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import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.datasets import load_breast_cancer
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.svm import SVC
from sklearn.metrics import classification_report, accuracy_score
from sklearn.preprocessing import StandardScaler
from mlxtend.plotting import plot_decision_regions
data = load_breast_cancer()
X = data.data
y = data.target
feature_names = data.feature_names
target_names = data.target_names
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y,
test_size=0.2, random_state=42)
svm_linear = SVC(kernel='linear', C=1)
svm_linear.fit(X_train, y_train)
y_pred_linear = svm_linear.predict(X_test)
print("□ Linear Kernel Accuracy:", accuracy_score(y_test,
y_pred_linear))
print(classification_report(y_test, y_pred_linear))
svm_rbf = SVC(kernel='rbf', C=1, gamma='scale')
svm_rbf.fit(X_train, y_train)
y_pred_rbf = svm_rbf.predict(X_test)
print("□ RBF Kernel Accuracy:", accuracy_score(y_test, y_pred_rbf))
print(classification_report(y_test, y_pred_rbf))
param_grid = {
    'C': [0.1, 1, 10, 100],
    'gamma': [1, 0.1, 0.01, 0.001],
    'kernel': ['rbf']
}
grid = GridSearchCV(SVC(), param_grid, refit=True, verbose=1, cv=5)
grid.fit(X_train, y_train)
print("□ Best Parameters:", grid.best_params_)
print("□ Best Score:", grid.best_score_)
best_model = grid.best_estimator_
y_best_pred = best_model.predict(X_test)
print("□ Tuned Model Accuracy:", accuracy_score(y_test, y_best_pred))
print(classification_report(y_test, y_best_pred))
X_vis = X_scaled[:, :2]
X_train_v, X_test_v, y_train_v, y_test_v = train_test_split(X_vis, y,
test_size=0.2, random_state=42)
model_vis = SVC(kernel='rbf', C=10, gamma=0.1)
model_vis.fit(X_train_v, y_train_v)
plt.figure(figsize=(10, 6))
plot_decision_regions(X_test_v, y_test_v, clf=model_vis, legend=2)
```

```
plt.xlabel(feature_names[0])
plt.ylabel(feature_names[1])
plt.title("SVM Decision Boundary (RBF Kernel on 2 features)")
plt.show()
```

```
 Linear Kernel Accuracy: 0.956140350877193
              precision    recall  f1-score   support

           0       0.93      0.95      0.94        43
           1       0.97      0.96      0.96        71

    accuracy                           0.96       114
   macro avg       0.95      0.96      0.95       114
weighted avg       0.96      0.96      0.96       114

 RBF Kernel Accuracy: 0.9736842105263158
              precision    recall  f1-score   support

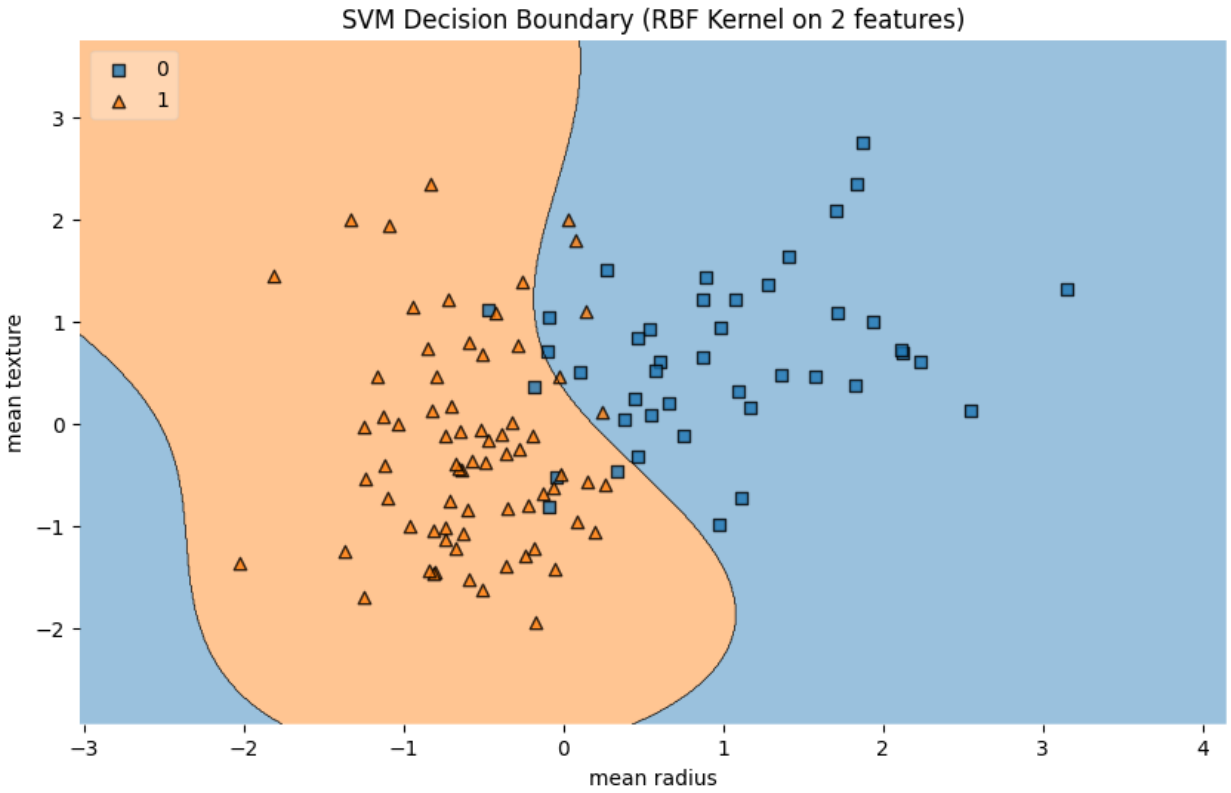
           0       0.98      0.95      0.96        43
           1       0.97      0.99      0.98        71

    accuracy                           0.97       114
   macro avg       0.97      0.97      0.97       114
weighted avg       0.97      0.97      0.97       114

Fitting 5 folds for each of 16 candidates, totalling 80 fits
 Best Parameters: {'C': 10, 'gamma': 0.01, 'kernel': 'rbf'}
 Best Score: 0.9736263736263737
 Tuned Model Accuracy: 0.9824561403508771
              precision    recall  f1-score   support

           0       1.00      0.95      0.98        43
           1       0.97      1.00      0.99        71

    accuracy                           0.98       114
   macro avg       0.99      0.98      0.98       114
weighted avg       0.98      0.98      0.98       114
```


SVM Decision Boundary (RBF Kernel on 2 features)
0
1
mean texture
mean radius
3
2
1
0
−1
−2
−3
−2
−1
0
1
2
3
4