Support Vector Classifier Implementation

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

In [2]:
```
## Lets create synthetic data points
from sklearn.datasets import make_classification
```

In [3]:
```
X,y=make_classification(n_samples=1000,n_features=2,n_classes=2,
                        n_clusters_per_class=2,n_redundant=0)
```

In [4]:
```
X
```

Out[4]:
```
array([[-1.04543182,  1.43917109],
       [ 2.02614712, -0.96344906],
       [ 0.52477663, -0.9804843 ],
       ...,
       [ 1.74491441,  0.63550927],
       [-0.79715152, -1.09210497],
       [ 0.37480977,  1.16665105]])
```

In [5]:
```
y
```

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

In [6]:
```
pd.DataFrame(X)[0]
```

Out[6]:
```
0     -1.045432
1      2.026147
2      0.524777
3     -0.433085
4      0.836881
          ...
995   -1.087434
996    1.666602
997    1.744914
998   -0.797152
999    0.374810
Name: 0, Length: 1000, dtype: float64
```

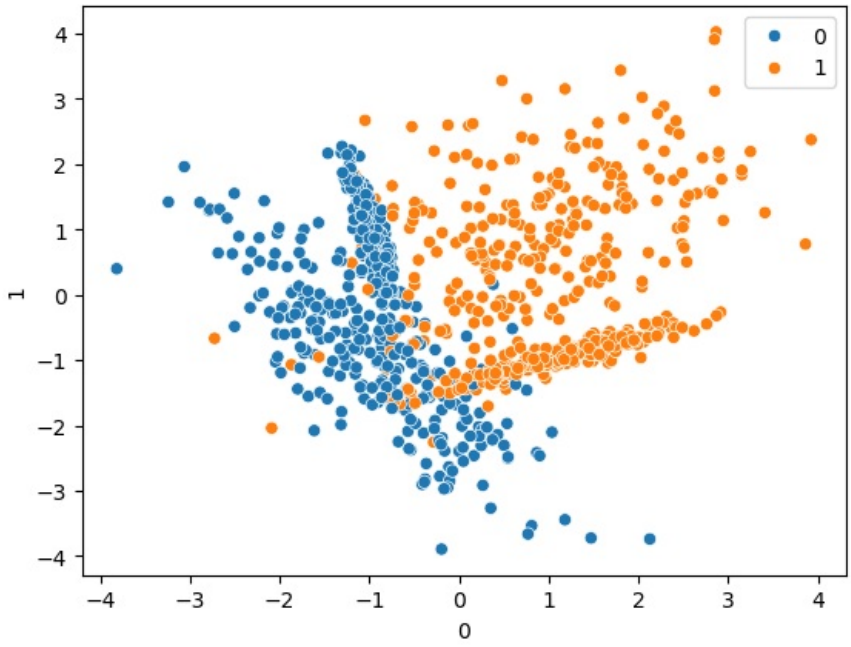
In [7]:
```
# sns.scatterplot(pd.DataFrame(X)[0],pd.DataFrame(X)[1],hue=y)
import seaborn as sns
import pandas as pd

# Assuming X is your data and y is the variable for coloring
df = pd.DataFrame(X)  # Convert X to a DataFrame if not already
print(df)
sns.scatterplot(x=df[0], y=df[1], hue=y)
```

```
           0         1
0   -1.045432  1.439171
1    2.026147 -0.963449
2    0.524777 -0.980484
3   -0.433085 -1.073359
4    0.836881 -0.906425
..        ...       ...
995 -1.087434  1.214817
996  1.666602 -0.783846
997  1.744914  0.635509
998 -0.797152 -1.092105
999  0.374810  1.166651

[1000 rows x 2 columns]
```

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



In [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)
```

In [10]:
```
from sklearn.svm import SVC
```

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

In [12]:
```
svc.fit(X_train,y_train)
```

Out[12]:
```
SVC
SVC(kernel='linear')
```

In [13]:
```
svc.coef_
```

Out[13]:
```
array([[2.15359963, 0.48784076]])
```

In [14]:
```
## Prediction
y_pred=svc.predict(X_test)
```

In [15]:
```
from sklearn.metrics import classification_report,confusion_matrix
```

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

```
              precision    recall  f1-score   support

           0       0.88      0.93      0.91       122
           1       0.93      0.88      0.91       128

    accuracy                           0.91       250
   macro avg       0.91      0.91      0.91       250
weighted avg       0.91      0.91      0.91       250

[[114   8]
 [ 15 113]]
```

In [17]:
```
rbf=SVC(kernel='rbf')
```

In [18]:
```
rbf.fit(X_train,y_train)
```

Out[18]:

▾ SVC

```
SVC()
```

In [19]:
```
## Prediction
y_pred1=rbf.predict(X_test)
```

In [20]:
```
print(classification_report(y_test,y_pred1))
print(confusion_matrix(y_test,y_pred1))
```

```
              precision    recall  f1-score   support

           0       0.91      0.98      0.94       122
           1       0.97      0.91      0.94       128

    accuracy                           0.94       250
   macro avg       0.94      0.94      0.94       250
weighted avg       0.94      0.94      0.94       250

[[119   3]
 [ 12 116]]
```

In [21]:
```
polynomial=SVC(kernel='poly')
polynomial.fit(X_train,y_train)
## Prediction
y_pred2=polynomial.predict(X_test)
print(classification_report(y_test,y_pred2))
print(confusion_matrix(y_test,y_pred2))
```

```
              precision    recall  f1-score   support

           0       0.91      0.96      0.94       122
           1       0.96      0.91      0.94       128

    accuracy                           0.94       250
   macro avg       0.94      0.94      0.94       250
weighted avg       0.94      0.94      0.94       250

[[117   5]
 [ 11 117]]
```

In [22]:
```
sigmoid=SVC(kernel='sigmoid')
sigmoid.fit(X_train,y_train)
## Prediction
y_pred3=sigmoid.predict(X_test)
print(classification_report(y_test,y_pred3))
print(confusion_matrix(y_test,y_pred3))
```

```
              precision    recall  f1-score   support

           0       0.78      0.84      0.81       122
           1       0.83      0.78      0.81       128

    accuracy                           0.81       250
   macro avg       0.81      0.81      0.81       250
weighted avg       0.81      0.81      0.81       250

[[102  20]
 [ 28 100]]
```

In [ ]:
```
sigmoid.intercept_
```

Hyperparametere Tuning With SVC

In [24]:
```
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': ['rbf']}
```

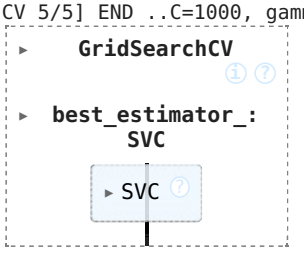
In [25]:
```
grid=GridSearchCV(SVC(),param_grid=param_grid,refit=True,cv=5,verbose=3)
```

In [26]:
```
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=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 3/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 4/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 5/5] END ........C=0.1, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 1/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.913 total time=   0.0s
[CV 2/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.900 total time=   0.0s
[CV 4/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.907 total time=   0.0s
[CV 5/5] END ......C=0.1, gamma=0.1, kernel=rbf;, score=0.913 total time=   0.0s
[CV 1/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.853 total time=   0.0s
[CV 2/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.847 total time=   0.0s
[CV 3/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.880 total time=   0.0s
[CV 4/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.827 total time=   0.0s
[CV 5/5] END .....C=0.1, gamma=0.01, kernel=rbf;, score=0.880 total time=   0.0s
[CV 1/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 2/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 3/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 4/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.507 total time=   0.0s
[CV 5/5] END ....C=0.1, gamma=0.001, kernel=rbf;, score=0.507 total time=   0.0s
[CV 1/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 2/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 3/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 4/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.507 total time=   0.0s
[CV 5/5] END ...C=0.1, gamma=0.0001, kernel=rbf;, score=0.507 total time=   0.0s
[CV 1/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 2/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 4/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 5/5] END ..........C=1, gamma=1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 3/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.920 total time=   0.0s
[CV 4/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 5/5] END ........C=1, gamma=0.1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 1/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.900 total time=   0.0s
[CV 2/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.920 total time=   0.0s
[CV 3/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.893 total time=   0.0s
[CV 4/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.900 total time=   0.0s
[CV 5/5] END .......C=1, gamma=0.01, kernel=rbf;, score=0.913 total time=   0.0s
[CV 1/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.853 total time=   0.0s
[CV 2/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.847 total time=   0.0s
[CV 3/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.880 total time=   0.0s
[CV 4/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.827 total time=   0.0s
[CV 5/5] END ......C=1, gamma=0.001, kernel=rbf;, score=0.880 total time=   0.0s
[CV 1/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 2/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 3/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.500 total time=   0.0s
[CV 4/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.507 total time=   0.0s
[CV 5/5] END .....C=1, gamma=0.0001, kernel=rbf;, score=0.507 total time=   0.0s
[CV 1/5] END .........C=10, gamma=1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 2/5] END .........C=10, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END .........C=10, gamma=1, kernel=rbf;, score=0.927 total time=   0.0s
```

```
[CV 4/5] END .........C=10, gamma=1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 5/5] END .........C=10, gamma=1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 3/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 4/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 5/5] END .......C=10, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.913 total time=   0.0s
[CV 4/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.927 total time=   0.0s
[CV 5/5] END ......C=10, gamma=0.01, kernel=rbf;, score=0.927 total time=   0.0s
[CV 1/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.900 total time=   0.0s
[CV 2/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 3/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.887 total time=   0.0s
[CV 4/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.893 total time=   0.0s
[CV 5/5] END .....C=10, gamma=0.001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 1/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.853 total time=   0.0s
[CV 2/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.847 total time=   0.0s
[CV 3/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.880 total time=   0.0s
[CV 4/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.833 total time=   0.0s
[CV 5/5] END ....C=10, gamma=0.0001, kernel=rbf;, score=0.887 total time=   0.0s
[CV 1/5] END ........C=100, gamma=1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 2/5] END ........C=100, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END ........C=100, gamma=1, kernel=rbf;, score=0.920 total time=   0.0s
[CV 4/5] END ........C=100, gamma=1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 5/5] END ........C=100, gamma=1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 1/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 2/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 3/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 4/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 5/5] END ......C=100, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.940 total time=   0.0s
[CV 3/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.913 total time=   0.0s
[CV 4/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.940 total time=   0.0s
[CV 5/5] END .....C=100, gamma=0.01, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.900 total time=   0.0s
[CV 2/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.927 total time=   0.0s
[CV 3/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.900 total time=   0.0s
[CV 4/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 5/5] END ....C=100, gamma=0.001, kernel=rbf;, score=0.933 total time=   0.0s
[CV 1/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.893 total time=   0.0s
[CV 2/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 3/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.887 total time=   0.0s
[CV 4/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.893 total time=   0.0s
[CV 5/5] END ...C=100, gamma=0.0001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 1/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.920 total time=   0.1s
[CV 2/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 4/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.940 total time=   0.0s
[CV 5/5] END .......C=1000, gamma=1, kernel=rbf;, score=0.940 total time=   0.1s
[CV 1/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 2/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.927 total time=   0.0s
[CV 4/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.953 total time=   0.0s
[CV 5/5] END .....C=1000, gamma=0.1, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.947 total time=   0.0s
[CV 3/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.920 total time=   0.0s
[CV 4/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.953 total time=   0.0s
[CV 5/5] END ....C=1000, gamma=0.01, kernel=rbf;, score=0.947 total time=   0.0s
[CV 1/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.920 total time=   0.0s
[CV 2/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.933 total time=   0.0s
[CV 3/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 4/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.927 total time=   0.0s
[CV 5/5] END ...C=1000, gamma=0.001, kernel=rbf;, score=0.940 total time=   0.0s
[CV 1/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.900 total time=   0.0s
[CV 2/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.927 total time=   0.0s
[CV 3/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.900 total time=   0.0s
[CV 4/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.913 total time=   0.0s
[CV 5/5] END ..C=1000, gamma=0.0001, kernel=rbf;, score=0.933 total time=   0.0s
```

Out[26]:



In [27]:
```
grid.best_params_
```

Out[27]: {'C': 100, 'gamma': 0.1, 'kernel': 'rbf'}

In [28]:
```
## Prediction
y_pred4=grid.predict(X_test)
print(classification_report(y_test,y_pred4))
print(confusion_matrix(y_test,y_pred4))
```

```
              precision    recall  f1-score   support

           0       0.92      0.97      0.94       122
           1       0.97      0.92      0.94       128

    accuracy                           0.94       250
   macro avg       0.94      0.94      0.94       250
weighted avg       0.95      0.94      0.94       250

[[118   4]
 [ 10 118]]
```

In [ ]: