Assignment2

May 28, 2022

Perform Comparative evaluation of Naïve Bayes, Decision Tree, Random Forest, and Support Vector Machine classifier. Use diabetes and hear disease datasets

0.1 Loading the Required Libaries

```
[1]: import pandas as pd
     from sklearn.model_selection import train_test_split
     from sklearn.naive_bayes import GaussianNB
     from sklearn.tree import DecisionTreeClassifier
     from sklearn.ensemble import RandomForestClassifier
     from sklearn.svm import SVC
     from sklearn.metrics import classification_report
     from sklearn.metrics import plot_confusion_matrix
     from sklearn import model_selection
     import matplotlib.pyplot as plt
     import warnings

     warnings.filterwarnings('ignore')
     %matplotlib inline
```

1 Using Diabetes Dataset

Reading the CSV File as a Pandas DataFrame

```
[2]: df = pd.read_csv('data/diabetes.csv')
```

Checking the first few rows

```
[3]: df.head()
```

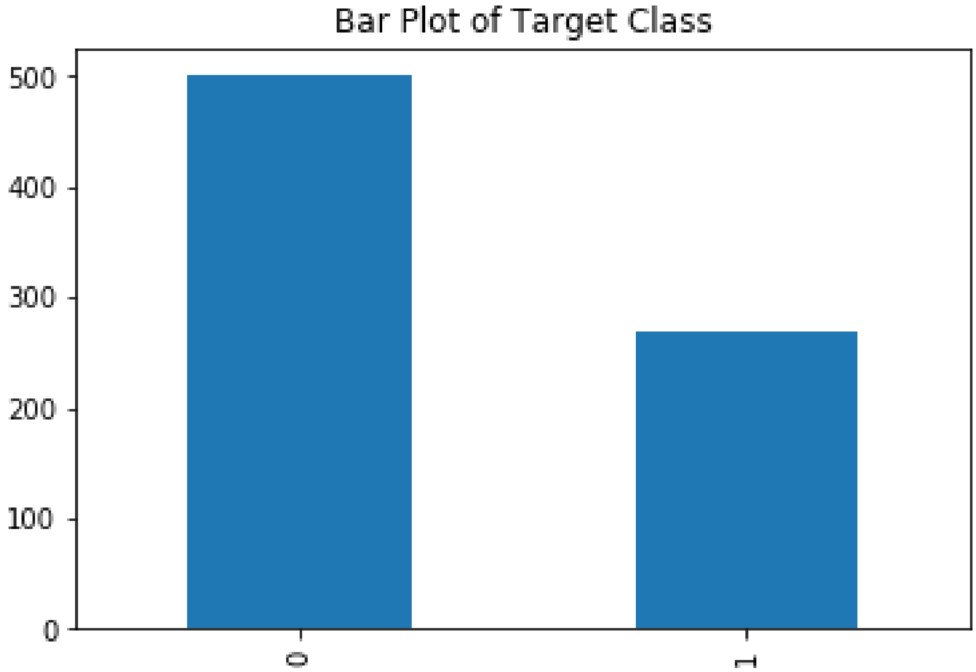
```
[3]:    Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
     0            6      148             72             35        0  33.6
     1            1       85             66             29        0  26.6
     2            8      183             64              0        0  23.3
     3            1       89             66             23       94  28.1
     4            0      137             40             35      168  43.1

        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
```

Plotting the Bar Graph of Target Class

```
[4]: df['Outcome'].value_counts().plot(kind='bar')
     plt.title('Bar Plot of Target Class')
```

```
[4]: Text(0.5, 1.0, 'Bar Plot of Target Class')
```



Checking if there is null values in the dataset

```
[5]: df.isna().sum()
```

```
[5]: Pregnancies                 0
     Glucose                     0
     BloodPressure               0
     SkinThickness               0
     Insulin                     0
     BMI                         0
     DiabetesPedigreeFunction    0
     Age                         0
```

```
Outcome                     0
dtype: int64
```

There are no an null values in the dataset

Train Test Split

[6]:

```python
X = df.drop(columns=['Outcome'],axis=1)
y = df['Outcome']
```

[7]:

```python
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.
 ↪2,random_state=0)
```

A helper function that runs all the machine models and gives the evaluation matrices as output

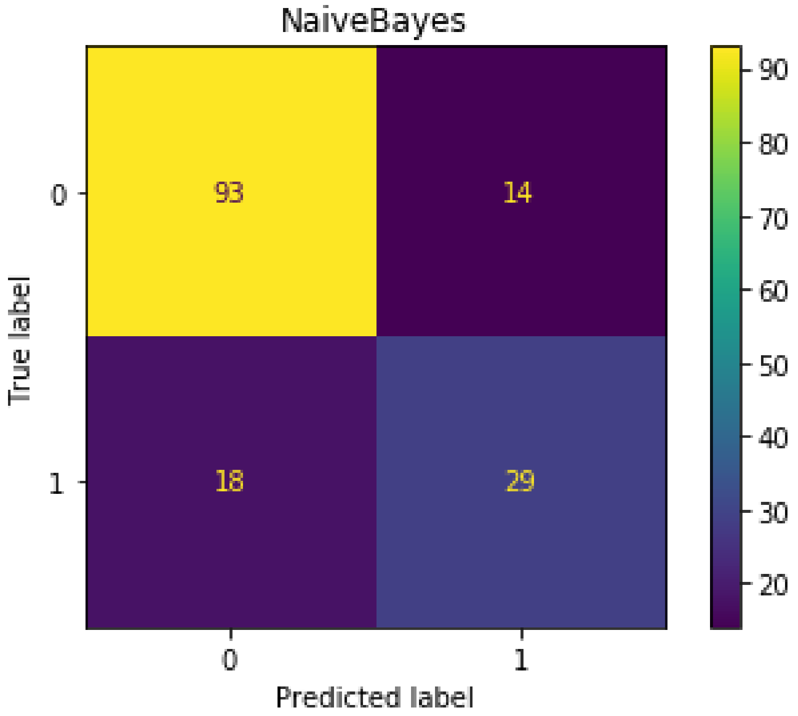
[8]:

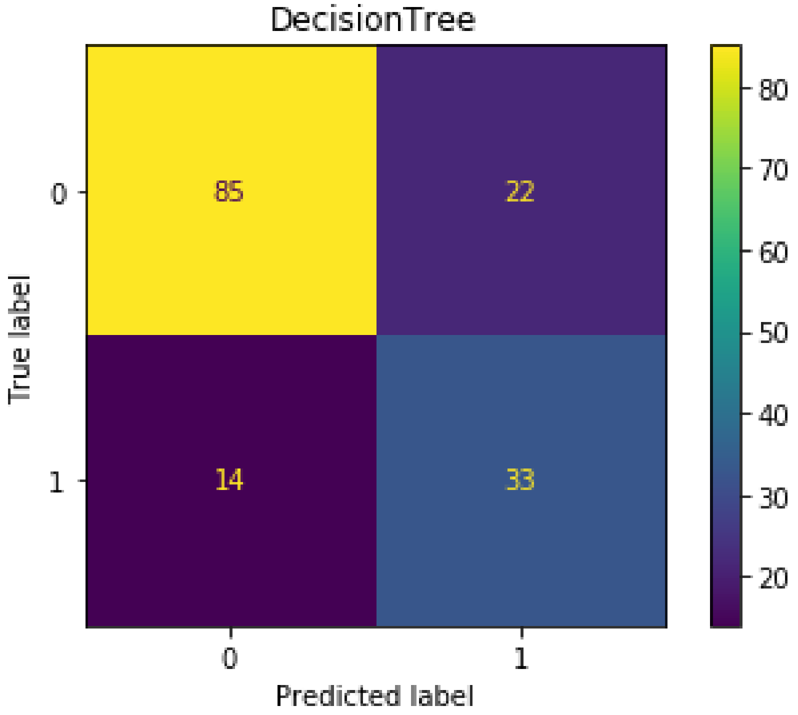
```python
def run_exps(X_train, y_train, X_test, y_test):
    dfs = []
    # Defining the Models and adding them to a list
    models = [
        ('NaiveBayes',GaussianNB()),
        ('DecisionTree',DecisionTreeClassifier()),
        ('RandomForest', RandomForestClassifier()),
        ('SVM', SVC())

    ]
    results = []
    names = []
    scoring = ['accuracy', 'precision', 'recall', 'f1']
    target_names = ['0','1']
    # Looping through Each Model in the list and making prediction to get␣
 ↪evaluation matrices
    for name, model in models:
        kfold = model_selection.KFold(n_splits=5, shuffle=True, random_state=0)
        cv_results = model_selection.cross_validate(model, X_train, y_train,␣
 ↪cv=kfold, scoring=scoring)
        clf = model.fit(X_train, y_train)
        y_pred = clf.predict(X_test)
        print("#####################")
        print(name)
        print(classification_report(y_test, y_pred, target_names=target_names))
        plot_confusion_matrix(clf, X_test, y_test)
        plt.title(name)
        results.append(cv_results)
        names.append(name)
        this_df = pd.DataFrame(cv_results)
        this_df['model'] = name
        dfs.append(this_df)
        final = pd.concat(dfs, ignore_index=True)
    return final
```

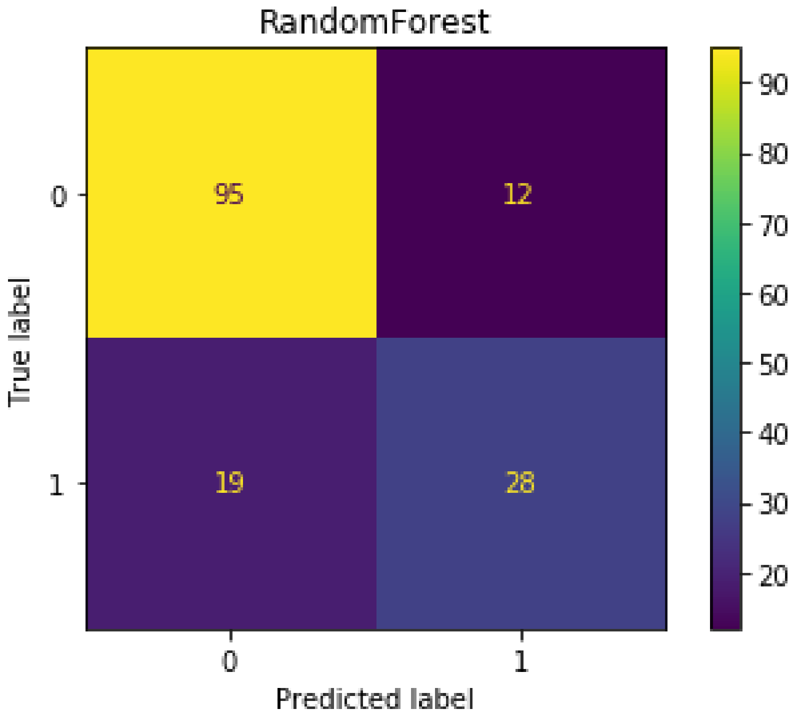
[9]:

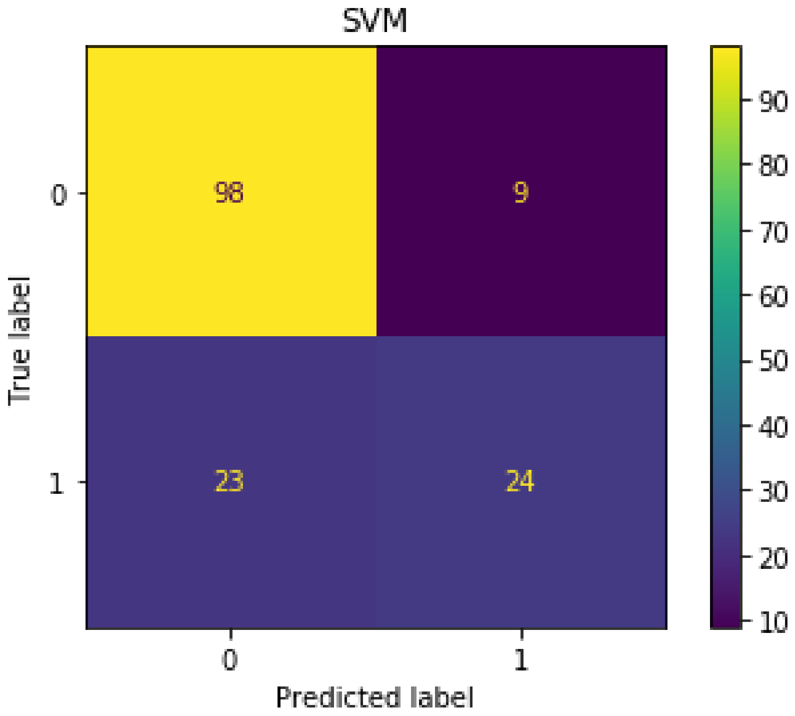
```
r_df = run_exps(X_train,y_train,X_test,y_test)
```

```
#####################
NaiveBayes
              precision    recall  f1-score   support

           0       0.84      0.87      0.85       107
           1       0.67      0.62      0.64        47

    accuracy                           0.79       154
   macro avg       0.76      0.74      0.75       154
weighted avg       0.79      0.79      0.79       154

#####################
DecisionTree
              precision    recall  f1-score   support

           0       0.86      0.79      0.83       107
           1       0.60      0.70      0.65        47

    accuracy                           0.77       154
   macro avg       0.73      0.75      0.74       154
weighted avg       0.78      0.77      0.77       154

#####################
RandomForest
              precision    recall  f1-score   support

           0       0.83      0.89      0.86       107
           1       0.70      0.60      0.64        47

    accuracy                           0.80       154
   macro avg       0.77      0.74      0.75       154
weighted avg       0.79      0.80      0.79       154

#####################
SVM
              precision    recall  f1-score   support

           0       0.81      0.92      0.86       107
           1       0.73      0.51      0.60        47

    accuracy                           0.79       154
   macro avg       0.77      0.71      0.73       154
weighted avg       0.78      0.79      0.78       154
```


NaiveBayes
True label
0
1
93
14
18
29
Predicted label
0
1
90
80
70
60
50
40
30
20


DecisionTree
True label
0
1
85
22
14
33
Predicted label
0
1
80
70
60
50
40
30
20


RandomForest


SVM

Getting the Average of Each Matrices from K-Fold CV of each Model

```
[10]: r_df.groupby('model').mean().reset_index()
```

```
[10]:          model  fit_time  score_time  test_accuracy  test_precision  \
      0  DecisionTree  0.004315    0.004933       0.698707        0.585716
      1    NaiveBayes  0.004870    0.007758       0.747621        0.669703
      2  RandomForest  0.186305    0.019301       0.750846        0.687880
      3           SVM  0.011196    0.008482       0.741090        0.710155

         test_recall   test_f1
      0     0.558024  0.565386
      1     0.600590  0.632148
      2     0.568713  0.621267
      3     0.470610  0.564164
```

From the above results we can say that RandomForest is the best model on the basis of accuracy.

2 Using Heart Disease Dataset

Reading the CSV File as a Pandas DataFrame

```
[11]: df = pd.read_csv('data/heart.csv')
```

Checking First few rows of the dataset

```
[12]: df.head()
```

```
[12]:    age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  slope  \
      0   52    1   0       125   212    0        1      168      0      1.0      2
      1   53    1   0       140   203    1        0      155      1      3.1      0
      2   70    1   0       145   174    0        1      125      1      2.6      0
      3   61    1   0       148   203    0        1      161      0      0.0      2
      4   62    0   0       138   294    1        1      106      0      1.9      1

         ca  thal  target
      0   2     3       0
      1   0     3       0
      2   0     3       0
      3   1     3       0
      4   3     2       0
```

Converting the `sex` feature to categorical

```
[13]: df['sex'] = df['sex'].astype('category')
```

Checking for missing values in the dataset

[14]:

```
df.isna().sum()
```

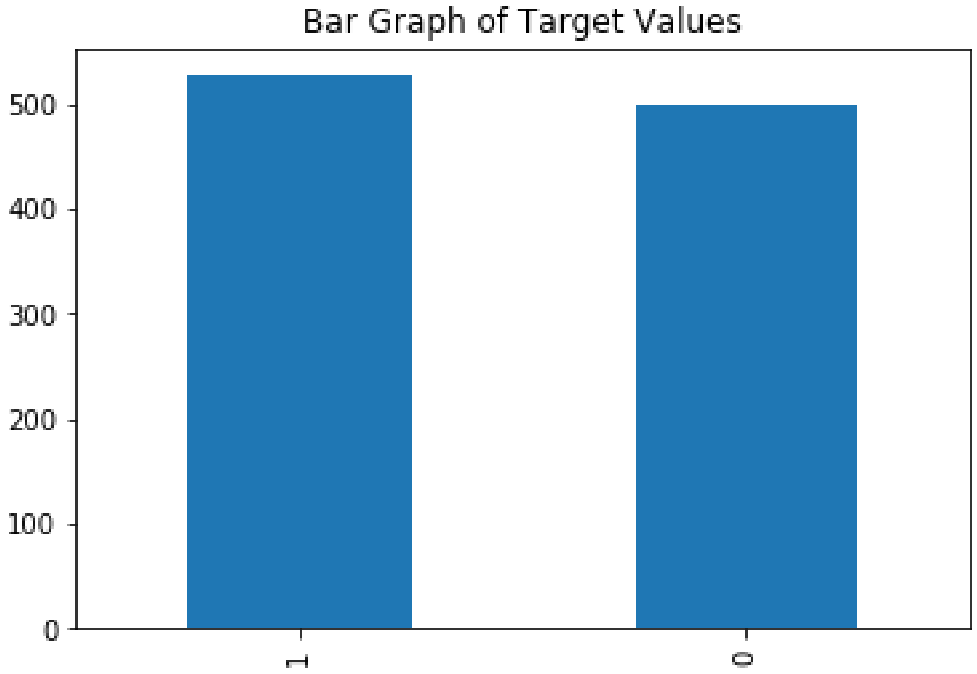
[14]:

```
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
```

There is no missing values in the dataset

[15]:

```
df['target'].value_counts().plot(kind='bar')
plt.title('Bar Graph of Target Values')
plt.show()
```



Train Test Split

[16]:

```
X = df.drop(columns=['target'])
y = df['target']
```

[17]:

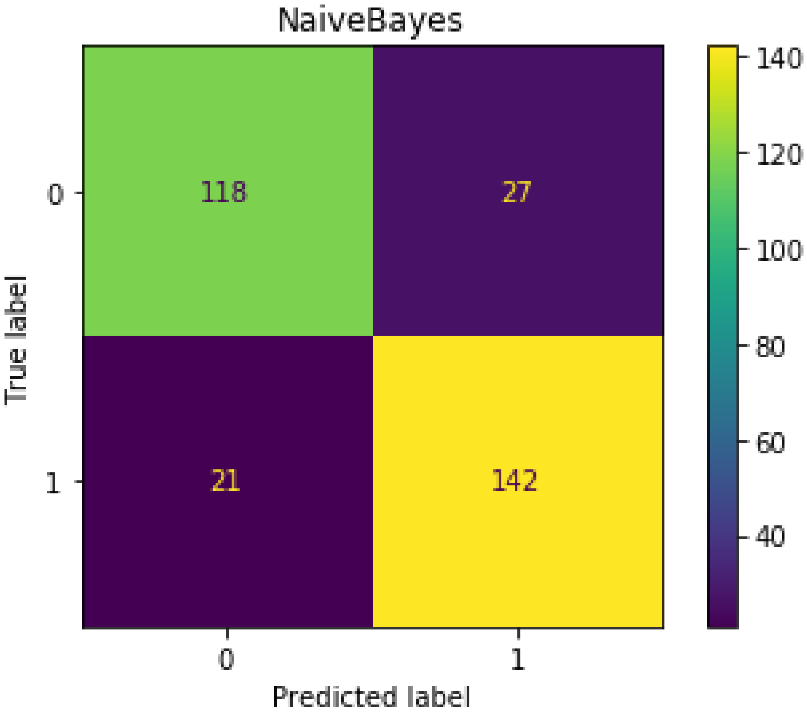
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.
 ↪3,random_state=0)
```

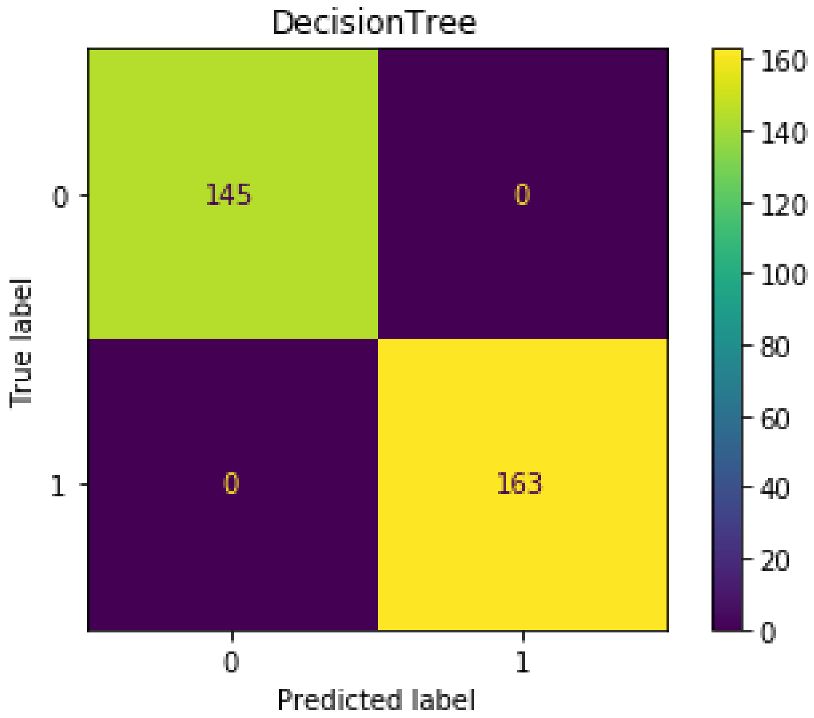
Calling the Helper Function

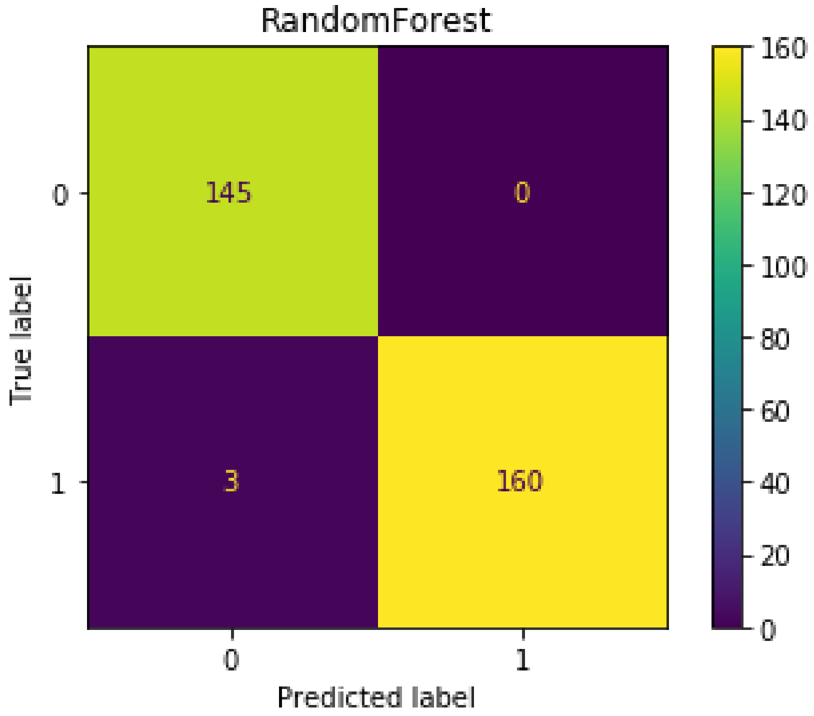
[18]:

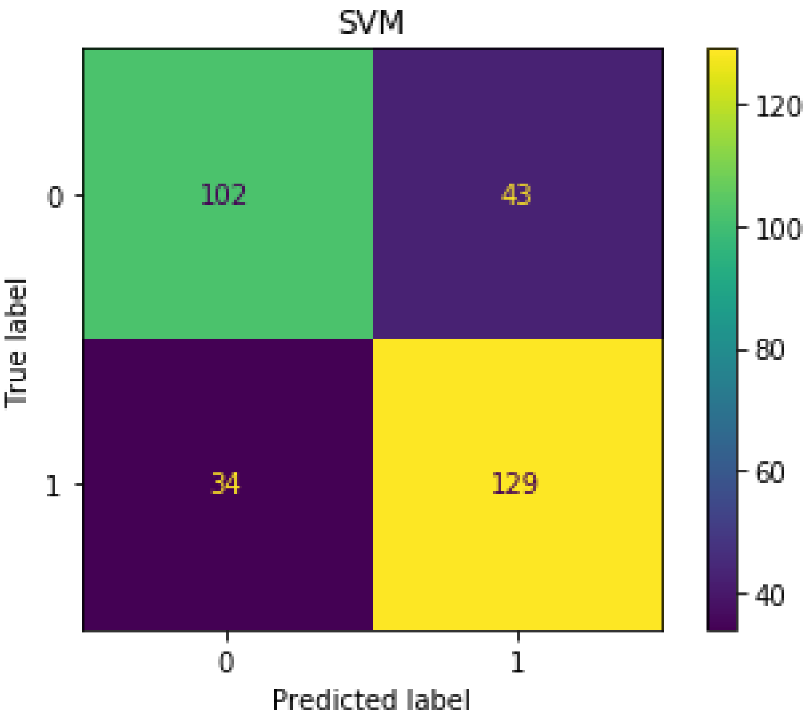
```
r_df = run_exps(X_train,y_train,X_test,y_test)
```

```
#####################
NaiveBayes
              precision    recall  f1-score   support

           0       0.85      0.81      0.83       145
           1       0.84      0.87      0.86       163

    accuracy                           0.84       308
   macro avg       0.84      0.84      0.84       308
weighted avg       0.84      0.84      0.84       308

#####################
DecisionTree
              precision    recall  f1-score   support

           0       1.00      1.00      1.00       145
           1       1.00      1.00      1.00       163

    accuracy                           1.00       308
   macro avg       1.00      1.00      1.00       308
weighted avg       1.00      1.00      1.00       308

#####################
RandomForest
              precision    recall  f1-score   support

           0       0.98      1.00      0.99       145
           1       1.00      0.98      0.99       163

    accuracy                           0.99       308
   macro avg       0.99      0.99      0.99       308
weighted avg       0.99      0.99      0.99       308

#####################
SVM
              precision    recall  f1-score   support

           0       0.75      0.70      0.73       145
           1       0.75      0.79      0.77       163

    accuracy                           0.75       308
   macro avg       0.75      0.75      0.75       308
weighted avg       0.75      0.75      0.75       308
```




DecisionTree
True label
0
1
145
0
0
163
0
1
Predicted label
160
140
120
100
80
60
40
20
0


RandomForest
True label
0
1
145
0
3
160
0
1
Predicted label
160
140
120
100
80
60
40
20
0



Getting Average score from K-Fold CV result for each model

```
[19]: r_df.groupby('model').mean().reset_index()
```

```
[19]:          model  fit_time  score_time  test_accuracy  test_precision  \
      0  DecisionTree  0.003666    0.004892       0.972067        0.976604
      1    NaiveBayes  0.004914    0.006603       0.811694        0.796276
      2  RandomForest  0.193031    0.021173       0.969279        0.973574
      3           SVM  0.019332    0.011124       0.694610        0.685327

         test_recall   test_f1
      0     0.965967  0.971049
      1     0.842783  0.818564
      2     0.962835  0.967949
      3     0.742913  0.710625
```

From the result above we can say that Random Forest is the best model as the values of accuracy, precision and recall is the highest.