Assignment -2

Data Visualization and Pre-processing

Assignment Date	30 september 2022
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Student Roll Number	310819104038
Maximum Marks	2 Marks

ASSIGNMENT 2

Importing libraries

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

Loading data set

```
ds=pd.read_csv('Churn_Modelling.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
```

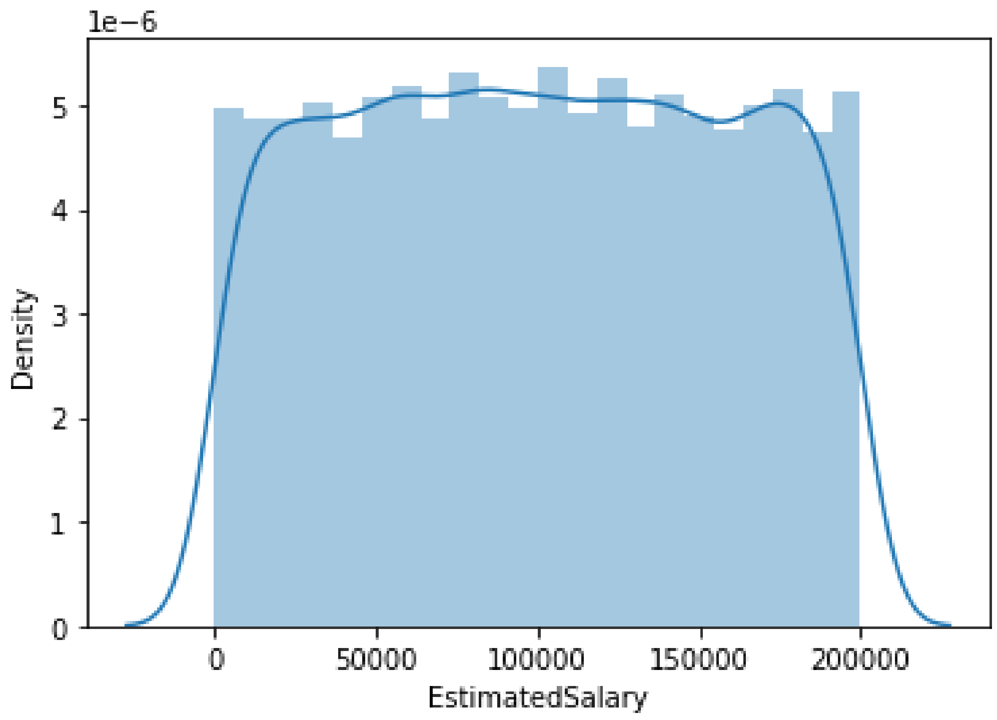
Visualization

1. Univariate

```
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)
```

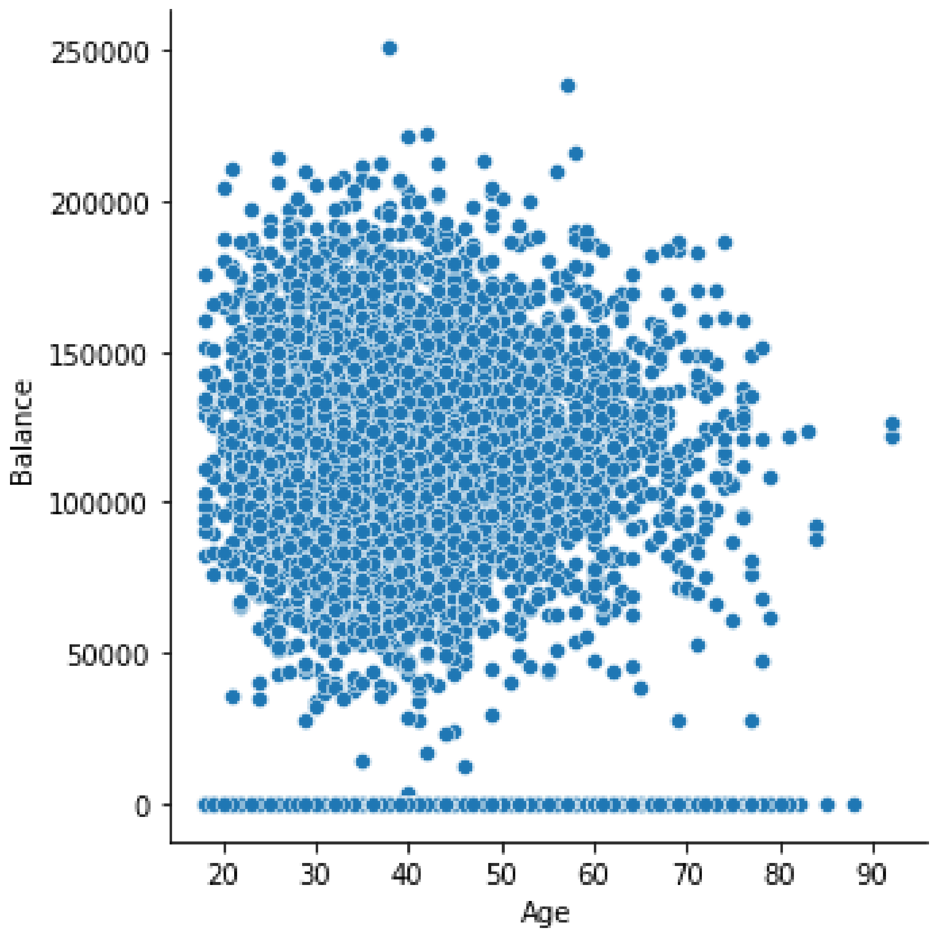
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8afae88250>
```



2. Bivariate

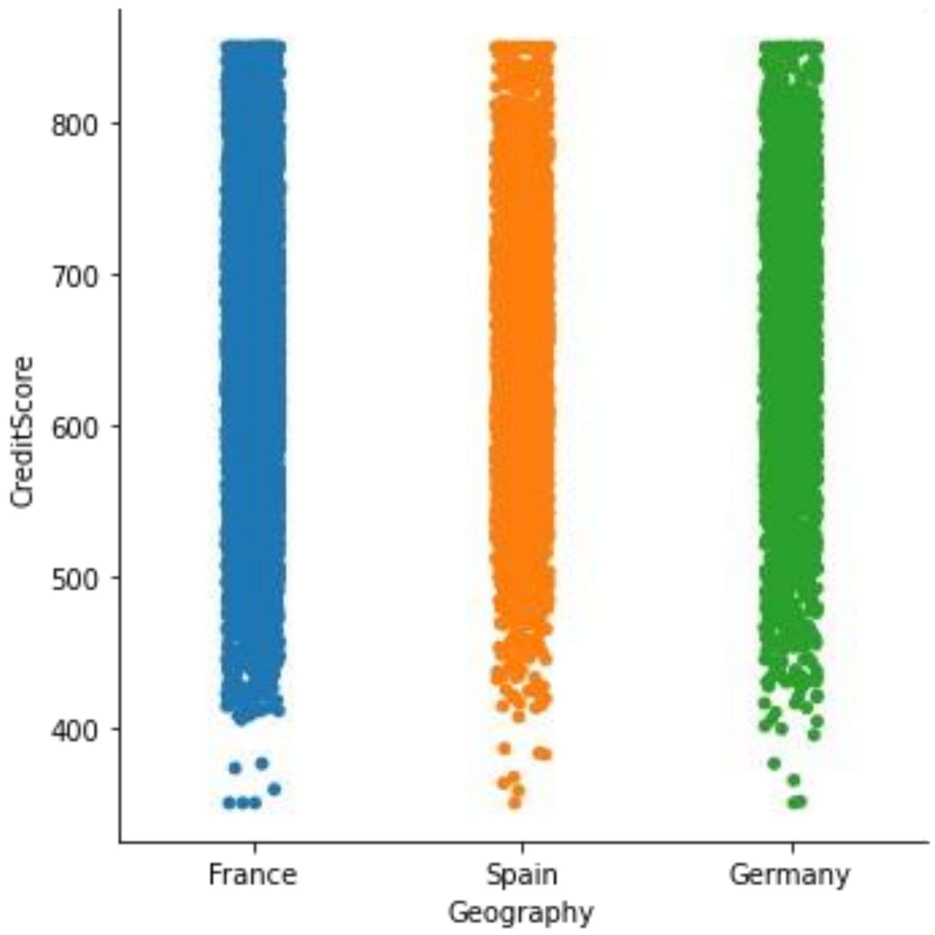
```
sns.relplot(x='Age',y='Balance',data=ds)
```

```
<seaborn.axisgrid.FacetGrid at 0x7f8afaaa3dd0>
```



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

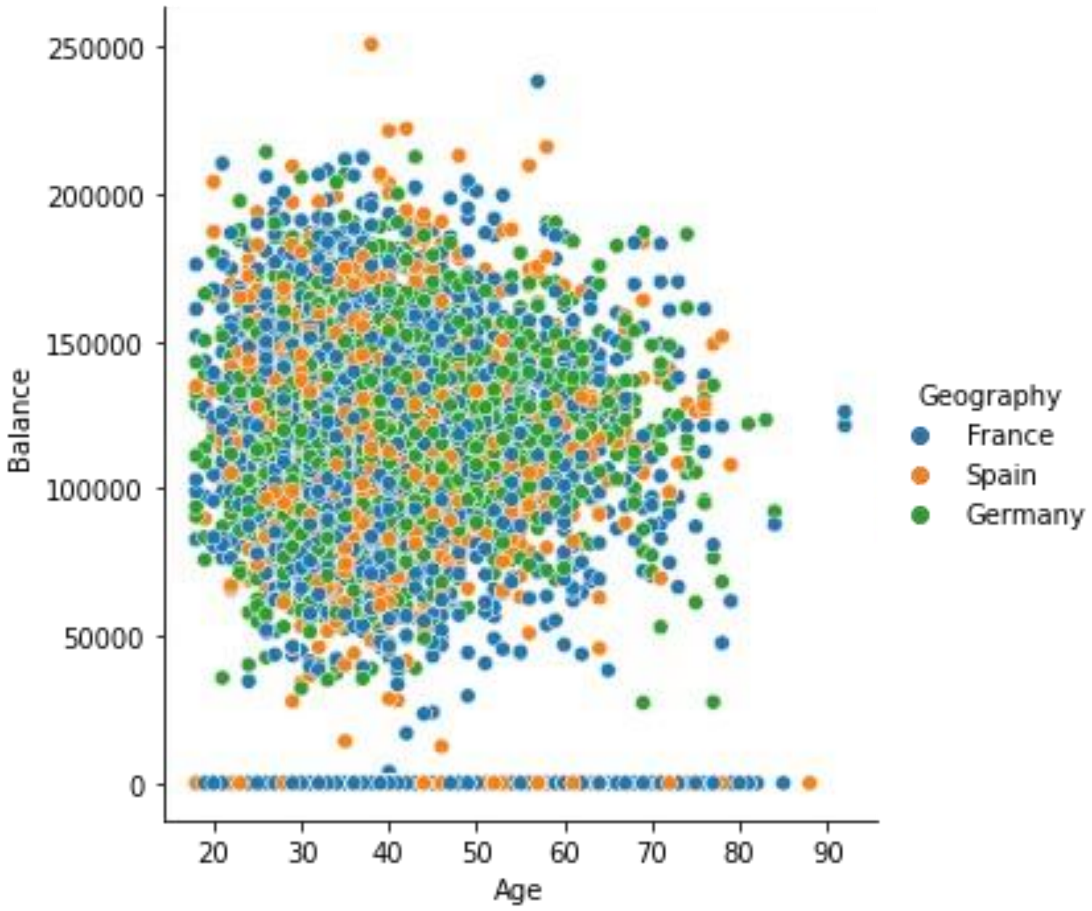
```
<seaborn.axisgrid.FacetGrid at 0x7f8afae83dd0>
```



3. Multivariate

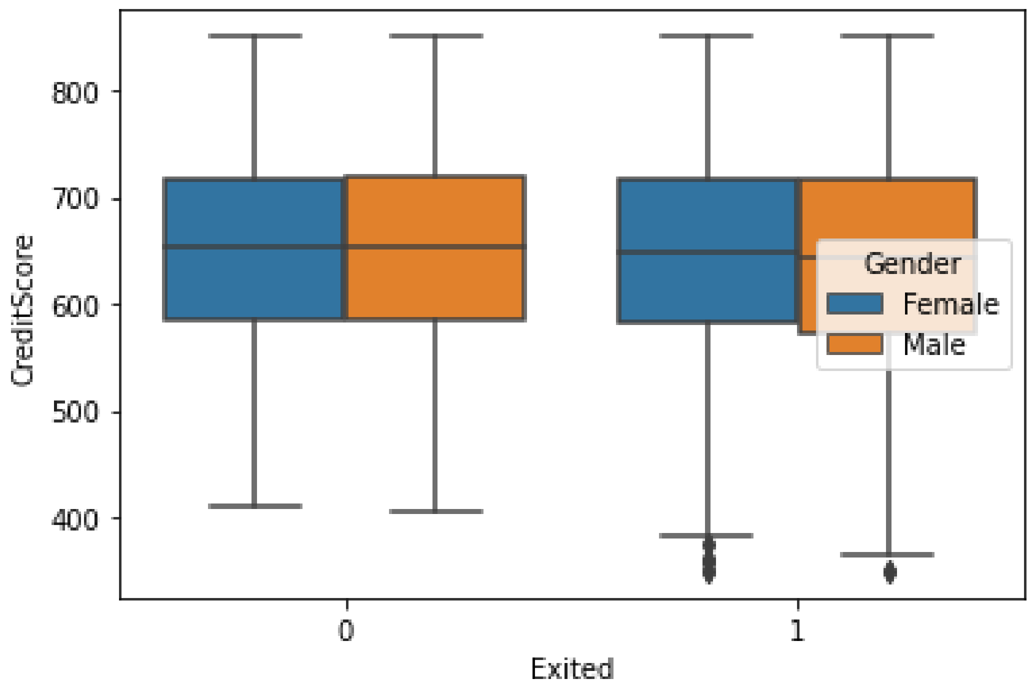
```
sns.relplot(x='Age',y='Balance',hue='Geography',data=ds)
```

```
<seaborn.axisgrid.FacetGrid at 0x7f8af64e6610>
```



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

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8af64ae810>
```



Descriptive Statistics

```
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
```

Handling the missing(null) 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
```

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)
```

Finding and Replacing Outliers

```
ds.skew()
```

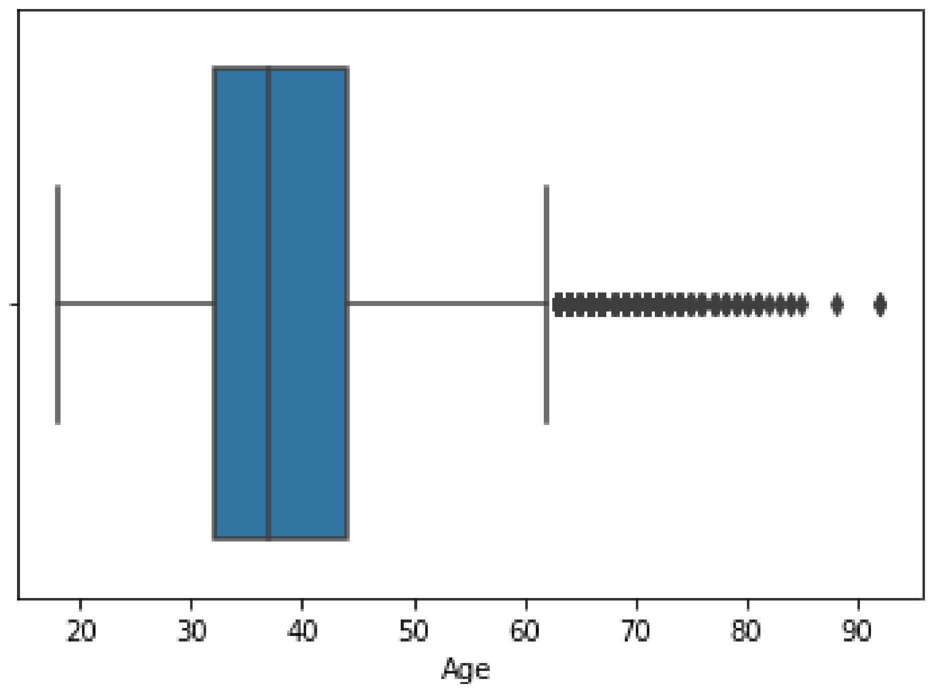
```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:1:
FutureWarning: Dropping of nuisance columns in DataFrame reductions
(with 'numeric_only=None') is deprecated; in a future version this
will raise TypeError. Select only valid columns before calling the
reduction.
  """Entry point for 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 0x7f8af6283850>
```



```
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]
```

```
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)
```

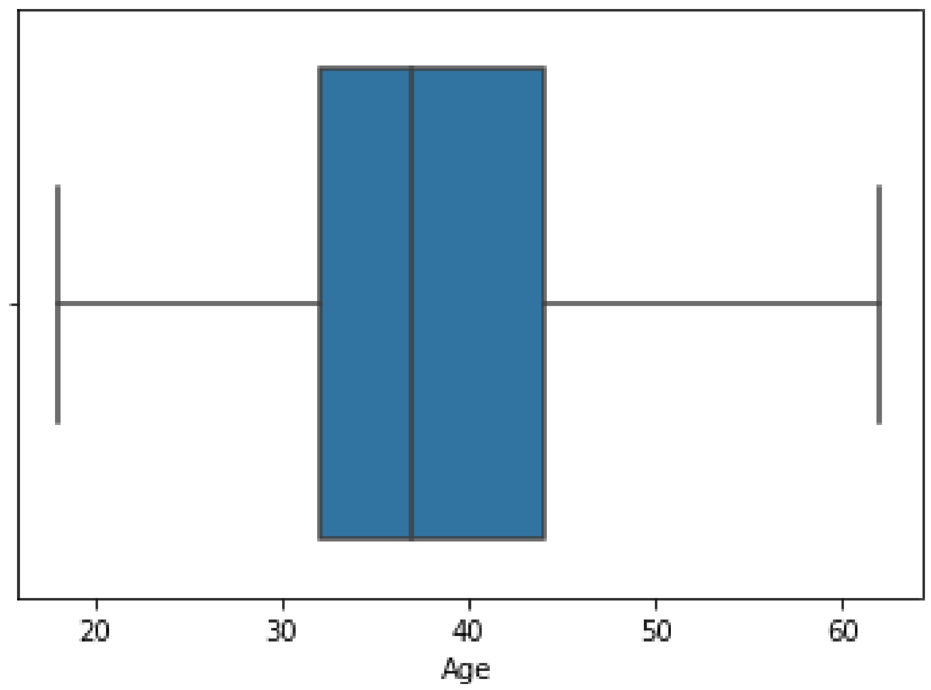
```
print(outlier_dict)
```

```
{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 0x7f8afae88150>
```



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

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

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, 13)
```

```
import joblib
joblib.dump(ct,"churnct.pkl")
```

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

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']
```