Diabetes Prediction

```
#Let's start with importing necessary libraries
import pandas as pd
import numpy as np
from sklearn.preprocessing import StandardScaler
#from sklearn.linear_model  import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC
from sklearn.naive_bayes import BernoulliNB
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, confusion_matrix
import matplotlib.pyplot as plt
import seaborn as sns

#read the data file
data = pd.read_csv("/config/workspace/Dataset/diabetes.csv")
data.head()
```

```
   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
```

```
data.describe()
```

```
       Pregnancies     Glucose  BloodPressure  SkinThickness
Insulin
count   768.000000  768.000000     768.000000     768.000000
768.000000  \
mean      3.845052  120.894531      69.105469      20.536458
79.799479
std       3.369578   31.972618      19.355807      15.952218
115.244002
min       0.000000    0.000000       0.000000       0.000000
```

```
0.000000
25%       1.000000   99.000000      62.000000       0.000000
0.000000
50%       3.000000  117.000000      72.000000      23.000000
30.500000
75%       6.000000  140.250000      80.000000      32.000000
127.250000
max      17.000000  199.000000     122.000000      99.000000
846.000000
```

```
              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    31.992578                  0.471876   33.240885    0.348958
std      7.884160                  0.331329   11.760232    0.476951
min      0.000000                  0.078000   21.000000    0.000000
25%     27.300000                  0.243750   24.000000    0.000000
50%     32.000000                  0.372500   29.000000    0.000000
75%     36.600000                  0.626250   41.000000    1.000000
max     67.100000                  2.420000   81.000000    1.000000
```

```
data.isnull().sum()
```

```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

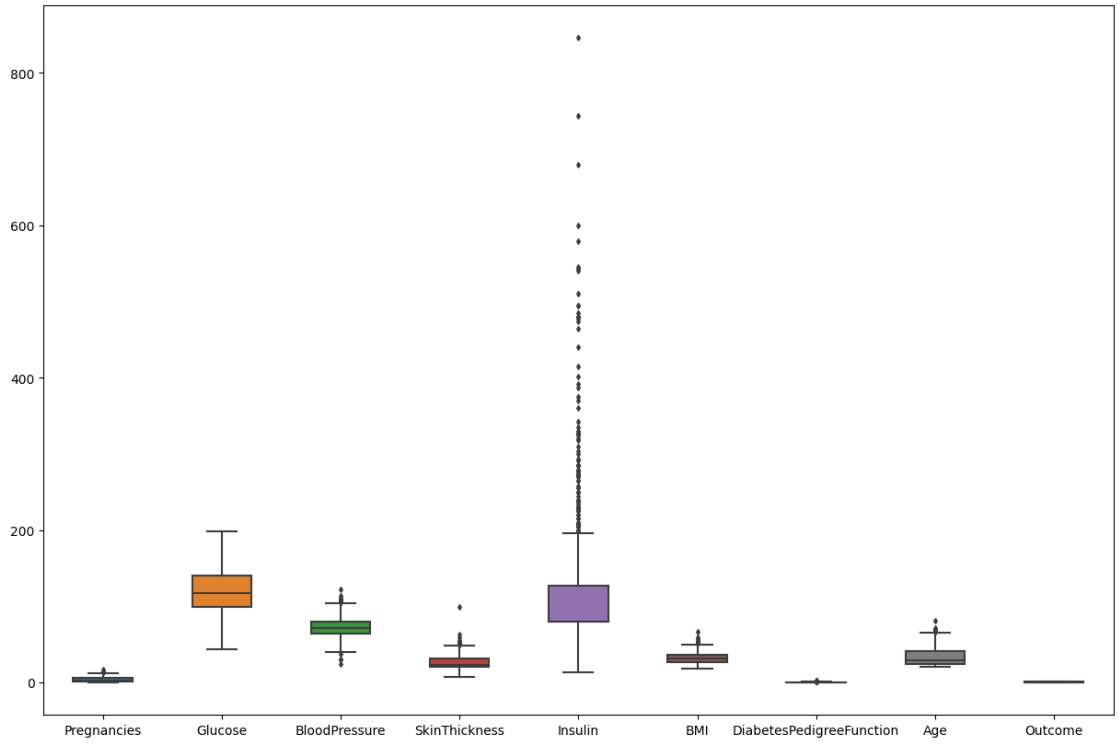
We can see there few data for columns Glucose , Insulin, skin thickenss, BMI and Blood Pressure which have value as 0. That's not possible,right? you can do a quick search to see that one cannot have 0 values for these. Let's deal with that. we can either remove such data or simply replace it with their respective mean values. Let's do the latter.

```
#here few misconception is there lke BMI can not be zero, BP can't be
zero, glucose, insuline can't be zero so lets try to fix it
# now replacing zero values with the mean of the column
data['BMI'] = data['BMI'].replace(0,data['BMI'].mean())
data['BloodPressure'] =
data['BloodPressure'].replace(0,data['BloodPressure'].mean())
data['Glucose'] = data['Glucose'].replace(0,data['Glucose'].mean())
data['Insulin'] = data['Insulin'].replace(0,data['Insulin'].mean())
data['SkinThickness'] =
data['SkinThickness'].replace(0,data['SkinThickness'].mean())


data.describe()
```

```
       Pregnancies     Glucose  BloodPressure  SkinThickness
Insulin
count   768.000000  768.000000     768.000000     768.000000
768.000000  \
mean      3.845052  121.681605      72.254807      26.606479
118.660163
std       3.369578   30.436016      12.115932       9.631241
93.080358
min       0.000000   44.000000      24.000000       7.000000
14.000000
25%       1.000000   99.750000      64.000000      20.536458
79.799479
50%       3.000000  117.000000      72.000000      23.000000
79.799479
75%       6.000000  140.250000      80.000000      32.000000
127.250000
max      17.000000  199.000000     122.000000      99.000000
846.000000

              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    32.450805                  0.471876   33.240885    0.348958
std      6.875374                  0.331329   11.760232    0.476951
min     18.200000                  0.078000   21.000000    0.000000
25%     27.500000                  0.243750   24.000000    0.000000
50%     32.000000                  0.372500   29.000000    0.000000
75%     36.600000                  0.626250   41.000000    1.000000
max     67.100000                  2.420000   81.000000    1.000000
```

```
#now we have dealt with the 0 values and data looks better. But, there
still are outliers present in some columns.lets visualize it
fig, ax = plt.subplots(figsize=(15,10))
sns.boxplot(data=data, width= 0.5,ax=ax,  fliersize=3)
```

```
<Axes: >
```




```
data.head()
```

```
   Pregnancies  Glucose  BloodPressure  SkinThickness     Insulin
BMI
0            6    148.0           72.0      35.000000   79.799479
33.6  \
1            1     85.0           66.0      29.000000   79.799479
26.6
2            8    183.0           64.0      20.536458   79.799479
23.3
3            1     89.0           66.0      23.000000   94.000000
28.1
4            0    137.0           40.0      35.000000  168.000000
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
```

```
#segregate the dependent and independent variable
X = data.drop(columns = ['Outcome'])
y = data['Outcome']

# separate dataset into train and test
X_train, X_test, y_train, y_test =
```

```
train_test_split(X,y,test_size=0.25,random_state=0)
X_train.shape, X_test.shape
```

```
((576, 8), (192, 8))
```

```
import pickle
##standard Scaling- Standardization
def scaler_standard(X_train, X_test):
    #scaling the data
    scaler = StandardScaler()
    X_train_scaled = scaler.fit_transform(X_train)
    X_test_scaled = scaler.transform(X_test)

    #saving the model
    file = open('/config/workspace/Model/standardScalar.pkl','wb')
    pickle.dump(scaler,file)
    file.close()

    return X_train_scaled, X_test_scaled

X_train_scaled, X_test_scaled = scaler_standard(X_train, X_test)
```

```
X_train_scaled
```

```
array([[ 1.50755225, -1.09947934, -0.89942504, ..., -1.45561965,
        -0.98325882, -0.04863985],
       [-0.82986389, -0.1331471 , -1.23618124, ...,  0.09272955,
        -0.62493647, -0.88246592],
       [-1.12204091, -1.03283573,  0.61597784, ..., -0.03629955,
         0.39884168, -0.5489355 ],
       ...,
       [ 0.04666716, -0.93287033, -0.64685789, ..., -1.14021518,
        -0.96519215, -1.04923114],
       [ 2.09190629, -1.23276654,  0.11084355, ..., -0.36604058,
        -0.5075031 ,  0.11812536],
       [ 0.33884418,  0.46664532,  0.78435594, ..., -0.09470985,
         0.51627505,  2.953134  ]])
```

```
## Decision Tree Model Training With Hyperparameter Tuning
import warnings
warnings.filterwarnings('ignore')
```

```
parameter={
 'criterion':['gini','entropy','log_loss'],
  'splitter':['best','random'],
  'max_depth':[1,2,3,4,5],
  'max_features':['auto', 'sqrt', 'log2']

}
```

```
from sklearn.model_selection import GridSearchCV
classifier=DecisionTreeClassifier()
```

```
clf=GridSearchCV(classifier,param_grid=parameter,cv=3,scoring='accurac
y',verbose=3)
clf.fit(X_train,y_train)
```

```
Fitting 3 folds for each of 90 candidates, totalling 270 fits
[CV 1/3] END criterion=gini, max_depth=1, max_features=auto,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=1, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=1, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=1, max_features=auto,
splitter=random;, score=0.750 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=1, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=1, max_features=auto,
splitter=random;, score=0.620 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=1, max_features=sqrt,
splitter=best;, score=0.667 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=1, max_features=sqrt,
splitter=best;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=1, max_features=sqrt,
splitter=best;, score=0.667 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=1, max_features=sqrt,
splitter=random;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=1, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=1, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=1, max_features=log2,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=1, max_features=log2,
splitter=best;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=1, max_features=log2,
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=1, max_features=log2,
splitter=random;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=1, max_features=log2,
splitter=random;, score=0.672 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=1, max_features=log2,
splitter=random;, score=0.651 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=2, max_features=auto,
splitter=best;, score=0.724 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=2, max_features=auto,
splitter=best;, score=0.573 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=auto,
splitter=best;, score=0.656 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=2, max_features=auto,
splitter=random;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=2, max_features=auto,
```

```
splitter=random;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=2, max_features=sqrt,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=2, max_features=sqrt,
splitter=best;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=sqrt,
splitter=best;, score=0.682 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=2, max_features=sqrt,
splitter=random;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=2, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=sqrt,
splitter=random;, score=0.635 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=2, max_features=log2,
splitter=best;, score=0.651 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=2, max_features=log2,
splitter=best;, score=0.661 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=log2,
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=2, max_features=log2,
splitter=random;, score=0.641 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=2, max_features=log2,
splitter=random;, score=0.594 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=log2,
splitter=random;, score=0.635 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=3, max_features=auto,
splitter=best;, score=0.672 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=3, max_features=auto,
splitter=best;, score=0.719 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=3, max_features=auto,
splitter=best;, score=0.677 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=3, max_features=auto,
splitter=random;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=3, max_features=auto,
splitter=random;, score=0.630 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=3, max_features=auto,
splitter=random;, score=0.719 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=3, max_features=sqrt,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=3, max_features=sqrt,
splitter=best;, score=0.615 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=3, max_features=sqrt,
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=3, max_features=sqrt,
splitter=random;, score=0.625 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=3, max_features=sqrt,
splitter=random;, score=0.724 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=3, max_features=sqrt,
```

```
splitter=random;, score=0.724 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=3, max_features=log2,
splitter=best;, score=0.729 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=3, max_features=log2,
splitter=best;, score=0.719 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=3, max_features=log2,
splitter=best;, score=0.667 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=3, max_features=log2,
splitter=random;, score=0.672 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=3, max_features=log2,
splitter=random;, score=0.740 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=3, max_features=log2,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=4, max_features=auto,
splitter=best;, score=0.745 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=4, max_features=auto,
splitter=best;, score=0.708 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=4, max_features=auto,
splitter=best;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=4, max_features=auto,
splitter=random;, score=0.635 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=4, max_features=auto,
splitter=random;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=4, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=4, max_features=sqrt,
splitter=best;, score=0.719 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=4, max_features=sqrt,
splitter=best;, score=0.745 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=4, max_features=sqrt,
splitter=best;, score=0.693 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=4, max_features=sqrt,
splitter=random;, score=0.656 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=4, max_features=sqrt,
splitter=random;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=4, max_features=sqrt,
splitter=random;, score=0.661 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=4, max_features=log2,
splitter=best;, score=0.703 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=4, max_features=log2,
splitter=best;, score=0.651 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=4, max_features=log2,
splitter=best;, score=0.672 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=4, max_features=log2,
splitter=random;, score=0.750 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=4, max_features=log2,
splitter=random;, score=0.724 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=4, max_features=log2,
splitter=random;, score=0.656 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=5, max_features=auto,
```

```
splitter=best;, score=0.734 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=5, max_features=auto,
splitter=best;, score=0.781 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=5, max_features=auto,
splitter=best;, score=0.682 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=5, max_features=auto,
splitter=random;, score=0.688 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=5, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=5, max_features=auto,
splitter=random;, score=0.714 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=5, max_features=sqrt,
splitter=best;, score=0.641 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=5, max_features=sqrt,
splitter=best;, score=0.724 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=5, max_features=sqrt,
splitter=best;, score=0.729 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=5, max_features=sqrt,
splitter=random;, score=0.677 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=5, max_features=sqrt,
splitter=random;, score=0.682 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=5, max_features=sqrt,
splitter=random;, score=0.672 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=5, max_features=log2,
splitter=best;, score=0.771 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=5, max_features=log2,
splitter=best;, score=0.719 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=5, max_features=log2,
splitter=best;, score=0.703 total time=   0.0s
[CV 1/3] END criterion=gini, max_depth=5, max_features=log2,
splitter=random;, score=0.667 total time=   0.0s
[CV 2/3] END criterion=gini, max_depth=5, max_features=log2,
splitter=random;, score=0.729 total time=   0.0s
[CV 3/3] END criterion=gini, max_depth=5, max_features=log2,
splitter=random;, score=0.677 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=1, max_features=auto,
splitter=best;, score=0.635 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=1, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=1, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=1, max_features=auto,
splitter=random;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=1, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=1, max_features=auto,
splitter=random;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=1, max_features=sqrt,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=1, max_features=sqrt,
```

splitter=best;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=1, max_features=sqrt,
splitter=best;, score=0.667 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=1, max_features=sqrt,
splitter=random;, score=0.667 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=1, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=1, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=1, max_features=log2,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=1, max_features=log2,
splitter=best;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=1, max_features=log2,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=1, max_features=log2,
splitter=random;, score=0.682 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=1, max_features=log2,
splitter=random;, score=0.766 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=1, max_features=log2,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=2, max_features=auto,
splitter=best;, score=0.667 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=2, max_features=auto,
splitter=best;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=2, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=2, max_features=auto,
splitter=random;, score=0.630 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=2, max_features=auto,
splitter=random;, score=0.667 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=2, max_features=auto,
splitter=random;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=2, max_features=sqrt,
splitter=best;, score=0.708 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=2, max_features=sqrt,
splitter=best;, score=0.661 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=2, max_features=sqrt,
splitter=best;, score=0.693 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=2, max_features=sqrt,
splitter=random;, score=0.620 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=2, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=2, max_features=sqrt,
splitter=random;, score=0.661 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=2, max_features=log2,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=2, max_features=log2,
splitter=best;, score=0.734 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=2, max_features=log2,

```
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=2, max_features=log2,
splitter=random;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=2, max_features=log2,
splitter=random;, score=0.609 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=2, max_features=log2,
splitter=random;, score=0.714 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=3, max_features=auto,
splitter=best;, score=0.755 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=3, max_features=auto,
splitter=best;, score=0.708 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=3, max_features=auto,
splitter=best;, score=0.714 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=3, max_features=auto,
splitter=random;, score=0.755 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=3, max_features=auto,
splitter=random;, score=0.734 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=3, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=3, max_features=sqrt,
splitter=best;, score=0.641 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=3, max_features=sqrt,
splitter=best;, score=0.677 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=3, max_features=sqrt,
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=3, max_features=sqrt,
splitter=random;, score=0.630 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=3, max_features=sqrt,
splitter=random;, score=0.750 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=3, max_features=sqrt,
splitter=random;, score=0.646 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=3, max_features=log2,
splitter=best;, score=0.708 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=3, max_features=log2,
splitter=best;, score=0.734 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=3, max_features=log2,
splitter=best;, score=0.703 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=3, max_features=log2,
splitter=random;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=3, max_features=log2,
splitter=random;, score=0.760 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=3, max_features=log2,
splitter=random;, score=0.693 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=4, max_features=auto,
splitter=best;, score=0.688 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=4, max_features=auto,
splitter=best;, score=0.750 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=4, max_features=auto,
splitter=best;, score=0.703 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=4, max_features=auto,
```

splitter=random;, score=0.656 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=4, max_features=auto,
splitter=random;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=4, max_features=auto,
splitter=random;, score=0.646 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=4, max_features=sqrt,
splitter=best;, score=0.708 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=4, max_features=sqrt,
splitter=best;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=4, max_features=sqrt,
splitter=best;, score=0.724 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=4, max_features=sqrt,
splitter=random;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=4, max_features=sqrt,
splitter=random;, score=0.667 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=4, max_features=sqrt,
splitter=random;, score=0.677 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=4, max_features=log2,
splitter=best;, score=0.698 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=4, max_features=log2,
splitter=best;, score=0.724 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=4, max_features=log2,
splitter=best;, score=0.724 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=4, max_features=log2,
splitter=random;, score=0.677 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=4, max_features=log2,
splitter=random;, score=0.698 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=4, max_features=log2,
splitter=random;, score=0.672 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=5, max_features=auto,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=5, max_features=auto,
splitter=best;, score=0.719 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=5, max_features=auto,
splitter=best;, score=0.693 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=5, max_features=auto,
splitter=random;, score=0.740 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=5, max_features=auto,
splitter=random;, score=0.786 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=5, max_features=auto,
splitter=random;, score=0.719 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=5, max_features=sqrt,
splitter=best;, score=0.745 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=5, max_features=sqrt,
splitter=best;, score=0.688 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=5, max_features=sqrt,
splitter=best;, score=0.703 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=5, max_features=sqrt,
splitter=random;, score=0.688 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=5, max_features=sqrt,

splitter=random;, score=0.740 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=5, max_features=sqrt,
splitter=random;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=5, max_features=log2,
splitter=best;, score=0.703 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=5, max_features=log2,
splitter=best;, score=0.734 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=5, max_features=log2,
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=entropy, max_depth=5, max_features=log2,
splitter=random;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=entropy, max_depth=5, max_features=log2,
splitter=random;, score=0.766 total time=   0.0s
[CV 3/3] END criterion=entropy, max_depth=5, max_features=log2,
splitter=random;, score=0.599 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=1, max_features=auto,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=1, max_features=auto,
splitter=best;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=1, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=1, max_features=auto,
splitter=random;, score=0.724 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=1, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=1, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=1, max_features=sqrt,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=1, max_features=sqrt,
splitter=best;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=1, max_features=sqrt,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=1, max_features=sqrt,
splitter=random;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=1, max_features=sqrt,
splitter=random;, score=0.656 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=1, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=1, max_features=log2,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=1, max_features=log2,
splitter=best;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=1, max_features=log2,
splitter=best;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=1, max_features=log2,
splitter=random;, score=0.635 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=1, max_features=log2,
splitter=random;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=1, max_features=log2,

splitter=random;, score=0.667 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=2, max_features=auto,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=2, max_features=auto,
splitter=best;, score=0.641 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=2, max_features=auto,
splitter=best;, score=0.688 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=2, max_features=auto,
splitter=random;, score=0.667 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=2, max_features=auto,
splitter=random;, score=0.656 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=2, max_features=auto,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=2, max_features=sqrt,
splitter=best;, score=0.646 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=2, max_features=sqrt,
splitter=best;, score=0.646 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=2, max_features=sqrt,
splitter=best;, score=0.698 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=2, max_features=sqrt,
splitter=random;, score=0.630 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=2, max_features=sqrt,
splitter=random;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=2, max_features=sqrt,
splitter=random;, score=0.641 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=2, max_features=log2,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=2, max_features=log2,
splitter=best;, score=0.771 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=2, max_features=log2,
splitter=best;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=2, max_features=log2,
splitter=random;, score=0.688 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=2, max_features=log2,
splitter=random;, score=0.635 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=2, max_features=log2,
splitter=random;, score=0.651 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=3, max_features=auto,
splitter=best;, score=0.703 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=3, max_features=auto,
splitter=best;, score=0.698 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=3, max_features=auto,
splitter=best;, score=0.693 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=3, max_features=auto,
splitter=random;, score=0.719 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=3, max_features=auto,
splitter=random;, score=0.693 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=3, max_features=auto,
splitter=random;, score=0.646 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=3, max_features=sqrt,

splitter=best;, score=0.698 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=3, max_features=sqrt,
splitter=best;, score=0.609 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=3, max_features=sqrt,
splitter=best;, score=0.745 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=3, max_features=sqrt,
splitter=random;, score=0.682 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=3, max_features=sqrt,
splitter=random;, score=0.693 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=3, max_features=sqrt,
splitter=random;, score=0.620 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=3, max_features=log2,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=3, max_features=log2,
splitter=best;, score=0.693 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=3, max_features=log2,
splitter=best;, score=0.714 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=3, max_features=log2,
splitter=random;, score=0.672 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=3, max_features=log2,
splitter=random;, score=0.682 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=3, max_features=log2,
splitter=random;, score=0.682 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=4, max_features=auto,
splitter=best;, score=0.703 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=4, max_features=auto,
splitter=best;, score=0.724 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=4, max_features=auto,
splitter=best;, score=0.714 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=4, max_features=auto,
splitter=random;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=4, max_features=auto,
splitter=random;, score=0.651 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=4, max_features=auto,
splitter=random;, score=0.693 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=4, max_features=sqrt,
splitter=best;, score=0.719 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=4, max_features=sqrt,
splitter=best;, score=0.734 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=4, max_features=sqrt,
splitter=best;, score=0.729 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=4, max_features=sqrt,
splitter=random;, score=0.688 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=4, max_features=sqrt,
splitter=random;, score=0.646 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=4, max_features=sqrt,
splitter=random;, score=0.734 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=4, max_features=log2,
splitter=best;, score=0.661 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=4, max_features=log2,

```
splitter=best;, score=0.760 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=4, max_features=log2,
splitter=best;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=4, max_features=log2,
splitter=random;, score=0.677 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=4, max_features=log2,
splitter=random;, score=0.750 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=4, max_features=log2,
splitter=random;, score=0.672 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=5, max_features=auto,
splitter=best;, score=0.698 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=5, max_features=auto,
splitter=best;, score=0.734 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=5, max_features=auto,
splitter=best;, score=0.719 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=5, max_features=auto,
splitter=random;, score=0.682 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=5, max_features=auto,
splitter=random;, score=0.703 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=5, max_features=auto,
splitter=random;, score=0.682 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=5, max_features=sqrt,
splitter=best;, score=0.714 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=5, max_features=sqrt,
splitter=best;, score=0.729 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=5, max_features=sqrt,
splitter=best;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=5, max_features=sqrt,
splitter=random;, score=0.667 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=5, max_features=sqrt,
splitter=random;, score=0.677 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=5, max_features=sqrt,
splitter=random;, score=0.682 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=5, max_features=log2,
splitter=best;, score=0.755 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=5, max_features=log2,
splitter=best;, score=0.740 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=5, max_features=log2,
splitter=best;, score=0.708 total time=   0.0s
[CV 1/3] END criterion=log_loss, max_depth=5, max_features=log2,
splitter=random;, score=0.682 total time=   0.0s
[CV 2/3] END criterion=log_loss, max_depth=5, max_features=log2,
splitter=random;, score=0.740 total time=   0.0s
[CV 3/3] END criterion=log_loss, max_depth=5, max_features=log2,
splitter=random;, score=0.714 total time=   0.0s

GridSearchCV(cv=3, estimator=DecisionTreeClassifier(),
             param_grid={'criterion': ['gini', 'entropy', 'log_loss'],
                         'max_depth': [1, 2, 3, 4, 5],
                         'max_features': ['auto', 'sqrt', 'log2'],
```

```
                          'splitter': ['best', 'random']},
             scoring='accuracy', verbose=3)
```

```
clf.best_params_
```

```
{'criterion': 'entropy',
 'max_depth': 5,
 'max_features': 'auto',
 'splitter': 'random'}
```

```
classifier=DecisionTreeClassifier(criterion='entropy',max_depth=5,max_
features='auto',splitter='random')
```

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

```
DecisionTreeClassifier(criterion='entropy', max_depth=5,
max_features='auto',
                       splitter='random')
```

```
## Support Vector Classifier With Hyperparameter Tuning

# defining parameter range
param_grid = {'C': [0.1, 1, 10],
              'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
              'kernel':['linear','rbf','polynomial']
              }

grid=GridSearchCV(SVC(),param_grid=param_grid,refit=True,cv=3,verbose=
3,scoring='accuracy')

grid.fit(X_train,y_train)
```

```
Fitting 3 folds for each of 45 candidates, totalling 135 fits
[CV 1/3] END .....C=0.1, gamma=1, kernel=linear;, score=0.771 total
time=   0.6s
[CV 2/3] END .....C=0.1, gamma=1, kernel=linear;, score=0.771 total
time=   0.2s
[CV 3/3] END .....C=0.1, gamma=1, kernel=linear;, score=0.745 total
time=   0.1s
[CV 1/3] END ........C=0.1, gamma=1, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END ........C=0.1, gamma=1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END ........C=0.1, gamma=1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 1/3] END ...C=0.1, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END ...C=0.1, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END ...C=0.1, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ...C=0.1, gamma=0.1, kernel=linear;, score=0.771 total
```

```
time=   0.6s
[CV 2/3] END ...C=0.1, gamma=0.1, kernel=linear;, score=0.771 total
time=   0.2s
[CV 3/3] END ...C=0.1, gamma=0.1, kernel=linear;, score=0.745 total
time=   0.1s
[CV 1/3] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 1/3] END .C=0.1, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END .C=0.1, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END .C=0.1, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.771 total
time=   0.5s
[CV 2/3] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.771 total
time=   0.2s
[CV 3/3] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.745 total
time=   0.1s
[CV 1/3] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 1/3] END C=0.1, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END C=0.1, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END C=0.1, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END .C=0.1, gamma=0.001, kernel=linear;, score=0.771 total
time=   0.6s
[CV 2/3] END .C=0.1, gamma=0.001, kernel=linear;, score=0.771 total
time=   0.2s
[CV 3/3] END .C=0.1, gamma=0.001, kernel=linear;, score=0.745 total
time=   0.1s
[CV 1/3] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.677 total
time=   0.0s
[CV 2/3] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.682 total
time=   0.0s
[CV 3/3] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.672 total
time=   0.0s
[CV 1/3] END C=0.1, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END C=0.1, gamma=0.001, kernel=polynomial;, score=nan total
```

```
time=   0.0s
[CV 3/3] END C=0.1, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END C=0.1, gamma=0.0001, kernel=linear;, score=0.771 total
time=   0.6s
[CV 2/3] END C=0.1, gamma=0.0001, kernel=linear;, score=0.771 total
time=   0.2s
[CV 3/3] END C=0.1, gamma=0.0001, kernel=linear;, score=0.745 total
time=   0.1s
[CV 1/3] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.708 total
time=   0.0s
[CV 2/3] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.740 total
time=   0.0s
[CV 3/3] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.719 total
time=   0.0s
[CV 1/3] END C=0.1, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END C=0.1, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END C=0.1, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END .......C=1, gamma=1, kernel=linear;, score=0.771 total
time=   2.6s
[CV 2/3] END .......C=1, gamma=1, kernel=linear;, score=0.776 total
time=   1.9s
[CV 3/3] END .......C=1, gamma=1, kernel=linear;, score=0.734 total
time=   0.8s
[CV 1/3] END ..........C=1, gamma=1, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END ..........C=1, gamma=1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END ..........C=1, gamma=1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 1/3] END .....C=1, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END .....C=1, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END .....C=1, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END .....C=1, gamma=0.1, kernel=linear;, score=0.771 total
time=   2.6s
[CV 2/3] END .....C=1, gamma=0.1, kernel=linear;, score=0.776 total
time=   1.9s
[CV 3/3] END .....C=1, gamma=0.1, kernel=linear;, score=0.734 total
time=   0.7s
[CV 1/3] END ........C=1, gamma=0.1, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END ........C=1, gamma=0.1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END ........C=1, gamma=0.1, kernel=rbf;, score=0.641 total
```

```
time=   0.0s
[CV 1/3] END ...C=1, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END ...C=1, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END ...C=1, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ....C=1, gamma=0.01, kernel=linear;, score=0.771 total
time=   2.5s
[CV 2/3] END ....C=1, gamma=0.01, kernel=linear;, score=0.776 total
time=   1.8s
[CV 3/3] END ....C=1, gamma=0.01, kernel=linear;, score=0.734 total
time=   0.7s
[CV 1/3] END .......C=1, gamma=0.01, kernel=rbf;, score=0.661 total
time=   0.0s
[CV 2/3] END .......C=1, gamma=0.01, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 3/3] END .......C=1, gamma=0.01, kernel=rbf;, score=0.656 total
time=   0.0s
[CV 1/3] END ..C=1, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END ..C=1, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END ..C=1, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ...C=1, gamma=0.001, kernel=linear;, score=0.771 total
time=   2.6s
[CV 2/3] END ...C=1, gamma=0.001, kernel=linear;, score=0.776 total
time=   1.9s
[CV 3/3] END ...C=1, gamma=0.001, kernel=linear;, score=0.734 total
time=   0.7s
[CV 1/3] END ......C=1, gamma=0.001, kernel=rbf;, score=0.708 total
time=   0.0s
[CV 2/3] END ......C=1, gamma=0.001, kernel=rbf;, score=0.719 total
time=   0.0s
[CV 3/3] END ......C=1, gamma=0.001, kernel=rbf;, score=0.703 total
time=   0.0s
[CV 1/3] END .C=1, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END .C=1, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END .C=1, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ..C=1, gamma=0.0001, kernel=linear;, score=0.771 total
time=   2.5s
[CV 2/3] END ..C=1, gamma=0.0001, kernel=linear;, score=0.776 total
time=   1.9s
[CV 3/3] END ..C=1, gamma=0.0001, kernel=linear;, score=0.734 total
time=   0.7s
[CV 1/3] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.750 total
```

```
time=   0.0s
[CV 2/3] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.760 total
time=   0.0s
[CV 3/3] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.755 total
time=   0.0s
[CV 1/3] END C=1, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END C=1, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END C=1, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ......C=10, gamma=1, kernel=linear;, score=0.771 total
time=  23.2s
[CV 2/3] END ......C=10, gamma=1, kernel=linear;, score=0.776 total
time=   9.5s
[CV 3/3] END ......C=10, gamma=1, kernel=linear;, score=0.740 total
time=   6.0s
[CV 1/3] END .........C=10, gamma=1, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END .........C=10, gamma=1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END .........C=10, gamma=1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 1/3] END ....C=10, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END ....C=10, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END ....C=10, gamma=1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ....C=10, gamma=0.1, kernel=linear;, score=0.771 total
time=  23.2s
[CV 2/3] END ....C=10, gamma=0.1, kernel=linear;, score=0.776 total
time=   9.5s
[CV 3/3] END ....C=10, gamma=0.1, kernel=linear;, score=0.740 total
time=   6.0s
[CV 1/3] END .......C=10, gamma=0.1, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 2/3] END .......C=10, gamma=0.1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END .......C=10, gamma=0.1, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 1/3] END ..C=10, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END ..C=10, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END ..C=10, gamma=0.1, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ...C=10, gamma=0.01, kernel=linear;, score=0.771 total
time=  23.0s
[CV 2/3] END ...C=10, gamma=0.01, kernel=linear;, score=0.776 total
```

```
time=   9.7s
[CV 3/3] END ...C=10, gamma=0.01, kernel=linear;, score=0.740 total
time=   6.1s
[CV 1/3] END ......C=10, gamma=0.01, kernel=rbf;, score=0.667 total
time=   0.0s
[CV 2/3] END ......C=10, gamma=0.01, kernel=rbf;, score=0.641 total
time=   0.0s
[CV 3/3] END ......C=10, gamma=0.01, kernel=rbf;, score=0.646 total
time=   0.0s
[CV 1/3] END .C=10, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END .C=10, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END .C=10, gamma=0.01, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END ..C=10, gamma=0.001, kernel=linear;, score=0.771 total
time=  23.1s
[CV 2/3] END ..C=10, gamma=0.001, kernel=linear;, score=0.776 total
time=   9.5s
[CV 3/3] END ..C=10, gamma=0.001, kernel=linear;, score=0.740 total
time=   6.0s
[CV 1/3] END .....C=10, gamma=0.001, kernel=rbf;, score=0.708 total
time=   0.0s
[CV 2/3] END .....C=10, gamma=0.001, kernel=rbf;, score=0.682 total
time=   0.0s
[CV 3/3] END .....C=10, gamma=0.001, kernel=rbf;, score=0.677 total
time=   0.0s
[CV 1/3] END C=10, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END C=10, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 3/3] END C=10, gamma=0.001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 1/3] END .C=10, gamma=0.0001, kernel=linear;, score=0.771 total
time=  23.1s
[CV 2/3] END .C=10, gamma=0.0001, kernel=linear;, score=0.776 total
time=   9.5s
[CV 3/3] END .C=10, gamma=0.0001, kernel=linear;, score=0.740 total
time=   6.0s
[CV 1/3] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.724 total
time=   0.0s
[CV 2/3] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.760 total
time=   0.0s
[CV 3/3] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.724 total
time=   0.0s
[CV 1/3] END C=10, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
[CV 2/3] END C=10, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s
```

```
[CV 3/3] END C=10, gamma=0.0001, kernel=polynomial;, score=nan total
time=   0.0s

GridSearchCV(cv=3, estimator=SVC(),
             param_grid={'C': [0.1, 1, 10],
                         'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
                         'kernel': ['linear', 'rbf', 'polynomial']},
             scoring='accuracy', verbose=3)

## Naive Baye's Implementation

grid.best_params_

{'C': 0.1, 'gamma': 1, 'kernel': 'linear'}

svc_clf=SVC(C=0.1,gamma=1,kernel='linear')
svc_clf.fit(X_train,y_train)

SVC(C=0.1, gamma=1, kernel='linear')
```

let's see how well our model performs on the test data set.

```
## Decision Tree prediction
y_pred = classifier.predict(X_test_scaled)

## SVC prediction
y_pred_svc = svc_clf.predict(X_test_scaled)
```

accuracy = accuracy_score(y_test,y_pred) accuracy

```
conf_mat = confusion_matrix(y_test,y_pred)
conf_mat

array([[130,   0],
       [ 62,   0]])

conf_mat = confusion_matrix(y_test,y_pred_svc)
conf_mat

array([[130,   0],
       [ 62,   0]])

true_positive = conf_mat[0][0]
false_positive = conf_mat[0][1]
false_negative = conf_mat[1][0]
true_negative = conf_mat[1][1]

Accuracy = (true_positive + true_negative) / (true_positive
+false_positive + false_negative + true_negative)
Accuracy

0.6770833333333334
```

```
Accuracy = (true_positive + true_negative) / (true_positive
+false_positive + false_negative + true_negative)
Accuracy
```

```
0.6770833333333334
```

```
Precision = true_positive/(true_positive+false_positive)
Precision
```

```
1.0
```

```
Recall = true_positive/(true_positive+false_negative)
Recall
```

```
0.6770833333333334
```

```
F1_Score = 2*(Recall * Precision) / (Recall + Precision)
F1_Score
```

```
0.8074534161490683
```

```
import pickle
file = open('/config/workspace/Model/modelForPrediction.pkl','wb')
pickle.dump(classifier,file)
file.close()
```