ASSIGNMENT 2

Importing Libraries

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

Loading Dataset

```
df=pd.read_csv(r'C:\Users\LENOVO\Downloads\Churn_Modelling.csv')
```

```
df.shape
```

```
(10000, 14)
```

df.head()

	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

df.tail()

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0

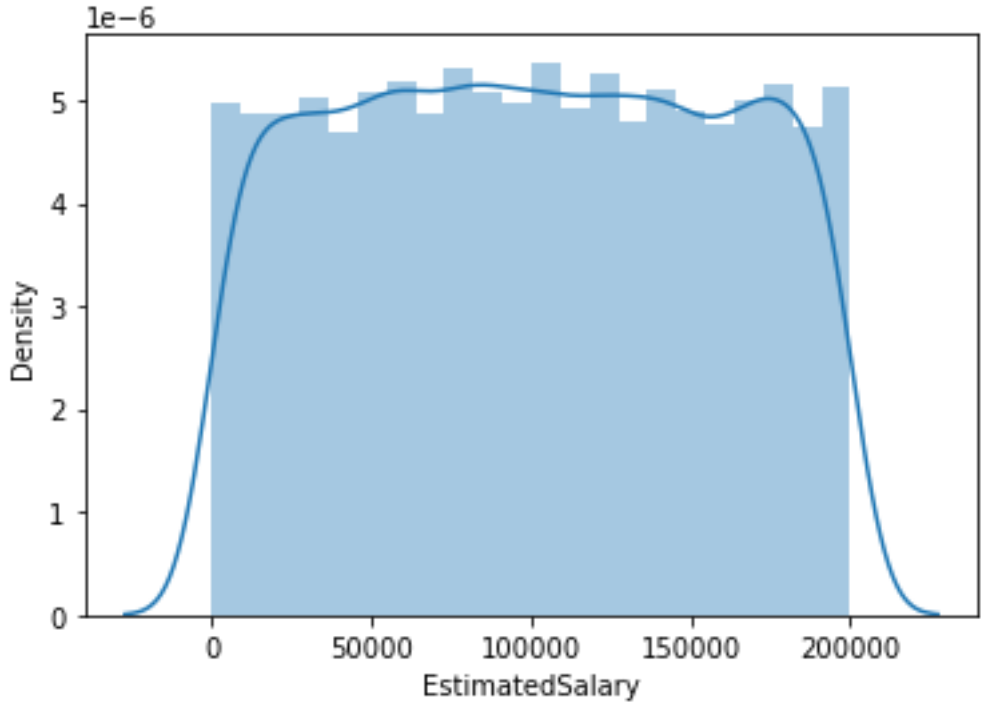
	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	9999	15682355	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

Visualizations

1. Univariate

sns.distplot(df['EstimatedSalary'],hist=**True**)

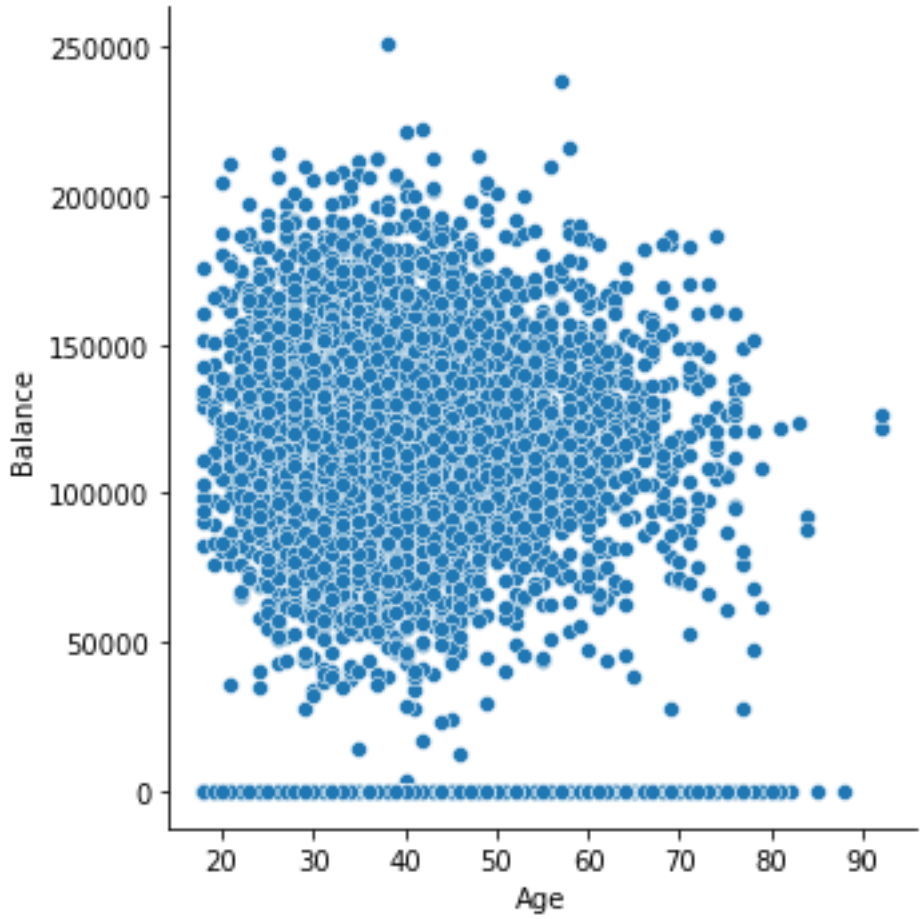
C:\Users\LENOVO\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
<AxesSubplot:xlabel='EstimatedSalary', ylabel='Density'>



2. Bivariate

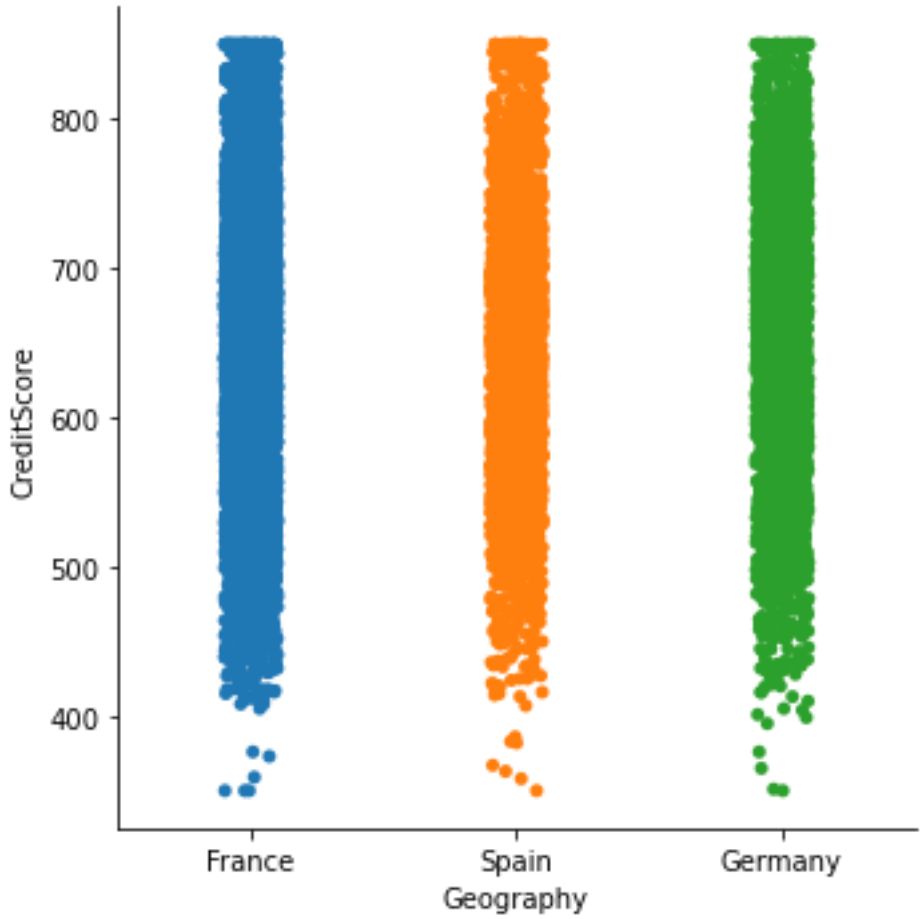
sns.relplot(x='Age',y='Balance',data=df)

<seaborn.axisgrid.FacetGrid at 0x1fd190d2070>




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

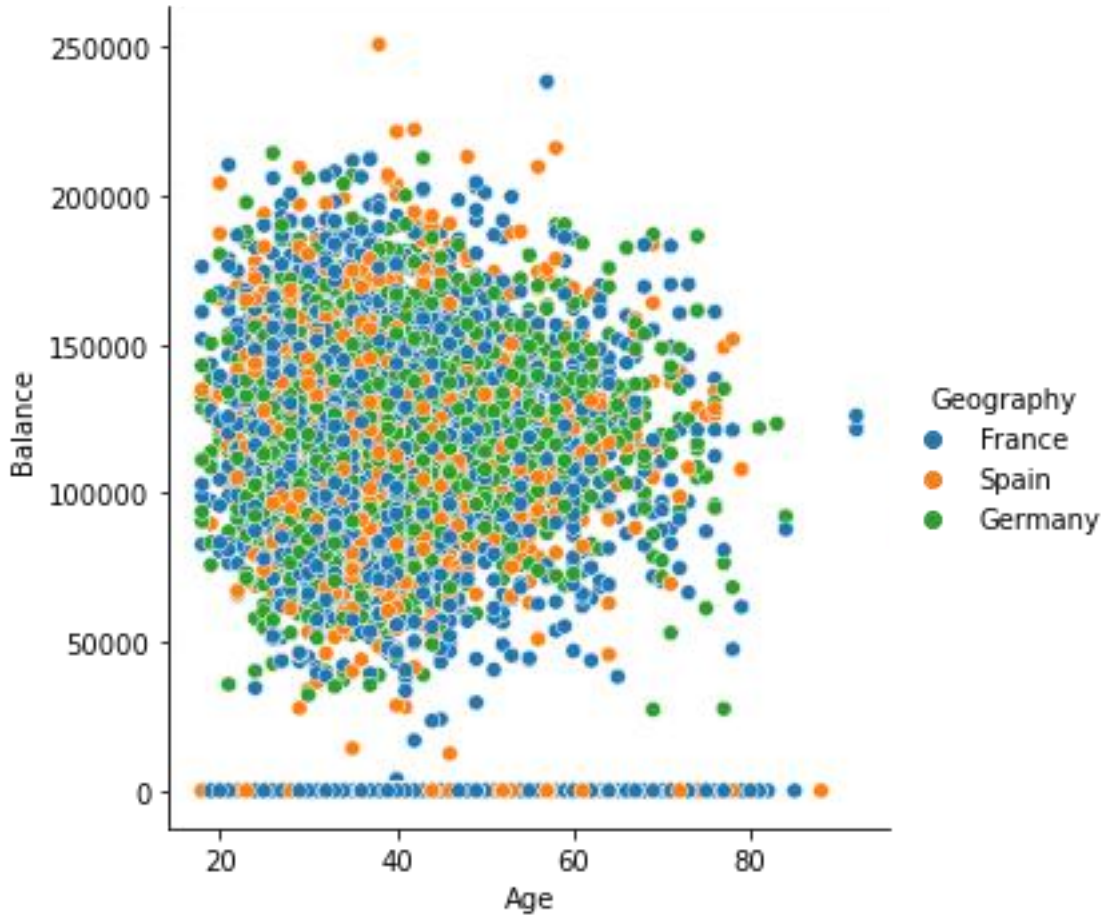
```
<seaborn.axisgrid.FacetGrid at 0x1fd194e8d90>
```



3. Multivariate

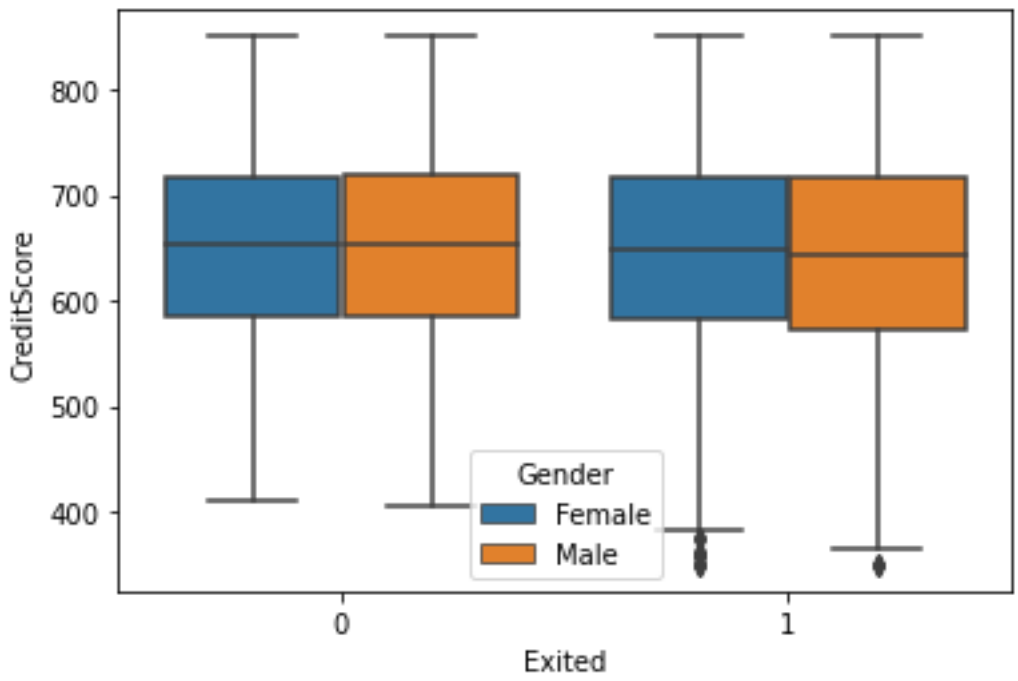
sns.relplot(x='Age',y='Balance',hue='Geography',data=df)

<seaborn.axisgrid.FacetGrid at 0x1fd1956e580>




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

<AxesSubplot:xlabel='Exited', ylabel='CreditScore'>



Descriptive Statistics

df.describe()

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000.00000	10000.000000	10000.000000	10000.000000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	1.530200	0.70550	0.515100	100090.239881	0.203700
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	0.581654	0.45584	0.499797	57510.492818	0.402769
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	1.000000	0.00000	0.000000	11.580000	0.000000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	1.000000	0.00000	0.000000	51002.110000	0.000000

	RowNumber	CustomerId	Credit Score	Age	Tenure	Balance	NumOf Products	HasCrCard	IsActive Member	EstimatedSalary	Exited
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000000	100193.915000	0.000000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.00000	1.000000	149388.247500	0.000000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.00000	1.000000	199992.480000	1.000000

Handling the missing(null) values

df.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
```

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
```

 # Since no null values are found no need to handle

Split the data into dependent and independent variables

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

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

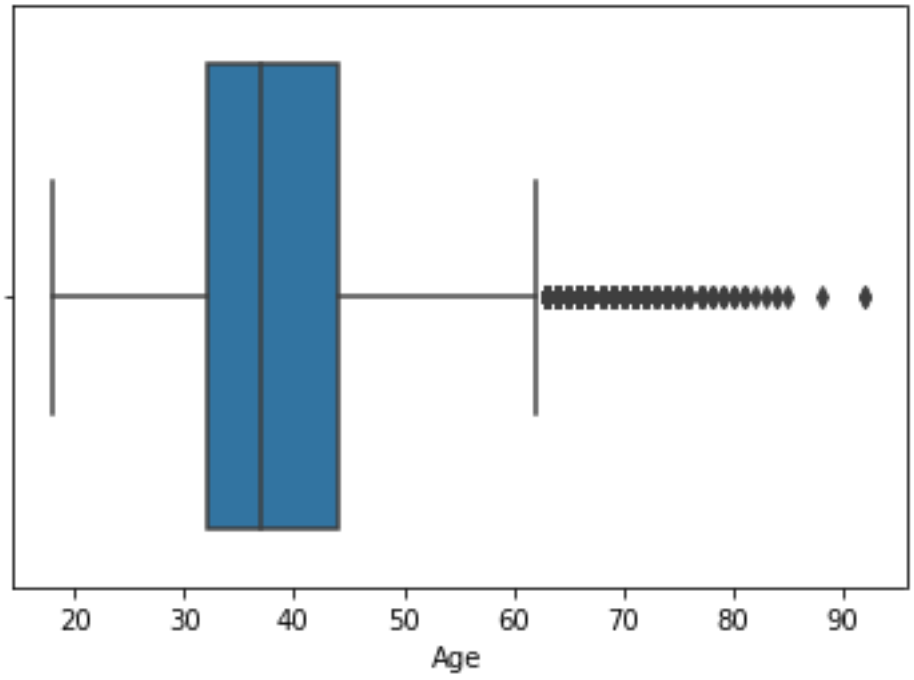
Finding and Replacing Outliers

```
df.skew()
```

```
C:\Users\LENOVO\AppData\Local\Temp\ipykernel_3336\1665899112.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.
  df.skew()
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(df["Age"])
```

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




```
q1 = df["Age"].describe()["25%"]
q3 = df["Age"].describe()["75%"]
iqr = q3-q1
l_b = q1 -(1.5*iqr)
u_b = q3 + (1.5*iqr)
df[df["Age"]<l_b]
```

	Row Number	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited

```
df[df["Age"]>u_b]
```

	Row Number	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
58	59	15623944	T'ien	511	Spain	Female	66	4	0.00	1	1	0	1643.11	1
85	86	15805254	Nduka	652	Spain	Female	75	10	0.00	2	1	1	114675.75	0
104	105	15804919	Dunbabin	670	Spain	Female	65	1	0.00	1	1	1	177655.68	1

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
158	159	15589975	Maclean	646	France	Female	73	6	97259.25	1	0	1	104719.66	0
181	182	15789669	Hsia	510	France	Male	65	2	0.00	2	1	1	48071.61	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9753	9754	15705174	Chiedozie	656	Germany	Male	68	7	153545.11	1	1	1	186574.68	0
9765	9766	15777067	Thomas	445	France	Male	64	2	136770.67	1	0	1	43678.06	0
9832	9833	15814690	Chukwujekwu	595	Germany	Female	64	2	105736.32	1	1	1	89935.73	1
9894	9895	15704795	Vagin	521	France	Female	77	6	0.00	2	1	1	49054.10	0
9936	9937	15653037	Parks	609	France	Male	77	1	0.00	1	0	1	18708.76	0

359 rows × 14 columns

#Replace the outlier

outlier_list = list(df[df["Age"] > u_b]["Age"])

outlier_list

[66,
75,
65,
73,
65,
72,
67,

67,
79,
80,
68,
75,
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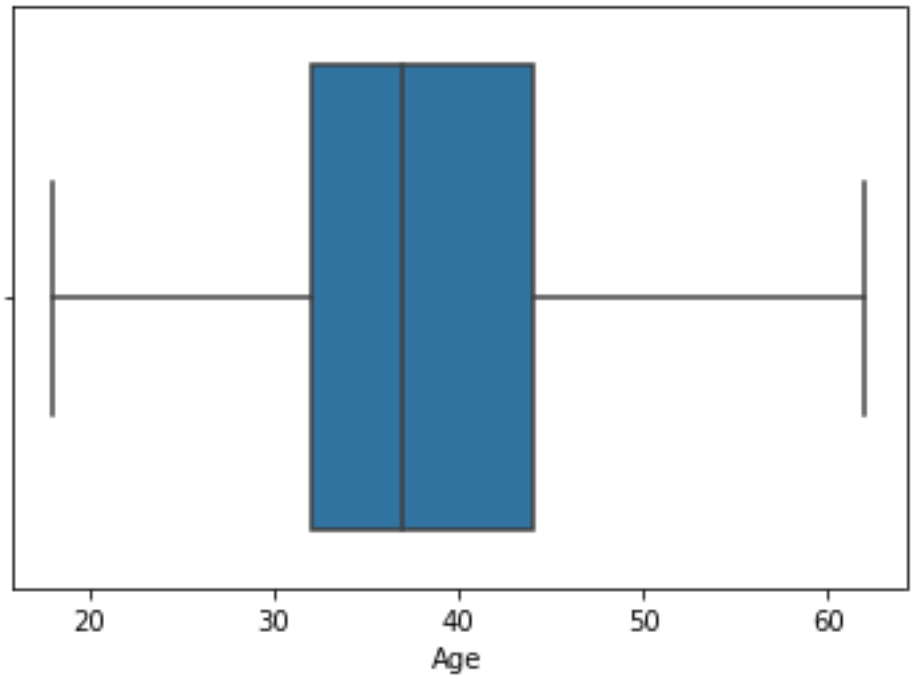
71,
78,
63,
63,

```
 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"])


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



df[df["Age"]>u_b]

Row Number	Customer Id	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited

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)

```
# saving the data
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)

Scale the independent variables

```
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']
```