

Diabetes_Decision_Tree_SVC

May 17, 2023

0.1 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()
```

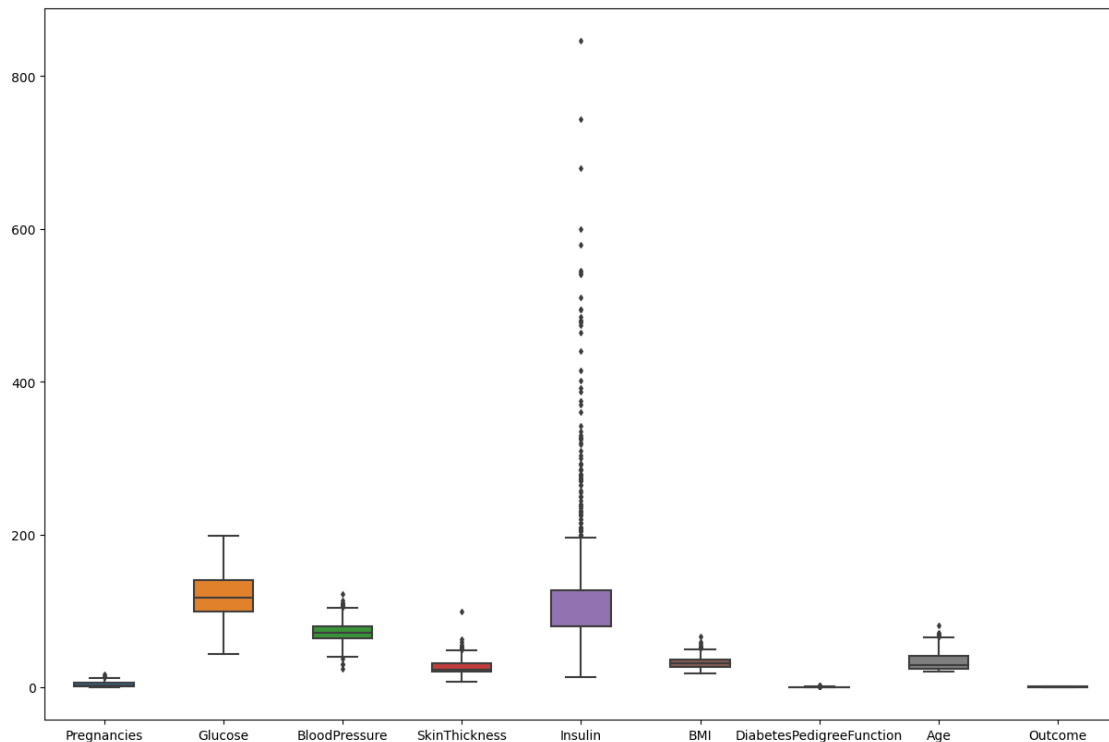
```
[ ]: Pregnancies    Glucose    BloodPressure    SkinThickness    Insulin
count    768.000000    768.000000    768.000000    768.000000    768.000000 \
mean      3.845052    121.681605    72.254807    26.606479    118.660163
std       3.369578    30.436016    12.115932    9.631241    93.080358
min       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='accuracy',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=0.667 total time=  0.0s
```

```

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
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score=0.646 total time= 0.0s
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score=0.703 total time= 0.0s
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score=0.688 total time= 0.0s
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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
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score=0.651 total time= 0.0s
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score=0.573 total time= 0.0s
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score=0.656 total time= 0.0s
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score=0.646 total time= 0.0s
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score=0.635 total time= 0.0s
[CV 3/3] END criterion=gini, max_depth=2, max_features=auto, splitter=random;,
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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
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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
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score=0.635 total time= 0.0s
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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
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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
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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
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score=0.703 total time= 0.0s
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score=0.682 total time= 0.0s
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score=0.688 total time= 0.0s
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[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;;
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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
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score=0.641 total time= 0.0s
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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

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[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()
```

```
[ ]:
```

```
[ ]:
```