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**Aim:**

To implement a Multi class classification algorithm with SVM. Also, to include gridSearch to fine tune hyper parameters for max performance.

**Dataset description:**

The dataset used in this code is the digits dataset from scikit-learn. It consists of 8x8 pixel images of handwritten digits (0 through 9). Each image is represented as an array of 64 numerical values, where each value represents the brightness of a pixel. The target variable (y) corresponds to the digit depicted in each image. The dataset is commonly used for classification tasks, particularly for digit recognition.

**Code:**

1. **Common Dataset:**

from sklearn.datasets import load\_digits

from sklearn.model\_selection import train\_test\_split, GridSearchCV

from sklearn.svm import SVC

from sklearn.metrics import classification\_report

# Load dataset

digits = load\_digits()

X, y = digits.data, digits.target

# Split dataset into training and testing sets

X\_train, X\_test, y\_train, y\_test = train\_test\_split(X, y, test\_size=0.2, random\_state=42)

# Define the parameter grid to search

param\_grid = {'C': [0.1, 1, 10, 100], 'gamma': [0.001, 0.01, 0.1, 1], 'kernel': ['rbf', 'linear', 'poly', 'sigmoid']}

# Create SVM classifier

svm = SVC()

# Perform grid search with cross-validation

grid\_search = GridSearchCV(estimator=svm, param\_grid=param\_grid, cv=5, scoring='accuracy', n\_jobs=-1)

grid\_search.fit(X\_train, y\_train)

# Best parameters found

print("Best Parameters:", grid\_search.best\_params\_)

# Evaluate model on test set

best\_svm = grid\_search.best\_estimator\_

y\_pred = best\_svm.predict(X\_test)

# Print classification report

print(classification\_report(y\_test, y\_pred))

**Result:**

Best Parameters: {'C': 10, 'gamma': 0.001, 'kernel': 'rbf'}

precision recall f1-score support

0 1.00 1.00 1.00 33

1 1.00 1.00 1.00 28

2 1.00 1.00 1.00 33

3 1.00 0.97 0.99 34

4 1.00 1.00 1.00 46

5 0.98 0.98 0.98 47

6 0.97 1.00 0.99 35

7 0.97 0.97 0.97 34

8 1.00 1.00 1.00 30

9 0.97 0.97 0.97 40

accuracy 0.99 360

macro avg 0.99 0.99 0.99 360

weighted avg 0.99 0.99 0.99 360

**Result Description:**

The grid search with cross-validation was performed on the SVM classifier using various combinations of hyperparameters, including the regularization parameter (C), the kernel coefficient (gamma), and the choice of kernel function (rbf, linear, poly, sigmoid). The best parameters found by the grid search were used to train the SVM model on the training set. The trained model was then evaluated on the test set using classification metrics, including precision, recall, and F1-score, to assess its performance in predicting the digits represented by the images. The classification report provides a detailed summary of the model's performance, including accuracy, precision, recall, and F1-score for each class.

**Conclusion:**

Thus the multiclass classification using SVM with gridSearch to fine tune hyper parameters is successfully implemented and executed achieving maximum performance.