MACHINE LEARNING – 2CS501

PRACTICAL 7

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Roll No.: 19BCE023

Batch No.: A-1

1) Linear SVC

Code:

```
from sklearn import svm, datasets, metrics
from sklearn.metrics import classification_report, confusion_matrix

if __name__ == '__main__':
    X, y = datasets.load_iris(return_X_y=True)

    X_train = X[range(0, 150, 2), :]
    y_train = y[range(0, 150, 2)]

    X_test = X[range(1, 150, 2), :]
    y_test = y[range(1, 150, 2)]

    clf = svm.LinearSVC(max_iter=5000)  # default = 1000
    clf.fit(X_train, y_train)

    prediction = clf.predict(X_test)

    print("Predicted Output : \n", prediction)
    print("\nAccuracy: ", (metrics.accuracy_score(prediction, y_test, normalize=True)) *
100)
    print("\nClassification report :\n", classification_report(y_test, prediction))
    print("\nConfusion Matrix :\n", confusion_matrix(y_test, prediction))

"""
For Multiple CLasses :

Linear SVC means one vs one
SVC means one vs all
"""

"""

Predicted Output :
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 2 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 1 2 2 2 2 2 2
 2]

Accuracy:  96.0

Classification report :
              precision    recall  f1-score   support
```

```
           0       1.00      1.00      1.00        25
           1       0.92      0.96      0.94        25
           2       0.96      0.92      0.94        25

    accuracy                           0.96        75
   macro avg       0.96      0.96      0.96        75
weighted avg       0.96      0.96      0.96        75


Confusion Matrix :
 [[25  0  0]
 [ 0 24  1]
 [ 0  2 23]]

"""
```

2) SVC

Code:

```
from sklearn import datasets, metrics
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVC
from sklearn.metrics import confusion_matrix, classification_report

X, y = datasets.load_iris(return_X_y=True)

X_train = X[range(0, 150, 2), :]
y_train = y[range(0, 150, 2)]

X_test = X[range(1, 150, 2), :]
y_test = y[range(1, 150, 2)]

param_grid = {"C": [0.1, 1, 10, 50, 100, 1000],
              "gamma": [10, 1, 0.1, 0.01, 0.001, 0.0001],
              "kernel": ["rbf"]}

grid = GridSearchCV(SVC(), param_grid, refit=True, verbose=3)

grid.fit(X_train, y_train)

print(grid.best_params_)
print(grid.best_estimator_)

prediction = grid.predict(X_test)
print("Predicted Output : \n", prediction)
print("\nAccuracy: ", (metrics.accuracy_score(prediction, y_test, normalize=True)) * 100)
print("\nClassification report :\n", classification_report(y_test, prediction))
print("\nConfusion Matrix :\n", confusion_matrix(y_test, prediction))

"""

Fitting 5 folds for each of 36 candidates, totalling 180 fits
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   2 out of   2 | elapsed:    0.0s remaining:    0.0s
[CV] C=0.1, gamma=10, kernel=rbf .....................................
[CV] ......... C=0.1, gamma=10, kernel=rbf, score=0.933, total=   0.0s
[CV] C=0.1, gamma=10, kernel=rbf .....................................
[CV] ......... C=0.1, gamma=10, kernel=rbf, score=0.600, total=   0.0s
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[CV] C=100, gamma=10, kernel=rbf ...................................
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[CV] C=100, gamma=10, kernel=rbf ...................................
[CV] ......... C=100, gamma=10, kernel=rbf, score=0.733, total=   0.0s
[CV] C=100, gamma=10, kernel=rbf ...................................
[CV] ......... C=100, gamma=10, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=10, kernel=rbf ...................................
[CV] ......... C=100, gamma=10, kernel=rbf, score=0.867, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ....................................
[CV] .......... C=100, gamma=1, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ....................................
[CV] .......... C=100, gamma=1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf ....................................
[CV] .......... C=100, gamma=1, kernel=rbf, score=0.867, total=   0.0s
```

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[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] .......... C=100, gamma=1, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=1, kernel=rbf .....................................
[CV] .......... C=100, gamma=1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ........ C=100, gamma=0.1, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ........ C=100, gamma=0.1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ........ C=100, gamma=0.1, kernel=rbf, score=0.867, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ........ C=100, gamma=0.1, kernel=rbf, score=0.867, total=   0.0s
[CV] C=100, gamma=0.1, kernel=rbf ...................................
[CV] ........ C=100, gamma=0.1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ....... C=100, gamma=0.01, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ....... C=100, gamma=0.01, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ....... C=100, gamma=0.01, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ....... C=100, gamma=0.01, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.01, kernel=rbf ..................................
[CV] ....... C=100, gamma=0.01, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ...... C=100, gamma=0.001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ...... C=100, gamma=0.001, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ...... C=100, gamma=0.001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ...... C=100, gamma=0.001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.001, kernel=rbf .................................
[CV] ...... C=100, gamma=0.001, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] ..... C=100, gamma=0.0001, kernel=rbf, score=0.800, total=   0.0s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] ..... C=100, gamma=0.0001, kernel=rbf, score=1.000, total=   0.0s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] ..... C=100, gamma=0.0001, kernel=rbf, score=0.800, total=   0.0s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] ..... C=100, gamma=0.0001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=100, gamma=0.0001, kernel=rbf ................................
[CV] ..... C=100, gamma=0.0001, kernel=rbf, score=0.867, total=   0.0s
[CV] C=1000, gamma=10, kernel=rbf ...................................
[CV] ........ C=1000, gamma=10, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=10, kernel=rbf ...................................
[CV] ........ C=1000, gamma=10, kernel=rbf, score=0.800, total=   0.0s
[CV] C=1000, gamma=10, kernel=rbf ...................................
[CV] ........ C=1000, gamma=10, kernel=rbf, score=0.733, total=   0.0s
[CV] C=1000, gamma=10, kernel=rbf ...................................
[CV] ........ C=1000, gamma=10, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=10, kernel=rbf ...................................
[CV] ........ C=1000, gamma=10, kernel=rbf, score=0.867, total=   0.0s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ......... C=1000, gamma=1, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ......... C=1000, gamma=1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ......... C=1000, gamma=1, kernel=rbf, score=0.867, total=   0.0s
[CV] C=1000, gamma=1, kernel=rbf ....................................
[CV] ......... C=1000, gamma=1, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=1, kernel=rbf ....................................
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[CV] ......... C=1000, gamma=1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] ....... C=1000, gamma=0.1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] ....... C=1000, gamma=0.1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] ....... C=1000, gamma=0.1, kernel=rbf, score=0.867, total=   0.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] ....... C=1000, gamma=0.1, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.1, kernel=rbf ..................................
[CV] ....... C=1000, gamma=0.1, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ...... C=1000, gamma=0.01, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ...... C=1000, gamma=0.01, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ...... C=1000, gamma=0.01, kernel=rbf, score=0.867, total=   0.0s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ...... C=1000, gamma=0.01, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.01, kernel=rbf .................................
[CV] ...... C=1000, gamma=0.01, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] ..... C=1000, gamma=0.001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] ..... C=1000, gamma=0.001, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] ..... C=1000, gamma=0.001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] ..... C=1000, gamma=0.001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.001, kernel=rbf ................................
[CV] ..... C=1000, gamma=0.001, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] .... C=1000, gamma=0.0001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] .... C=1000, gamma=0.0001, kernel=rbf, score=1.000, total=   0.0s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] .... C=1000, gamma=0.0001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] .... C=1000, gamma=0.0001, kernel=rbf, score=0.933, total=   0.0s
[CV] C=1000, gamma=0.0001, kernel=rbf ...............................
[CV] .... C=1000, gamma=0.0001, kernel=rbf, score=1.000, total=   0.0s
{'C': 1, 'gamma': 1, 'kernel': 'rbf'}
SVC(C=1, gamma=1)
Predicted Output :
 [0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 2 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 2]

Accuracy:  98.66666666666667
[Parallel(n_jobs=1)]: Done 180 out of 180 | elapsed:    0.1s finished

Classification report :
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        25
           1       1.00      0.96      0.98        25
           2       0.96      1.00      0.98        25

    accuracy                           0.99        75
   macro avg       0.99      0.99      0.99        75
weighted avg       0.99      0.99      0.99        75
```

```
Confusion Matrix :
 [[25  0  0]
 [ 0 24  1]
 [ 0  0 25]]

"""
```

3) SVR

Code:

```
import numpy as np
from sklearn import datasets, metrics, svm
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVR


X, y = datasets.load_boston(return_X_y=True)

X_train_temp1 = X[0:400, :]
X_train = np.ones((X_train_temp1.shape[0], X_train_temp1.shape[1] + 1))
X_train[:, 1:] = X_train_temp1
y_train = y[:400]
X_test_temp1 = X[400:506, :]
X_test = np.ones((X_test_temp1.shape[0], X_test_temp1.shape[1] + 1))
X_test[:, 1:] = X_test_temp1
y_test = y[400:506]

scaler = StandardScaler()
scaler.fit(X_train[:, 1:])
X_train[:, 1:] = scaler.transform(X_train[:, 1:])
X_test[:, 1:] = scaler.transform(X_test[:, 1:])

clf1 = svm.LinearSVR(max_iter=1000, C=0.1)  # default = 1000
clf1.fit(X_train, y_train)

prediction = clf1.predict(X_test)

print("MAE: ", metrics.mean_absolute_error(y_true=y_test, y_pred=prediction))
print("MSE: ", metrics.mean_squared_error(y_true=y_test, y_pred=prediction))

"""
Grid Search For SVR:

param_grid = {"C": [25, 50, 100, 1000],
              "gamma": [0.001, 0.0001, 0.00001],
              "kernel": ["rbf"]}

grid = GridSearchCV(SVR(), param_grid, refit=True, verbose=3)

grid.fit(X_train, y_train)

print(grid.best_params_)
//gamma = 0.00001 and C = 50
print(grid.best_estimator_)

prediction = grid.predict(X_test)
```

```
print("MAE: ", metrics.mean_absolute_error(y_true=y_test, y_pred=prediction))
print("MSE: ", metrics.mean_squared_error(y_true=y_test, y_pred=prediction))
"""


"""

MAE:  3.197004730519652
MSE:  20.10695477659058

"""
```