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Class =IT 4th year 1st semester

Subject = Machine Learning

Question no 1

Import required header files

```
import pandas as pd

from sklearn.datasets import load_wine # import datasets
from matplotlib import pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
import seaborn as sns

from sklearn.svm import SVC #import SVM classifier

from sklearn.tree import DecisionTreeClassifier # import decision tree classifier

from sklearn.ensemble import RandomForestClassifier # import random forest classifier

from sklearn.naive_bayes import GaussianNB # import naive bayes classifier
```

Load Wine Dataset

```
# load wine dataset
wine = load_wine()
dir(wine)
```

```
['DESCR', 'data', 'feature_names', 'frame', 'target', 'target_names']
```

```
wine.feature_names
```

```
['alcohol',
 'malic_acid',
 'ash',
 'alcalinity_of_ash',
 'magnesium',
 'total_phenols',
 'flavanoids',
 'nonflavanoid_phenols',
 'proanthocyanins',
 'color_intensity',
 'hue',
 'od280/od315_of_diluted_wines',
 'proline']
```

```
df = pd.DataFrame(wine.data, columns=wine.feature_names)
df.head()
```

```
   alcohol  malic_acid   ash  alcalinity_of_ash  magnesium
total_phenols  \
0    14.23        1.71  2.43               15.6      127.0
2.80
1    13.20        1.78  2.14               11.2      100.0
2.65
2    13.16        2.36  2.67               18.6      101.0
2.80
3    14.37        1.95  2.50               16.8      113.0
3.85
4    13.24        2.59  2.87               21.0      118.0
2.80

   flavanoids  nonflavanoid_phenols  proanthocyanins  color_intensity
hue  \
0        3.06                  0.28             2.29             5.64
1.04
1        2.76                  0.26             1.28             4.38
1.05
2        3.24                  0.30             2.81             5.68
1.03
3        3.49                  0.24             2.18             7.80
0.86
4        2.69                  0.39             1.82             4.32
1.04

   od280/od315_of_diluted_wines  proline
0                          3.92   1065.0
1                          3.40   1050.0
2                          3.17   1185.0
3                          3.45   1480.0
4                          2.93    735.0
```

```
df['target'] = wine.target
df.head()
```

```
   alcohol  malic_acid   ash  alcalinity_of_ash  magnesium  
total_phenols  \
0    14.23        1.71  2.43               15.6      127.0           
2.80   
1    13.20        1.78  2.14               11.2      100.0           
2.65   
2    13.16        2.36  2.67               18.6      101.0           
2.80   
3    14.37        1.95  2.50               16.8      113.0           
3.85   
4    13.24        2.59  2.87               21.0      118.0           
2.80   

   flavanoids  nonflavanoid_phenols  proanthocyanins  color_intensity  
hue  \
0        3.06                  0.28             2.29             5.64  
1.04   
1        2.76                  0.26             1.28             4.38  
1.05   
2        3.24                  0.30             2.81             5.68  
1.03   
3        3.49                  0.24             2.18             7.80  
0.86   
4        2.69                  0.39             1.82             4.32  
1.04   

   od280/od315_of_diluted_wines  proline  target  
0                          3.92   1065.0       0  
1                          3.40   1050.0       0  
2                          3.17   1185.0       0  
3                          3.45   1480.0       0  
4                          2.93    735.0       0  
```

```
wine.target_names
```

```
array(['class_0', 'class_1', 'class_2'], dtype='<U7')
```

```
df['target'].value_counts()
```

```
1    71
0    59
2    48
Name: target, dtype: int64
```

```
X = df.drop(['target'], axis='columns')
len(X)
```

```
178
```

```
y = df.target
len(y)
```

```
178
```

training and test data split

```
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.3,random_state=0)
```

Work for SVM classifier

```
model = SVC(kernel='linear')
```

```
model.fit(X_train, y_train)
```

```
SVC(kernel='linear')
```

```
model.score(X_test,y_test)
```

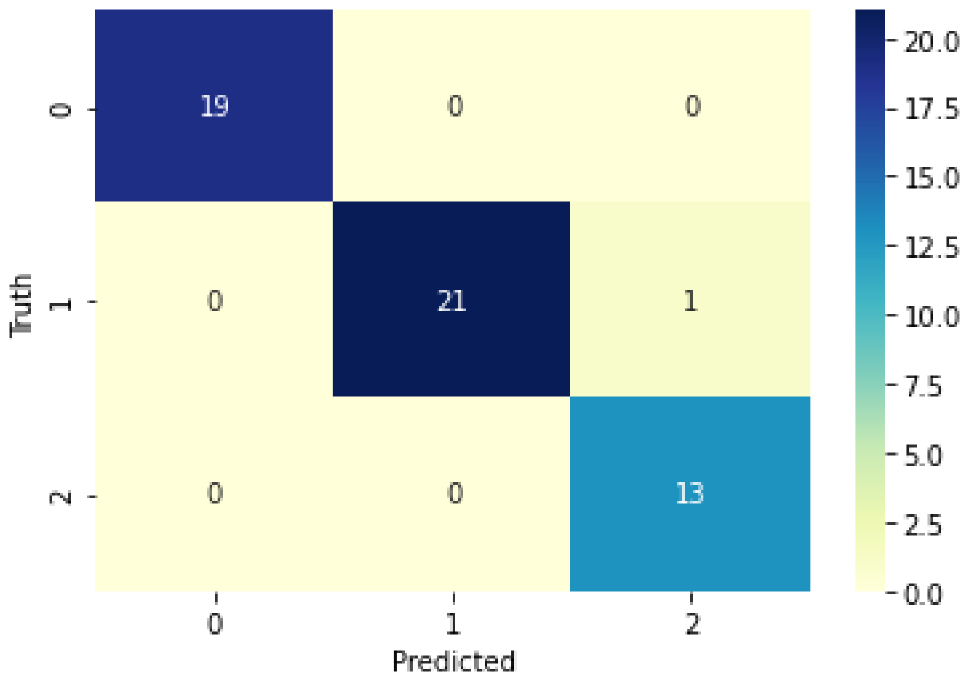
```
0.9814814814814815
```

```
y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))
```

```
Accuracy: 98.14814814814815%

Confusion Matrix:
[[19  0  0]
 [ 0 21  1]
 [ 0  0 13]]

Classification Report:

              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      0.95      0.98        22
           2       0.93      1.00      0.96        13

    accuracy                           0.98        54
   macro avg       0.98      0.98      0.98        54
weighted avg       0.98      0.98      0.98        54
```

```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```



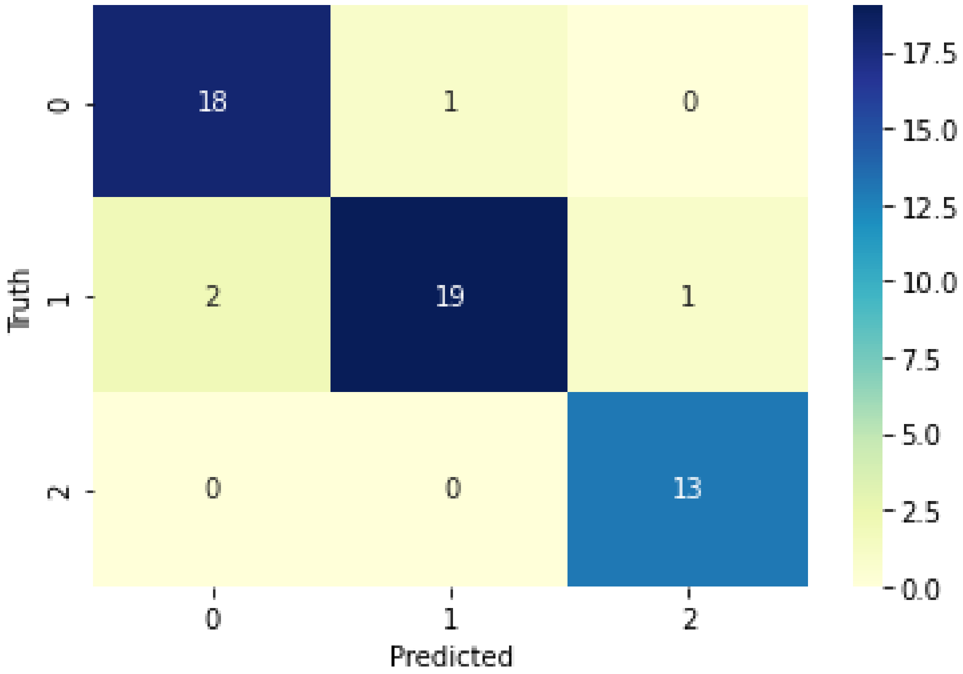
Work for Decision Tree classifier

```
model = DecisionTreeClassifier(criterion='entropy')

model.fit(X_train, y_train)

DecisionTreeClassifier(criterion='entropy')

model.score(X_test, y_test)

0.9259259259259259

y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))

Accuracy: 92.5925925925926%

Confusion Matrix:
[[18  1  0]
 [ 2 19  1]
 [ 0  0 13]]

Classification Report:

              precision    recall  f1-score   support
```

```
           0       0.90      0.95      0.92        19
           1       0.95      0.86      0.90        22
           2       0.93      1.00      0.96        13

    accuracy                           0.93        54
   macro avg       0.93      0.94      0.93        54
weighted avg       0.93      0.93      0.93        54
```

```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```



Work for Random forest classifier

```
model = RandomForestClassifier()
```

```
model.fit(X_train,y_train)
```

```
RandomForestClassifier()
```

```
model.score(X_test,y_test)
```

```
0.9814814814814815
```

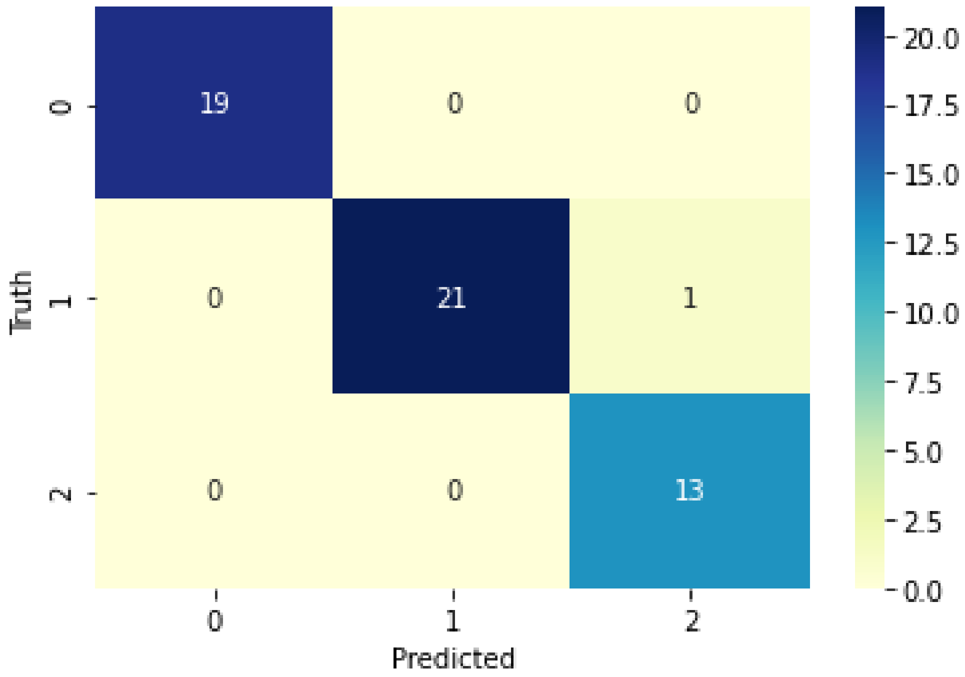
```
y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
```

```
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))
```

```
Accuracy: 98.14814814814815%

Confusion Matrix:
[[19  0  0]
 [ 0 21  1]
 [ 0  0 13]]

Classification Report:

              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      0.95      0.98        22
           2       0.93      1.00      0.96        13

    accuracy                           0.98        54
   macro avg       0.98      0.98      0.98        54
weighted avg       0.98      0.98      0.98        54
```

```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```



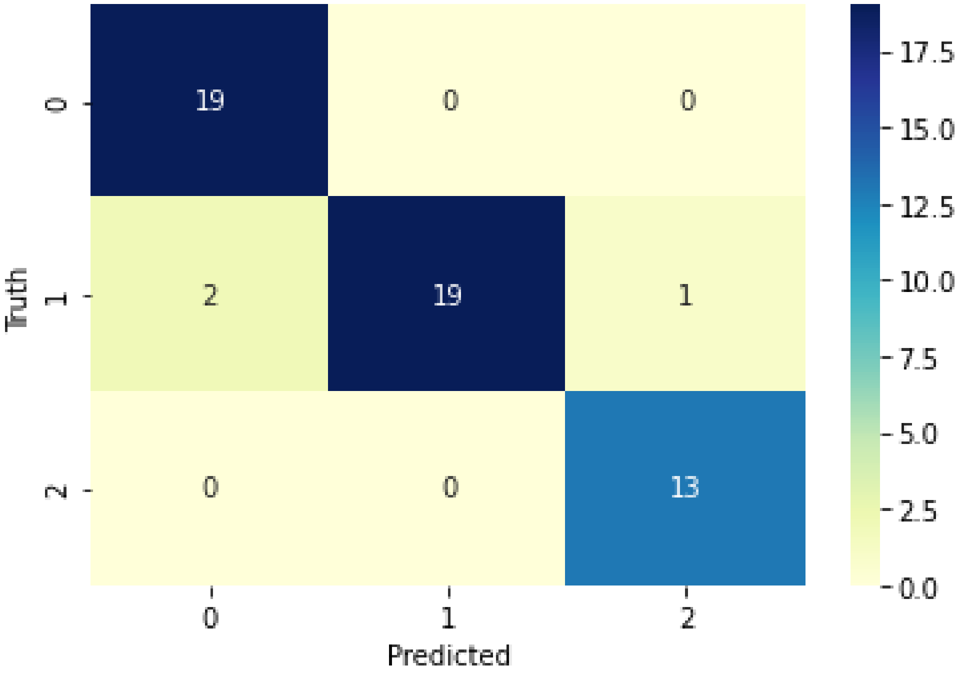
Work for Naive Bayes Classifier

```
model = GaussianNB()

model.fit(X_train,y_train)

GaussianNB()

model.score(X_test, y_test)

0.9444444444444444

y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))

Accuracy: 94.44444444444444%

Confusion Matrix:
[[19  0  0]
 [ 2 19  1]
 [ 0  0 13]]

Classification Report:

              precision    recall  f1-score   support
```

```
           0       0.90      1.00      0.95        19
           1       1.00      0.86      0.93        22
           2       0.93      1.00      0.96        13

    accuracy                           0.94        54
   macro avg       0.94      0.95      0.95        54
weighted avg       0.95      0.94      0.94        54
```

```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```



Ionosphere Dataset

```
# load ionosphere dataset
df = pd.read_csv('ionosphere_data.csv')
df.head()
```

```
   column_a  column_b  column_c  column_d  column_e  column_f  
column_g  \
0      True     False   0.99539  -0.05889   0.85243   0.02306   
0.83398   
1      True     False   1.00000  -0.18829   0.93035  -0.36156  -
0.10868   
2      True     False   1.00000  -0.03365   1.00000   0.00485   
1.00000   
```

```
3      True     False   1.00000  -0.45161   1.00000   1.00000
0.71216
4      True     False   1.00000  -0.02401   0.94140   0.06531
0.92106

   column_h  column_i  column_j  ...  column_z  column_aa
column_ab  \
0  -0.37708   1.00000   0.03760  ...  -0.51171    0.41078   -0.46168

1  -0.93597   1.00000  -0.04549  ...  -0.26569   -0.20468   -0.18401

2  -0.12062   0.88965   0.01198  ...  -0.40220    0.58984   -0.22145

3  -1.00000   0.00000   0.00000  ...   0.90695    0.51613    1.00000

4  -0.23255   0.77152  -0.16399  ...  -0.65158    0.13290   -0.53206


   column_ac  column_ad  column_ae  column_af  column_ag  column_ah
column_ai
0    0.21266   -0.34090    0.42267   -0.54487    0.18641   -0.45300
g
1   -0.19040   -0.11593   -0.16626   -0.06288   -0.13738   -0.02447
b
2    0.43100   -0.17365    0.60436   -0.24180    0.56045   -0.38238
g
3    1.00000   -0.20099    0.25682    1.00000   -0.32382    1.00000
b
4    0.02431   -0.62197   -0.05707   -0.59573   -0.04608   -0.65697
g

[5 rows x 35 columns]
```

```
X = df.drop(['column_ai'],axis='columns')
len(X)
```

```
351
```

```
y = df['column_ai']
len(y)
```

```
351
```

training and test split

```
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.3,random_state=0)
```

Work for SVM classifier

```
model = SVC(kernel='linear')
```

```
model.fit(X_train,y_train)
```

```
SVC(kernel='linear')
```

```
model.score(X_test,y_test)
```

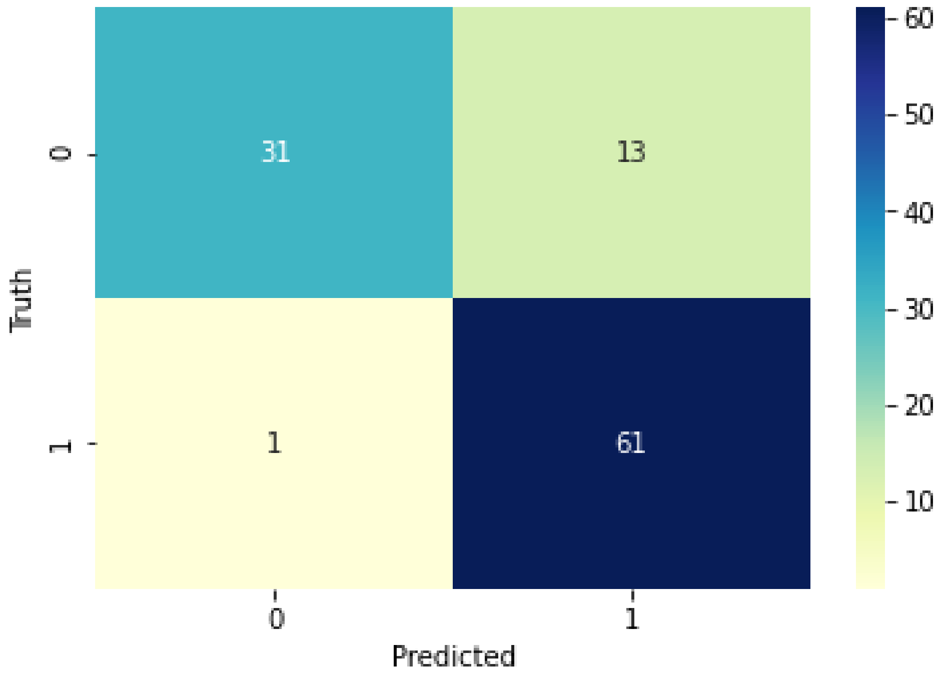
```
0.8679245283018868
```

```
y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))
```

```
Accuracy: 86.79245283018868%

Confusion Matrix:
[[31 13]
 [ 1 61]]

Classification Report:

              precision    recall  f1-score   support

           b       0.97      0.70      0.82        44
           g       0.82      0.98      0.90        62

    accuracy                           0.87       106
   macro avg       0.90      0.84      0.86       106
weighted avg       0.88      0.87      0.86       106
```

```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```

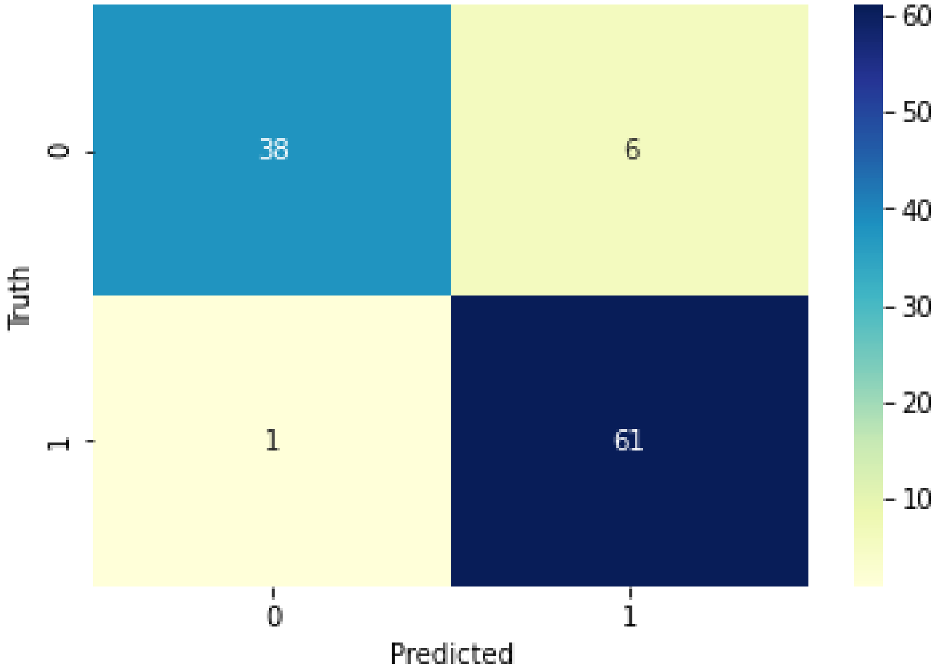


Work for Decision Tree classifier

```
model = DecisionTreeClassifier(criterion='entropy')

model.fit(X_train,y_train)

DecisionTreeClassifier(criterion='entropy')

model.score(X_test,y_test)

0.9339622641509434

y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))

Accuracy: 93.39622641509435%

Confusion Matrix:
[[38  6]
 [ 1 61]]

Classification Report:

              precision    recall  f1-score   support

           b       0.97      0.86      0.92        44
           g       0.91      0.98      0.95        62

    accuracy                           0.93       106
   macro avg       0.94      0.92      0.93       106
weighted avg       0.94      0.93      0.93       106
```

```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```



Work for Random forest classifier

```
model = RandomForestClassifier()
```

```
model.fit(X_train,y_train)
```

```
RandomForestClassifier()
```

```
model.score(X_test,y_test)
```

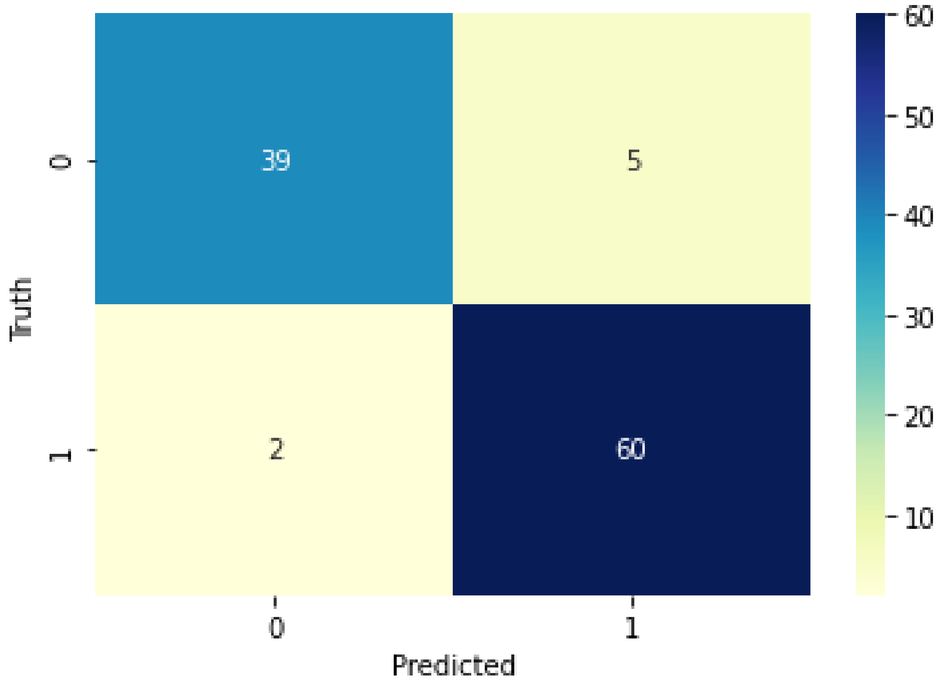
```
0.9339622641509434
```

```
y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))
```

```
Accuracy: 93.39622641509435%

Confusion Matrix:
[[39  5]
 [ 2 60]]

Classification Report:

              precision    recall  f1-score   support

           b       0.95      0.89      0.92        44
           g       0.92      0.97      0.94        62

    accuracy                           0.93       106
   macro avg       0.94      0.93      0.93       106
weighted avg       0.93      0.93      0.93       106
```

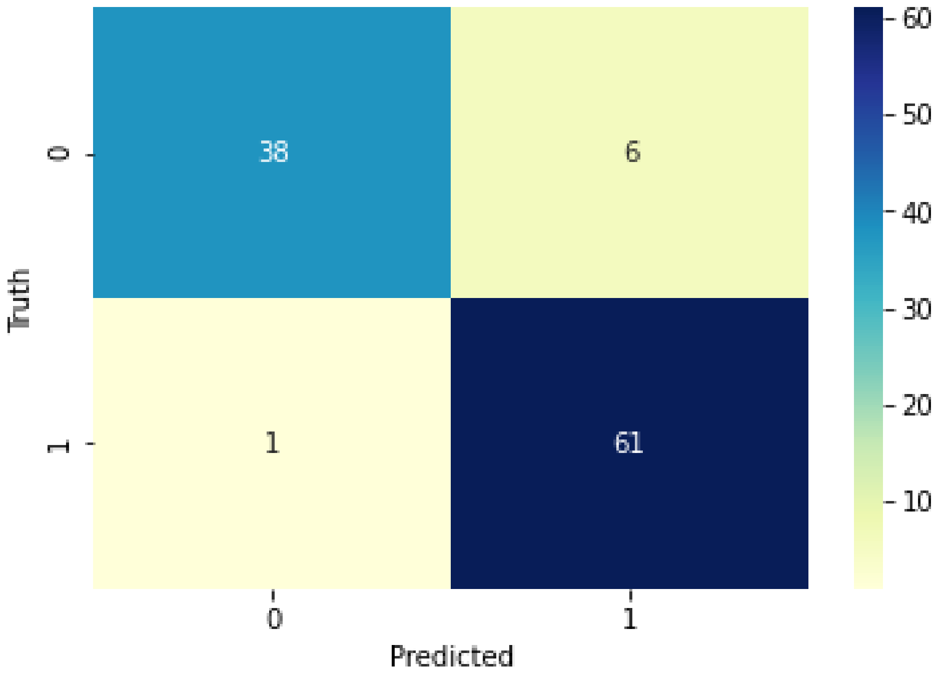
```
%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(33.0, 0.5, 'Truth')
```



Work for Nayes Bayes classifier

```
model = GaussianNB()

model.fit(X_train,y_train)

GaussianNB()

model.score(X_test,y_test)

0.9339622641509434

y_pred = model.predict(X_test)
print(f"Accuracy: {100 * accuracy_score(y_test,y_pred)}%\n")
cf_matrix = confusion_matrix(y_test,y_pred)
print("Confusion Matrix:")
print(cf_matrix)
print("\nClassification Report:\n")
print(classification_report(y_test,y_pred))

Accuracy: 93.39622641509435%

Confusion Matrix:
[[38  6]
 [ 1 61]]

Classification Report:

              precision    recall  f1-score   support

           b       0.97      0.86      0.92        44
           g       0.91      0.98      0.95        62

    accuracy                           0.93       106
   macro avg       0.94      0.92      0.93       106
weighted avg       0.94      0.93      0.93       106


%matplotlib inline
sns.heatmap(cf_matrix,annot=True,cmap="YlGnBu")
plt.xlabel('Predicted')
plt.ylabel('Truth')

Text(33.0, 0.5, 'Truth')
```


38
6
1
61
Truth
0
1
0
1
Predicted
60
50
40
30
20
10