Assignment -2

Assignment Date	21 October 2022
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Student Roll Number	210519205044
Maximum Marks	2 Marks

Data Visualization and Pre-processing

1. Perform Below Visualizations.

Univariate Analysis

1.Summary Statistics

In [6]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
```

In [7]:
```
file_data = pd.read_csv(r'/content/Churn_Modelling (1).csv')
```

In [8]:
```
file_data
```

Out[8]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Bala
0	1	15634602	Hargrave	619	France	Female	42	2	0
1	2	15647311	Hill	608	Spain	Female	41	1	83807
2	3	15619304	Onio	502	France	Female	42	8	159660
3	4	15701354	Boni	699	France	Female	39	1	0
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510
...	...	...	...	...	...	...	...	...	
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369
9997	9998	15584532	Liu	709	France	Female	36	7	0
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075
9999	10000	15628319	Walker	792	France	Female	28	4	130142

10000 rows × 14 columns

In [10]:
```
file_data['Balance'].mean()
```

Out[10]: 76485.889288

In [11]:
```
file_data['Balance'].median()
```

Out[11]:
```
97198.54000000001
```

In [12]:
```
file_data['Balance'].std()
```

Out[12]:
```
62397.405202385955
```

1. Frequency Table

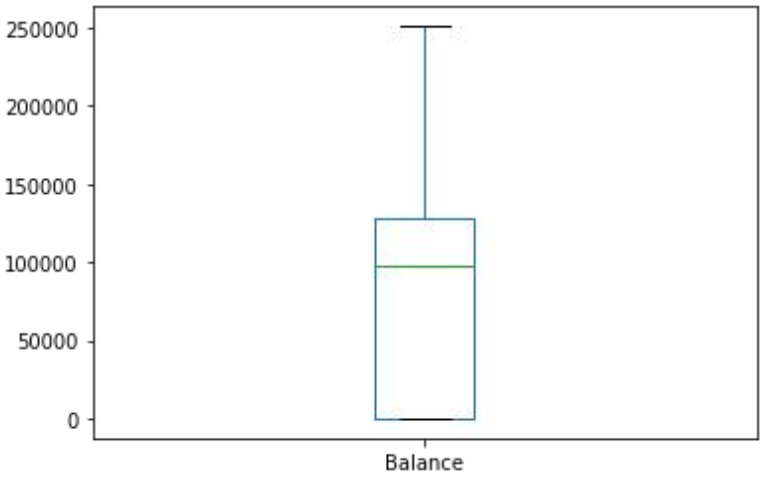
In [13]:
```
file_data['Surname'].value_counts()
```

Out[13]:
```
Smith        32
Scott        29
Martin       29
Walker       28
Brown        26
             ..
Izmailov      1
Bold          1
Bonham        1
Poninski      1
Burbidge      1
Name: Surname, Length: 2932, dtype: int64
```

3. Create Charts

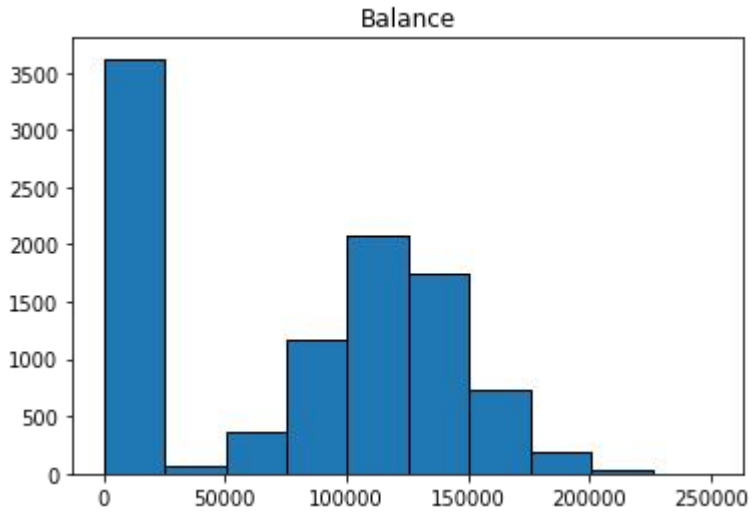
In [14]:
```
file_data.boxplot(column=['Balance'],  grid=False)
```

Out[14]:
```
<matplotlib.axes._subplots.AxesSubplot  at  0x7f92739f6bd0>
```



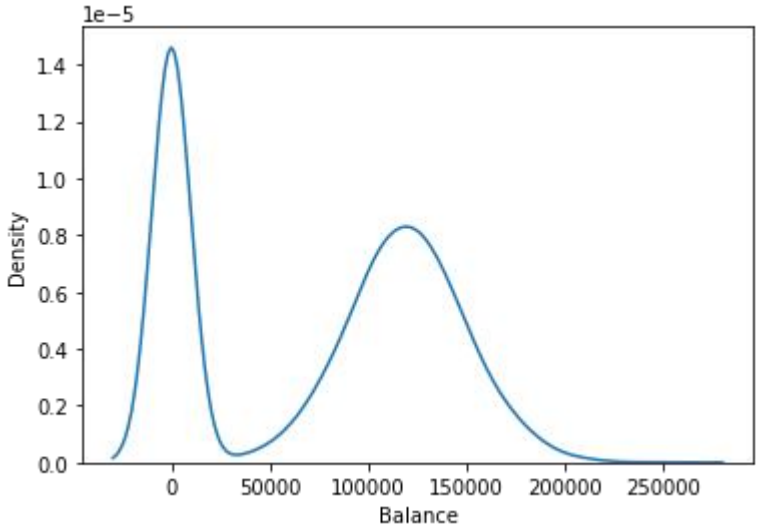
In [15]:
```
file_data.hist(column='Balance', grid=False, edgecolor='black')
```

Out[15]:
```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x7f9267897050>]],
      dtype=object)
```



In [16]:
```
sns.kdeplot(file_data['Balance'])
```

Out[16]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f92673be410>
```

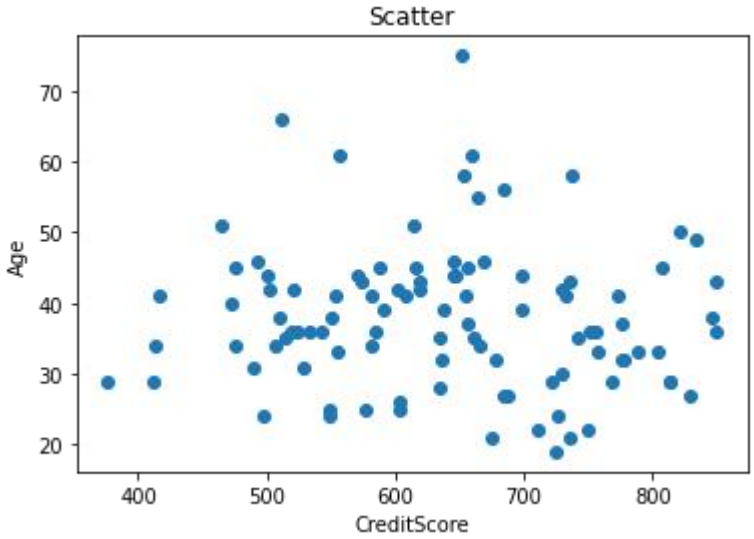


Bi - Variate Analysis

1. Scatterplots

In [17]:
```
plt.scatter(file_data.CreditScore.head(100), file_data.Age.head(100))
plt.title('Scatter')
plt.xlabel('CreditScore')
plt.ylabel('Age')
```

Out[17]: Text(0, 0.5, 'Age')



1. Correlation Coefficients

In [18]:
```
file_data.corr()
```

Out[18]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfPr
RowNumber	1.000000	0.004202	0.005840	0.000783	-0.006495	-0.009067	0.0
CustomerId	0.004202	1.000000	0.005308	0.009497	-0.014883	-0.012419	0.0
CreditScore	0.005840	0.005308	1.000000	-0.003965	0.000842	0.006268	0.0
Age	0.000783	0.009497	-0.003965	1.000000	-0.009997	0.028308	-0.0
Tenure	-0.006495	-0.014883	0.000842	-0.009997	1.000000	-0.012254	0.0
Balance	-0.009067	-0.012419	0.006268	0.028308	-0.012254	1.000000	-0.3
NumOfProducts	0.007246	0.016972	0.012238	-0.030680	0.013444	-0.304180	1.0
HasCrCard	0.000599	-0.014025	-0.005458	-0.011721	0.022583	-0.014858	0.0
IsActiveMember	0.012044	0.001665	0.025651	0.085472	-0.028362	-0.010084	0.0
EstimatedSalary	-0.005988	0.015271	-0.001384	-0.007201	0.007784	0.012797	0.0
Exited	-0.016571	-0.006248	-0.027094	0.285323	-0.014001	0.118533	-0.0

1. Simple Linear Regression

In [19]:
```
y = file_data['CustomerId']
x =  file_data['HasCrCard']
x =  sm.add_constant(x)
model = sm.OLS(y,x).fit()
model.summary()
```

```
/usr/local/lib/python3.7/dist-packages/statsmodels/tsa/tsatools.py:142:    Fut
ureWarning: In a future version of pandas all arguments of concat except fo
r the argument 'objs' will be keyword-only
  x = pd.concat(x[::order], 1)
```

Out[19]:

OLS Regression Results

Dep. Variable:	CustomerId	**R-squared:**	0.000
Model:	OLS	**Adj. R-squared:**	0.000
Method:	Least Squares	**F-statistic:**	1.967
Date:	Sun, 02 Oct 2022	**Prob (F-statistic):**	0.161
Time:	12:47:16	**Log-Likelihood:**	-1.2602e+05
No. Observations:	10000	**AIC:**	2.521e+05
Df Residuals:	9998	**BIC:**	2.521e+05
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.569e+07	1325.512	1.18e+04	0.000	1.57e+07	1.57e+07
HasCrCard	-2213.3059	1578.103	-1.403	0.161	-5306.705	880.093

Omnibus:	8394.858	**Durbin-Watson:**	2.019
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	596.113
Skew:	0.001	**Prob(JB):**	3.60e-130
Kurtosis:	1.804	**Cond. No.**	3.45

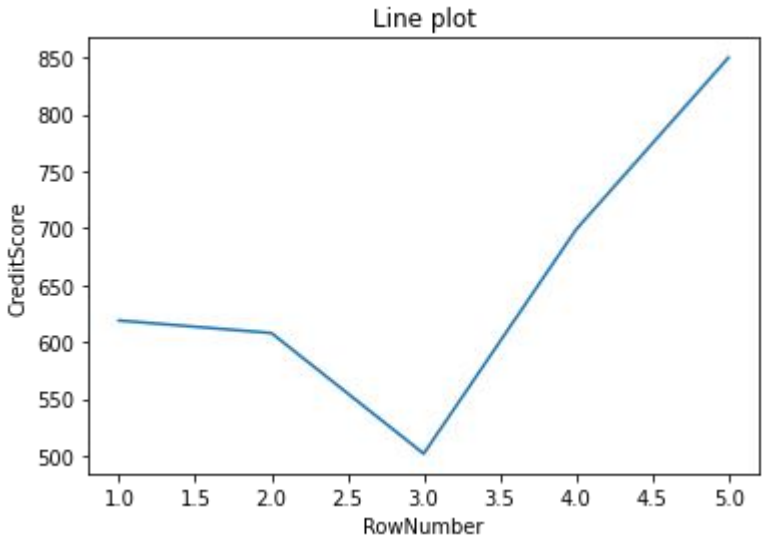
Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

In [20]:
```
plt.plot(file_data['RowNumber'].head()  ,file_data['CreditScore'].head(),    )

plt.title('Line plot')
plt.xlabel('RowNumber')
plt.ylabel('CreditScore')
```

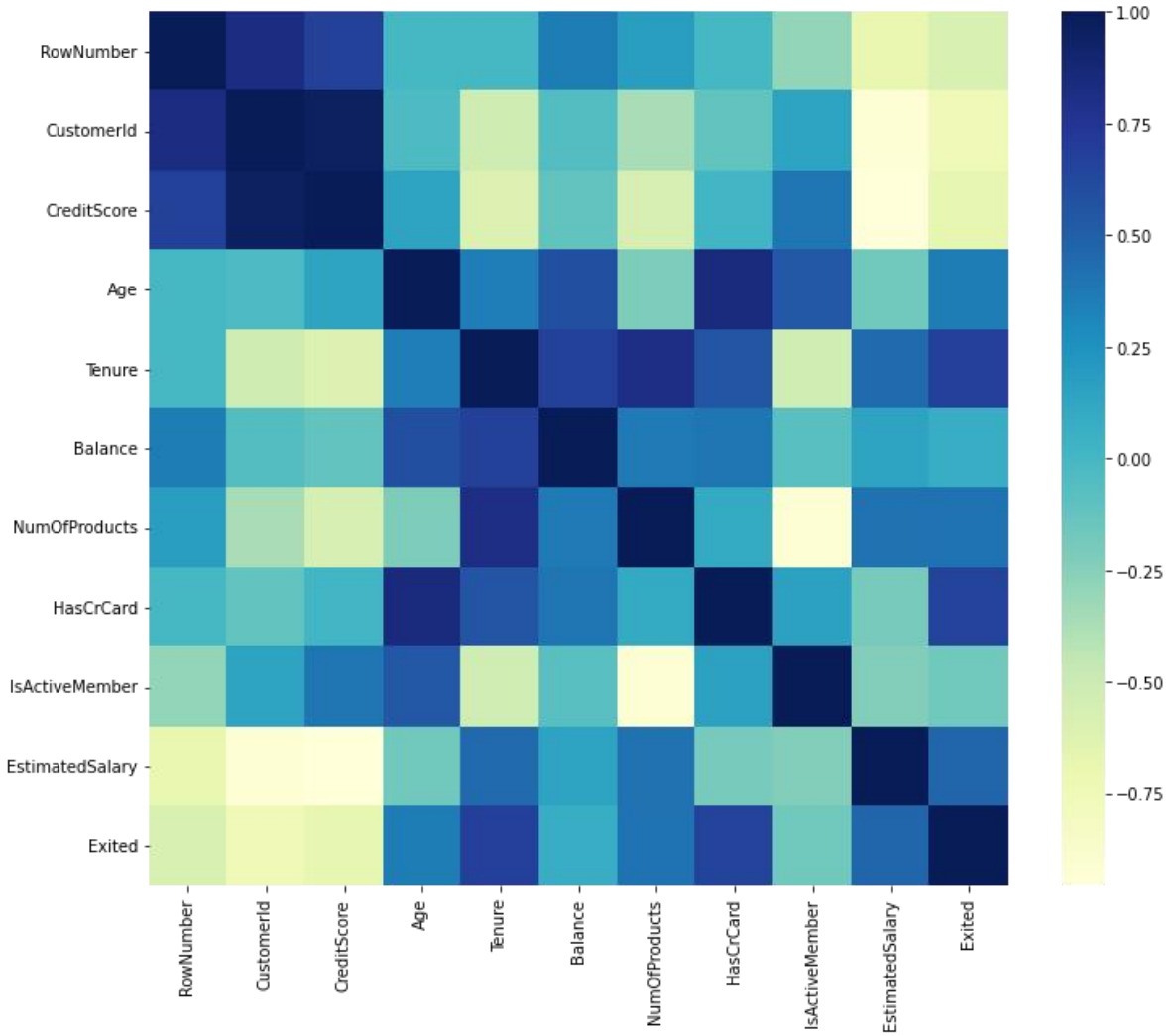
Out[20]: Text(0, 0.5, 'CreditScore')



Multi - Variate Analysis

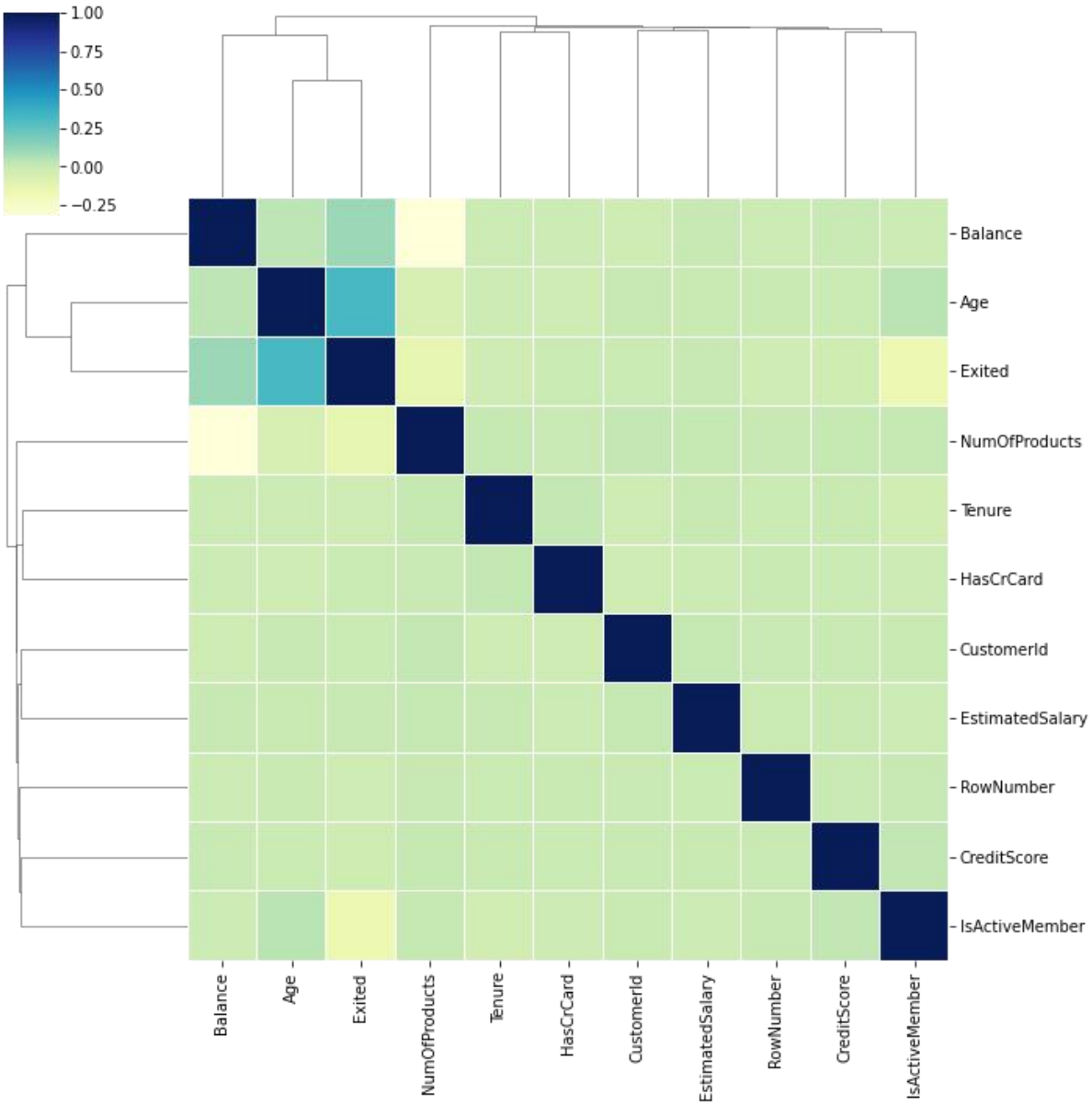
In [21]:
```
f = plt.subplots(figsize=(12,10))
sns.heatmap(file_data.head().corr(), cmap="YlGnBu")
```

Out[21]: <matplotlib.axes._subplots.AxesSubplot at 0x7f926722f550>



In [22]:
```
corrmat = file_data.corr(method='spearman')
cg = sns.clustermap(corrmat, cmap="YlGnBu", linewidths=0.1);
plt.setp(cg.ax_heatmap.yaxis.get_majorticklabels(), rotation=0)
cg
```

Out[22]: <seaborn.matrix.ClusterGrid at 0x7f9264904d90>



1. Perform descriptive statistics on the dataset.

In [23]:
```
file_data.shape
```

Out[23]: (10000, 14)

In [24]:
```
file_data.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
```

In [25]:
```
file_data.describe()
```

Out[25]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	N
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000	
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288	
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202	
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000	
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000	
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	

In [26]:
```
file_data.head()
```

Out[26]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance
0	1	15634602	Hargrave	619	France	Female	42	2	0.00
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86
2	3	15619304	Onio	502	France	Female	42	8	159660.80
3	4	15701354	Boni	699	France	Female	39	1	0.00
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82

In [27]:
```
file_data.tail()
```

Out[27]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Bala
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369
9997	9998	15584532	Liu	709	France	Female	36	7	0
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075
9999	10000	15628319	Walker	792	France	Female	28	4	130142

In [28]:
```
file_data.mean(numeric_only=True)
```

Out[28]:
```
RowNumber           5.000500e+03
CustomerId          1.569094e+07
CreditScore         6.505288e+02
Age                 3.892180e+01
Tenure              5.012800e+00
Balance             7.648589e+04
NumOfProducts       1.530200e+00
HasCrCard           7.055000e-01
IsActiveMember      5.151000e-01
EstimatedSalary     1.000902e+05
Exited              2.037000e-01
dtype: float64
```

In [29]:
```
file_data.median(numeric_only=True)
```

Out[29]:
```
RowNumber          5.000500e+03
CustomerId         1.569074e+07
CreditScore        6.520000e+02
Age                3.700000e+01
Tenure             5.000000e+00
Balance            9.719854e+04
NumOfProducts      1.000000e+00
HasCrCard          1.000000e+00
IsActiveMember     1.000000e+00
EstimatedSalary    1.001939e+05
Exited             0.000000e+00
dtype: float64
```

In [30]:
```
file_data.mode()
```

Out[30]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance
0	1	15565701	Smith	850.0	France	Male	37.0	2.0	0.0
1	2	15565706	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2	3	15565714	NaN	NaN	NaN	NaN	NaN	NaN	NaN
3	4	15565779	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	5	15565796	NaN	NaN	NaN	NaN	NaN	NaN	NaN
...	...	...	...	...	...	...	...	...	..
9995	9996	15815628	NaN	NaN	NaN	NaN	NaN	NaN	NaN
9996	9997	15815645	NaN	NaN	NaN	NaN	NaN	NaN	NaN
9997	9998	15815656	NaN	NaN	NaN	NaN	NaN	NaN	NaN
9998	9999	15815660	NaN	NaN	NaN	NaN	NaN	NaN	NaN
9999	10000	15815690	NaN	NaN	NaN	NaN	NaN	NaN	NaN

10000 rows × 14 columns

In [31]:
```
file_data.var(numeric_only=True)
```

Out[31]:
```
RowNumber          8.334167e+06
CustomerId         5.174815e+09
CreditScore        9.341860e+03
Age                1.099941e+02
Tenure             8.364673e+00
Balance            3.893436e+09
NumOfProducts      3.383218e-01
HasCrCard          2.077905e-01
IsActiveMember     2.497970e-01
EstimatedSalary    3.307457e+09
Exited             1.622225e-01
dtype: float64
```

In [32]:
```
file_data.std(numeric_only=True)
```

Out[32]:
```
RowNumber            2886.895680
CustomerId          71936.186123
CreditScore            96.653299
Age                    10.487806
Tenure                  2.892174
Balance             62397.405202
NumOfProducts           0.581654
HasCrCard               0.455840
IsActiveMember          0.499797
EstimatedSalary     57510.492818
Exited                  0.402769
dtype: float64
```

In [33]:
```
file_data.skew(numeric_only=True)
```

Out[33]:
```
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
```

In [34]:
```
file_data.kurt(numeric_only=True)
```

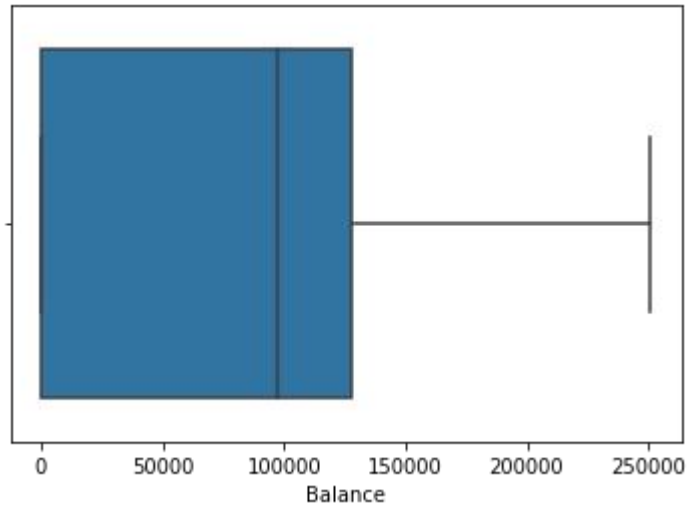
Out[34]:
```
RowNumber          -1.200000
CustomerId         -1.196113
CreditScore        -0.425726
Age                 1.395347
Tenure             -1.165225
Balance            -1.489412
NumOfProducts       0.582981
HasCrCard          -1.186973
IsActiveMember     -1.996747
EstimatedSalary    -1.181518
Exited              0.165671
dtype: float64
```

In [35]:
```
quantile = file_data['Balance'].quantile(q=[0.75, 0.25])
quantile
```

Out[35]:
```
0.75    127644.24
0.25         0.00
Name: Balance, dtype: float64
```

In [36]:
```
x = file_data.Balance
sns.boxplot(x=x)
```

Out[36]: <matplotlib.axes._subplots.AxesSubplot at 0x7f9264746b10>



1. Handle the Missing values.

In [37]:
```
print(file_data.isnull())
```

```
      RowNumber  CustomerId  Surname  CreditScore  Geography  Gender    Age
\
0         False       False    False        False      False   False  False
1         False       False    False        False      False   False  False
2         False       False    False        False      False   False  False
3         False       False    False        False      False   False  False
4         False       False    False        False      False   False  False
...         ...         ...      ...          ...        ...     ...    ...
9995      False       False    False        False      False   False  False
9996      False       False    False        False      False   False  False
9997      False       False    False        False      False   False  False
9998      False       False    False        False      False   False  False
9999      False       False    False        False      False   False  False

      Tenure  Balance  NumOfProducts  HasCrCard  IsActiveMember  \
0      False    False          False      False           False
1      False    False          False      False           False
2      False    False          False      False           False
3      False    False          False      False           False
4      False    False          False      False           False
...      ...      ...            ...        ...             ...
9995   False    False          False      False           False
9996   False    False          False      False           False
9997   False    False          False      False           False
9998   False    False          False      False           False
9999   False    False          False      False           False

      EstimatedSalary  Exited
0               False   False
1               False   False
2               False   False
3               False   False
4               False   False
...               ...     ...
9995            False   False
9996            False   False
9997            False   False
9998            False   False
9999            False   False

[10000 rows x 14 columns]
```

In [38]:
```
print(file_data.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
```

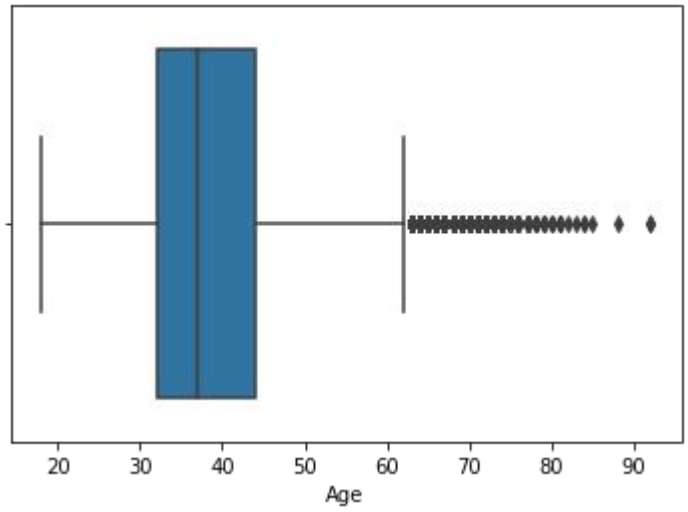
In [39]:
```
file_data.isna().any()
```

Out[39]:
```
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
```

1. Find the outliers and replace the outliers

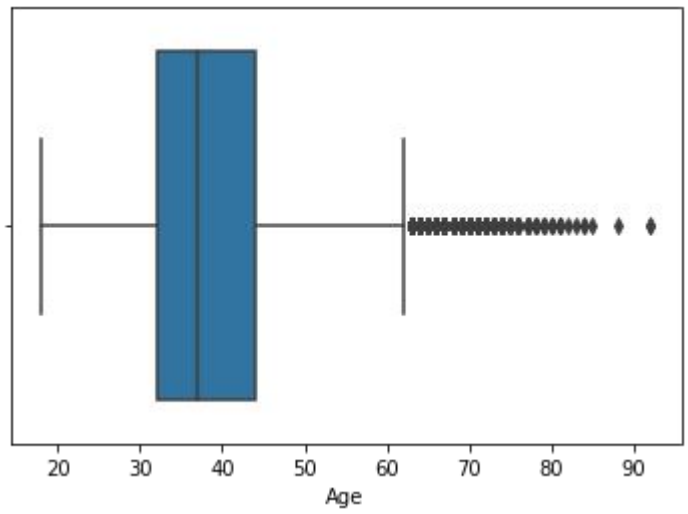
In [40]:
```
x = sns.boxplot(x=file_data["Age"])
x
```

Out[40]: <matplotlib.axes._subplots.AxesSubplot at 0x7f92646aea50>



In [41]:
```
x = file_data.Age
sns.boxplot(x=x)
```

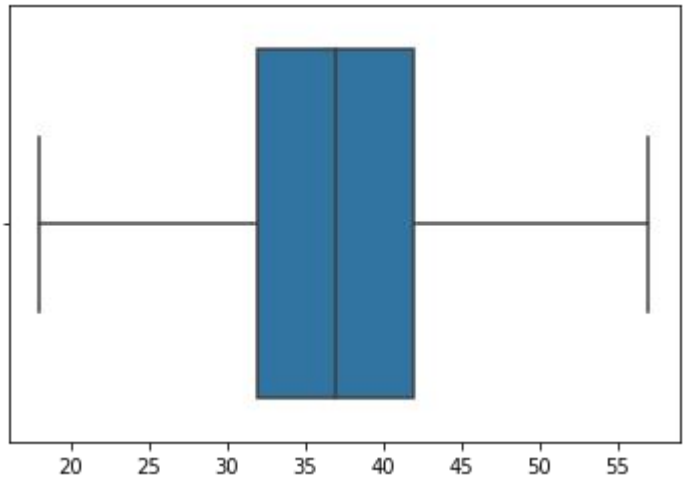
Out[41]: <matplotlib.axes._subplots.AxesSubplot at 0x7f92646864d0>



In [42]:
```
x = np.where(file_data['Age']>57,39, file_data['Age'])
```

In [43]:
```
sns.boxplot(x=x)
```

Out[43]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f92646147d0>
```



1. Check for Categorical columns and perform encoding.

In [44]:
```
pd.Categorical(file_data["Geography"])
```

Out[44]:
```
['France', 'Spain', 'France', 'France', 'Spain', ..., 'France', 'France',
'France', 'Germany', 'France']
Length: 10000
Categories (3, object): ['France', 'Germany', 'Spain']
```

In [45]:
```
pd.get_dummies(file_data["Geography"]).head(10)
```

Out[45]:

	France	Germany	Spain
0	1	0	0
1	0	0	1
2	1	0	0
3	1	0	0
4	0	0	1
5	0	0	1
6	1	0	0
7	0	1	0
8	1	0	0
9	1	0	0

In [46]:
```
pd.get_dummies(file_data).head(10)
```

Out[46]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	Is
0	1	15634602	619	42	2	0.00	1	1	
1	2	15647311	608	41	1	83807.86	1	0	
2	3	15619304	502	42	8	159660.80	3	1	
3	4	15701354	699	39	1	0.00	2	0	
4	5	15737888	850	43	2	125510.82	1	1	
5	6	15574012	645	44	8	113755.78	2	1	
6	7	15592531	822	50	7	0.00	2	1	
7	8	15656148	376	29	4	115046.74	4	1	
8	9	15792365	501	44	4	142051.07	2	0	
9	10	15592389	684	27	2	134603.88	1	1	

10 rows × 2948 columns

1. Split the data into dependent and independent variables.

In [47]:
```
X = file_data.iloc[:, :-1].values
print(X)
```

```
[[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]]
```

In [48]:
```
Y = file_data.iloc[:, -1].values
print(Y)
```

```
[1 0 1 ... 1 1 0]
```

1. Scale the independent variables

In [49]:
```
from sklearn.preprocessing import scale
```

In [50]:
```
x = scale(file_data["EstimatedSalary"])
x
```

Out[50]:
```
array([ 0.02188649,  0.21653375,  0.2406869 , ..., -1.00864308,
       -0.12523071, -1.07636976])
```

In [51]:
```
y = file_data.EstimatedSalary
y
```

Out[51]:
```
0       101348.88
1       112542.58
2       113931.57
3        93826.63
4        79084.10
           ...
9995     96270.64
9996    101699.77
9997     42085.58
9998     92888.52
9999     38190.78
Name: EstimatedSalary, Length: 10000, dtype: float64
```

In [54]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-54-a058a839cfb2> in <module>
----> 1 x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2)

NameError: name 'train_test_split' is not defined
```