ML 26 - Support Vector Machine Classifier By Virat Tiwari

December 28, 2023

1 ML 26 - Support Vector Machine Classifier By Virat Tiwari

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
```

[2]:
```
# Here we create synthetic datapoints

from sklearn.datasets import make_classification
```

[3]:
```
x,y=make_classification(n_samples=1000,n_features=2,n_classes=2,n_clusters_per_class=2,n_redun
```

[4]:
```
x
```

[4]:
```
array([[-1.31559905e+00, -4.91625991e-01],
       [-5.99934077e-01,  9.83467289e-01],
       [ 7.95434642e-01, -7.89132237e-01],
       …,
       [-3.14211516e-03, -2.32625638e+00],
       [-2.40197034e+00,  1.12753131e+00],
       [-4.79005389e-04, -1.78454192e+00]])
```

[5]:
```
y
```

[5]:
```
array([0, 1, 1, 1, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0,
       0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0,
       1, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0,
       0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0,
       1, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1,
       1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1,
       1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1,
       0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 1, 1, 1,
       0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 0, 0,
```

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 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1,
 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0,
 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1,
 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1,
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 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0,
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 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 0,
 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 1,
 0, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0,
 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0,
 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1,
 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1,
 0, 1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1,
 0, 0, 1, 1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 1, 0,
 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1,
 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0,
 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1,
 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1,
 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 1,
 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 1, 0,
 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0,
 0, 1, 1, 0, 1, 0, 0, 1, 1, 0])
```

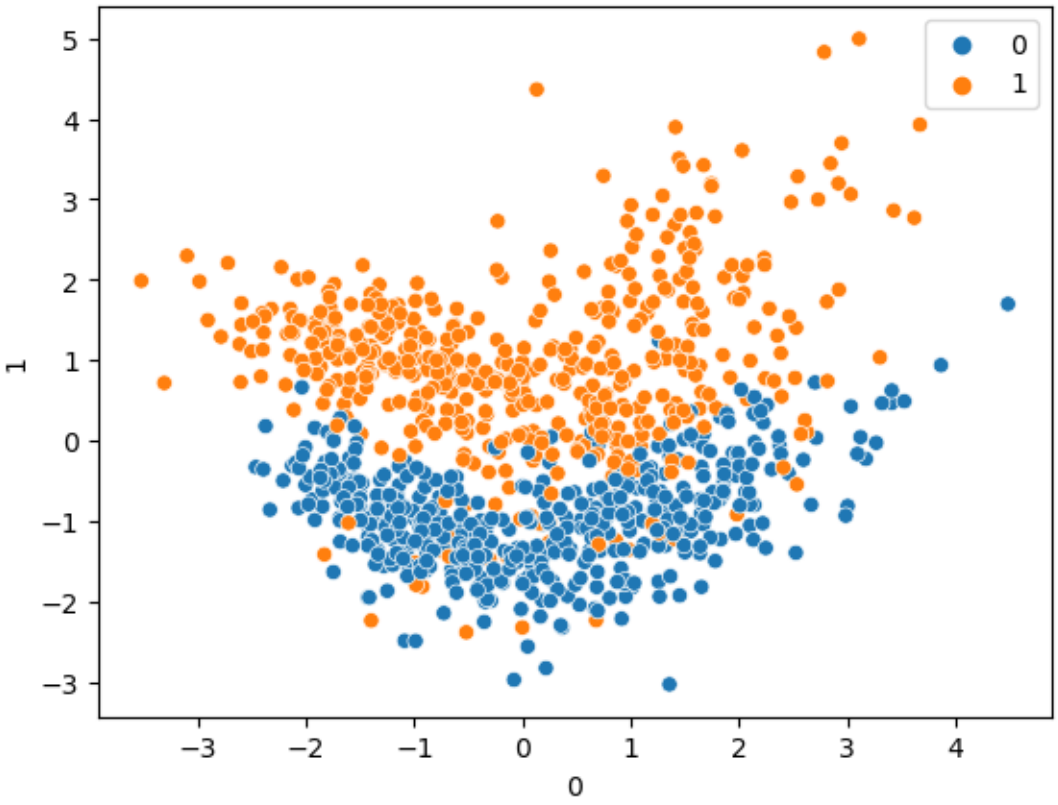
[6]:
```
pd.DataFrame(x)[0]
```

[6]:
```
0     -1.315599
1     -0.599934
2      0.795435
3      1.571768
4     -0.759468
         …
995   -1.618356
996   -0.411744
997   -0.003142
```

```
998   -2.401970
999   -0.000479
Name: 0, Length: 1000, dtype: float64
```

[7]:
```
sns.scatterplot(x=pd.DataFrame(x)[0],y=pd.DataFrame(x)[1],hue=y)
```

[7]:
```
<AxesSubplot: xlabel='0', ylabel='1'>
```



[8]:
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.
  ↪25,random_state=10)
```

[9]:
```
from sklearn.svm import SVC
```

[10]:
```
svc=SVC(kernel="linear")
```

[11]:
```
svc.fit(x_train,y_train)
```

[11]:
```
SVC(kernel='linear')
```

[12]:
```
svc.coef_
```

[12]:
```
array([[-0.09344151,  1.69253252]])
```

[13]:
```
# PREDICTION

y_pred=svc.predict(x_test)
```

[14]:
```
y_pred
```

[14]:
```
array([0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0,
       1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0,
       1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0,
       0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 0, 1, 0,
       0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1,
       0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0,
       1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0,
       0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 0, 0, 0,
       1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0,
       1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 1,
       1, 1, 0, 1, 0, 1, 1, 1])
```

[15]:
```
from sklearn.metrics import␣
 ↪classification_report,confusion_matrix,accuracy_score
```

[16]:
```
print(classification_report(y_test,y_pred))
print(confusion_matrix(y_test,y_pred))
print(accuracy_score(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.84      0.92      0.88       128
           1       0.91      0.82      0.86       122

    accuracy                           0.87       250
   macro avg       0.88      0.87      0.87       250
weighted avg       0.88      0.87      0.87       250

[[118  10]
 [ 22 100]]
0.872
```

2 Hyperparameter Tuning With SVC

[17]:
```
from sklearn.model_selection import GridSearchCV
```

[22]:
```
from sklearn.model_selection import GridSearchCV

# defining parameter range
param_grid = {'C': [0.1, 1, 10, 100, 1000],
              'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
              'kernel':['linear']
              }
```

[23]:
```
grid=GridSearchCV(SVC(),param_grid=param_grid,refit=True,cv=5,verbose=3)
```

[25]:
```
grid.fit(x_train,y_train)
```

```
Fitting 5 folds for each of 25 candidates, totalling 125 fits
[CV 1/5] END …C=0.1, gamma=1, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END …C=0.1, gamma=1, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=0.1, gamma=1, kernel=linear;, score=0.907 total time=   0.0s
[CV 4/5] END …C=0.1, gamma=1, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=0.1, gamma=1, kernel=linear;, score=0.873 total time=   0.0s
[CV 1/5] END …C=0.1, gamma=0.1, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END …C=0.1, gamma=0.1, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=0.1, gamma=0.1, kernel=linear;, score=0.907 total time=   0.0s
[CV 4/5] END …C=0.1, gamma=0.1, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=0.1, gamma=0.1, kernel=linear;, score=0.873 total time=   0.0s
[CV 1/5] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.907 total time=   0.0s
[CV 4/5] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END ..C=0.1, gamma=0.01, kernel=linear;, score=0.873 total time=   0.0s
[CV 1/5] END .C=0.1, gamma=0.001, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END .C=0.1, gamma=0.001, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END .C=0.1, gamma=0.001, kernel=linear;, score=0.907 total time=   0.0s
[CV 4/5] END .C=0.1, gamma=0.001, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END .C=0.1, gamma=0.001, kernel=linear;, score=0.873 total time=   0.0s
[CV 1/5] END C=0.1, gamma=0.0001, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END C=0.1, gamma=0.0001, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END C=0.1, gamma=0.0001, kernel=linear;, score=0.907 total time=   0.0s
[CV 4/5] END C=0.1, gamma=0.0001, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END C=0.1, gamma=0.0001, kernel=linear;, score=0.873 total time=   0.0s
[CV 1/5] END …C=1, gamma=1, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END …C=1, gamma=1, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=1, gamma=1, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=1, gamma=1, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=1, gamma=1, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=1, gamma=0.1, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END …C=1, gamma=0.1, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=1, gamma=0.1, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=1, gamma=0.1, kernel=linear;, score=0.900 total time=   0.0s
```

```
[CV 5/5] END …C=1, gamma=0.1, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=1, gamma=0.01, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END …C=1, gamma=0.01, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=1, gamma=0.01, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=1, gamma=0.01, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=1, gamma=0.01, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=1, gamma=0.001, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END …C=1, gamma=0.001, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=1, gamma=0.001, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=1, gamma=0.001, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=1, gamma=0.001, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END ..C=1, gamma=0.0001, kernel=linear;, score=0.887 total time=   0.0s
[CV 2/5] END ..C=1, gamma=0.0001, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END ..C=1, gamma=0.0001, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END ..C=1, gamma=0.0001, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END ..C=1, gamma=0.0001, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=10, gamma=1, kernel=linear;, score=0.893 total time=   0.0s
[CV 2/5] END …C=10, gamma=1, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=10, gamma=1, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=10, gamma=1, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=10, gamma=1, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=10, gamma=0.1, kernel=linear;, score=0.893 total time=   0.0s
[CV 2/5] END …C=10, gamma=0.1, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=10, gamma=0.1, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=10, gamma=0.1, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=10, gamma=0.1, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=10, gamma=0.01, kernel=linear;, score=0.893 total time=   0.0s
[CV 2/5] END …C=10, gamma=0.01, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END …C=10, gamma=0.01, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END …C=10, gamma=0.01, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END …C=10, gamma=0.01, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END ..C=10, gamma=0.001, kernel=linear;, score=0.893 total time=   0.0s
[CV 2/5] END ..C=10, gamma=0.001, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END ..C=10, gamma=0.001, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END ..C=10, gamma=0.001, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END ..C=10, gamma=0.001, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END .C=10, gamma=0.0001, kernel=linear;, score=0.893 total time=   0.0s
[CV 2/5] END .C=10, gamma=0.0001, kernel=linear;, score=0.920 total time=   0.0s
[CV 3/5] END .C=10, gamma=0.0001, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END .C=10, gamma=0.0001, kernel=linear;, score=0.900 total time=   0.0s
[CV 5/5] END .C=10, gamma=0.0001, kernel=linear;, score=0.880 total time=   0.0s
[CV 1/5] END …C=100, gamma=1, kernel=linear;, score=0.893 total time=   0.1s
[CV 2/5] END …C=100, gamma=1, kernel=linear;, score=0.920 total time=   0.1s
[CV 3/5] END …C=100, gamma=1, kernel=linear;, score=0.887 total time=   0.1s
[CV 4/5] END …C=100, gamma=1, kernel=linear;, score=0.900 total time=   0.1s
[CV 5/5] END …C=100, gamma=1, kernel=linear;, score=0.880 total time=   0.1s
[CV 1/5] END …C=100, gamma=0.1, kernel=linear;, score=0.893 total time=   0.1s
[CV 2/5] END …C=100, gamma=0.1, kernel=linear;, score=0.920 total time=   0.1s
```

```
[CV 3/5] END …C=100, gamma=0.1, kernel=linear;, score=0.887 total time=   0.1s
[CV 4/5] END …C=100, gamma=0.1, kernel=linear;, score=0.900 total time=   0.1s
[CV 5/5] END …C=100, gamma=0.1, kernel=linear;, score=0.880 total time=   0.1s
[CV 1/5] END ..C=100, gamma=0.01, kernel=linear;, score=0.893 total time=   0.1s
[CV 2/5] END ..C=100, gamma=0.01, kernel=linear;, score=0.920 total time=   0.1s
[CV 3/5] END ..C=100, gamma=0.01, kernel=linear;, score=0.887 total time=   0.1s
[CV 4/5] END ..C=100, gamma=0.01, kernel=linear;, score=0.900 total time=   0.1s
[CV 5/5] END ..C=100, gamma=0.01, kernel=linear;, score=0.880 total time=   0.1s
[CV 1/5] END .C=100, gamma=0.001, kernel=linear;, score=0.893 total time=   0.0s
[CV 2/5] END .C=100, gamma=0.001, kernel=linear;, score=0.920 total time=   0.1s
[CV 3/5] END .C=100, gamma=0.001, kernel=linear;, score=0.887 total time=   0.0s
[CV 4/5] END .C=100, gamma=0.001, kernel=linear;, score=0.900 total time=   0.1s
[CV 5/5] END .C=100, gamma=0.001, kernel=linear;, score=0.880 total time=   0.1s
[CV 1/5] END C=100, gamma=0.0001, kernel=linear;, score=0.893 total time=   0.1s
[CV 2/5] END C=100, gamma=0.0001, kernel=linear;, score=0.920 total time=   0.1s
[CV 3/5] END C=100, gamma=0.0001, kernel=linear;, score=0.887 total time=   0.1s
[CV 4/5] END C=100, gamma=0.0001, kernel=linear;, score=0.900 total time=   0.1s
[CV 5/5] END C=100, gamma=0.0001, kernel=linear;, score=0.880 total time=   0.1s
[CV 1/5] END …C=1000, gamma=1, kernel=linear;, score=0.893 total time=   0.3s
[CV 2/5] END …C=1000, gamma=1, kernel=linear;, score=0.920 total time=   0.3s
[CV 3/5] END …C=1000, gamma=1, kernel=linear;, score=0.887 total time=   0.3s
[CV 4/5] END …C=1000, gamma=1, kernel=linear;, score=0.900 total time=   0.4s
[CV 5/5] END …C=1000, gamma=1, kernel=linear;, score=0.880 total time=   0.5s
[CV 1/5] END ..C=1000, gamma=0.1, kernel=linear;, score=0.893 total time=   0.3s
[CV 2/5] END ..C=1000, gamma=0.1, kernel=linear;, score=0.920 total time=   0.3s
[CV 3/5] END ..C=1000, gamma=0.1, kernel=linear;, score=0.887 total time=   0.3s
[CV 4/5] END ..C=1000, gamma=0.1, kernel=linear;, score=0.900 total time=   0.4s
[CV 5/5] END ..C=1000, gamma=0.1, kernel=linear;, score=0.880 total time=   0.5s
[CV 1/5] END .C=1000, gamma=0.01, kernel=linear;, score=0.893 total time=   0.3s
[CV 2/5] END .C=1000, gamma=0.01, kernel=linear;, score=0.920 total time=   0.3s
[CV 3/5] END .C=1000, gamma=0.01, kernel=linear;, score=0.887 total time=   0.3s
[CV 4/5] END .C=1000, gamma=0.01, kernel=linear;, score=0.900 total time=   0.4s
[CV 5/5] END .C=1000, gamma=0.01, kernel=linear;, score=0.880 total time=   0.5s
[CV 1/5] END C=1000, gamma=0.001, kernel=linear;, score=0.893 total time=   0.3s
[CV 2/5] END C=1000, gamma=0.001, kernel=linear;, score=0.920 total time=   0.3s
[CV 3/5] END C=1000, gamma=0.001, kernel=linear;, score=0.887 total time=   0.3s
[CV 4/5] END C=1000, gamma=0.001, kernel=linear;, score=0.900 total time=   0.3s
[CV 5/5] END C=1000, gamma=0.001, kernel=linear;, score=0.880 total time=   0.5s
[CV 1/5] END C=1000, gamma=0.0001, kernel=linear;, score=0.893 total time=
0.3s
[CV 2/5] END C=1000, gamma=0.0001, kernel=linear;, score=0.920 total time=
0.3s
[CV 3/5] END C=1000, gamma=0.0001, kernel=linear;, score=0.887 total time=
0.3s
[CV 4/5] END C=1000, gamma=0.0001, kernel=linear;, score=0.900 total time=
0.4s
[CV 5/5] END C=1000, gamma=0.0001, kernel=linear;, score=0.880 total time=
0.5s
```

[25]:
```
GridSearchCV(cv=5, estimator=SVC(),
             param_grid={'C': [0.1, 1, 10, 100, 1000],
                         'gamma': [1, 0.1, 0.01, 0.001, 0.0001],
                         'kernel': ['linear']},
             verbose=3)
```

[26]:
```
grid.best_params_
```

[26]:
```
{'C': 0.1, 'gamma': 1, 'kernel': 'linear'}
```

[29]:
```
# PREDICTION

y_pred4=grid.predict(x_test)
print(classification_report(y_test,y_pred4))
print(confusion_matrix(y_test,y_pred4))
print(accuracy_score(y_test,y_pred4))
```

```
              precision    recall  f1-score   support

           0       0.84      0.92      0.88       128
           1       0.91      0.81      0.86       122

    accuracy                           0.87       250
   macro avg       0.87      0.87      0.87       250
weighted avg       0.87      0.87      0.87       250

[[118  10]
 [ 23  99]]
0.868
```

THANK YOU SO MUCH !!

YOURS VIRAT TIWARI :)