1. Download the Datatset

2. Load the dataset

```
import pandas as pd
import numpy as np
```

```
file=pd.read_csv("Churn_Modelling.csv")
df=pd.DataFrame(file)
df.head()
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Ba
0	1	15634602	Hargrave	619	France	Female	42	2	
1	2	15647311	Hill	608	Spain	Female	41	1	838
2	3	15619304	Onio	502	France	Female	42	8	1596
3	4	15701354	Boni	699	France	Female	39	1	
4	5	15737888	Mitchell	850	Spain	Female	43	2	1255

```
df['HasCrCard'] = df['HasCrCard'].astype('category')
```

```
df['IsActiveMember'] = df['IsActiveMember'].astype('category')
df['Exited'] = df['Exited'].astype('category')
```

```
df = df.drop(columns=['RowNumber', 'CustomerId', 'Surname'])
```

```
df.head()
```

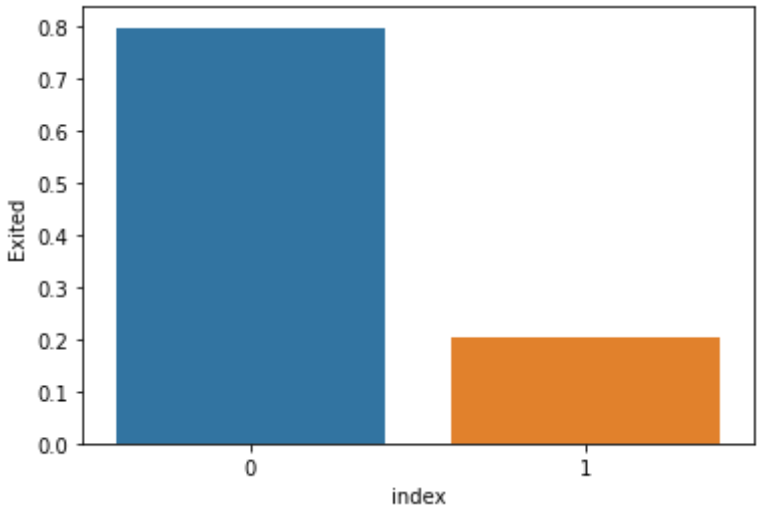
	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard
0	619	France	Female	42	2	0.00	1	1
1	608	Spain	Female	41	1	83807.86	1	0
2	502	France	Female	42	8	159660.80	3	1
3	699	France	Female	39	1	0.00	2	0
4	850	Spain	Female	43	2	125510.82	1	1

3. Perform Below Visualizations.

● Univariate Analysis ● Bi - Variate Analysis ● Multi - Variate Analysis

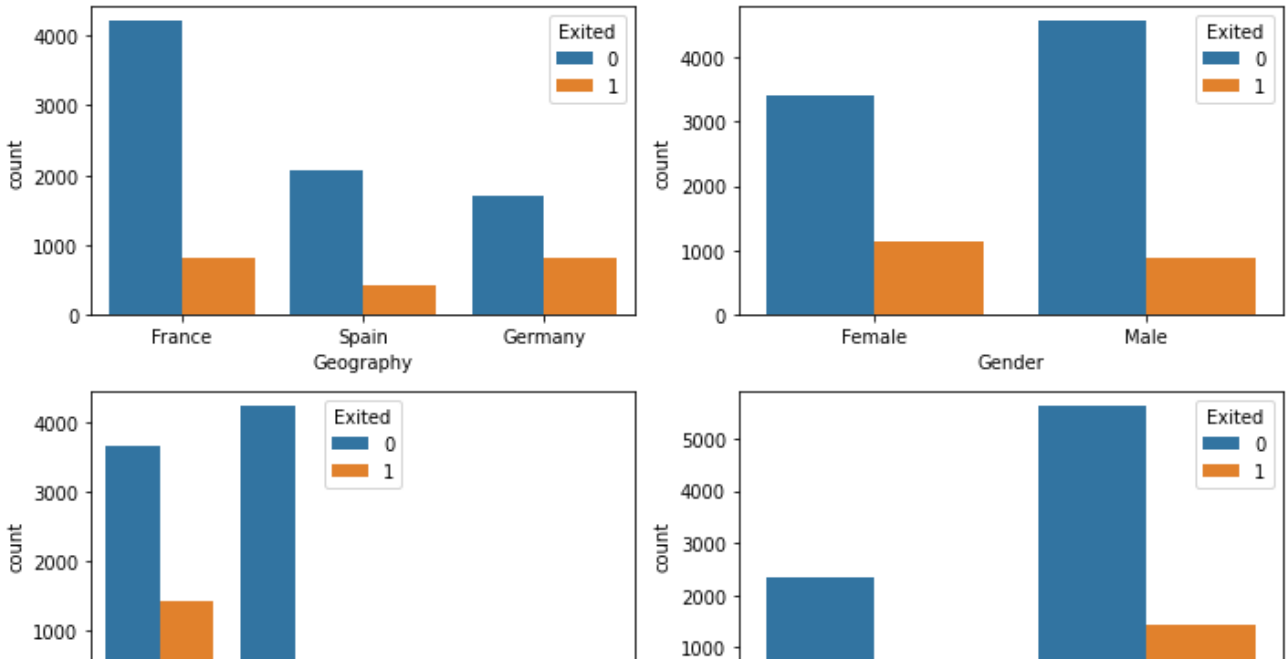
```
import seaborn as sns
density = df['Exited'].value_counts(normalize=True).reset_index()
sns.barplot(data=density, x='index', y='Exited', );
density
```

	index	Exited
0	0	0.7963
1	1	0.2037



The data is significantly imbalanced

```
import matplotlib.pyplot as plt


categorical = df.drop(columns=['CreditScore', 'Age', 'Tenure', 'Balance', 'EstimatedSalary
rows = int(np.ceil(categorical.shape[1] / 2)) - 1

# create sub-plots anf title them
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. Perform descriptive statistics on the dataset.

```
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	Estimat
count	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	100
mean	650.528800	38.921800	5.012800	76485.889288	1.530200	1000
min	350.000000	18.000000	0.000000	0.000000	1.000000	

5. Handle the 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
```

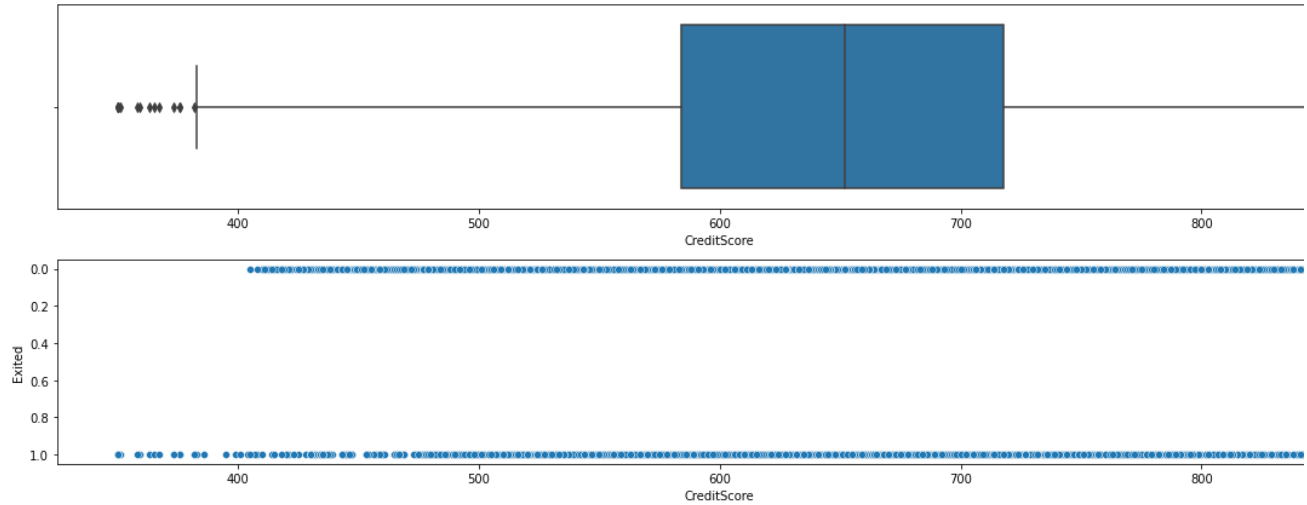
```
for i in df:
    if df[i].dtype=='object' or df[i].dtype=='category':
        print("unique of "+i+" is "+str(len(set(df[i])))+" they are "+str(set(df[i])))
```

```
unique of Geography is 3 they are {'France', 'Spain', 'Germany'}
unique of Gender is 2 they are {'Male', 'Female'}
unique of HasCrCard is 2 they are {0, 1}
unique of IsActiveMember is 2 they are {0, 1}
unique of Exited is 2 they are {0, 1}
```

6. Find the outliers and replace the outliers

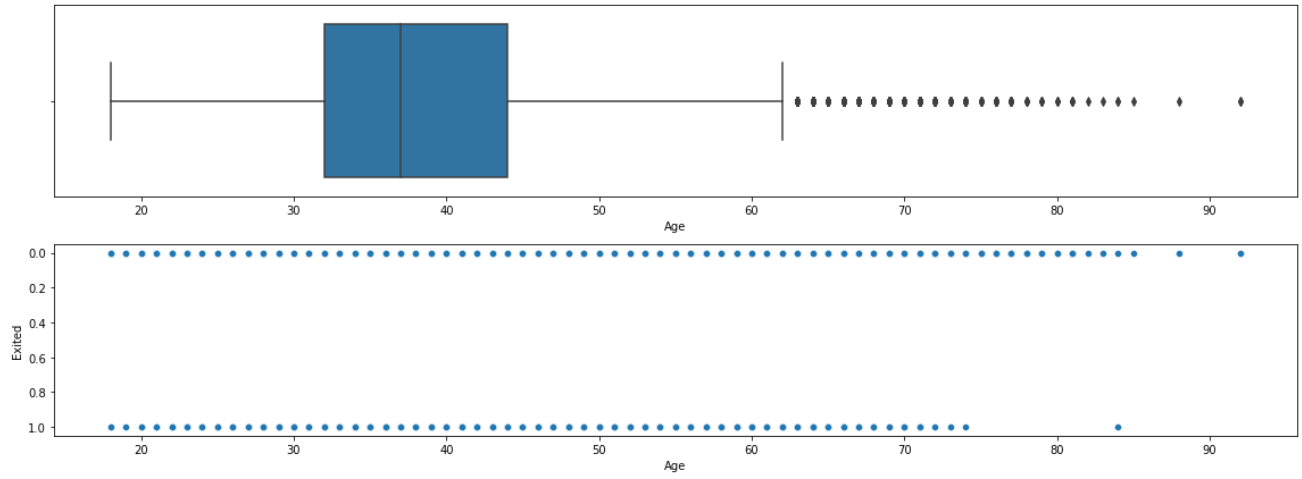
```
def box_scatter(data, x, y):
    fig, (ax1, ax2) = plt.subplots(nrows=2, ncols=1, figsize=(16,6))
    sns.boxplot(data=data, x=x, ax=ax1)
    sns.scatterplot(data=data, x=x,y=y,ax=ax2)


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

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



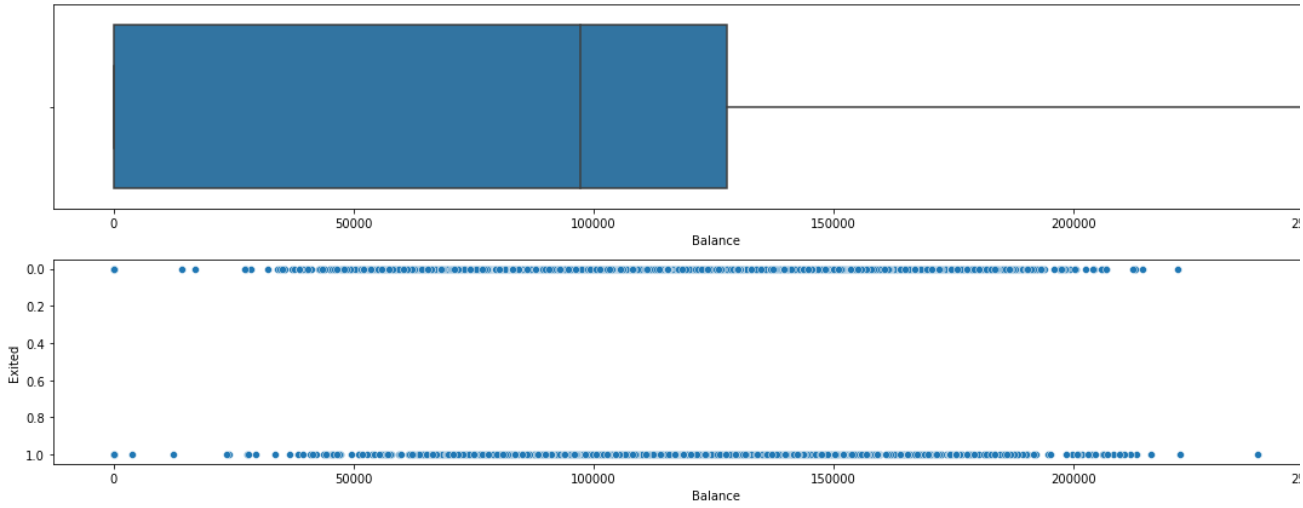

```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

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

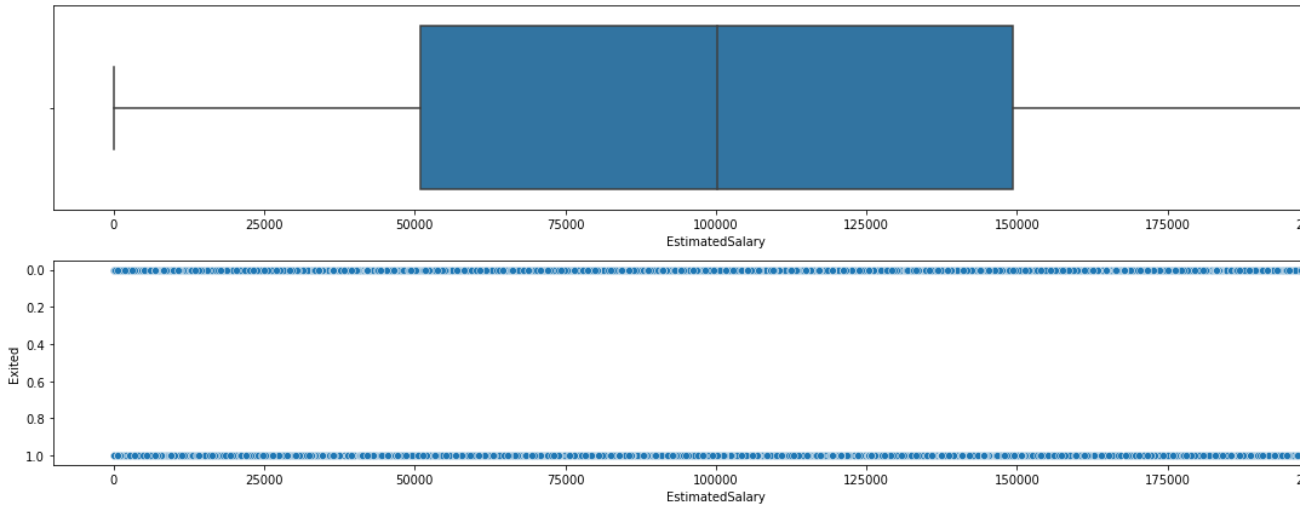



```
box_scatter(df,'Balance','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Balance'] > 220000])}")
```

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




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



Removing outliers

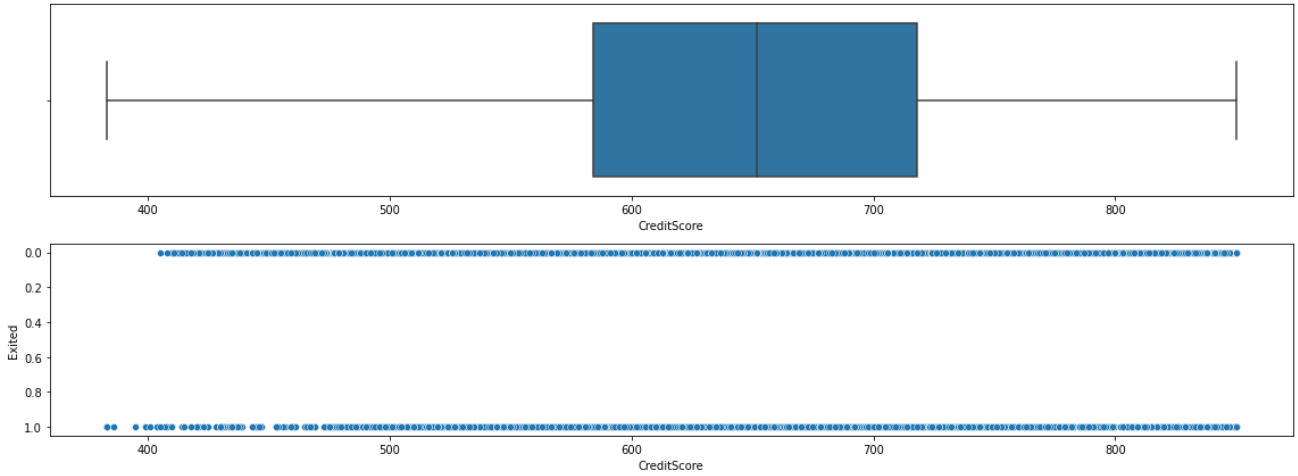
```
for i in df:
    if df[i].dtype=='int64' or df[i].dtypes=='float64':
        q1=df[i].quantile(0.25)
        q3=df[i].quantile(0.75)
        iqr=q3-q1
        upper=q3+1.5*iqr
        lower=q1-1.5*iqr
        df[i]=np.where(df[i]>upper, upper, df[i])
```

```
        df[i]=np.where(df[i] <lower, lower, df[i])
```

After replacing outliers

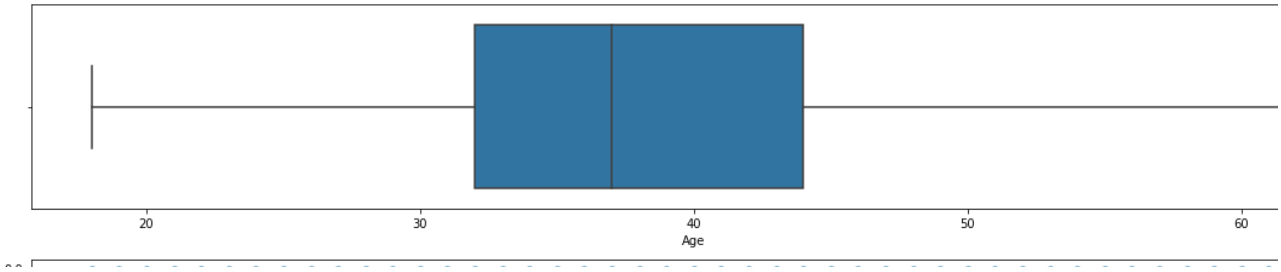
```
box_scatter(df,'CreditScore','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['CreditScore'] < 400])}")
```

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



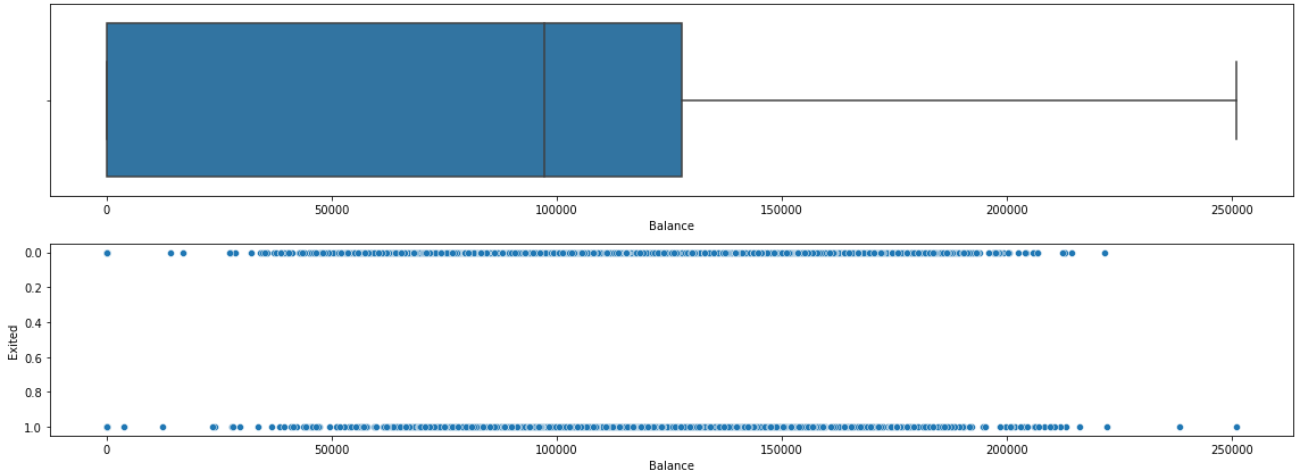

```
box_scatter(df,'Age','Exited');
plt.tight_layout()
print(f"# of Bivariate Outliers: {len(df.loc[df['Age'] > 87])}")
```

```
# 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	HasCrCard
0	619.0	0	0	42.0	2.0	0.00	1.0	1
1	608.0	2	0	41.0	1.0	83807.86	1.0	0
2	502.0	0	0	42.0	8.0	159660.80	3.0	1
3	699.0	0	0	39.0	1.0	0.00	2.0	0
4	850.0	2	0	43.0	2.0	125510.82	1.0	1

```
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)
```

```
x
```

```
array([[-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=0.33)
```

```
x_train.shape
```

```
(6700, 10)
```

```
x_test.shape
```

```
(3300, 10)
```

```
y_train.shape
```

```
(6700,)
```

```
y_test.shape
```

```
(3300,)
```