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  \
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
```

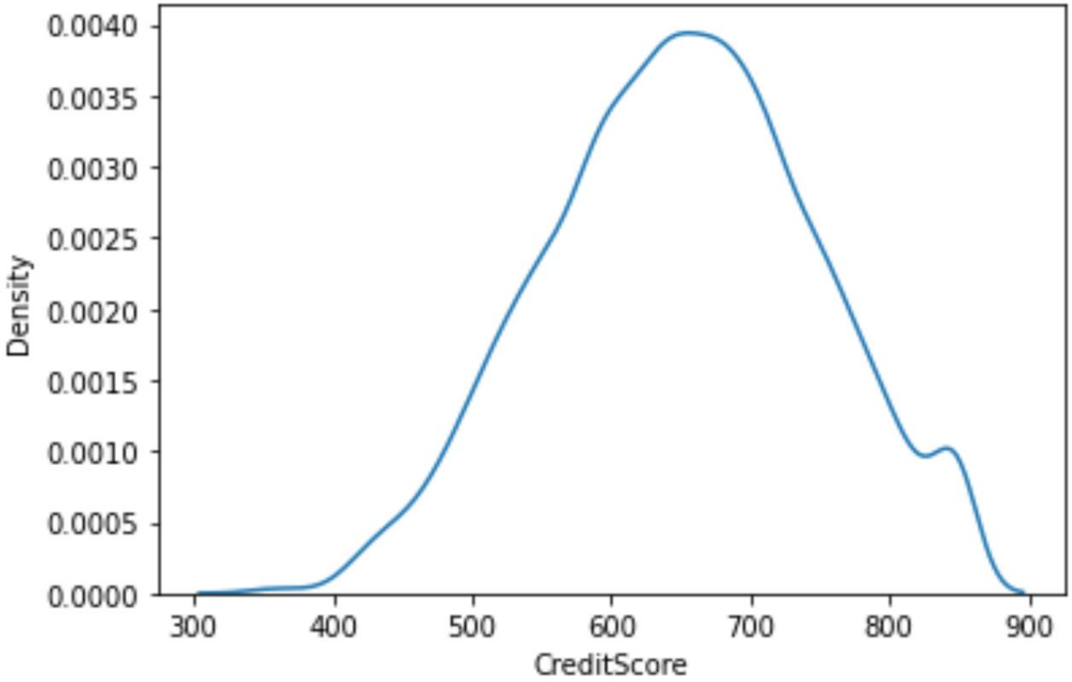
```
df.info( )
```

```
<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
```

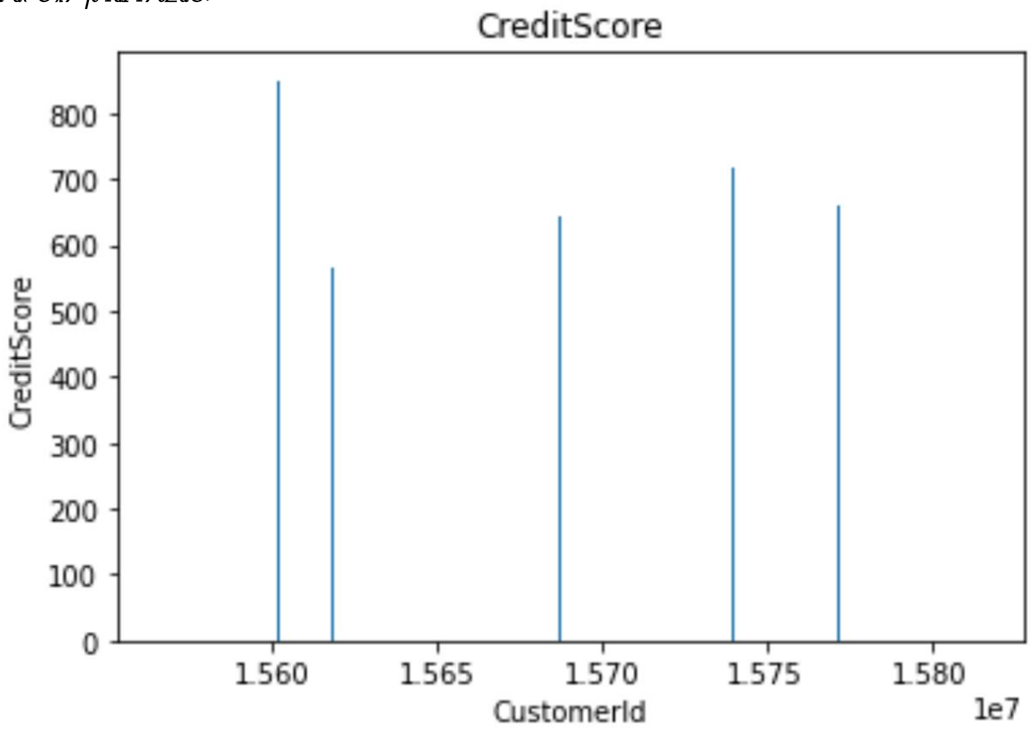
```
#Visualizations
#Univariate Analysis
import seaborn as sns
sns.kdeplot( df['CreditScore'])
```

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

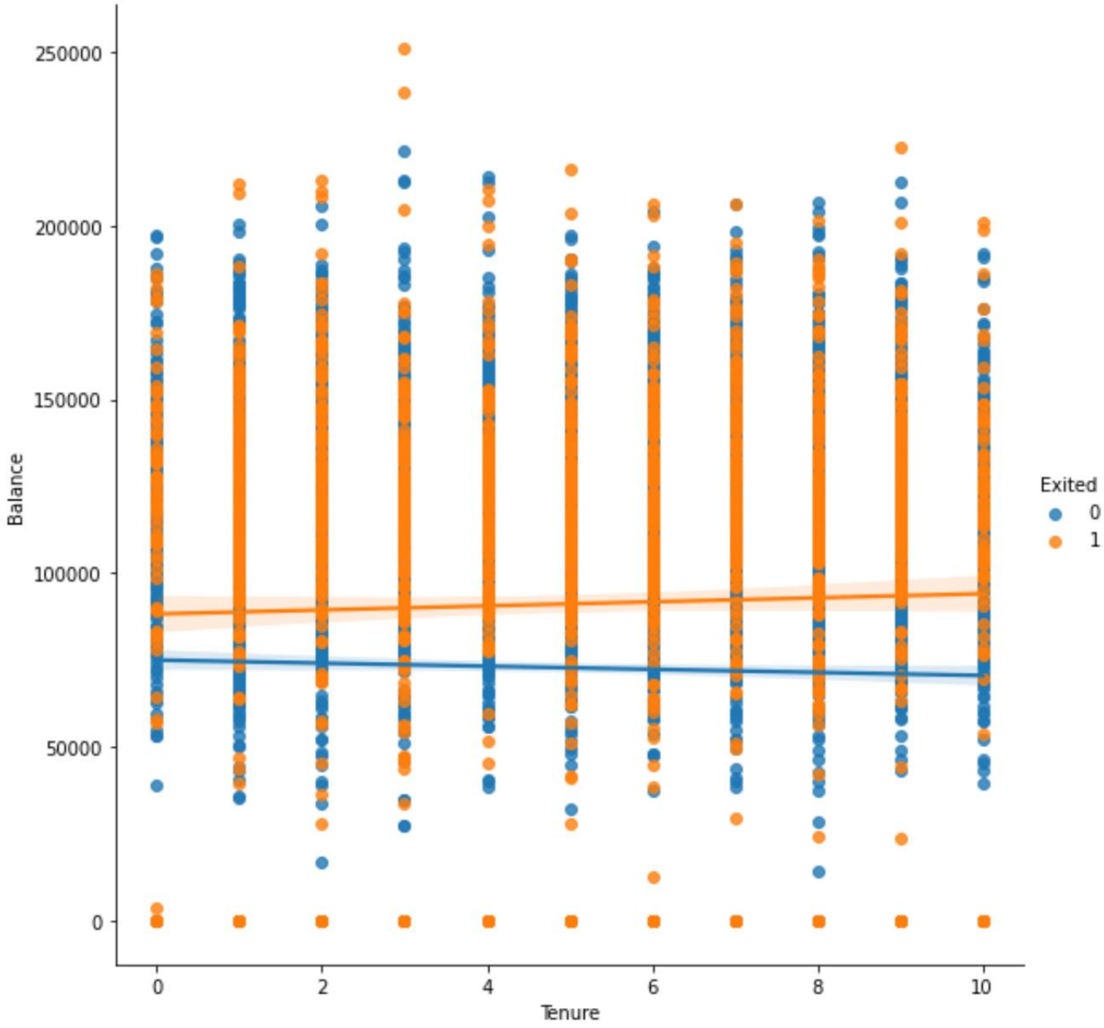
```
#Bi - Variate Analysis
plt.bar(df.CustomerId, df.CreditScore)
plt.title('CreditScore')
plt.xlabel('CustomerId')
plt.ylabel('CreditScore')
Text(0, 0.5, 'CreditScore')
```



```
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>
```



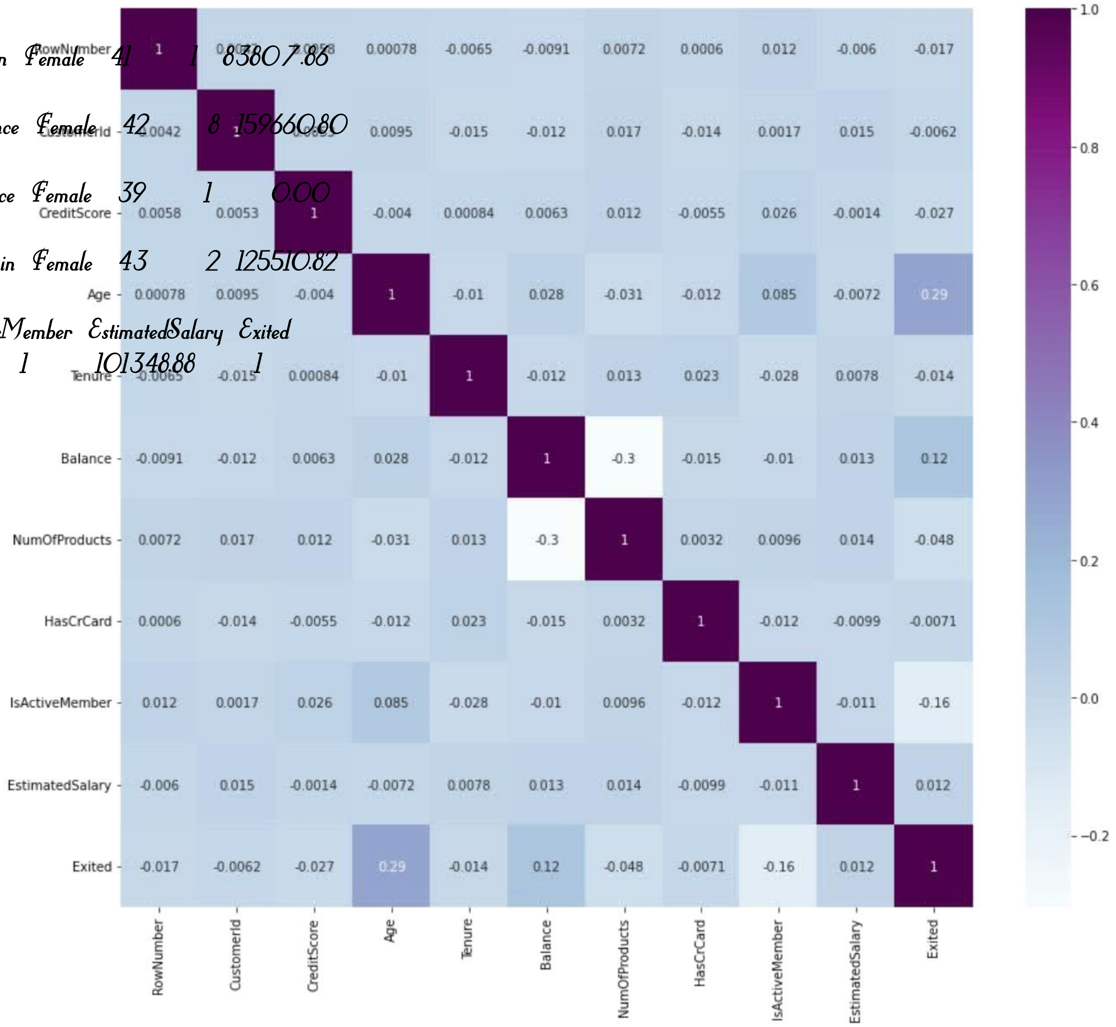
```
#Multi - Variate Analysis
ax =
df[["CreditScore","Age","Tenure","Balance"]].plot(figsize=(80,40))
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5));
```



```
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  \
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]])
```