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DEGREE:	Bachelor of Engineering
DEPARTMENT:	Electronics and communication Engineering
ASSIGNMENT:	2
PROJECT NAME:	Emerging Methods for Early Detection of Forest Fires

```
import panda as pd
import numpy as np

df = pd.read_csv('Churn_Modelling.csv')
df
```

```

      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
...         ...         ...         ...         ...         ...         ...
9995         9996    15606229  Obijiaku         771      France   Male  39
9996         9997    15569892  Johnstone         516      France   Male  35
9997         9998    15584532      Liu         709      France  Female  36
9998         9999    15682355  Sabbatini         772    Germany   Male  42
9999        10000    15628319    Walker         792      France  Female  28
```

```

      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
...         ...         ...         ...         ...         ...
9995         5      0.00              2           1              0
9996        10  57369.61              1           1              1
9997         7      0.00              1           0              1
9998         3  75075.31              2           1              0
9999         4 130142.79              1           1              0
```

```

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

```
9995      96270.64      0
9996     101699.77      0
9997      42085.58      1
9998      92888.52      1
9999      38190.78      0
```

```
[10000 rows x 14 columns]
```

```
##visulaizations
```

```
##univariate
```

```
df['Age'].mean()
```

```
38.9218
```

```
df['Balance'].median()
```

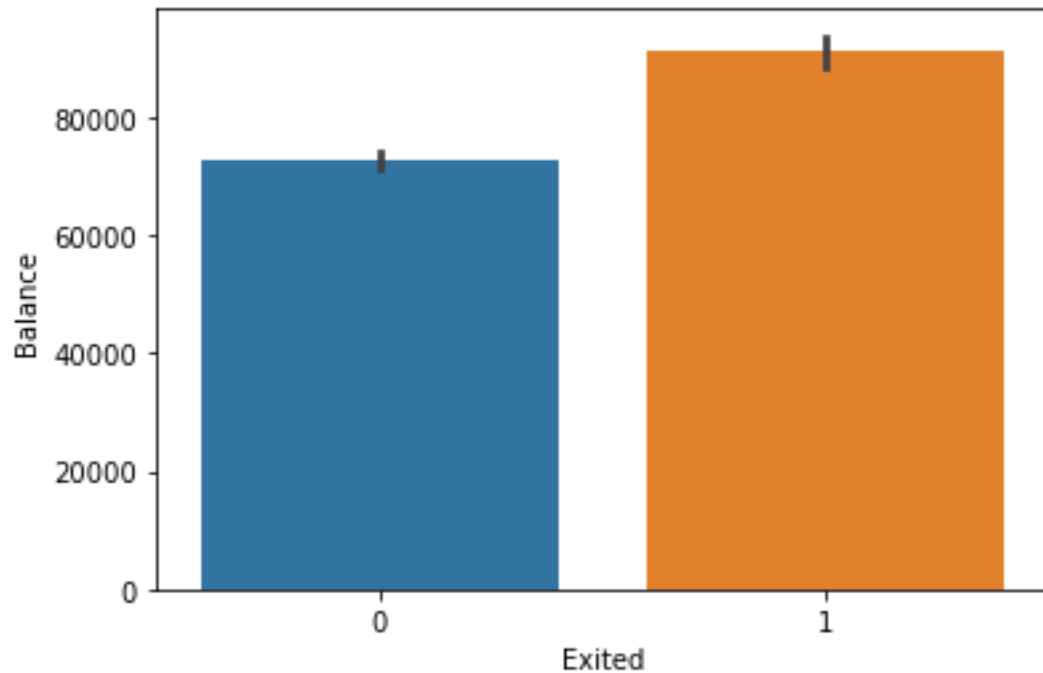
```
97198.54000000001
```

```
##bivariate
```

```
import matplotlib.pyplot as plt
```

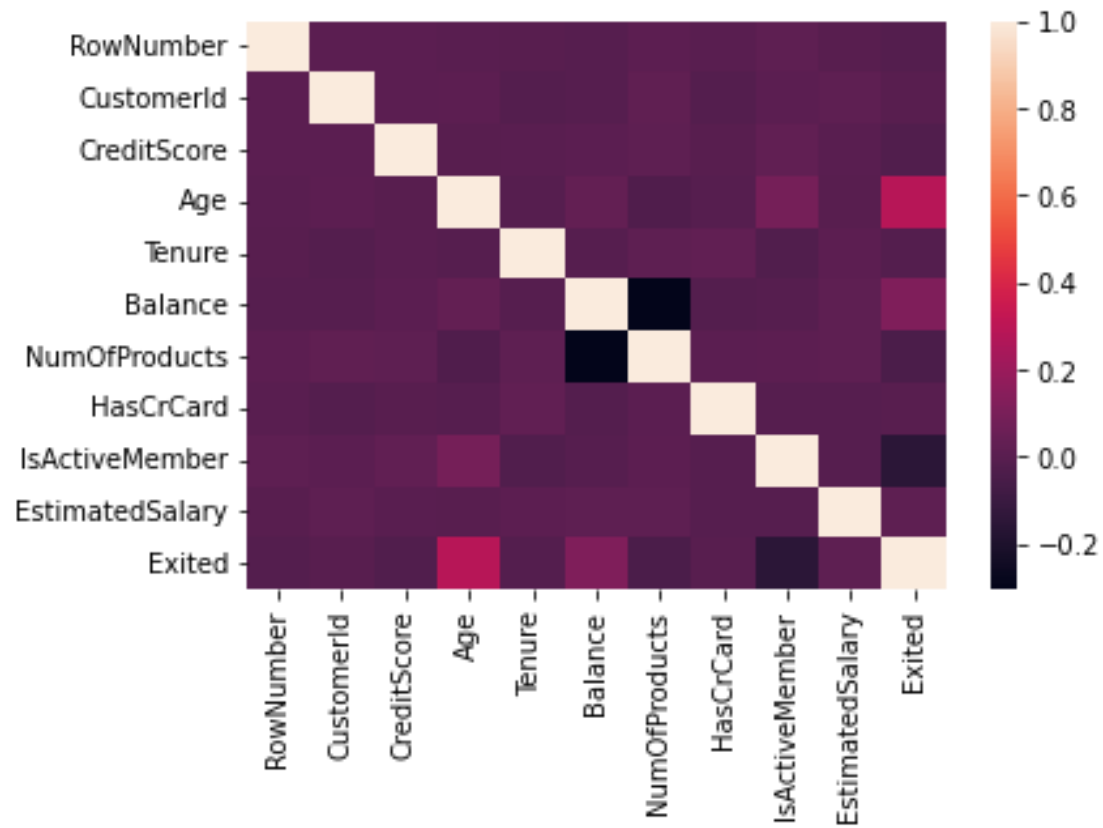
```
import seaborn as sns
```

```
sns.barplot(x = df['Exited'] , y = df['Balance']);
```



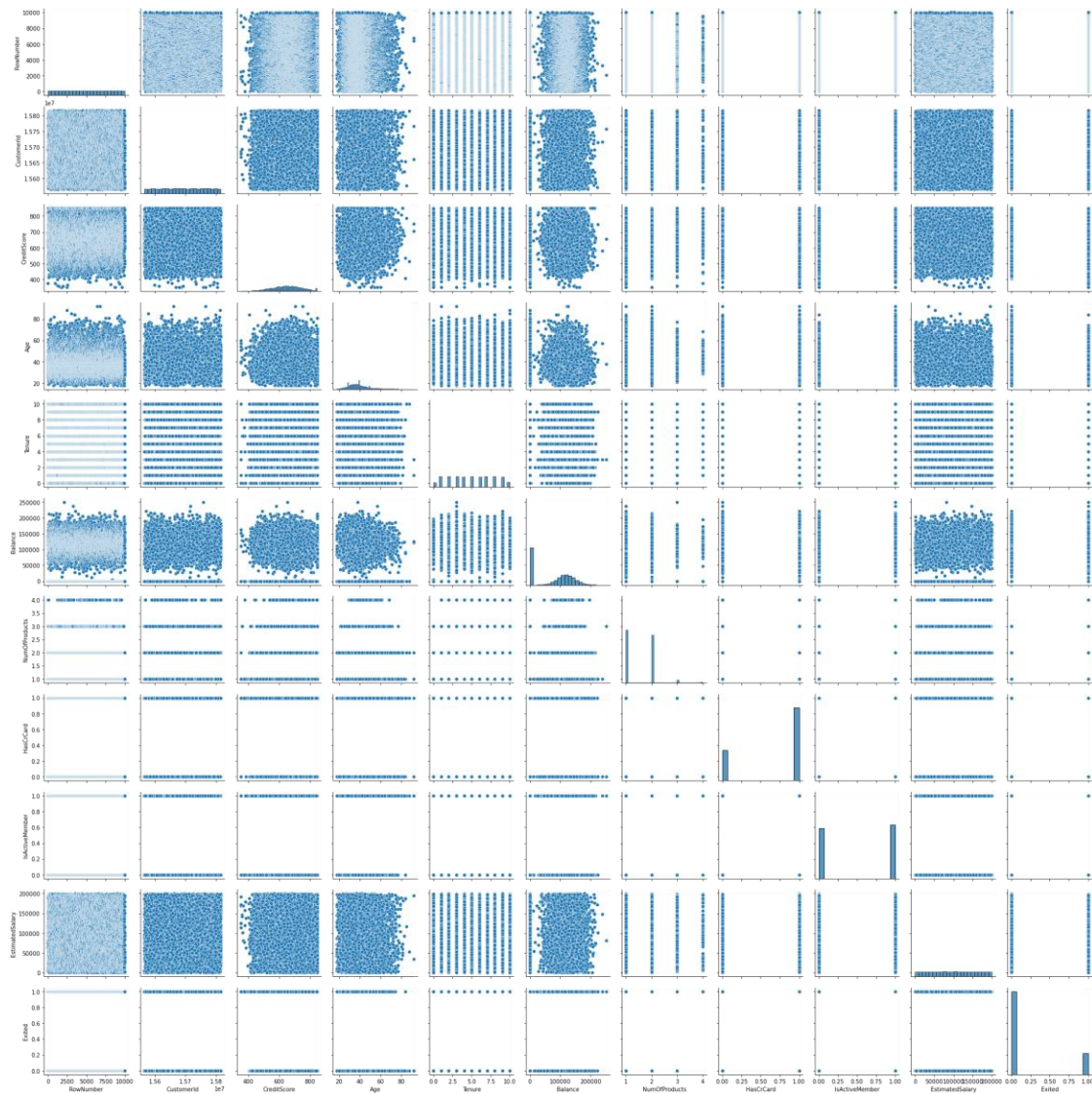
```
##multivariate
```

```
sns.heatmap(df.corr());
```



```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x29387e55970>
```



perform Descriptive statistics

`df.describe()`

	RowNumber	CustomerId	CreditScore	Age	Tenure	\
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	

	Balance	NumOfProducts	HasCrCard	IsActiveMember	\
count	10000.000000	10000.000000	10000.00000	10000.000000	
mean	76485.889288	1.530200	0.70550	0.515100	

std	62397.405202	0.581654	0.45584	0.499797
min	0.000000	1.000000	0.00000	0.000000
25%	0.000000	1.000000	0.00000	0.000000
50%	97198.540000	1.000000	1.00000	1.000000
75%	127644.240000	2.000000	1.00000	1.000000
max	250898.090000	4.000000	1.00000	1.000000

	EstimatedSalary	Exited
count	10000.000000	10000.000000
mean	100090.239881	0.203700
std	57510.492818	0.402769
min	11.580000	0.000000
25%	51002.110000	0.000000
50%	100193.915000	0.000000
75%	149388.247500	0.000000
max	199992.480000	1.000000

#handle missing values

```
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

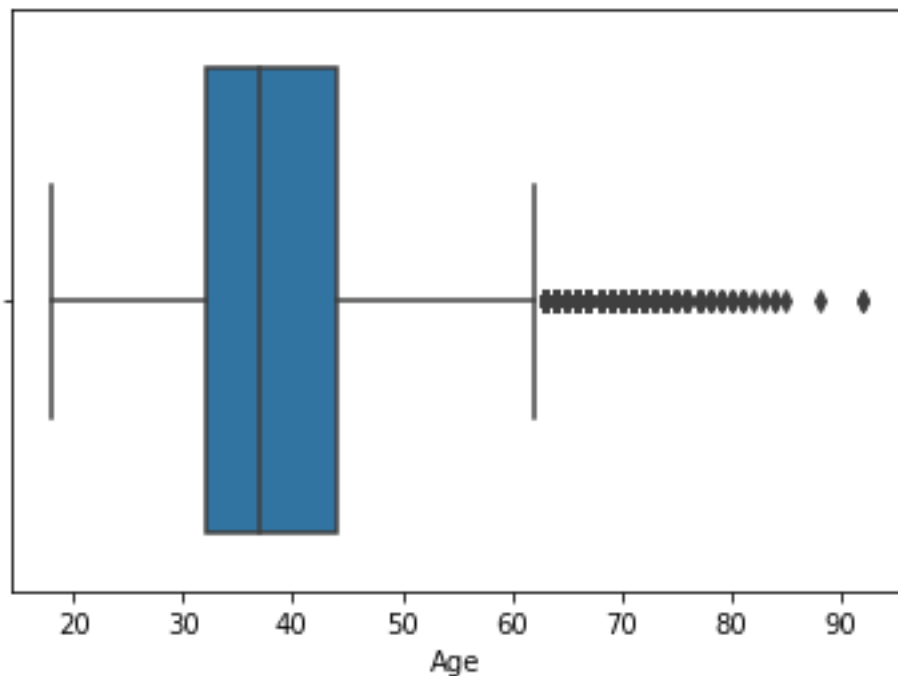
```

#find the outliers and replace it

```
sns.boxplot(df['Age']);
```

C:\Users\BALAJI POWER MART\anaconda3\lib\site-packages\seaborn_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

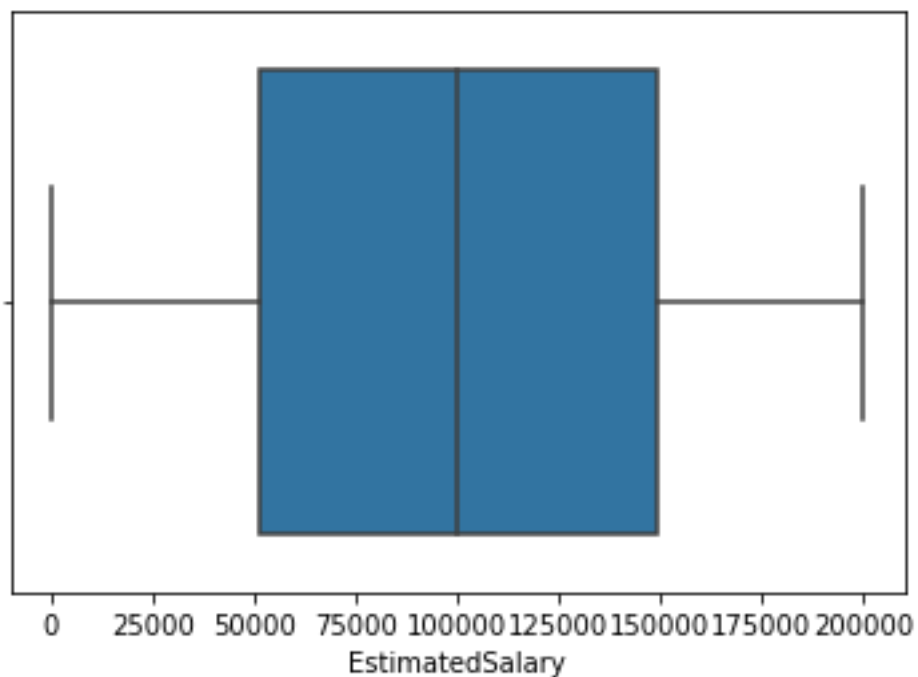
```
warnings.warn(
```



```
sns.boxplot(df['EstimatedSalary']);
```

C:\Users\BALAJI POWER MART\anaconda3\lib\site-packages\seaborn_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.

```
warnings.warn(
```

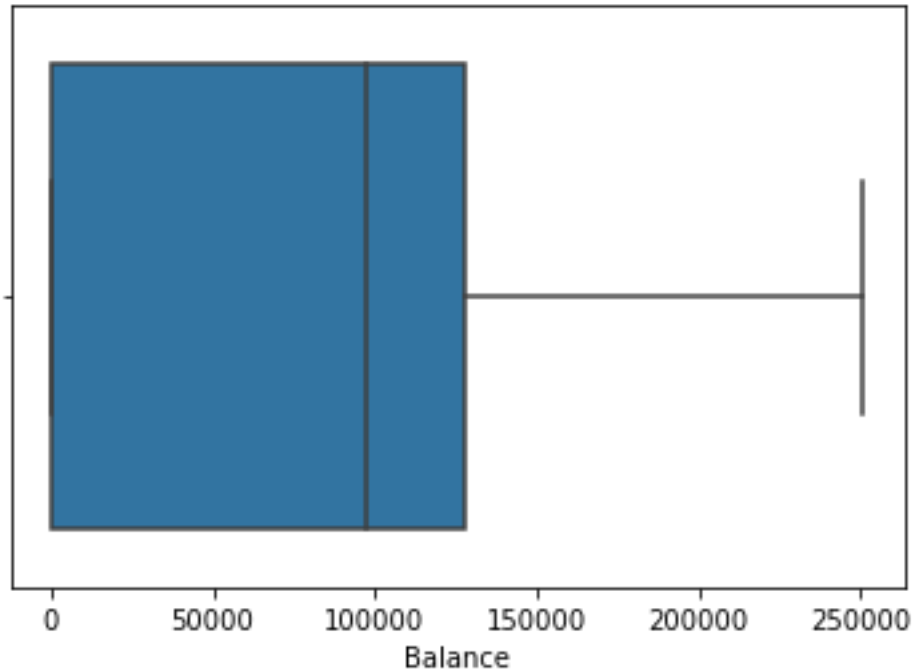


```
sns.boxplot(df['Balance'])
```

```
C:\Users\BALAJI POWER MART\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```

```
warnings.warn(
```

```
<AxesSubplot:xlabel='Balance'>
```

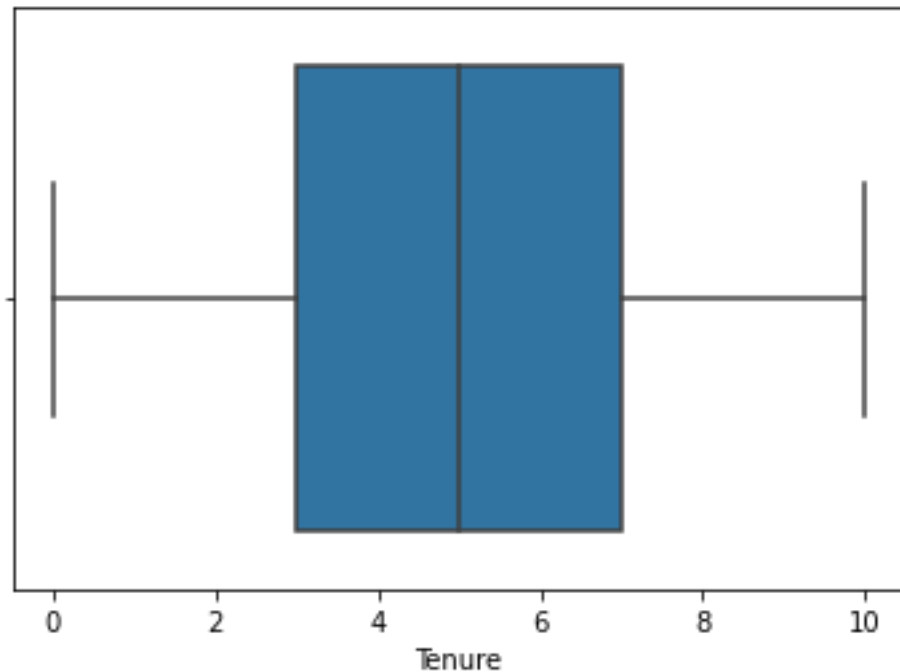


```
sns.boxplot(df['Tenure'])
```

```
C:\Users\BALAJI POWER MART\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```

```
warnings.warn(
```

```
<AxesSubplot:xlabel='Tenure'>
```

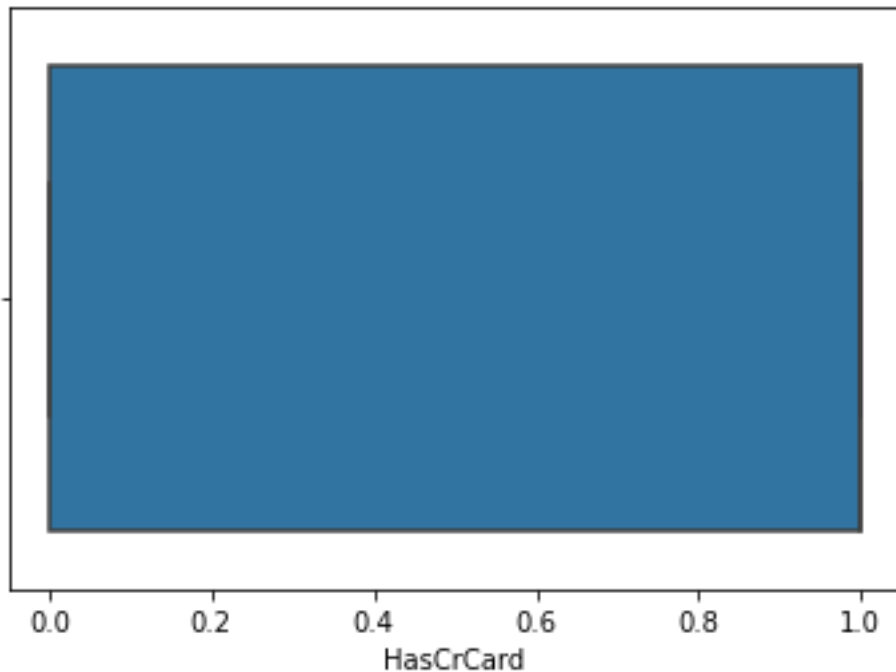


```
sns.boxplot(df['HasCrCard'])
```

```
C:\Users\BALAJI POWER MART\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
```

```
warnings.warn(
```

```
<AxesSubplot:xlabel='HasCrCard'>
```

#CHECK FOR CATEGORICAL COLUMNS AND PERFORM ENCODING

```
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
```

```
from sklearn.preprocessing import LabelEncoder
```

```
le = LabelEncoder()
```

```
df['Geography'] = le.fit_transform(df['Geography'])
```

```
df['CreditScore'] = le.fit_transform(df['CreditScore'])
```

```
df
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age
\							
0	1	15634602	Hargrave	228	0	Female	42
1	2	15647311	Hill	217	2	Female	41
2	3	15619304	Onio	111	0	Female	42
3	4	15701354	Boni	308	0	Female	39
4	5	15737888	Mitchell	459	2	Female	43
...
9995	9996	15606229	Obijiaku	380	0	Male	39
9996	9997	15569892	Johnstone	125	0	Male	35
9997	9998	15584532	Liu	318	0	Female	36
9998	9999	15682355	Sabbatini	381	1	Male	42
9999	10000	15628319	Walker	401	0	Female	28

	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	
...
9995	5	0.00	2	1	0	
9996	10	57369.61	1	1	1	
9997	7	0.00	1	0	1	
9998	3	75075.31	2	1	0	
9999	4	130142.79	1	1	0	

	EstimatedSalary	Exited
0	101348.88	1
1	112542.58	0
2	113931.57	1
3	93826.63	0
4	79084.10	0
...
9995	96270.64	0
9996	101699.77	0
9997	42085.58	1
9998	92888.52	1
9999	38190.78	0

```
[10000 rows x 14 columns]
```

```
#SPLIT THE DATA INTO DEPENDENT AND INDEPENDENT VARIABLES
```

```
X = df.iloc[:, :-1].values
```

```
X
```

```
array([[1, 15634602, 'Hargrave', ..., 1, 1, 101348.88],  
       [2, 15647311, 'Hill', ..., 0, 1, 112542.58],  
       [3, 15619304, 'Onio', ..., 1, 0, 113931.57],  
       ...,  
       [9998, 15584532, 'Liu', ..., 0, 1, 42085.58],  
       [9999, 15682355, 'Sabbatini', ..., 1, 0, 92888.52],  
       [10000, 15628319, 'Walker', ..., 1, 0, 38190.78]], dtype=object)
```

```
#SCALE THE INDEPENDENT VARIABLES
```

```
from sklearn.preprocessing import StandardScaler
```

```
sc = StandardScaler()
```

```
Y = sc.fit_transform(X)
```

```
y
```

```
array([2, 2, 0, 2, 2, 0, 1, 0, 1, 1, 2, 1, 1, 2, 1, 1, 2, 0, 2, 0, 2, 1,  
       1, 0, 1, 2, 1, 2, 0, 2, 2, 2, 0, 0, 0, 1, 2, 2, 0, 0, 1, 1, 0, 2,  
       1, 2, 2, 0, 1, 0, 1, 1, 1, 1, 2, 1, 1, 2, 1, 2, 2, 0, 1, 2, 0, 1,  
       2, 0, 2, 1, 0, 0, 2, 0, 0, 0, 2, 0, 0, 2, 2, 2, 1, 0, 2, 0, 2, 1,  
       0, 1, 0, 0, 0, 2, 1, 2, 0, 1, 0, 1, 0, 0, 2, 1, 1, 1, 2, 2, 1, 0,  
       1, 1, 2, 2, 0, 2, 1, 1, 1, 2, 0, 0, 1, 1, 2, 2, 1, 0, 2, 1, 0, 1,  
       1, 2, 0, 0, 0, 2, 1, 0, 1, 1, 0, 2, 0, 0, 2, 0, 1, 0, 1, 2, 2, 1,  
       0, 0, 1, 0, 2, 1, 0, 2, 0, 1, 2, 1, 2, 1, 1, 1, 0, 0, 2, 1, 2, 2,  
       2, 0, 1, 2, 2, 1, 1, 2, 2, 0, 0, 2, 1, 1, 2, 2, 1, 1, 1, 0, 2, 0,  
       0, 0, 0, 0, 1, 1, 2, 2, 2, 1, 0, 1, 1, 2, 0, 1, 0, 0, 0, 2, 1, 2,  
       1, 1, 2, 1, 0, 0, 0, 0, 0, 2, 0, 2, 0, 2, 0, 1, 2, 1, 1, 1, 0, 0,  
       1, 1, 1, 1, 1, 2, 1, 1, 2, 0, 1, 1, 0, 1, 2, 0, 1, 2, 2, 2, 0, 0,  
       1, 1, 0, 1, 2, 1, 1, 2, 2, 2, 2, 0, 0, 1, 2, 1, 1, 1, 2, 1, 2, 1,  
       2, 1, 1, 0, 0, 1, 2, 2, 2, 1, 2, 0, 0, 0, 1, 2, 2, 2, 0, 0, 2, 0,  
       1, 2, 2, 2, 2, 2, 0, 1, 1, 2, 2, 0, 0, 1, 1, 1, 2, 1, 1, 0, 2, 0,  
       0, 2, 1, 2, 1, 1, 1, 0, 1, 2, 2, 1, 2, 0, 2, 1, 0, 0, 1, 0, 2, 1,  
       2, 2, 2, 2, 2, 1, 1, 0, 1, 2, 0, 2, 1, 2, 2, 2, 0, 0, 1, 2, 2, 0,  
       0, 2, 0, 0, 1, 2, 2, 0, 0, 1, 1, 2, 2, 2, 0, 0, 2, 1, 1, 2, 0, 1,  
       2, 0, 2, 0, 0, 1, 2, 2, 2, 0, 2, 2, 2, 2, 0, 2, 1, 0, 0, 1, 1, 1,  
       0, 2, 0, 0, 1, 2, 2, 1, 2, 2, 1, 2, 2, 2, 1, 0, 1, 0, 1, 0, 0, 1,  
       2, 2, 0, 2, 2, 0, 0, 2, 1, 1, 2, 2, 1, 1, 0, 2, 2, 0, 0, 0, 0, 1,  
       0, 1, 2, 1, 2, 0, 0, 0, 1, 2, 0, 0, 1, 1, 0, 0, 0, 0, 0, 2, 1, 1,  
       0, 1, 1, 1, 0, 0, 2, 2, 0, 1, 2, 1, 2, 2, 1, 0, 0, 2, 2, 1, 1, 2,  
       0, 2, 1, 0, 1, 2, 1, 2, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 2, 2,  
       1, 0, 2, 0, 0, 1, 0, 2, 2, 1, 0, 0, 0, 1, 0, 2, 1, 1, 1, 1, 2, 0,  
       0, 0, 0, 2, 0, 2, 1, 1, 2, 1, 0, 0, 0, 0, 2, 1, 1, 1, 2, 0, 0, 2,  
       1, 0, 2, 0, 0, 0, 2, 2, 0, 1, 0, 1, 1, 0, 0, 1, 2, 0, 1, 0, 0, 0,  
       0, 1, 1, 1, 1, 0, 0, 2, 0, 1, 0, 1, 2, 0, 0, 0, 2, 0, 0, 1, 0, 1,  
       0, 1, 2, 2, 2, 0, 1, 0, 0, 0, 0, 2, 1, 2, 2, 0, 1, 2, 2, 0, 1, 0,  
       1, 2, 1, 2, 2, 1, 2, 0, 1, 2, 1, 1, 0, 0, 2, 1, 0, 1, 2, 1, 0, 1,  
       2, 2, 0, 1, 1, 0, 0, 1, 1, 2, 1, 0, 0, 0, 1, 2, 2, 1, 0, 0, 2, 0])
```

```

2, 0, 1, 2, 2, 0, 1, 1, 1, 1, 0, 0, 1, 2, 0, 0, 1, 2, 0, 0, 2, 2,
1, 1, 2, 0, 0, 0, 0, 1, 0, 1, 1, 1, 0, 1, 2, 1, 2, 1, 2, 2, 0, 2,
0, 2, 0, 1, 2, 1, 2, 1, 2, 2, 2, 1, 1, 0, 1, 0, 0, 2, 2, 0, 2, 1,
0, 0, 0, 1, 0, 0, 1, 2, 0, 2, 2, 2, 1, 0, 2, 0, 2, 2, 2, 1, 1,
0, 1, 2, 1, 1, 2, 0, 2, 2, 2, 0, 2, 1, 1, 2, 1, 2, 0, 2, 1, 1, 0,
2, 0, 1, 0, 0, 1, 0, 0, 0, 0, 2, 2, 2, 1, 1, 1, 1, 2, 2, 0, 2, 2,
1, 2, 2, 0, 2, 0, 0, 1, 2, 1, 0, 2, 0, 2, 1, 0, 1, 2, 0, 1, 2, 1,
1, 2, 2, 0, 2, 0, 0, 1, 1, 2, 1, 1, 0, 1, 1, 2, 2, 1, 2, 0, 1, 0,
0, 2, 1, 0, 2, 2, 2, 2, 1, 0, 2, 1, 1, 2, 2, 1, 2, 1, 2, 0, 1, 0,
1, 0, 1, 1, 2, 2, 2, 2, 2, 0, 0, 0, 2, 2, 1, 1, 1, 1, 0, 1, 2, 0,
0, 2, 2, 2, 2, 0, 2, 1, 0, 1, 1, 2, 1, 1, 0, 2, 2, 1, 2, 1, 1, 0,
0, 0, 2, 1, 0, 1, 0, 2, 1, 1, 2, 0, 2, 1, 0, 0, 1, 0, 0, 2, 2, 2,
0, 1, 1, 0, 1, 2, 0, 0, 2, 0, 0, 2, 2, 0, 1, 1, 0, 0, 2, 0, 0, 2,
2, 0, 2, 1, 1, 2, 0, 1, 2, 1, 1, 1, 0, 2, 0, 1, 0, 0, 0, 2, 0, 2,
0, 0, 2, 0, 2, 1, 1, 2, 0, 0])

```

split data into training and testing

```

from sklearn.datasets import make_blobs
from sklearn.model_selection import train_test_split
X, y = make_blobs(n_samples=1000)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33)
print(X_train.shape, X_test.shape, y_train.shape, y_test.shape)

(670, 2) (330, 2) (670,) (330,)

```