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B.E IT 4TH YEAR 1ST SEM

MACHINE LEARNING LAB

ASSIGNMENT #1

UCI datasets (can be loaded from the package itself):

a. Iris plants dataset: https://archive.ics.uci.edu/ml/datasets/Iris/

b. Diabetes dataset:
https://www4.stat.ncsu.edu/~boos/var.select/diabetes.html

c. Wisconsin Breast Cancer Dataset:
https://archive.ics.uci.edu/ml/datasets/Breast+Cancer+Wisconsin+(Diagnostic)

**********************SOLUTION************************

1.Employ Naive Bayes (Gaussian, Multinomial & Bernoulli) classifier and show classification results (Accuracy, Precision, Recall, F-score, confusion matrix) with and without parameter tuning.

**********************FOR IRISH DATASET************************:

```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
os.chdir(r"C:\Users\ghosa\Projects\ML\ass1\iris")
dataset = pd.read_csv("iris.data")
dataset.head()
```

	s_length(cm)	s_width(cm)	p_length(cm)	p_width(cm)	species
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa

```
dataset.groupby('species').size()
```

```
species
Iris-setosa        50
Iris-versicolor    50
Iris-virginica     50
dtype: int64
```

```
train, test = train_test_split(dataset, test_size = 0.4)
X_train = train[['s_length(cm)','s_width(cm)','p_length(cm)','p_width(cm)']]
y_train = train.species
X_test = test[['s_length(cm)','s_width(cm)','p_length(cm)','p_width(cm)']]
y_test = test.species
from sklearn.naive_bayes import GaussianNB
```

#Without Parameter tuning Gaussian NB

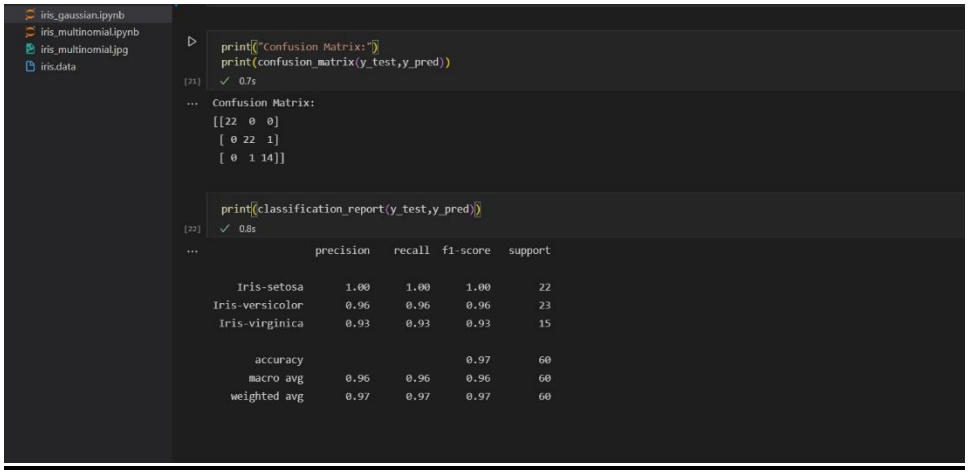
```
classifier = GaussianNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[22  0  0]
 [ 0 22  1]
 [ 0  1 14]]
```

```
print(classification_report(y_test,y_pred))
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
Iris-setosa	1.00	1.00	1.00	22
Iris-versicolor	0.96	0.96	0.96	23
Iris-virginica	0.93	0.93	0.93	15
accuracy			0.97	60
macro avg	0.96	0.96	0.96	60
weighted avg	0.97	0.97	0.97	60



#With Parameter tuning Gaussian NB

```
classifier = GaussianNB(priors=None,var_smoothing=1e-5).fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
print('Confusion Matrix:')
print(confusion_matrix(y_test,y_pred))
```

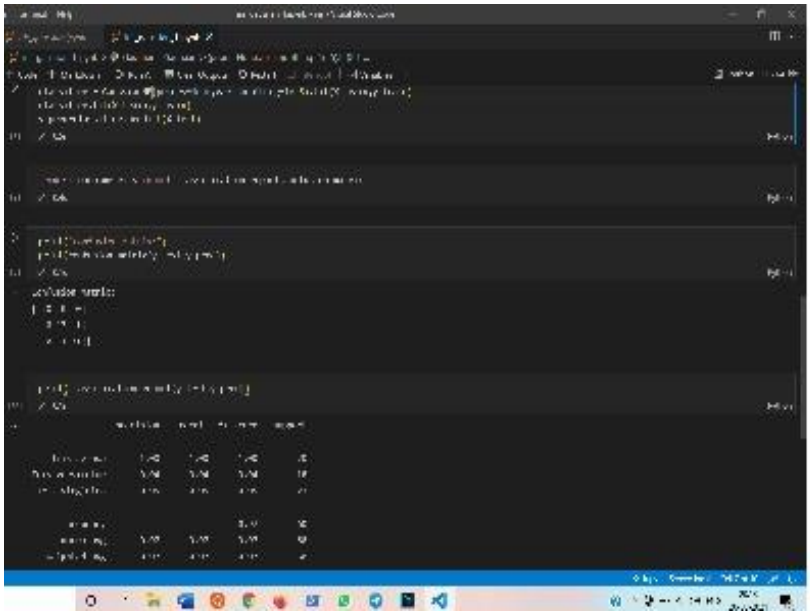
```
Confusion Matrix:
[[20  0  0]
 [ 0 17  1]
 [ 0  1 21]]
```

```
print(classification_report(y_test,y_pred))
```

```
[10]
...                 precision    recall  f1-score   support

    Iris-setosa       1.00      1.00      1.00        20
Iris-versicolor       0.94      0.94      0.94        18
 Iris-virginica       0.95      0.95      0.95        22

       accuracy                           0.97        60
      macro avg       0.97      0.97      0.97        60
   weighted avg       0.97      0.97      0.97        60
```



#Without Parameter tuning Multinomial NB

```
from sklearn.naive_bayes import MultinomialNB
classifier=MultinomialNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

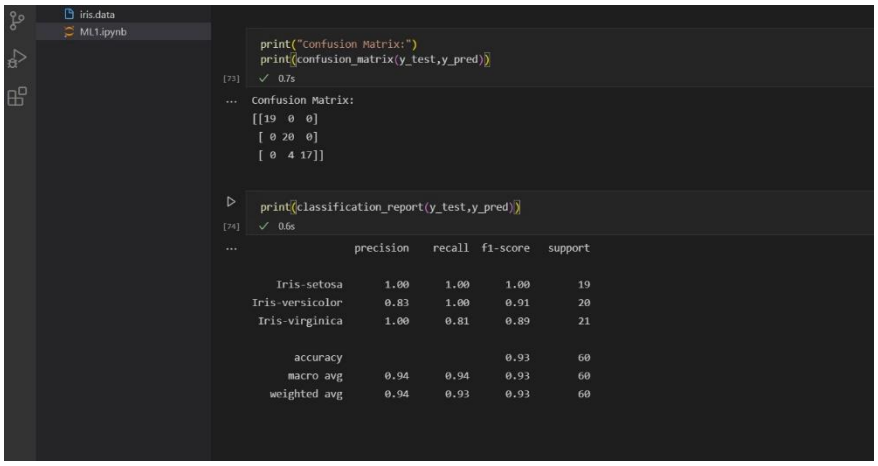
```
Confusion Matrix:
[[19  0  0]
 [ 0 20  0]
 [ 0  4 17]]
```

```
print(classification_report(y_test,y_pred))
```

```
                  precision    recall  f1-score   support

      Iris-setosa       1.00      1.00      1.00        19
  Iris-versicolor       0.83      1.00      0.91        20
   Iris-virginica       1.00      0.81      0.89        21

        accuracy                           0.93        60
       macro avg       0.94      0.94      0.93        60
    weighted avg       0.94      0.93      0.93        60
```



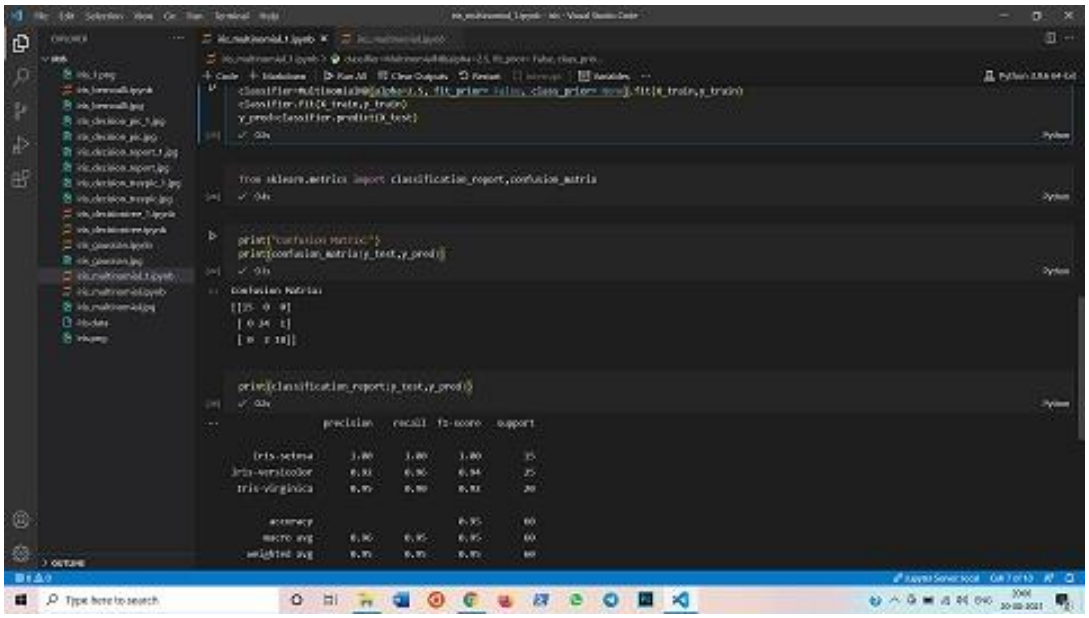
#With Parameter tuning Multinomial NB

```
from sklearn.naive_bayes import MultinomialNB
classifier=MultinomialNB(alpha=2.5, fit_prior= False, class_prior= None).fit(X
_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[15  0  0]
 [ 0 24  1]
 [ 0  2 18]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
Iris-setosa	1.00	1.00	1.00	15
Iris-versicolor	0.92	0.96	0.94	25
Iris-virginica	0.95	0.90	0.92	20
accuracy			0.95	60
macro avg	0.96	0.95	0.95	60
weighted avg	0.95	0.95	0.95	60



#Without Parameter tuning Bernoulli NB

```
from sklearn.naive_bayes import BernoulliNB
classifier = BernoulliNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[ 0  0 21]
 [ 0  0 21]
 [ 0  0 18]]
```

```
print(classification_report(y_test,y_pred))
```

```
                 precision    recall  f1-score   support

    Iris-setosa       0.00      0.00      0.00        21
Iris-versicolor       0.00      0.00      0.00        21
 Iris-virginica       0.30      1.00      0.46        18

       accuracy                           0.30        60
      macro avg       0.10      0.33      0.15        60
   weighted avg       0.09      0.30      0.14        60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```
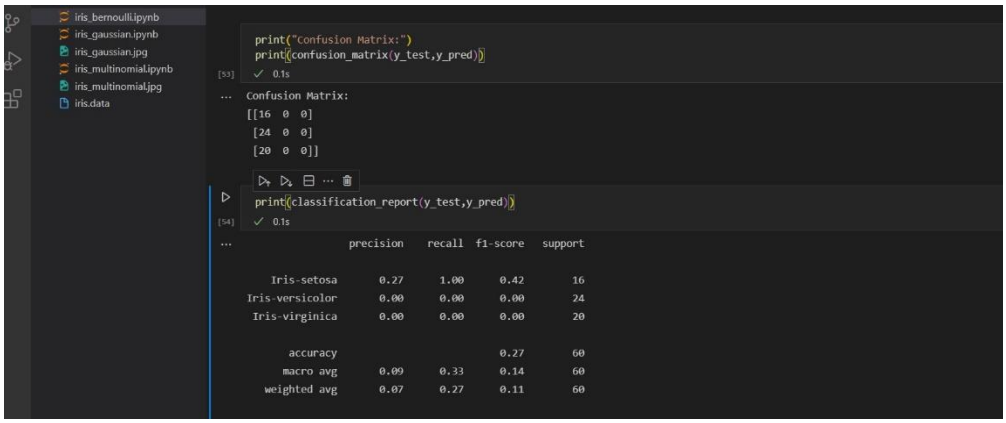



#With Parameter tuning Bernoulli NB

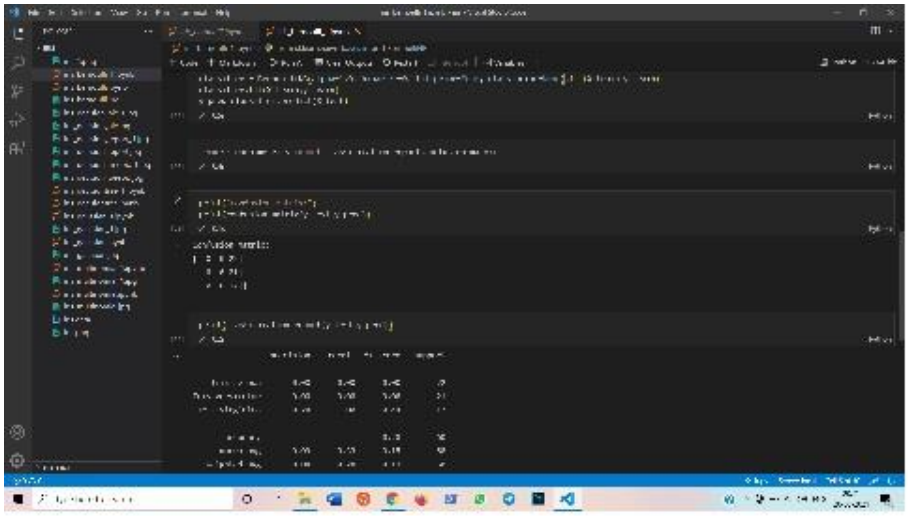
```
classifier = BernoulliNB(alpha=1.0, binarize=0, fit_prior=True, class_prior=No
ne).fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
```

```
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[ 0  0 22]
 [ 0  0 21]
 [ 0  0 17]]
```

```
print(classification_report(y_test,y_pred))
```

```
                precision    recall  f1-score   support

    Iris-setosa       0.00      0.00      0.00        22
Iris-versicolor       0.00      0.00      0.00        21
 Iris-virginica       0.28      1.00      0.44        17

       accuracy                           0.28        60
      macro avg       0.09      0.33      0.15        60
   weighted avg       0.08      0.28      0.13        60
```



**********************FOR DIABETES DATASET********************:**

```
mport os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
os.chdir(r"C:\Users\ghosa\Projects\ML\ass1\diabetes")
```

```
dataset = pd.read_csv('diabetes.data')
dataset.head()
```

	AGE	SEX	BMI	BP	S1	S2	S3	S4	S5	S6	Y
0	59	2	32.1	101.0	157	93.2	38.0	4.0	4.8598	87	151
1	48	1	21.6	87.0	183	103.2	70.0	3.0	3.8918	69	75
2	72	2	30.5	93.0	156	93.6	41.0	4.0	4.6728	85	141
3	24	1	25.3	84.0	198	131.4	40.0	5.0	4.8903	89	206
4	50	1	23.0	101.0	192	125.4	52.0	4.0	4.2905	80	135

```
X=dataset.drop(['SEX','Y'],axis=1)
y=dataset['SEX']
X_train,X_test,y_train,y_test= train_test_split(X,y, test_size = 0.4)
```

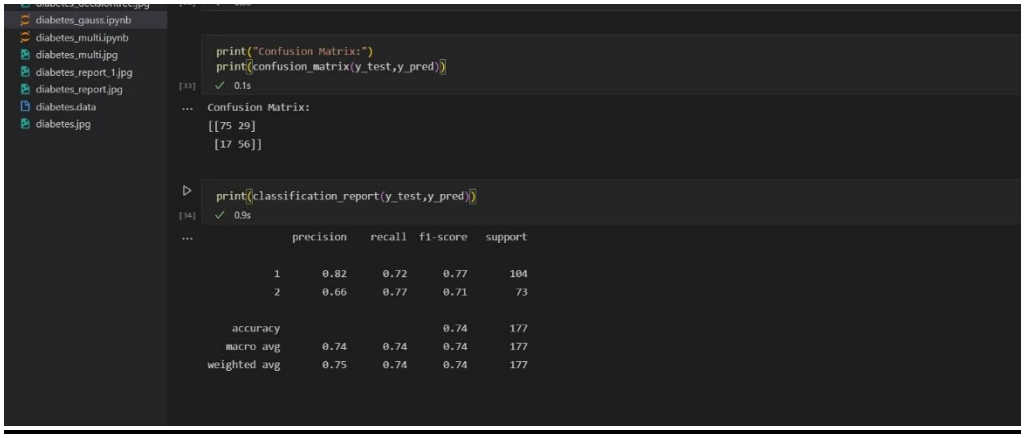
#Without Parameter tuning Gaussian NB

```
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
rint("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[32  8]
 [24 25]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
1	0.57	0.80	0.67	40
2	0.76	0.51	0.61	49
accuracy			0.64	89
macro avg	0.66	0.66	0.64	89
weighted avg	0.67	0.64	0.64	89



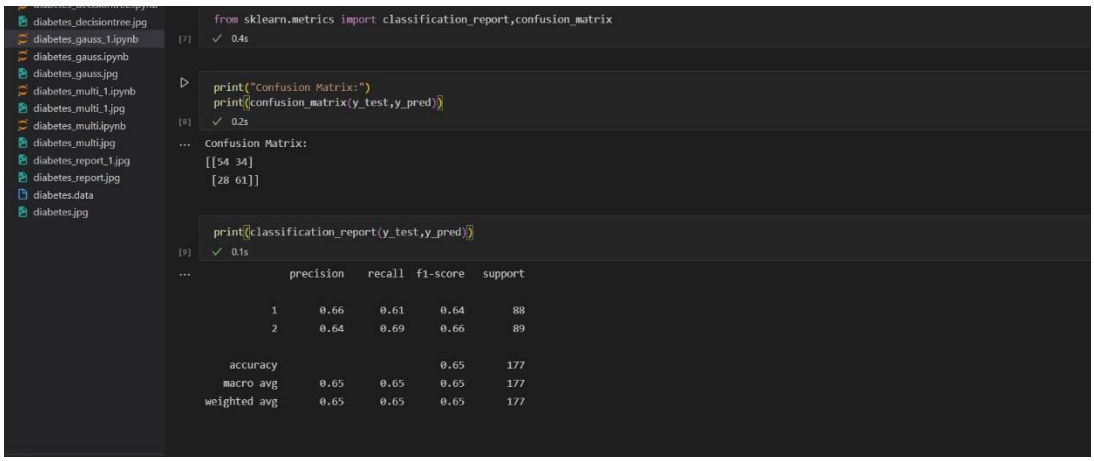
#With Parameter tuning Gaussian NB

```
lassifier = GaussianNB(priors=None,var_smoothing=1e-5).fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
rint("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[54 34]
 [28 61]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
1	0.66	0.61	0.64	88
2	0.64	0.69	0.66	89
accuracy			0.65	177
macro avg	0.65	0.65	0.65	177
weighted avg	0.65	0.65	0.65	177



#Without Parameter tuning Multinomial NB

```
from sklearn.naive_bayes import MultinomialNB
classifier = MultinomialNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[54 29]
 [30 64]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
1	0.64	0.65	0.65	83
2	0.69	0.68	0.68	94
accuracy			0.67	177
macro avg	0.67	0.67	0.67	177
weighted avg	0.67	0.67	0.67	177

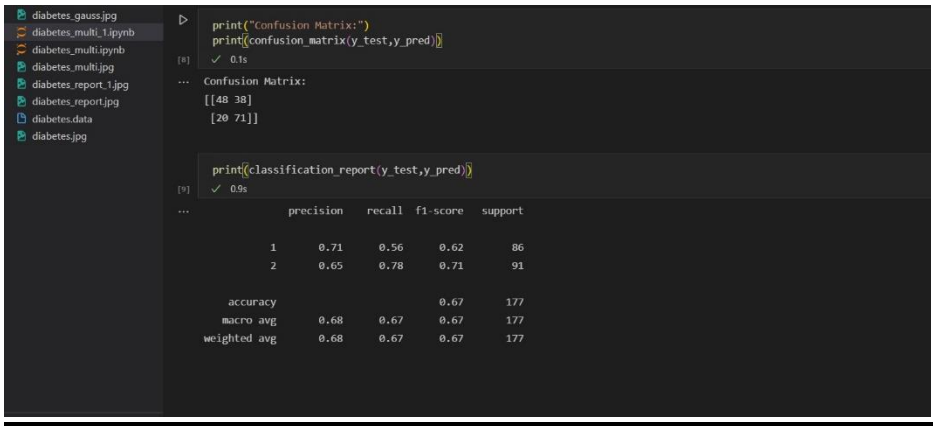
#With Parameter tuning Multinomial NB

```
classifier = MultinomialNB(alpha=2.5, fit_prior= False, class_prior= None).fit
(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[54 40]
 [25 58]]
```

```
print(classification_report(y_test,y_pred))
```

```
0.1s
                precision    recall  f1-score   support

           1       0.68      0.57      0.62        94
           2       0.59      0.70      0.64        83

    accuracy                           0.63       177
   macro avg       0.64      0.64      0.63       177
weighted avg       0.64      0.63      0.63       177
```



#Without Parameter tuning Bernoulli NB

```
from sklearn.naive_bayes import BernoulliNB
classifier = BernoulliNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[97  0]
 [80  0]]
```

```
print(classification_report(y_test,y_pred))
```

```
                precision    recall  f1-score   support

           1       0.55      1.00      0.71        97
           2       0.00      0.00      0.00        80

    accuracy                           0.55       177
   macro avg       0.27      0.50      0.35       177
weighted avg       0.30      0.55      0.39       177

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```
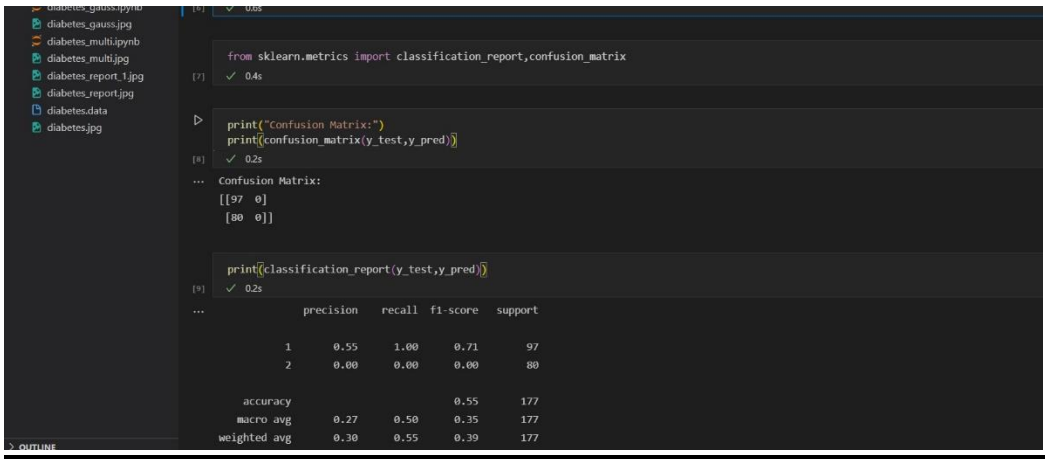



#With Parameter tuning Bernoulli NB

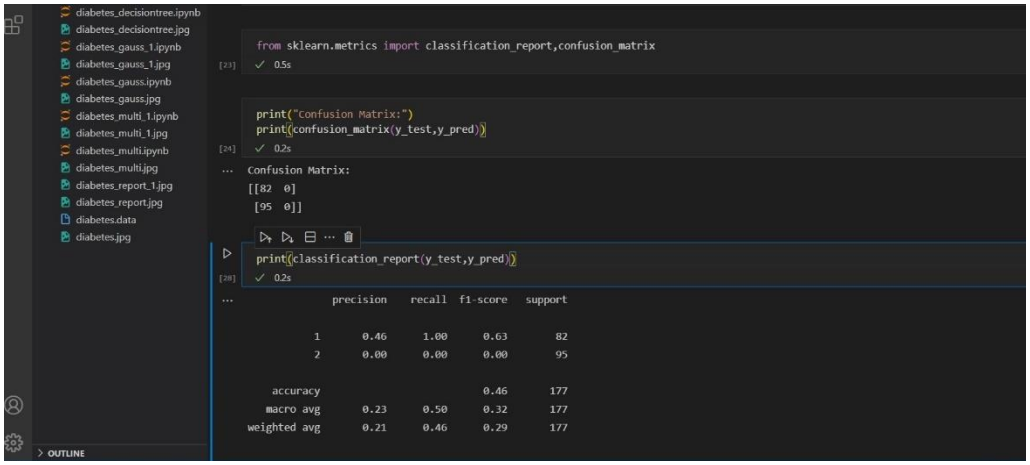
```
classifier = BernoulliNB(alpha=1.0, binarize=0, fit_prior=True, class_prior=No
ne).fit(X_train,y_train)
```

```
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
[24]
...  Confusion Matrix:
     [[82  0]
      [95  0]]
```

```
print(classification_report(y_test,y_pred))
```

```
                precision    recall  f1-score   support

           1       0.46      1.00      0.63        82
           2       0.00      0.00      0.00        95

    accuracy                           0.46       177
   macro avg       0.23      0.50      0.32       177
weighted avg       0.21      0.46      0.29       177
```



**********FOR CANCER DATASET**********:

```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn import datasets
os.chdir(r"C:\Users\ghosa\Projects\ML\ass1\cancer")
dataset= datasets.load_breast_cancer()
print(dataset.feature_names)
```

```
['mean radius' 'mean texture' 'mean perimeter' 'mean area'
 'mean smoothness' 'mean compactness' 'mean concavity'
 'mean concave points' 'mean symmetry' 'mean fractal dimension'
 'radius error' 'texture error' 'perimeter error' 'area error'
 'smoothness error' 'compactness error' 'concavity error'
 'concave points error' 'symmetry error' 'fractal dimension error'
 'worst radius' 'worst texture' 'worst perimeter' 'worst area'
 'worst smoothness' 'worst compactness' 'worst concavity'
 'worst concave points' 'worst symmetry' 'worst fractal dimension']
```

```
print(dataset.target_names)
```

```
['malignant' 'benign']
```

```
X=dataset.data
y=dataset.target
X_train,X_test,y_train,y_test= train_test_split(X,y, test_size = 0.4)
```

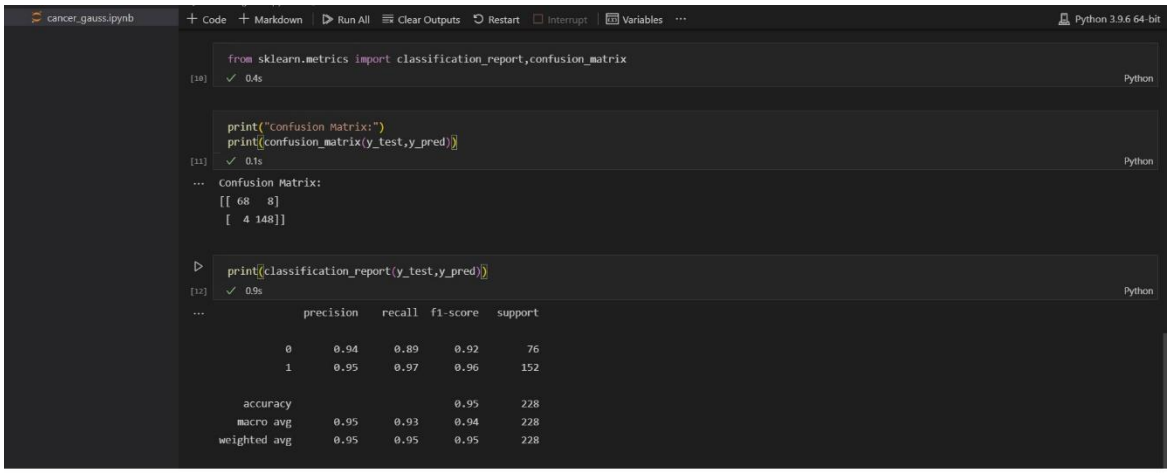
#Without Parameter tuning Gaussian NB

```
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[ 68   8]
 [  4 148]]
```

```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.94      0.89      0.92        76
           1       0.95      0.97      0.96       152

    accuracy                           0.95       228
   macro avg       0.95      0.93      0.94       228
weighted avg       0.95      0.95      0.95       228
```



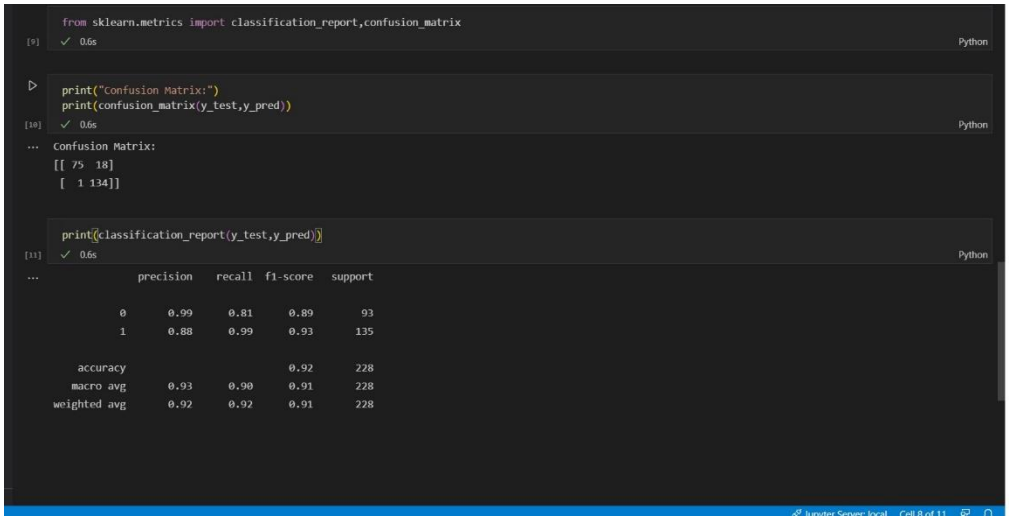
#With Parameter tuning Gaussian NB

```
lassifier = GaussianNB(priors=None,var_smoothing=1e-5).fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
rint("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[ 75  18]
 [  1 134]]
```

```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.99      0.81      0.89        93
           1       0.88      0.99      0.93       135

    accuracy                           0.92       228
   macro avg       0.93      0.90      0.91       228
weighted avg       0.92      0.92      0.91       228
```



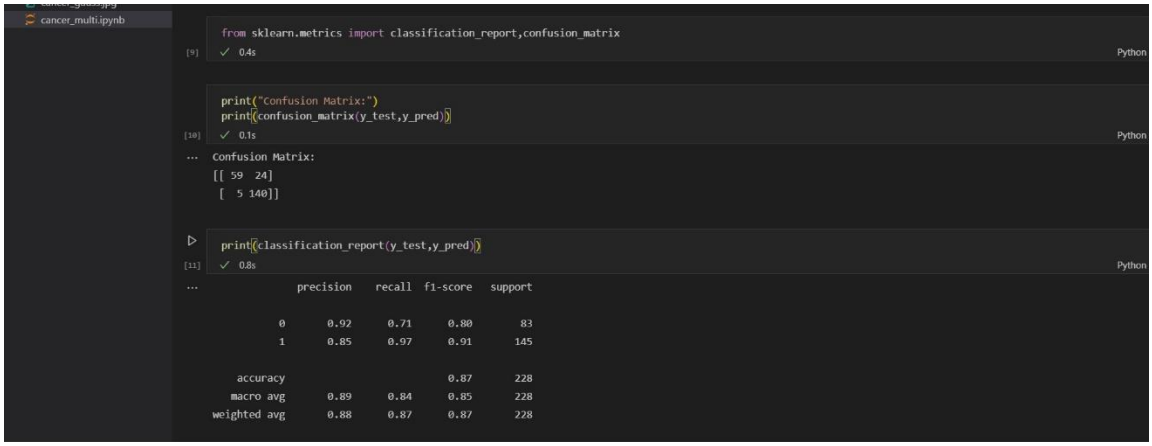
#Without Parameter tuning Multinomial NB

```
from sklearn.naive_bayes import MultinomialNB
classifier = MultinomialNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[ 59  24]
 [  5 140]]
```

```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.92      0.71      0.80        83
           1       0.85      0.97      0.91       145

    accuracy                           0.87       228
   macro avg       0.89      0.84      0.85       228
weighted avg       0.88      0.87      0.87       228
```



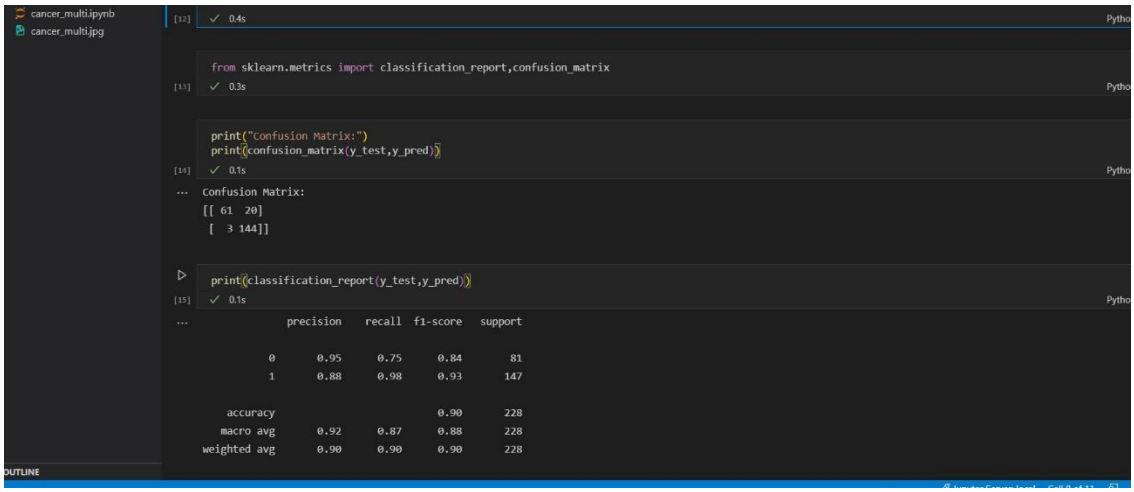
#With Parameter tuning Multinomial NB

```
lassifier = MultinomialNB(alpha=2.5, fit_prior= False, class_prior= None).fit(
X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[ 61  20]
 [  3 144]]
```

```
print(classification_report(y_test,y_pred))
```

```
                precision    recall  f1-score   support

           0       0.95      0.75      0.84        81
           1       0.88      0.98      0.93       147

    accuracy                           0.90       228
   macro avg       0.92      0.87      0.88       228
weighted avg       0.90      0.90      0.90       228
```



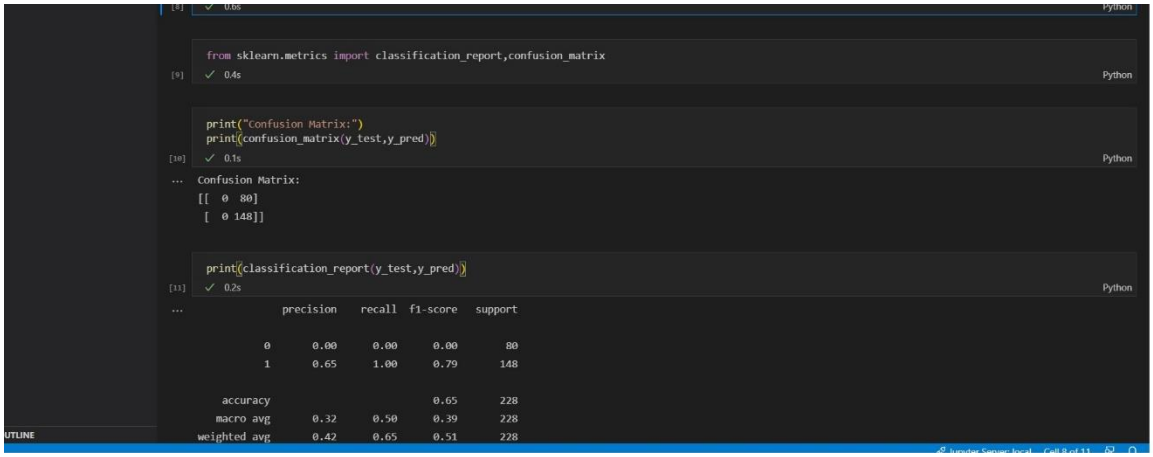
#Without Parameter tuning Bernoulli NB

```
from sklearn.naive_bayes import BernoulliNB
classifier = BernoulliNB().fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[  0  86]
 [  0 142]]
```

```
print(classification_report(y_test,y_pred))
```

```
                precision    recall  f1-score   support

           0       0.00      0.00      0.00        86
           1       0.62      1.00      0.77       142

    accuracy                           0.62       228
   macro avg       0.31      0.50      0.38       228
weighted avg       0.39      0.62      0.48       228
```



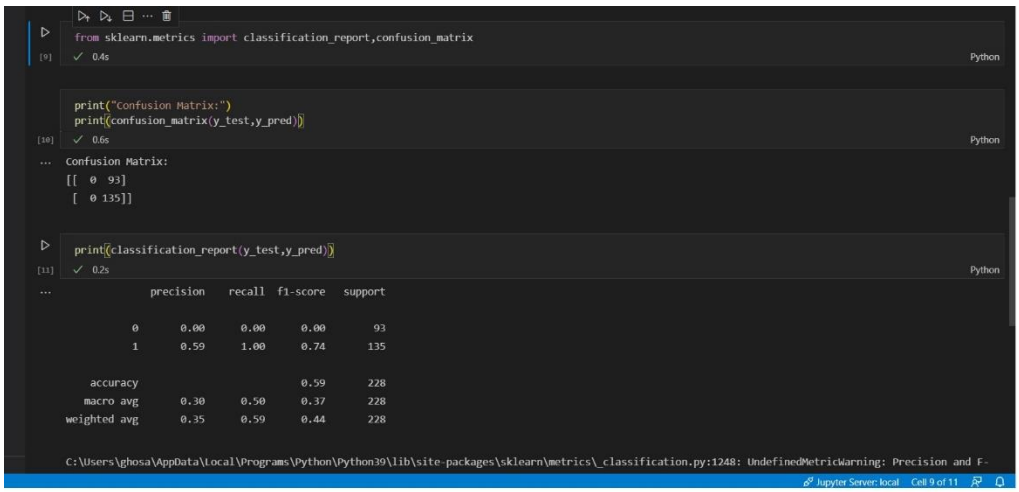
#With Parameter tuning Bernoulli NB

```
classifier = BernoulliNB(alpha=1.0, binarize=0, fit_prior=True, class_prior=No
ne).fit(X_train,y_train)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[  0  93]
 [  0 135]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
0	0.00	0.00	0.00	93
1	0.59	1.00	0.74	135
accuracy			0.59	228
macro avg	0.30	0.50	0.37	228
weighted avg	0.35	0.59	0.44	228



2.Use Decision Tree classifier for all the three datasets and show classification results (Accuracy, Precision, Recall, F-score, confusion matrix) with and without parameter tuning. Generate the decision tree images for all cases highlighting information like Gini and Entropy.

**********************FOR IRISH DATASET********************:**

```
train, test = train_test_split(dataset, test_size = 0.4)
X_train = train[['s_length(cm)','s_width(cm)','p_length(cm)','p_width(cm)']]
y_train = train.species
X_test = test[['s_length(cm)','s_width(cm)','p_length(cm)','p_width(cm)']]
y_test = test.species
from sklearn.tree import DecisionTreeClassifier
```

#Without Parameter tuning Decision Tree Classifier (by default Gini)

```
classifier = DecisionTreeClassifier()
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[20  0  0]
 [ 0 21  0]
 [ 0  3 16]]
```

```
print(classification_report(y_test,y_pred))
```

```
                 precision    recall  f1-score   support

    Iris-setosa       1.00      1.00      1.00        20
Iris-versicolor       0.88      1.00      0.93        21
 Iris-virginica       1.00      0.84      0.91        19

       accuracy                           0.95        60
      macro avg       0.96      0.95      0.95        60
   weighted avg       0.96      0.95      0.95        60
```

```
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

```
Confusion Matrix:
[[22  0  0]
 [ 0 19  1]
 [ 0  1 17]]
```

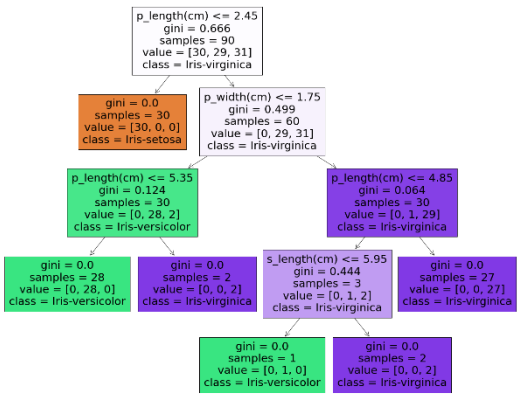
```
print(classification_report(y_test,y_pred))
```

```
                precision    recall  f1-score   support

    Iris-setosa       1.00      1.00      1.00        22
Iris-versicolor       0.95      0.95      0.95        20
 Iris-virginica       0.94      0.94      0.94        18

      accuracy                           0.97        60
     macro avg       0.96      0.96      0.96        60
  weighted avg       0.97      0.97      0.97        60
```

```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```

```
|--- feature_2 <= 2.45
|   |--- class: Iris-setosa
|--- feature_2 >  2.45
|   |--- feature_3 <= 1.75
|   |   |--- feature_2 <= 5.35
|   |   |   |--- feature_2 <= 4.95
|   |   |   |   |--- class: Iris-versicolor
|   |   |   |--- feature_2 >  4.95
|   |   |   |   |--- feature_3 <= 1.55
|   |   |   |   |   |--- class: Iris-virginica
|   |   |   |   |--- feature_3 >  1.55
|   |   |   |   |   |--- class: Iris-versicolor
|   |   |--- feature_2 >  5.35
|   |   |   |--- class: Iris-virginica
|   |--- feature_3 >  1.75
|   |   |--- class: Iris-virginica
```

```
from sklearn.tree import plot_tree
fig=plt.figure(figsize=(25,20))
fig= plot_tree(classifier,
      feature_names = ["s_length(cm)", "s_width(cm)", "p_length(cm)", "p_width
(cm)"],
      class_names = ['Iris-setosa', 'Iris-versicolor', 'Iris-
virginica'], filled = True) #
plt.savefig("iris.png")
```



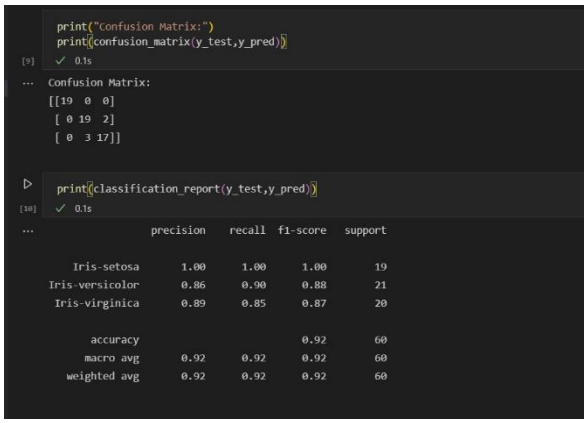
#With Parameter tuning Decision Tree Classifier (Entropy)

```
classifier = DecisionTreeClassifier(criterion="entropy",max_depth=20)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

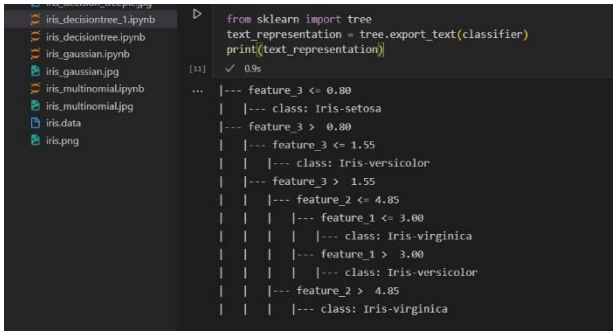
```
Confusion Matrix:
[[19  0  0]
 [ 0 19  2]
 [ 0  3 17]]
```

```
print(classification_report(y_test,y_pred))
```

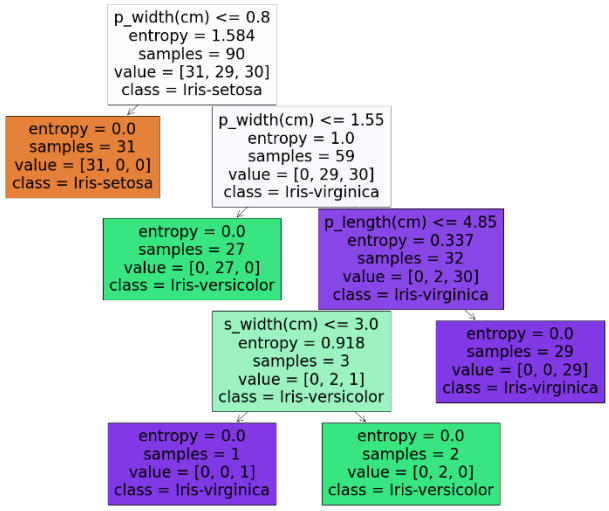
```
..                 precision    recall  f1-score   support

      Iris-setosa       1.00      1.00      1.00        19
  Iris-versicolor       0.86      0.90      0.88        21
   Iris-virginica       0.89      0.85      0.87        20

         accuracy                           0.92        60
        macro avg       0.92      0.92      0.92        60
     weighted avg       0.92      0.92      0.92        60
```




```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```




```
from sklearn.tree import plot_tree
fig=plt.figure(figsize=(25,20))
fig= plot_tree(classifier,
      feature_names = ["s_length(cm)", "s_width(cm)", "p_length(cm)", "p_width
(cm)"],
      class_names = ['Iris-setosa', 'Iris-versicolor', 'Iris-
virginica'], filled = True) #
plt.savefig("iris_1.png")
```



**********FOR DIABETES DATASET**********:

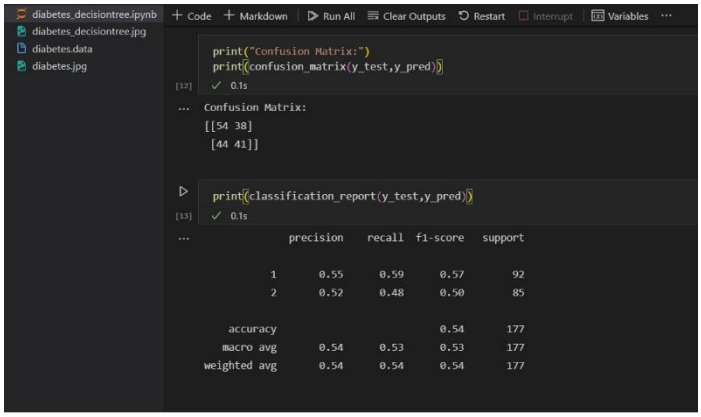
#Without Parameter tuning Decision Tree Classifier (by default Gini)

```
X=dataset.drop(['SEX','Y'],axis=1)
y=dataset['SEX']
X_train,X_test,y_train,y_test= train_test_split(X,y, test_size = 0.4)
from sklearn.tree import DecisionTreeClassifier
classifier = DecisionTreeClassifier()
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix

print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

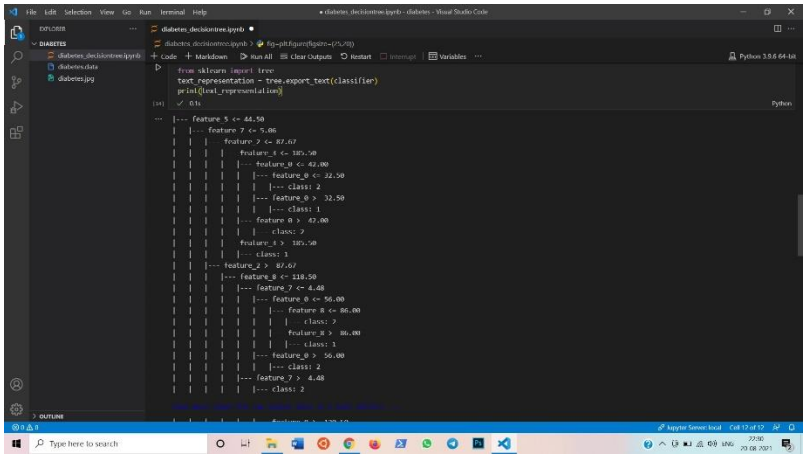
```
Confusion Matrix:
[[54 38]
 [44 41]]
```

```
print(classification_report(y_test,y_pred))
```

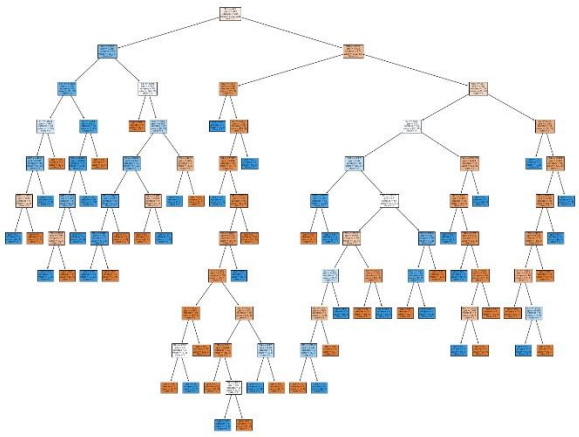
```
              precision    recall  f1-score   support

           1       0.55      0.59      0.57        92
           2       0.52      0.48      0.50        85

    accuracy                           0.54       177
   macro avg       0.54      0.53      0.53       177
weighted avg       0.54      0.54      0.54       177
```




```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```



```
fig=plt.figure(figsize=(25,20))
fig=tree.plot_tree(decision_tree=classifier,feature_names=dataset.columns,class_names=['1','2'],filled=True)
plt.savefig("diabetes.jpg")
```



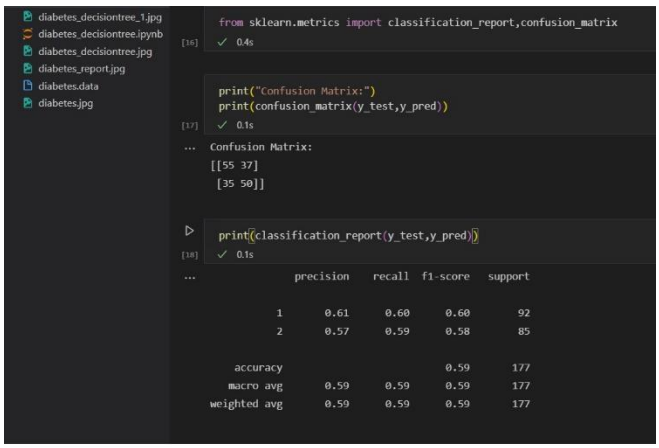
#With Parameter tuning Decision Tree Classifier (Entropy)

```
classifier = DecisionTreeClassifier(criterion="entropy",max_depth=10)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

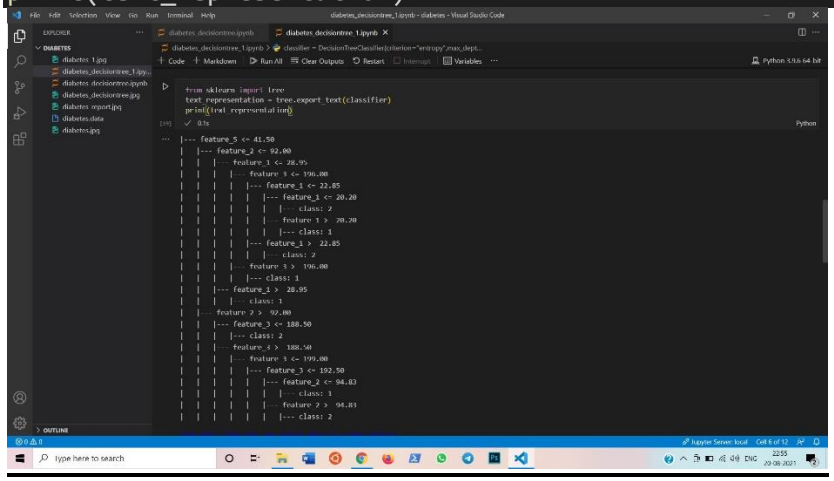
```
Confusion Matrix:
[[55 37]
 [35 50]]
```

```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           1       0.61      0.60      0.60        92
           2       0.57      0.59      0.58        85

    accuracy                           0.59       177
   macro avg       0.59      0.59      0.59       177
weighted avg       0.59      0.59      0.59       177
```

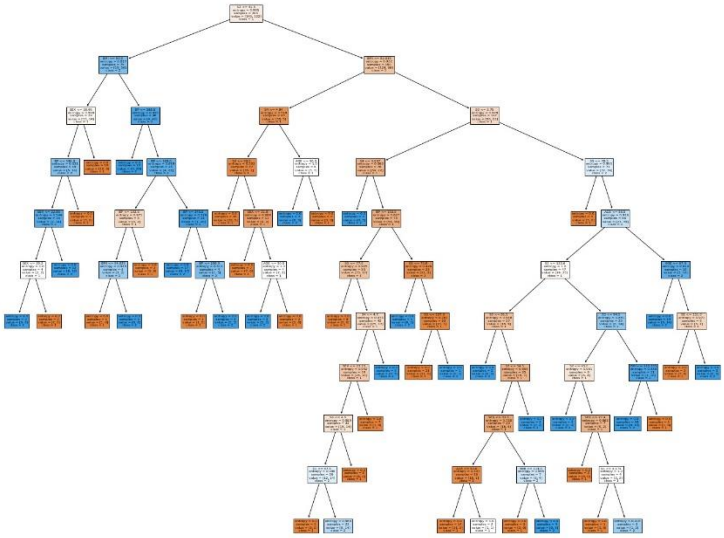



```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```



```
from sklearn.tree import plot_tree
fig=plt.figure(figsize=(25,20))
```

```
fig=tree.plot_tree(decision_tree=classifier,feature_names=dataset.columns,clas
s_names=['1','2'],filled=True)
plt.savefig("diabetes_1.jpg")
```



**********************FOR CANCER DATASET********************:**

```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn import datasets
os.chdir(r"C:\Users\ghosa\Projects\ML\ass1\cancer")
dataset= datasets.load_breast_cancer()
print(dataset.feature_names)
```

```
['mean radius' 'mean texture' 'mean perimeter' 'mean area'
 'mean smoothness' 'mean compactness' 'mean concavity'
 'mean concave points' 'mean symmetry' 'mean fractal dimension'
 'radius error' 'texture error' 'perimeter error' 'area error'
 'smoothness error' 'compactness error' 'concavity error'
 'concave points error' 'symmetry error' 'fractal dimension error'
 'worst radius' 'worst texture' 'worst perimeter' 'worst area'
 'worst smoothness' 'worst compactness' 'worst concavity'
 'worst concave points' 'worst symmetry' 'worst fractal dimension']
```

```
print(dataset.target_names)
```

```
['malignant' 'benign']
```

```
X=dataset.data
y=dataset.target
X_train,X_test,y_train,y_test= train_test_split(X,y, test_size = 0.4)
from sklearn.tree import DecisionTreeClassifier
```

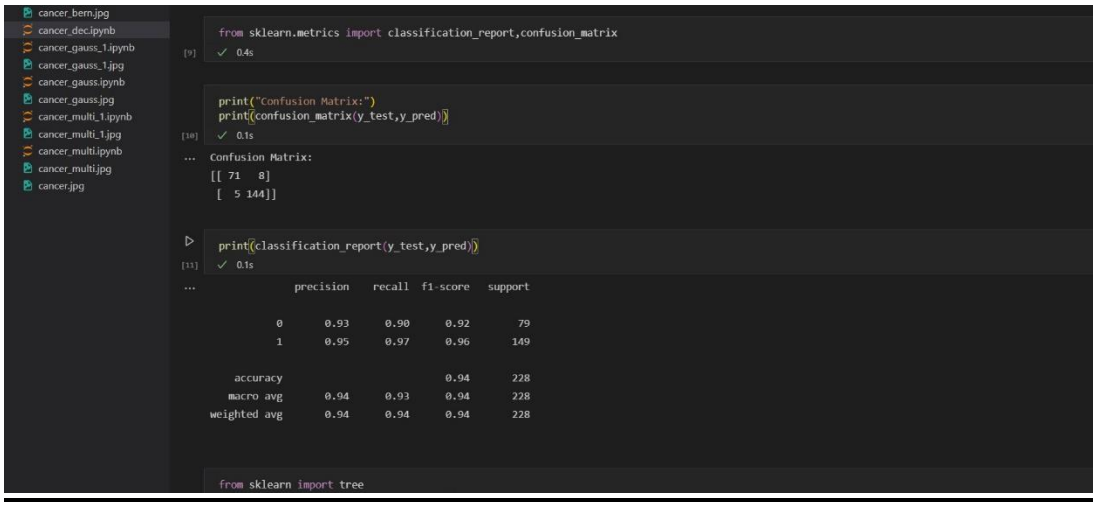
#Without Parameter tuning Decision Tree Classifier (by default Gini)

```
classifier = DecisionTreeClassifier()
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

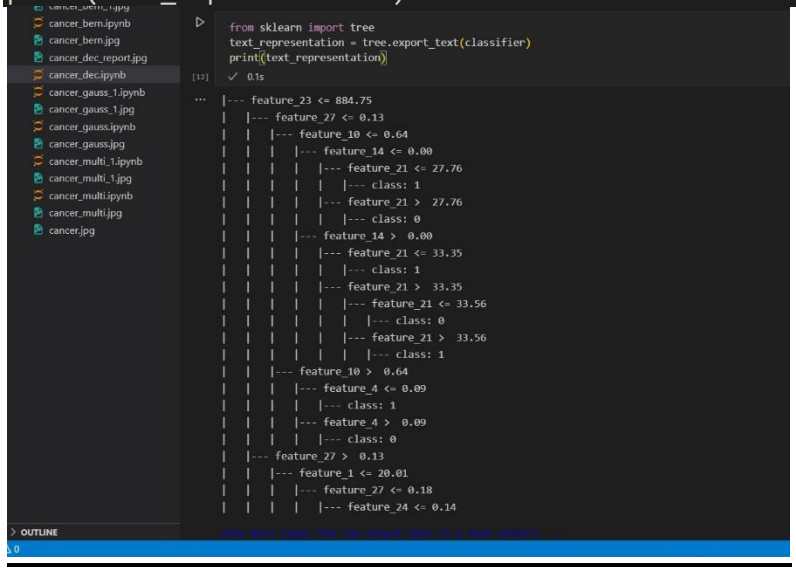
```
Confusion Matrix:
[[ 71   8]
 [  5 144]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
0	0.93	0.90	0.92	79
1	0.95	0.97	0.96	149
accuracy			0.94	228
macro avg	0.94	0.93	0.94	228
weighted avg	0.94	0.94	0.94	228

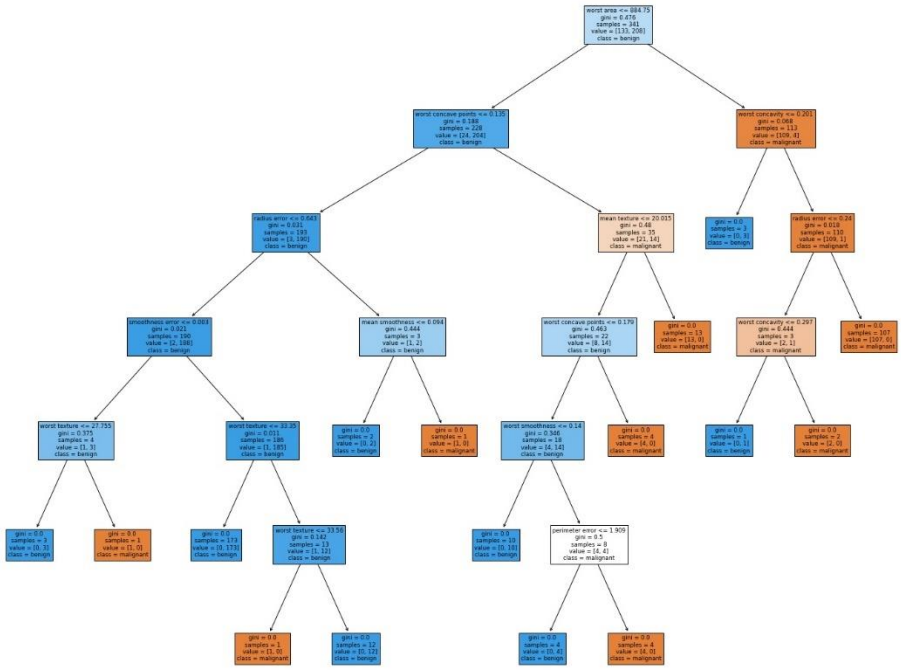



```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```




```
from sklearn.tree import plot_tree
```

```
fig=plt.figure(figsize=(25,20))
fig=tree.plot_tree(decision_tree=classifier,feature_names=dataset.feature_name
s,class_names=['malignant','benign'],filled=True)
plt.savefig("cancer.jpg")
```



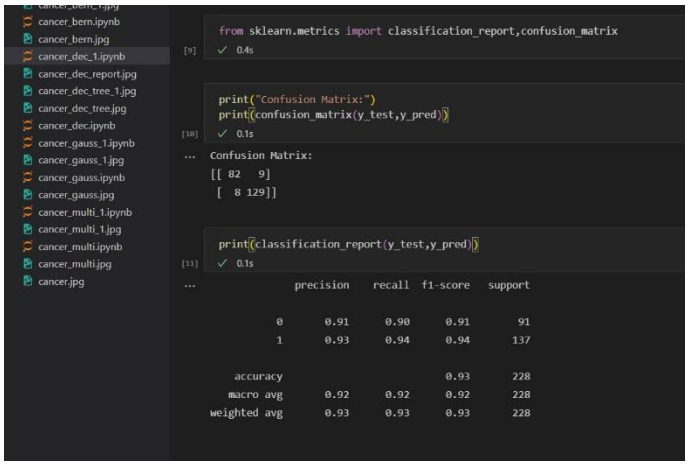
#With Parameter tuning Decision Tree Classifier (Entropy)

```
classifier = DecisionTreeClassifier(criterion="entropy",max_depth=10)
classifier.fit(X_train,y_train)
y_pred=classifier.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print("Confusion Matrix:")
print(confusion_matrix(y_test,y_pred))
```

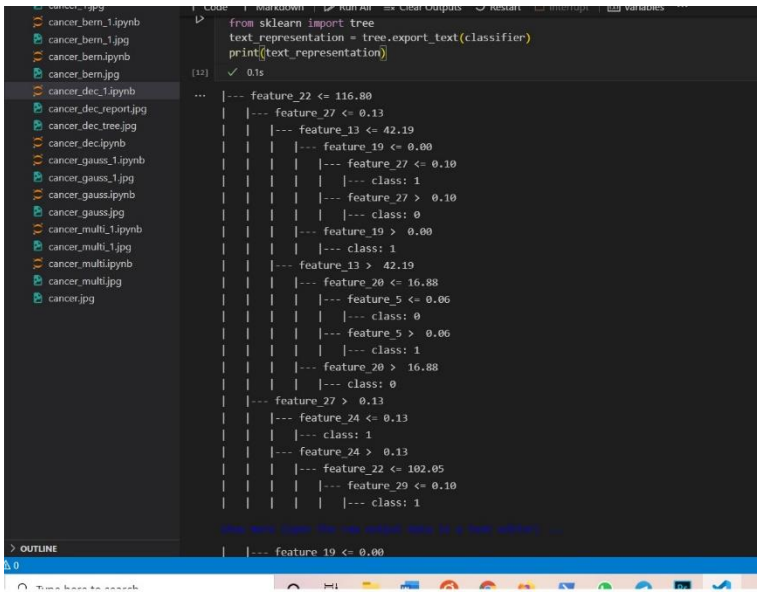
```
Confusion Matrix:
[[ 79   6]
 [  6 137]]
```

```
print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
0	0.93	0.93	0.93	85
1	0.96	0.96	0.96	143
accuracy			0.95	228
macro avg	0.94	0.94	0.94	228
weighted avg	0.95	0.95	0.95	228




```
from sklearn import tree
text_representation = tree.export_text(classifier)
print(text_representation)
```



```
from sklearn.tree import plot_tree
fig=plt.figure(figsize=(25,20))
fig=tree.plot_tree(decision_tree=classifier,feature_names=dataset.feature_name
s,class_names=['malignant','benign'],filled=True)
plt.savefig("cancer_1.jpg")
```