1. DOWNLOAD THE DATASET

```
#importing required libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

1. LOADING THE DATA SET

```
#loading the dataset into the dataflow
df=pd.read_csv('Churn_Modelling.csv')
```

#information about the dataset
df

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	3	15619304	Onio	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	4	15701354	Boni	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
999	9998	1558	Liu	709	Fran	Fema	3	7	0.00	1	0	1	42085.5	1

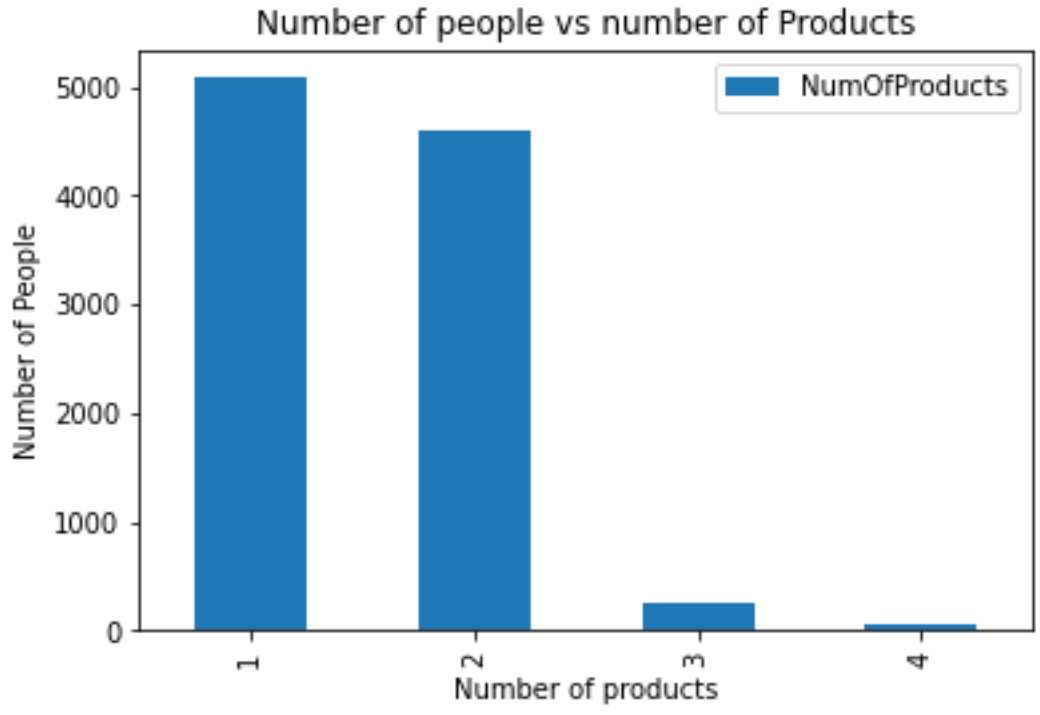
	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
97		4532			ce	le	6						8	
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

10000 rows × 14 columns

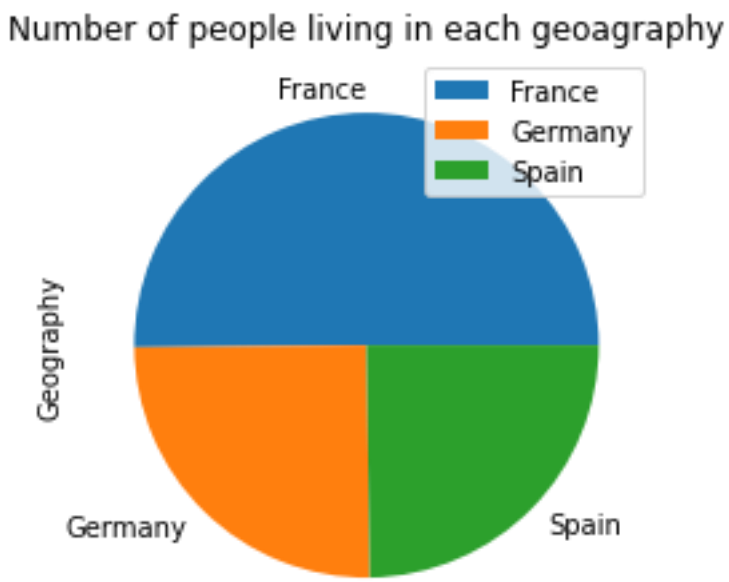
1. Perform below visualization

● Univariate Analysis

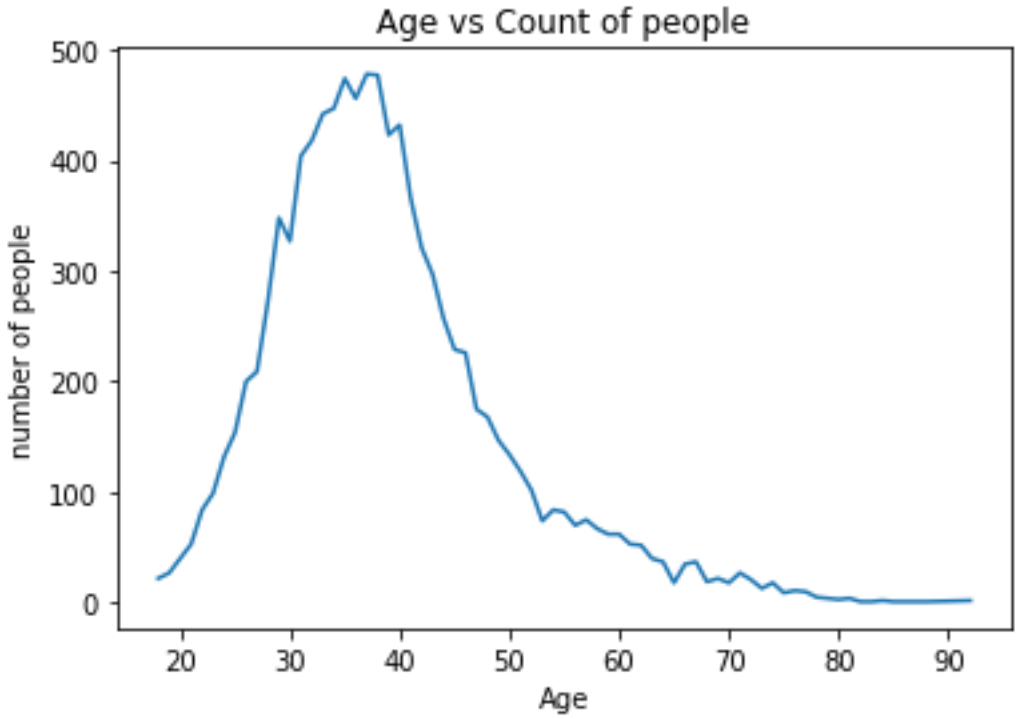
```
data=pd.DataFrame(df['NumOfProducts'].value_counts())
data.plot.bar()

plt.xlabel("Number of products")
plt.ylabel("Number of People")
plt.title("Number of people vs number of Products");
```



```
data=pd.DataFrame(df['Geography'].value_counts())
data.plot.pie(subplots='True')
plt.title("Number of people living in each geoagraphy");
```




```
df['Age'].value_counts().sort_index().plot.line()
plt.xlabel("Age")
plt.ylabel("number of people")
plt.title("Age vs Count of people");
```

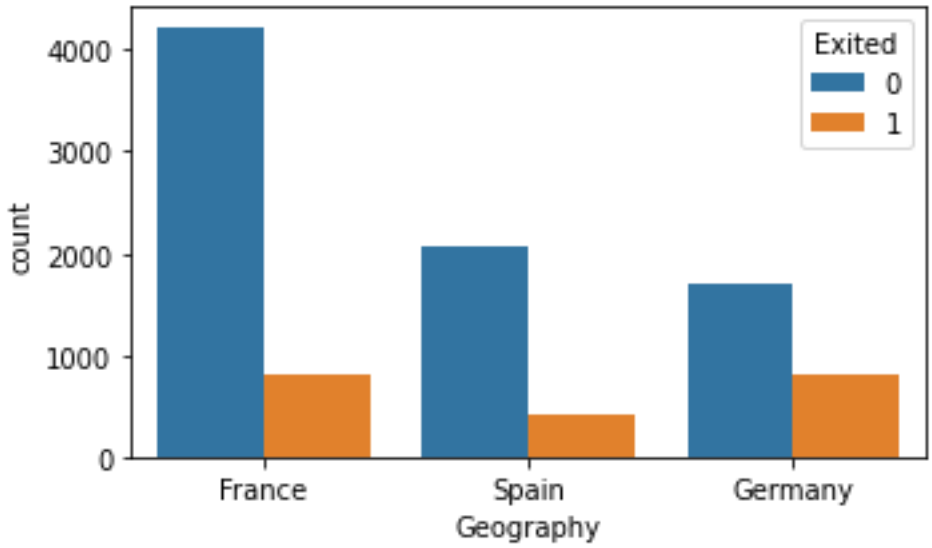


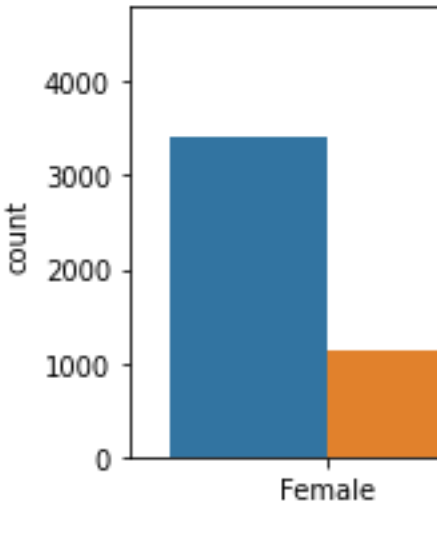
● Bivariate Analysis ● Multivariate Analysis

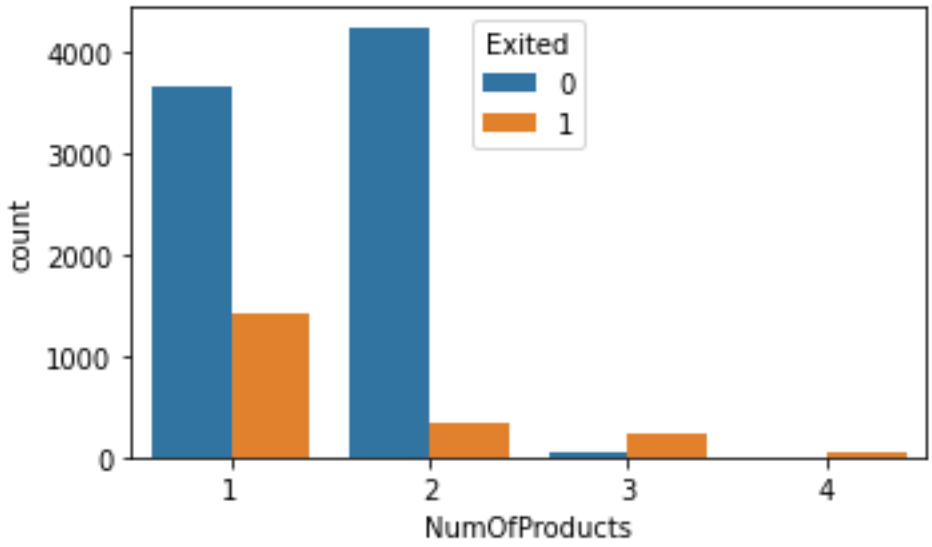
```
df['HasCrCard'] = df['HasCrCard'].astype('category')
df['IsActiveMember'] = df['IsActiveMember'].astype('category')
df['Exited'] = df['Exited'].astype('category')
df = df.drop(columns=['RowNumber', 'CustomerId', 'Surname'])
```

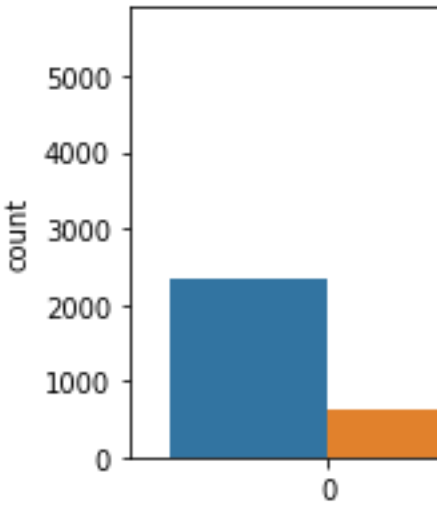
```
import seaborn as sns
categorical = df.drop(columns=['CreditScore', 'Age', 'Tenure', 'Balance', 'EstimatedSalary'])
rows = int(np.ceil(categorical.shape[1] / 2)) - 1
```

```
# 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()
```









#information about 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

#statistical analysis

df.describe()

	CreditScore	Age	Tenure	Balance	NumOfProducts	EstimatedSalary
count	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000
mean	650.528800	38.921800	5.012800	76485.889288	1.530200	100090.239881
std	96.653299	10.487806	2.892174	62397.405202	0.581654	57510.492818
min	350.000000	18.000000	0.000000	0.000000	1.000000	11.580000
25%	584.000000	32.000000	3.000000	0.000000	1.000000	51002.110000
50%	652.000000	37.000000	5.000000	97198.540000	1.000000	100193.915000
75%	718.000000	44.000000	7.000000	127644.240000	2.000000	149388.247500
max	850.000000	92.000000	10.000000	250898.090000	4.000000	199992.480000

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("Number of unique values of "+i+" are "+str(len(set(df[i])))+" Values are "+str(set(df[i])))
```

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

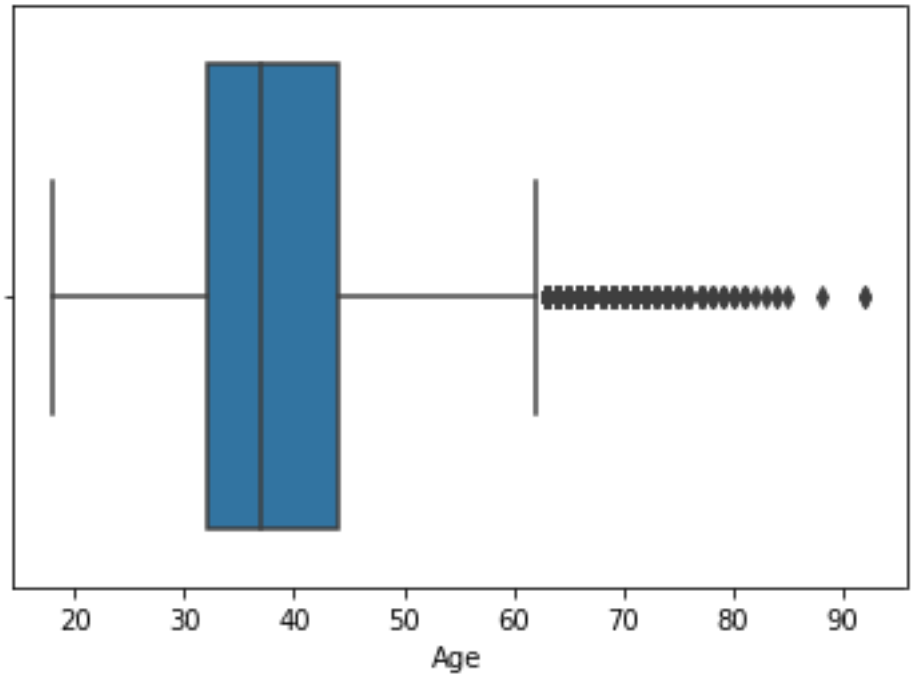
1. Find the outliers and replace the outliers

```
df.skew()
```

```
CreditScore       -0.071607
Age                1.011320
Tenure             0.010991
Balance           -0.141109
NumOfProducts      0.745568
EstimatedSalary    0.002085
dtype: float64
```

```
sns.boxplot(df["Age"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9dab43c410>
```




```
q1= df["Age"].describe()["25%"]
q3= df["Age"].describe()["75%"]
```

```
q1
```

```
32.0
```

```
q3
```

```
44.0
```

```
iqr=q3-q1
iqr
```

```
12.0
```

```
l_b=q1-(1.5*iqr)
```

u_b=q3+(1.5*iqr)

l_b

14.0
u_b

62.0
df[df["Age"]<l_b]

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited

df[df["Age"]>u_b].head()

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	Estimated Salary	Exited
58	511	Spain	Female	66	4	0.00	1	1	0	1643.11	1
85	652	Spain	Female	75	10	0.00	2	1	1	114675.75	0
104	670	Spain	Female	65	1	0.00	1	1	1	177655.68	1
158	646	France	Female	73	6	97259.25	1	0	1	104719.66	0
181	510	France	Male	65	2	0.00	2	1	1	48071.61	0

df.dtypes

CreditScore int64
Geography object
Gender object
Age int64
Tenure int64
Balance float64
NumOfProducts int64
HasCrCard category
IsActiveMember category
EstimatedSalary float64
Exited category
dtype: object
outlier_list=list(df[df["Age"]>u_b]["Age"])
outlier_list

[66,
75,
65,
73,

65,
72,
67,
67,
79,
80,
68,
75,
66,
66,
70,
63,
72,
64,
64,
70,
67,
82,
63,
69,
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69,
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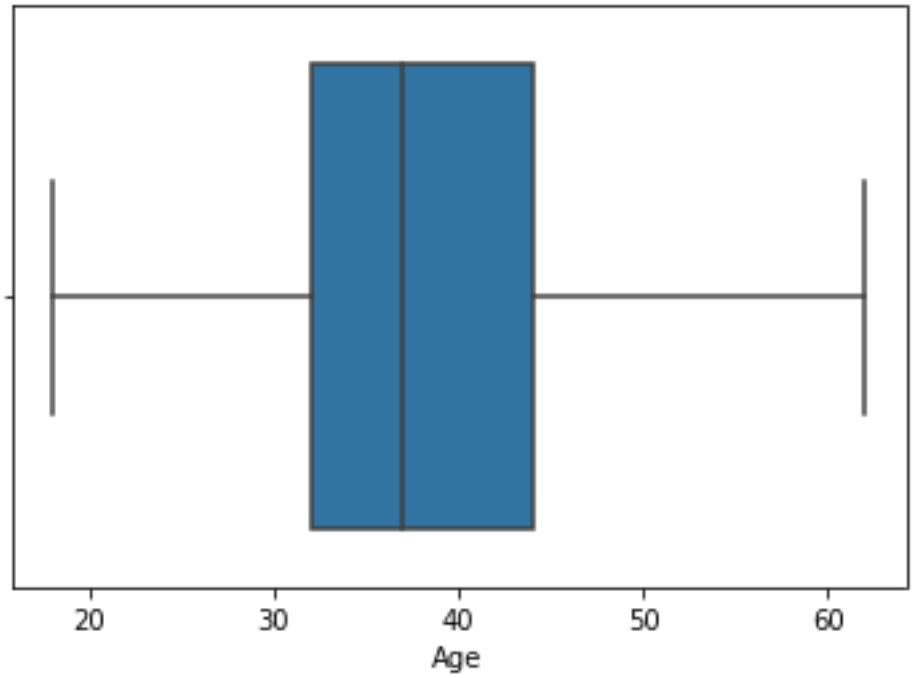
71,

```
 78,
 63,
 63,
 68,
 64,
 70,
 78,
 69,
 68,
 64,
 64,
 77,
 77]
outlier_dict={}.fromkeys(outlier_list,u_b)
outlier_dict
```

```
{66: 62.0,
 75: 62.0,
 65: 62.0,
 73: 62.0,
 72: 62.0,
 67: 62.0,
 79: 62.0,
 80: 62.0,
 68: 62.0,
 70: 62.0,
 63: 62.0,
 64: 62.0,
 82: 62.0,
 69: 62.0,
 74: 62.0,
 71: 62.0,
 76: 62.0,
 77: 62.0,
 88: 62.0,
 85: 62.0,
 84: 62.0,
 78: 62.0,
 81: 62.0,
 92: 62.0,
 83: 62.0}
```

```
df["Age"]=df["Age"].replace(outlier_dict)
sns.boxplot(df["Age"])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f9dab23a9d0>
```



7.Check for Categorical columns and perform encoding.

```
df.isnull().any()
```

```
CreditScore        False
Geography          False
Gender             False
Age                False
Tenure             False
Balance            False
NumOfProducts      False
HasCrCard          False
IsActiveMember     False
EstimatedSalary    False
Exited             False
dtype: bool
```

```
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])
```

1. Split the data into dependent and independent variables

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

CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary
0	619	0	0	42.0	2	0.00	1	1	1	101348.88
1	608	2	0	41.0	1	83807.86	1	0	1	112542.58
2	502	0	0	42.0	8	159660.80	3	1	0	113931.57
3	699	0	0	39.0	1	0.00	2	0	0	93826.63
4	850	2	0	43.0	2	125510.82	1	1	1	79084.10

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

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

1. Scale the independent variables

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

```
array([[-0.32622142, -0.90188624, -1.09598752, ...,  0.64609167,
         0.97024255,  0.02188649],
       [-0.44003595,  1.51506738, -1.09598752, ..., -1.54776799,
         0.97024255,  0.21653375],
       [-1.53679418, -0.90188624, -1.09598752, ...,  0.64609167,
        -1.03067011,  0.2406869 ],
       ...,
       [ 0.60498839, -0.90188624, -1.09598752, ..., -1.54776799,
         0.97024255, -1.00864308],
       [ 1.25683526,  0.30659057,  0.91241915, ...,  0.64609167,
        -1.03067011, -0.12523071],
       [ 1.46377078, -0.90188624, -1.09598752, ...,  0.64609167,
        -1.03067011, -1.07636976]])
```

1. 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=0.28)
```

```
x_train.shape
```

```
(7199, 10)
```

```
y_train.shape
```

```
(7199,)
```

```
x_test.shape
```

```
(2801, 10)
```

```
y_test.shape
```

```
(2801,)
```