CMSE428 Task 1

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1 Task 1

[149]:
```
%matplotlib inline

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

1.1 Dataset Loaded in

[150]:
```
dataset = pd.read_csv('dataset.csv')
```

1.2 Original Dataset

[151]:
```
dataset
```

[151]:
```
     ClassLabel  Gender  Age  Race  Education  FamilyHistory  HighBloodSugar  \
0      Negative       1   44     3        3.0              1               1
1      Negative       2   44     1        2.0              2               1
2      Negative       1   22     3        5.0              1               1
3      Negative       2   35     3        4.0              1               1
4      Negative       1   54     2        5.0              2               1
…           …       …    …   …         …             …               …
1498   Positive       2   59     3        3.0              2               1
1499   Positive       2   74     3        NaN              2               1
1500   Positive       2   80     3        2.0              1               1
1501   Positive       2   78     3        4.0              2               1
1502   Positive       1   80     2        3.0              1               1

        BMI  WaistCircumference  SystolicBP  DiastolicBP  LDL  HDL  \
0     29.10               106.6         119           88  113   37
1     25.06                82.3         130           86  138   63
2     28.07                94.5         120           87   96   57
3     20.29                71.9         110           64   93   89
```

```
4     36.32               116.4           92            42   110    62
…     …                 …         …           …  …  …
1498  26.67               103.0          110            60   132    47
1499  25.08                95.5          135            60   114    36
1500    NaN               119.3          121            40   111    38
1501  46.98               129.5          146            78   136    56
1502  27.14                96.7          154            30   128    65

      Triglycerides
0               235
1                61
2               111
3                58
4                71
…              …
1498            190
1499            270
1500            131
1501            144
1502            108

[1503 rows x 14 columns]
```

1.3 Checking which columns have missing Data

By running the below code, we can see that Education and BMI has missing data.

```
[152]: dataset.isnull().sum()
```

```
[152]: ClassLabel              0
       Gender                  0
       Age                     0
       Race                    0
       Education              12
       FamilyHistory           0
       HighBloodSugar          0
       BMI                     9
       WaistCircumference      0
       SystolicBP              0
       DiastolicBP             0
       LDL                     0
       HDL                     0
       Triglycerides           0
       dtype: int64
```

1.4 For example, 150th row of BMI has no data

[153]:
```
dataset.loc[150,'BMI']
```

[153]:
```
nan
```

1.5 Filling in missing BMI data by Mean and Education by Most Frequent Value

BMI value can be a float, so we can use mean to impute missing data.By running the print command, we can see that the missing values are filled in with mean.

[154]:
```
dataset['BMI'].fillna(dataset['BMI'].mean(), inplace=True)
dataset['Education'].fillna(dataset['Education'].value_counts().index[0],␣
 ↪inplace=True)
dataset.isnull().sum()
```

[154]:
```
ClassLabel            0
Gender                0
Age                   0
Race                  0
Education             0
FamilyHistory         0
HighBloodSugar        0
BMI                   0
WaistCircumference    0
SystolicBP            0
DiastolicBP           0
LDL                   0
HDL                   0
Triglycerides         0
dtype: int64
```

1.6 Checking the 150th row again

[155]:
```
dataset.loc[150,'BMI']
```

[155]:
```
28.41636546184739
```

1.7 Number of Positives and Negatives

[156]:
```
dataset['ClassLabel'].value_counts()
```

[156]:
```
Negative    775
Positive    728
Name: ClassLabel, dtype: int64
```

1.8 Number of Positives and Gender==1 and Race==2

```
[157]: len(dataset[(dataset['ClassLabel']=='Positive') & (dataset['Gender']==1) &␣
        ↪(dataset['Race']==2)])
```

```
[157]: 40
```

1.9 Race that is most frequent in Negative samples

```
[158]: negativeData = dataset[(dataset['ClassLabel']=='Negative')]
       negativeData
```

```
[158]:     ClassLabel  Gender  Age  Race  Education  FamilyHistory  HighBloodSugar  \
       0     Negative       1   44     3        3.0              1               1
       1     Negative       2   44     1        2.0              2               1
       2     Negative       1   22     3        5.0              1               1
       3     Negative       2   35     3        4.0              1               1
       4     Negative       1   54     2        5.0              2               1
       ..          …      …   …    …        …              …               …
       770   Negative       2   53     2        5.0              2               1
       771   Negative       1   56     3        5.0              1               1
       772   Negative       2   67     1        4.0              2               1
       773   Negative       2   34     2        1.0              1               1
       774   Negative       2   48     3        5.0              1               1

              BMI  WaistCircumference  SystolicBP  DiastolicBP  LDL  HDL  \
       0    29.10               106.6         119           88  113   37
       1    25.06                82.3         130           86  138   63
       2    28.07                94.5         120           87   96   57
       3    20.29                71.9         110           64   93   89
       4    36.32               116.4          92           42  110   62
       ..     …                  …          …            …   …   …
       770  20.09                75.0          94           60  148   67
       771  30.89               113.1         120           83  139   65
       772  20.37                71.6         150           80   95   60
       773  38.74               117.4         107           67   91   34
       774  21.66                71.5         102           61   88   72

            Triglycerides
       0              235
       1               61
       2              111
       3               58
       4               71
       ..             …
       770             72
       771             84
       772            138
```

```
773              60
774              50

[775 rows x 14 columns]
```

[159]:

```
negativeData['Race'].value_counts()
```

[159]:

```
3    404
1    127
4    117
2     86
5     41
Name: Race, dtype: int64
```

1.10 Average BMI of samples with Education==3

[160]:

```
education_ft = dataset[(dataset['Education']==3)]
education_ft['BMI'].mean()
```

[160]:

```
29.276166255235008
```

1.11 Average BMI of Gender==1

[161]:

```
gender_filter = dataset[(dataset['Gender']==1)]
gender_filter['BMI'].mean()
```

[161]:

```
28.49773850117451
```

1.12 Average BMI of Gender==2

[162]:

```
gender_filter = dataset[(dataset['Gender']==2)]
gender_filter['BMI'].mean()
```

[162]:

```
28.347488282367802
```

2 Task 2

2.1 Seperating Categorical and Numerical

Because that datatypes of columns are given not correctly, the columns are seperated manually.

Seperating Categorical Columns

[163]:

```
categorical_dataset =␣
 ↪dataset[['ClassLabel','Gender','Race','Education','FamilyHistory','HighBloodSugar']]
categorical_dataset
```

```
[163]:      ClassLabel  Gender  Race  Education  FamilyHistory  HighBloodSugar
       0      Negative       1     3        3.0              1               1
       1      Negative       2     1        2.0              2               1
       2      Negative       1     3        5.0              1               1
       3      Negative       2     3        4.0              1               1
       4      Negative       1     2        5.0              2               1
       …         …      …    …        …              …             …
       1498   Positive       2     3        3.0              2               1
       1499   Positive       2     3        4.0              2               1
       1500   Positive       2     3        2.0              1               1
       1501   Positive       2     3        4.0              2               1
       1502   Positive       1     2        3.0              1               1

       [1503 rows x 6 columns]
```

Seperating Numerical Values

```
[164]: numerical_dataset =␣
        ↪dataset[['Age','BMI','WaistCircumference','SystolicBP','DiastolicBP','LDL','HDL','Triglycer
       numerical_dataset
```

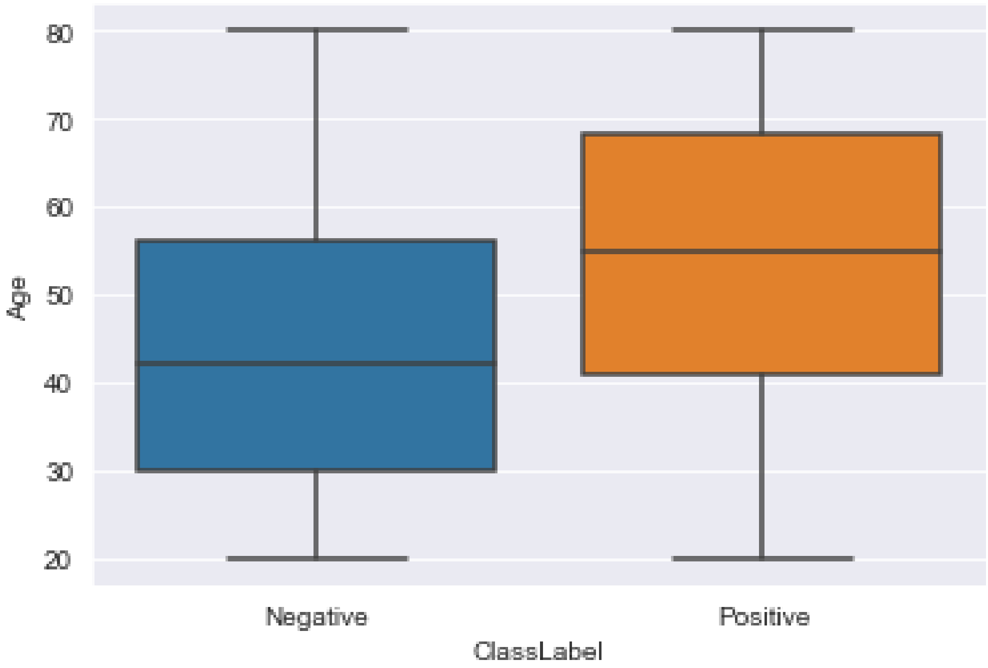
```
[164]:       Age        BMI  WaistCircumference  SystolicBP  DiastolicBP  LDL  HDL  \
       0      44  29.100000               106.6         119           88  113   37
       1      44  25.060000                82.3         130           86  138   63
       2      22  28.070000                94.5         120           87   96   57
       3      35  20.290000                71.9         110           64   93   89
       4      54  36.320000               116.4          92           42  110   62
       …   …        …                  …          …           …   …   …
       1498   59  26.670000               103.0         110           60  132   47
       1499   74  25.080000                95.5         135           60  114   36
       1500   80  28.416365               119.3         121           40  111   38
       1501   78  46.980000               129.5         146           78  136   56
       1502   80  27.140000                96.7         154           30  128   65

             Triglycerides
       0               235
       1                61
       2               111
       3                58
       4                71
       …              …
       1498            190
       1499            270
       1500            131
       1501            144
       1502            108

       [1503 rows x 8 columns]
```

2.2 Boxplots for Classes with respect to each Variable

Age

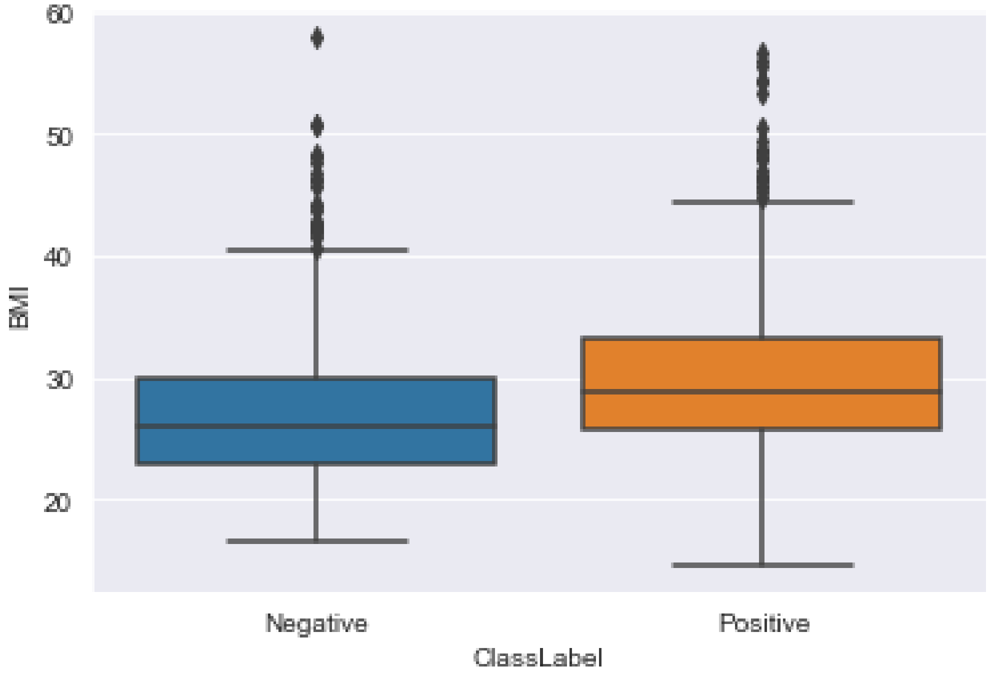
```
[165]: sns.set_style("darkgrid")
       sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[0])
```

```
[165]: <AxesSubplot:xlabel='ClassLabel', ylabel='Age'>
```



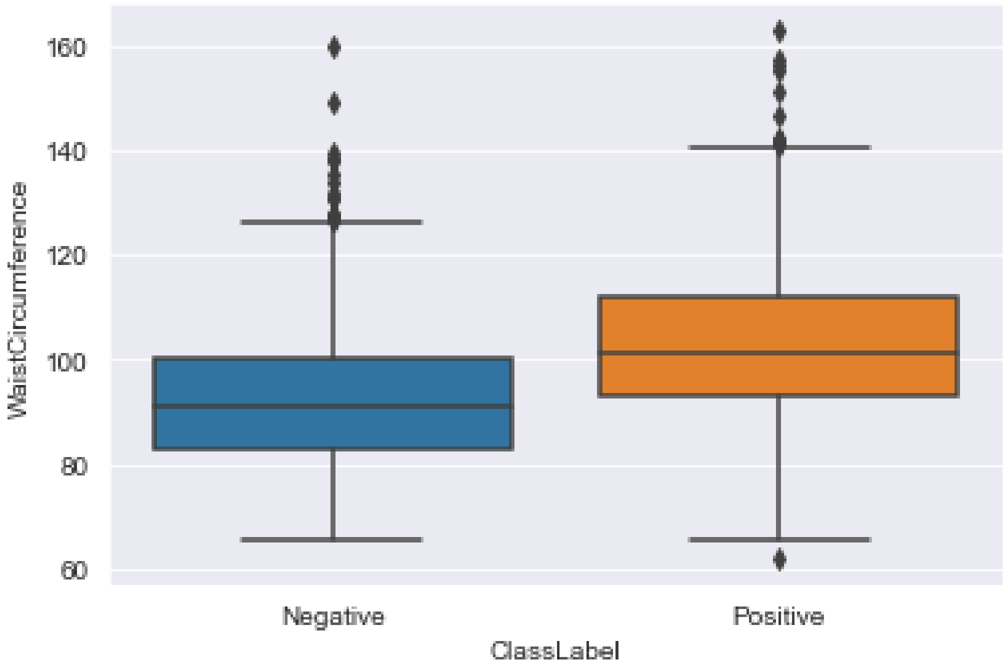
```
[166]: sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[1])
```

```
[166]: <AxesSubplot:xlabel='ClassLabel', ylabel='BMI'>
```



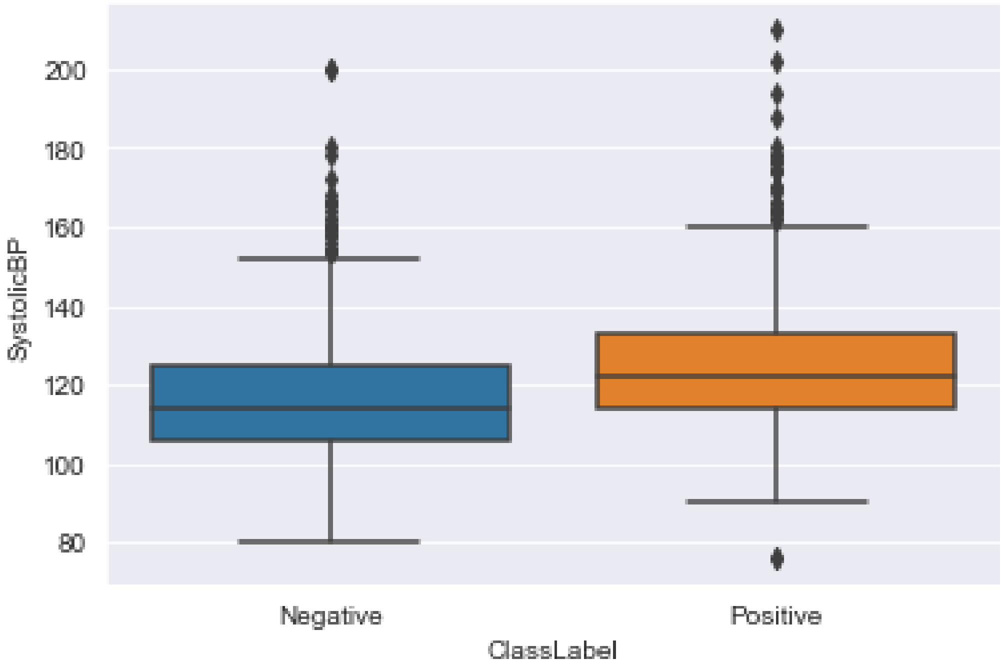
```
[167]: sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[2])
```

```
[167]: <AxesSubplot:xlabel='ClassLabel', ylabel='WaistCircumference'>
```



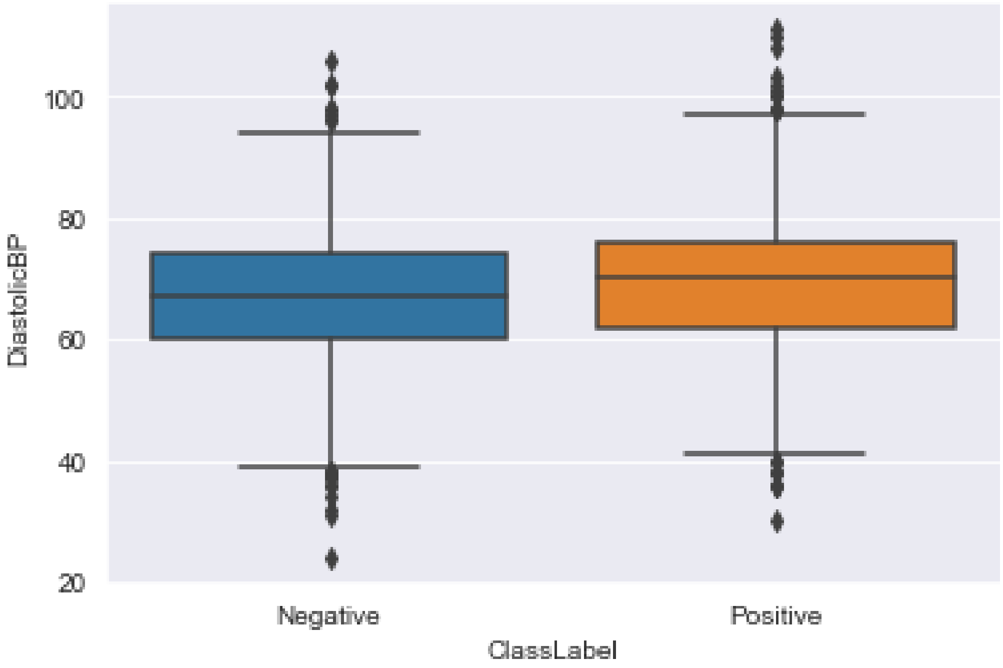
[168]:
```
sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[3])
```

[168]:
```
<AxesSubplot:xlabel='ClassLabel', ylabel='SystolicBP'>
```



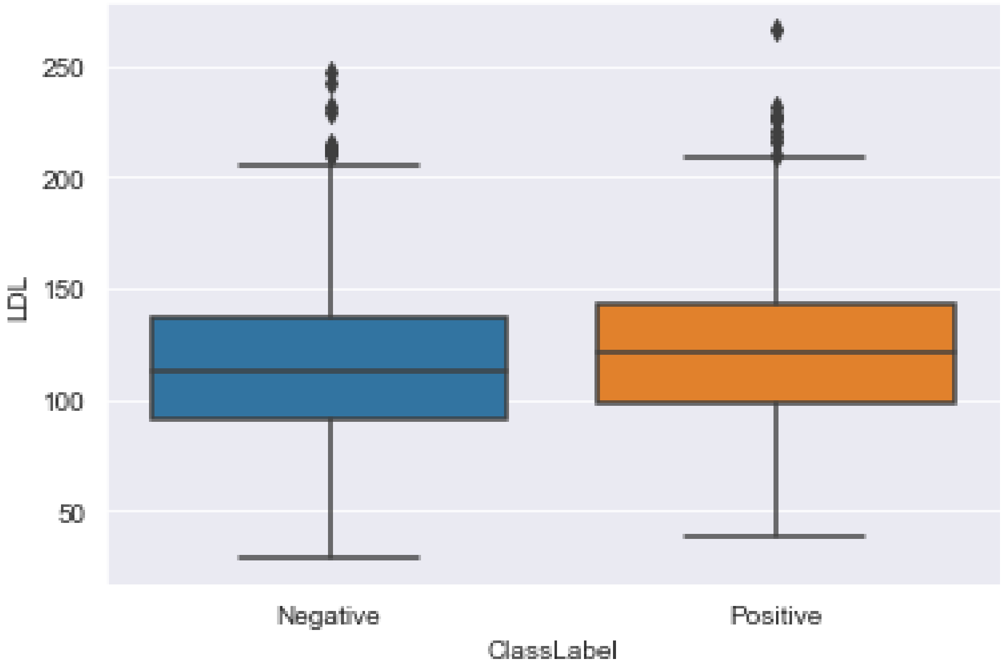
[169]:
```
sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[4])
```

[169]:
```
<AxesSubplot:xlabel='ClassLabel', ylabel='DiastolicBP'>
```



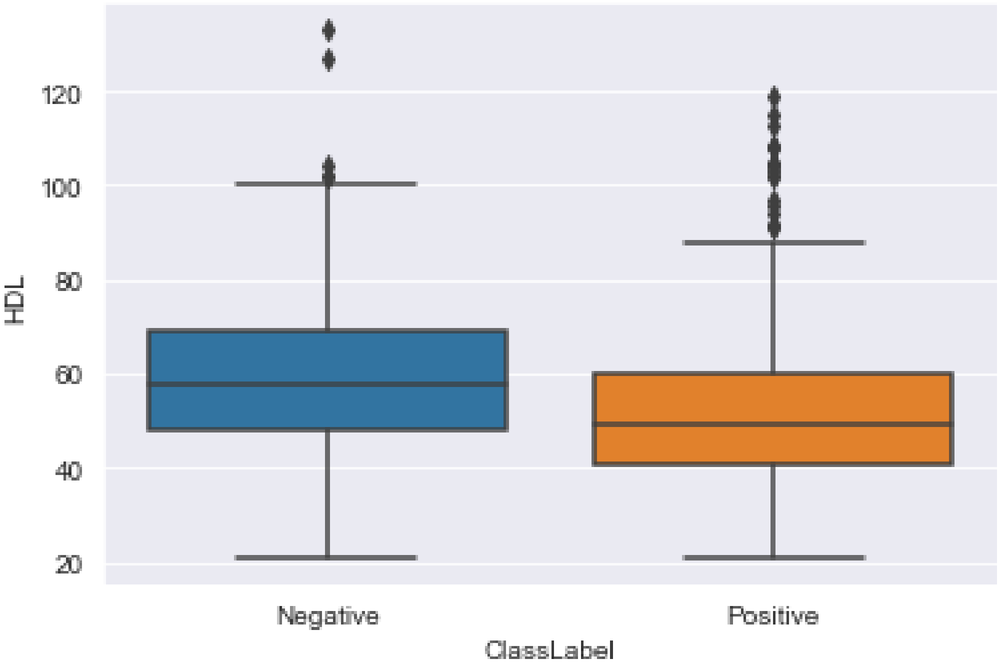
```
[170]: sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[5])
```

```
[170]: <AxesSubplot:xlabel='ClassLabel', ylabel='LDL'>
```



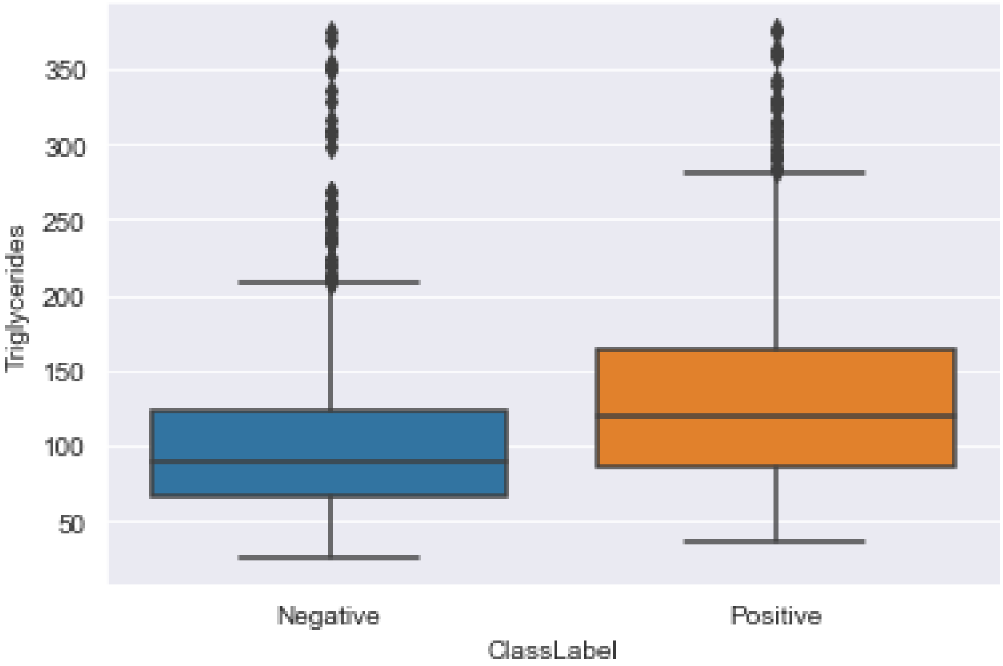
[171]:
```
sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[6])
```

[171]:
```
<AxesSubplot:xlabel='ClassLabel', ylabel='HDL'>
```



[172]:
```
sns.boxplot(data=dataset, x='ClassLabel', y=numerical_dataset.columns[7])
```

[172]:
```
<AxesSubplot:xlabel='ClassLabel', ylabel='Triglycerides'>
```



2.3 Table of Quartiles (Q1,Q2/Median,Q3) for each numerical value

```
[173]: q1_list = [] ; q2_list = [] ; q3_list = []

       for column in numerical_dataset:
           q1 = dataset[column].quantile(0.25)
           q2 = dataset[column].mean()
           q3 = dataset[column].quantile(0.75)
           q1_list.append(q1)
           q2_list.append(q2)
           q3_list.append(q3)

       quartiles = {}
       quartiles['index']=numerical_dataset.columns.tolist()
       quartiles['Q1']=q1_list
       quartiles['Q2']=q2_list
       quartiles['Q3']=q3_list

       quartiles_df = pd.DataFrame(quartiles, index=quartiles['index'],␣
        ↪columns=['Q1','Q2','Q3'])
       quartiles_df
```

```
[173]:                             Q1          Q2       Q3
       Age                      34.00   49.231537   63.000
```

```
BMI                   24.16   28.416365   31.715
WaistCircumference    86.50   97.555888  106.350
SystolicBP           108.00  120.359947  130.000
DiastolicBP           61.00   68.152362   76.000
LDL                   94.00  118.815702  140.000
HDL                   44.00   55.480373   65.000
Triglycerides         75.00  117.979375  146.000
```

2.4 Number of Outliers for each continous variable

[174]:
```
print('---Amount of Outliers---')
for index in quartiles_df.index:
    q1 = quartiles_df.loc[index,'Q1']
    q2 = quartiles_df.loc[index,'Q2']
    q3 = quartiles_df.loc[index,'Q3']

    iqr = q3 - q1

    upper_limit = q3 + 1.5*iqr
    lower_limit = q1 - 1.5*iqr

    print (index+': '+str(len(dataset[(dataset[index]> upper_limit) |␣
 ↪(dataset[index] < lower_limit)])))
```

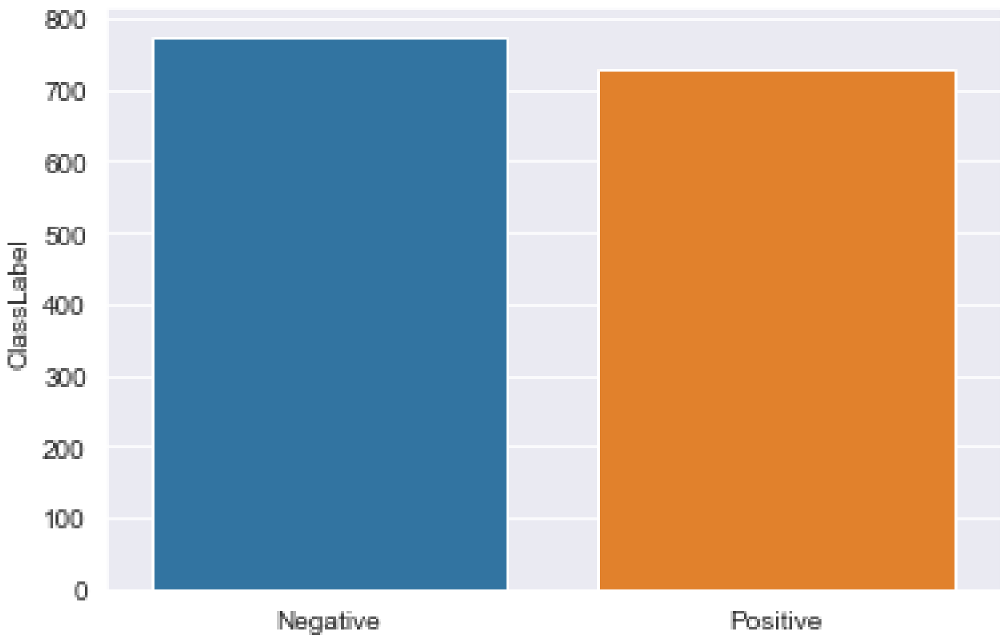
```
---Amount of Outliers---
Age: 0
BMI: 42
WaistCircumference: 22
SystolicBP: 32
DiastolicBP: 30
LDL: 19
HDL: 24
Triglycerides: 59
```

3 Task 3

3.1 BarPlot for each categorical variable

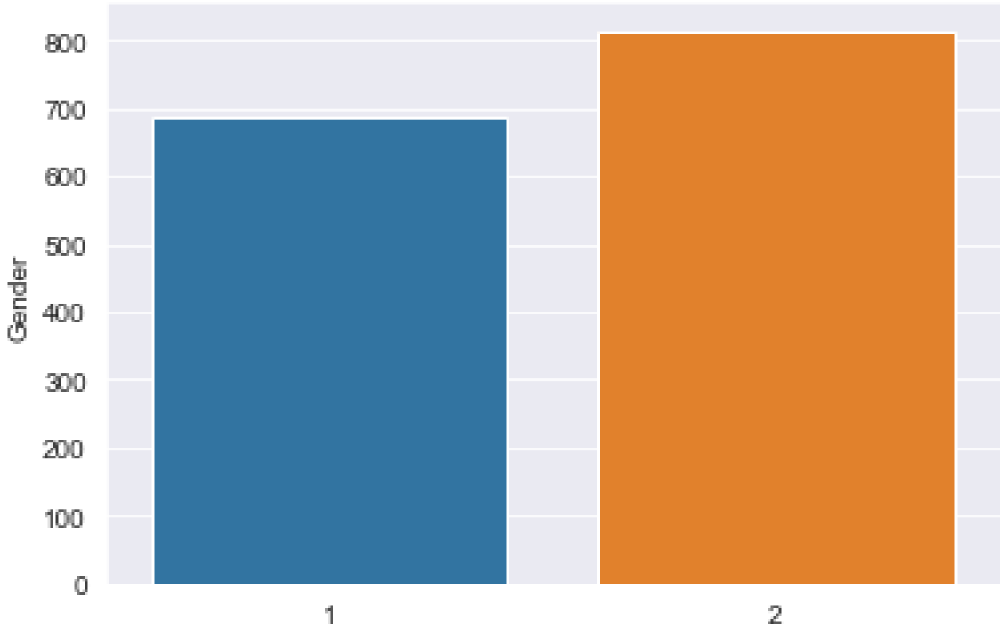
[175]:
```
sns.barplot(x=categorical_dataset.iloc[:, 0].value_counts().index,␣
 ↪y=categorical_dataset.iloc[:, 0].value_counts())
```

[175]:
```
<AxesSubplot:ylabel='ClassLabel'>
```



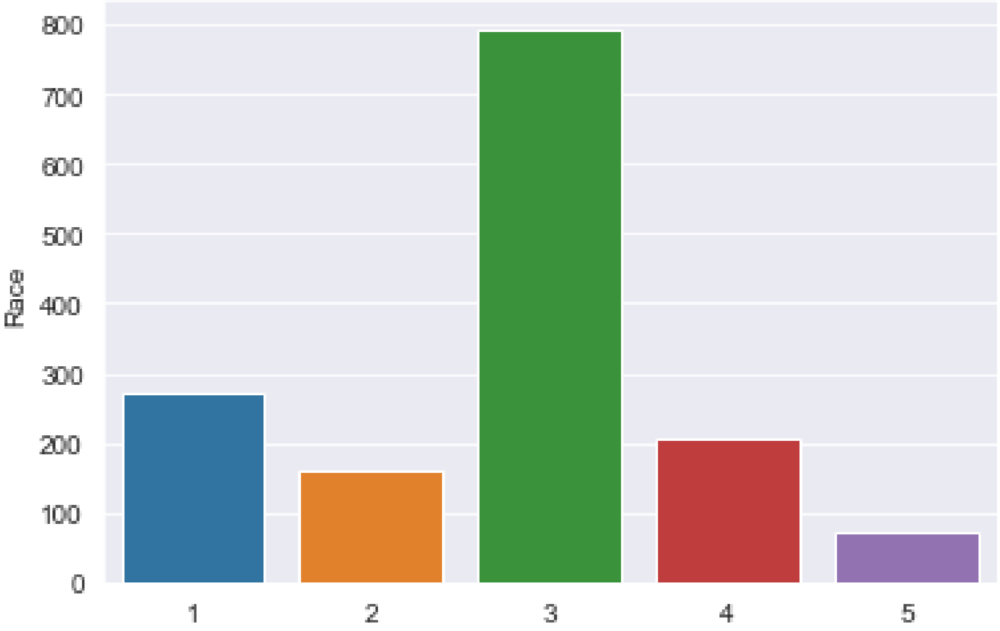
```
[176]: sns.barplot(x=categorical_dataset.iloc[:, 1].value_counts().index,␣
        ↪y=categorical_dataset.iloc[:, 1].value_counts())
```

```
[176]: <AxesSubplot:ylabel='Gender'>
```



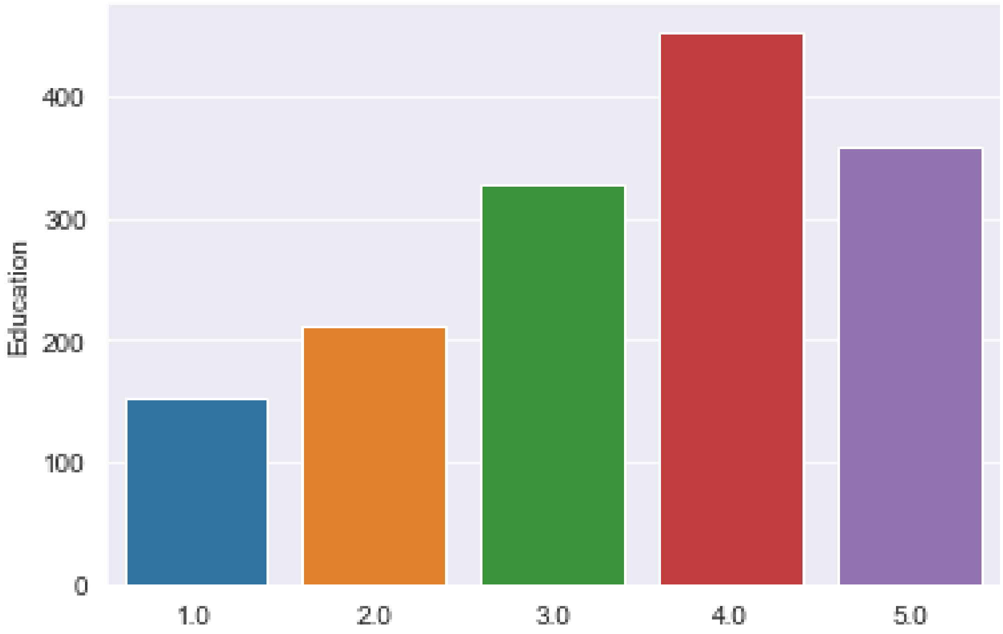
```
[177]: sns.barplot(x=categorical_dataset.iloc[:, 2].value_counts().index,␣
        ↪y=categorical_dataset.iloc[:, 2].value_counts())
```

```
[177]: <AxesSubplot:ylabel='Race'>
```



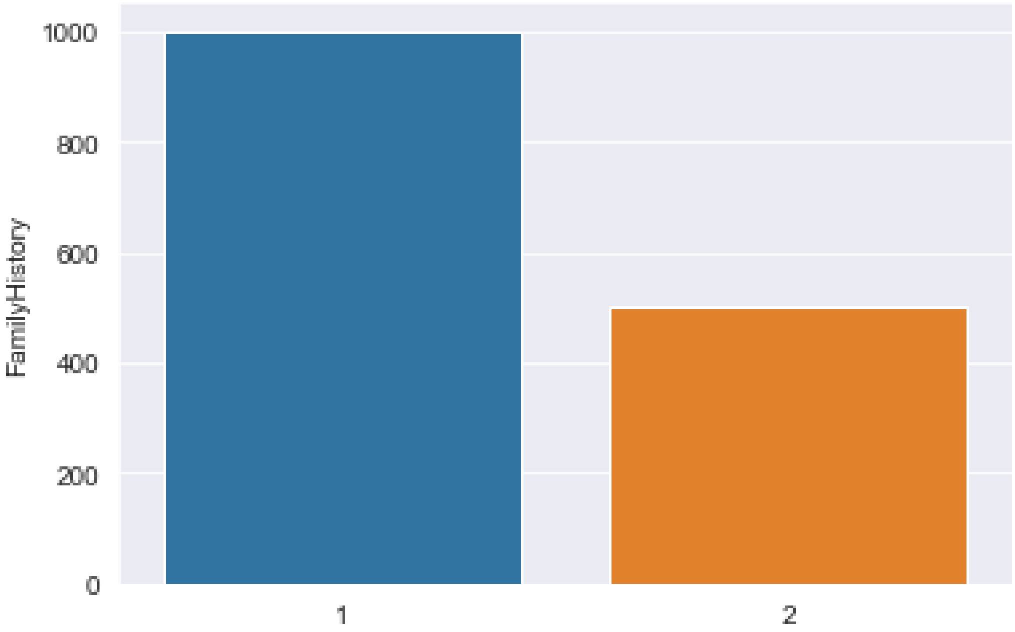
```
[178]: sns.barplot(x=categorical_dataset.iloc[:, 3].value_counts().index,␣
        ↪y=categorical_dataset.iloc[:, 3].value_counts())
```

```
[178]: <AxesSubplot:ylabel='Education'>
```



[179]:
```
sns.barplot(x=categorical_dataset.iloc[:, 4].value_counts().index,␣
↪y=categorical_dataset.iloc[:, 4].value_counts())
```

[179]:
```
<AxesSubplot:ylabel='FamilyHistory'>
```

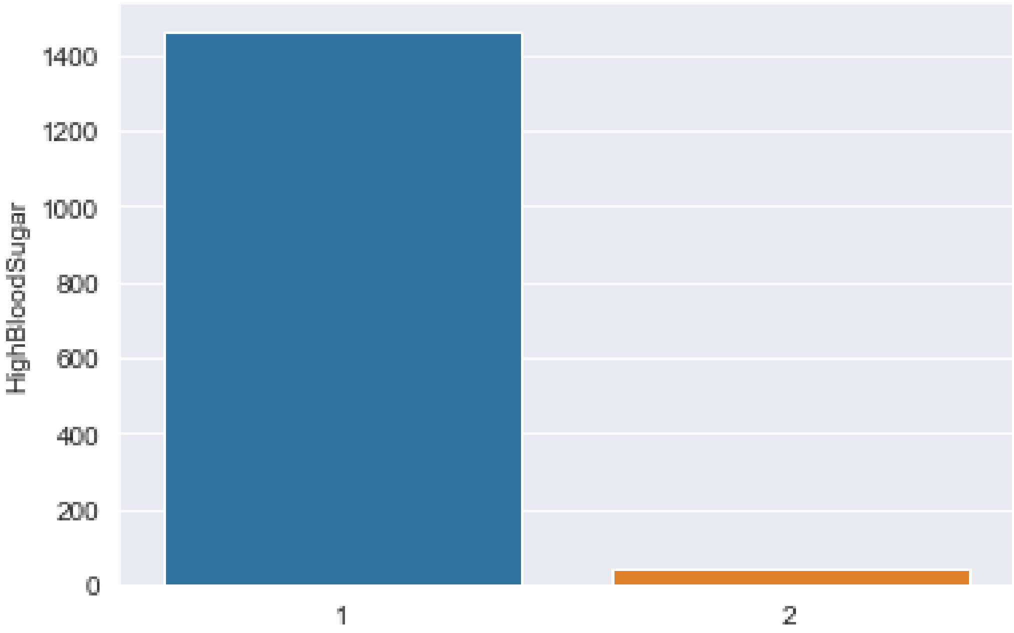


[180]:

```
sns.barplot(x=categorical_dataset.iloc[:, 5].value_counts().index,␣
↪y=categorical_dataset.iloc[:, 5].value_counts())
```

[180]:

```
<AxesSubplot:ylabel='HighBloodSugar'>
```



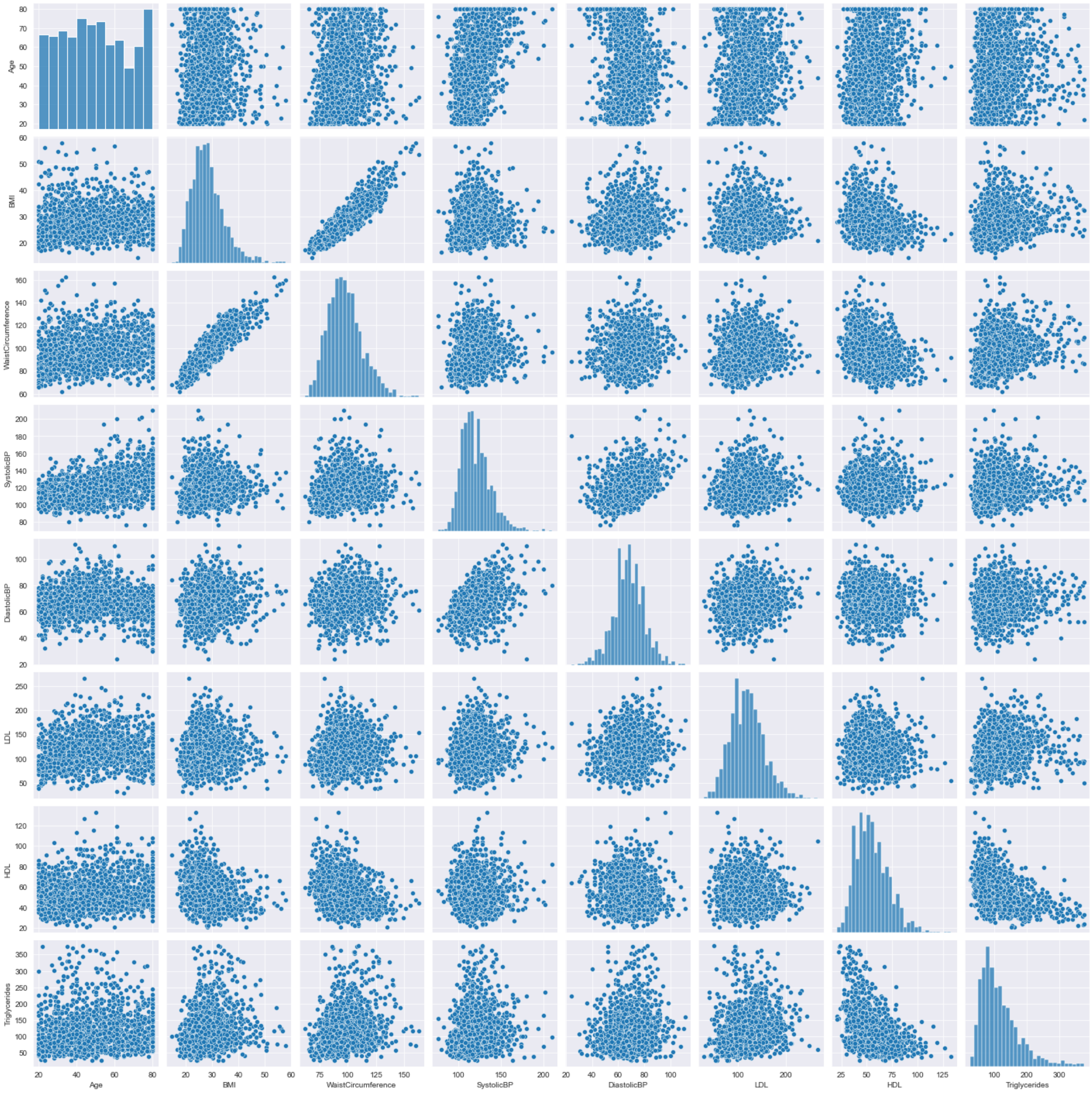
4 Task 4

[181]:

```
sns.pairplot(numerical_dataset)
```

[181]:

```
<seaborn.axisgrid.PairGrid at 0x16891c8bbb0>
```


Age
80
70
60
50
40
30
20
BMI
60
50
40
30
20
WaistCircumference
160
140
120
100
80
60
SystolicBP
200
180
160
140
120
100
80
DiastolicBP
100
80
60
40
20
LDL
250
200
150
100
50
HDL
120
100
80
60
40
20
Triglycerides
350
300
250
200
150
100
50
20 40 60 80
Age
20 30 40 50 60
BMI
75 100 125 150
WaistCircumference
100 150 200
SystolicBP
20 40 60 80 100
DiastolicBP
100 200
LDL
25 50 75 100 125
HDL
100 200 300
Triglycerides