```
# Importing required libraries

import numpy as np
import pandas as pd

# Reading the dataset

df = pd.read_csv('/content/Churn_Modelling.csv')

# Visualizing 1st 50 data

df.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

```
# Checking for null values

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
```

```
df.dtypes
```

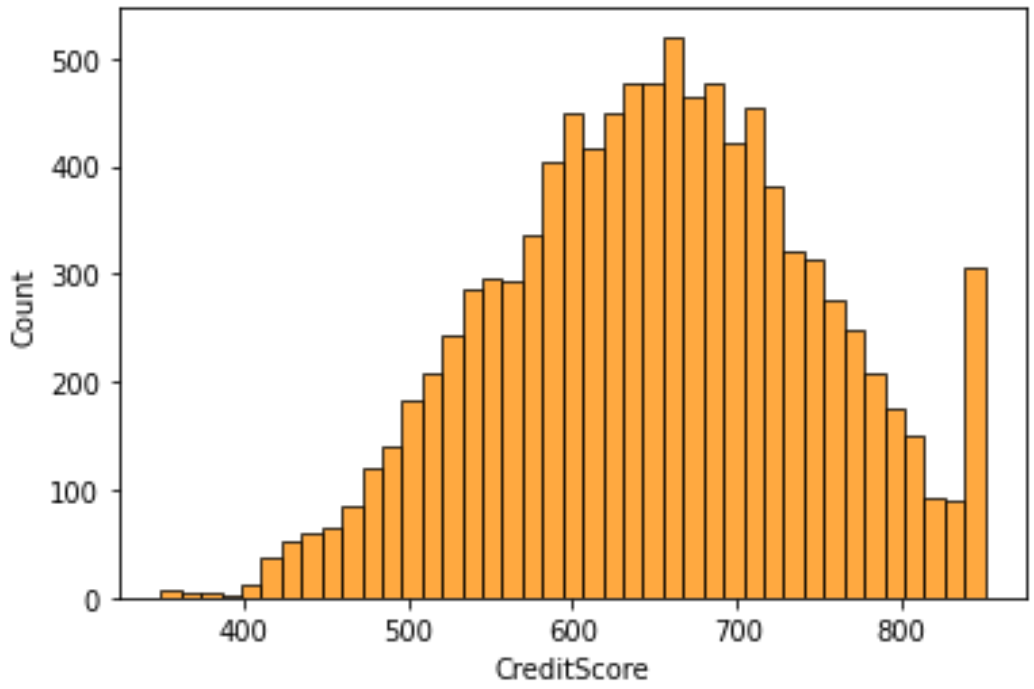
```
RowNumber            int64
CustomerId           int64
Surname             object
CreditScore          int64
Geography           object
Gender              object
Age                  int64
Tenure               int64
Balance            float64
NumOfProducts        int64
HasCrCard            int64
IsActiveMember       int64
EstimatedSalary    float64
Exited               int64
dtype: object
```

```
import matplotlib.pyplot as plt
import seaborn as sns
```

Univariate Analysis

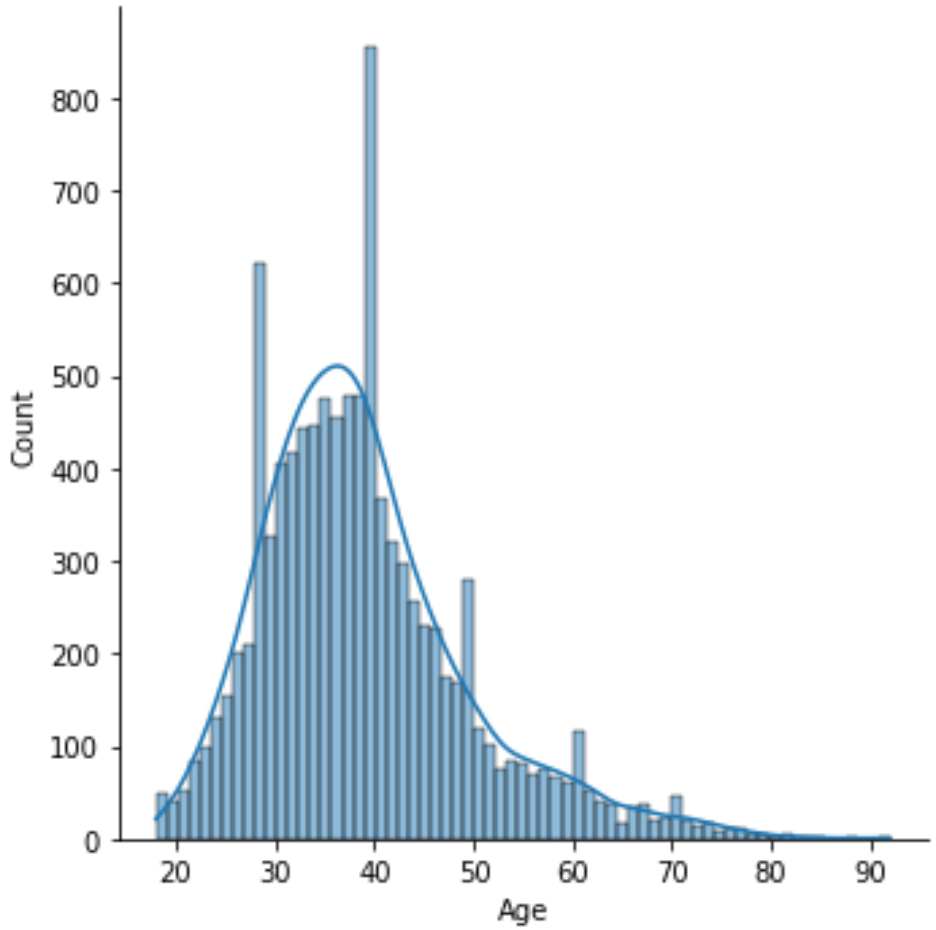
```
sns.histplot(data["CreditScore"],color='darkorange')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f831677f6d0>
```




```
sns.displot(data['Age'], kde=True)
```

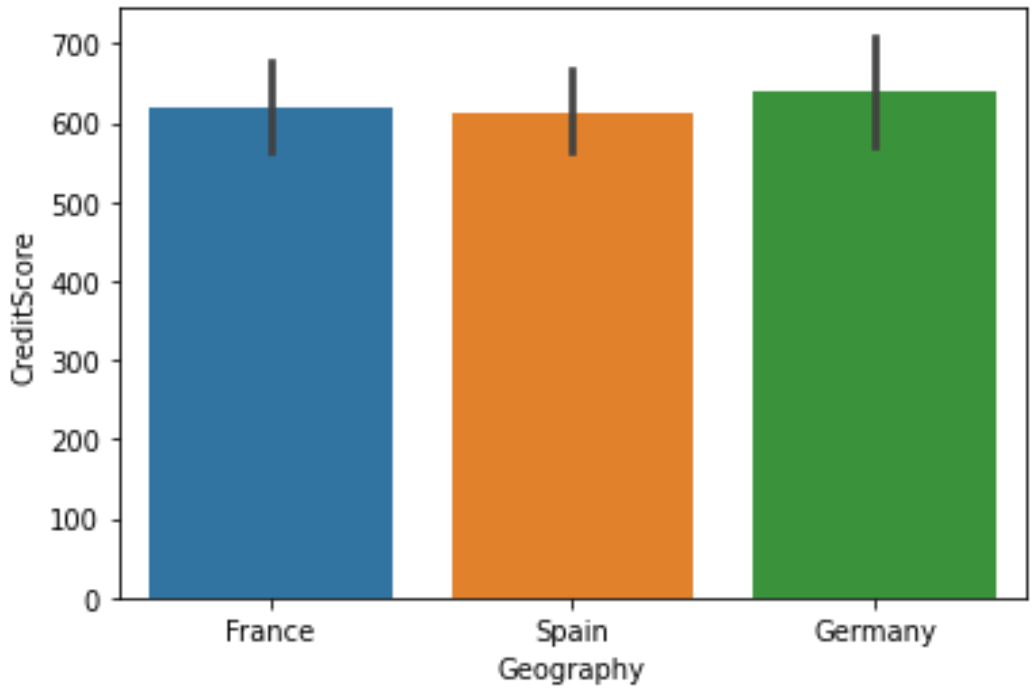
```
<seaborn.axisgrid.FacetGrid at 0x7f831661b210>
```



Bi - Variate Analysis

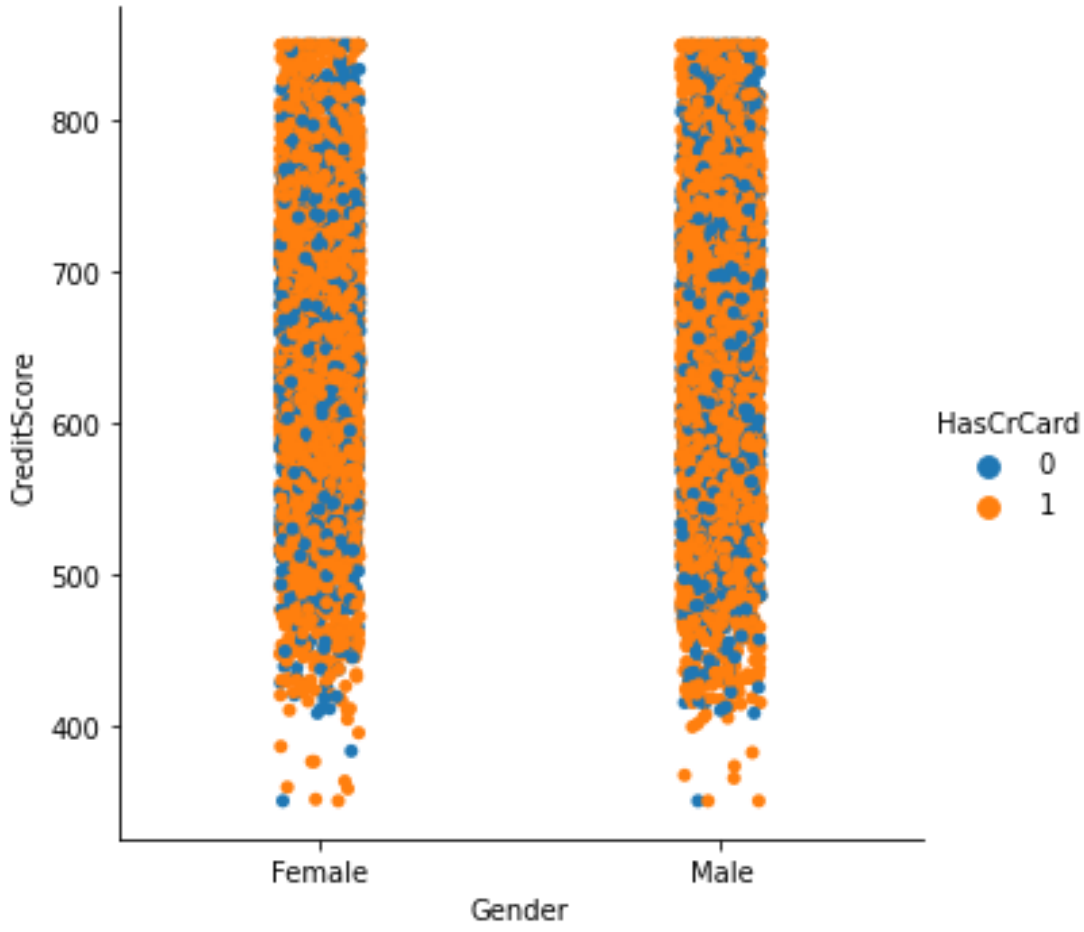
```
sns.barplot(data=data.head(50), x="Geography", y="CreditScore")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8313ce63d0>
```



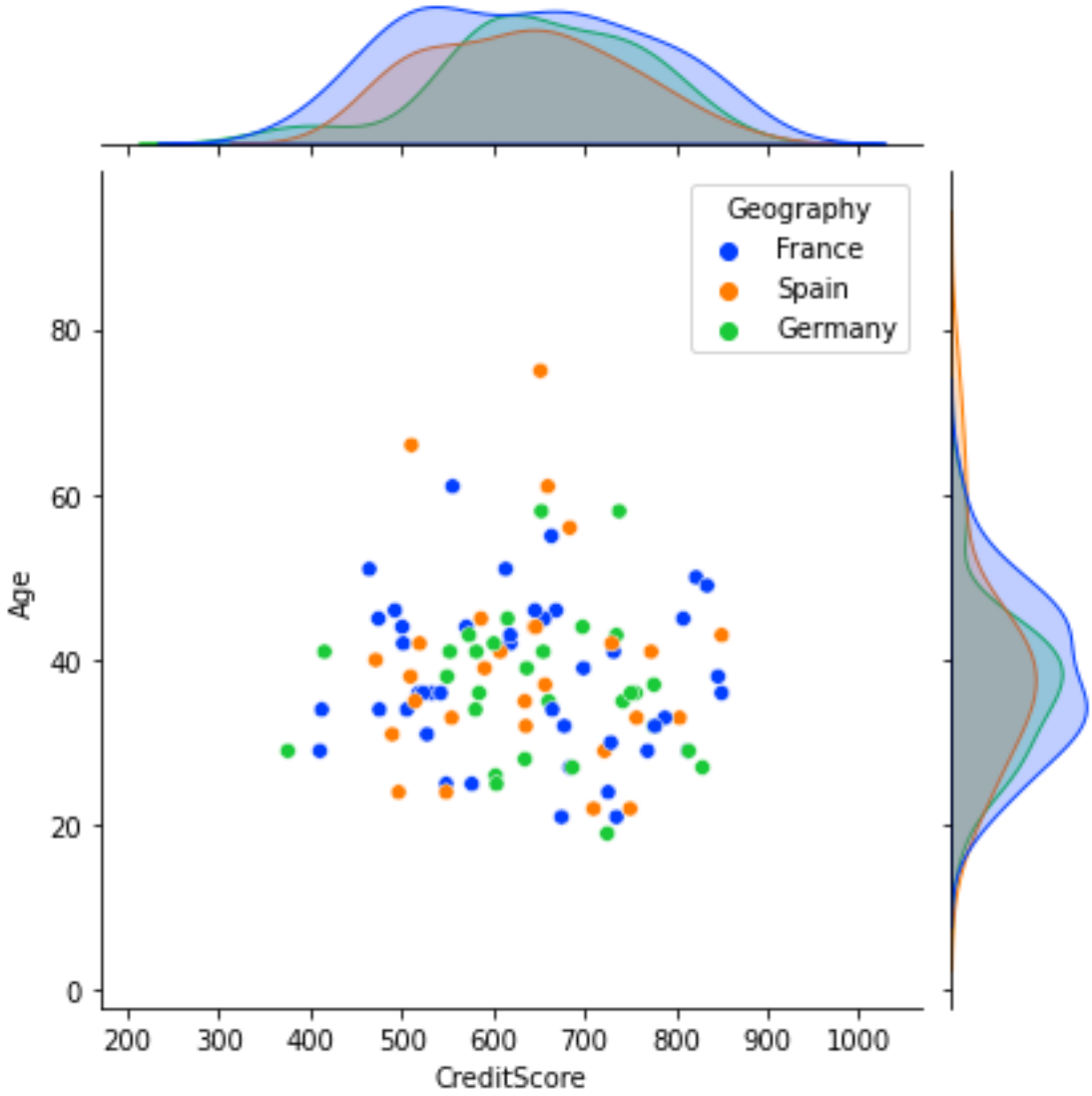

```
sns.catplot(x='Gender', y='CreditScore', hue='HasCrCard', data=data)
```

```
<seaborn.axisgrid.FacetGrid at 0x7f8317198a90>
```



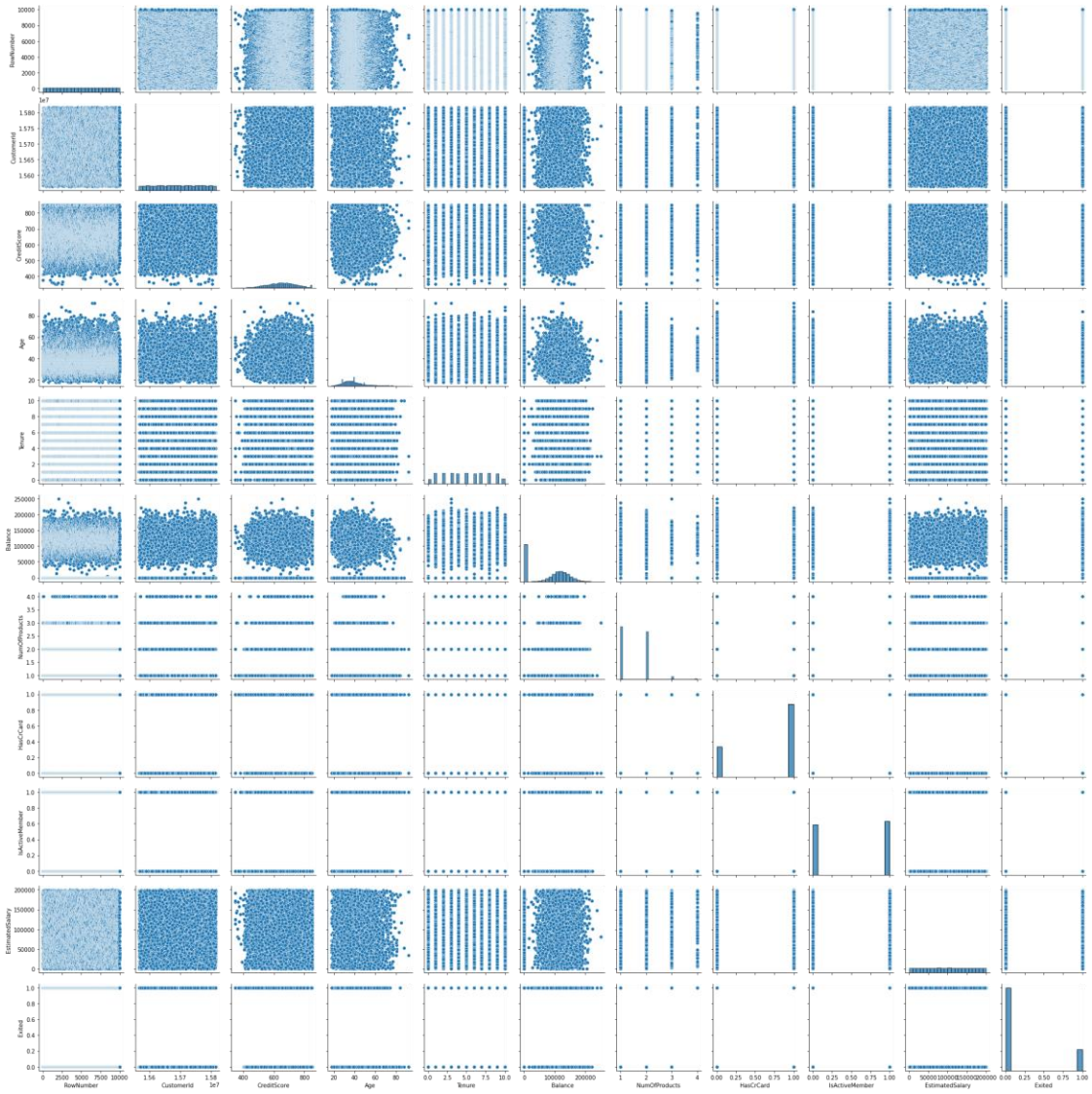
Multi - Variate Analysis

```
sns.jointplot(
    x='CreditScore',
    y='Age',
    data=data.head(100),
    palette='bright',
    hue='Geography');
```




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

```
<seaborn.axisgrid.PairGrid at 0x7f8313a71390>
```



Perform descriptive statistics on the dataset

```
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
```

Handle the Missing values

```
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
```

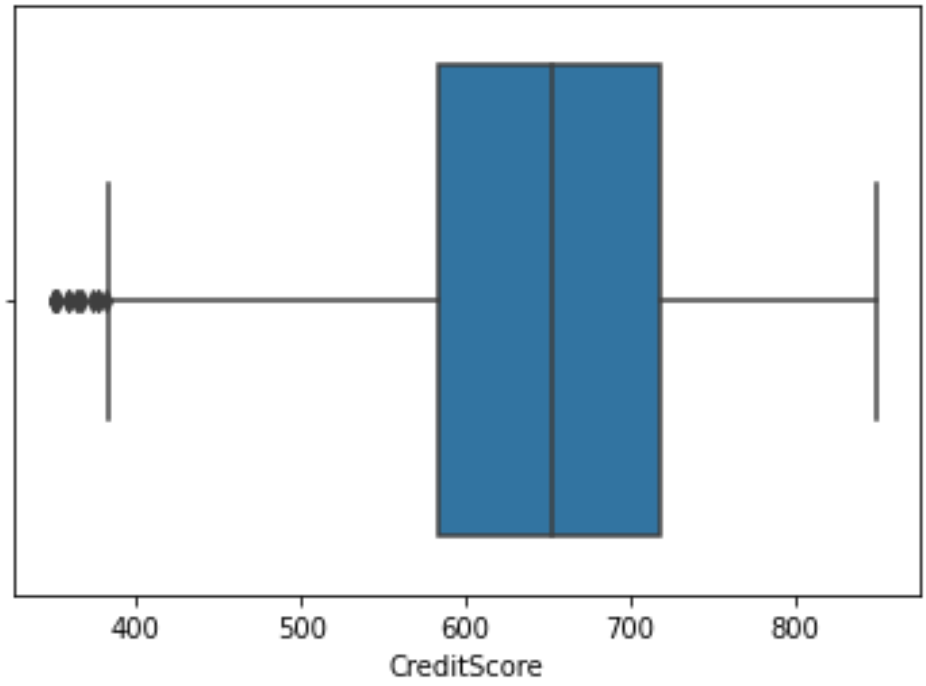
Find the outliers and replace the outliers

```
import seaborn as sns

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 0x7f8310b82990>
```




```
import numpy as np

Q1 = np.percentile(data['CreditScore'], 25,
                   interpolation = 'midpoint')

Q3 = np.percentile(data['CreditScore'], 75,
                   interpolation = 'midpoint')
IQR = Q3 - Q1



#Upper bound
upper = np.where(data['CreditScore'] >= (Q3+1.5*IQR))
#Lower bound
lower = np.where(data['CreditScore'] <= (Q1-1.5*IQR))


print("Q3: ",Q3)
print("Q1: ",Q1)
print("IQR: ",IQR)


mean = data["CreditScore"].mean()

data["CreditScore"] = np.where(data["CreditScore"] > 850, mean,
data['CreditScore'])
```

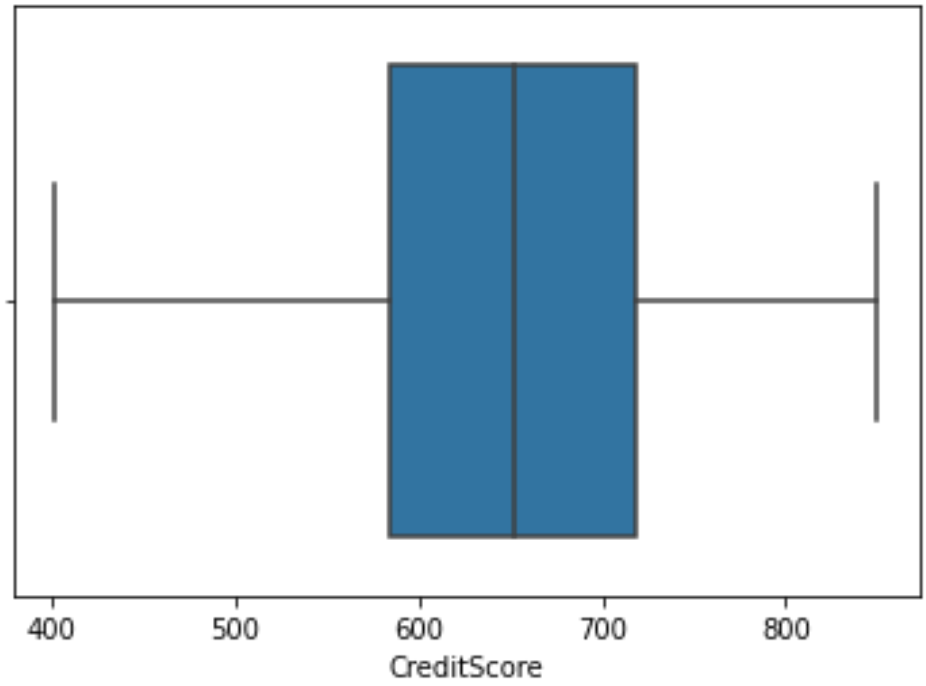
```
data["CreditScore"] = np.where(data["CreditScore"] < 400, mean,
data['CreditScore'])
```

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

```
Q3:  718.0
Q1:  584.0
IQR:  134.0
```

```
/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 0x7f83177a7310>
```



Check for Categorical columns and perform encoding

```
from sklearn.preprocessing import LabelEncoder

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

```
data.head()
```

```
   RowNumber  CustomerId   Surname  CreditScore  Geography  Gender  Age  \
0          1    15634602  Hargrave        619.0          0       0   42
1          2    15647311      Hill        608.0          2       0   41
2          3    15619304      Onio        502.0          0       0   42
3          4    15701354      Boni        699.0          0       0   39
4          5    15737888  Mitchell        850.0          2       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
```

Split the data into dependent and independent variables

```
y = data['CreditScore'] #dependent
x = data.drop(columns = ['CreditScore'],axis = 1) #independent
x.head()
```

```
   RowNumber  CustomerId   Surname  Geography  Gender  Age  Tenure    Balance
\
0          1    15634602  Hargrave          0       0   42       2       0.00
1          2    15647311      Hill          2       0   41       1   83807.86
2          3    15619304      Onio          0       0   42       8  159660.80
3          4    15701354      Boni          0       0   39       1       0.00
4          5    15737888  Mitchell          2       0   43       2  125510.82

   NumOfProducts  HasCrCard  IsActiveMember  EstimatedSalary  Exited
0              1          1               1        101348.88       1
1              1          0               1        112542.58       0
2              3          1               0        113931.57       1
3              2          0               0         93826.63       0
4              1          1               1         79084.10       0
```

Scale the independent variables

```
names =
['RowNumber','CustomerId','Geography','Gender','Age','Tenure','Balance','NumO
fProducts','HasCrCard','IsActiveMember','EstimatedSalary','Exited']

from sklearn.preprocessing import scale

x = scale(x[names])
x
```

```
array([[-1.73187761, -0.78321342, -0.90188624, ...,  0.97024255,
         0.02188649,  1.97716468],
       [-1.7315312 , -0.60653412,  1.51506738, ...,  0.97024255,
         0.21653375, -0.50577476],
       [-1.73118479, -0.99588476, -0.90188624, ..., -1.03067011,
         0.2406869 ,  1.97716468],
       ...,
       [ 1.73118479, -1.47928179, -0.90188624, ...,  0.97024255,
        -1.00864308,  1.97716468],
       [ 1.7315312 , -0.11935577,  0.30659057, ..., -1.03067011,
        -0.12523071,  1.97716468],
       [ 1.73187761, -0.87055909, -0.90188624, ..., -1.03067011,
        -1.07636976, -0.50577476]])
```

```
x = pd.DataFrame(x,columns = names)
x.head()
```

	RowNumber	CustomerId	Geography	Gender	Age	Tenure	Balance
0	-1.731878	-0.783213	-0.901886	-1.095988	0.293517	-1.041760	-1.225848
1	-1.731531	-0.606534	1.515067	-1.095988	0.198164	-1.387538	0.117350
2	-1.731185	-0.995885	-0.901886	-1.095988	0.293517	1.032908	1.333053
3	-1.730838	0.144767	-0.901886	-1.095988	0.007457	-1.387538	-1.225848
4	-1.730492	0.652659	1.515067	-1.095988	0.388871	-1.041760	0.785728

	NumOfProducts	HasCrCard	IsActiveMember	EstimatedSalary	Exited
0	-0.911583	0.646092	0.970243	0.021886	1.977165
1	-0.911583	-1.547768	0.970243	0.216534	-0.505775
2	2.527057	0.646092	-1.030670	0.240687	1.977165
3	0.807737	-1.547768	-1.030670	-0.108918	-0.505775
4	-0.911583	0.646092	0.970243	-0.365276	-0.505775

Split the data into training and testing

```
from sklearn.model_selection import train_test_split

# Split training and testing data
```

```
xtrain,xtest,ytrain,ytest =
train_test_split(x,y,test_size=0.20,random_state=0)

# Checking shape of data

xtrain.shape,xtest.shape
```

```
((8000, 12), (2000, 12))
```