1. The Dataset was successfully downloaded.

Import Libraries

In [3]:

```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
from sklearn.preprocessing import LabelEncoder, MinMaxScaler
from sklearn.model_selection  import train_test_split
```

2. Load the Dataset

In [4]:

```
data = pd.read_csv("Churn_Modelling.csv")
```

In [5]:

```
data.head()
```

Out[5]:

	Row Number	Customer Id	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

3. Perform Below Visualizations

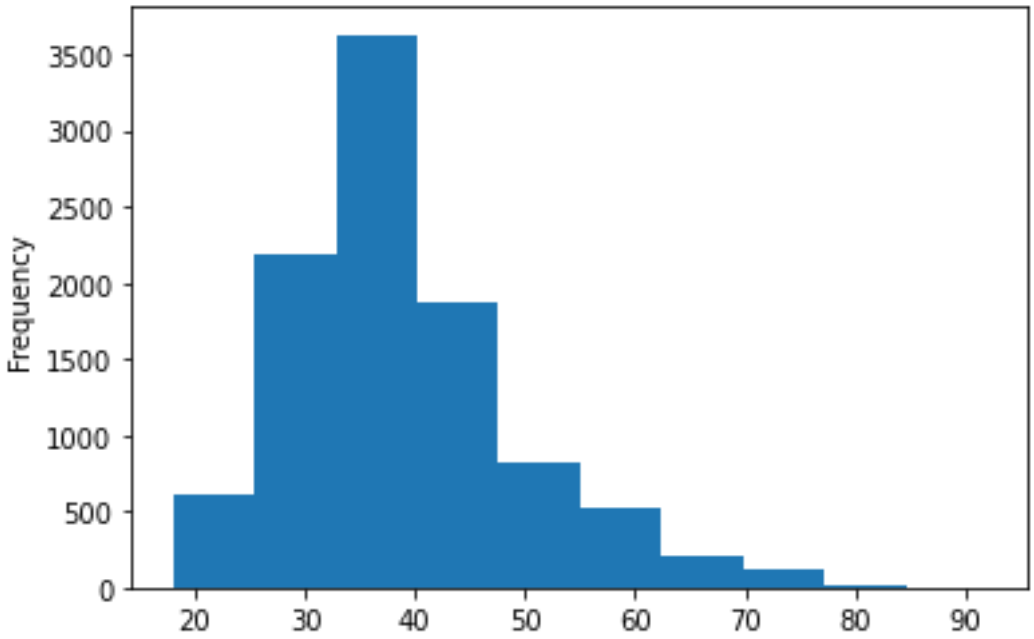
3.1 Univariate Analysis

In [6]:

```
#Histogram
data['Age'].plot(kind='hist')
```

Out[6]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fcfc78bbfd0>
```

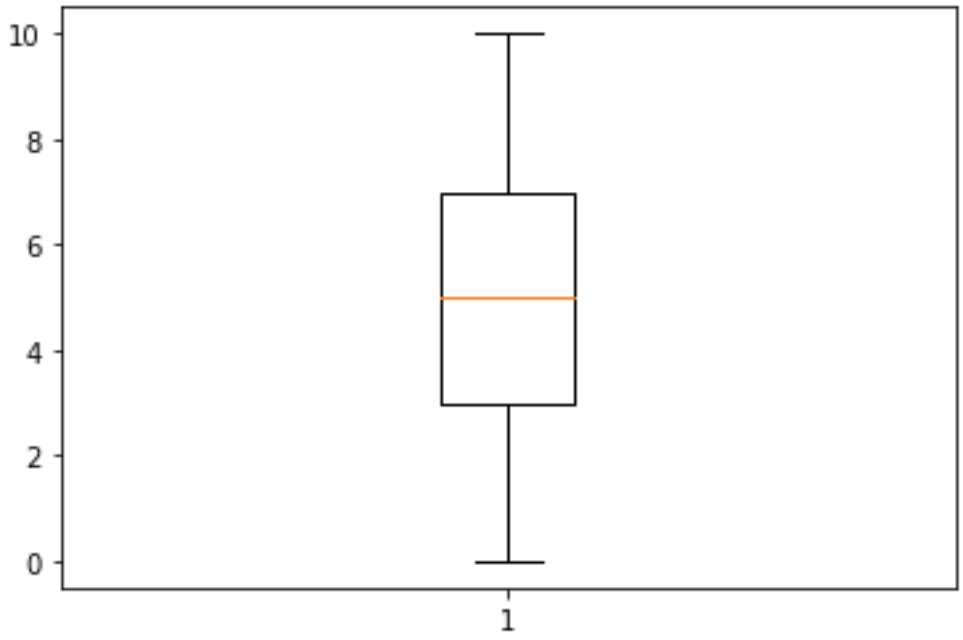


In [7]:

```
#Boxplot
plt.boxplot(data['Tenure'])
```

Out[7]:

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7fcfc72d4050>,
  <matplotlib.lines.Line2D at 0x7fcfc72d4590>],
 'caps': [<matplotlib.lines.Line2D at 0x7fcfc72d4ad0>,
  <matplotlib.lines.Line2D at 0x7fcfc72db050>],
 'boxes': [<matplotlib.lines.Line2D at 0x7fcfc7349a90>],
 'medians': [<matplotlib.lines.Line2D at 0x7fcfc72db5d0>],
 'fliers': [<matplotlib.lines.Line2D at 0x7fcfc72dbb10>],
 'means': []}
```

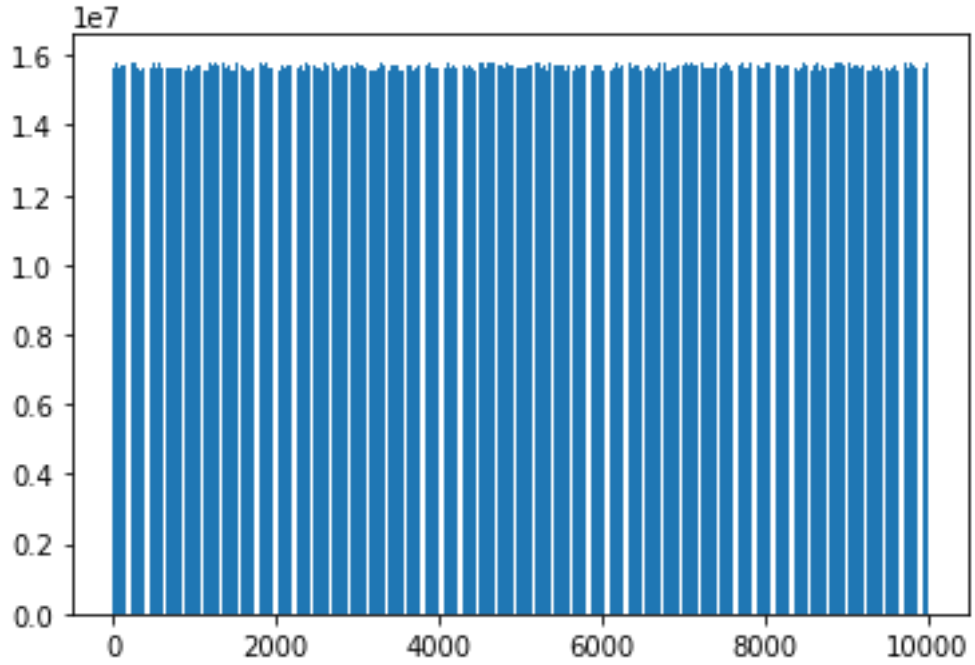


In [8]:

```
#Bar chart
df = pd.DataFrame(data)
X = list(df.iloc[:,0])
Y = list(df.iloc[:,1])
plt.bar(X,Y)
```

Out[8]:

```
<BarContainer object of 10000 artists>
```



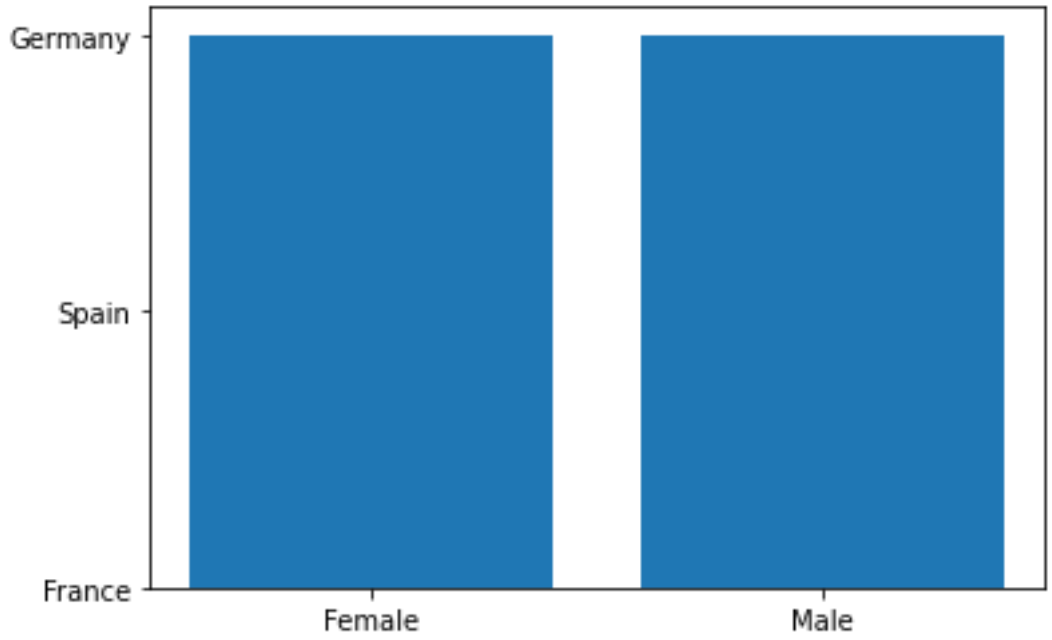
3.2 Bivariate Analysis

In [9]:

```
#Stacked Bar Chart
plt.bar(data['Gender'],data['Geography'])
```

Out[9]:

```
<BarContainer object of 10000 artists>
```

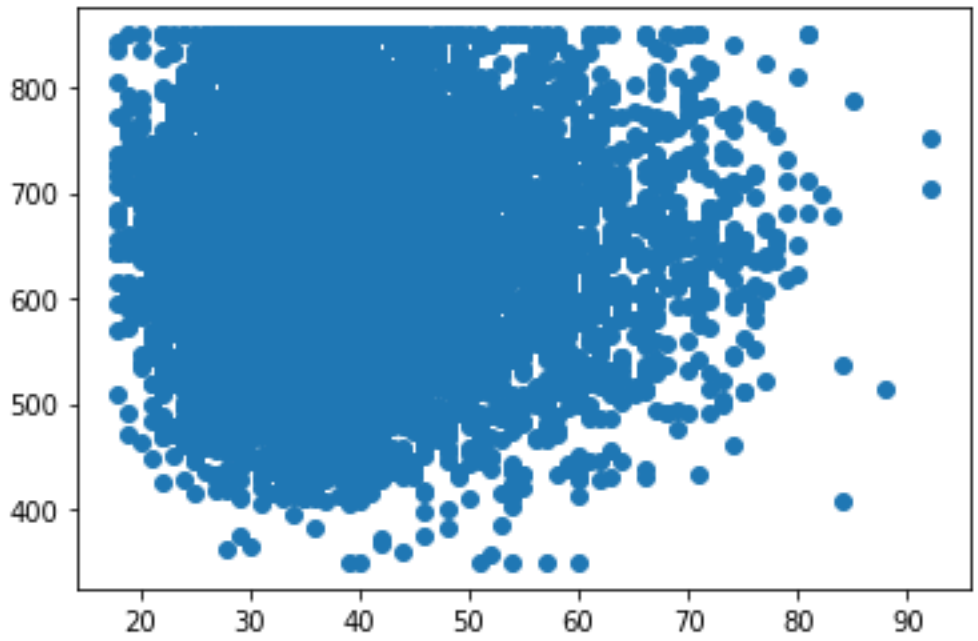


In [10]:

```
#Scatter plot
plt.scatter(data['Age'],data['CreditScore'])
```

Out[10]:

```
<matplotlib.collections.PathCollection at 0x7fcfb9647f90>
```



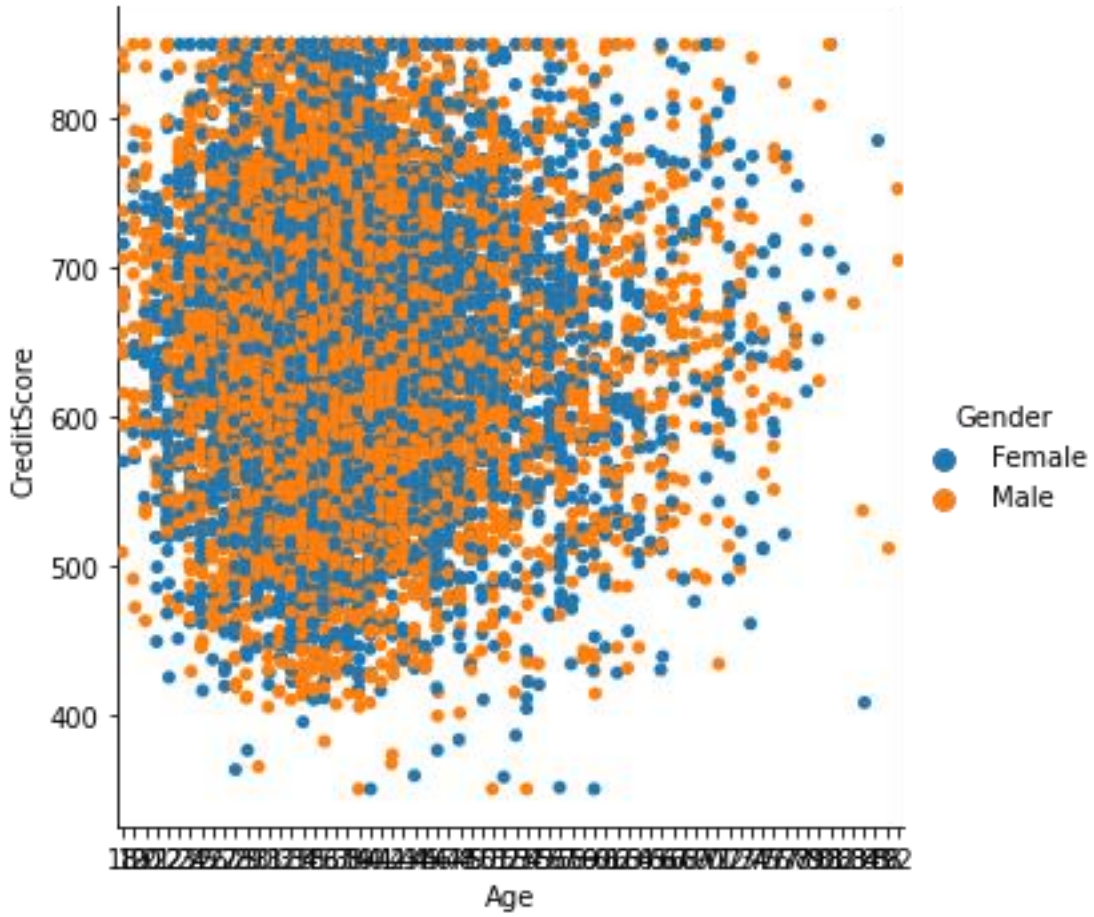
3.3 Multivariate Analysis

In [11]:

```
sns.catplot(data=data,x='Age',y='CreditScore',hue='Gender')
```

Out[11]:

```
<seaborn.axisgrid.FacetGrid at 0x7fcfbfd54a10>
```

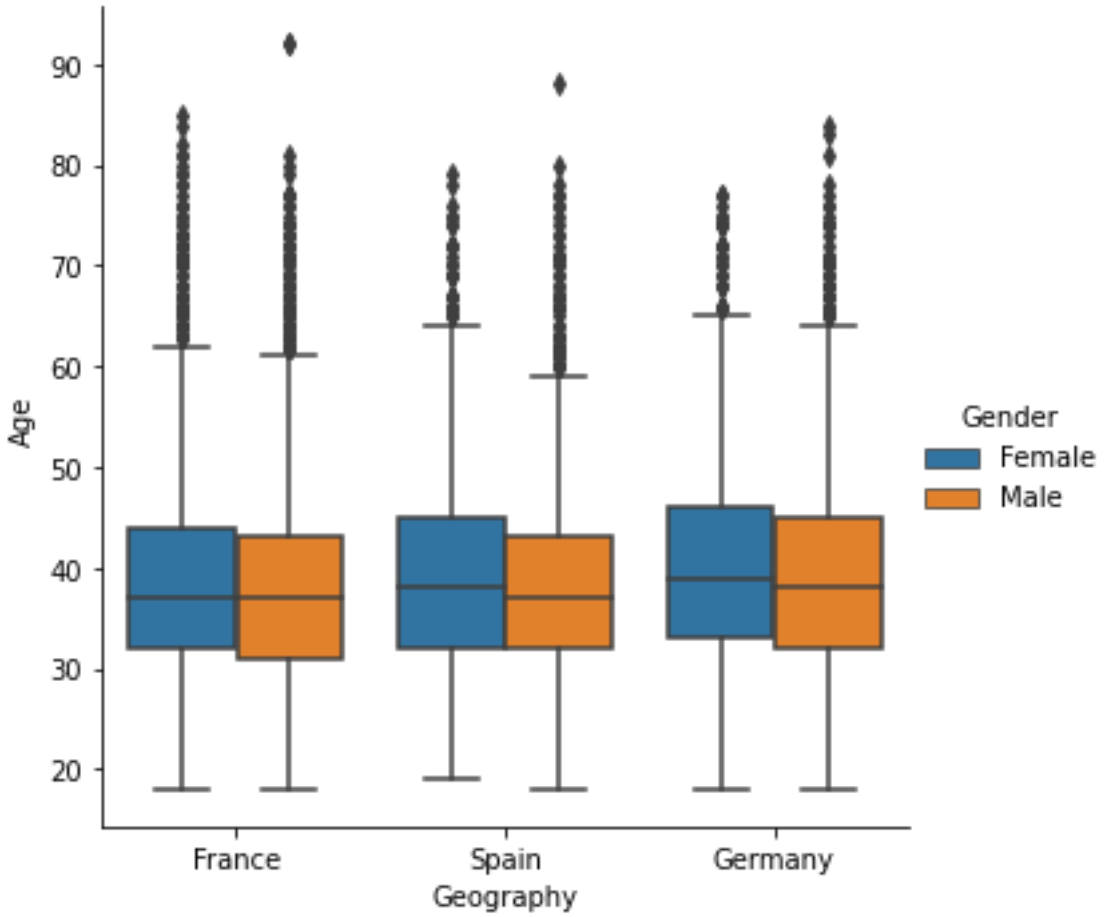


In [12]:

```
#Box Plot
sns.catplot(data=data,x='Geography',y='Age',hue='Gender',kind='box')
```

Out[12]:

```
<seaborn.axisgrid.FacetGrid at 0x7fcfb93821d0>
```



4. Perform Descriptive Statistics on the dataset

In [13]:

```
data.mean()
```

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

Out[13]:

```
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 [14]:

```
data.median()
```

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

Out[14]:

```
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 [15]:

```
data.describe()
```

Out[15]:

	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
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000	1.000000	1.00000	1.000000	100193.915000	0.000000

	RowNumber	CustomerId	Credit Score	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
75%	7500.250000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000	2.000000	1.00000	1.000000	149388.247500	0.000000
max	10000.000000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000	4.000000	1.00000	1.000000	199992.480000	1.000000

In [16]:

```
data.shape
```

Out[16]:

```
(10000, 14)
```

5. Handle the missing values

In [17]:

```
data.isnull().sum()
```

Out[17]:

```
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
```

6. Find the Outliners and replace the Outliners

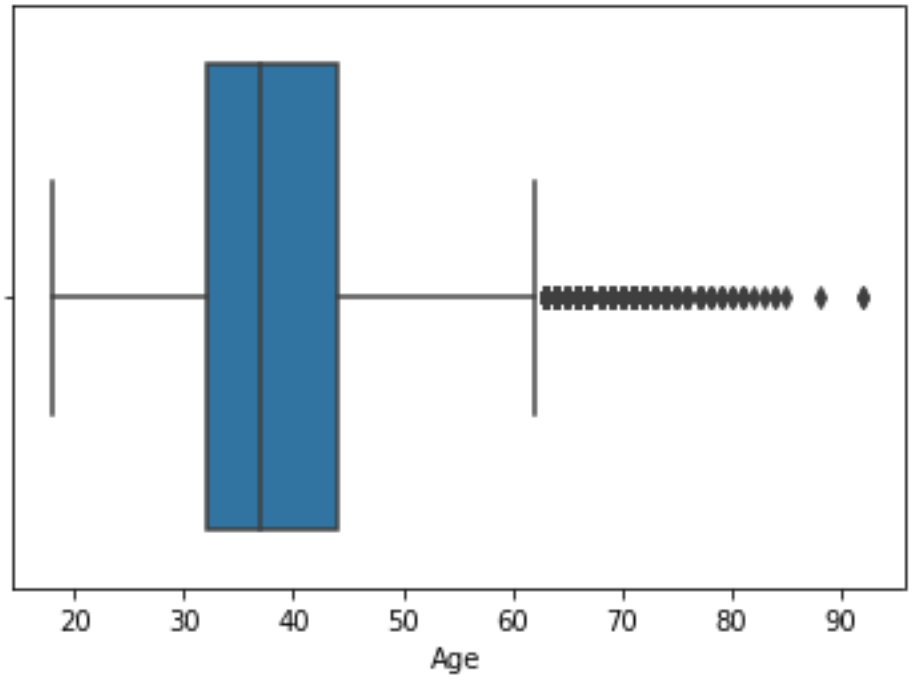
In [18]:

```
sns.boxplot(data['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
```

Out[18]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fcfb4080c50>
```



In [19]:

```
qnt = data.quantile(q=[0.25,0.75])
qnt
```

Out[19]:

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0.25	2500.75	15628528.25	584.0	32.0	3.0	0.00	1.0	0.0	0.0	51002.1100	0.0
0.75	7500.25	15753233.75	718.0	44.0	7.0	127644.24	2.0	1.0	1.0	149388.2475	0.0

In [20]:

```
IQR = qnt.loc[0.75] - qnt.loc[0.25]
IQR
```

Out[20]:

```
RowNumber            4999.5000
CustomerId         124705.5000
CreditScore           134.0000
Age                    12.0000
Tenure                  4.0000
Balance            127644.2400
NumOfProducts           1.0000
HasCrCard               1.0000
IsActiveMember          1.0000
EstimatedSalary     98386.1375
Exited                  0.0000
dtype: float64
```

In [21]:

```
upper_extreme = qnt.loc[0.75]+1.5*IQR
upper_extreme
```

Out[21]:

```
RowNumber          1.499950e+04
CustomerId         1.594029e+07
CreditScore        9.190000e+02
Age                6.200000e+01
Tenure             1.300000e+01
Balance            3.191106e+05
NumOfProducts      3.500000e+00
HasCrCard          2.500000e+00
IsActiveMember     2.500000e+00
EstimatedSalary    2.969675e+05
Exited             0.000000e+00
dtype: float64
```

In [22]:

```
lower_extreme = qnt.loc[0.25]-1.5*IQR
lower_extreme
```

Out[22]:

```
RowNumber         -4.998500e+03
CustomerId         1.544147e+07
CreditScore        3.830000e+02
Age                1.400000e+01
Tenure            -3.000000e+00
Balance           -1.914664e+05
NumOfProducts     -5.000000e-01
HasCrCard         -1.500000e+00
IsActiveMember    -1.500000e+00
EstimatedSalary   -9.657710e+04
Exited             0.000000e+00
dtype: float64
```

In [23]:

```
df2 = data[(data['Age']<upper_extreme['Age']) &
(data['Age']>lower_extreme['Age'])]
df.shape
```

Out[23]:

```
(10000, 14)
```

In [24]:

```
df2.shape
```

Out[24]:

```
(9589, 14)
```

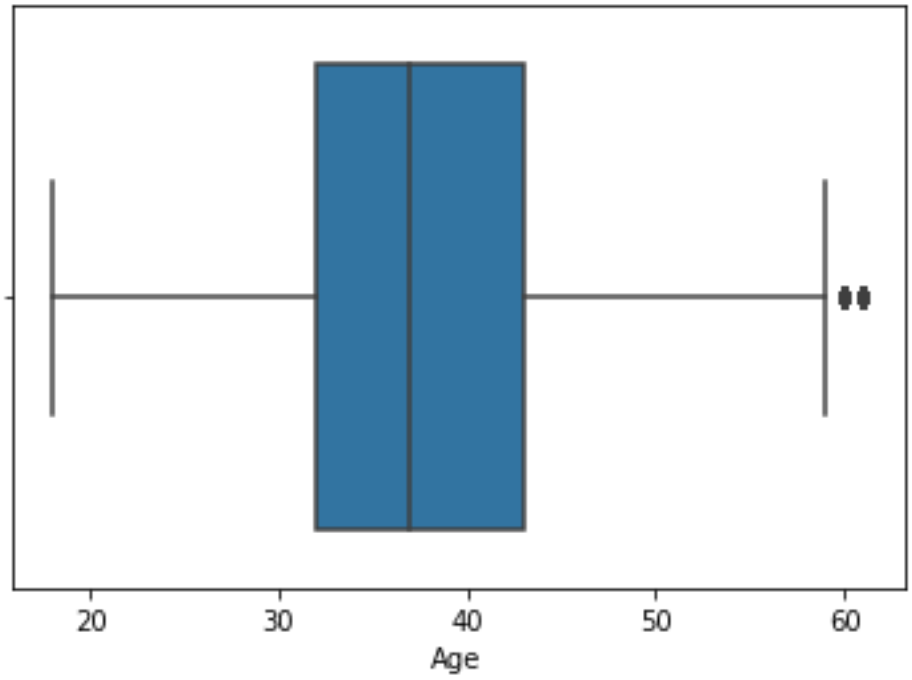
In [25]:

```
sns.boxplot(df2['Age'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWar
ning: Pass the following variable as a keyword arg: x. From version 0.12, t
he only valid positional argument will be `data`, and passing other argumen
ts without an explicit keyword will result in an error or misinterpretation
.
  FutureWarning
```

Out[25]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fcfb593ecd0>
```



7. Check the Categorial columns and perform Encoding

In [26]:

```
le = LabelEncoder()
df2['Geography'] = le.fit_transform(df2['Geography'])
df2['Gender'] = le.fit_transform(df2['Gender'])
df2.head()
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:2: SettingWith
CopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs
/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:3: SettingWith
CopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs
/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  This is separate from the ipykernel package so we can avoid doing imports
until
```

Out[26]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	15634602	Hargrave	619	0	0	42	2	0.00	1	1	1	101348.88	1
1	2	15647311	Hill	608	2	0	41	1	83807.86	1	0	1	112542.58	0
2	3	15619304	Onio	502	0	0	42	8	159660.80	3	1	0	113931.57	1
3	4	15701354	Boni	699	0	0	39	1	0.00	2	0	0	93826.63	0
4	5	15737888	Mitchell	850	2	0	43	2	125510.82	1	1	1	79084.10	0

In [26]:

8. Split the data into dependent and independent variables

In [27]:

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

Out[27]:

```
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)
```

In [28]:

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

Out[28]:

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

9. Scale the independent variables

In [29]:

```
scaler = MinMaxScaler()
df[['CustomerId']] = scaler.fit_transform(df[['CustomerId']])
df
```

Out[29]:

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	1	0.275616	Hargrave	619	France	Female	42	2	0.00	1	1	1	101348.88	1
1	2	0.326454	Hill	608	Spain	Female	41	1	83807.86	1	0	1	112542.58	0
2	3	0.214421	Onio	502	France	Female	42	8	159660.80	3	1	0	113931.57	1
3	4	0.542636	Boni	699	France	Female	39	1	0.00	2	0	0	93826.63	0
4	5	0.688778	Mitchell	850	Spain	Female	43	2	125510.82	1	1	1	79084.10	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9995	9996	0.162119	Obijiaku	771	France	Male	39	5	0.00	2	1	0	96270.64	0
9996	9997	0.016765	Johnstone	516	France	Male	35	10	57369.61	1	1	1	101699.77	0
9997	9998	0.075327	Liu	709	France	Female	36	7	0.00	1	0	1	42085.58	1
9998	9999	0.466637	Sabbatini	772	Germany	Male	42	3	75075.31	2	1	0	92888.52	1

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
9999	10000	0.250483	Walker	792	France	Female	28	4	130142.79	1	1	0	38190.78	0

10000 rows × 14 columns

10. Split the data into training and testing

In [30]:

```
train_size=0.8
X = df.drop(columns=['Tenure']).copy()
Y = df['Tenure']
X_train, X_test, Y_train, Y_test = train_test_split(X,Y,train_size=0.8)
print(X_train)
print(Y_train)
print(X_test)
print(Y_test)
```

```
      RowNumber  CustomerId          Surname  CreditScore Geography  Gender
\
3893       3894    0.396421        Chinweuba          543    France  Female
3109       3110    0.680738              Law          850   Germany  Female
603         604    0.106749            Burke          566    France    Male
904         905    0.915556            Ch'en          599    France    Male
3469       3470    0.361596  Cumbrae-Stewart          679     Spain  Female
...         ...         ...              ...          ...       ...     ...
5935       5936    0.849589        Stevenson          544     Spain    Male
6210       6211    0.105989          Simmons          522     Spain    Male
7570       7571    0.905012           Harker          697    France    Male
6644       6645    0.008768              Lei          556   Germany    Male
8260       8261    0.248527         Nikitina          640   Germany  Female

      Age    Balance  NumOfProducts  HasCrCard  IsActiveMember  \
3893   42       0.00              2          0               0
3109   47  134381.52              1          0               0
603    30       0.00              1          1               0
904    58       0.00              1          0               0
3469   26   76554.06              1          1               1
...   ...        ...            ...        ...             ...
5935   37       0.00              2          0               0
6210   30       0.00              2          1               0
7570   32  175464.85              3          1               0
6644   33  124213.36              2          1               0
8260   30   32197.64              1          0               1

      EstimatedSalary  Exited
3893        101905.34       0
3109         26812.89       1
603          54926.51       1
904         176407.15       1
3469        184800.27       0
```

```
...              ...     ...
5935        135067.02       0
6210        145490.85       0
7570        116442.42       1
6644         62627.55       0
8260        141446.01       0

[8000 rows x 13 columns]
3893     5
3109    10
603      5
904      4
3469     3
        ..
5935     2
6210     3
7570     7
6644     3
8260     5
Name: Tenure, Length: 8000, dtype: int64
      RowNumber  CustomerId    Surname  CreditScore Geography  Gender  Age
\
1041       1042    0.506486      Craig          722    France    Male   30
5208       5209    0.396161        Lei          779     Spain  Female   38
3628       3629    0.030473   Azubuike          493   Germany  Female   35
4635       4636    0.781326       Long          619    France  Female   33
8221       8222    0.834665  Robertson          443   Germany    Male   59
...         ...         ...        ...          ...       ...     ...  ...
449         450    0.369888       Cook          778     Spain  Female   47
4162       4163    0.431551       Bell          652    France  Female   74
9585       9586    0.179432   McCarthy          695     Spain  Female   35
4494       4495    0.605775     Watson          850     Spain    Male   31
7207       7208    0.021157     Begley          520     Spain  Female   30

        Balance  NumOfProducts  HasCrCard  IsActiveMember  EstimatedSalary
\
1041       0.00              2          1               0        166376.54
5208       0.00              2          1               1        138542.87
3628  178317.60              1          0               0        197428.64
4635  167733.51              2          1               1         65222.48
8221  110939.30              1          1               0         72846.58
...         ...            ...        ...             ...              ...
449   127299.34              2          1               0        124694.99
4162       0.00              2          1               1           937.15
9585   79858.13              2          1               1        127977.66
4494   82613.56              2          1               0        149170.92
7207  145222.99              2          0               0        145160.96

      Exited
1041       0
5208       0
3628       0
4635       0
8221       1
...      ...
449        0
4162       0
```

```
9585       0
4494       0
7207       0

[2000 rows x 13 columns]
1041    5
5208    7
3628    8
4635    2
8221    4
       ..
449     6
4162    5
9585    7
4494    6
7207    4
Name: Tenure, Length: 2000, dtype: int64
```