In [ ]:

```python

```

In [67]:

```python
#importing relevant libraries

import pandas as pd
import numpy as np
import matplotlib.pyplot as plot
import seaborn as sns
from sklearn.preprocessing import StandardScaler


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

In [ ]:

```python

```

In [68]:

```python
cardioDataset = pd.read_csv('heart.csv')
```

In [69]:

```python
cardioDataset.head(30)
```

Out[69]:

| | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 63 | 1 | 3 | 145 | 233 | 1 | 0 | 150 | 0 | 2.3 | 0 | 0 | 1 | 1 |
| **1** | 37 | 1 | 2 | 130 | 250 | 0 | 1 | 187 | 0 | 3.5 | 0 | 0 | 2 | 1 |
| **2** | 41 | 0 | 1 | 130 | 204 | 0 | 0 | 172 | 0 | 1.4 | 2 | 0 | 2 | 1 |
| **3** | 56 | 1 | 1 | 120 | 236 | 0 | 1 | 178 | 0 | 0.8 | 2 | 0 | 2 | 1 |
| **4** | 57 | 0 | 0 | 120 | 354 | 0 | 1 | 163 | 1 | 0.6 | 2 | 0 | 2 | 1 |
| **5** | 57 | 1 | 0 | 140 | 192 | 0 | 1 | 148 | 0 | 0.4 | 1 | 0 | 1 | 1 |
| **6** | 56 | 0 | 1 | 140 | 294 | 0 | 0 | 153 | 0 | 1.3 | 1 | 0 | 2 | 1 |
| **7** | 44 | 1 | 1 | 120 | 263 | 0 | 1 | 173 | 0 | 0.0 | 2 | 0 | 3 | 1 |
| **8** | 52 | 1 | 2 | 172 | 199 | 1 | 1 | 162 | 0 | 0.5 | 2 | 0 | 3 | 1 |
| **9** | 57 | 1 | 2 | 150 | 168 | 0 | 1 | 174 | 0 | 1.6 | 2 | 0 | 2 | 1 |
| **10** | 54 | 1 | 0 | 140 | 239 | 0 | 1 | 160 | 0 | 1.2 | 2 | 0 | 2 | 1 |
| **11** | 48 | 0 | 2 | 130 | 275 | 0 | 1 | 139 | 0 | 0.2 | 2 | 0 | 2 | 1 |
| **12** | 49 | 1 | 1 | 130 | 266 | 0 | 1 | 171 | 0 | 0.6 | 2 | 0 | 2 | 1 |
| **13** | 64 | 1 | 3 | 110 | 211 | 0 | 0 | 144 | 1 | 1.8 | 1 | 0 | 2 | 1 |
| **14** | 58 | 0 | 3 | 150 | 283 | 1 | 0 | 162 | 0 | 1.0 | 2 | 0 | 2 | 1 |
| **15** | 50 | 0 | 2 | 120 | 219 | 0 | 1 | 158 | 0 | 1.6 | 1 | 0 | 2 | 1 |
| **16** | 58 | 0 | 2 | 120 | 340 | 0 | 1 | 172 | 0 | 0.0 | 2 | 0 | 2 | 1 |
| **17** | 66 | 0 | 3 | 150 | 226 | 0 | 1 | 114 | 0 | 2.6 | 0 | 0 | 2 | 1 |
| **18** | 43 | 1 | 0 | 150 | 247 | 0 | 1 | 171 | 0 | 1.5 | 2 | 0 | 2 | 1 |
| **19** | 69 | 0 | 3 | 140 | 239 | 0 | 1 | 151 | 0 | 1.8 | 2 | 2 | 2 | 1 |
| **20** | 59 | 1 | 0 | 135 | 234 | 0 | 1 | 161 | 0 | 0.5 | 1 | 0 | 3 | 1 |

|  | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpeak | slope | ca | thal | target |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **21** | 44 | 1 | 2 | 130 | 233 | 0 | 1 | 179 | 1 | 0.4 | 2 | 0 | 2 | 1 |
| **22** | 42 | 1 | 0 | 140 | 226 | 0 | 1 | 178 | 0 | 0.0 | 2 | 0 | 2 | 1 |
| **23** | 61 | 1 | 2 | 150 | 243 | 1 | 1 | 137 | 1 | 1.0 | 1 | 0 | 2 | 1 |
| **24** | 40 | 1 | 3 | 140 | 199 | 0 | 1 | 178 | 1 | 1.4 | 2 | 0 | 3 | 1 |
| **25** | 71 | 0 | 1 | 160 | 302 | 0 | 1 | 162 | 0 | 0.4 | 2 | 2 | 2 | 1 |
| **26** | 59 | 1 | 2 | 150 | 212 | 1 | 1 | 157 | 0 | 1.6 | 2 | 0 | 2 | 1 |
| **27** | 51 | 1 | 2 | 110 | 175 | 0 | 1 | 123 | 0 | 0.6 | 2 | 0 | 2 | 1 |
| **28** | 65 | 0 | 2 | 140 | 417 | 1 | 0 | 157 | 0 | 0.8 | 2 | 1 | 2 | 1 |
| **29** | 53 | 1 | 2 | 130 | 197 | 1 | 0 | 152 | 0 | 1.2 | 0 | 0 | 2 | 1 |

In [70]:

```
cardioDataset.shape
```

Out[70]:

```
(303, 14)
```

In [71]:

```
cardioDataset.describe()
```

Out[71]:

|  | age | sex | cp | trestbps | chol | fbs | restecg | thalach | exang | oldpe |
|---|---|---|---|---|---|---|---|---|---|---|
| **count** | 303.000000 | 303.000000 | 303.000000 | 303.000000 | 303.000000 | 303.000000 | 303.000000 | 303.000000 | 303.000000 | 303.0000 |
| **mean** | 54.366337 | 0.683168 | 0.966997 | 131.623762 | 246.264026 | 0.148515 | 0.528053 | 149.646865 | 0.326733 | 1.0396 |
| **std** | 9.082101 | 0.466011 | 1.032052 | 17.538143 | 51.830751 | 0.356198 | 0.525860 | 22.905161 | 0.469794 | 1.1610 |
| **min** | 29.000000 | 0.000000 | 0.000000 | 94.000000 | 126.000000 | 0.000000 | 0.000000 | 71.000000 | 0.000000 | 0.0000 |
| **25%** | 47.500000 | 0.000000 | 0.000000 | 120.000000 | 211.000000 | 0.000000 | 0.000000 | 133.500000 | 0.000000 | 0.0000 |
| **50%** | 55.000000 | 1.000000 | 1.000000 | 130.000000 | 240.000000 | 0.000000 | 1.000000 | 153.000000 | 0.000000 | 0.8000 |
| **75%** | 61.000000 | 1.000000 | 2.000000 | 140.000000 | 274.500000 | 0.000000 | 1.000000 | 166.000000 | 1.000000 | 1.6000 |
| **max** | 77.000000 | 1.000000 | 3.000000 | 200.000000 | 564.000000 | 1.000000 | 2.000000 | 202.000000 | 1.000000 | 6.2000 |

In [72]:

```
cardioDataset.isnull().sum()
```

Out[72]:

```
age         0
sex         0
cp          0
trestbps    0
chol        0
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
target      0
dtype: int64
```

In [73]:

```
cardioDataset.columns = ['Age', 'Sex', 'ChestPainType', 'RestingBloodPressure', 'Cholest
erol', 'FastingBloodSugar', 'RestingECG', 'MaxHeartRate',
       'ExerciseInducedAngina', 'PreviousPeak', 'Slope', 'MajorBloodVessels', 'ThalRate'
, 'ProbHA']
```

In [74]:

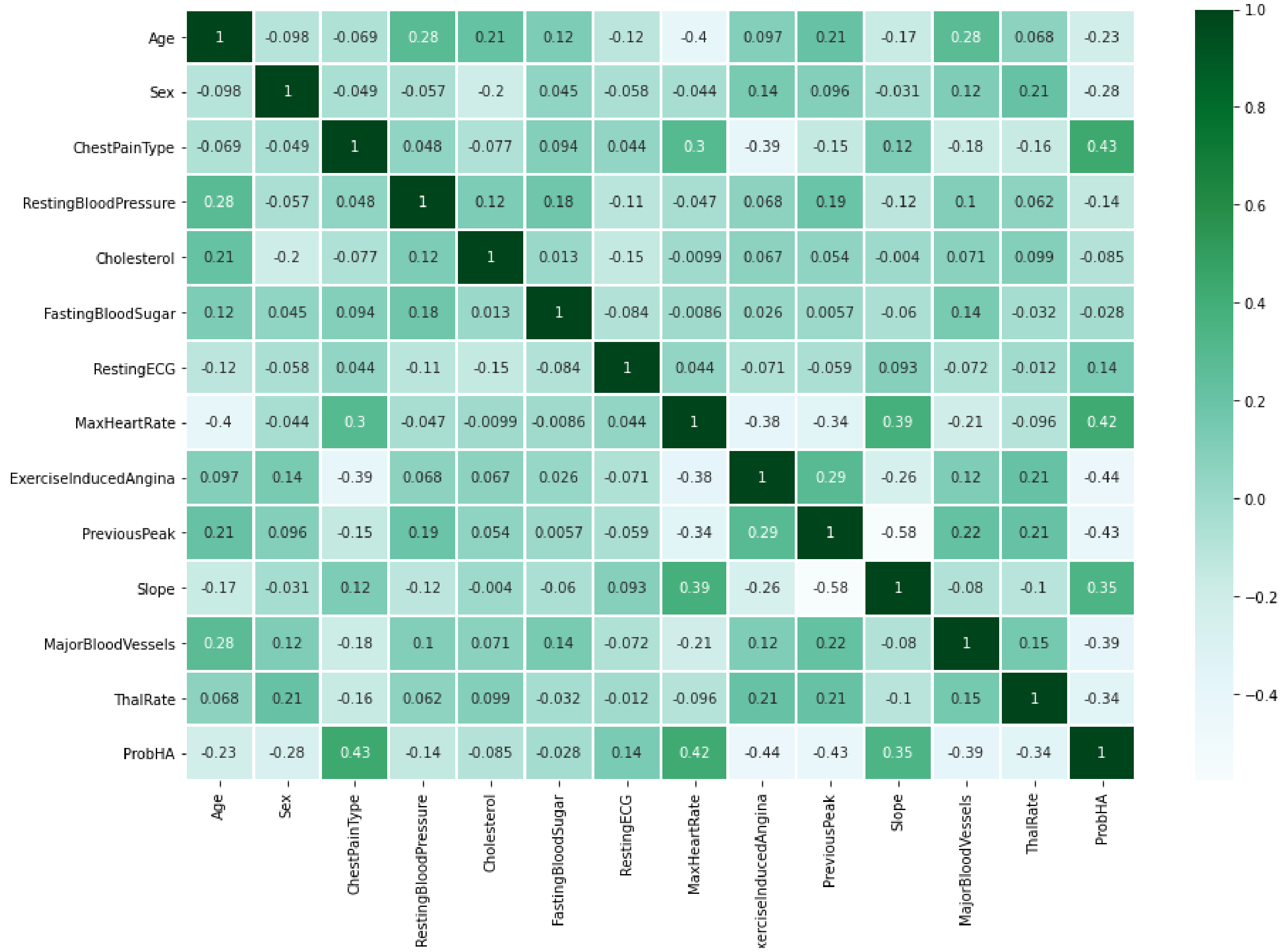
```
cardioDataset.dtypes
```

Out[74]:

```
Age                        int64
Sex                        int64
ChestPainType              int64
RestingBloodPressure       int64
Cholesterol                int64
FastingBloodSugar          int64
RestingECG                 int64
MaxHeartRate               int64
ExerciseInducedAngina      int64
PreviousPeak             float64
Slope                      int64
MajorBloodVessels          int64
ThalRate                   int64
ProbHA                     int64
dtype: object
```

In [75]:

```
#Correlation matrix

plot.figure(figsize = (15, 10))

correlation = cardioDataset.corr()
mask = np.triu(np.ones_like(correlation, dtype=bool))

sns.heatmap(correlation, annot = True, cmap='BuGn', linewidths=1)
plot.show()
```



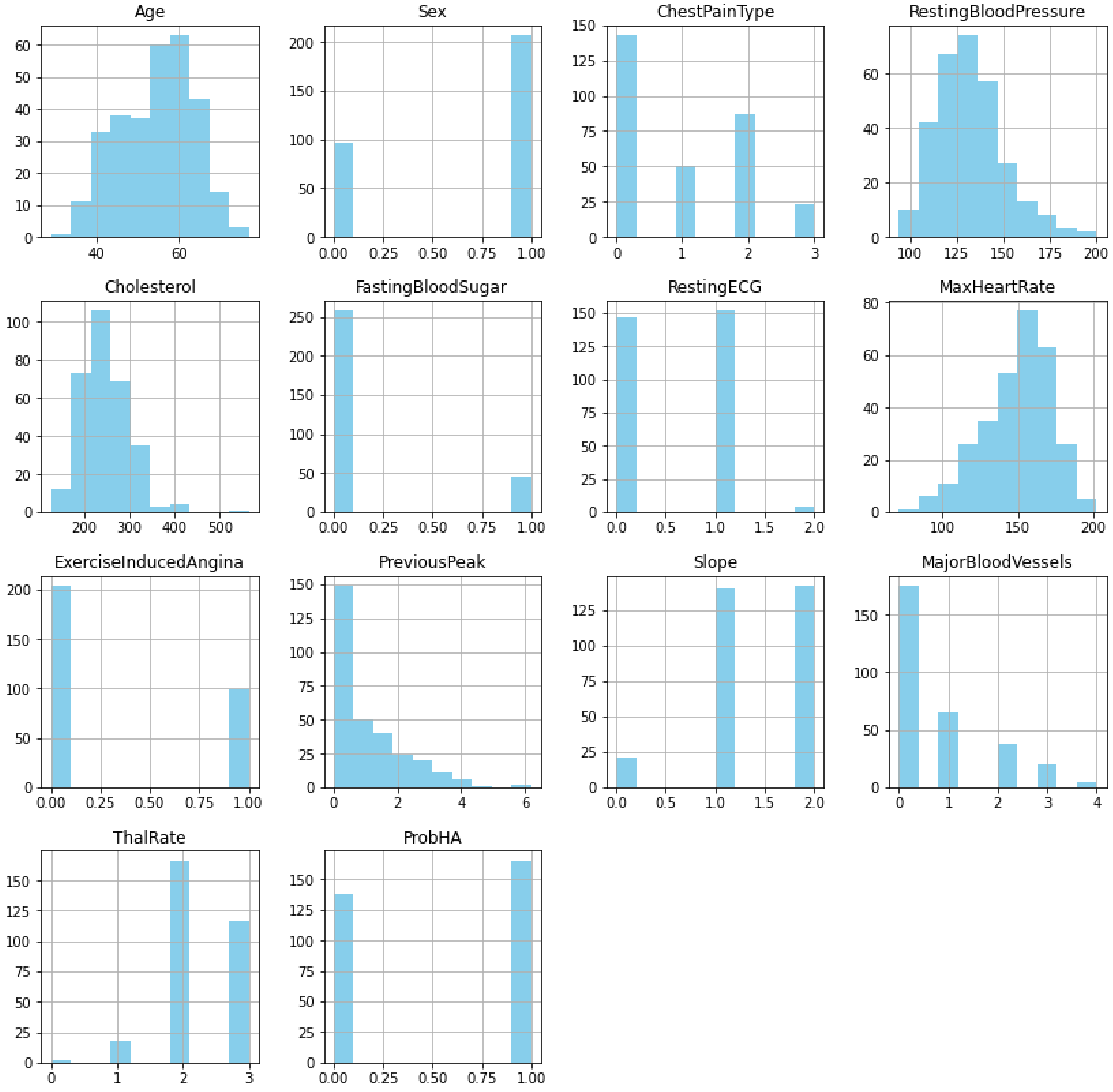
| | Age | Sex | ChestPainType | RestingBloodPressure | Cholesterol | FastingBloodSugar | RestingECG | MaxHeartRate | xerciseInducedAngina | PreviousPeak | Slope | MajorBloodVessels | ThalRate | ProbHA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | 1 | -0.098 | -0.069 | 0.28 | 0.21 | 0.12 | -0.12 | -0.4 | 0.097 | 0.21 | -0.17 | 0.28 | 0.068 | -0.23 |
| Sex | -0.098 | 1 | -0.049 | -0.057 | -0.2 | 0.045 | -0.058 | -0.044 | 0.14 | 0.096 | -0.031 | 0.12 | 0.21 | -0.28 |
| ChestPainType | -0.069 | -0.049 | 1 | 0.048 | -0.077 | 0.094 | 0.044 | 0.3 | -0.39 | -0.15 | 0.12 | -0.18 | -0.16 | 0.43 |
| RestingBloodPressure | 0.28 | -0.057 | 0.048 | 1 | 0.12 | 0.18 | -0.11 | -0.047 | 0.068 | 0.19 | -0.12 | 0.1 | 0.062 | -0.14 |
| Cholesterol | 0.21 | -0.2 | -0.077 | 0.12 | 1 | 0.013 | -0.15 | -0.0099 | 0.067 | 0.054 | -0.004 | 0.071 | 0.099 | -0.085 |
| FastingBloodSugar | 0.12 | 0.045 | 0.094 | 0.18 | 0.013 | 1 | -0.084 | -0.0086 | 0.026 | 0.0057 | -0.06 | 0.14 | -0.032 | -0.028 |
| RestingECG | -0.12 | -0.058 | 0.044 | -0.11 | -0.15 | -0.084 | 1 | 0.044 | -0.071 | -0.059 | 0.093 | -0.072 | -0.012 | 0.14 |
| MaxHeartRate | -0.4 | -0.044 | 0.3 | -0.047 | -0.0099 | -0.0086 | 0.044 | 1 | -0.38 | -0.34 | 0.39 | -0.21 | -0.096 | 0.42 |
| ExerciseInducedAngina | 0.097 | 0.14 | -0.39 | 0.068 | 0.067 | 0.026 | -0.071 | -0.38 | 1 | 0.29 | -0.26 | 0.12 | 0.21 | -0.44 |
| PreviousPeak | 0.21 | 0.096 | -0.15 | 0.19 | 0.054 | 0.0057 | -0.059 | -0.34 | 0.29 | 1 | -0.58 | 0.22 | 0.21 | -0.43 |
| Slope | -0.17 | -0.031 | 0.12 | -0.12 | -0.004 | -0.06 | 0.093 | 0.39 | -0.26 | -0.58 | 1 | -0.08 | -0.1 | 0.35 |
| MajorBloodVessels | 0.28 | 0.12 | -0.18 | 0.1 | 0.071 | 0.14 | -0.072 | -0.21 | 0.12 | 0.22 | -0.08 | 1 | 0.15 | -0.39 |
| ThalRate | 0.068 | 0.21 | -0.16 | 0.062 | 0.099 | -0.032 | -0.012 | -0.096 | 0.21 | 0.21 | -0.1 | 0.15 | 1 | -0.34 |
| ProbHA | -0.23 | -0.28 | 0.43 | -0.14 | -0.085 | -0.028 | 0.14 | 0.42 | -0.44 | -0.43 | 0.35 | -0.39 | -0.34 | 1 |

In [76]:

```
chart = plot.figure(figsize = (14, 14))
ax = chart.gca()
cardioDataset.hist(ax=ax, color="skyblue")
```

Out[76]:

```
array([[<AxesSubplot:title={'center':'Age'}>,
        <AxesSubplot:title={'center':'Sex'}>,
        <AxesSubplot:title={'center':'ChestPainType'}>,
        <AxesSubplot:title={'center':'RestingBloodPressure'}>],
       [<AxesSubplot:title={'center':'Cholesterol'}>,
        <AxesSubplot:title={'center':'FastingBloodSugar'}>,
        <AxesSubplot:title={'center':'RestingECG'}>,
        <AxesSubplot:title={'center':'MaxHeartRate'}>],
       [<AxesSubplot:title={'center':'ExerciseInducedAngina'}>,
        <AxesSubplot:title={'center':'PreviousPeak'}>,
        <AxesSubplot:title={'center':'Slope'}>,
        <AxesSubplot:title={'center':'MajorBloodVessels'}>],
       [<AxesSubplot:title={'center':'ThalRate'}>,
        <AxesSubplot:title={'center':'ProbHA'}>, <AxesSubplot:>,
        <AxesSubplot:>]], dtype=object)
```



In [77]:

```
cardioDataset.var()
```

Out[77]:

```
Age                         82.484558
Sex                          0.217166
ChestPainType                1.065132
RestingBloodPressure       307.586453
Cholesterol               2686.426748
FastingBloodSugar            0.126877
RestingECG                   0.276528
MaxHeartRate               524.646406
ExerciseInducedAngina        0.220707
PreviousPeak                 1.348095
Slope                        0.379735
MajorBloodVessels            1.045724
ThalRate                     0.374883
ProbHA                       0.248836
dtype: float64
```

In [78]:

```
cardioDataset['RestingBloodPressure']=np.log(cardioDataset['RestingBloodPressure'])
cardioDataset["Cholesterol"] = np.log(cardioDataset["Cholesterol"])
cardioDataset["MaxHeartRate"] = np.log(cardioDataset["MaxHeartRate"])

np.var(cardioDataset[["RestingBloodPressure", "Cholesterol", "MaxHeartRate"]])
```

Out[78]:

```
RestingBloodPressure    0.016894
Cholesterol             0.041401
MaxHeartRate            0.027054
dtype: float64
```

In [79]:

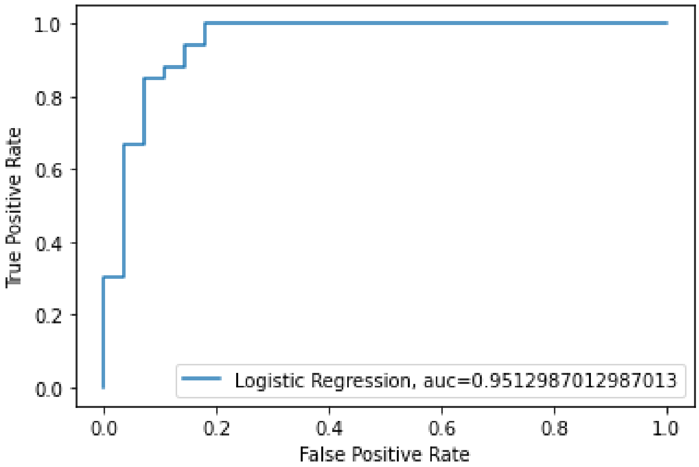
```
x = cardioDataset.drop('ProbHA', axis=1)
y = cardioDataset["ProbHA"]
```

In [80]:

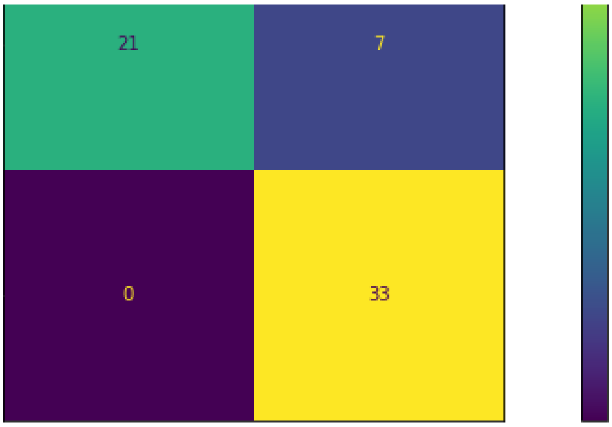
```
#splitting the dataset

from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.20, random_state=43)
```

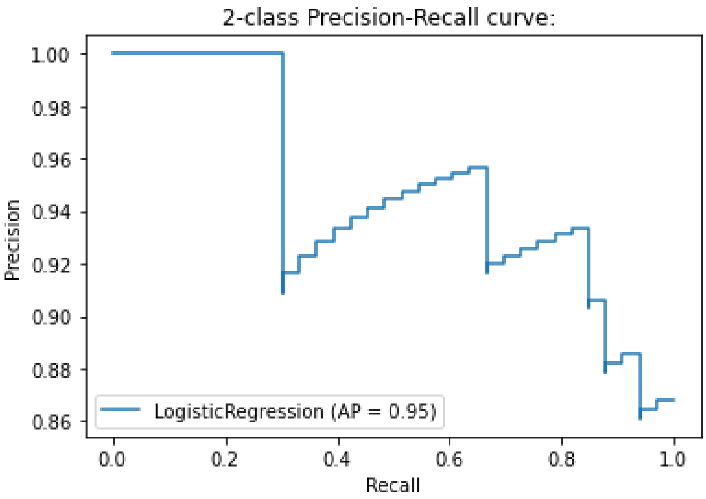
In [81]:

```
#Logistic Regression

accuracies_Of_Algorithms= {}


from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report, f1_score, roc_auc_score, roc_curve,plot_confusion_matrix,precision_recall_curve, plot_precision_recall_curve








def logisticModel():
    logisticRegression = LogisticRegression(penalty='l2')
    logisticRegression.fit(x_train, y_train)
    y_pred = logisticRegression.predict(x_test)

    y_predProbability = logisticRegression.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability)
    auc = roc_auc_score(y_test, y_predProbability)

    plot.plot(falsePositiveRate, truePositiveRate, label="Logistic Regression, auc="+str
(auc))
    plot.legend(loc=4)
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")
    plot.show()

    accuracy = accuracy_score(y_test, y_pred)
    accuracies_Of_Algorithms["Logistic Regression"] = accuracy*100

    print('Accuracy score of Logistic Regression is:' , accuracy_score(y_test, y_pred)*1
00, "%")
    print("Confusion Matrix of Logistic Regression", confusion_matrix(y_test, y_pred))

    print("ClassificationReport", classification_report(y_test, y_pred))


    plottedMatrix = plot_confusion_matrix(logisticRegression, x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of Logistic Regression', color='white')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    plot.show()


    disp = plot_precision_recall_curve(logisticRegression, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: '
                   )

logisticModel()
```



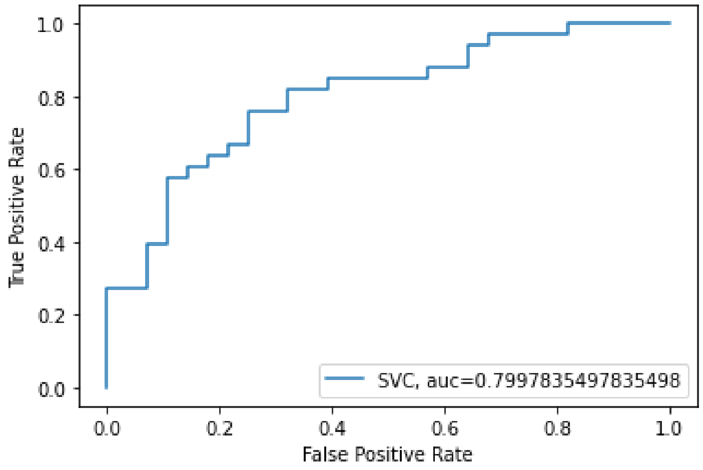
```
Accuracy score of Logistic Regression is: 88.52459016393442 %
Confusion Matrix of Logistic Regression [[21  7]
 [ 0 33]]
ClassificationReport               precision    recall  f1-score   support

           0       1.00      0.75      0.86        28
           1       0.82      1.00      0.90        33

    accuracy                           0.89        61
   macro avg       0.91      0.88      0.88        61
weighted avg       0.91      0.89      0.88        61
```



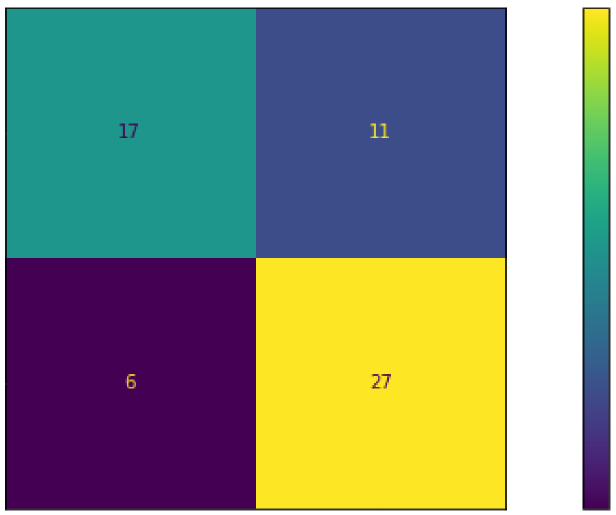


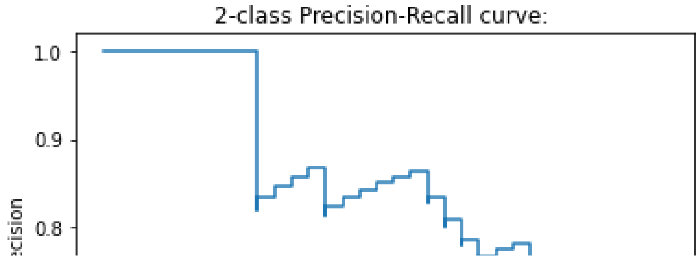
In [82]:

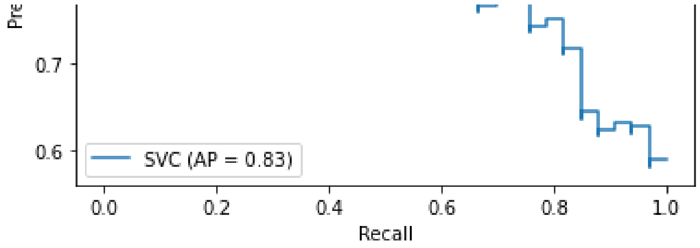
```
#support vector

from sklearn.svm import SVC


def svcClassifier():

    svc = SVC(probability=True)
    svc.fit(x_train, y_train)

    y_pred1 = svc.predict(x_test)

    y_predProbability1 = svc.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability1)
    auc = roc_auc_score(y_test, y_predProbability1)

    plot.plot(falsePositiveRate, truePositiveRate, label="SVC, auc="+str(auc))
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")

    plot.legend(loc=4)
    plot.show()

    accuracy1 = accuracy_score(y_test,y_pred1)
    accuracies_Of_Algorithms['supportVectorMachine'] = accuracy1*100

    accuracy_score(y_train, svc.predict(x_train))

    print("Accuracy score of the model is:", accuracy_score(y_test, y_pred1)*100, "%")
    print("Confusion matrix of the model", confusion_matrix(y_test, y_pred1))

    print("Classification Report", classification_report(y_test, y_pred1))

    plottedMatrix = plot_confusion_matrix(svc, x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of Support Vector Machines', color='whi
te')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    plot.show()

    disp = plot_precision_recall_curve(svc, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: '
                   )

svcClassifier()
```



```
Accuracy score of the model is: 72.1311475409836 %
Confusion matrix of the model [[17 11]
 [ 6 27]]
Classification Report                    precision    recall  f1-score   support

           0       0.74      0.61      0.67        28
           1       0.71      0.82      0.76        33

    accuracy                           0.72        61
   macro avg       0.72      0.71      0.71        61
weighted avg       0.72      0.72      0.72        61
```

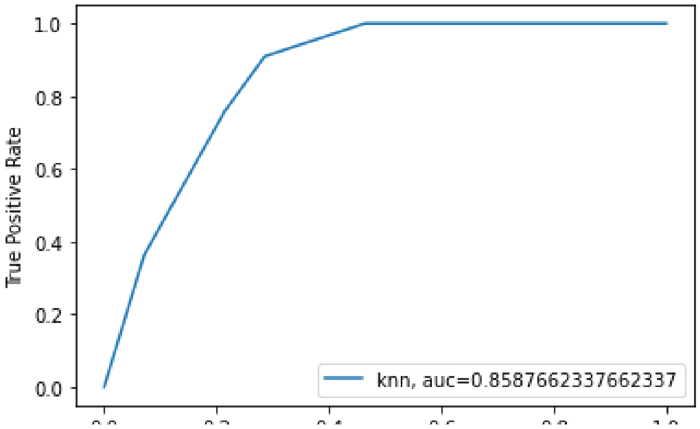




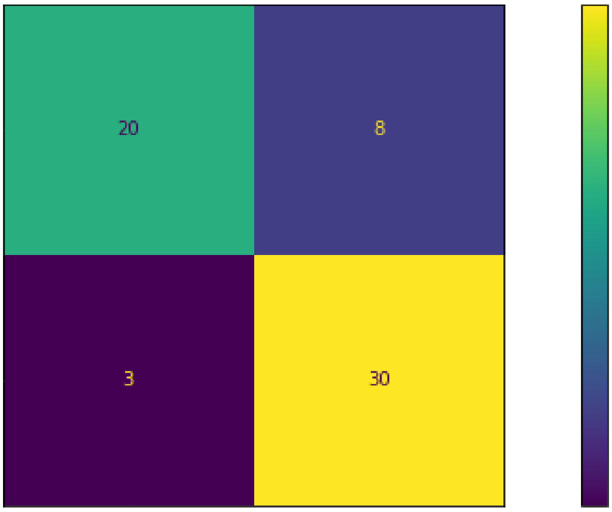


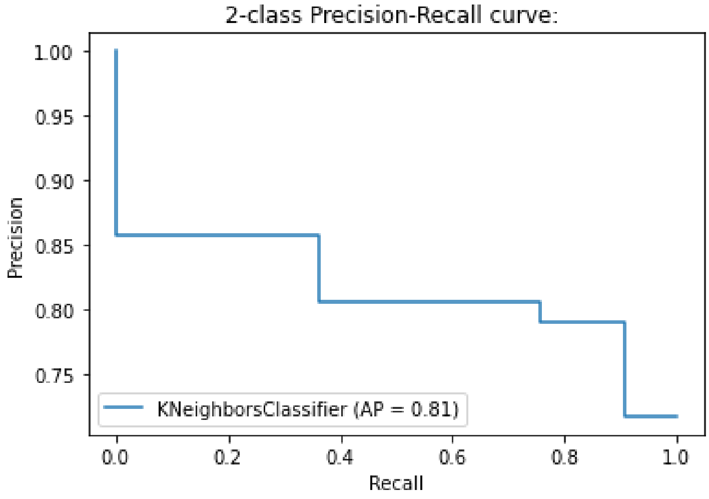
In [83]:

```
#kNearestNeighbours

from sklearn.neighbors import KNeighborsClassifier

def knnClassifier():

    knn = KNeighborsClassifier()

    knn.fit(x_train, y_train)

    y_pred2 = knn.predict(x_test)


    y_predProbability2 = knn.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability2)
    auc = roc_auc_score(y_test, y_predProbability2)

    plot.plot(falsePositiveRate, truePositiveRate, label="knn, auc="+str(auc))
    plot.legend(loc=4)
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")

    plot.show()

    accuracy2 = accuracy_score(y_test, y_pred2)
    accuracies_Of_Algorithms['KNeighborsClassifier'] = accuracy2*100

    accuracy_score(y_train, knn.predict(x_train))

    print("Accuracy score of the KNN:", accuracy_score(y_test, y_pred2)*100, "%")
    print("Confusion matrix of the model", confusion_matrix(y_test, y_pred2))

    print("Classification Report", classification_report(y_test, y_pred2))
    plottedMatrix = plot_confusion_matrix(knn,x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of knn', color='white')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    plot.show()


    disp = plot_precision_recall_curve(knn, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: ')
knnClassifier()
```



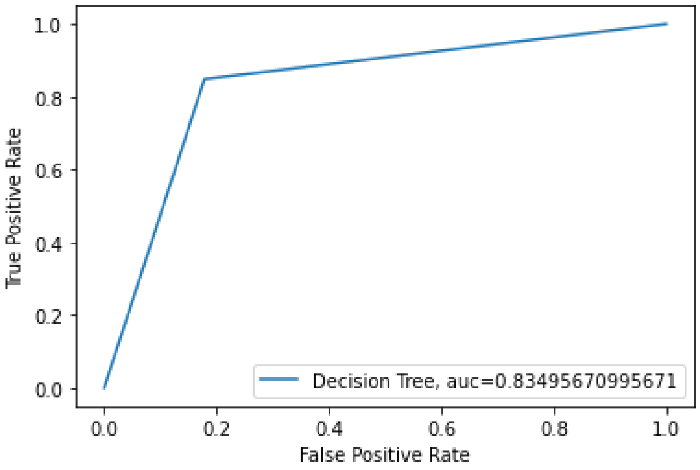
```
Accuracy score of the KNN: 81.9672131147541 %
Confusion matrix of the model [[20  8]
 [ 3 30]]
Classification Report               precision    recall  f1-score   support

           0       0.87      0.71      0.78        28
           1       0.79      0.91      0.85        33

    accuracy                           0.82        61
   macro avg       0.83      0.81      0.81        61
weighted avg       0.83      0.82      0.82        61
```



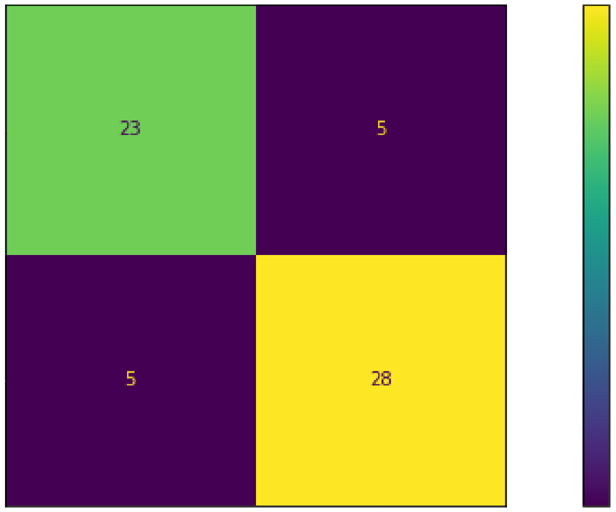


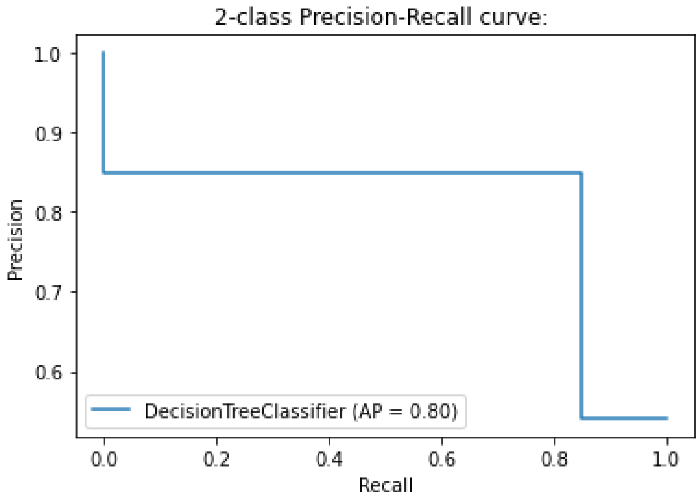
In [84]:

```
from sklearn.tree import DecisionTreeClassifier

def decisionClassifier():
    dt = DecisionTreeClassifier()
    dt.fit(x_train, y_train)

    y_pred3 = dt.predict(x_test)
    y_predProbability3 = dt.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability3)
    auc = roc_auc_score(y_test, y_predProbability3)

    plot.plot(falsePositiveRate, truePositiveRate, label="Decision Tree, auc="+str(auc))
    plot.legend(loc=4)
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")
    plot.show()
    accuracy3= accuracy_score(y_test, y_pred3)
    accuracies_Of_Algorithms['DecisionTreeClassifier'] = accuracy3*100

    accuracy_score(y_train, dt.predict(x_train))

    print("Accuracy score of the model is:", accuracy_score(y_test,y_pred3)*100, "%")

    print("Confusion matrix of the model", confusion_matrix(y_test, y_pred3))

    print("Classification Report", classification_report(y_test, y_pred3))


    plottedMatrix = plot_confusion_matrix(dt, x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of Decision Tree', color='white')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    disp = plot_precision_recall_curve(dt, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: ')

decisionClassifier()
```



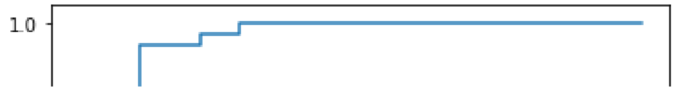
```
Accuracy score of the model is: 83.60655737704919 %
Confusion matrix of the model [[23  5]
 [ 5 28]]
Classification Report               precision    recall  f1-score   support

           0       0.82      0.82      0.82        28
           1       0.85      0.85      0.85        33

    accuracy                           0.84        61
   macro avg       0.83      0.83      0.83        61
weighted avg       0.84      0.84      0.84        61
```

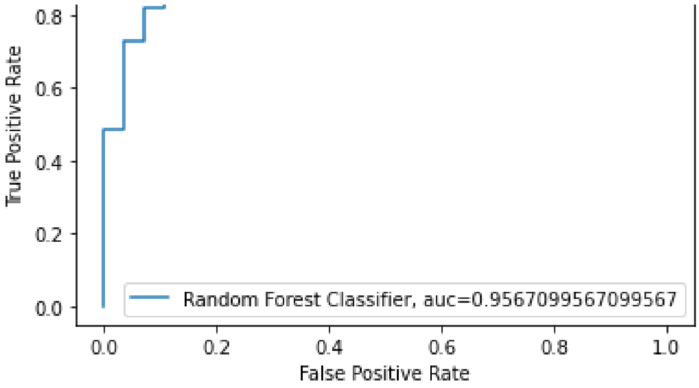




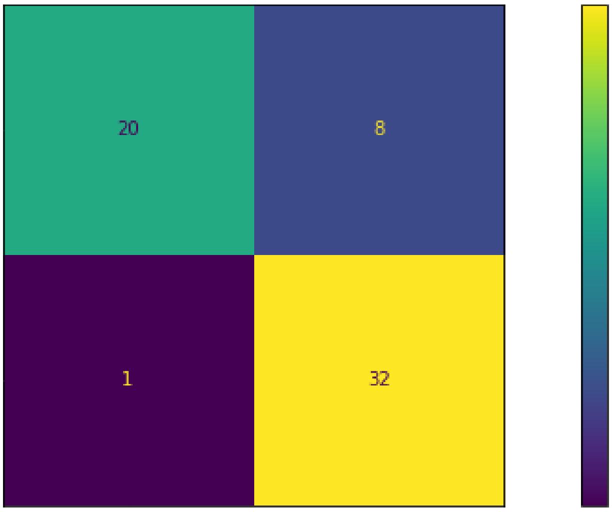
In [85]:

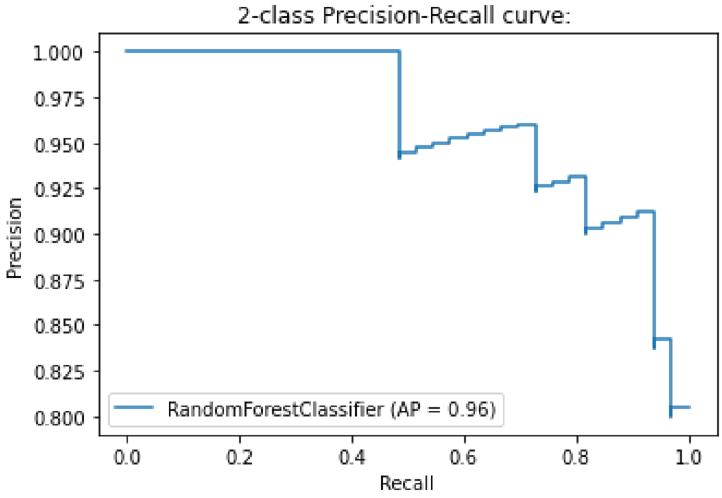
```
from sklearn.ensemble import RandomForestClassifier


def randomForest():

    rfc = RandomForestClassifier(criterion = 'gini', max_depth = 7,  max_features = 'sqr
t',
                                 min_samples_leaf = 2, min_samples_split = 4, n_estimators =
180)
    rfc.fit(x_train, y_train)


    y_pred5 = rfc.predict(x_test)

    y_predProbability5 = rfc.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability5)
    auc = roc_auc_score(y_test, y_predProbability5)

    plot.plot(falsePositiveRate, truePositiveRate, label="Random Forest Classifier, auc=
"+str(auc))
    plot.legend(loc=4)
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")
    plot.show()

    accuracy5 = accuracy_score(y_test, y_pred5)
    accuracies_Of_Algorithms['RandomForestClassifier'] = accuracy5*100

    accuracy_score(y_train, rfc.predict(x_train))
    print("Accuracy score of the model is:", accuracy_score(y_test, y_pred5)*100, "%")
    print("Confusion matrix of the model", confusion_matrix(y_test, y_pred5))

    print("Classification Report", classification_report(y_test, y_pred5))

    plottedMatrix = plot_confusion_matrix(rfc, x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of Random Forest', color='white')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    plot.show()
    disp = plot_precision_recall_curve(rfc, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: ')

randomForest()
```





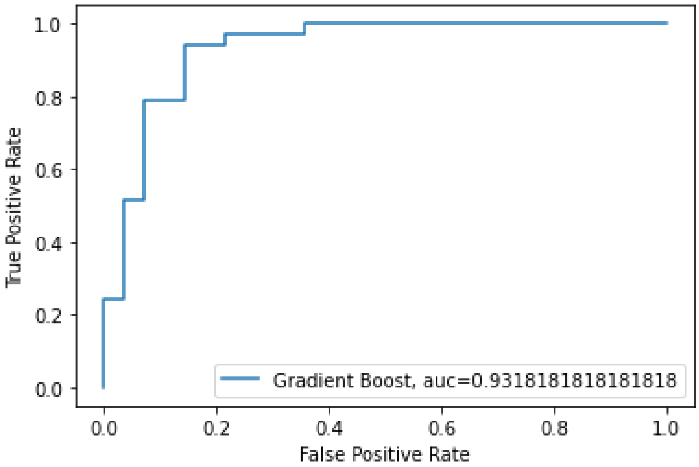
```
Accuracy score of the model is: 85.24590163934425 %
Confusion matrix of the model [[20  8]
 [ 1 32]]
Classification Report                precision    recall  f1-score   support

           0       0.95      0.71      0.82        28
           1       0.80      0.97      0.88        33

    accuracy                           0.85        61
   macro avg       0.88      0.84      0.85        61
weighted avg       0.87      0.85      0.85        61
```



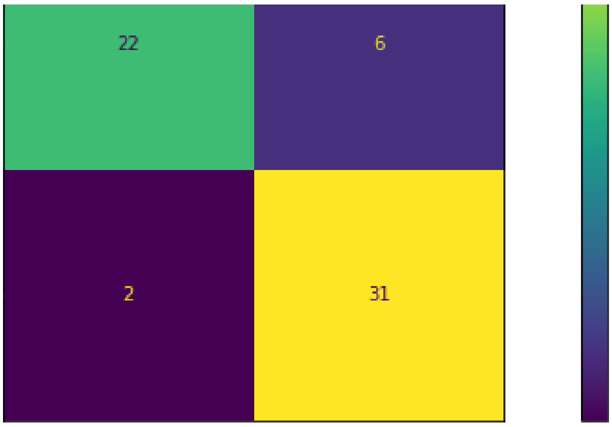


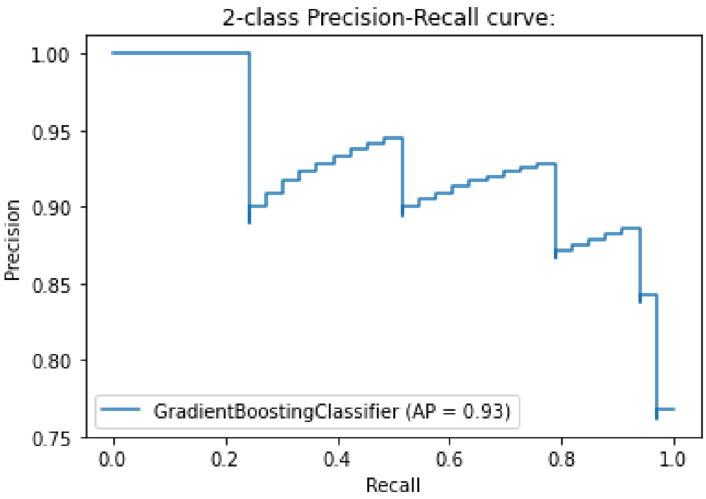
In [86]:

```
from sklearn.ensemble import GradientBoostingClassifier


def GradientBoost():
    gbc = GradientBoostingClassifier()


    gbc.fit(x_train, y_train)

    y_pred6 = gbc.predict(x_test)

    y_predProbability6 = gbc.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability6)
    auc = roc_auc_score(y_test, y_predProbability6)

    plot.plot(falsePositiveRate, truePositiveRate, label="Gradient Boost, auc="+str(auc)
)
    plot.legend(loc=4)
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")
    plot.show()

    accuracy6=accuracy_score(y_test, y_pred6)

    accuracies_Of_Algorithms['GradientBoosting']  = accuracy6*100
    print("Accuracy score of the model is:", accuracy_score(y_test, y_pred6)*100, "%")

    print("Confusion matrix of the model", confusion_matrix(y_test, y_pred6))

    print("Classification Report", classification_report(y_test, y_pred6))

    plottedMatrix = plot_confusion_matrix(gbc, x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of Gradient Boost', color='white')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    plot.show()
    disp = plot_precision_recall_curve(gbc, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: ')
GradientBoost()
```



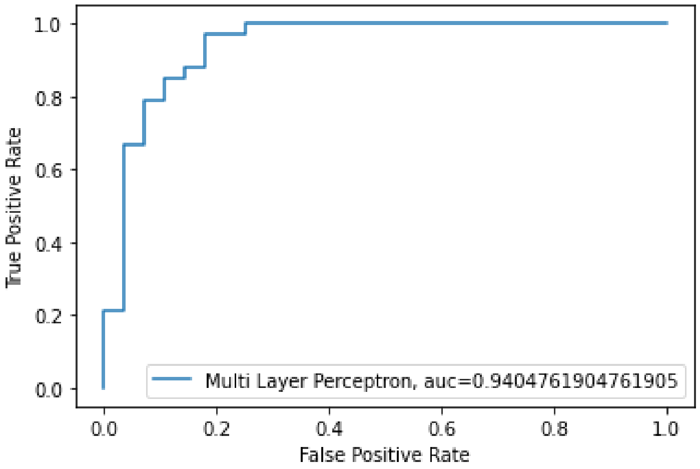
```
Accuracy score of the model is: 86.88524590163934 %
Confusion matrix of the model [[22  6]
 [ 2 31]]
Classification Report               precision    recall  f1-score   support

           0       0.92      0.79      0.85        28
           1       0.84      0.94      0.89        33

    accuracy                           0.87        61
   macro avg       0.88      0.86      0.87        61
weighted avg       0.87      0.87      0.87        61
```



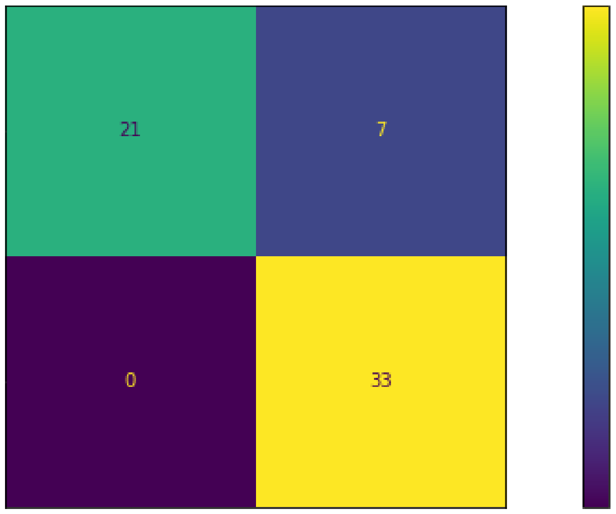


In [87]:

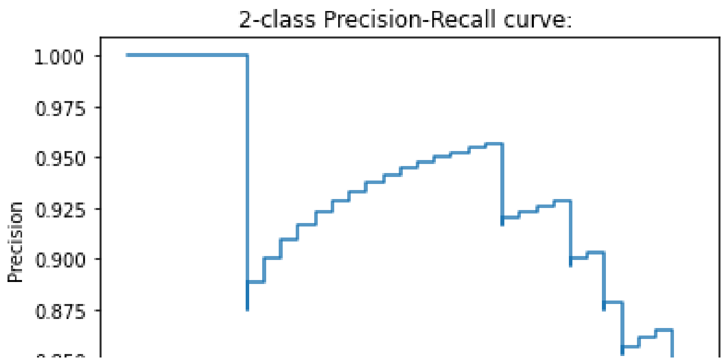
```
from sklearn.neural_network import MLPClassifier


def multiLayerClassifier():

    multiLayerPerceptron = MLPClassifier(random_state = 10,max_iter=300,activation="relu
",
                                         hidden_layer_sizes=(34,34,34))

    multiLayerPerceptron.fit(x_train, y_train)

    y_pred7 = multiLayerPerceptron.predict(x_test)

    y_predProbability7 = multiLayerPerceptron.predict_proba(x_test)[::,1]
    falsePositiveRate, truePositiveRate, _ = roc_curve(y_test, y_predProbability7)
    auc = roc_auc_score(y_test, y_predProbability7)

    plot.plot(falsePositiveRate, truePositiveRate, label="Multi Layer Perceptron, auc="+
str(auc))
    plot.legend(loc=4)
    plot.ylabel("True Positive Rate")
    plot.xlabel("False Positive Rate")
    plot.show()
    accuracy7 = accuracy_score(y_test, y_pred7)

    accuracies_Of_Algorithms['MLPClassifier'] = accuracy7*100

    print("Confusion Matrix of MLPClassifier", confusion_matrix(y_test, y_pred7))
    print("Classification Report", classification_report(y_test, y_pred7))
    plottedMatrix = plot_confusion_matrix(multiLayerPerceptron, x_test, y_test)
    plottedMatrix.ax_.set_title('Confusion Matrix Of MultiLayer PERCEPTRON', color='white
')
    plot.xlabel("Predicted Outcome", color='white')
    plot.ylabel("Actual Outcome", color='white')
    plot.gcf().axes[1].tick_params(colors='white')
    plot.gcf().axes[0].tick_params(colors='white')
    plot.gcf().set_size_inches(15,5)
    plot.show()

    accuracy_score(y_test, y_pred7)
    print("Accuracy score of the model is:", accuracy_score(y_test, y_pred7)*100, "%")
    disp = plot_precision_recall_curve(multiLayerPerceptron, x_test, y_test)
    disp.ax_.set_title('2-class Precision-Recall curve: ')
multiLayerClassifier()
```

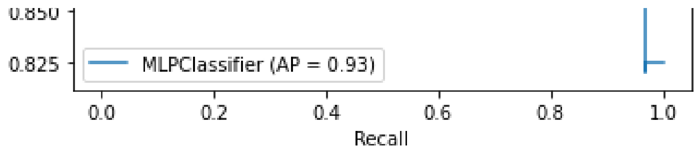


```
Confusion Matrix of MLPClassifier [[21  7]
 [ 0 33]]
Classification Report                precision    recall  f1-score   support

           0       1.00      0.75      0.86        28
           1       0.82      1.00      0.90        33

    accuracy                           0.89        61
   macro avg       0.91      0.88      0.88        61
weighted avg       0.91      0.89      0.88        61
```



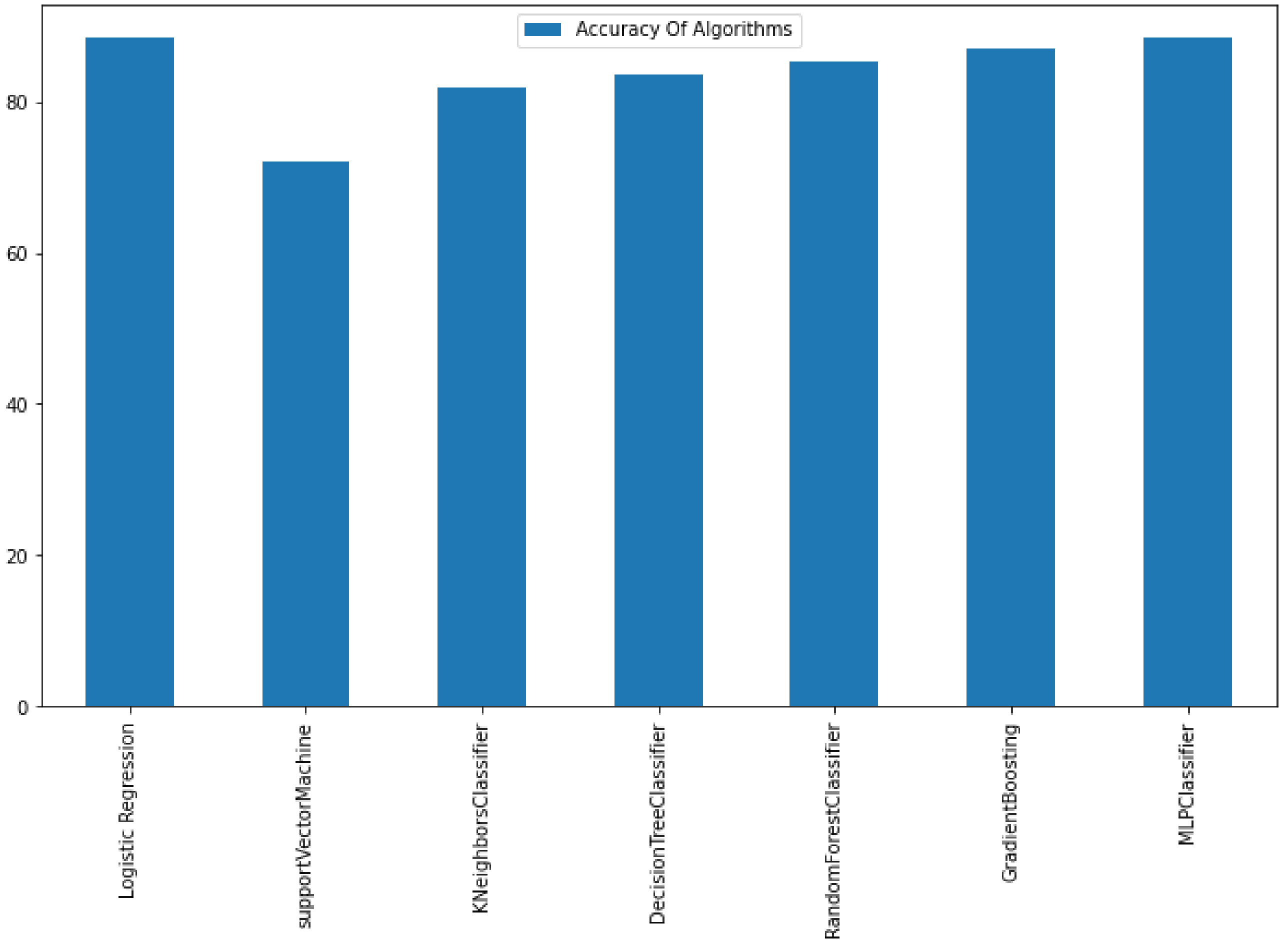
```
Accuracy score of the model is: 88.52459016393442 %
```





In [88]:

```
cardioBarChart = pd.DataFrame(accuracies_Of_Algorithms.values(),
                              accuracies_Of_Algorithms.keys(),
                              columns=["Accuracy Of Algorithms"])

cardioBarChart.plot.bar(figsize = (12,7));
```



In [ ]:

In [ ]: