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1.DownloadingDataset:Chrun_Modelling

2. Load The Dataset

```
import numpy as np import
pandas as pd import seaborn as
sns import matplotlib.pyplot as
plt
```

```
df = pd.read_csv('/content/drive/MyDrive/Churn_Modelling.csv')
df.head()
```

```
   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


   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

   EstimatedSalary  Exited  0
101348.88        1
1        112542.58       0
2        113931.57       1
3        93826.63       0   4         79084.10       0
```

```
df = df.drop(columns=['RowNumber', 'CustomerId', 'Surname'])
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['IsActiveMember'] = df['IsActiveMember'].astype('category')
df['Exited'] = df['Exited'].astype('category') df['HasCrCard']
= df['HasCrCard'].astype('category')
```

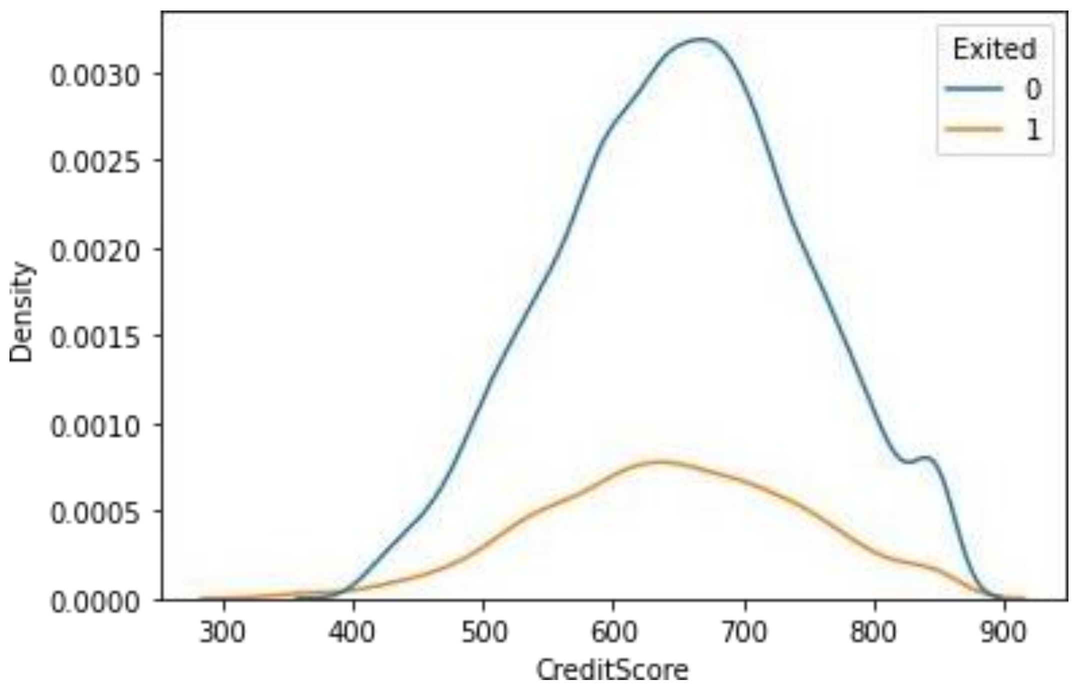
3. Perform

Univariate Analysis

Bi - Variate Analysis

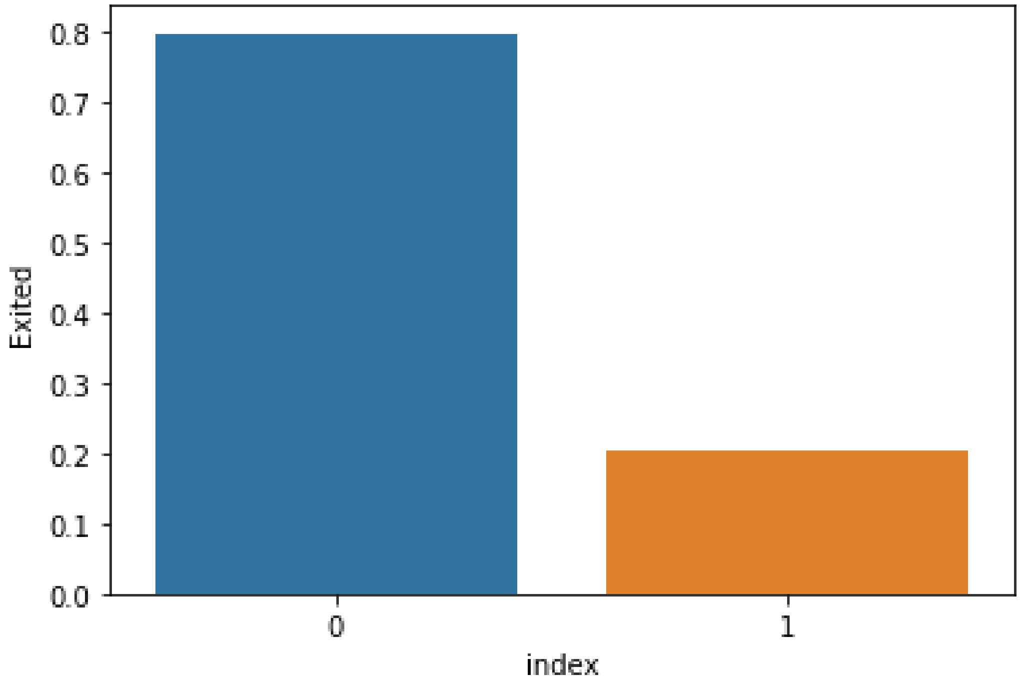
Multi - Variate Analysis

```
sns.kdeplot(x='CreditScore', data = df , hue = 'Exited')
plt.show()
```




```
density = df['Exited'].value_counts(normalize=True).reset_index()
sns.barplot(data=density, x='index', y='Exited', ); density
```

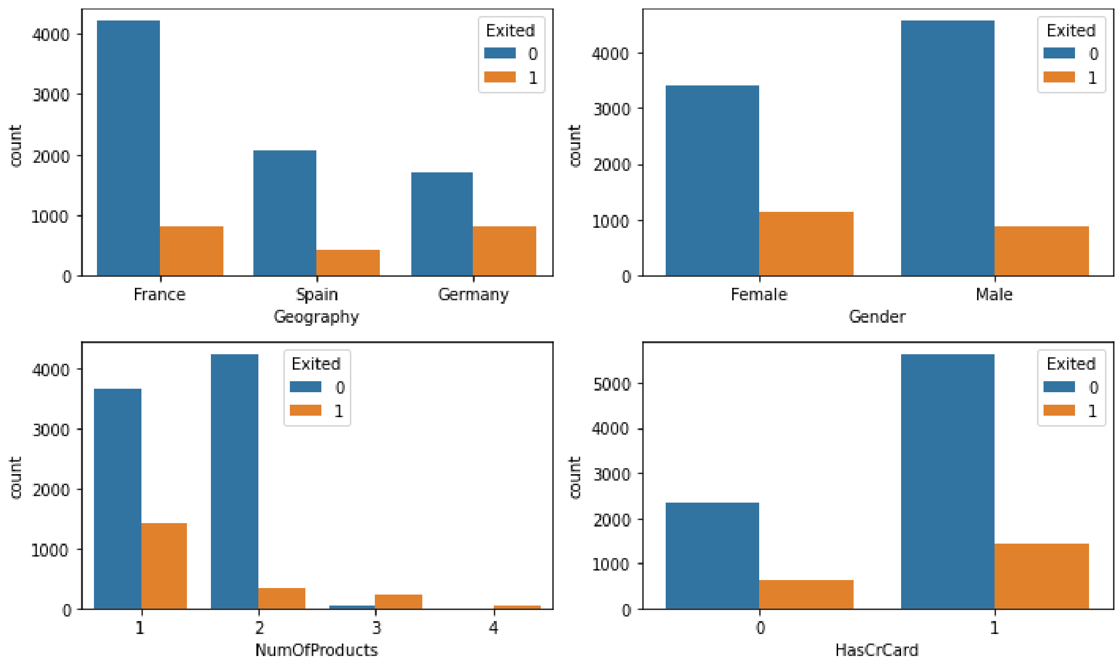
```
  index  Exited
0      0  0.7963
1      1  0.2037
```




```
categorical = df.drop(columns=['CreditScore', 'Age', 'Tenure',
'Balance', 'EstimatedSalary'])
rows = int(np.ceil(categorical.shape[1] / 2)) - 1 fig, axes =
plt.subplots(nrows=rows, ncols=2, figsize=(10,6)) axes =
axes.flatten()

for row in range(rows):
    cols = min(2, categorical.shape[1] - row*2)
for col in range(cols):          col_name =
categorical.columns[2 * row + col]          ax =
axes[row*2 + col]

        sns.countplot(data=categorical, x=col_name, hue="Exited",
ax=ax);          plt.tight_layout()
```



4. Descriptive statistics bold text

```
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  category  8
 IsActiveMember   10000 non-null  category  9
 EstimatedSalary  10000 non-null  float64  10  Exited
10000 non-null category dtypes: category(3),
float64(2), int64(4), object(2) memory usage: 654.8+
KB df.describe()
```

```
        CreditScore          Age       Tenure        Balance
NumOfProducts  \
count  10000.000000  10000.000000  10000.000000   10000.000000
10000.000000
mean     650.528800     38.921800      5.012800   76485.889288
1.530200
std       96.653299     10.487806      2.892174   62397.405202
```

```
0.581654
min       350.000000     18.000000      0.000000       0.000000
1.000000
25%       584.000000     32.000000      3.000000       0.000000
1.000000
50%       652.000000     37.000000      5.000000   97198.540000
1.000000
75%       718.000000     44.000000      7.000000  127644.240000
2.000000
max       850.000000     92.000000     10.000000  250898.090000
4.000000

       EstimatedSalary
count     10000.000000
mean     100090.239881  std
57510.492818  min
11.580000  25%
51002.110000
50%      100193.915000
75%      149388.247500
max      199992.480000
```

5.

Handle Missing Values

```
df.isna().sum()
```

```
CreditScore        0
Geography          0
Gender             0
Age                0
Tenure             0
Balance            0
NumOfProducts      0
HasCrCard          0
IsActiveMember     0
EstimatedSalary    0
Exited             0
dtype: int64
```

In this dataset there is no missing values

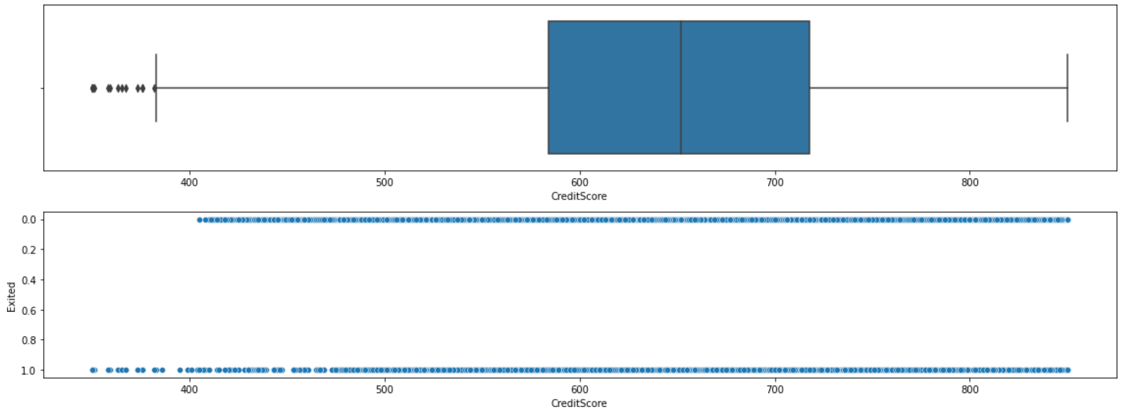
6. Find the outliers and replace the outliers Finding

Outliers

```
def box_scatter(data, x, y):        fig, (ax1, ax2) =
plt.subplots(nrows=2, ncols=1, figsize=(16,6))
sns.boxplot(data=data, x=x, ax=ax1)     sns.scatterplot(data=data,
x=x,y=y,ax=ax2) box_scatter(df,'CreditScore','Exited');
plt.tight_layout()
```

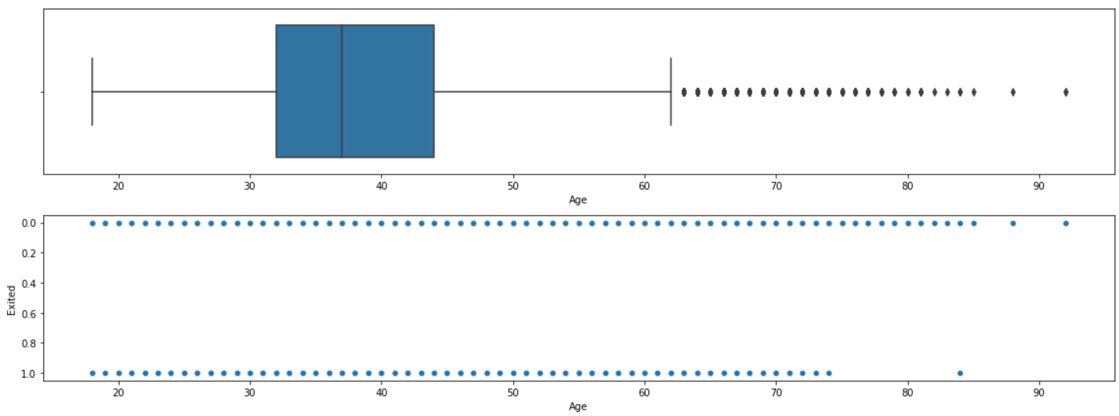
```python
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] <
400])}")
```

```
# of Bivariate Outliers: 19
```



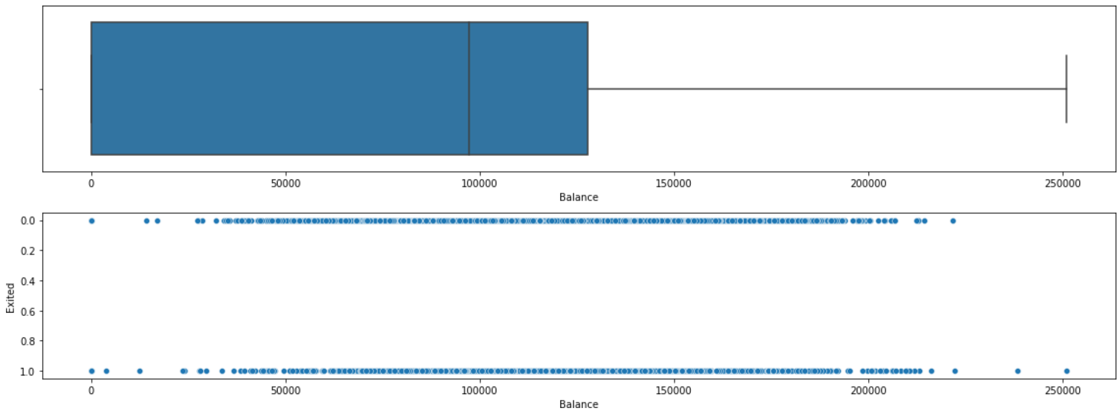

```python
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

```
# of Bivariate Outliers: 3
```

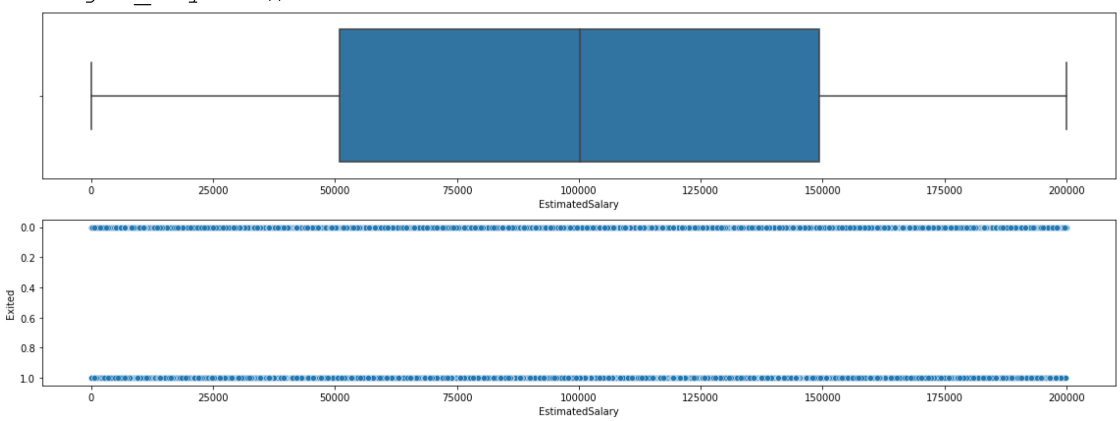



```python
box_scatter(df,'Balance','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] >
220000])}")
```

```
# of Bivariate Outliers: 4
```




```
box_scatter(df,'EstimatedSalary','Exited');
plt.tight_layout()
```

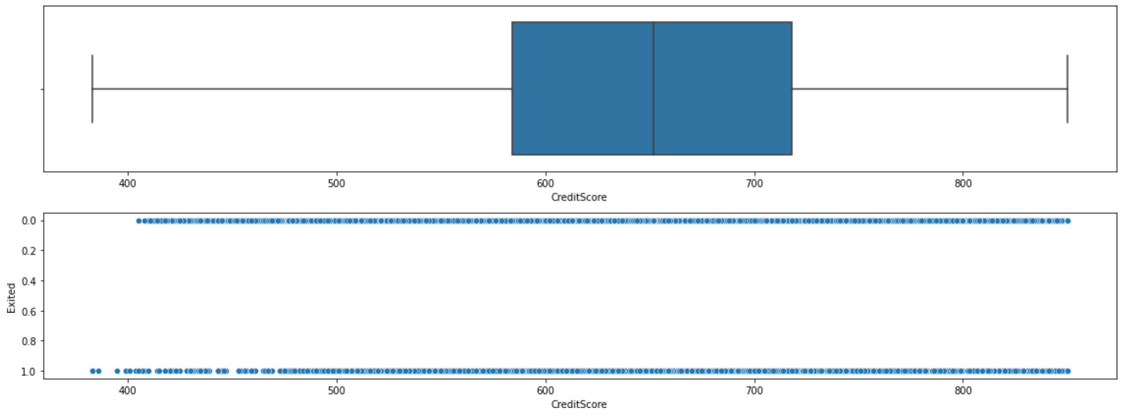


Removing The Outliers

```
for i in df:      if df[i].dtype=='int64' or
df[i].dtypes=='float64':
q1=df[i].quantile(0.25)          q3=df[i].quantile(0.75)
iqr=q3-q1         upper=q3+1.5*iqr          lower=q1-
1.5*iqr
        df[i]=np.where(df[i] >upper, upper, df[i])
df[i]=np.where(df[i] <lower, lower, df[i])
```

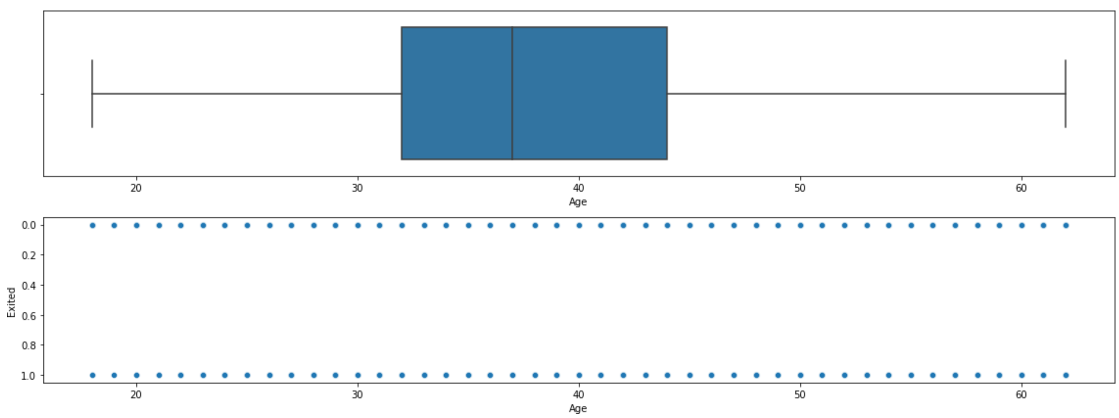
```
box_scatter(df,'CreditScore','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] <
400])}")
```

```
# of Bivariate Outliers: 19
```



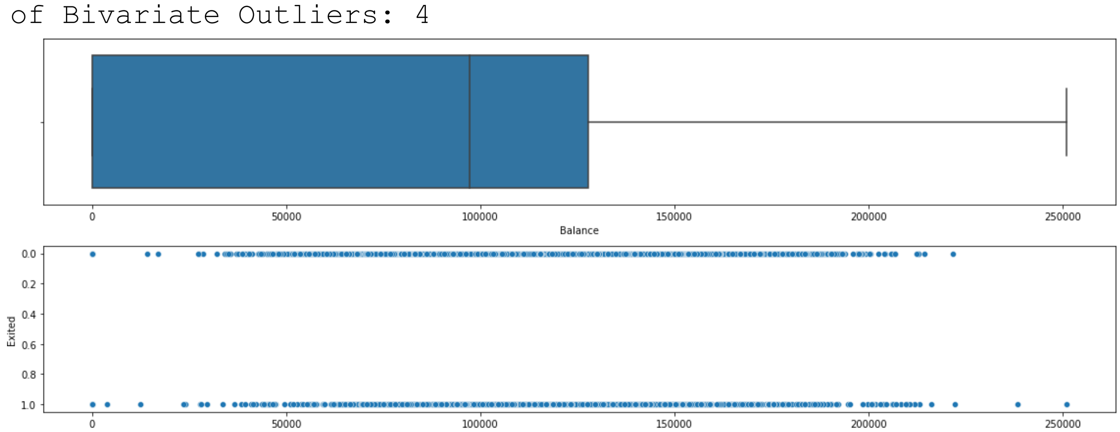

```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

```
# of Bivariate Outliers: 0
```




```
box_scatter(df,'Balance','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] > 
220000])}")
```

```
# of Bivariate Outliers: 4
```



7. Check for Categorical columns and perform encoding.

```
from sklearn.preprocessing import LabelEncoder
encoder=LabelEncoder() for i in df:     if
df[i].dtype=='object' or df[i].dtype=='category':
df[i]=encoder.fit_transform(df[i])
```

8. Split the data into dependent and independent variables.

```
x=df.iloc[:,:-1]
x.head()
```

```
   CreditScore  Geography  Gender   Age  Tenure    Balance
NumOfProducts  \
0        619.0          0       0  42.0     2.0       0.00
1.0
1        608.0          2       0  41.0     1.0   83807.86
1.0
2        502.0          0       0  42.0     8.0  159660.80
3.0
3        699.0          0       0  39.0     1.0       0.00
2.0
4        850.0          2       0  43.0     2.0  125510.82
1.0

   HasCrCard  IsActiveMember  EstimatedSalary
0          1               1        101348.88
1          0               1        112542.58
2          1               0        113931.57
3          0               0         93826.63   4          1
           1         79084.10
```

```
y=df.iloc[:,-1]
y.head()
```

```
0    1
1    0
2    1
3    0
4    0
Name: Exited, dtype: int64
```

9. Scale the independent variables

```
from sklearn.preprocessing import StandardScaler
scaler=StandardScaler()
x=scaler.fit_transform(x) print(x)
```

```
[[-0.32687761 -0.90188624 -1.09598752 ...  0.64609167  0.97024255
0.02188649]
 [-0.44080365  1.51506738 -1.09598752 ... -1.54776799  0.97024255
   0.21653375]
```

```
 [-1.53863634 -0.90188624 -1.09598752 ...  0.64609167 -1.03067011
0.2406869 ]
 ...
 [ 0.60524449 -0.90188624 -1.09598752 ... -1.54776799  0.97024255
  -1.00864308]
 [ 1.25772996  0.30659057  0.91241915 ...  0.64609167 -1.03067011
  -0.12523071]
 [ 1.4648682  -0.90188624 -1.09598752 ...  0.64609167 -1.03067011   -
1.07636976]]
```

10. Split the data into training and testing.

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.20)
```

```
print(x_train.shape)
print(x_test.shape)
```

```
(8000, 10)
(2000, 10)
```

```
print(y_train.shape)
print(y_test.shape)
```

```
(8000,)
(2000,)
```