Importing Necessary Packages

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.tree import DecisionTreeClassifier
from sklearn import tree
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import LogisticRegression
from sklearn import metrics
from sklearn.model_selection import GridSearchCV
```

Data Preprocessing

```
df=pd.read_csv(r"C:\Users\Arigala.Adarsh\Downloads\diabetes(1).csv")
```

```
df.head(10)
```

```
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin  
BMI  \
0            6      148             72             35        0  33.6

1            1       85             66             29        0  26.6

2            8      183             64              0        0  23.3

3            1       89             66             23       94  28.1

4            0      137             40             35      168  43.1

5            5      116             74              0        0  25.6

6            3       78             50             32       88  31.0

7           10      115              0              0        0  35.3

8            2      197             70             45      543  30.5

9            8      125             96              0        0   0.0


   DiabetesPedigreeFunction  Age  Outcome
```

```
0                     0.627   50         1
1                     0.351   31         0
2                     0.672   32         1
3                     0.167   21         0
4                     2.288   33         1
5                     0.201   30         0
6                     0.248   26         1
7                     0.134   29         0
8                     0.158   53         1
9                     0.232   54         1
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Pregnancies               768 non-null    int64  
 1   Glucose                   768 non-null    int64  
 2   BloodPressure             768 non-null    int64  
 3   SkinThickness             768 non-null    int64  
 4   Insulin                   768 non-null    int64  
 5   BMI                       768 non-null    float64
 6   DiabetesPedigreeFunction  768 non-null    float64
 7   Age                       768 non-null    int64  
 8   Outcome                   768 non-null    int64  
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

```
df.columns
```

```
Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness',
'Insulin',
       'BMI', 'DiabetesPedigreeFunction', 'Age', 'Outcome'],
      dtype='object')
```

Exploratory Data Analysis

```
df.describe()
```

```
       Pregnancies     Glucose  BloodPressure  SkinThickness
Insulin  \
count   768.000000  768.000000     768.000000     768.000000
768.000000
mean      3.845052  120.894531      69.105469      20.536458
79.799479
std       3.369578   31.972618      19.355807      15.952218
115.244002
```

```
min       0.000000    0.000000       0.000000       0.000000
0.000000
25%       1.000000   99.000000      62.000000       0.000000
0.000000
50%       3.000000  117.000000      72.000000      23.000000
30.500000
75%       6.000000  140.250000      80.000000      32.000000
127.250000
max      17.000000  199.000000     122.000000      99.000000
846.000000

              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    31.992578                  0.471876   33.240885    0.348958
std      7.884160                  0.331329   11.760232    0.476951
min      0.000000                  0.078000   21.000000    0.000000
25%     27.300000                  0.243750   24.000000    0.000000
50%     32.000000                  0.372500   29.000000    0.000000
75%     36.600000                  0.626250   41.000000    1.000000
max     67.100000                  2.420000   81.000000    1.000000
```

```
df.shape
```

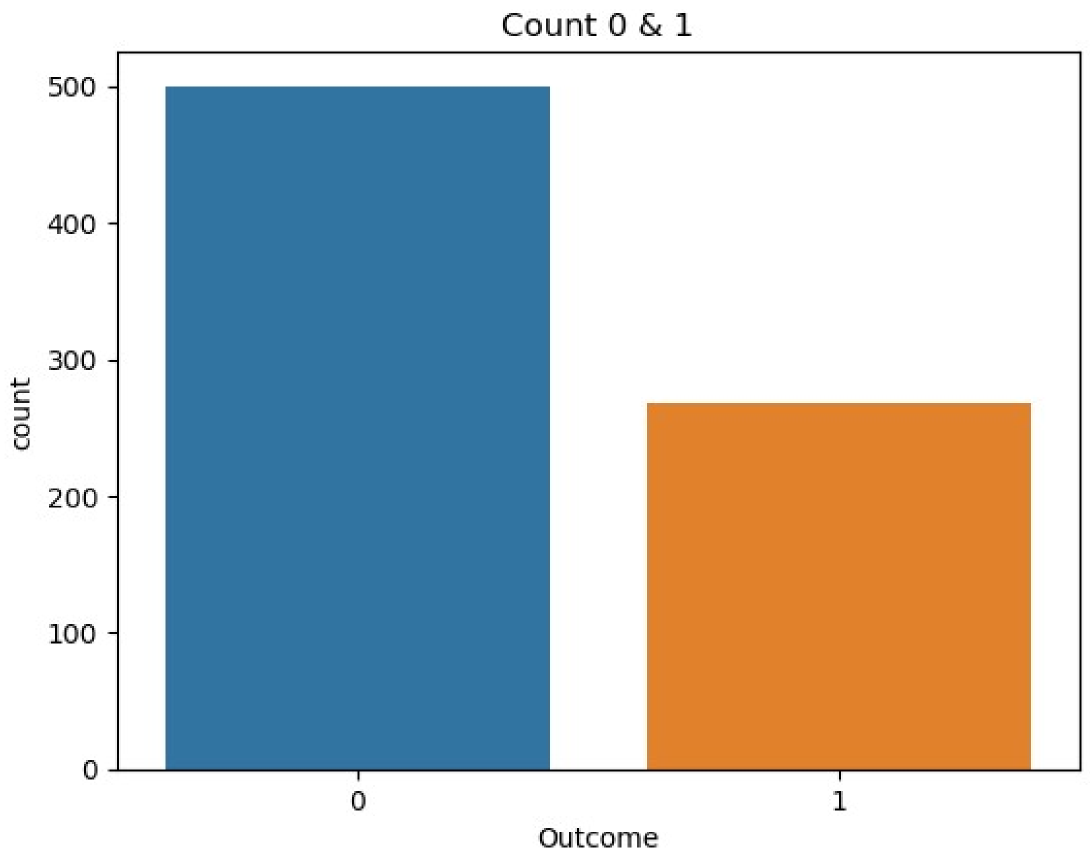
```
(768, 9)
```

```
df.isnull().sum()
```

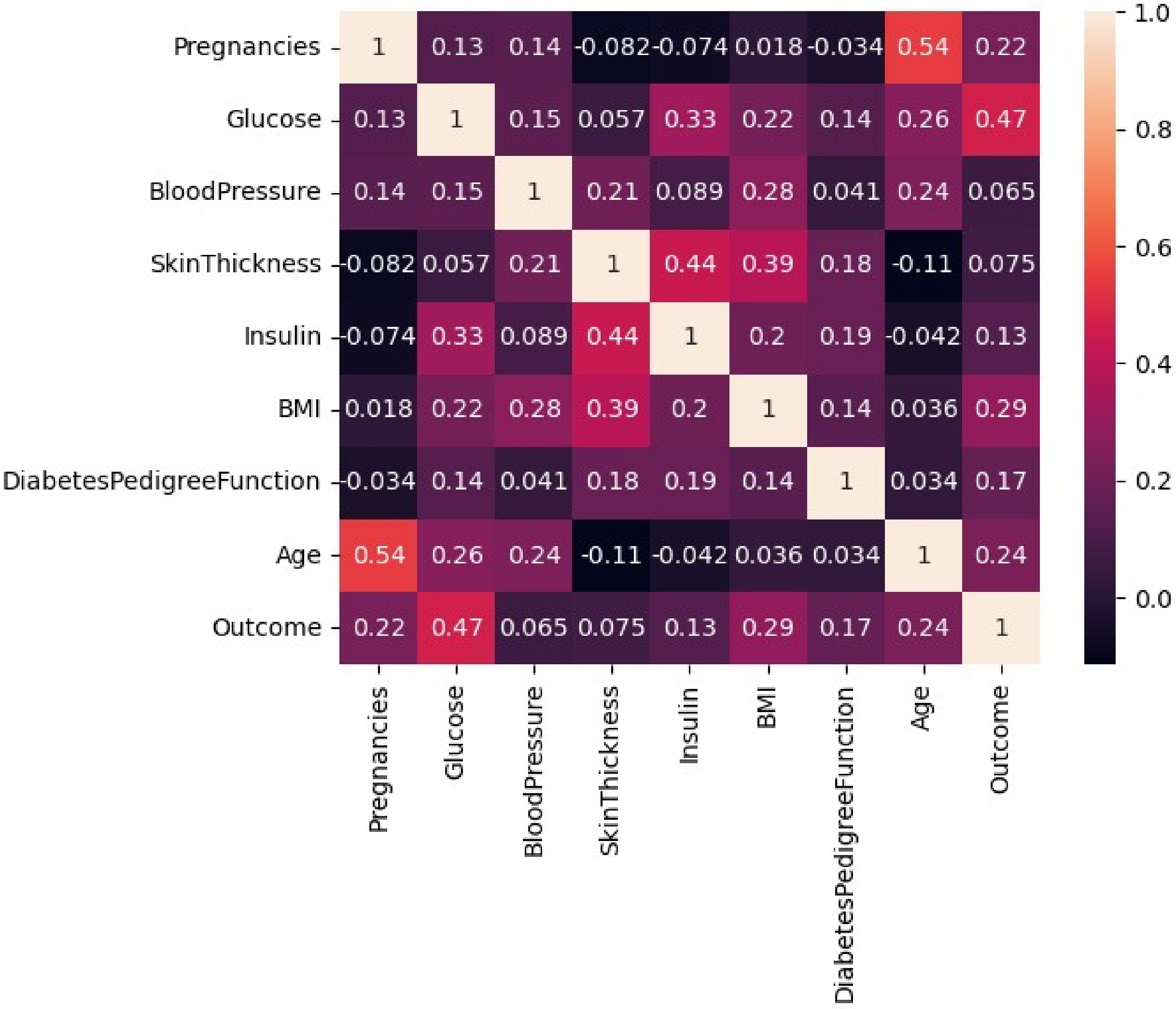
```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

```
sns.countplot(df.Outcome)
plt.title('Count 0 & 1')
plt.show()
```

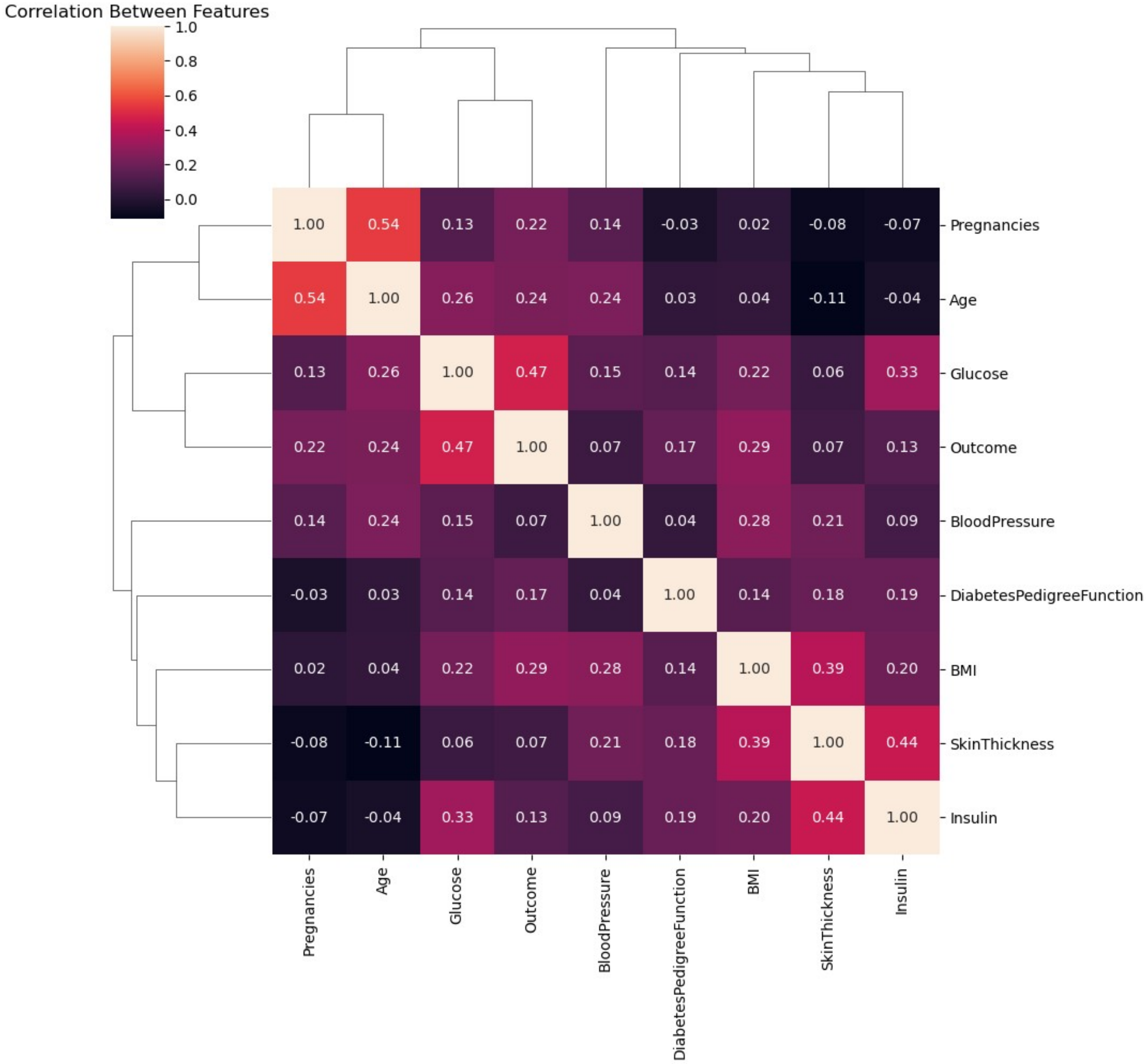
```
C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\seaborn\
_decorators.py:36: FutureWarning: Pass the following variable as a
keyword arg: x. From version 0.12, the only valid positional argument
will be `data`, and passing other arguments without an explicit
keyword will result in an error or misinterpretation.
  warnings.warn(
```



```
sns.heatmap(df.corr(),annot=True)
plt.show()
```

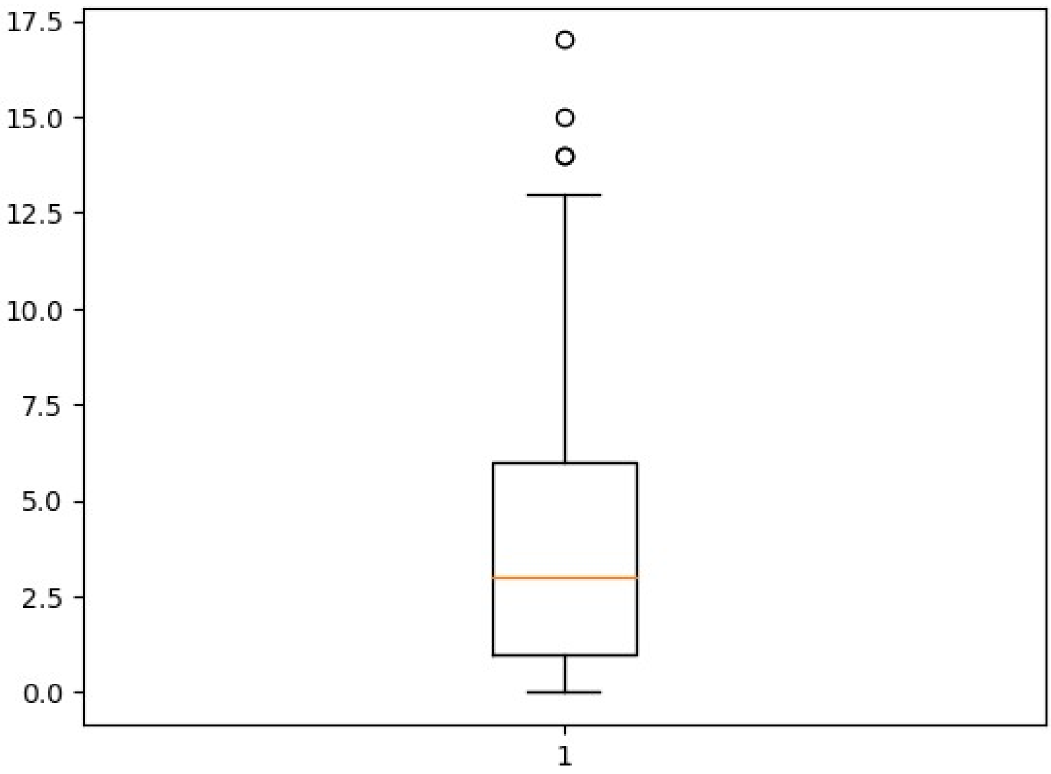


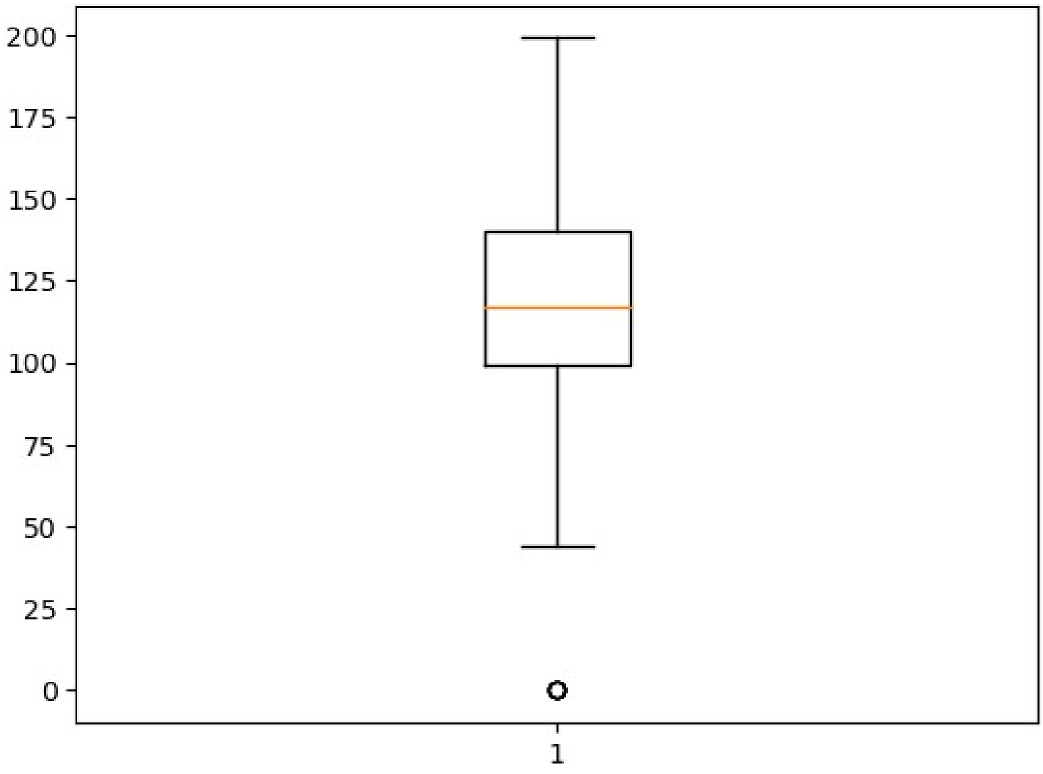
```
sns.clustermap(df.corr(),annot=True,fmt=".2f")
plt.title('Correlation Between Features')
plt.show()
```

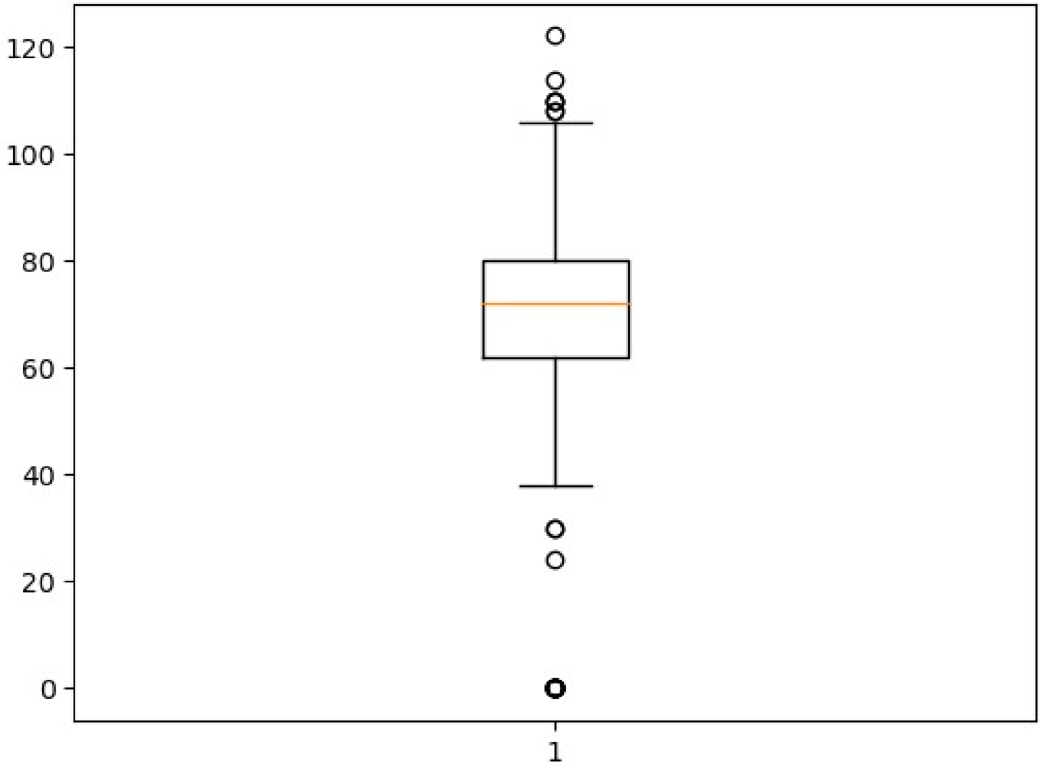


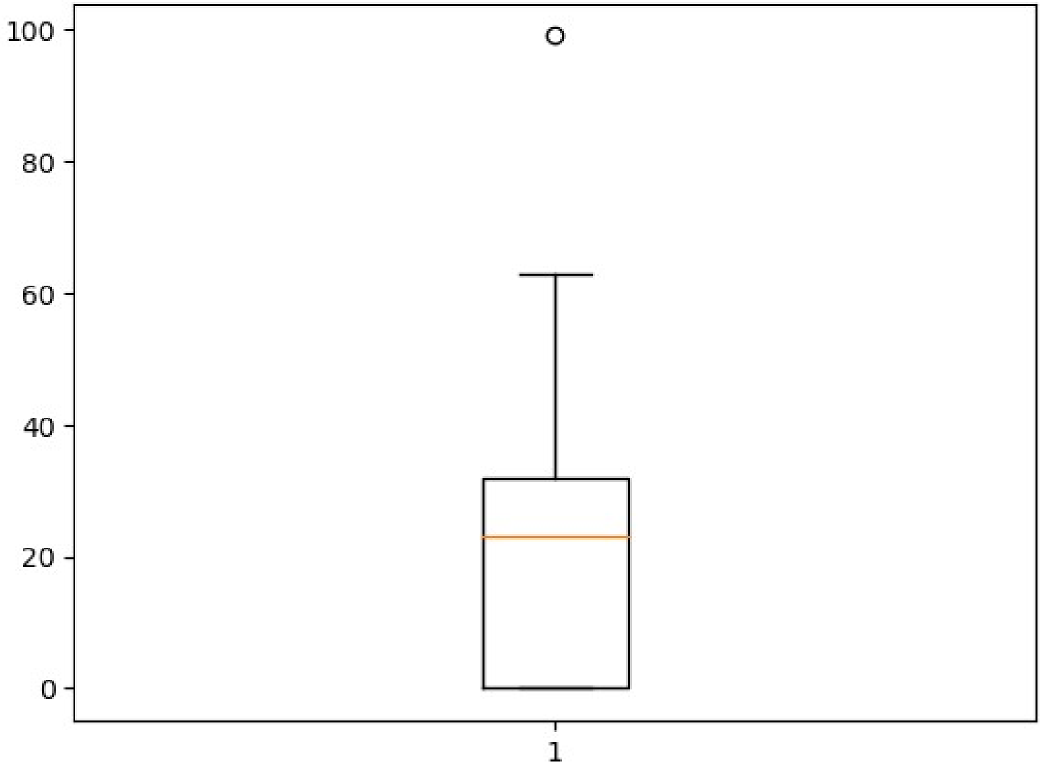
	Pregnancies	Age	Glucose	Outcome	BloodPressure	DiabetesPedigreeFunction	BMI	SkinThickness	Insulin
Pregnancies	1.00	0.54	0.13	0.22	0.14	-0.03	0.02	-0.08	-0.07
Age	0.54	1.00	0.26	0.24	0.24	0.03	0.04	-0.11	-0.04
Glucose	0.13	0.26	1.00	0.47	0.15	0.14	0.22	0.06	0.33
Outcome	0.22	0.24	0.47	1.00	0.07	0.17	0.29	0.07	0.13
BloodPressure	0.14	0.24	0.15	0.07	1.00	0.04	0.28	0.21	0.09
DiabetesPedigreeFunction	-0.03	0.03	0.14	0.17	0.04	1.00	0.14	0.18	0.19
BMI	0.02	0.04	0.22	0.29	0.28	0.14	1.00	0.39	0.20
SkinThickness	-0.08	-0.11	0.06	0.07	0.21	0.18	0.39	1.00	0.44
Insulin	-0.07	-0.04	0.33	0.13	0.09	0.19	0.20	0.44	1.00

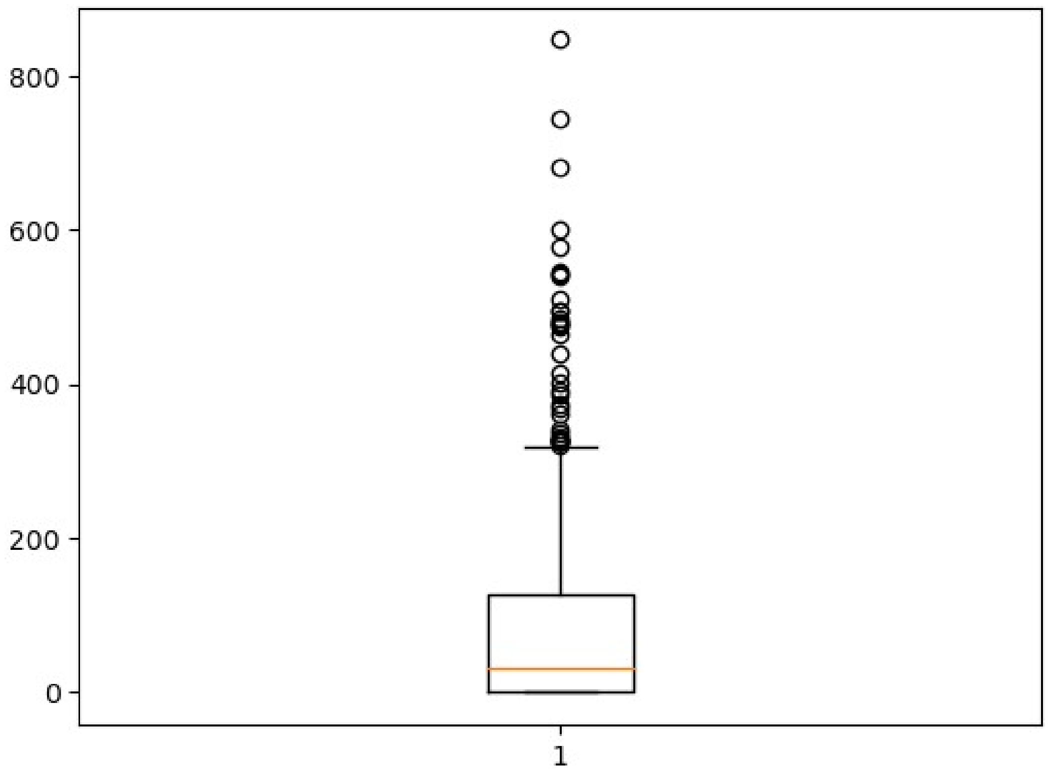
```
for i in df.columns:
       if(i!='Outcome'):
           plt.boxplot(df[i])
           plt.show()
```

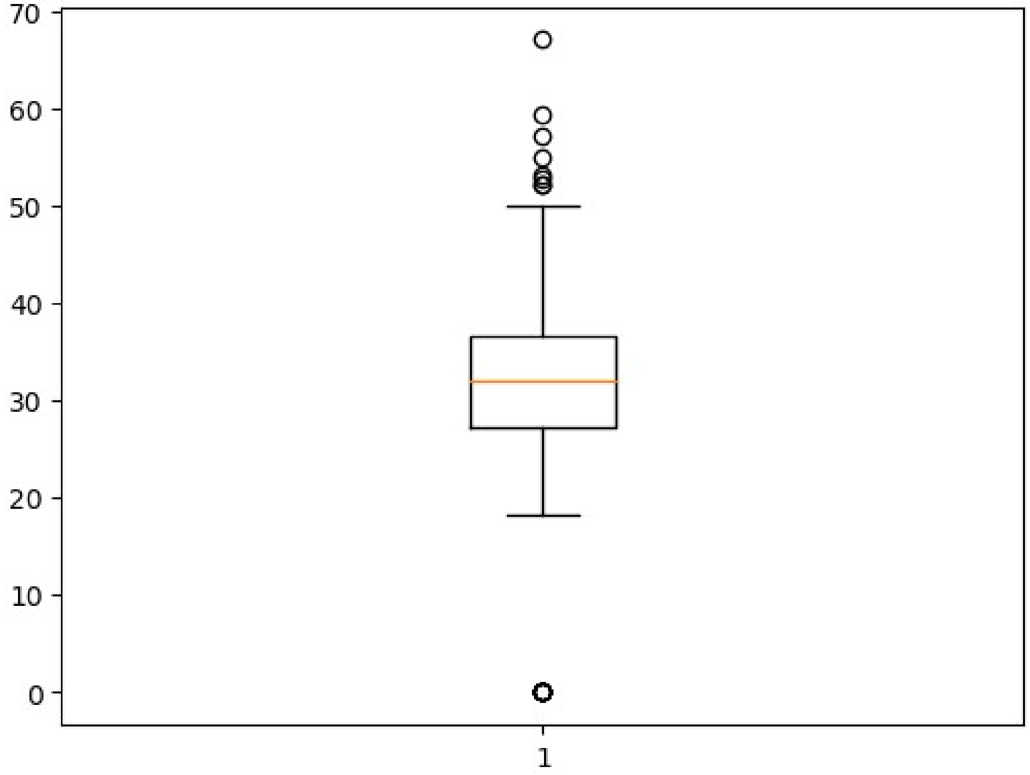

17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1

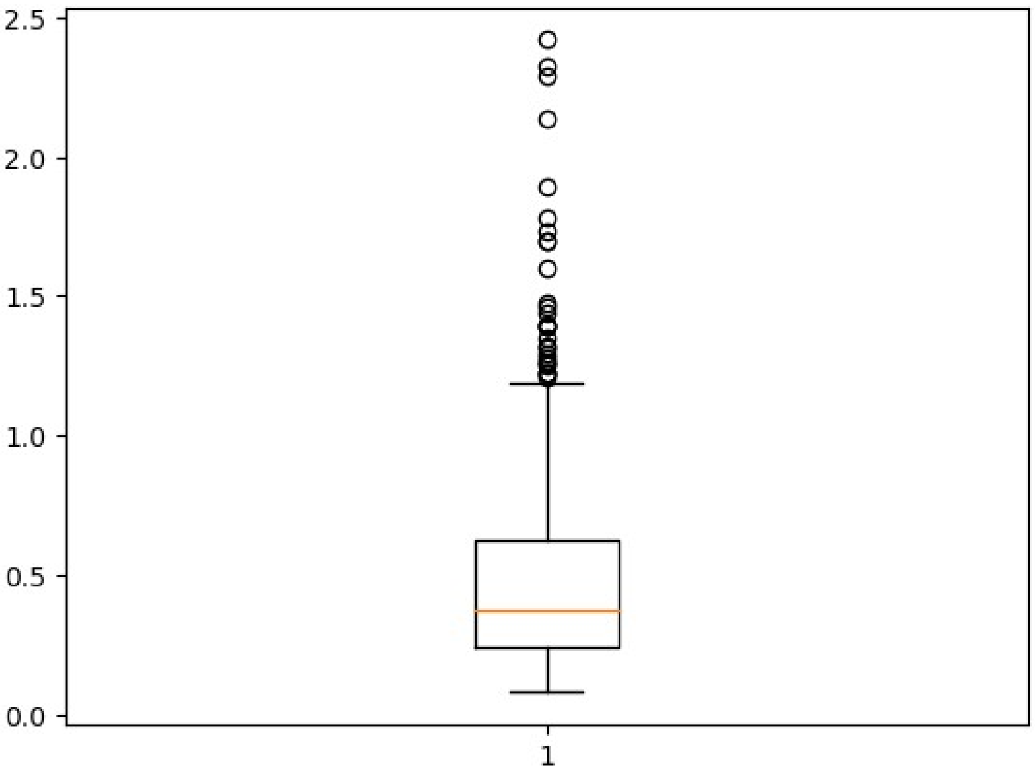

200
175
150
125
100
75
50
25
0
1

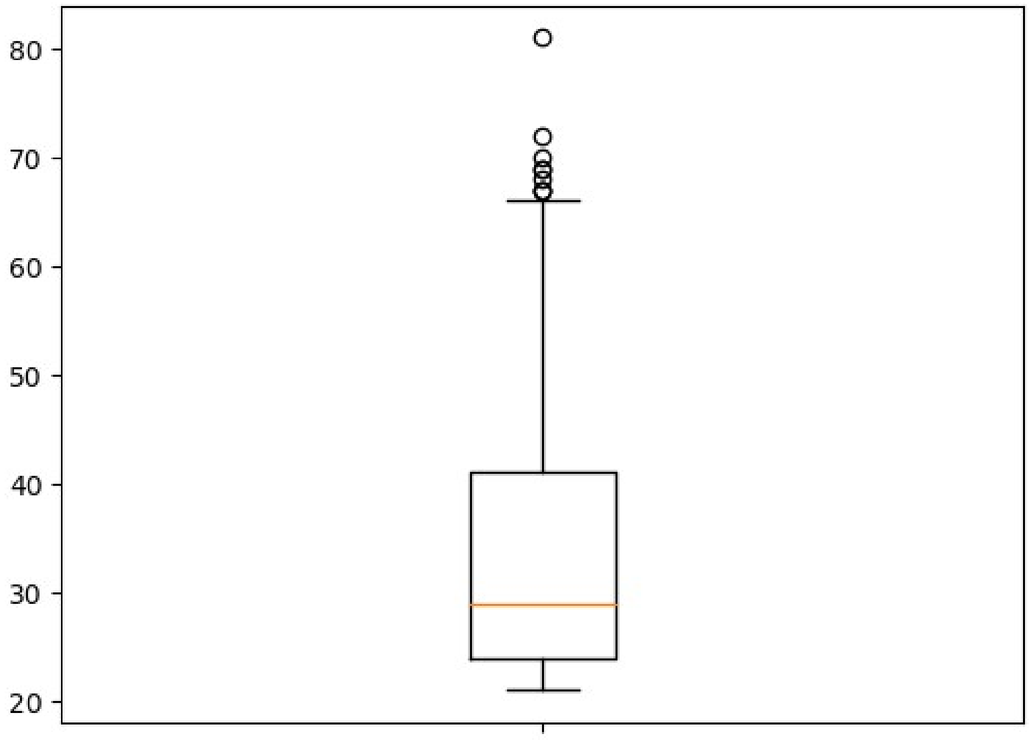

120
100
80
60
40
20
0
1


100
80
60
40
20
0
1

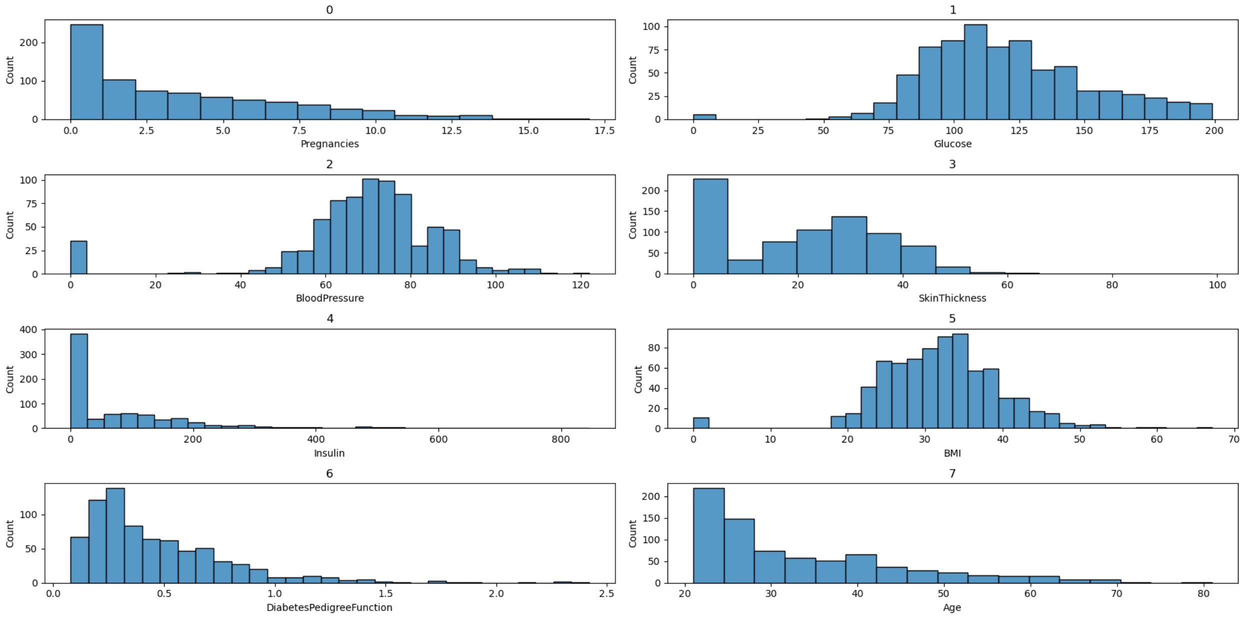

800
600
400
200
0
1


70
60
50
40
30
20
10
0
1


2.5
2.0
1.5
1.0
0.5
0.0
1

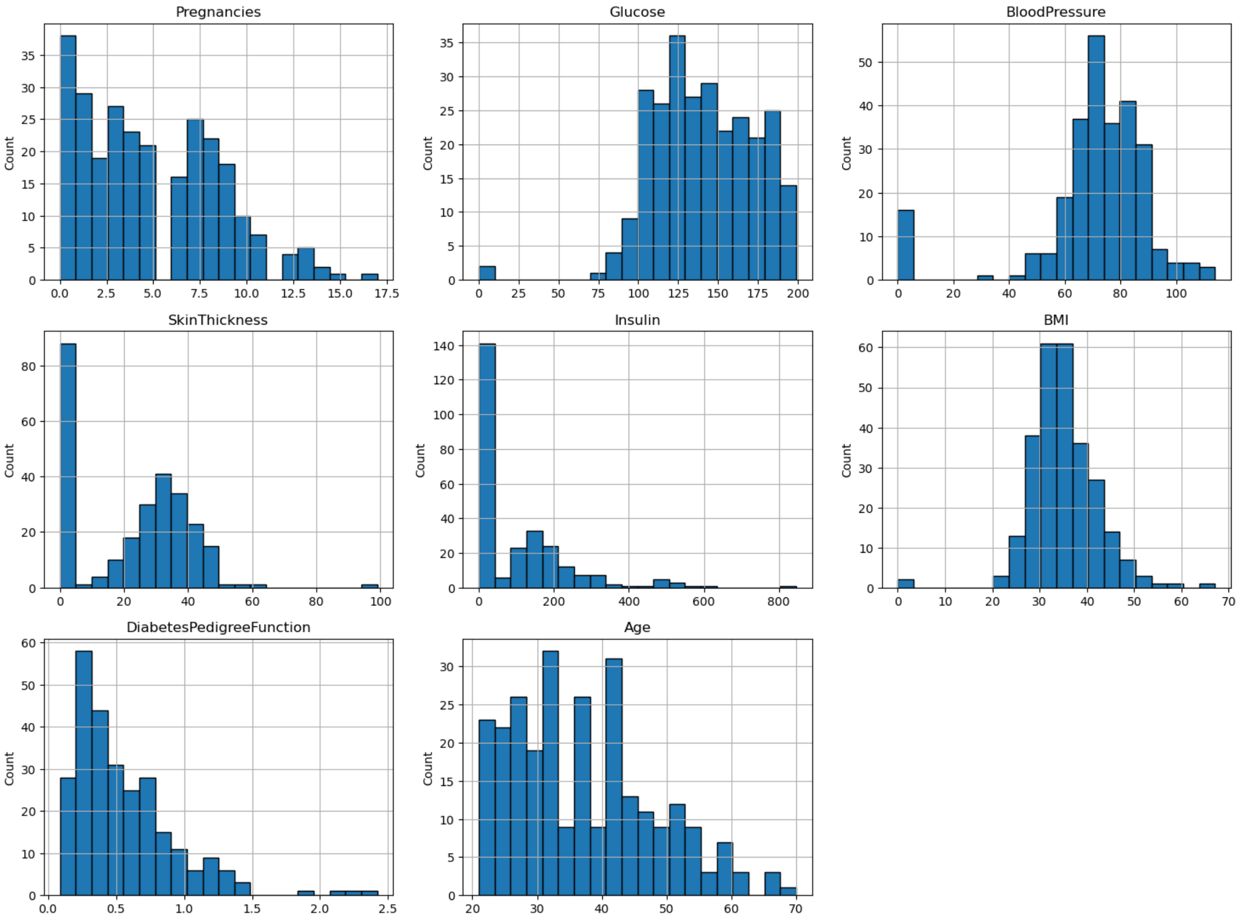

80
70
60
50
40
30
20
1

```
data1 = df[df["Outcome"] == 1]
columns = df.columns[:8]

plt.subplots(figsize=(18, 9))

for i, column in enumerate(columns):
    ax= plt.subplot(4, 2, i + 1)
    # Plot the histogram for all data
    sns.histplot(df[column], kde=False)
    plt.title(i)


plt.tight_layout()
plt.show()
```



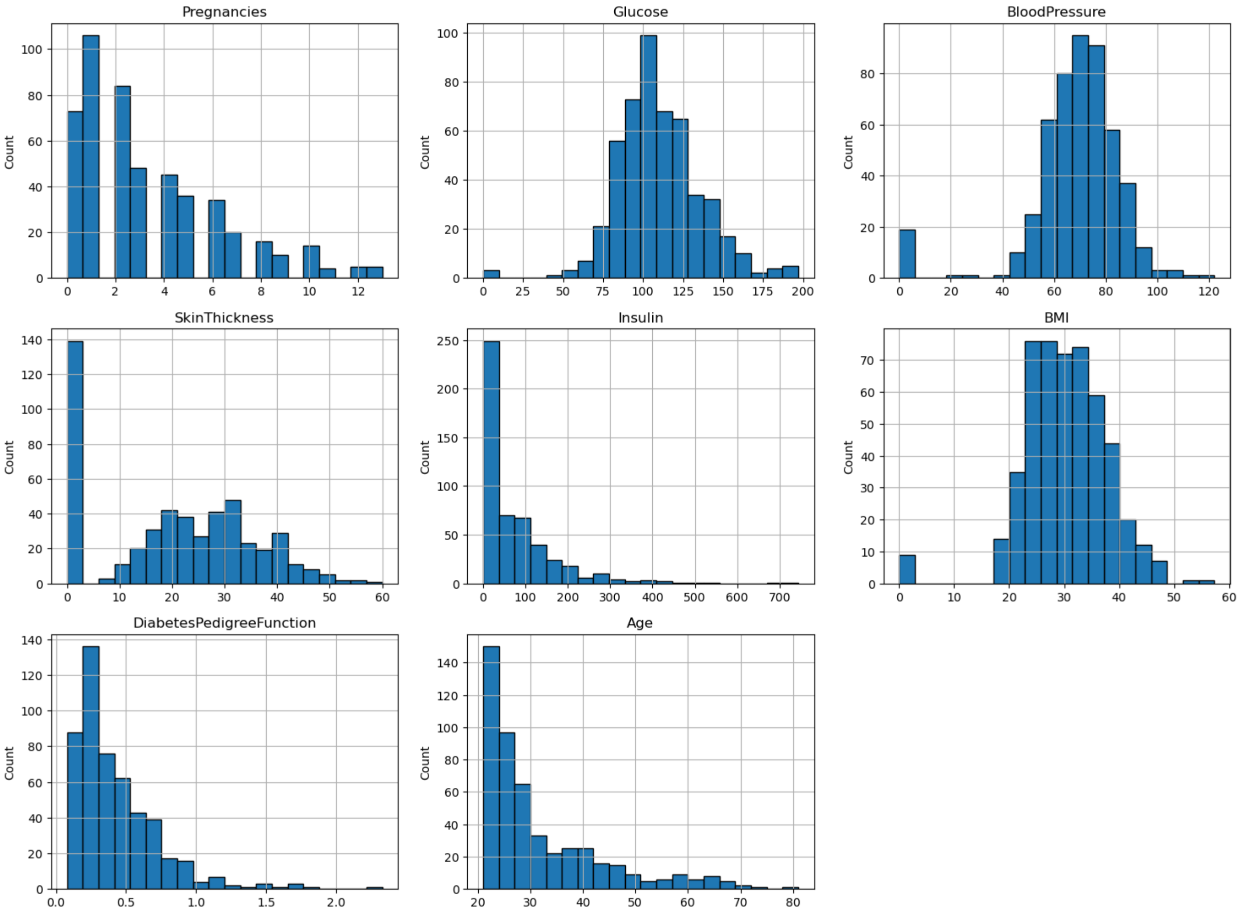
Analysis of Diabetic Cases

```
 #General Analysis
data1 = df[df["Outcome"]==1]
columns = df.columns[:8]
plt.subplots(figsize=(18,18))
length=len(columns)
for i, j in zip(columns, range(length)):
    plt.subplot((length//2),3,j+1)
    plt.ylabel("Count")
    data1[i].hist(bins=20,edgecolor='black')
    plt.title(i)
plt.show()
```

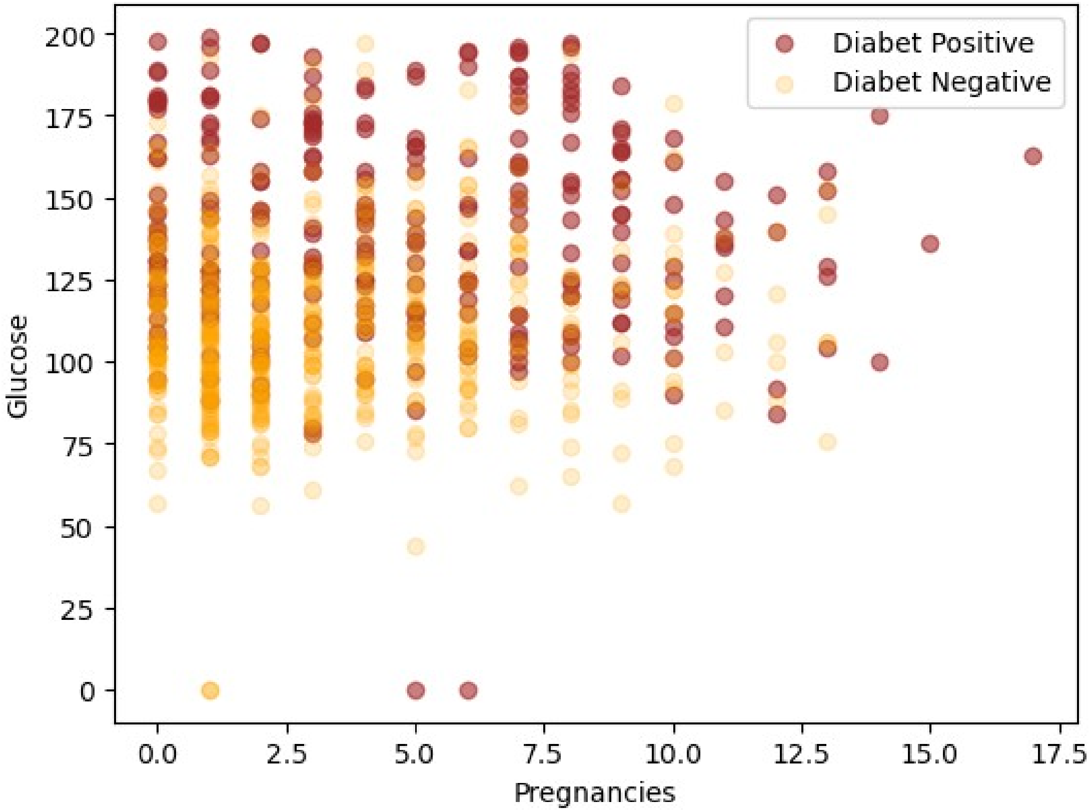


Analysis of Non-Diabetic Cases

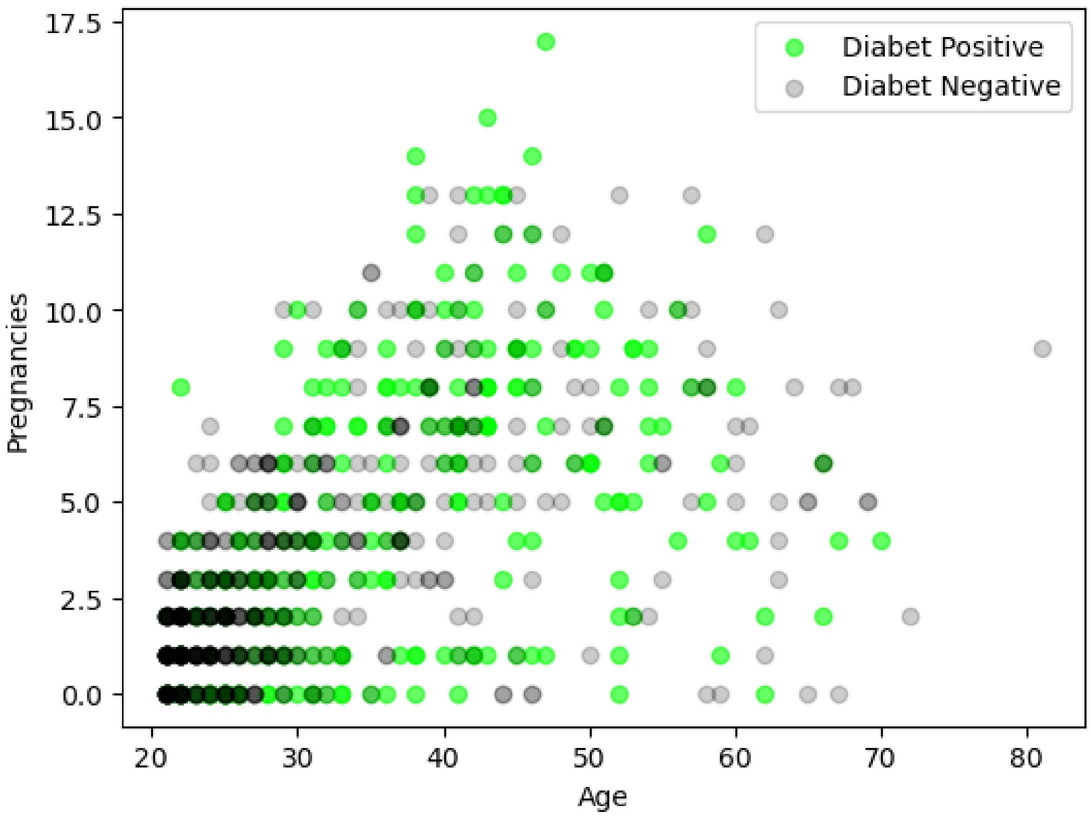
```
 #General Analysis
data1 = df[df["Outcome"]==0]
columns = df.columns[:8]
plt.subplots(figsize=(18,18))
length=len(columns)
for i, j in zip(columns, range(length)):
    plt.subplot((length//2),3,j+1)
    plt.ylabel("Count")
    data1[i].hist(bins=20,edgecolor='black')
    plt.title(i)
plt.show()
```



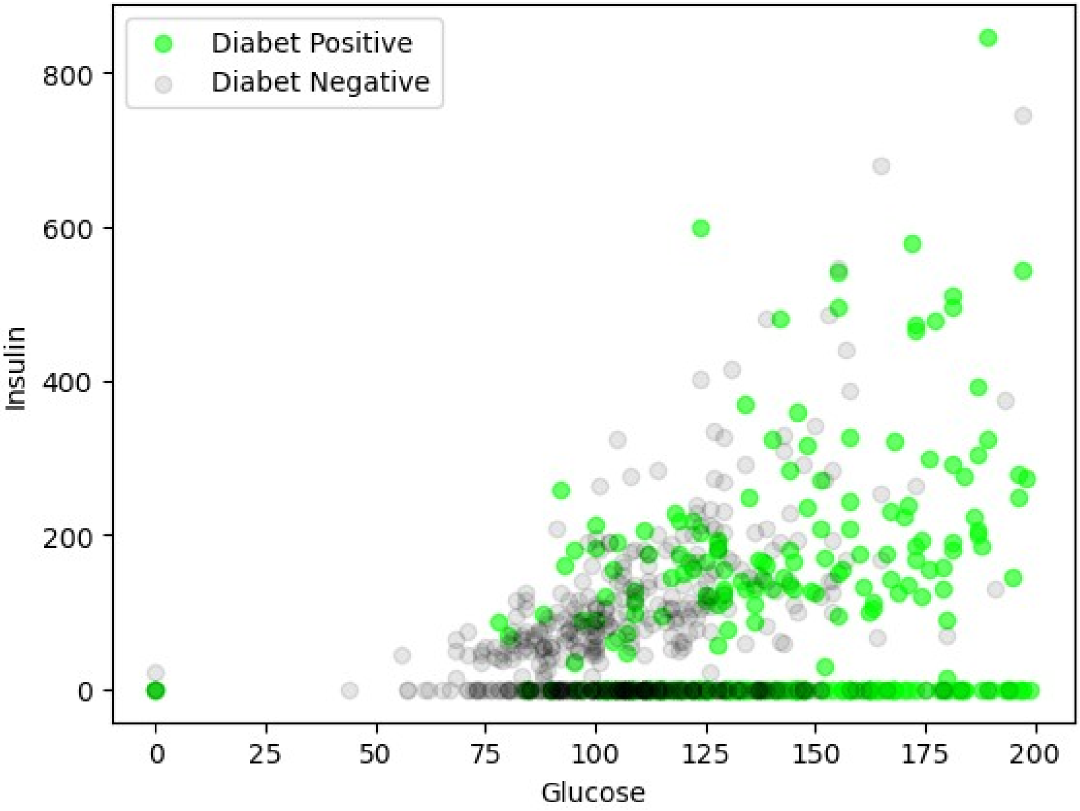
```python
#Split Data
p = df[df.Outcome == 1]
n = df[df.Outcome == 0]

plt.scatter(p.Pregnancies,p.Glucose,color = "brown",label="Diabet
Positive",alpha=0.6)
plt.scatter(n.Pregnancies,n.Glucose,color = "Orange",label="Diabet
Negative",alpha=0.2)
plt.xlabel("Pregnancies")
plt.ylabel("Glucose")
plt.legend()
plt.show()
```



```
plt.scatter(p.Age,p.Pregnancies,color = "lime",label="Diabet
Positive",alpha=0.6)
plt.scatter(n.Age,n.Pregnancies,color = "black",label="Diabet
Negative",alpha=0.2)
plt.xlabel("Age")
plt.ylabel("Pregnancies")
plt.legend()
plt.show()
```

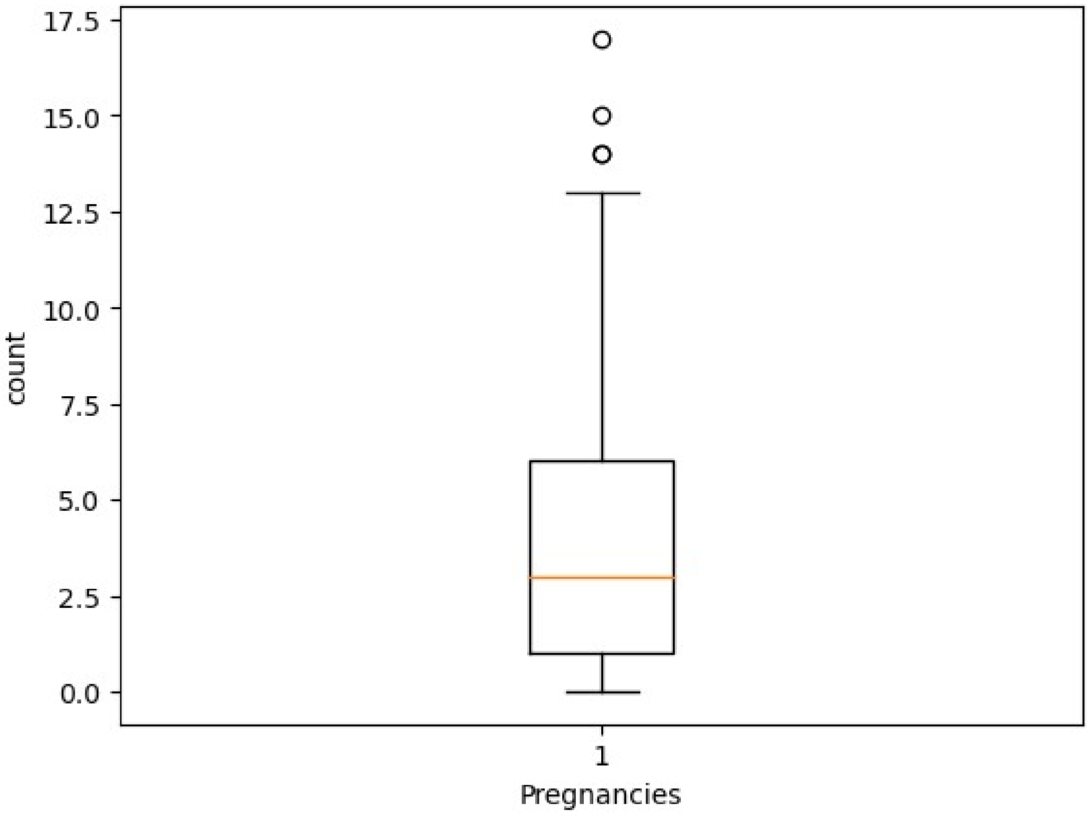


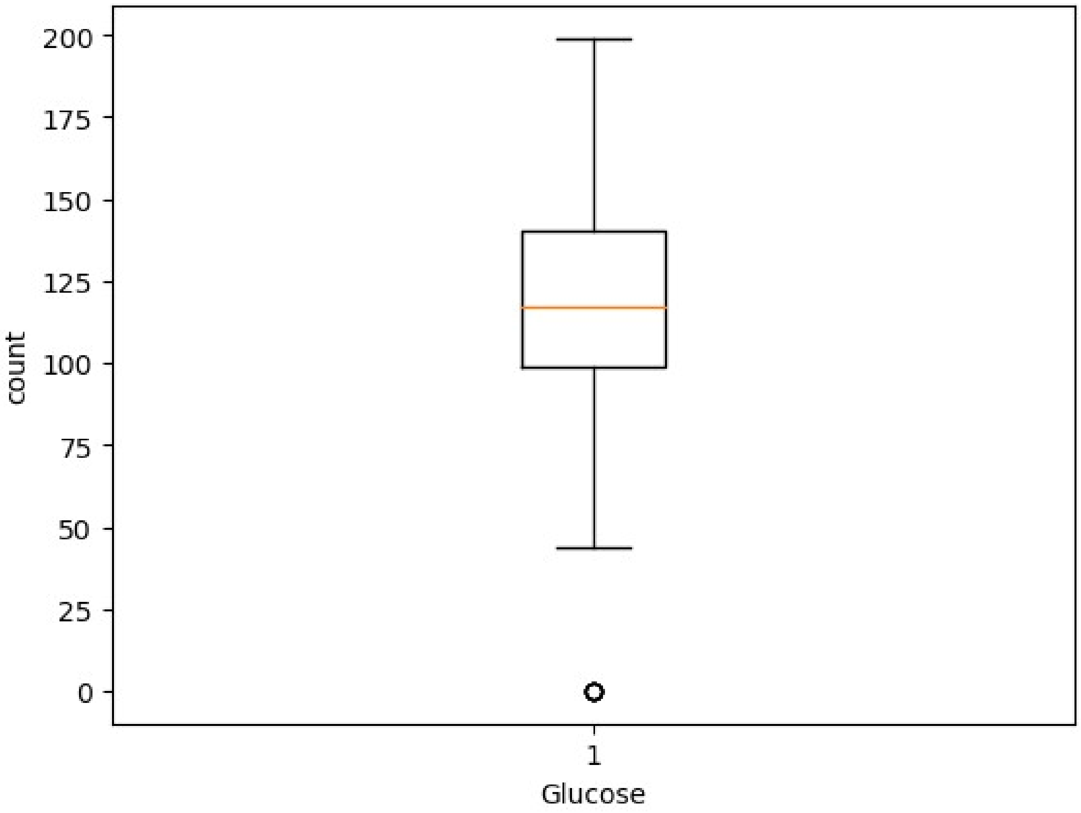
```
plt.scatter(p.Glucose,p.Insulin,color = "lime",label="Diabet
Positive",alpha=0.6)
plt.scatter(n.Glucose,n.Insulin,color = "black",label="Diabet
Negative",alpha=0.1)
plt.xlabel("Glucose")
plt.ylabel("Insulin")
plt.legend()
plt.show()
```

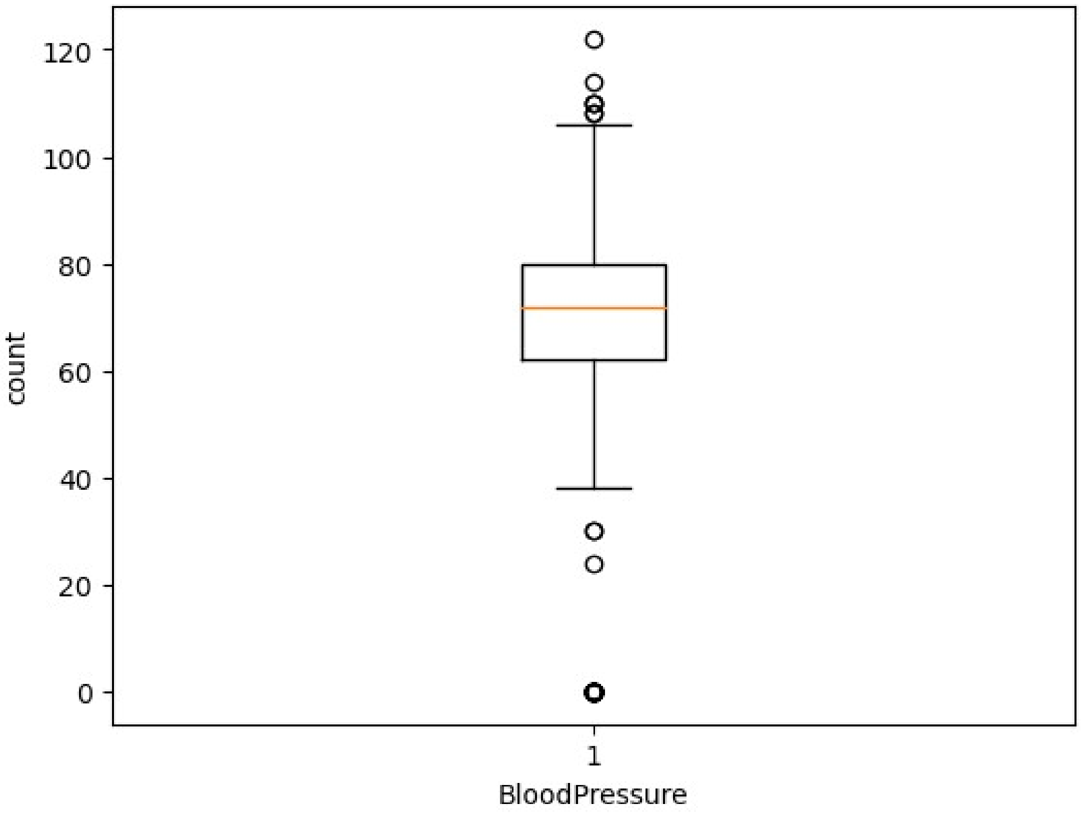


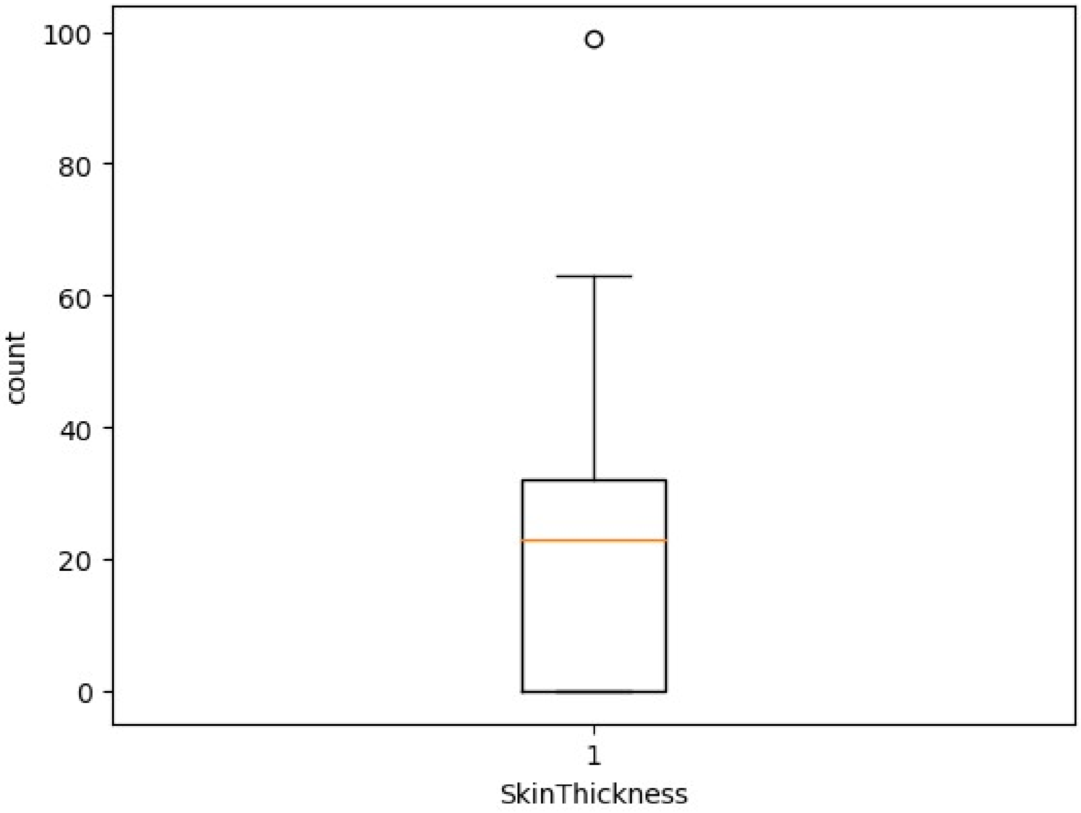
Identifying and Removal of Outlier

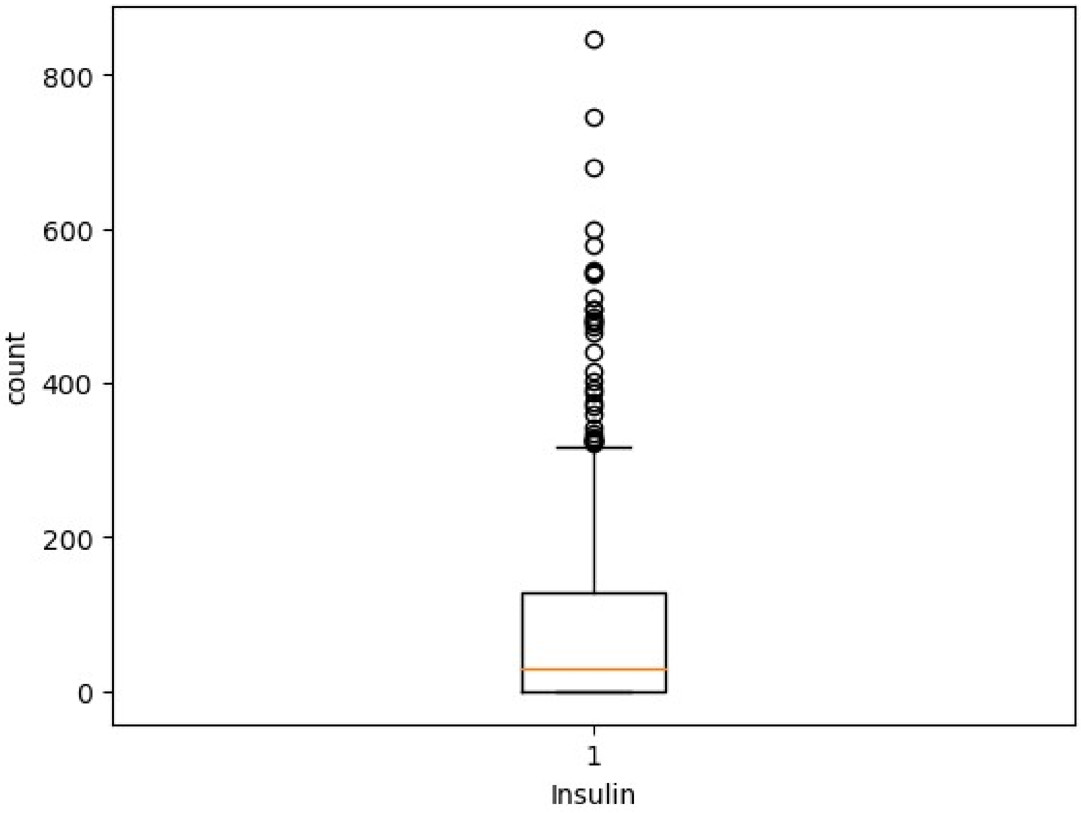
```
for col_name in df.columns:
    if(df[col_name].dtypes=='int64' or
df[col_name].dtypes=='float64'):
        plt.boxplot(df[col_name])
        plt.xlabel(col_name)
        plt.ylabel('count')
        plt.show()
```

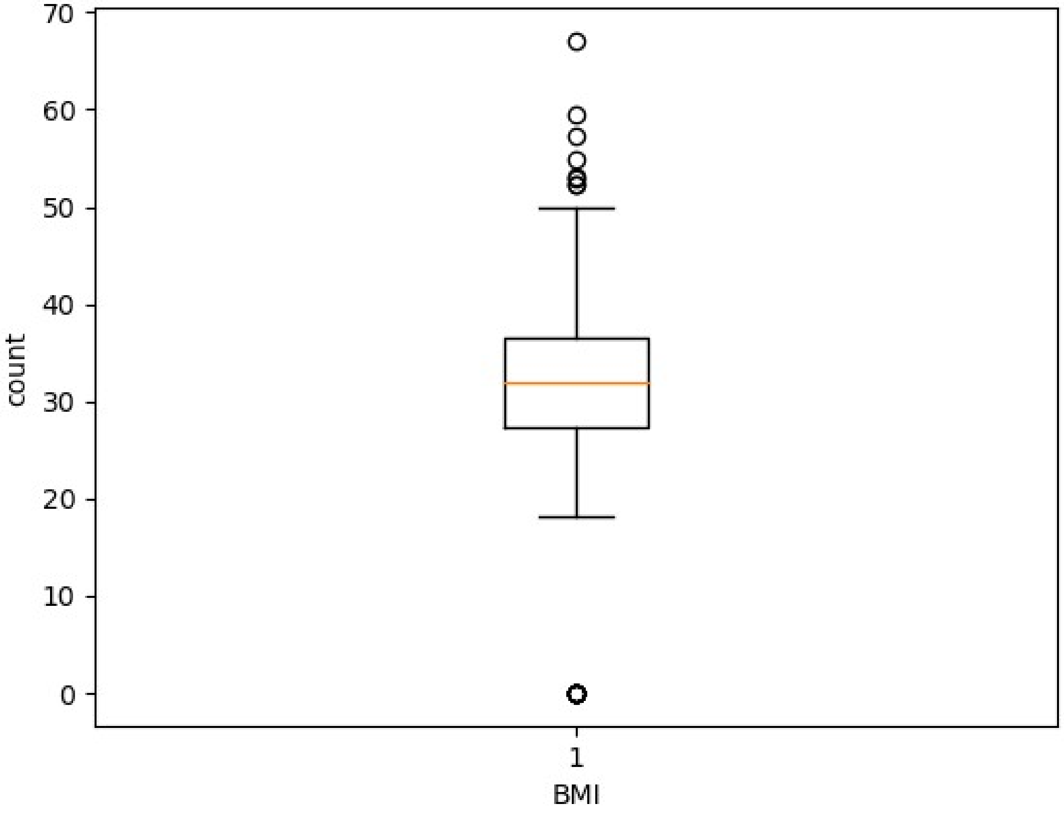

17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
count
1
Pregnancies

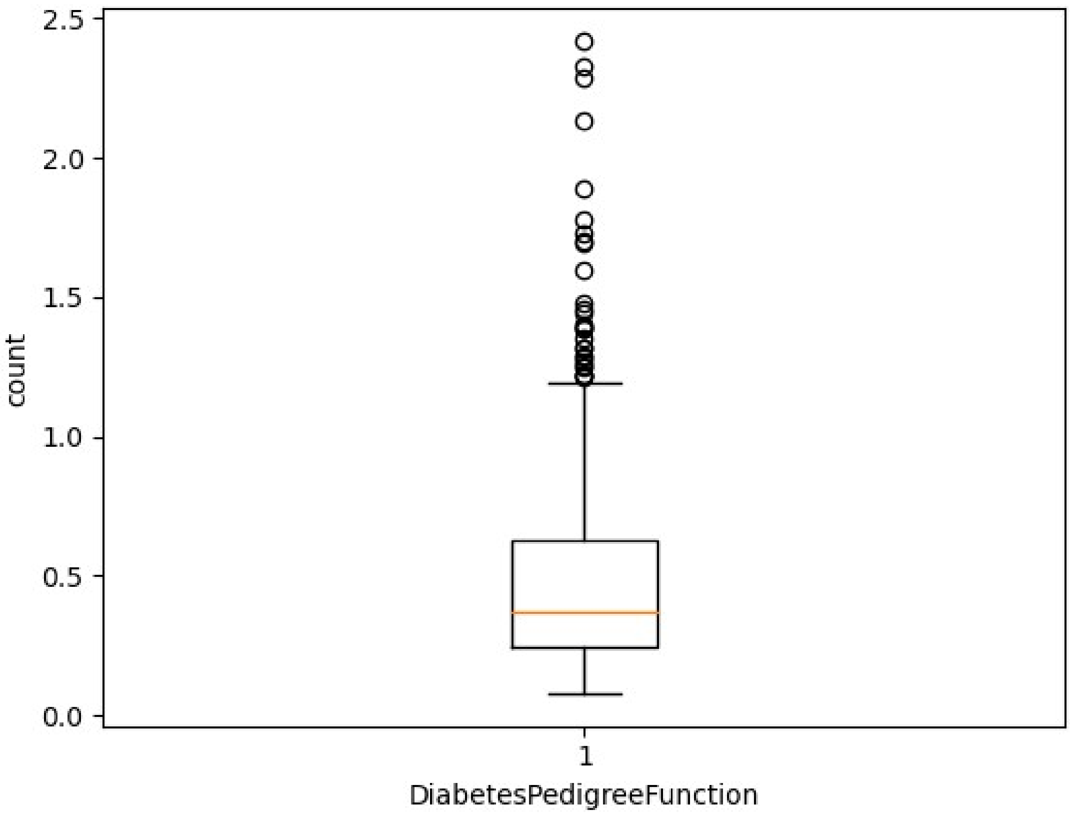

200
175
150
125
100
75
50
25
0
count
1
Glucose

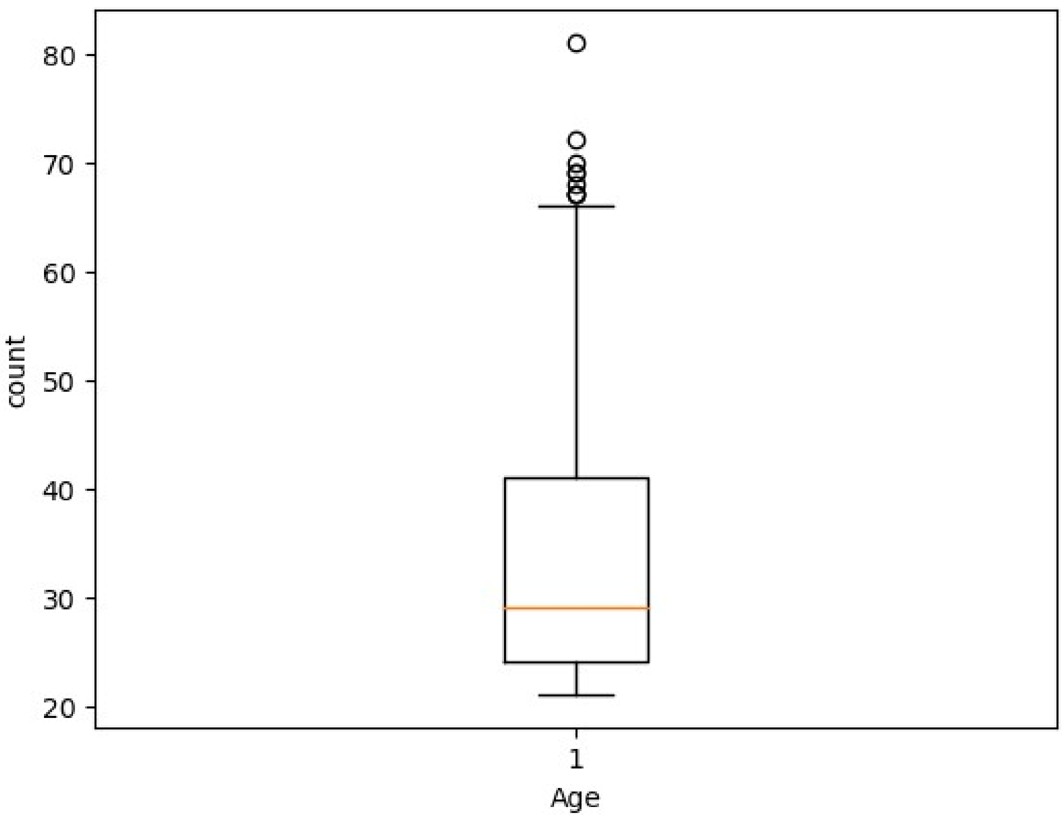

120
100
80
60
40
20
0
count
1
BloodPressure

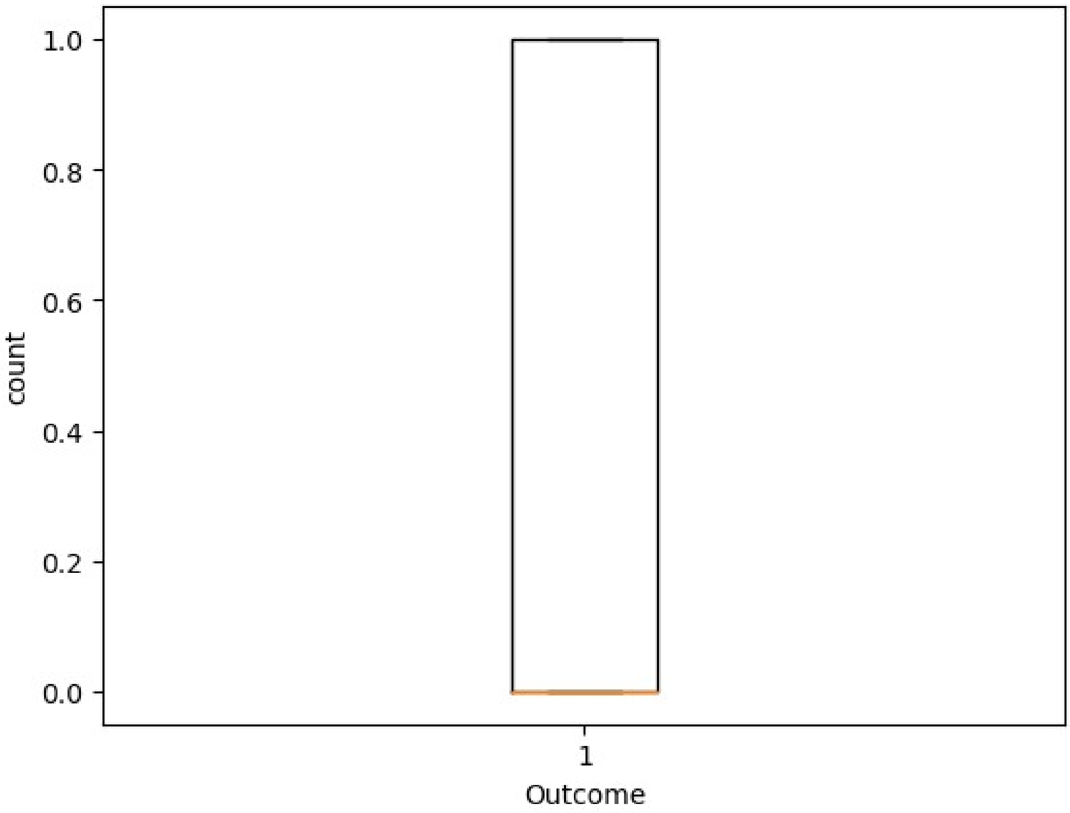

100
80
60
40
20
0
count
1
SkinThickness


800
600
400
200
0
count
1
Insulin

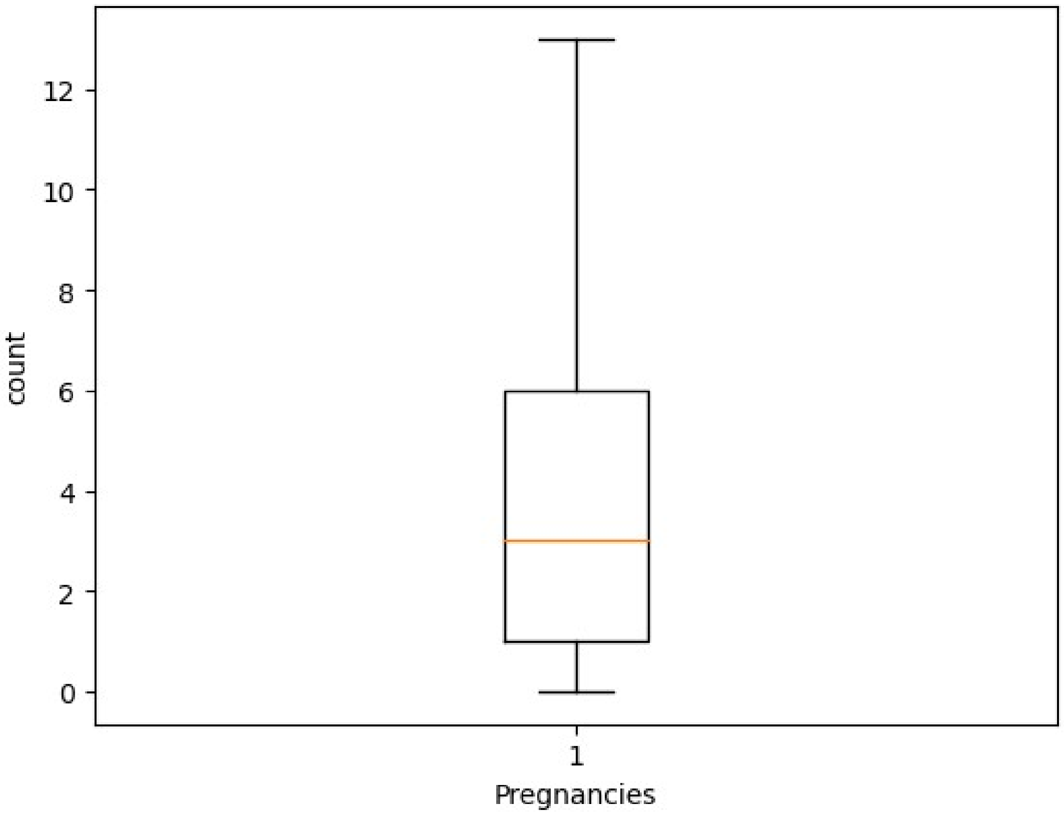

70
60
50
40
30
20
10
0
count
1
BMI

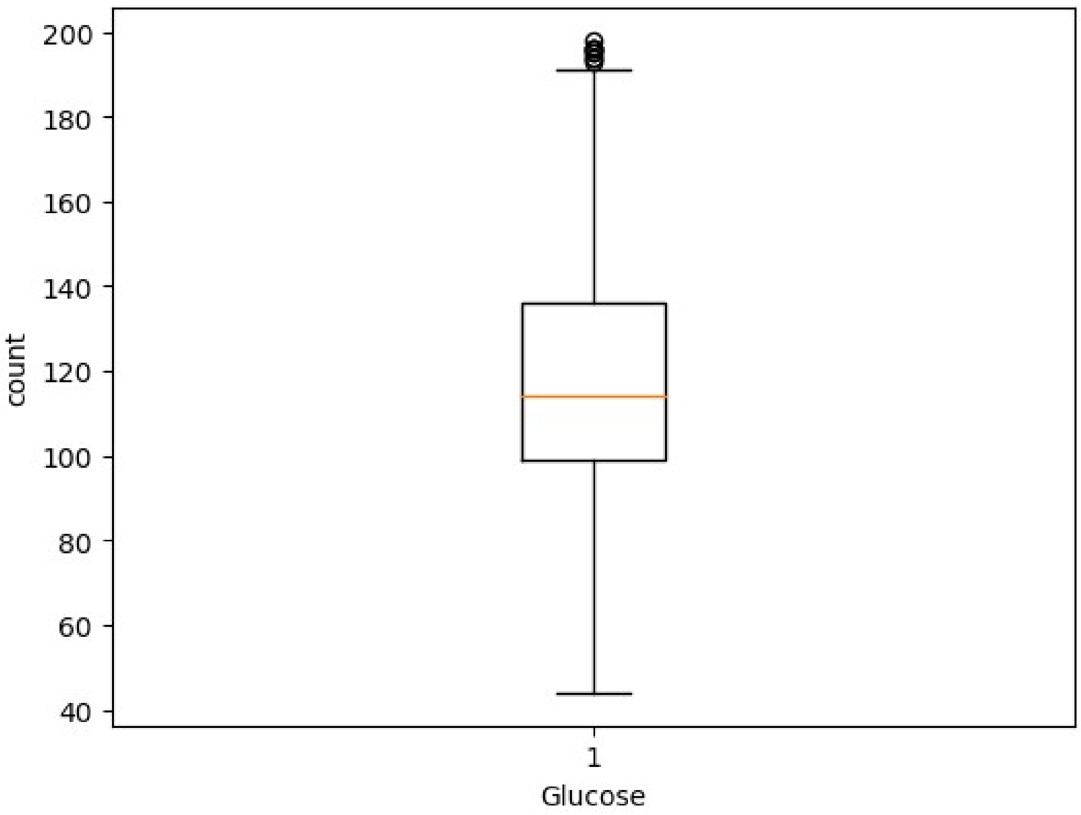

2.5
2.0
1.5
1.0
0.5
0.0
count
1
DiabetesPedigreeFunction

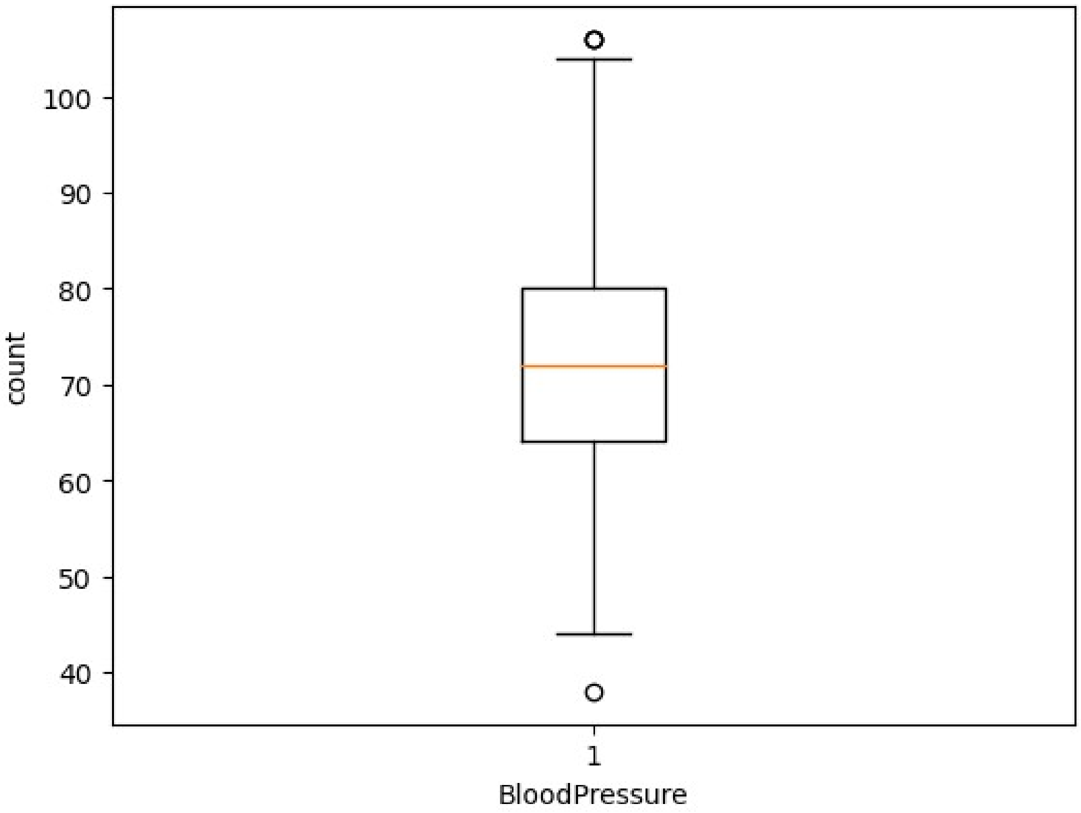

80
70
60
50
40
30
20
count
1
Age

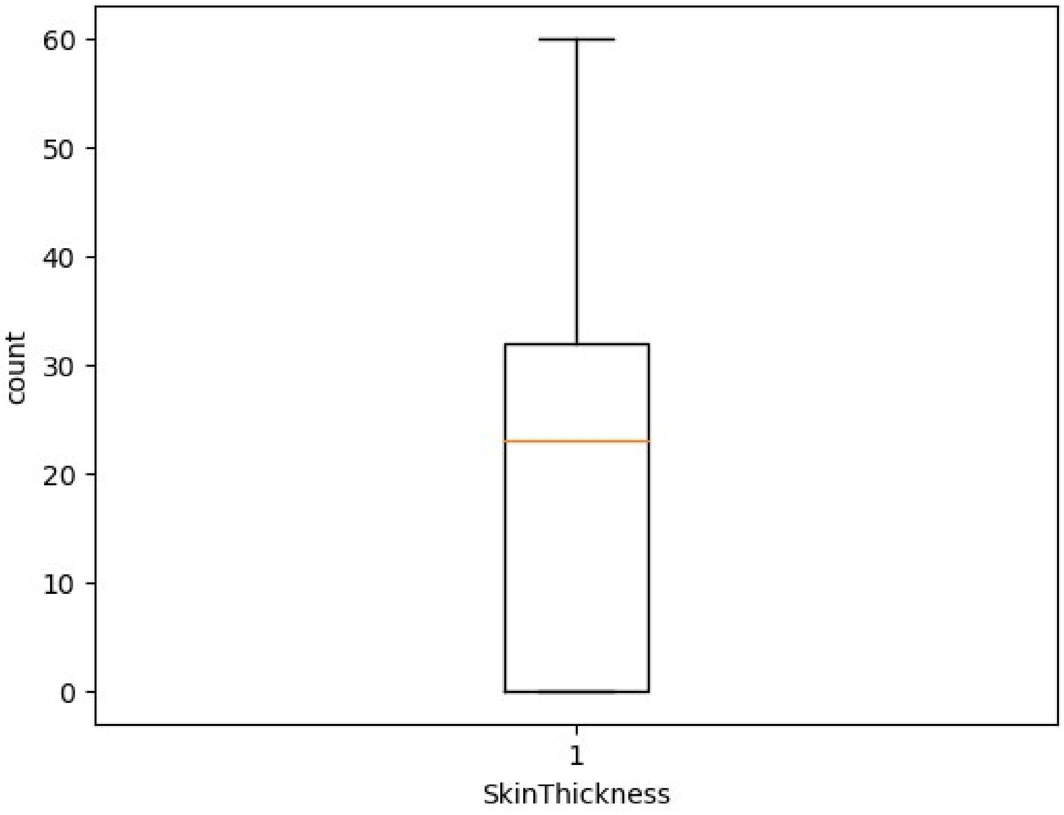


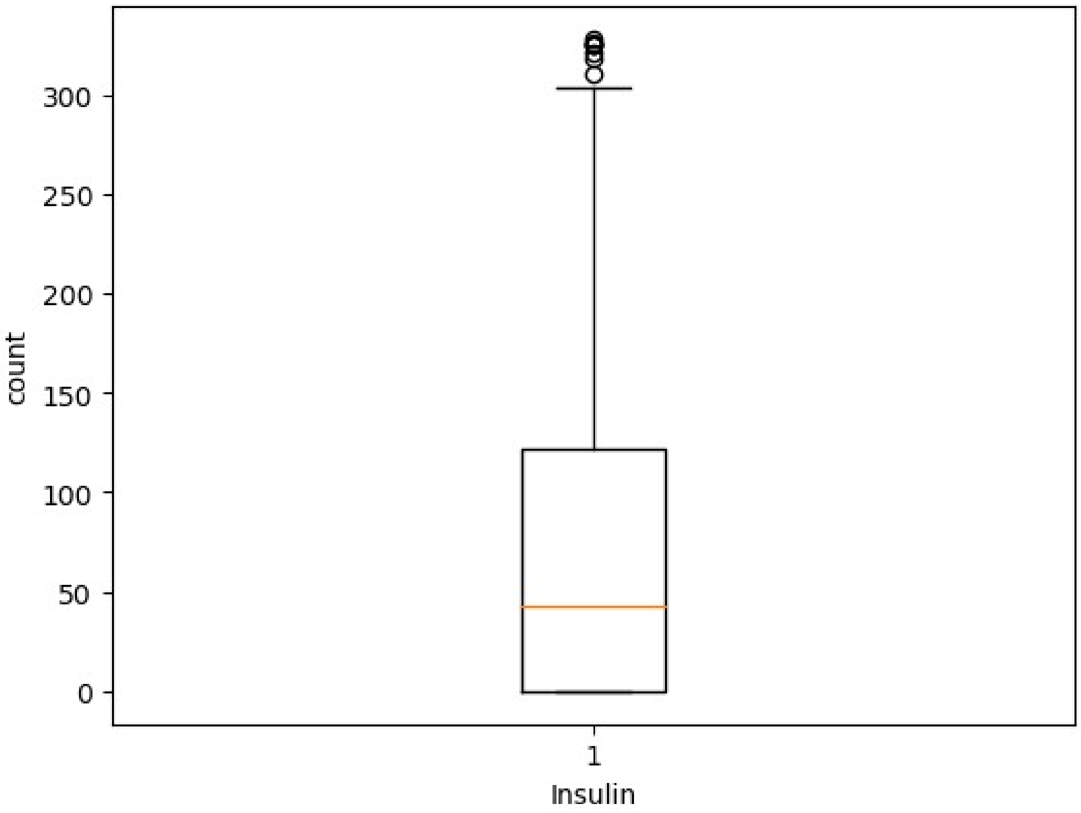
```
for i in df.columns:
    if(i!='Outcome'):
        q1=df[i].quantile(0.25)
        q3=df[i].quantile(0.75)
        iqr=q3-q1
        df=df[(df[i]>q1-1.5*iqr) & (df[i]<q3+1.5*iqr)]

for col_name in df.columns:
    if(df[col_name].dtypes=='int64' or
df[col_name].dtypes=='float64'):
        plt.boxplot(df[col_name])
        plt.xlabel(col_name)
        plt.ylabel('count')
        plt.show()
```

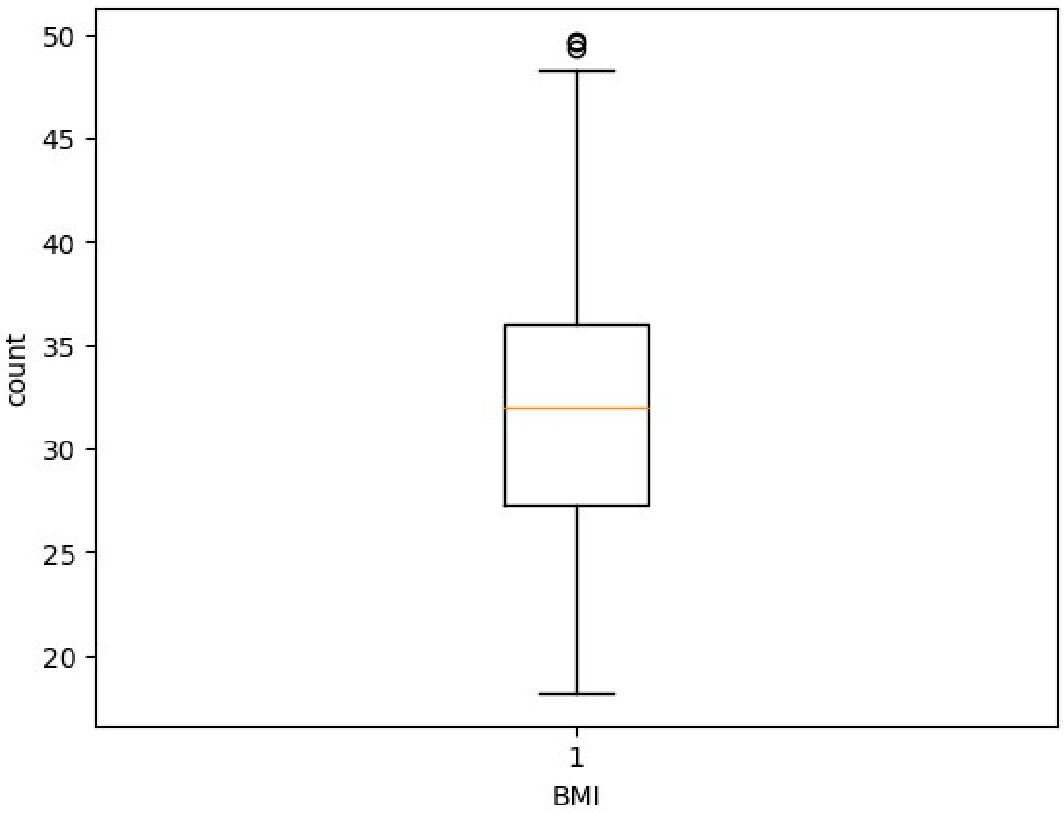

count
0
2
4
6
8
10
12
1
Pregnancies

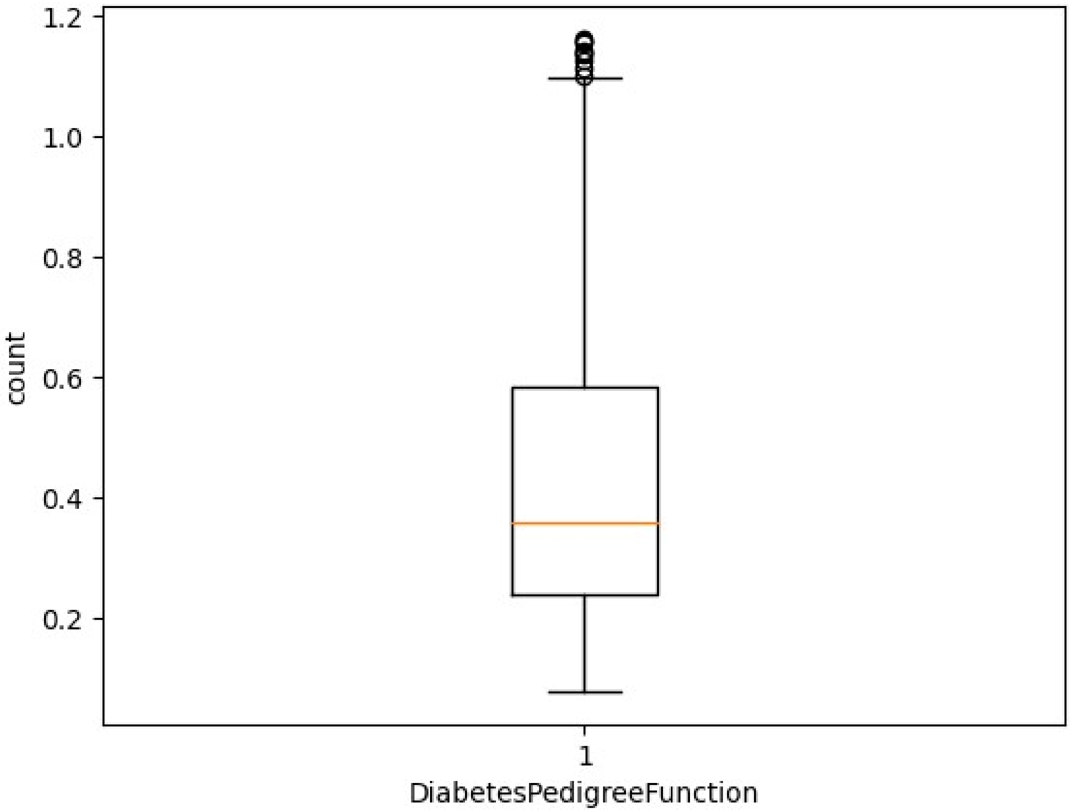

count
40
60
80
100
120
140
160
180
200
1
Glucose

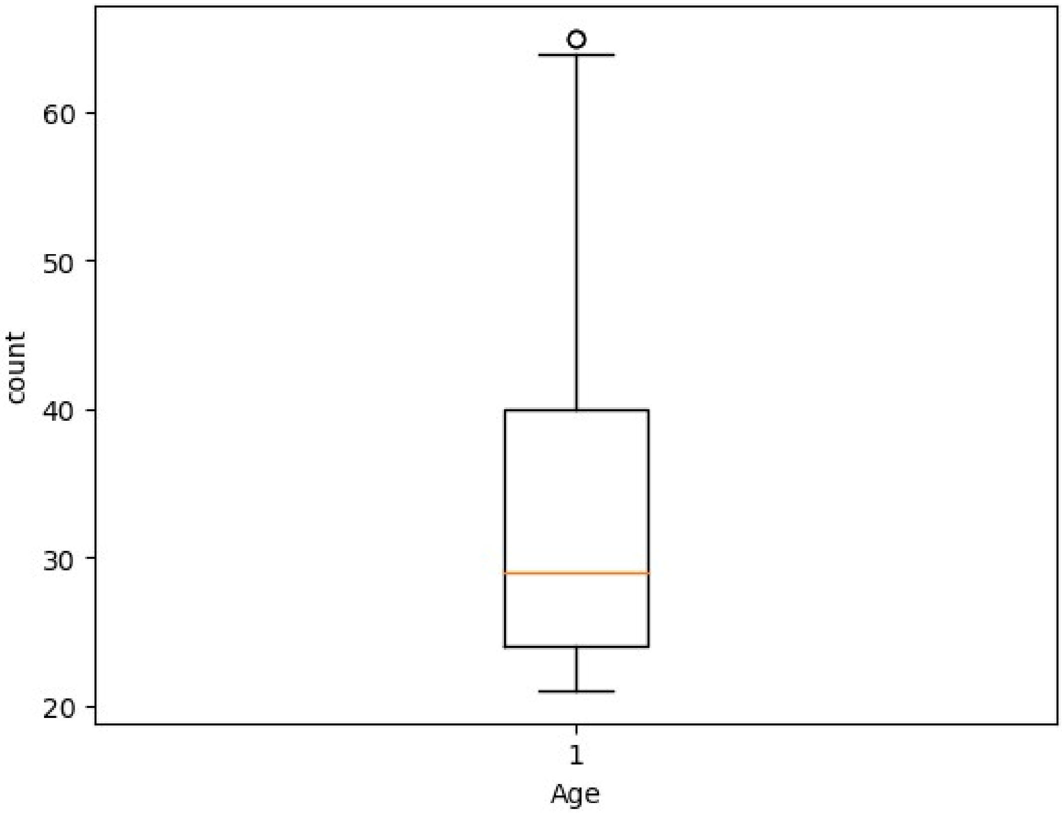

100
90
80
70
60
50
40
count
1
BloodPressure

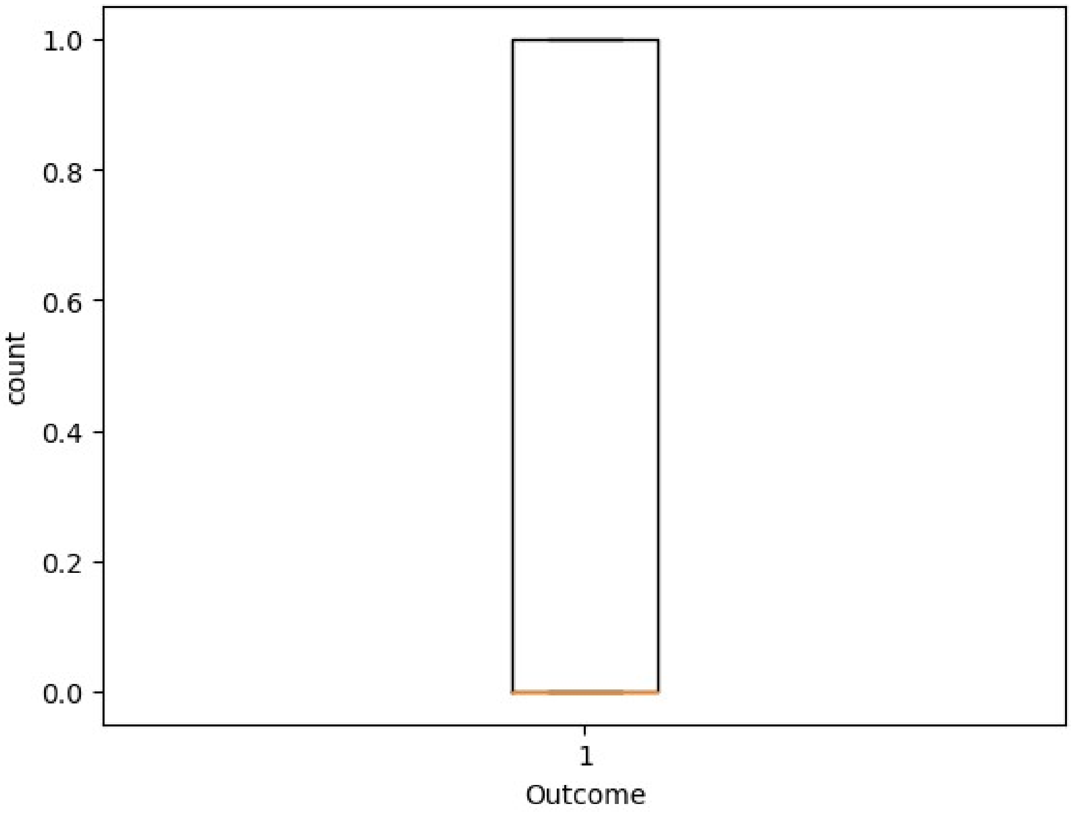

60
50
40
30
20
10
0
count
1
SkinThickness


300
250
200
150
100
50
0
count
1
Insulin


50
45
40
35
30
25
20
count
1
BMI


1.2
1.0
0.8
0.6
0.4
0.2
count
1
DiabetesPedigreeFunction


60
50
40
30
20
count
1
Age



Segregration od Data(independent and Dependent)

```
x=df.drop('Outcome',axis=1)
y=df['Outcome']
```

Spliting of Dataset into Train and Test Data

```
test_size = 0.2

x_train, x_test, y_train, y_test = 
train_test_split(x,y,test_size=test_size,random_state=42)
```

- StandardScaler is a preprocessing technique used in machine learning and statistics to scale (standardize) the features of a dataset. The goal of StandardScaler is to transform the data such that it has a mean of 0 and a standard deviation of 1. This process is also known as "z-score normalization" or "z-score scaling."

  Z = (X - μ) / σ "Z" is the standardized value. "X" is the original value. "μ" is the mean of the feature. "σ" is the standard deviation of the feature.

- StandardScaler is a good choice when you have features with different scales or units, and you want to ensure that they all have the same scale for modeling purposes. It's commonly used with algorithms like Support Vector Machines (SVM), Principal Component Analysis (PCA), and k-Nearest Neighbors (k-NN).

```
scaler = StandardScaler()
x_train = scaler.fit_transform(x_train)

x_test = scaler.transform(x_test)
```

Decision Tree Model

```
model = tree.DecisionTreeClassifier()
model.fit(x_train, y_train)
```

```
DecisionTreeClassifier()
```

```
prediction=model.predict(x_test)
```

```
print(metrics.classification_report(y_test,prediction))
```

```
              precision    recall  f1-score   support

           0       0.86      0.76      0.81        97
           1       0.45      0.61      0.52        31

    accuracy                           0.73       128
   macro avg       0.66      0.69      0.66       128
weighted avg       0.76      0.73      0.74       128
```

```
print(metrics.accuracy_score(y_test,prediction))
```

```
0.7265625
```

Hyper Parameter Tuning

```
parameter={
    'max_depth':[None,10,20,30],
    'min_samples_leaf':[1,2,4],
    'min_samples_split':[2,5,10],
    'max_features':['auto','sqrt'],
    'criterion': ['gini', 'entropy']

}
rf_classifier = DecisionTreeClassifier(random_state=42)
grid_search=GridSearchCV( estimator=rf_classifier ,param_grid=paramete
r,verbose=2,cv=5,n_jobs=-1)
grid_search.fit(x, y)
```

```
print("Best Parameters",grid_search.best_params_)
```

```
Fitting 5 folds for each of 144 candidates, totalling 720 fits
Best Parameters {'criterion': 'gini', 'max_depth': None,
'max_features': 'sqrt', 'min_samples_leaf': 4, 'min_samples_split': 2}

C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py:425: FitFailedWarning:
360 fits failed out of a total of 720.
The score on these train-test partitions for these parameters will be
set to nan.
If these failures are not expected, you can try to debug them by
setting error_score='raise'.

Below are more details about the failures:
----------------------------------------------------------------------
----------
195 fits failed with the following error:
Traceback (most recent call last):
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 1145, in wrapper
    estimator._validate_params()
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 638, in _validate_params
    validate_parameter_constraints(
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
utils\_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The
'max_features' parameter of DecisionTreeClassifier must be an int in
the range [1, inf), a float in the range (0.0, 1.0], a str among
{'sqrt', 'log2'} or None. Got 'auto' instead.

----------------------------------------------------------------------
----------
165 fits failed with the following error:
Traceback (most recent call last):
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 1145, in wrapper
    estimator._validate_params()
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 638, in _validate_params
```

```
    validate_parameter_constraints(
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
utils\_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The
'max_features' parameter of DecisionTreeClassifier must be an int in
the range [1, inf), a float in the range (0.0, 1.0], a str among
{'log2', 'sqrt'} or None. Got 'auto' instead.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_search.py:979: UserWarning: One or more of the test
scores are non-finite: [       nan        nan        nan        nan
nan        nan
        nan        nan        nan 0.69345472 0.70131644 0.72802657
 0.69811762 0.68235728 0.72956447 0.74685039 0.74685039 0.72962598
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.72952756 0.69970472 0.70282972
 0.73897638 0.71226624 0.72641486 0.74533711 0.74533711 0.73277559
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.69345472 0.70131644 0.72802657
 0.69811762 0.68235728 0.72956447 0.74685039 0.74685039 0.72962598
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.69345472 0.70131644 0.72802657
 0.69811762 0.68235728 0.72956447 0.74685039 0.74685039 0.72962598
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.73113927 0.71062992 0.72011565
 0.72331447 0.71703986 0.70441683 0.72647638 0.72647638 0.73582677
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.72010335 0.74057579 0.71697835
 0.71385335 0.71384104 0.71686762 0.72645177 0.72645177 0.73115157
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.73113927 0.71062992 0.72011565
 0.72331447 0.71703986 0.70441683 0.72647638 0.72647638 0.73582677
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.73113927 0.71062992 0.72011565
 0.72331447 0.71703986 0.70441683 0.72647638 0.72647638 0.73582677]
  warnings.warn(
```

```
model = tree.DecisionTreeClassifier(criterion= 'gini', max_depth=
None, max_features= 'sqrt', min_samples_leaf= 4, min_samples_split= 2)
model.fit(x_train, y_train)
```

```
DecisionTreeClassifier(max_features='sqrt', min_samples_leaf=4)
```

```
prediction=model.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test,prediction))
```

```
Accuracy: 0.671875
```

Random Forest Model

```
model=RandomForestClassifier()
model.fit(x_train,y_train)
prediction=model.predict(x_test)

print(metrics.classification_report(y_test,prediction))
```

```
              precision    recall  f1-score   support

           0       0.86      0.85      0.85        97
           1       0.55      0.58      0.56        31

    accuracy                           0.78       128
   macro avg       0.70      0.71      0.71       128
weighted avg       0.79      0.78      0.78       128
```

```
print(metrics.accuracy_score(y_test,prediction))
```

```
0.78125
```

Hyper Parameter Tuning

```
parameter={
    'max_depth':[None,10,20,30],
    'min_samples_leaf':[1,2,4],
    'min_samples_split':[2,5,10],
    'max_features':['auto','sqrt'],
    'n_estimators':[100,200,300]
}
rf_classifier = RandomForestClassifier(random_state=42)
grid_search=GridSearchCV( estimator=rf_classifier ,param_grid=paramete
r,verbose=2,cv=5,n_jobs=-1)
grid_search.fit(x, y)
```

```
Fitting 5 folds for each of 216 candidates, totalling 1080 fits

C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py:425: FitFailedWarning: 
540 fits failed out of a total of 1080.
The score on these train-test partitions for these parameters will be
set to nan.
If these failures are not expected, you can try to debug them by
setting error_score='raise'.

Below are more details about the failures:
----------------------------------------------------------------------
----------
158 fits failed with the following error:
```

```
Traceback (most recent call last):
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 1145, in wrapper
    estimator._validate_params()
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 638, in _validate_params
    validate_parameter_constraints(
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
utils\_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The
'max_features' parameter of RandomForestClassifier must be an int in
the range [1, inf), a float in the range (0.0, 1.0], a str among
{'sqrt', 'log2'} or None. Got 'auto' instead.

----------------------------------------------------------------------
----------
382 fits failed with the following error:
Traceback (most recent call last):
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 729, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 1145, in wrapper
    estimator._validate_params()
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py", line 638, in _validate_params
    validate_parameter_constraints(
  File "C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
utils\_param_validation.py", line 95, in
validate_parameter_constraints
    raise InvalidParameterError(
sklearn.utils._param_validation.InvalidParameterError: The
'max_features' parameter of RandomForestClassifier must be an int in
the range [1, inf), a float in the range (0.0, 1.0], a str among
{'log2', 'sqrt'} or None. Got 'auto' instead.

  warnings.warn(some_fits_failed_message, FitFailedWarning)
C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
model_selection\_search.py:979: UserWarning: One or more of the test
scores are non-finite: [       nan        nan        nan        nan
nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.78458415 0.77672244 0.79243356
 0.78302165 0.78617126 0.78302165 0.78930856 0.78617126 0.78458415
 0.78613435 0.78457185 0.78617126 0.78142224 0.78300935 0.78614665
 0.78460876 0.78930856 0.78930856 0.77989665 0.78615896 0.78772146
 0.77989665 0.78615896 0.78772146 0.78300935 0.78773376 0.79243356
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.79558317 0.78615896 0.78930856
 0.78459646 0.79089567 0.78932087 0.78932087 0.78615896 0.78615896
 0.78300935 0.78145915 0.78617126 0.78929626 0.78458415 0.78773376
 0.78144685 0.79087106 0.78458415 0.78300935 0.78615896 0.78930856
 0.78300935 0.78615896 0.78930856 0.78302165 0.78615896 0.79088337
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.78458415 0.77672244 0.79243356
 0.78302165 0.78617126 0.78302165 0.78930856 0.78617126 0.78458415
 0.78613435 0.78457185 0.78617126 0.78142224 0.78300935 0.78614665
 0.78460876 0.78930856 0.78930856 0.77989665 0.78615896 0.78772146
 0.77989665 0.78615896 0.78772146 0.78300935 0.78773376 0.79243356
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan        nan        nan        nan
        nan        nan        nan 0.78458415 0.77672244 0.79243356
 0.78302165 0.78617126 0.78302165 0.78930856 0.78617126 0.78458415
 0.78613435 0.78457185 0.78617126 0.78142224 0.78300935 0.78614665
 0.78460876 0.78930856 0.78930856 0.77989665 0.78615896 0.78772146
 0.77989665 0.78615896 0.78772146 0.78300935 0.78773376 0.79243356]
  warnings.warn(
```

```
GridSearchCV(cv=5, estimator=RandomForestClassifier(random_state=42),
n_jobs=-1,
             param_grid={'max_depth': [None, 10, 20, 30],
                         'max_features': ['auto', 'sqrt'],
                         'min_samples_leaf': [1, 2, 4],
                         'min_samples_split': [2, 5, 10],
                         'n_estimators': [100, 200, 300]},
             verbose=2)
```

```
print("Best Hyperparameters:", grid_search.best_params_)
```

```
Best Hyperparameters: {'max_depth': 10, 'max_features': 'sqrt',
'min_samples_leaf': 1, 'min_samples_split': 2, 'n_estimators': 100}
```

```
model=RandomForestClassifier(max_depth=10,max_features='sqrt',min_samp
les_leaf=1,min_samples_split=2,n_estimators=100)
```

```
model.fit(x_train,y_train)
prediction=model.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test,prediction))
```

```
Accuracy: 0.765625
```

KNN Model

```
model=KNeighborsClassifier(n_neighbors=3)
model.fit(x_train,y_train)
prediction=model.predict(x_test)

print(metrics.classification_report(y_test,prediction))
```

```
              precision    recall  f1-score   support

           0       0.86      0.84      0.85        97
           1       0.53      0.58      0.55        31

    accuracy                           0.77       128
   macro avg       0.70      0.71      0.70       128
weighted avg       0.78      0.77      0.78       128
```

```
print(metrics.accuracy_score(y_test,prediction))
```

```
0.7734375
```

Hyper Parameter Tuning

```
# Define the hyperparameter grid
param_grid = {
    'n_neighbors': [3,5,7,9,11],  # Example values for n_neighbors
    'weights': ['uniform', 'distance'],  # Weighting options
    'metric': ['euclidean', 'manhattan']  # Distance metrics
}

# Create the KNN classifier
knn = KNeighborsClassifier()

# Perform grid search with cross-validation
grid_search = GridSearchCV(estimator=knn, param_grid=param_grid,
scoring='accuracy', cv=5)
grid_search.fit(x_train, y_train)
print("best parameters :",grid_search.best_params_)
```

```
best parameters : {'metric': 'euclidean', 'n_neighbors': 11,
'weights': 'distance'}
```

```
hyper_knn =
KNeighborsClassifier(n_neighbors=11,metric="euclidean",weights="distan
ce")
hyper_knn.fit(x_train,y_train)
hyper_prediction = hyper_knn.predict(x_test)
print("Accuracy:",metrics.accuracy_score(y_test,hyper_prediction))

Accuracy: 0.734375
```

Naive Bayes Model

```
from sklearn.naive_bayes import GaussianNB
model=GaussianNB()
model.fit(x_train,y_train)
prediction=model.predict(x_test)

print(metrics.classification_report(y_test,prediction))

              precision    recall  f1-score   support

           0       0.83      0.79      0.81        97
           1       0.43      0.48      0.45        31

    accuracy                           0.72       128
   macro avg       0.63      0.64      0.63       128
weighted avg       0.73      0.72      0.72       128


print(metrics.accuracy_score(y_test,prediction))

0.71875
```

Logistic Regression Model

```
logistic=LogisticRegression(solver="liblinear")
logistic_model=logistic.fit(x,y)
logistic_model

LogisticRegression(solver='liblinear')

 prediction=logistic.predict(x_test)

C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\
base.py:465: UserWarning: X does not have valid feature names, but
LogisticRegression was fitted with feature names
  warnings.warn(

print(metrics.classification_report(y_test,prediction))
```

```
              precision    recall  f1-score   support

           0       0.76      1.00      0.86        97
           1       0.00      0.00      0.00        31

    accuracy                           0.76       128
   macro avg       0.38      0.50      0.43       128
weighted avg       0.57      0.76      0.65       128


C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\metrics\
_classification.py:1469: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\metrics\
_classification.py:1469: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\Arigala.Adarsh\anaconda3\lib\site-packages\sklearn\metrics\
_classification.py:1469: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
print("Accuracy:",metrics.accuracy_score(y_test,prediction))
```

```
Accuracy: 0.7578125
```

Conclusion

- Random forest Classfier gives more accuracy than other model