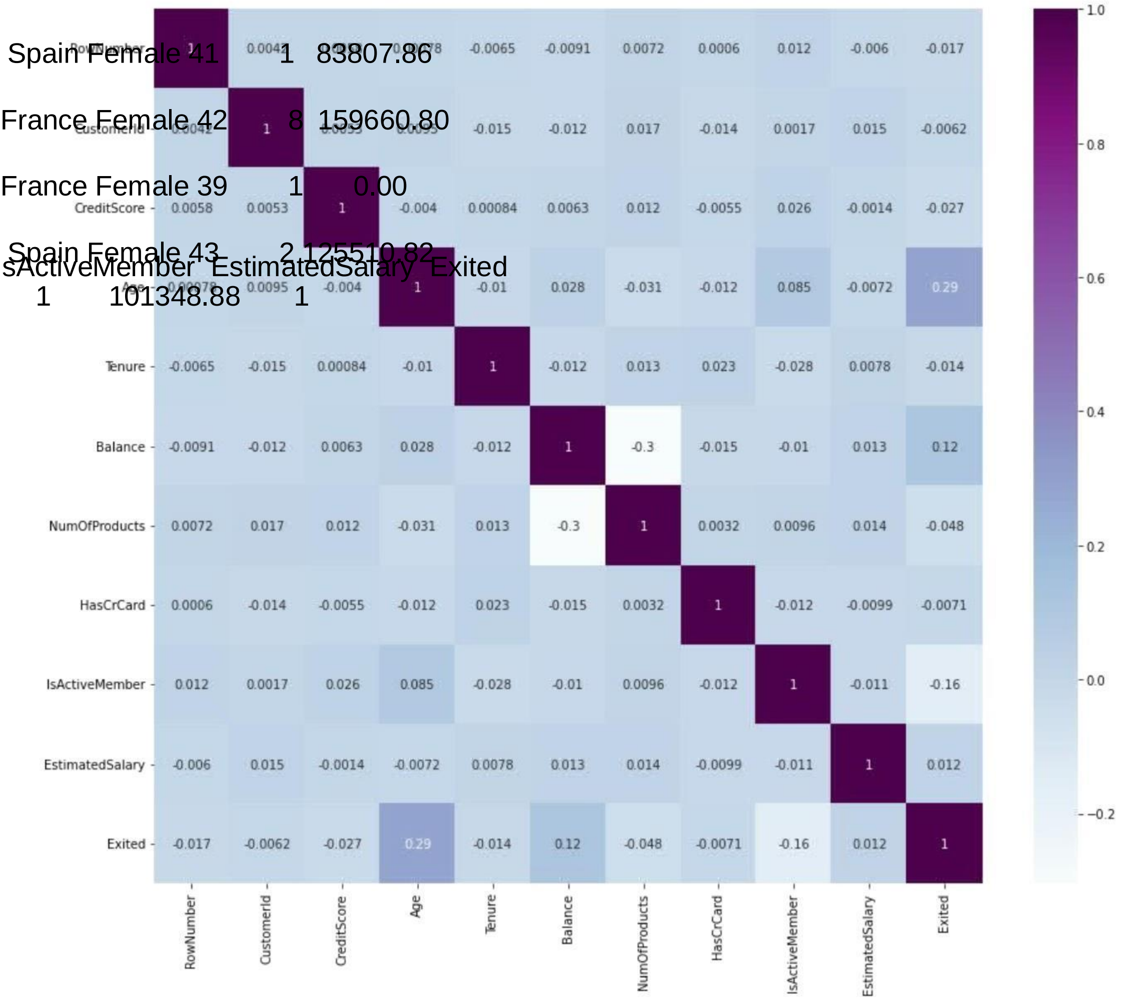
```
#Multi - Variate Analysis
ax =
df[["CreditScore","Age","Tenure","Balance"]].plot(figsize=(80,40))
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5));
```



```
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 \
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
```

```
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]])
```