TEAM ID : PNT2022TMID03970

Data Visualization and Pre-Processing

#Import the necessary libraries

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

2.Download and Load the dataset

```
data = pd.read_csv(r"/content/Churn_Modelling.csv")
```

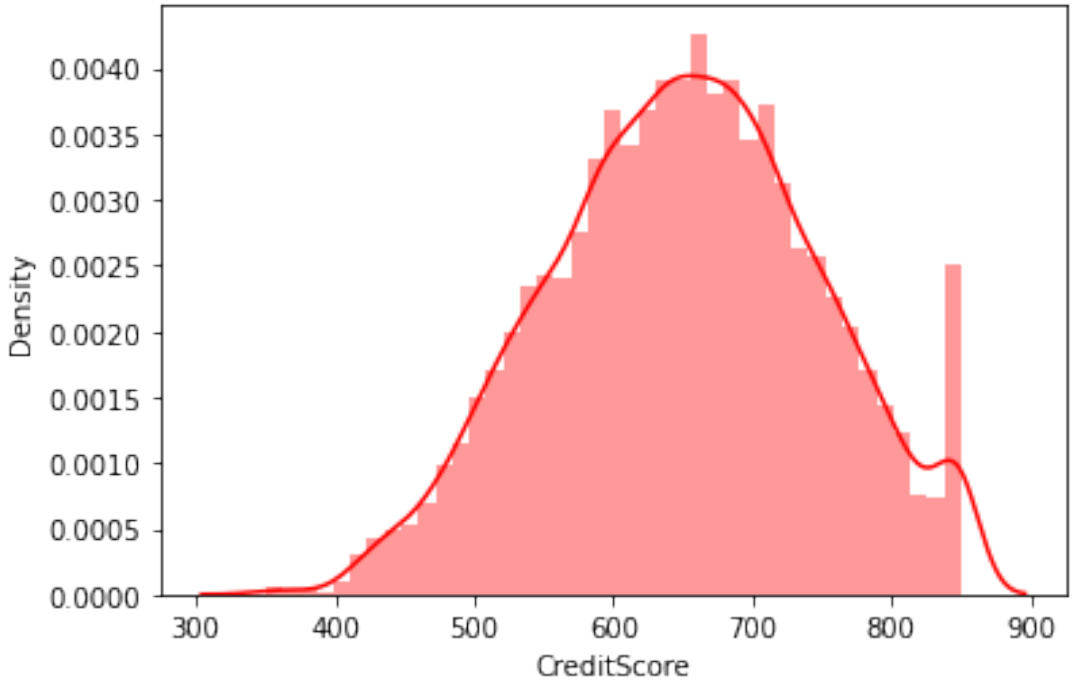
```
data.head()
```

```
   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)(a)Uni-variate Analysis

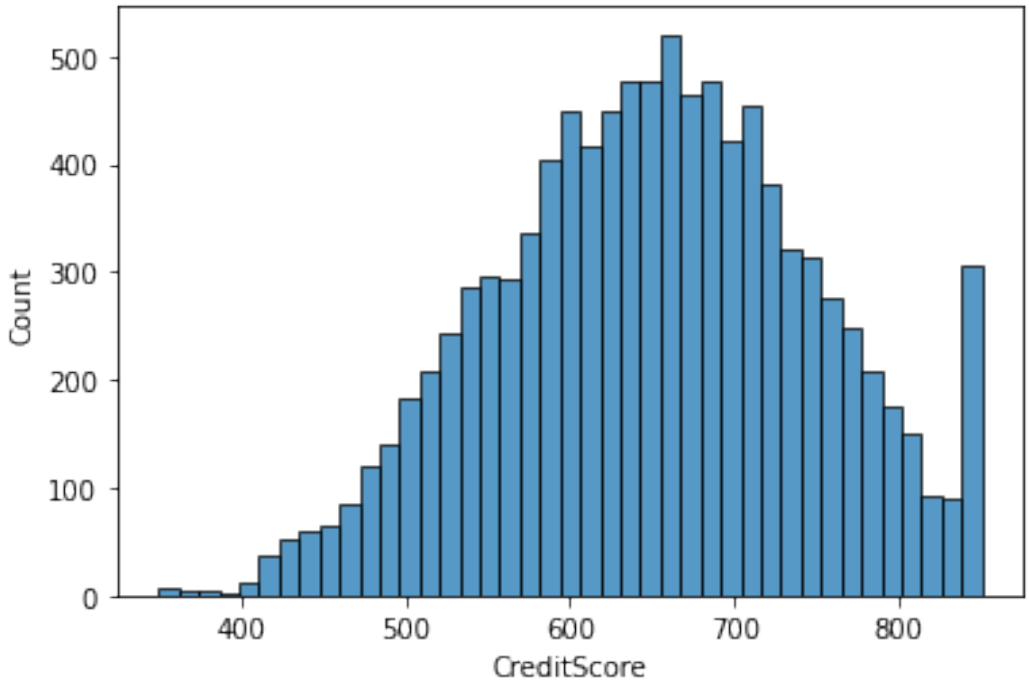
```
sns.distplot(data['CreditScore'],color="r")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08cfbfce10>
```



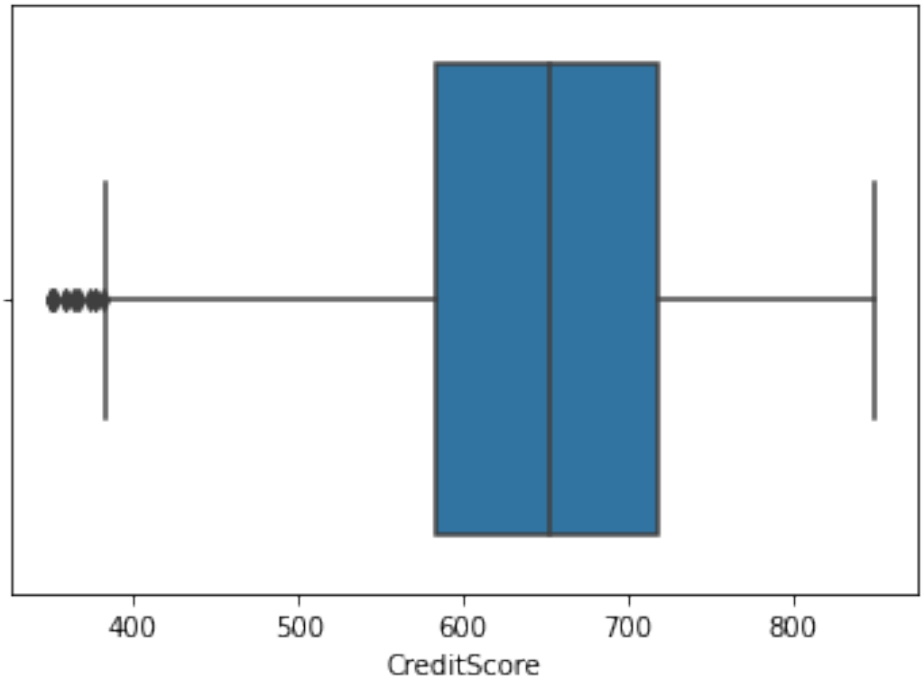

```
sns.histplot(data['CreditScore'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d894ccd0>
```

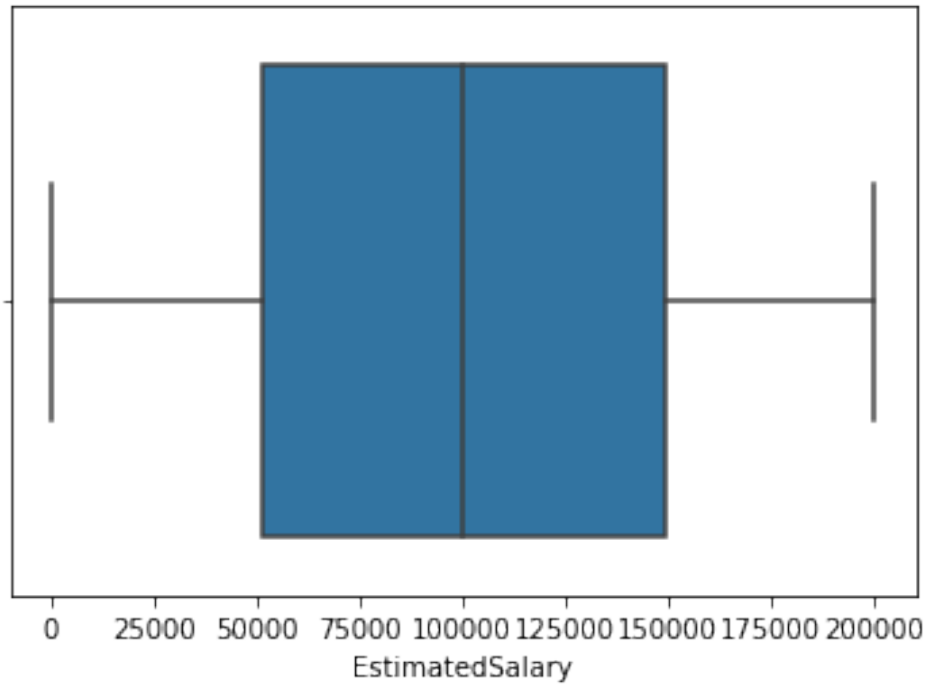



```
sns.boxplot(data['CreditScore'])
```

```
/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 0x7f08d8403350>
```



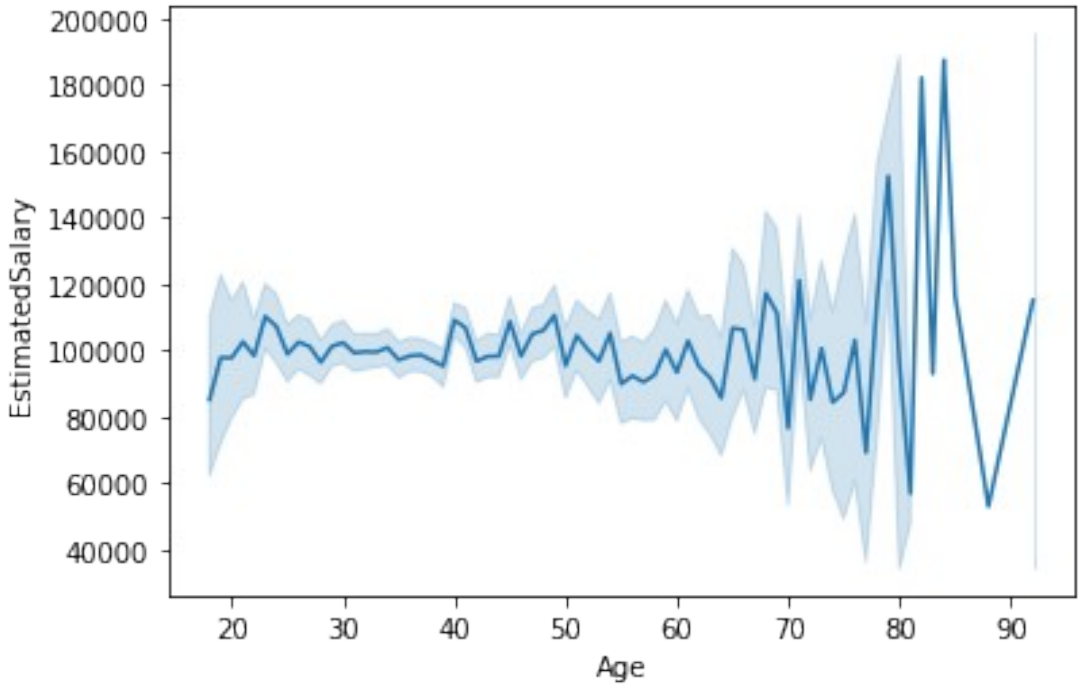

```
sns.boxplot(data['EstimatedSalary'])

/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 0x7f08d83791d0>
```



3)(B)Bi-variate Analysis

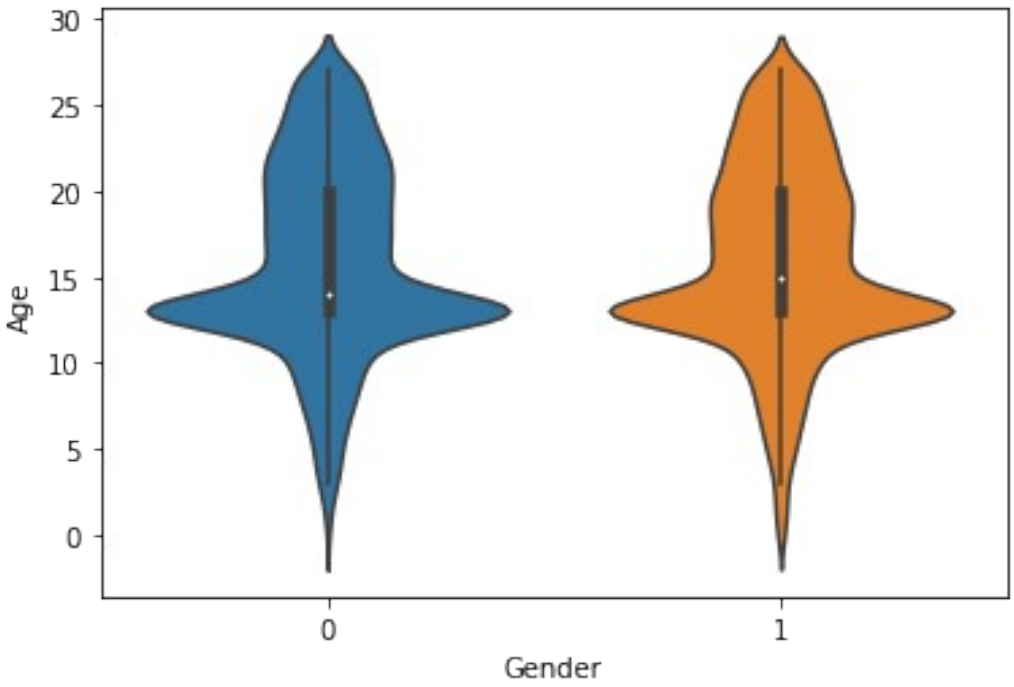
```
import warnings
warnings.filterwarnings("ignore")

sns.lineplot(data['Age'], data['EstimatedSalary'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d82f8290>
```



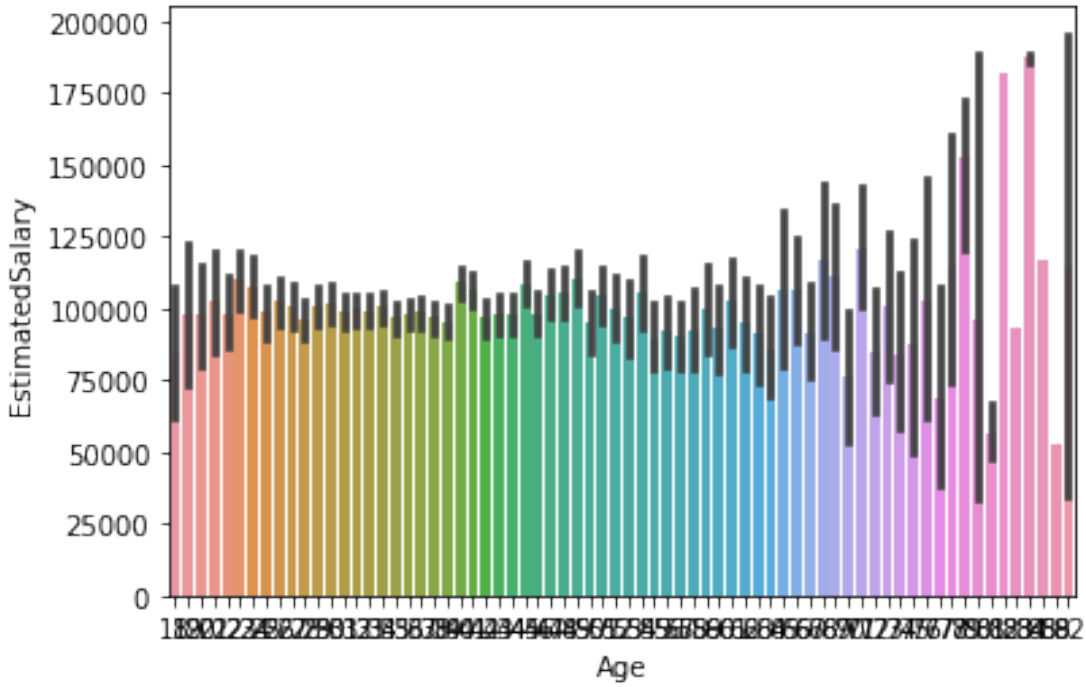

```
import seaborn as sns
sns.violinplot(y = data['Age'], x = data['Gender'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08c7535990>
```



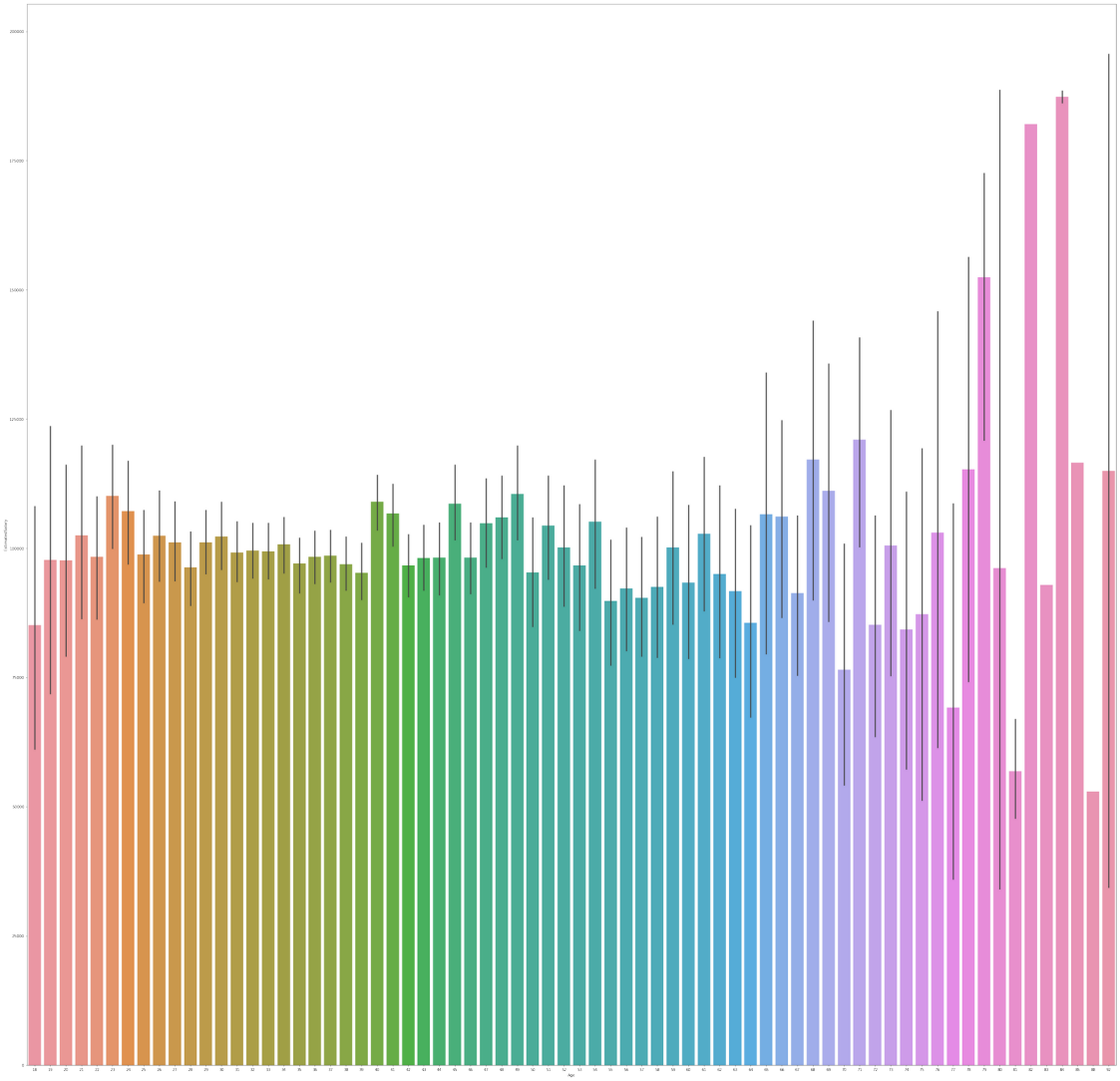

```
sns.barplot(data['Age'], data['EstimatedSalary'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d82e0bd0>
```



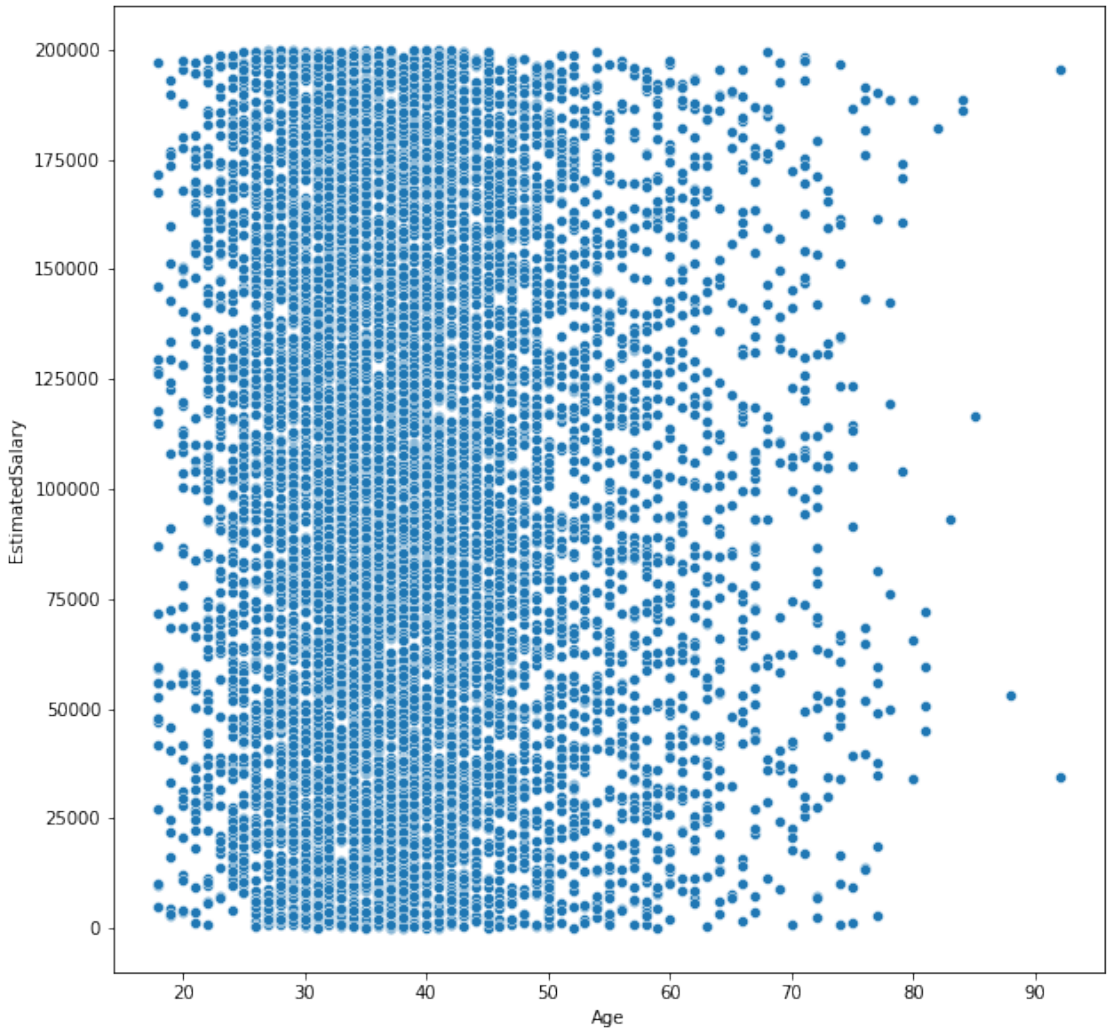

```
plt.figure(figsize=(50,50))
sns.barplot(data['Age'], data['EstimatedSalary'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d7fd5e90>
```



```
plt.figure(figsize=(10,10))
sns.scatterplot(data['Age'], data['EstimatedSalary'])
```

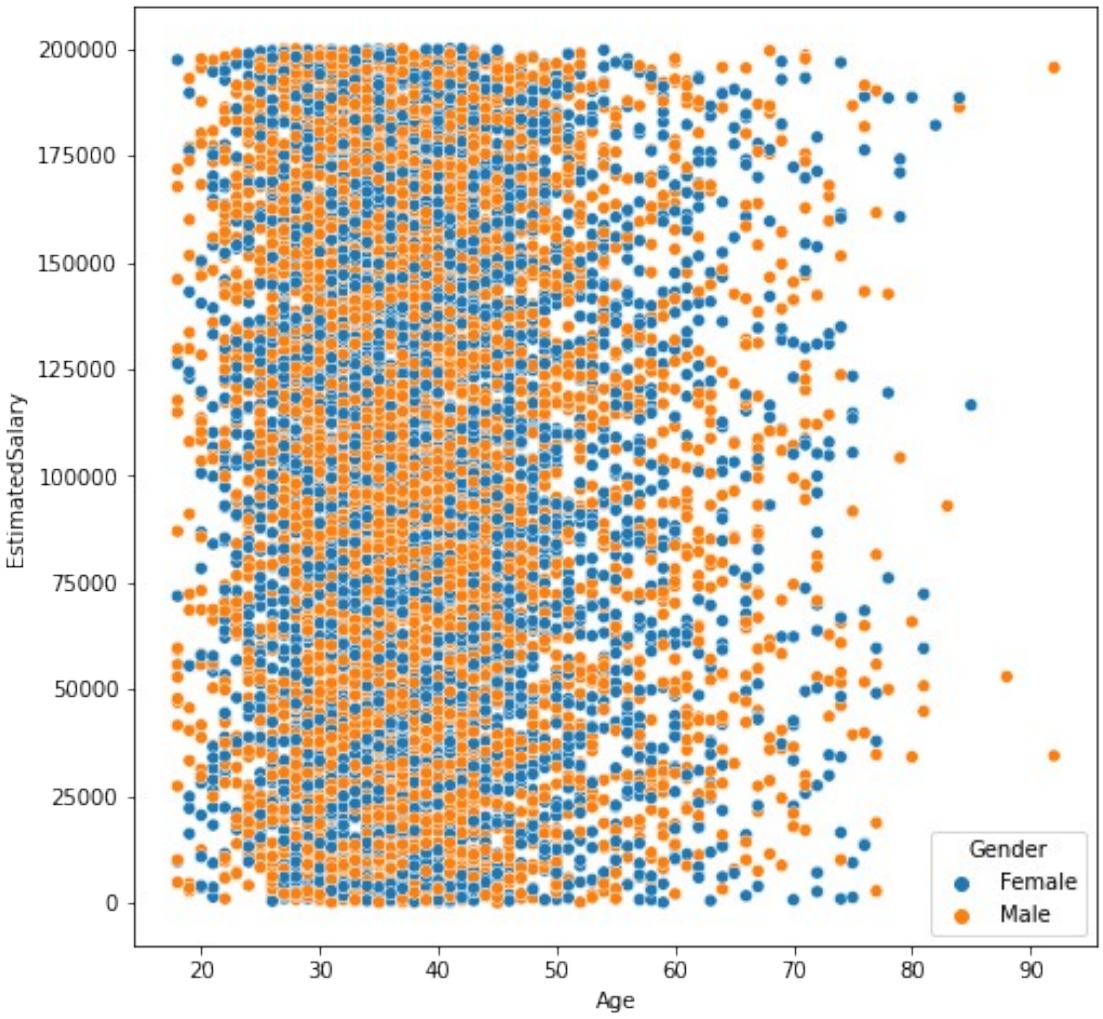
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d7fdb450>
```



3)(C)Multi-Variate Analysis

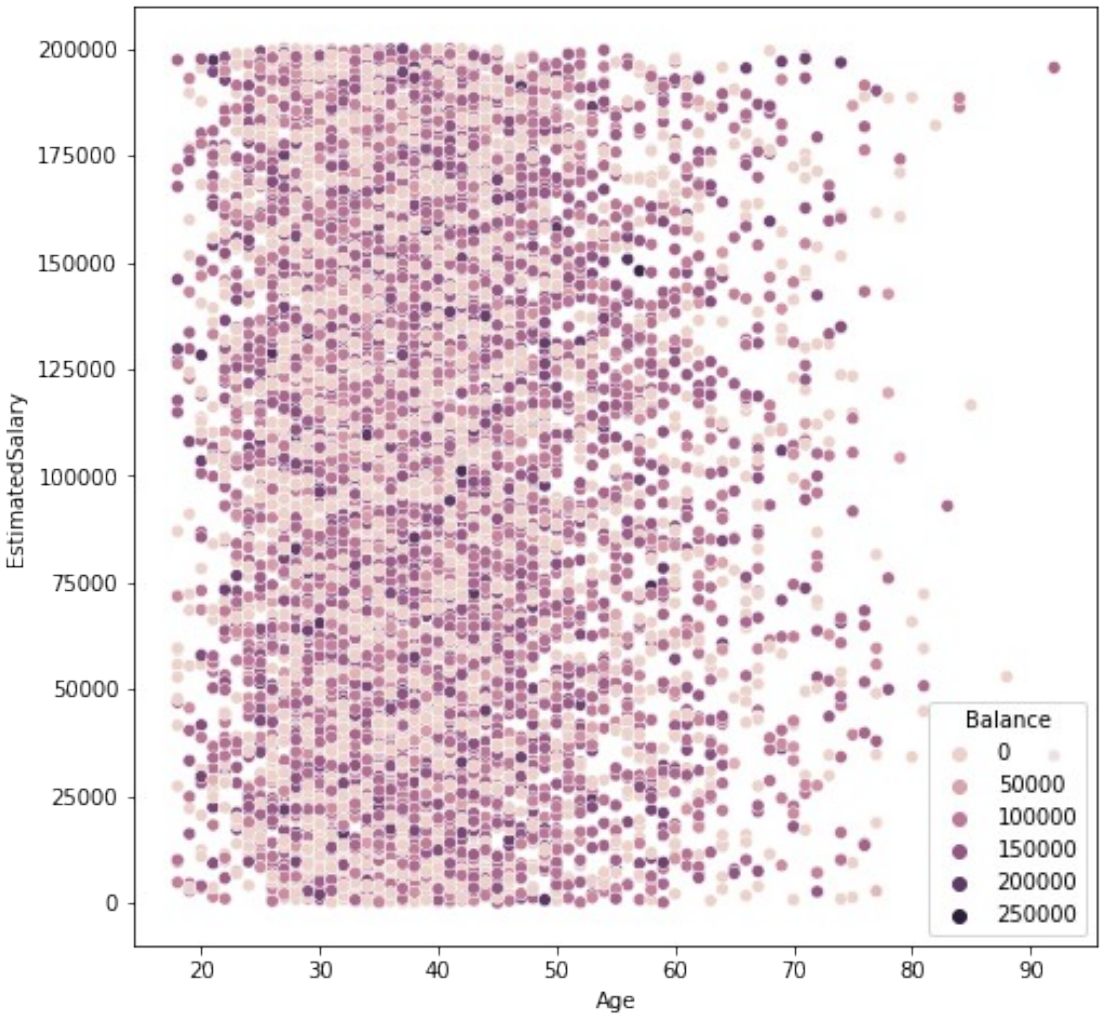
```
plt.figure(figsize=(8,8))
sns.scatterplot(data['Age'], data['EstimatedSalary'], hue =
data['Gender'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d7c67d90>
```



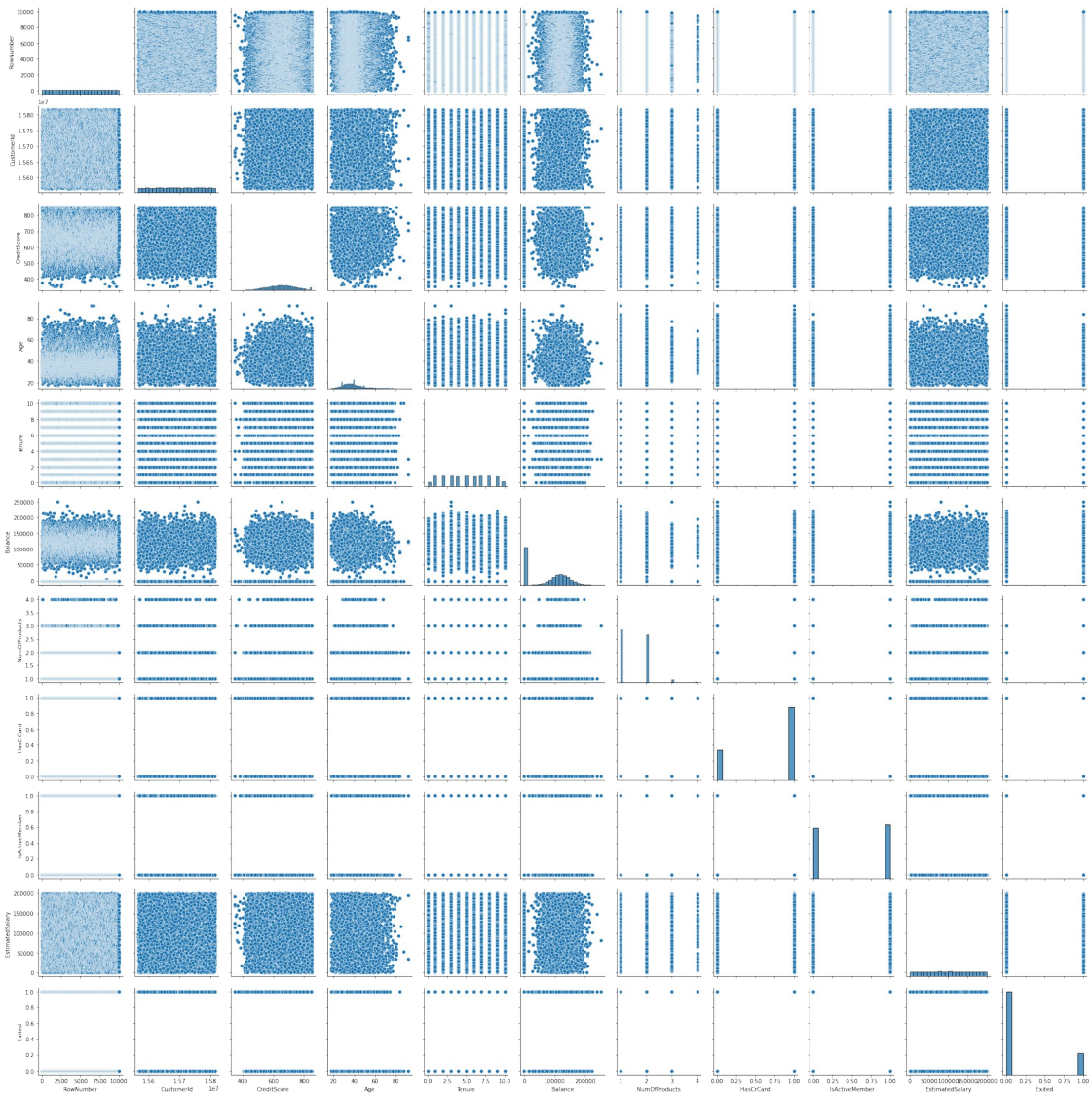

```
plt.figure(figsize=(8,8))
sns.scatterplot(data['Age'], data['EstimatedSalary'], hue =
data['Balance'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d637b1d0>
```




```
sns.pairplot(data)
```

```
<seaborn.axisgrid.PairGrid at 0x7f08d63ed250>
```




```
sns.pairplot(df,hue="Gender",size=2)
```

```
<seaborn.axisgrid.PairGrid at 0x7f08c721f350>
```

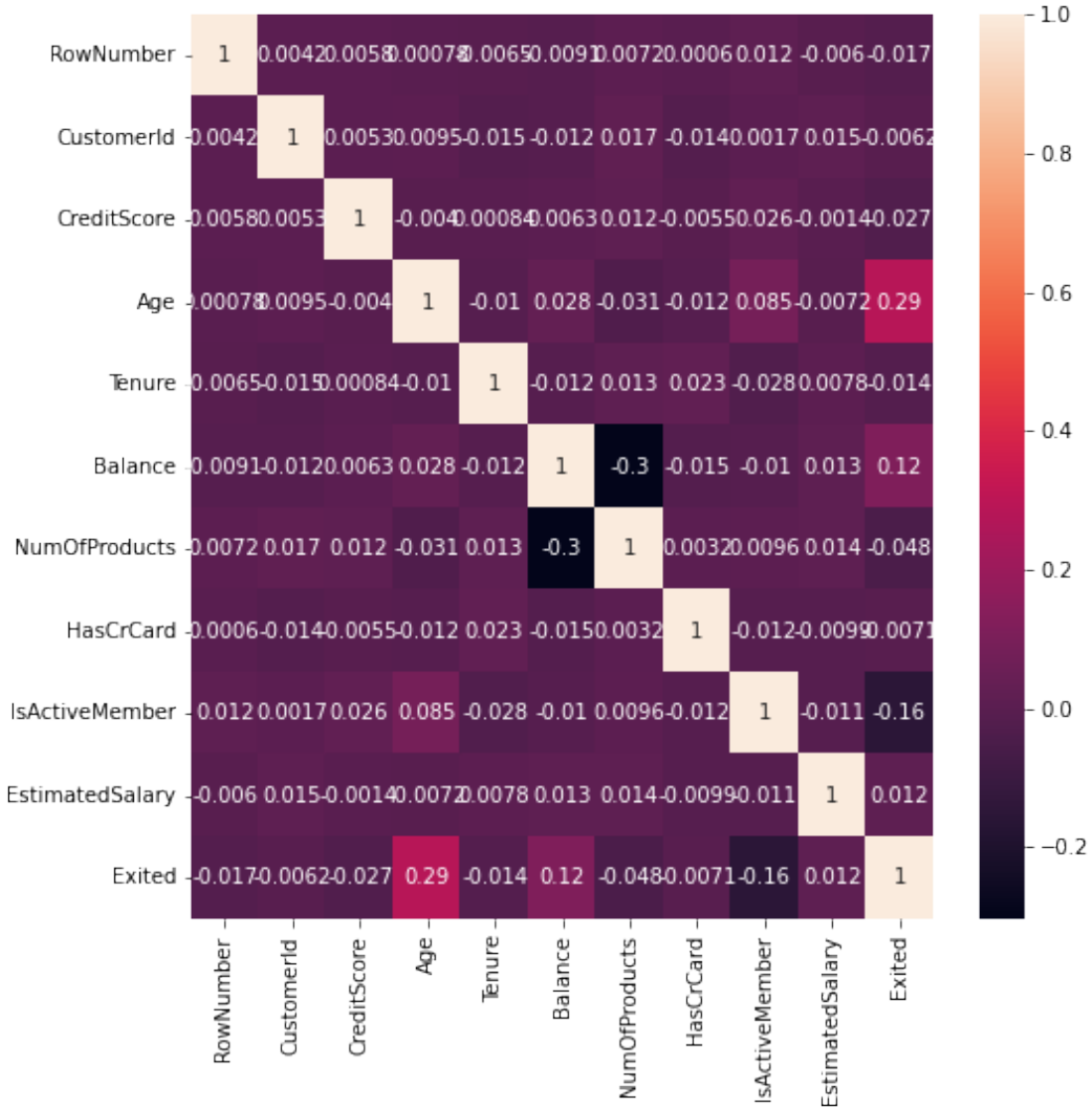

```
data.corr()
```

	RowNumber	CustomerId	CreditScore	Age	Tenure
RowNumber	1.000000	0.004202	0.005840	0.000783	-0.006495
CustomerId	0.004202	1.000000	0.005308	0.009497	-0.014883
CreditScore	0.005840	0.005308	1.000000	-0.003965	0.000842
Age	0.000783	0.009497	-0.003965	1.000000	-0.009997
Tenure	-0.006495	-0.014883	0.000842	-0.009997	1.000000
Balance	-0.009067	-0.012419	0.006268	0.028308	-0.012254
NumOfProducts	0.007246	0.016972	0.012238	-0.030680	0.013444
HasCrCard	0.000599	-0.014025	-0.005458	-0.011721	

```
0.022583
IsActiveMember    0.012044    0.001665     0.025651  0.085472 -
0.028362
EstimatedSalary  -0.005988    0.015271    -0.001384 -0.007201
0.007784
Exited           -0.016571   -0.006248    -0.027094  0.285323 -
0.014001

                  Balance  NumOfProducts  HasCrCard  IsActiveMember  \
RowNumber       -0.009067       0.007246   0.000599        0.012044
CustomerId      -0.012419       0.016972  -0.014025        0.001665
CreditScore      0.006268       0.012238  -0.005458        0.025651
Age              0.028308      -0.030680  -0.011721        0.085472
Tenure          -0.012254       0.013444   0.022583       -0.028362
Balance          1.000000      -0.304180  -0.014858       -0.010084
NumOfProducts   -0.304180       1.000000   0.003183        0.009612
HasCrCard       -0.014858       0.003183   1.000000       -0.011866
IsActiveMember  -0.010084       0.009612  -0.011866        1.000000
EstimatedSalary  0.012797       0.014204  -0.009933       -0.011421
Exited           0.118533      -0.047820  -0.007138       -0.156128

                 EstimatedSalary    Exited
RowNumber              -0.005988 -0.016571
CustomerId              0.015271 -0.006248
CreditScore            -0.001384 -0.027094
Age                    -0.007201  0.285323
Tenure                  0.007784 -0.014001
Balance                 0.012797  0.118533
NumOfProducts           0.014204 -0.047820
HasCrCard              -0.009933 -0.007138
IsActiveMember         -0.011421 -0.156128
EstimatedSalary         1.000000  0.012097
Exited                  0.012097  1.000000
```

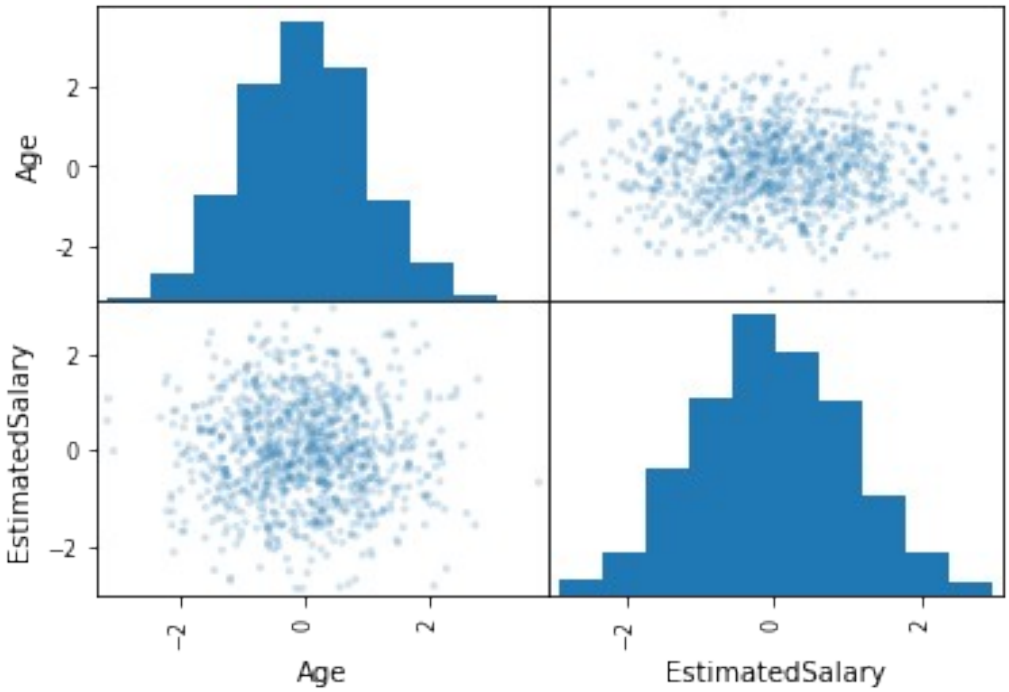
```
plt.figure(figsize=(8,8))
sns.heatmap(data.corr(), annot = True)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d5329850>
```




```
df = pd.DataFrame(np.random.randn(1000, 2),
columns=['Age','EstimatedSalary'])
pd.plotting.scatter_matrix(df, alpha=0.2)
```

```
array([[<matplotlib.axes._subplots.AxesSubplot object at
0x7f08d0675410>,
        <matplotlib.axes._subplots.AxesSubplot object at
0x7f08d069e990>],
       [<matplotlib.axes._subplots.AxesSubplot object at
0x7f08d0656f90>,
        <matplotlib.axes._subplots.AxesSubplot object at
0x7f08d06195d0>]],
      dtype=object)
```



4)Descriptive Statistics

```
data.mean()

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

data.median()

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
```

```
data.mode()
```

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

      Tenure  Balance  NumOfProducts  HasCrCard  IsActiveMember  \
0        2.0      0.0            1.0        1.0             1.0
1        NaN      NaN            NaN        NaN             NaN
2        NaN      NaN            NaN        NaN             NaN
3        NaN      NaN            NaN        NaN             NaN
4        NaN      NaN            NaN        NaN             NaN
...      ...      ...            ...        ...             ...
9995     NaN      NaN            NaN        NaN             NaN
9996     NaN      NaN            NaN        NaN             NaN
9997     NaN      NaN            NaN        NaN             NaN
9998     NaN      NaN            NaN        NaN             NaN
9999     NaN      NaN            NaN        NaN             NaN

      EstimatedSalary  Exited
0            24924.92     0.0
1                 NaN     NaN
2                 NaN     NaN
3                 NaN     NaN
4                 NaN     NaN
```

```
...               ...     ...
9995              NaN     NaN
9996              NaN     NaN
9997              NaN     NaN
9998              NaN     NaN
9999              NaN     NaN

[10000 rows x 14 columns]
```

```
data.var()
```

```
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
```

```
data.std
```

```
<bound method NDFrame._add_numeric_operations.<locals>.std of
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
...         ...         ...        ...          ...       ...     ...
...
9995       9996    15606229   Obijiaku          771    France    Male
39
9996       9997    15569892  Johnstone          516    France    Male
35
9997       9998    15584532        Liu          709    France  Female
36
9998       9999    15682355  Sabbatini          772   Germany    Male
42
9999      10000    15628319     Walker          792    France  Female
28
```

```
      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
...      ...        ...            ...        ...             ...
9995       5       0.00              2          1               0
9996      10   57369.61              1          1               1
9997       7       0.00              1          0               1
9998       3   75075.31              2          1               0
9999       4  130142.79              1          1               0

      EstimatedSalary  Exited
0           101348.88       1
1           112542.58       0
2           113931.57       1
3            93826.63       0
4            79084.10       0
...               ...     ...
9995         96270.64       0
9996        101699.77       0
9997         42085.58       1
9998         92888.52       1
9999         38190.78       0

[10000 rows x 14 columns]>
```

```
data.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
```

```
data['Age'].unique()
```

```
array([42, 41, 39, 43, 44, 50, 29, 27, 31, 24, 34, 25, 35, 45, 58, 32,
38,
       46, 36, 33, 40, 51, 61, 49, 37, 19, 66, 56, 26, 21, 55, 75, 22,
30,
       28, 65, 48, 52, 57, 73, 47, 54, 72, 20, 67, 79, 62, 53, 80, 59,
68,
       23, 60, 70, 63, 64, 18, 82, 69, 74, 71, 76, 77, 88, 85, 84, 78,
81,
       92, 83])
```

```
data['Gender'].unique()
```

```
array(['Female', 'Male'], dtype=object)
```

```
data['Age'].value_counts()
```

```
37    478
38    477
35    474
36    456
34    447
     ...
92      2
82      1
88      1
85      1
83      1
Name: Age, Length: 70, dtype: int64
```

```
data.max()
```

```
RowNumber              10000
CustomerId          15815690
Surname               Zuyeva
CreditScore              850
Geography              Spain
Gender                  Male
Age                       92
Tenure                    10
Balance             250898.09
NumOfProducts               4
HasCrCard                   1
IsActiveMember              1
EstimatedSalary    199992.48
Exited                      1
dtype: object
```

5)Handle Missing Values

```
data.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
```

```
data.shape
```

```
(10000, 14)
```

```
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
```

```
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]
```

```
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
```

```
df=data.fillna(value=0)
df
```

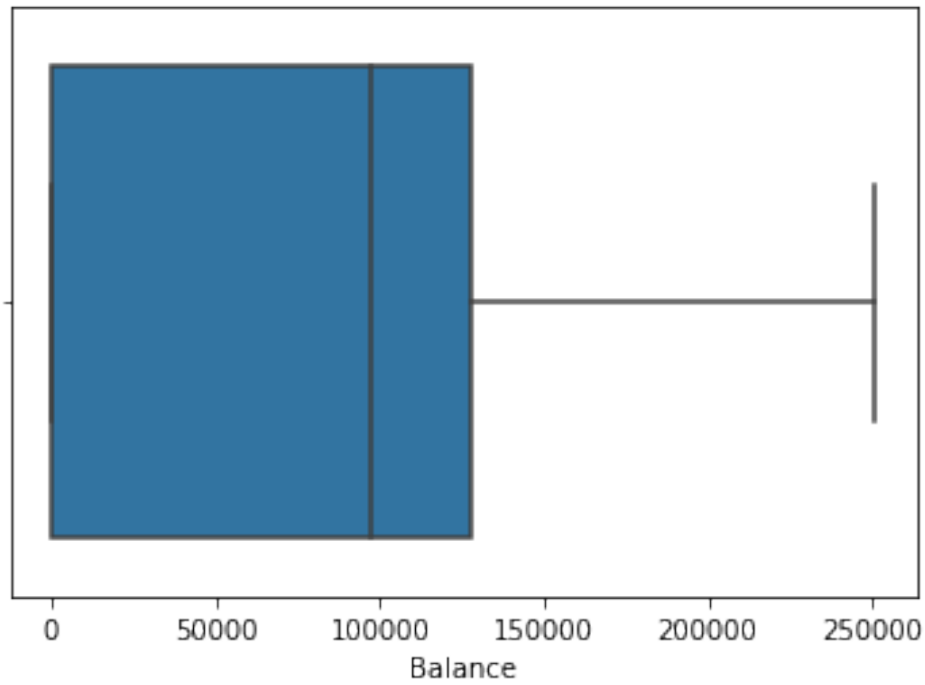
```
      RowNumber  CustomerId    Surname  CreditScore Geography  Gender
Age  \
```

```
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
...        ...         ...        ...          ...       ...     ...
...
9995      9996    15606229   Obijiaku          771    France    Male
39
9996      9997    15569892  Johnstone          516    France    Male
35
9997      9998    15584532        Liu          709    France  Female
36
9998      9999    15682355  Sabbatini          772   Germany    Male
42
9999     10000    15628319     Walker          792    France  Female
28

      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
...      ...        ...            ...        ...             ...
9995       5       0.00              2          1               0
9996      10   57369.61              1          1               1
9997       7       0.00              1          0               1
9998       3   75075.31              2          1               0
9999       4  130142.79              1          1               0

      EstimatedSalary  Exited
0           101348.88       1
1           112542.58       0
2           113931.57       1
3            93826.63       0
4            79084.10       0
...               ...     ...
9995         96270.64       0
9996        101699.77       0
9997         42085.58       1
9998         92888.52       1
9999         38190.78       0

[10000 rows x 14 columns]
```

6)Outliers

```
sns.boxplot(data['Balance'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d7c3e750>
```




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

```
      RowNumber   CustomerId  CreditScore   Age  Tenure    Balance  \
0.75    7500.25  15753233.75        718.0  44.0     7.0  127644.24
0.25    2500.75  15628528.25        584.0  32.0     3.0       0.00

      NumOfProducts  HasCrCard  IsActiveMember  EstimatedSalary
Exited
0.75            2.0        1.0             1.0      149388.2475
0.0
0.25            1.0        0.0             0.0       51002.1100
0.0
```

```
iqr =  q.iloc[0] - q.iloc[1]
```

```
iqr
```

```
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
```

```
u = q.iloc[0] + (1.5*iqr)
u
```

```
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
```

```
l = q.iloc[1] - (1.5*iqr)
l
```

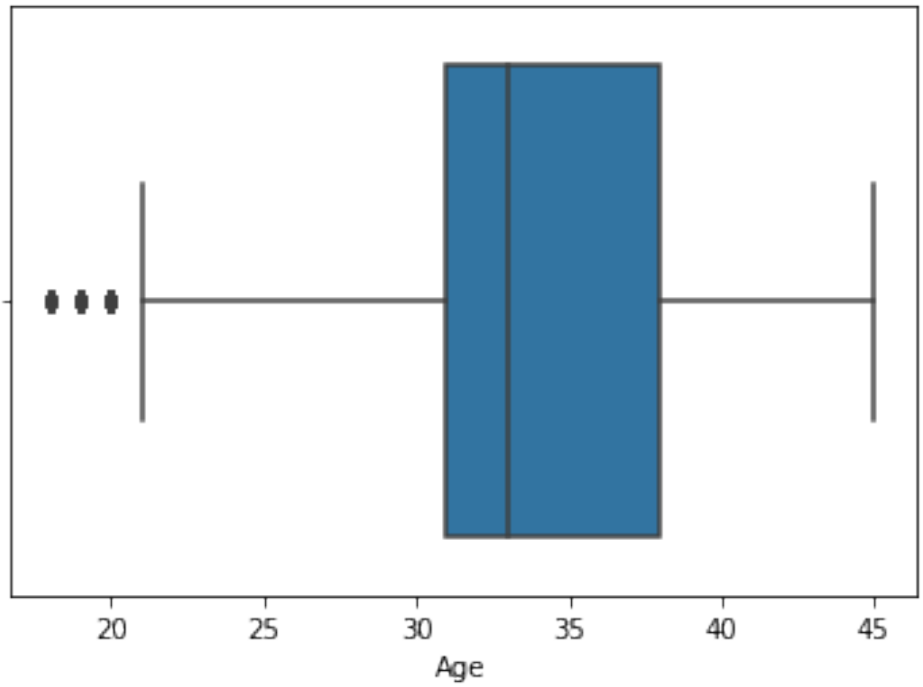
```
RowNumber         -4.998500e+03
CustomerId         1.544147e+07
CreditScore        3.830000e+02
Age                1.400000e+01
Tenure            -3.000000e+00
Balance           -1.914664e+05
NumOfProducts     -5.000000e-01
HasCrCard         -1.500000e+00
IsActiveMember    -1.500000e+00
EstimatedSalary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

Handling outliers

```
data['Age'] = np.where(data['Age']>45, 31, data['Age'])
```

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

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f08d04a8550>
```



7)Check for Categorical columns and perform encoding

```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
le = LabelEncoder()
oneh = OneHotEncoder()
data['Gender'] = le.fit_transform(data['Gender'])
```

```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
le = LabelEncoder()
oneh = OneHotEncoder()
data['Gender'] = le.fit_transform(data['Gender'])

data.head()
```

```
   RowNumber  CustomerId   Surname  CreditScore Geography  Gender  Age
\
0          1    15634602  Hargrave          619    France       0   42

1          2    15647311      Hill          608     Spain       0   41

2          3    15619304      Onio          502    France       0   42

3          4    15701354      Boni          699    France       0   39

4          5    15737888  Mitchell          850     Spain       0   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
```

```
data['Age'] = le.fit_transform(data['Age'])
data['Geography'] = le.fit_transform(data['Geography'])

data.head()
```

```
   RowNumber  CustomerId   Surname  CreditScore  Geography  Gender
Age  \
0          1    15634602  Hargrave          619          0       0
24
1          2    15647311      Hill          608          2       0
23
2          3    15619304      Onio          502          0       0
24
3          4    15701354      Boni          699          0       0
21
4          5    15737888  Mitchell          850          2       0
25

   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
```

8)Split the data into dependent and independent variables

```
X=data.iloc[:,0:10]
X
```

```
      RowNumber  CustomerId    Surname  CreditScore  Geography  Gender
Age  \
0             1    15634602   Hargrave          619          0       0
24
1             2    15647311       Hill          608          2       0
23
2             3    15619304       Onio          502          0       0
24
3             4    15701354       Boni          699          0       0
21
4             5    15737888   Mitchell          850          2       0
25
...         ...         ...        ...          ...        ...     ...
...
9995       9996    15606229   Obijiaku          771          0       1
21
9996       9997    15569892  Johnstone          516          0       1
17
9997       9998    15584532        Liu          709          0       0
18
9998       9999    15682355  Sabbatini          772          1       1
24
9999      10000    15628319     Walker          792          0       0
10

      Tenure    Balance  NumOfProducts
0          2       0.00              1
1          1   83807.86              1
2          8  159660.80              3
3          1       0.00              2
4          2  125510.82              1
...      ...        ...            ...
9995       5       0.00              2
9996      10   57369.61              1
9997       7       0.00              1
9998       3   75075.31              2
9999       4  130142.79              1

[10000 rows x 10 columns]

Y=data.iloc[:,10]
Y

0       1
1       0
2       1
3       0
4       1
       ..
9995    1
```

```
9996    1
9997    0
9998    1
9999    1
Name: HasCrCard, Length: 10000, dtype: int64
```

```
y = data['EstimatedSalary']
```

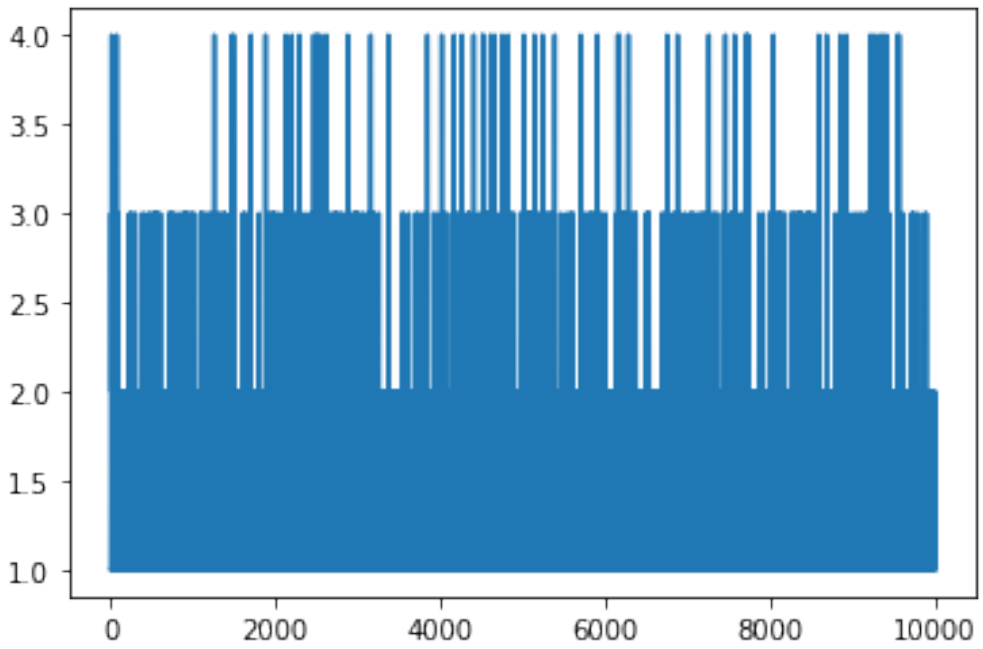
```
y
```

```
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
```

9)Scale the independent variables

```
EstimatedSalary=data.NumOfProducts
plt.plot(EstimatedSalary)
```

```
[<matplotlib.lines.Line2D at 0x7f08d020d5d0>]
```

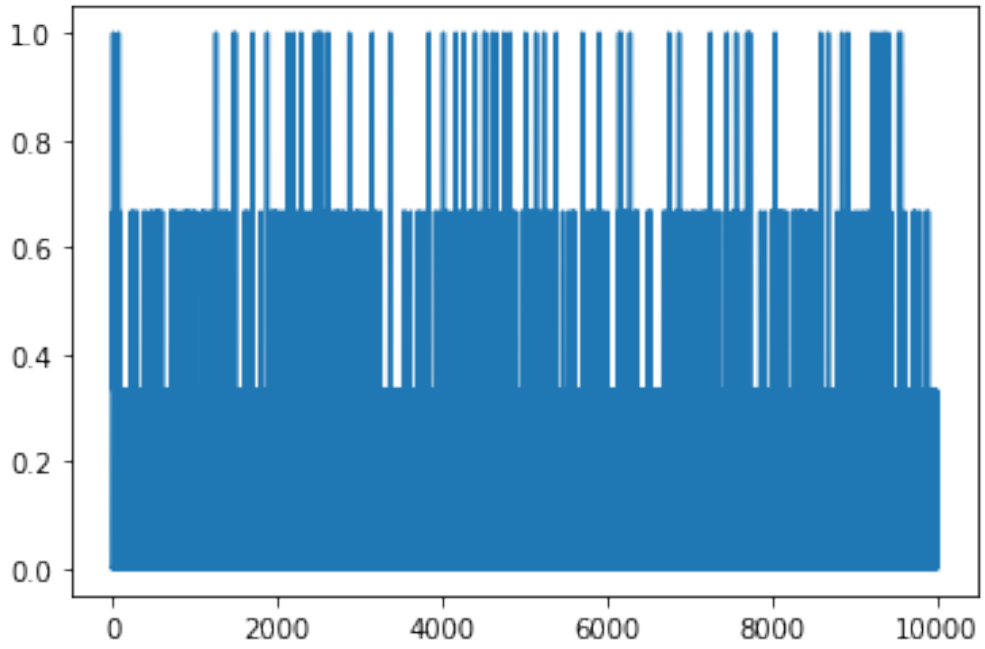


```
data[['EstimatedSalary']].describe()
```

```
       EstimatedSalary
count     10000.000000
mean     100090.239881
std       57510.492818
min          11.580000
25%       51002.110000
50%      100193.915000
75%      149388.247500
max      199992.480000
```

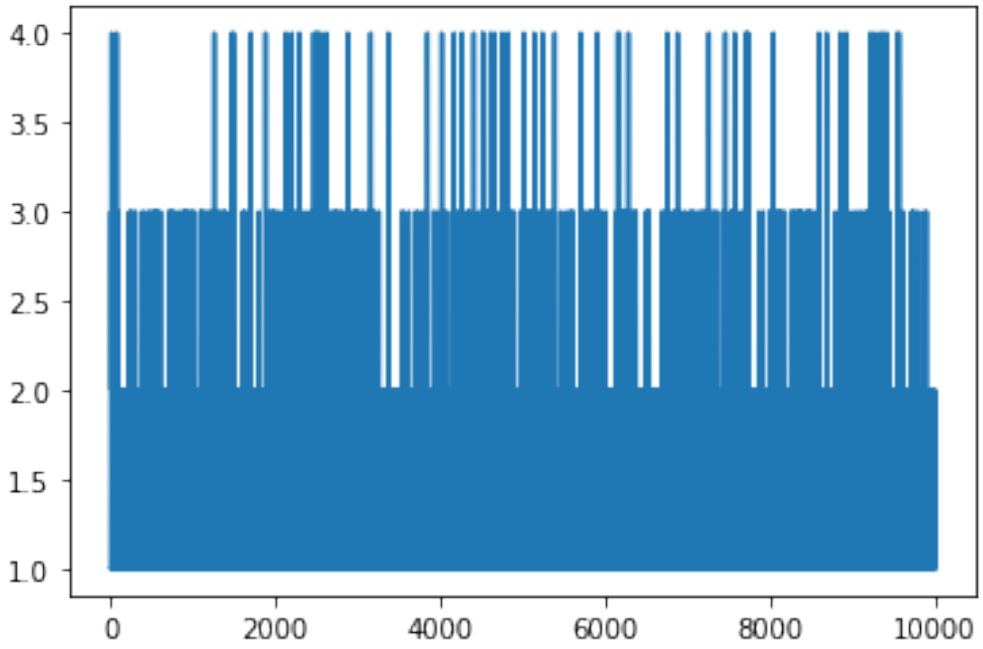
```
from sklearn import preprocessing
from sklearn.preprocessing import scale
EstimatedSalary_matrix=EstimatedSalary.values.reshape(-1,1)
scaled=preprocessing.MinMaxScaler()
scaled_EstimatedSalary=scaled.fit_transform(EstimatedSalary_matrix)
plt.plot(scaled_EstimatedSalary)
```

```
[<matplotlib.lines.Line2D at 0x7f08d01fb5d0>]
```



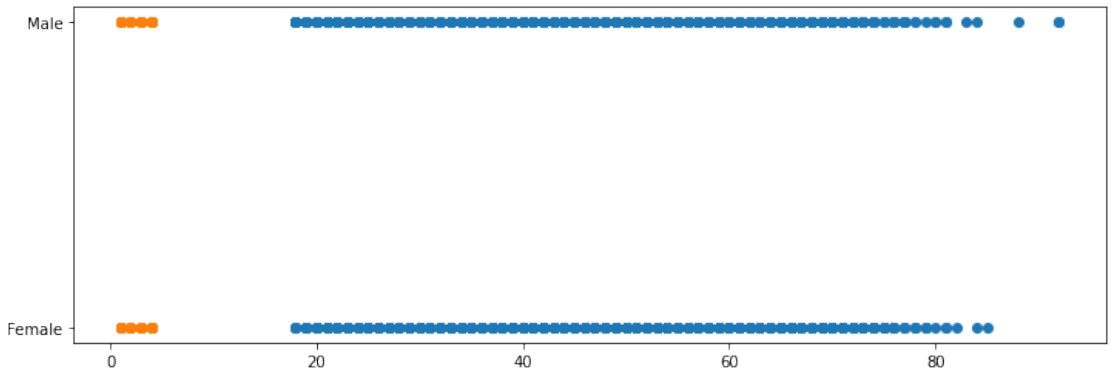

```
std_EstimatedSalary=scale(EstimatedSalary,axis=0,with_mean=False,with_
std=False)
plt.plot(std_EstimatedSalary)
```

```
[<matplotlib.lines.Line2D at 0x7f08d015eed0>]
```



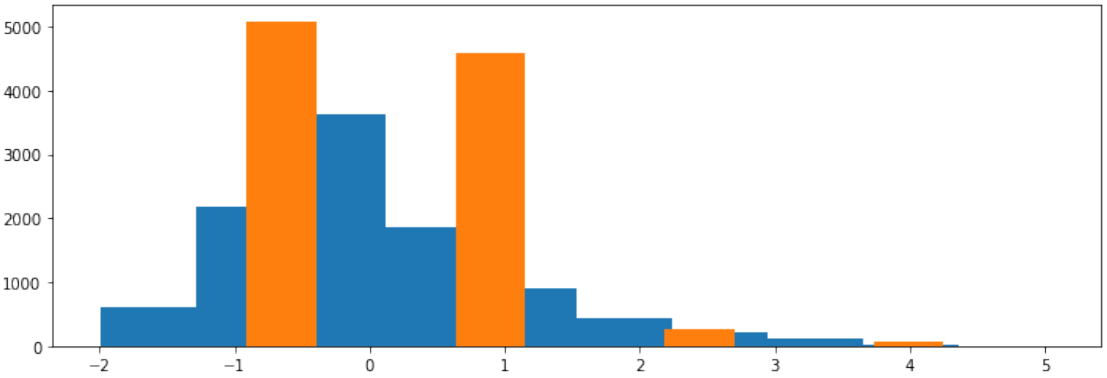

```
x = df[['Age', 'NumOfProducts']].values
y = df['Gender'].values

fig, ax = plt.subplots(figsize=(12, 4))

ax.scatter(x[:,0], y)
ax.scatter(x[:,1], y)
```

```
<matplotlib.collections.PathCollection at 0x7f08c4e6ae50>
```



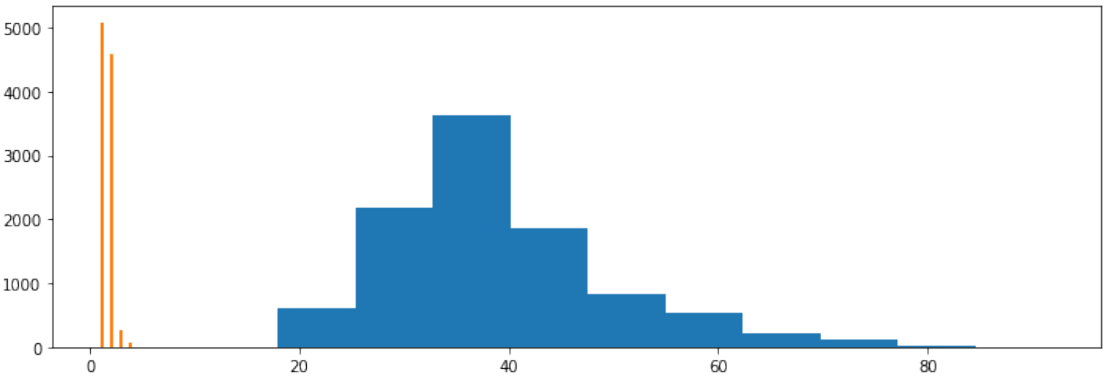

```
from sklearn.preprocessing import StandardScaler
fig, ax = plt.subplots(figsize=(12, 4))

scaler = StandardScaler()
x_std = scaler.fit_transform(x)

ax.hist(x_std[:,0])
ax.hist(x_std[:,1])
```

```
(array([5084.,    0.,    0., 4590.,    0.,    0.,  266.,    0.,    0.,
          60.]),
 array([-0.91158349, -0.39578748,  0.12000854,  0.63580456,
1.15160057,
         1.66739659,  2.18319261,  2.69898862,  3.21478464,
3.73058066,
         4.24637668]),
 <a list of 10 Patch objects>)
```




```
fig, ax = plt.subplots(figsize=(12, 4))

ax.hist(x[:,0])
ax.hist(x[:,1])
```

```
(array([5084.,    0.,    0., 4590.,    0.,    0.,  266.,    0.,    0.,
          60.]),
 array([1. , 1.3, 1.6, 1.9, 2.2, 2.5, 2.8, 3.1, 3.4, 3.7, 4. ]),
 <a list of 10 Patch objects>)
```



10)Split the data into training and testing

```
x=np.array(data["Surname"]).reshape(-1,1)

x.shape
```

```
(10000, 1)
```

```
y=np.array(data["EstimatedSalary"])
y.shape
```

```
(10000,)
```

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.30)
```

```
x_train
```

```
array([['Gardner'],
       ['Stevenson'],
       ['Costa'],
       ...,
       ['McCawley'],
       ['Miller'],
       ['Capon']], dtype=object)
```

```
x_train.shape
```

```
(7000, 1)
```

```
x_test
```

```
array([['Duncan'],
       ["O'Brien"],
       ['Hunt'],
       ...,
       ['Chiang'],
       ['Ferguson'],
       ['Wimble']], dtype=object)
```

```
x_test.shape
```

```
(3000, 1)
```

```
y_train
```

```
array([ 47848.56, 125518.32,  43174.49, ..., 198914.8 , 109794.31,
        52796.31])
```

```
y_test
```

```
array([ 86410.28, 177025.79, 101455.07, ..., 110114.38, 106918.67,
        54865.92])
```