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```
from google.colab import drive
drive.mount('/content/drive')
%cd /content/drive/MyDrive/Artificial_Intelligence
/Theory_Assignments/AI_project

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

BP_DataSet = pd.read_csv('bodyPerformance.csv')

df = pd.DataFrame(BP_DataSet)

df = df.rename(columns={"body fat_%":"body_fat", "height_cm":"height",
"weight_kg":"weight",
                        "sit and bend forward_cm":"bend_forward",
"gripForce":"grip_force",
                        "sit-ups counts":"sit_ups", "broad
jump_cm":"broad_jump"})

df.head()
```

```
   age gender  height  weight  body_fat  diastolic  systolic
grip_force  \
0   27      M   172.3   75.24      21.3       80.0     130.0
54.9
1   25      M   165.0   55.80      15.7       77.0     126.0
36.4
2   31      M   179.6   78.00      20.1       92.0     152.0
44.8
3   32      M   174.5   71.10      18.4       76.0     147.0
41.4
4   28      M   173.8   67.70      17.1       70.0     127.0
43.5

   bend_forward  sit_ups  broad_jump class
0          18.4     60.0       217.0     C
1          16.3     53.0       229.0     A
2          12.0     49.0       181.0     C
3          15.2     53.0       219.0     B
4          27.1     45.0       217.0     B
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13393 entries, 0 to 13392
```

```
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   age           13393 non-null  int64
 1   gender        13393 non-null  object
 2   height        13393 non-null  float64
 3   weight        13393 non-null  float64
 4   body_fat      13393 non-null  float64
 5   diastolic     13393 non-null  float64
 6   systolic      13393 non-null  float64
 7   grip_force    13393 non-null  float64
 8   bend_forward  13393 non-null  float64
 9   sit_ups       13393 non-null  float64
 10  broad_jump    13393 non-null  float64
 11  class         13393 non-null  object
dtypes: float64(9), int64(1), object(2)
memory usage: 1.2+ MB
```

```
df.describe()
```

```
                age        height        weight      body_fat
diastolic  \
count  13393.000000  13393.000000  13393.000000  13393.000000
13393.000000
mean      36.775106    168.559807     67.447316     23.240165
78.796842
std       13.625639      8.426583     11.949666      7.256844
10.742033
min       21.000000    125.000000     26.300000      3.000000
0.000000
25%       25.000000    162.400000     58.200000     18.000000
71.000000
50%       32.000000    169.200000     67.400000     22.800000
79.000000
75%       48.000000    174.800000     75.300000     28.000000
86.000000
max       64.000000    193.800000    138.100000     78.400000
156.200000

           systolic    grip_force  bend_forward       sit_ups
broad_jump
count  13393.000000  13393.000000  13393.000000  13393.000000
13393.000000
mean     130.234817     36.963877     15.209268     39.771224
190.129627
std       14.713954     10.624864      8.456677     14.276698
39.868000
min        0.000000      0.000000    -25.000000      0.000000
0.000000
25%      120.000000     27.500000     10.900000     30.000000
```

```
162.000000
50%      130.000000     37.900000     16.200000     41.000000
193.000000
75%      141.000000     45.200000     20.700000     50.000000
221.000000
max      201.000000     70.500000    213.000000     80.000000
303.000000
```

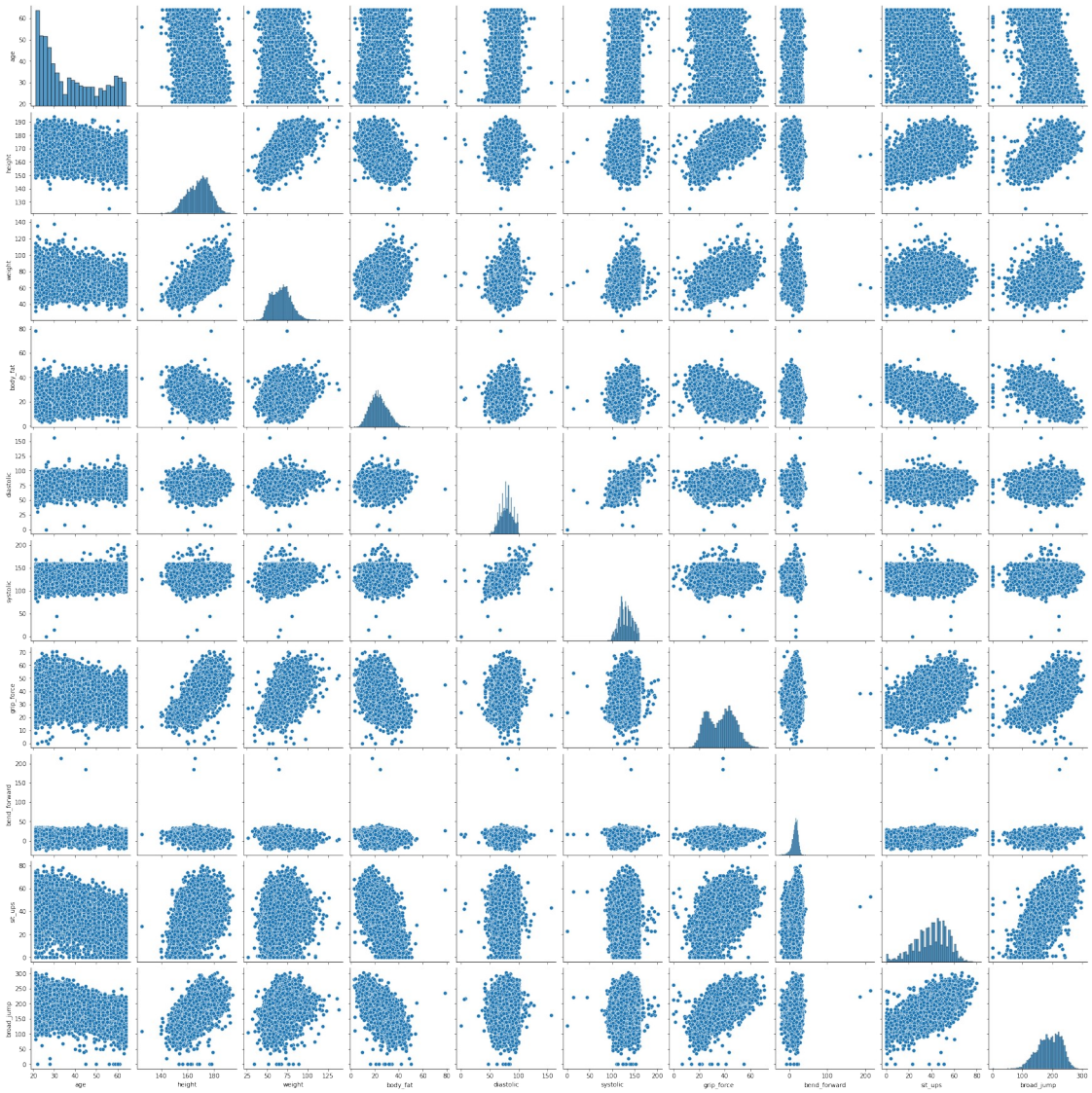
```
df.columns
```

```
Index(['age', 'gender', 'height', 'weight', 'body_fat', 'diastolic',
       'systolic', 'grip_force', 'bend_forward', 'sit_ups',
'broad_jump',
       'class'],
      dtype='object')
```

EDA

```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x2dc55b817c0>
```




```
df.corr('pearson')
```

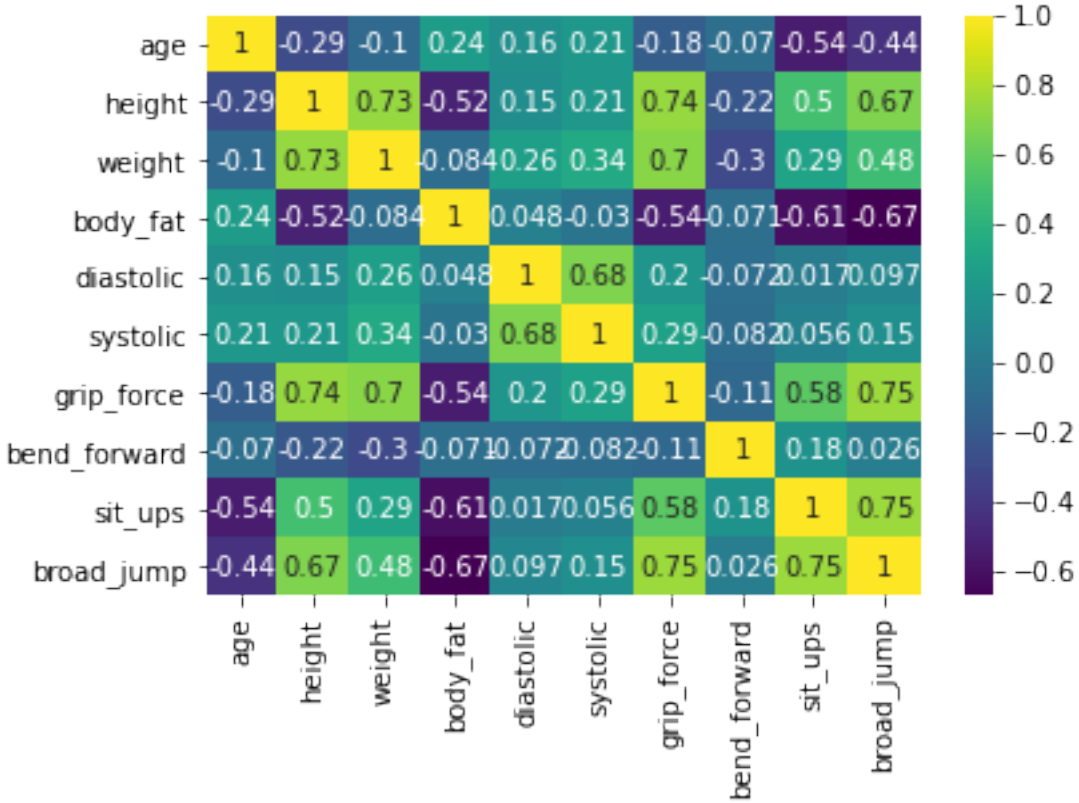
```
                    age    height    weight  body_fat  diastolic
systolic  \
age            1.000000 -0.293980 -0.099966  0.242302   0.158508
0.211167
height        -0.293980  1.000000  0.734909 -0.515440   0.145933
0.210186
weight        -0.099966  0.734909  1.000000 -0.084065   0.262317
0.338943
body_fat       0.242302 -0.515440 -0.084065  1.000000   0.048059 -
0.030376
diastolic      0.158508  0.145933  0.262317  0.048059   1.000000
0.676309
systolic       0.211167  0.210186  0.338943 -0.030376   0.676309
1.000000
grip_force    -0.179583  0.735024  0.700119 -0.541788   0.202062
```

```
0.286012
bend_forward -0.070033 -0.221970 -0.296249 -0.071225  -0.072098 -
0.082434
sit_ups      -0.544581  0.500424  0.294899 -0.608912   0.016547
0.056276
broad_jump   -0.435172  0.674589  0.479564 -0.673273   0.097243
0.152894
```

	grip_force	bend_forward	sit_ups	broad_jump
age	-0.179583	-0.070033	-0.544581	-0.435172
height	0.735024	-0.221970	0.500424	0.674589
weight	0.700119	-0.296249	0.294899	0.479564
body_fat	-0.541788	-0.071225	-0.608912	-0.673273
diastolic	0.202062	-0.072098	0.016547	0.097243
systolic	0.286012	-0.082434	0.056276	0.152894
grip_force	1.000000	-0.112577	0.576669	0.746853
bend_forward	-0.112577	1.000000	0.177153	0.026487
sit_ups	0.576669	0.177153	1.000000	0.748273
broad_jump	0.746853	0.026487	0.748273	1.000000

```
sns.heatmap(df.corr(),cmap='viridis',annot=True,fmt='0.2g')
```

```
<AxesSubplot:>
```



Data Preprocessing

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

```
age             0
gender          0
height          0
weight          0
body_fat        0
diastolic       0
systolic        0
grip_force      0
bend_forward    0
sit_ups         0
broad_jump      0
class           0
dtype: int64
```

```
df.dtypes
```

```
age               int64
gender           object
height          float64
weight          float64
body_fat        float64
diastolic       float64
systolic        float64
grip_force      float64
bend_forward    float64
sit_ups         float64
broad_jump      float64
class            object
dtype: object
```

```
# Now we transformed df['Gender'] column to numeric :

from sklearn.preprocessing import LabelEncoder
lab = LabelEncoder()
df['gender'] = lab.fit_transform(df['gender'])
df.head(20)
```

```
    age  gender  height  weight  body_fat  diastolic  systolic
grip_force  \
0    27       1   172.3   75.24      21.3       80.0     130.0
54.9
1    25       1   165.0   55.80      15.7       77.0     126.0
36.4
2    31       1   179.6   78.00      20.1       92.0     152.0
44.8
3    32       1   174.5   71.10      18.4       76.0     147.0
41.4
4    28       1   173.8   67.70      17.1       70.0     127.0
```

```
43.5
5    36       0   165.4   55.40      22.0       64.0     119.0
23.8
6    42       0   164.5   63.70      32.2       72.0     135.0
22.7
7    33       1   174.9   77.20      36.9       84.0     137.0
45.9
8    54       1   166.8   67.50      27.6       85.0     165.0
40.4
9    28       1   185.0   84.60      14.4       81.0     156.0
57.9
10   42       1   169.2   65.40      19.3       63.0     110.0
43.5
11   57       0   153.0   49.00      20.9       69.0     106.0
21.5
12   27       0   156.0   53.90      35.5       69.0     116.0
23.1
13   22       1   175.7   67.90      11.3       71.0     103.0
52.5
14   24       1   181.0   84.40      20.4       80.0     120.0
48.9
15   45       0   159.0   63.10      30.9       93.0     144.0
34.1
16   25       0   164.2   66.60      30.2       82.0     120.0
25.7
17   26       1   179.9   71.50       9.7       64.0     135.0
59.6
18   26       1   169.2   70.60      21.0       63.0     129.0
41.3
19   21       0   162.7   47.20      18.9       78.0     133.0
25.4

    bend_forward  sit_ups  broad_jump class
0           18.4     60.0       217.0     C
1           16.3     53.0       229.0     A
2           12.0     49.0       181.0     C
3           15.2     53.0       219.0     B
4           27.1     45.0       217.0     B
5           21.0     27.0       153.0     B
6            0.8     18.0       146.0     D
7           12.3     42.0       234.0     B
8           18.6     34.0       148.0     C
9           12.1     55.0       213.0     B
10          16.0     68.0       211.0     A
11          30.0      0.0        90.0     D
12          13.1     28.0       144.0     C
13          19.2     55.0       232.0     C
14           7.2     54.0       213.0     C
15          19.0     30.0       155.0     A
16          22.9     39.0       178.0     C
```

```
17          17.8     61.0       239.0     A
18          15.1     53.0       225.0     B
19          20.5     36.0       137.0     B
```

```
df.dtypes
```

```
age               int64
gender            int32
height          float64
weight          float64
body_fat        float64
diastolic       float64
systolic        float64
grip_force      float64
bend_forward    float64
sit_ups         float64
broad_jump      float64
class            object
dtype: object
```

Train Test Split

```
X = df.drop('class' , axis = 1)
y = df['class']
```

```
from sklearn.model_selection import train_test_split
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=101)
```

```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
```

```
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

```
X_train
```

```
array([[ 1.11873291,  0.76556148, -0.66479811, ...,  0.13884524,
         0.01048614,  0.34715724],
       [-0.27460791,  0.76556148,  1.30944595, ...,  0.13884524,
        -0.05946936,  1.32545692],
       [ 1.26540037, -1.30623082, -1.23224551, ..., -1.38834145,
        -1.66844605, -1.68469593],
       ...,
       [-0.71461027,  0.76556148, -0.10917254, ..., -0.29581559,
         1.19972978,  0.39732646],
       [-0.71461027, -1.30623082,  0.26912572, ...,  0.66748679,
         0.01048614, -0.58097322],
       [ 0.16539445,  0.76556148,  0.55284942, ...,  0.11535006,
         0.77999673,  1.12478006]])
```

```
X_test
```

```
array([[-0.93461146,  0.76556148,  1.59316964, ...,  1.56030363,
         0.77999673,  1.37562613],
       [ 0.67873055, -1.30623082, -0.16828164, ..., -0.08435897,
        -0.4092469 , -0.68131165],
       [-0.42127536,  0.76556148,  0.23366026, ..., -0.26057282,
        -0.3392914 , -0.1545349 ],
       ...,
       [ 1.33873409,  0.76556148, -0.64115447, ..., -0.27232041,
        -0.61911343, -0.43046558],
       [-0.86127773,  0.76556148,  1.81778424, ...,  0.62049643,
         0.36026368,  0.32207264],
       [ 0.75206427,  0.76556148,  2.08968611, ..., -1.50581735,
        -0.54915792,  0.34715724]])
```

Logistic Regression

```
from sklearn.linear_model import LogisticRegressionCV
log_model = LogisticRegressionCV()
log_model.fit(X_train , y_train)
```

```
LogisticRegressionCV()
```

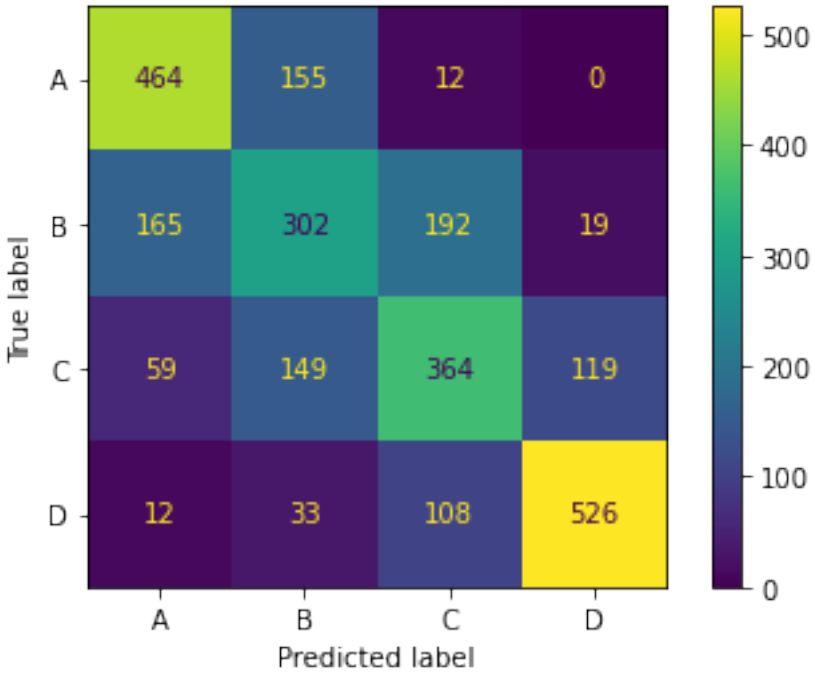
```
# Now model fit on training data , and now will predict data that has
never seen before :
```

```
y_pred = log_model.predict(X_test)
```

```
# Now we are going to evaluate the model :
from sklearn.metrics import accuracy_score ,
plot_confusion_matrix,roc_curve,auc
```

```
plot_confusion_matrix(log_model ,X_test ,y_test)
```

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x223a6b86fa0>
```




```
from sklearn.metrics import
classification_report,confusion_matrix,accuracy_score
y_pred = log_model.predict(X_test)
print("Model Accuracy is {:.2f}%\
n".format(accuracy_score(y_test,y_pred)*100))
print("Classification of report of Model is:\
n{}".format(classification_report(y_test,y_pred)))
```

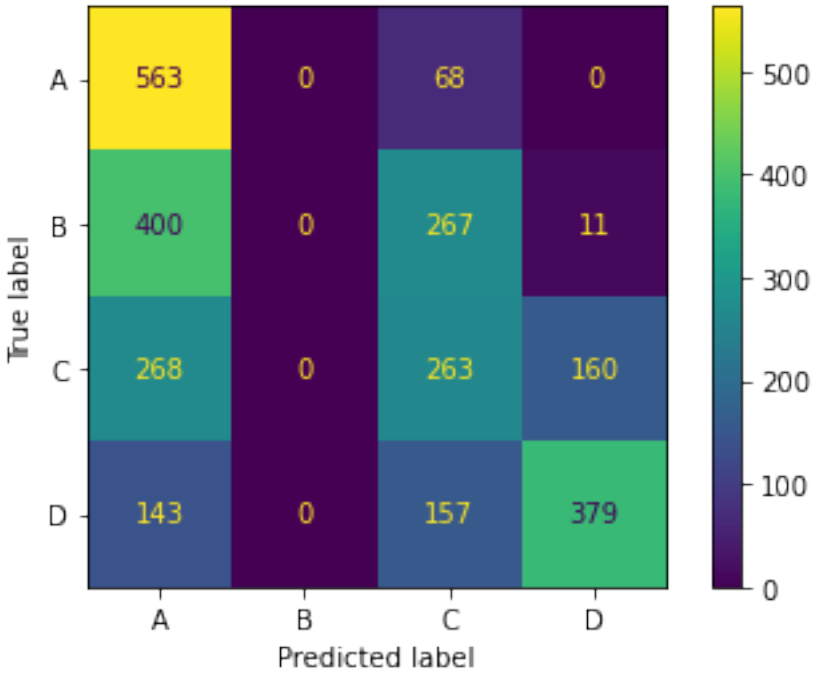
```
Model Accuracy is 61.81%

Classification of report of Model is:
              precision    recall  f1-score   support

           A       0.66      0.74      0.70       631
           B       0.47      0.45      0.46       678
           C       0.54      0.53      0.53       691
           D       0.79      0.77      0.78       679

    accuracy                           0.62      2679
   macro avg       0.62      0.62      0.62      2679
weighted avg       0.62      0.62      0.62      2679
```

Decision Tree

```
from sklearn.tree import DecisionTreeClassifier
dtc =
```

```
DecisionTreeClassifier(criterion="gini",max_leaf_nodes=3,random_state=
42)

dtc

DecisionTreeClassifier(max_leaf_nodes=3, random_state=42)

dtc.fit(X_train,y_train)

DecisionTreeClassifier(max_leaf_nodes=3, random_state=42)

from sklearn.metrics import
classification_report,confusion_matrix,accuracy_score
y_pred = dtc.predict(X_test)
print("Model Accuracy is {:.2f}%\
n".format(accuracy_score(y_test,y_pred)*100))
print("Classification of report of Model is:\
n{}".format(classification_report(y_test,y_pred)))

Model Accuracy is 44.98%

Classification of report of Model is:
              precision    recall  f1-score   support

           A       0.41      0.89      0.56       631
           B       0.00      0.00      0.00       678
           C       0.35      0.38      0.36       691
           D       0.69      0.56      0.62       679

    accuracy                           0.45      2679
   macro avg       0.36      0.46      0.39      2679
weighted avg       0.36      0.45      0.38      2679


C:\Users\zaina\anaconda3\lib\site-packages\sklearn\metrics\
_classification.py:1245: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\zaina\anaconda3\lib\site-packages\sklearn\metrics\
_classification.py:1245: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\zaina\anaconda3\lib\site-packages\sklearn\metrics\
_classification.py:1245: UndefinedMetricWarning: Precision and F-score
are ill-defined and being set to 0.0 in labels with no predicted
samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))

plot_confusion_matrix(dtc ,X_test ,y_test)
```

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x223a1ed59a0>
```



Random Forest Classifier

```
from sklearn.ensemble import RandomForestClassifier

rfc = RandomForestClassifier(random_state=0)

rfc.fit(X_train, y_train)

RandomForestClassifier(random_state=0)

y_pred = rfc.predict(X_test)

from sklearn.metrics import
classification_report,confusion_matrix,accuracy_score
print("Model Accuracy is {:.2f}%\
n".format(accuracy_score(y_test,y_pred)*100))
print("Classification of report of Model is:\
n{}".format(classification_report(y_test,y_pred)))

Model Accuracy is 74.17%

Classification of report of Model is:
              precision    recall  f1-score   support

           A       0.70      0.88      0.78       631
           B       0.65      0.59      0.62       678
           C       0.72      0.69      0.70       691
```

```
           D       0.91      0.82      0.86       679

    accuracy                           0.74      2679
   macro avg       0.74      0.74      0.74      2679
weighted avg       0.75      0.74      0.74      2679
```

SVM

```
from sklearn.svm import SVC
SVM = SVC(kernel = 'linear',gamma ='auto',class_weight='balanced')

SVM.fit(X_train,y_train)

SVC(class_weight='balanced', gamma='auto', kernel='linear')

y_pred = SVM.predict(X_test)
y_pred[0:5]

array(['A', 'C', 'C', 'C', 'B'], dtype=object)

from sklearn.metrics import
classification_report,confusion_matrix,accuracy_score
print("Model Accuracy is {:.2f}%\
n".format(accuracy_score(y_test,y_pred)*100))
print("Classification of report of Model is:\
n{}".format(classification_report(y_test,y_pred)))

Model Accuracy is 62.71%

Classification of report of Model is:
              precision    recall  f1-score   support

           A       0.65      0.76      0.70       631
           B       0.49      0.50      0.50       678
           C       0.56      0.52      0.54       691
           D       0.81      0.74      0.78       679

    accuracy                           0.63      2679
   macro avg       0.63      0.63      0.63      2679
weighted avg       0.63      0.63      0.63      2679
```

GridSearch CV to optimize hyperparameters

```
from sklearn.model_selection import GridSearchCV
#Parameter tuning with GridSearchCV

#######################
### Support Vector Machines
```

```
######################

estimator_SVM = SVC(gamma='scale',class_weight='balanced')
parameters_SVM = {
    'C': (0.1, 15.0, 1),
    'kernel': ('linear', 'poly', 'rbf', 'sigmoid'),
    'coef0': (0.0, 10.0, 1.0),
    'shrinking': (True, False),
                  }

# with GridSearch
grid_search_SVM = GridSearchCV(
    estimator=estimator_SVM,
    param_grid=parameters_SVM,
    scoring = 'accuracy',
    n_jobs = -1,
    cv = 5
)

grid_search_SVM.fit(X_train,y_train)
```

```
GridSearchCV(cv=5, estimator=SVC(class_weight='balanced'), n_jobs=-1,
             param_grid={'C': (0.1, 15.0, 1), 'coef0': (0.0, 10.0,
1.0),
                         'kernel': ('linear', 'poly', 'rbf',
'sigmoid'),
                         'shrinking': (True, False)},
             scoring='accuracy')
```

```
grid_search_SVM.best_params_
```

```
{'C': 1, 'coef0': 10.0, 'kernel': 'poly', 'shrinking': True}
```

```
grid_search_SVM.best_score_
```

```
0.7095466666666667
```

```
y_pred_SVM_GS = grid_search_SVM.predict(X_test)
```

```
print('BEST SVM')
print('Accuracy Score - SVM:', accuracy_score(y_test, y_pred_SVM_GS))
```

```
BEST SVM
Accuracy Score - SVM: 0.7162767546042808
```

K-Nearest Neighbor Classifier

```
from sklearn.neighbors import KNeighborsClassifier

KNN =
KNeighborsClassifier(n_neighbors=3,metric='minkowski',weights='uniform
')
```

```
KNN.fit(X_train,y_train)
y_pred = KNN.predict(X_test)
y_pred[:5]
```

```
array(['B', 'B', 'D', 'A', 'C'], dtype=object)
```

```
print("Model Accuracy is {:.2f}%\
n".format(accuracy_score(y_test,y_pred)*100))
print("Classification of report of Model is:\
n{}".format(classification_report(y_test,y_pred)))
```

```
Model Accuracy is 57.19%

Classification of report of Model is:
              precision    recall  f1-score   support

           A       0.54      0.82      0.65       631
           B       0.40      0.38      0.39       678
           C       0.55      0.45      0.50       691
           D       0.89      0.65      0.75       679

    accuracy                           0.57      2679
   macro avg       0.59      0.58      0.57      2679
weighted avg       0.59      0.57      0.57      2679
```

GridSearch CV to optimize hyperparameters

```
#Parameter tuning with GridSearchCV

########################
### K-Nearest Neighbors
########################
estimator_KNN = KNeighborsClassifier(algorithm='auto')
parameters_KNN = {
    'n_neighbors': (1,3,5,10),
    'leaf_size': (20,30,40),
    'p': (1,2),
    'weights': ('uniform', 'distance'),
    'metric': ('minkowski', 'chebyshev'),
       }
# with GridSearch
grid_search_KNN = GridSearchCV(
    estimator=estimator_KNN,
    param_grid=parameters_KNN,
    scoring = 'accuracy',
    n_jobs = -1,
    cv = 5
)
```

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

```
GridSearchCV(cv=5, estimator=KNeighborsClassifier(), n_jobs=-1,
             param_grid={'leaf_size': (20, 30, 40),
                         'metric': ('minkowski', 'chebyshev'),
                         'n_neighbors': (1, 3, 5, 10), 'p': (1, 2),
                         'weights': ('uniform', 'distance')},
             scoring='accuracy')
```

```
y_pred_KNN_GS = grid_search_KNN.predict(X_test)
```

```
grid_search_KNN.best_score_
```

```
0.621895228771241
```

```
print('BEST KNN')
print('Accuracy Score - KNN:', accuracy_score(y_test, y_pred_KNN_GS))
```

```
BEST KNN
Accuracy Score - KNN: 0.6323254945875326
```

Grid Search with Logistic Regression

```
# Grid search cross validation
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import LogisticRegression

grid={"C":np.logspace(-3,3,7), "penalty":["l1","l2"]}# l1 lasso l2
ridge

logreg=LogisticRegression()
logreg_cv=GridSearchCV(logreg,grid,cv=10)

logreg_cv.fit(X_train,y_train)
```

```
C:\Users\zaina\anaconda3\lib\site-packages\sklearn\model_selection\
_validation.py:610: FitFailedWarning: Estimator fit failed. The score
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  File "C:\Users\zaina\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 593, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\zaina\anaconda3\lib\site-packages\sklearn\
linear_model\_logistic.py", line 1306, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
  File "C:\Users\zaina\anaconda3\lib\site-packages\sklearn\
linear_model\_logistic.py", line 443, in _check_solver
    raise ValueError("Solver %s supports only 'l2' or 'none'
penalties, "
ValueError: Solver lbfgs supports only 'l2' or 'none' penalties, got
l1 penalty.

  warnings.warn("Estimator fit failed. The score on this train-test"

C:\Users\zaina\anaconda3\lib\site-packages\sklearn\model_selection\
_search.py:918: UserWarning: One or more of the test scores are non-
finite: [       nan 0.57438987        nan 0.61200449        nan
0.61881959
        nan 0.61937973        nan 0.61975304        nan 0.61975304
        nan 0.61975304]
  warnings.warn(
```

```
GridSearchCV(cv=10, estimator=LogisticRegression(),
             param_grid={'C': array([1.e-03, 1.e-02, 1.e-01, 1.e+00,
1.e+01, 1.e+02, 1.e+03]),
                         'penalty': ['l1', 'l2']})
```

```
print("tuned hpyerparameters :(best parameters)
",logreg_cv.best_params_)
print("accuracy :",logreg_cv.best_score_)
```

```
tuned hpyerparameters :(best parameters)  {'C': 10.0, 'penalty': 'l2'}
accuracy : 0.6197530380311328
```

GridSearchCV using Decision Tree

```
param_grid = {'max_features': ['auto', 'sqrt', 'log2'],
              'ccp_alpha': [0.1, .01, .001],
              'max_depth' : [5, 6, 7, 8, 9],
              'criterion' :['gini', 'entropy']
             }
```

```
tree_clas = DecisionTreeClassifier(random_state=1024)
grid_search = GridSearchCV(estimator=tree_clas, param_grid=param_grid,
cv=5, verbose=True)

grid_search.fit(X_train, y_train)
```

```
Fitting 5 folds for each of 90 candidates, totalling 450 fits

GridSearchCV(cv=5,
estimator=DecisionTreeClassifier(random_state=1024),
             param_grid={'ccp_alpha': [0.1, 0.01, 0.001],
                         'criterion': ['gini', 'entropy'],
                         'max_depth': [5, 6, 7, 8, 9],
                         'max_features': ['auto', 'sqrt', 'log2']},
             verbose=True)
```

```
print("tuned hpyerparameters :(best parameters)
",grid_search .best_params_)
print("accuracy :",grid_search .best_score_)
```

```
tuned hpyerparameters :(best parameters)  {'ccp_alpha': 0.001,
'criterion': 'entropy', 'max_depth': 9, 'max_features': 'auto'}
accuracy : 0.6157377743444554
```

GridSearchCV using Random Forest

```
rfc=RandomForestClassifier(random_state=42)

param_grid = {
    'n_estimators': [200, 500],
    'max_features': ['auto', 'sqrt', 'log2'],
    'max_depth' : [4,5,6,7,8],
    'criterion' :['gini', 'entropy']
}

CV_rfc = GridSearchCV(estimator=rfc, param_grid=param_grid, cv= 5)
CV_rfc.fit(X_train, y_train)
```

```
GridSearchCV(cv=5, estimator=RandomForestClassifier(random_state=42),
             param_grid={'criterion': ['gini', 'entropy'],
                         'max_depth': [4, 5, 6, 7, 8],
                         'max_features': ['auto', 'sqrt', 'log2'],
                         'n_estimators': [200, 500]})

CV_rfc.best_params_

{'criterion': 'entropy',
 'max_depth': 8,
 'max_features': 'auto',
 'n_estimators': 500}
```

```
rfc1=RandomForestClassifier(random_state=42, max_features='auto',
n_estimators= 200, max_depth=8, criterion='gini')

rfc1.fit(X_train, y_train)

RandomForestClassifier(max_depth=8, n_estimators=200, random_state=42)

pred=rfc1.predict(X_test)

print("Accuracy for Random Forest on CV data:
",accuracy_score(y_test,pred))

Accuracy for Random Forest on CV data:  0.7006345651362449
```