Importing Libraries

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

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

2.Load the dataset

```
ds=pd.read_csv(r'/content/Churn_Modelling (1).csv')
```

```
ds.shape
```

```
(10000, 14)
```

```
ds.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  
```

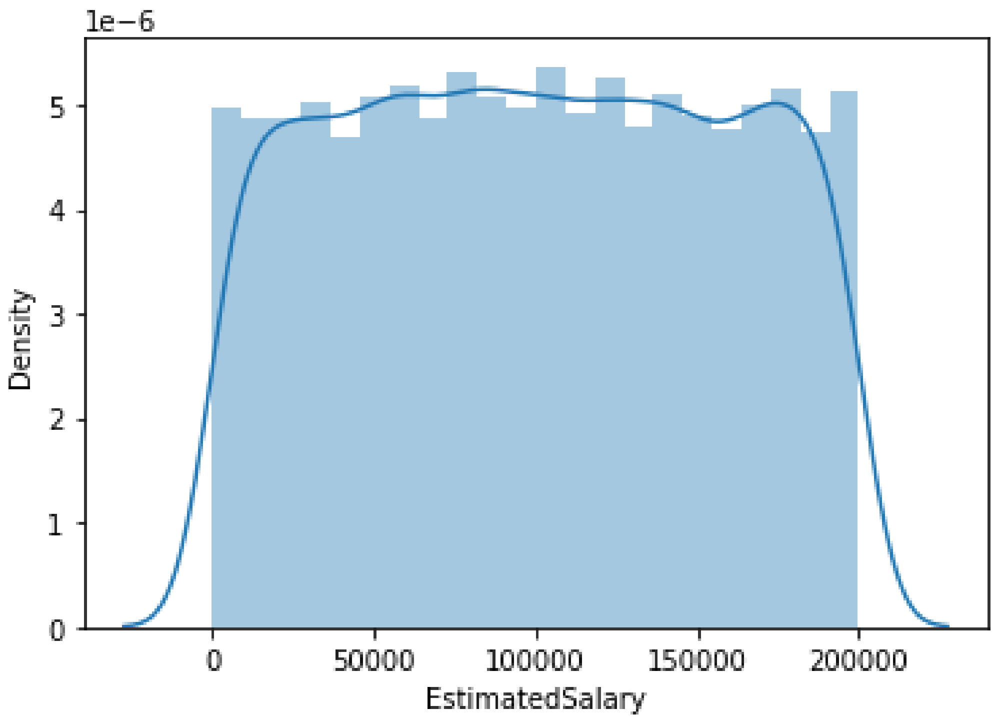
3. Perform Below Visualizations

(i)Univariate Analysis

```
sns.distplot(ds['EstimatedSalary'],hist=True)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

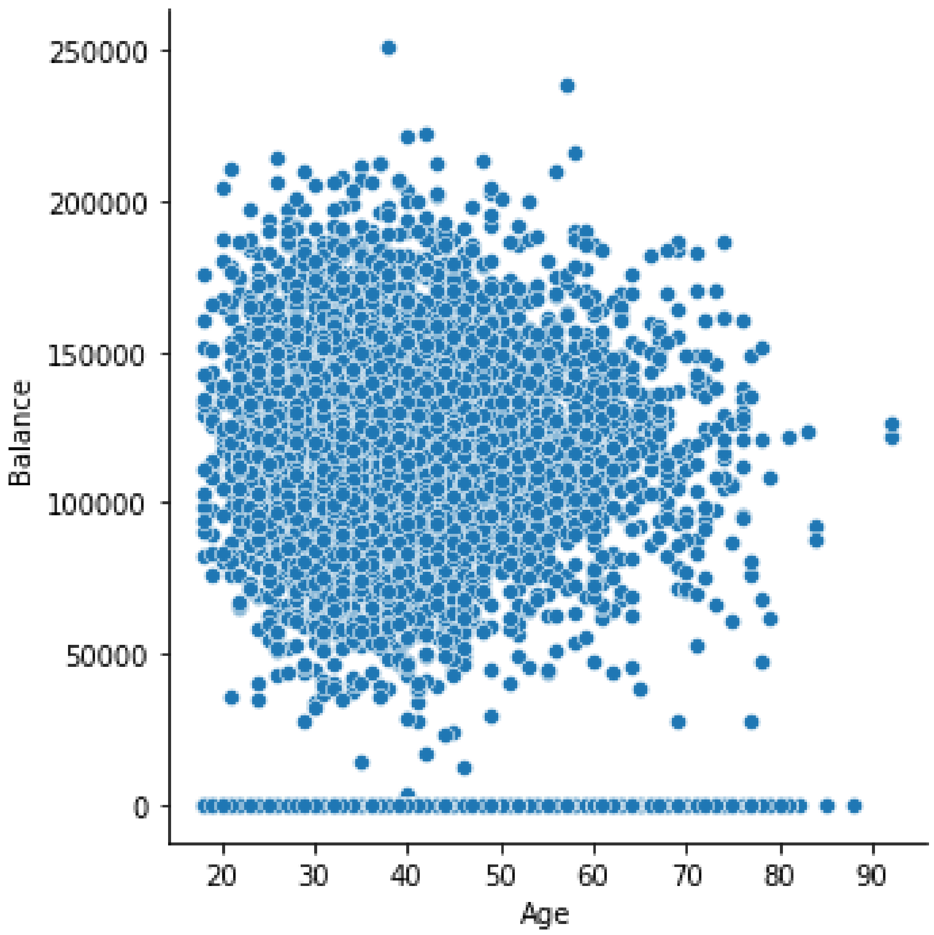
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe4602c7450>
```



##(ii)Bivariate Analysis

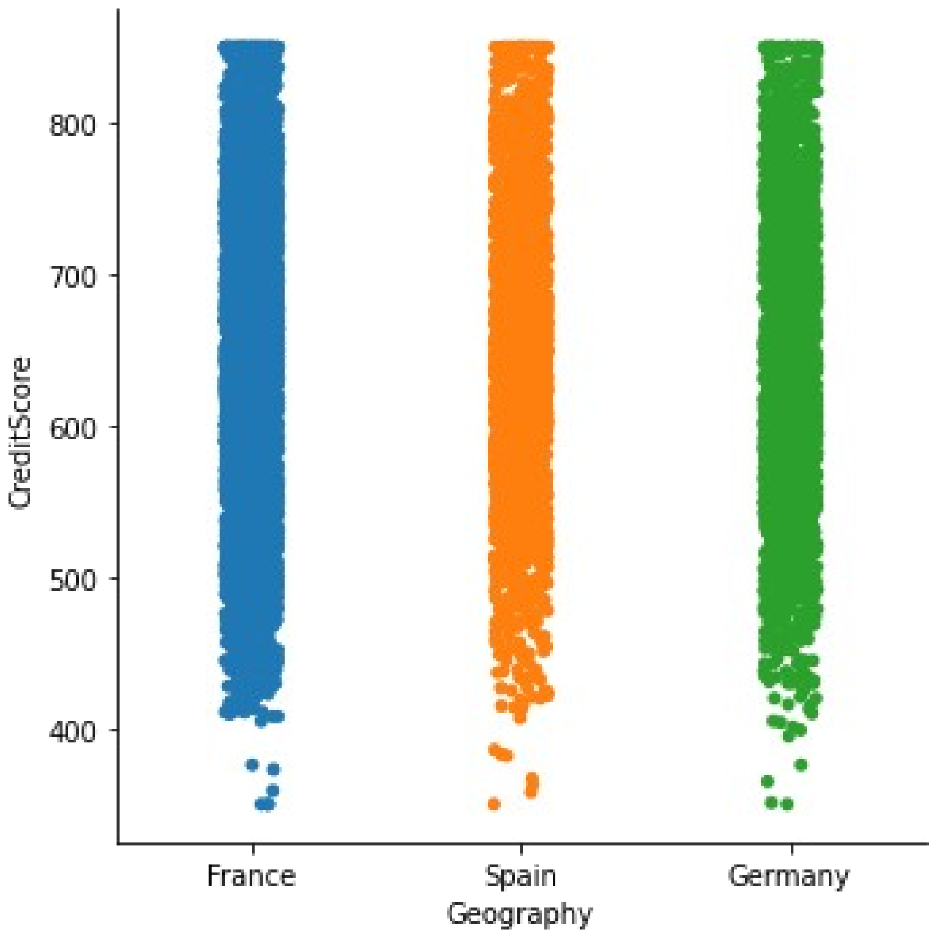
```
sns.relplot(x='Age',y='Balance',data=ds)
```

```
<seaborn.axisgrid.FacetGrid at 0x7fe46026cc50>
```



```
#categorical data
sns.catplot(x='Geography',y='CreditScore',data=ds)
```

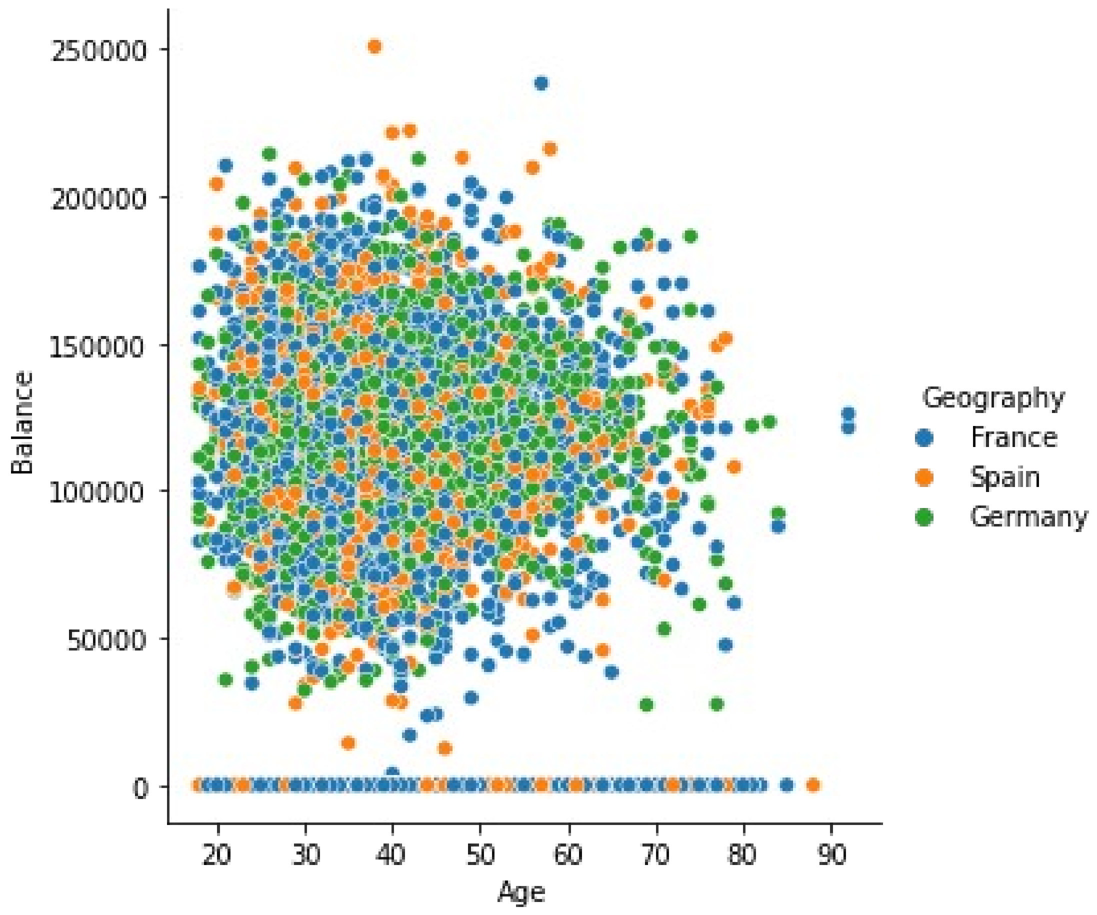
```
<seaborn.axisgrid.FacetGrid at 0x7fe45fcaf6d0>
```



(iii)Multivariate Analysis

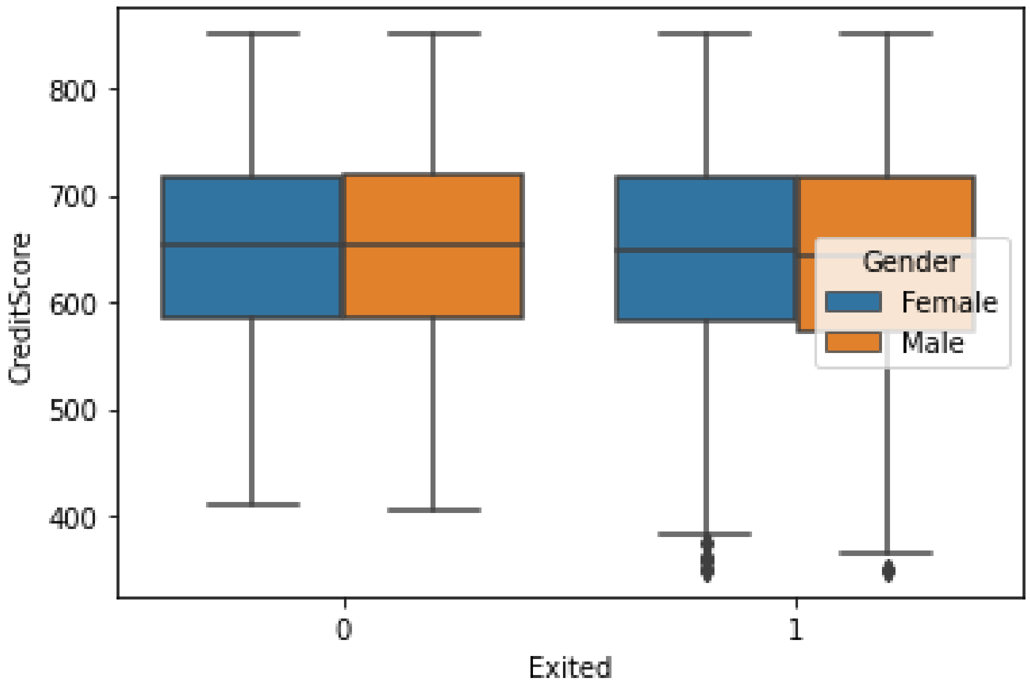
```
sns.relplot(x='Age',y='Balance',hue='Geography',data=ds)
```

```
<seaborn.axisgrid.FacetGrid at 0x7fe45bc46f50>
```



```
#categorical data
sns.boxplot(x='Exited',y='CreditScore',hue='Gender',data=ds)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe45bb27910>
```



4. Perform descriptive statistics on the dataset

```
ds.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
```

5. Handle the Missing values

```
ds.isnull().any()

RowNumber          False
CustomerId         False
Surname            False
CreditScore        False
Geography          False
Gender             False
Age                False
Tenure             False
Balance            False
NumOfProducts      False
HasCrCard          False
IsActiveMember     False
EstimatedSalary    False
Exited             False
dtype: bool

ds.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
```

```
#no null values found , so no need to handle.
```

8. Split the data into dependent and independent variables

```
x=ds.iloc[:,3:13].values
print(x.shape)
y=ds.iloc[:,13:14].values
print(y.shape)
```

```
(10000, 10)
(10000, 1)
```

6. Find the outliers and replace the outliers

```
ds.skew()
```

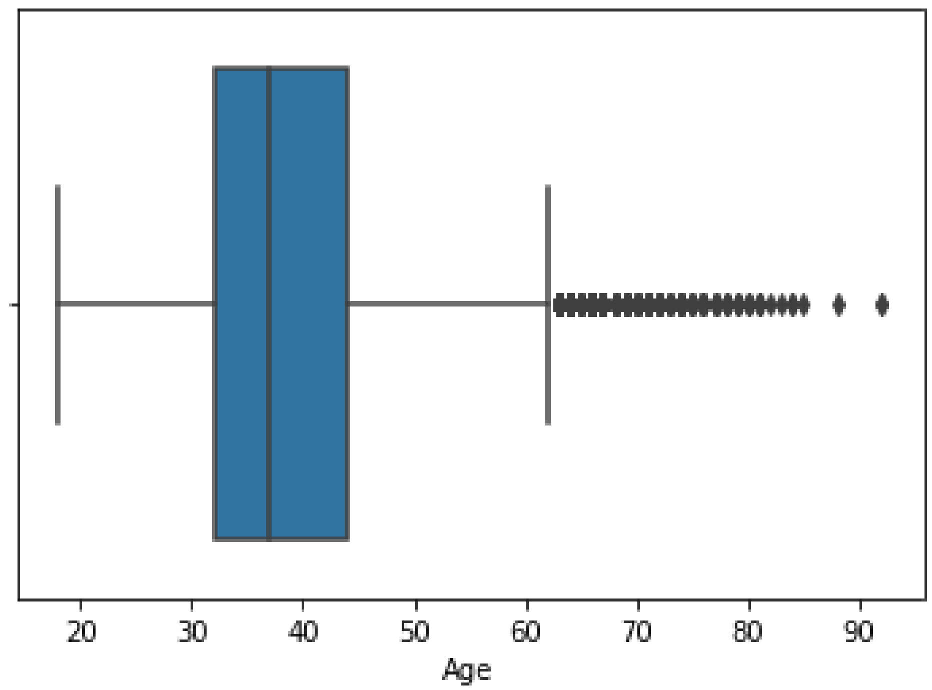
```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1: 
FutureWarning: Dropping of nuisance columns in DataFrame reductions 
(with 'numeric_only=None') is deprecated; in a future version this 
will raise TypeError.  Select only valid columns before calling the 
reduction.
  """Entry point for launching an IPython kernel.
```

```
RowNumber          0.000000
CustomerId         0.001149
CreditScore       -0.071607
Age                1.011320
Tenure             0.010991
Balance           -0.141109
NumOfProducts      0.745568
HasCrCard         -0.901812
IsActiveMember    -0.060437
EstimatedSalary    0.002085
Exited             1.471611
dtype: float64
```

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

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: 
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.
  FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe45b968290>
```



```
q0 = ds["Age"].describe()["25%"]

q1 = ds["Age"].describe()["75%"]

iqr=q1-q0

lb = q0 -(1.5*iqr)
ub = q1 + (1.5*iqr)

ds[ds["Age"]<lb]

Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography,
Gender, Age, Tenure, Balance, NumOfProducts, HasCrCard,
IsActiveMember, EstimatedSalary, Exited]
Index: []

ds[ds["Age"]>ub]

      RowNumber  CustomerId      Surname  CreditScore Geography
Gender  Age  \
58            59    15623944       T'ien          511     Spain
Female   66
85            86    15805254     Ndukaku          652     Spain
Female   75
104          105    15804919    Dunbabin          670     Spain
Female   65
158          159    15589975     Maclean          646    France
Female   73
181          182    15789669        Hsia          510    France
```

```
Male   65
...         ...        ...          ...          ...        ...      ..
.  ...
9753       9754    15705174    Chiedozie          656   Germany
Male   68
9765       9766    15777067       Thomas          445    France
Male   64
9832       9833    15814690  Chukwujekwu          595   Germany
Female   64
9894       9895    15704795        Vagin          521    France
Female   77
9936       9937    15653037        Parks          609    France
Male   77

      Tenure    Balance  NumOfProducts  HasCrCard  IsActiveMember  \
58         4       0.00              1          1               0
85        10       0.00              2          1               1
104        1       0.00              1          1               1
158        6   97259.25              1          0               1
181        2       0.00              2          1               1
...      ...        ...            ...        ...             ...
9753       7  153545.11              1          1               1
9765       2  136770.67              1          0               1
9832       2  105736.32              1          1               1
9894       6       0.00              2          1               1
9936       1       0.00              1          0               1

      EstimatedSalary  Exited
58            1643.11       1
85          114675.75       0
104         177655.68       1
158         104719.66       0
181          48071.61       0
...               ...     ...
9753        186574.68       0
9765         43678.06       0
9832         89935.73       1
9894         49054.10       0
9936         18708.76       0

[359 rows x 14 columns]
```

```
#Replacing the outlier
outlier_list = list(ds[ds["Age"] > ub]["Age"])

print(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, 65, 69, 64, 65, 74, 67, 66, 67, 63, 70,
71, 72, 67, 74, 76, 66, 63, 66, 68, 67, 63, 71, 66, 69, 73, 65, 66,
64, 69, 64, 77, 74, 65, 70, 67, 69, 67, 74, 69, 74, 74, 64, 63, 63,
70, 74, 65, 72, 77, 66, 65, 74, 88, 63, 71, 63, 64, 67, 70, 68, 72,
71, 66, 75, 67, 73, 69, 76, 63, 85, 67, 74, 76, 66, 69, 66, 72, 63,
71, 63, 74, 67, 72, 72, 66, 84, 71, 66, 63, 74, 69, 84, 67, 64, 68,
66, 77, 70, 67, 79, 67, 76, 73, 66, 67, 64, 73, 76, 72, 64, 71, 63,
70, 65, 66, 65, 80, 66, 63, 63, 63, 63, 66, 74, 69, 63, 64, 76, 75,
68, 69, 77, 64, 66, 74, 71, 67, 68, 64, 68, 70, 64, 75, 66, 64, 78,
65, 74, 64, 64, 71, 77, 79, 70, 81, 64, 68, 68, 63, 79, 66, 64, 70,
69, 71, 72, 66, 68, 63, 71, 72, 72, 64, 78, 75, 65, 65, 67, 63, 68,
71, 73, 64, 66, 71, 69, 71, 66, 76, 69, 73, 64, 64, 75, 73, 71, 72,
63, 67, 68, 73, 67, 64, 63, 92, 65, 75, 67, 71, 64, 66, 64, 66, 67,
77, 92, 67, 63, 66, 66, 68, 65, 72, 71, 76, 63, 67, 67, 66, 67, 63,
65, 70, 72, 77, 74, 72, 73, 77, 67, 71, 64, 72, 81, 76, 69, 68, 74,
64, 64, 71, 68, 63, 67, 63, 64, 76, 63, 63, 68, 67, 72, 70, 81, 67,
73, 66, 68, 71, 66, 63, 75, 69, 64, 69, 70, 71, 71, 66, 70, 63, 64,
65, 63, 67, 71, 67, 65, 66, 63, 73, 66, 64, 72, 71, 69, 67, 64, 81,
73, 63, 67, 74, 83, 69, 71, 78, 63, 70, 69, 72, 70, 63, 74, 80, 69,
72, 67, 76, 71, 67, 71, 78, 63, 63, 68, 64, 70, 78, 69, 68, 64, 64,
77, 77]
```

```
outlier_dict = {}.fromkeys(outlier_list,ub)
```

```
print(outlier_dict)
```

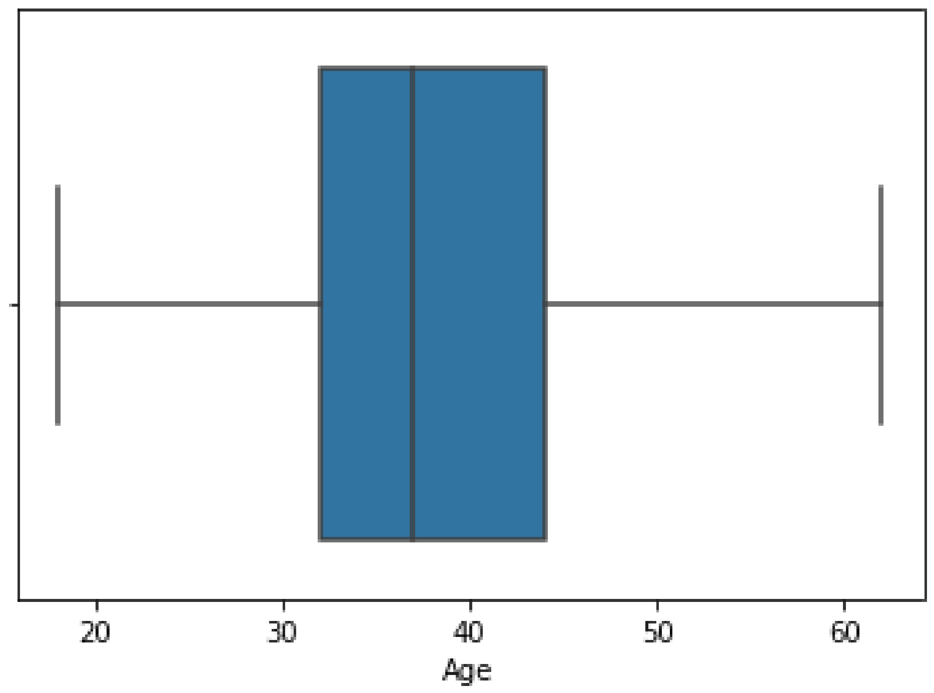
```
{66: 62.0, 75: 62.0, 65: 62.0, 73: 62.0, 72: 62.0, 67: 62.0, 79: 62.0,
80: 62.0, 68: 62.0, 70: 62.0, 63: 62.0, 64: 62.0, 82: 62.0, 69: 62.0,
74: 62.0, 71: 62.0, 76: 62.0, 77: 62.0, 88: 62.0, 85: 62.0, 84: 62.0,
78: 62.0, 81: 62.0, 92: 62.0, 83: 62.0}
```

```
ds["Age"] = ds["Age"].replace(outlier_dict)
```

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

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
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.
  FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fe4613adf10>
```



```
ds[ds["Age"]>ub]
```

```
Empty DataFrame
Columns: [RowNumber, CustomerId, Surname, CreditScore, Geography,
Gender, Age, Tenure, Balance, NumOfProducts, HasCrCard,
IsActiveMember, EstimatedSalary, Exited]
Index: []
```

7. Check for Categorical columns and perform encoding

```
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct=ColumnTransformer([('oh',OneHotEncoder(),
[1,2])],remainder='passthrough')
x=ct.fit_transform(x)
print(x.shape)
```

```
(10000, 15)
```

```
# saving the data
import joblib
joblib.dump(ct,"churnct.pkl")
```

```
['churnct.pkl']
```

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=0.2,random_state=0)
print(x_train.shape)
print(x_test.shape)
```

```
(8000, 13)
(2000, 13)
```

```
from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
x_train=sc.fit_transform(x_train)
x_test=sc.transform(x_test)
```

```
joblib.dump(sc,"churnsc.pkl")
```

```
['churnsc.pkl']
```