Pattern & Anomaly Detection Lab

Experiment 12

Support Vector Machines

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AIML B3

Submitted To:

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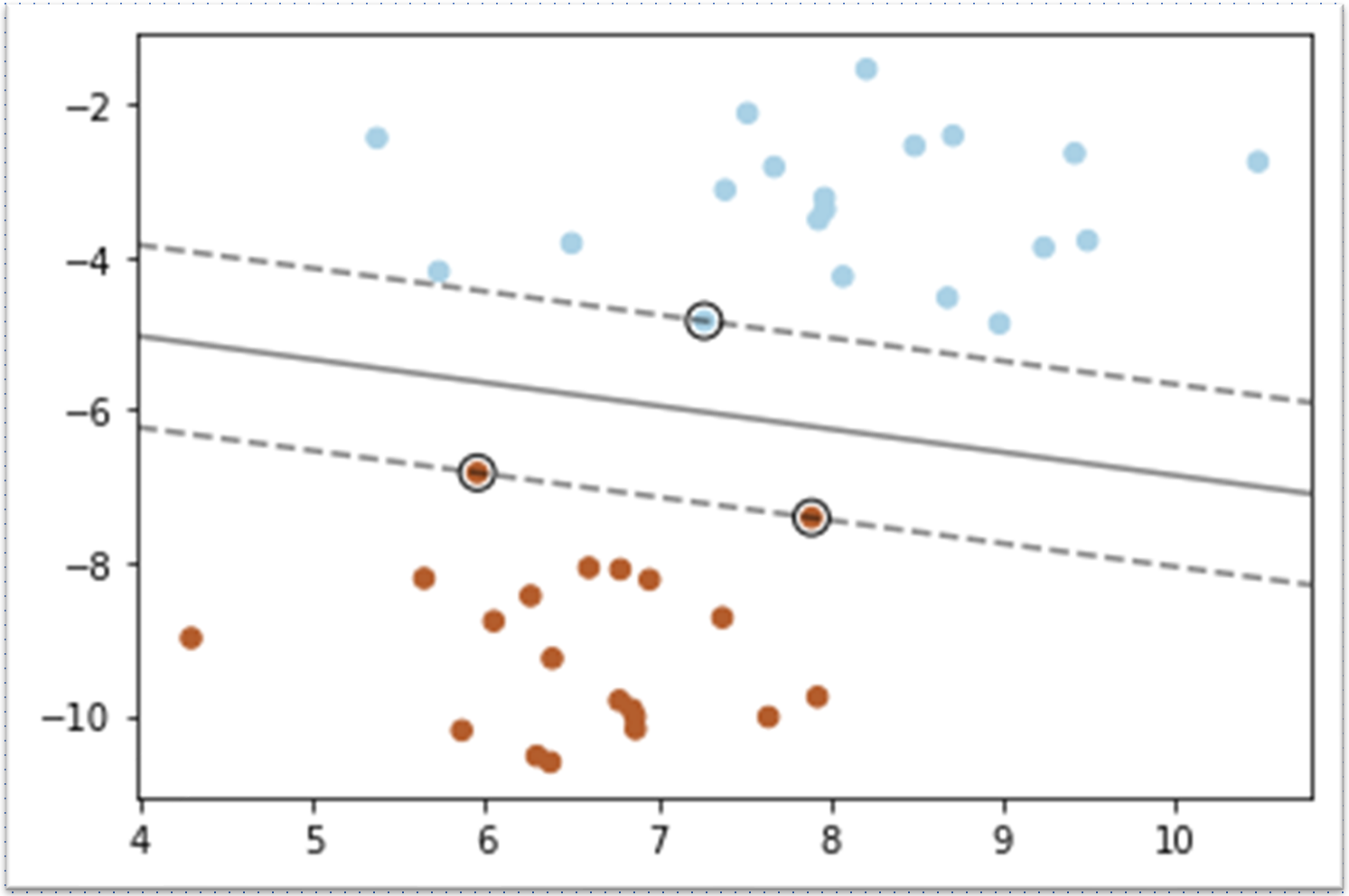
SOCS

UPES

CODE:

```python
import numpy as np
import matplotlib.pyplot as plt
from sklearn import svm
from sklearn.datasets import make_blobs


# we create 40 separable points
X, y = make_blobs(n_samples=40, centers=2, random_state=6)

# fit the model, don't regularize for illustration purposes
clf = svm.SVC(kernel="linear", C=1000)
clf.fit(X, y)

plt.scatter(X[:, 0], X[:, 1], c=y, s=30, cmap=plt.cm.Paired)

# plot the decision function
ax = plt.gca()
xlim = ax.get_xlim()
ylim = ax.get_ylim()

# create grid to evaluate model
xx = np.linspace(xlim[0], xlim[1], 30)
yy = np.linspace(ylim[0], ylim[1], 30)
YY, XX = np.meshgrid(yy, xx)
xy = np.vstack([XX.ravel(), YY.ravel()]).T
Z = clf.decision_function(xy).reshape(XX.shape)

# plot decision boundary and margins
ax.contour(
    XX, YY, Z, colors="k", levels=[-1, 0, 1], alpha=0.5, linestyles=["--", "-", "--"]
)
# plot support vectors
ax.scatter(
    clf.support_vectors_[:, 0],
    clf.support_vectors_[:, 1],
    s=100,
    linewidth=1,
    facecolors="none",
    edgecolors="k",
)
plt.show()
```

OUTPUT:

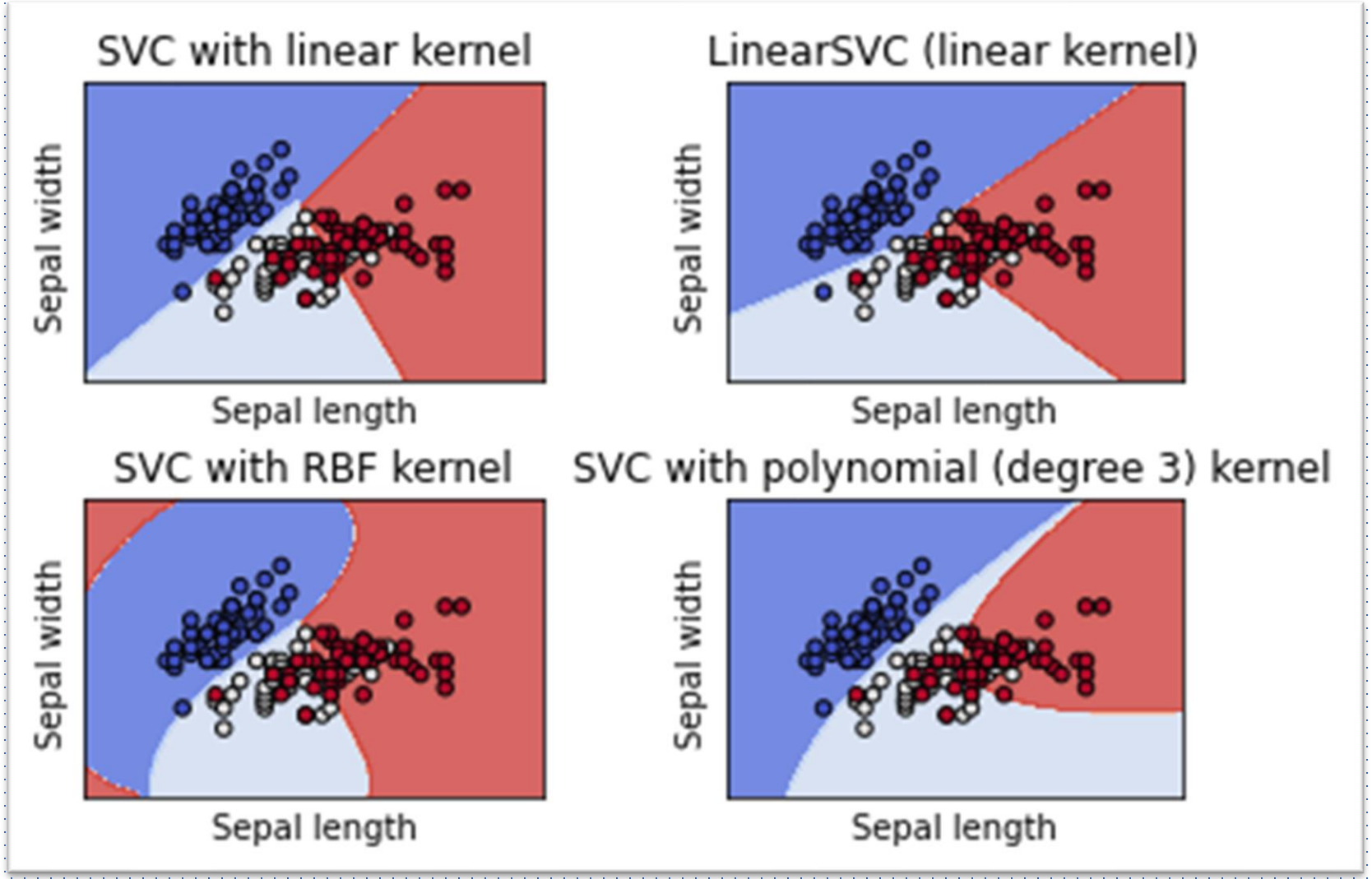


CODE:

```python
import numpy as np
import matplotlib.pyplot as plt
from sklearn import svm, datasets


def make_meshgrid(x, y, h=0.02):
    """Create a mesh of points to plot in

    Parameters
    ----------
    x: data to base x-axis meshgrid on
    y: data to base y-axis meshgrid on
    h: stepsize for meshgrid, optional

    Returns
    -------
    xx, yy : ndarray
    """
    x_min, x_max = x.min() - 1, x.max() + 1
    y_min, y_max = y.min() - 1, y.max() + 1
    xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
    return xx, yy


def plot_contours(ax, clf, xx, yy, **params):
    """Plot the decision boundaries for a classifier.

    Parameters
    ----------
    ax: matplotlib axes object
    clf: a classifier
    xx: meshgrid ndarray
    yy: meshgrid ndarray
    params: dictionary of params to pass to contourf, optional
    """
    Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])
```

```
    Z = Z.reshape(xx.shape)
    out = ax.contourf(xx, yy, Z, **params)
    return out


# import some data to play with
iris = datasets.load_iris()
# Take the first two features. We could avoid this by using a two-dim dataset
X = iris.data[:, :2]
y = iris.target

# we create an instance of SVM and fit out data. We do not scale our
# data since we want to plot the support vectors
C = 1.0  # SVM regularization parameter
models = (
    svm.SVC(kernel="linear", C=C),
    svm.LinearSVC(C=C, max_iter=10000),
    svm.SVC(kernel="rbf", gamma=0.7, C=C),
    svm.SVC(kernel="poly", degree=3, gamma="auto", C=C),
)
models = (clf.fit(X, y) for clf in models)

# title for the plots
titles = (
    "SVC with linear kernel",
    "LinearSVC (linear kernel)",
    "SVC with RBF kernel",
    "SVC with polynomial (degree 3) kernel",
)

# Set-up 2x2 grid for plotting.
fig, sub = plt.subplots(2, 2)
plt.subplots_adjust(wspace=0.4, hspace=0.4)

X0, X1 = X[:, 0], X[:, 1]
xx, yy = make_meshgrid(X0, X1)

for clf, title, ax in zip(models, titles, sub.flatten()):
    plot_contours(ax, clf, xx, yy, cmap=plt.cm.coolwarm, alpha=0.8)
    ax.scatter(X0, X1, c=y, cmap=plt.cm.coolwarm, s=20, edgecolors="k")
    ax.set_xlim(xx.min(), xx.max())
    ax.set_ylim(yy.min(), yy.max())
    ax.set_xlabel("Sepal length")
    ax.set_ylabel("Sepal width")
    ax.set_xticks(())
    ax.set_yticks(())
    ax.set_title(title)

plt.show()
```

OUTPUT:

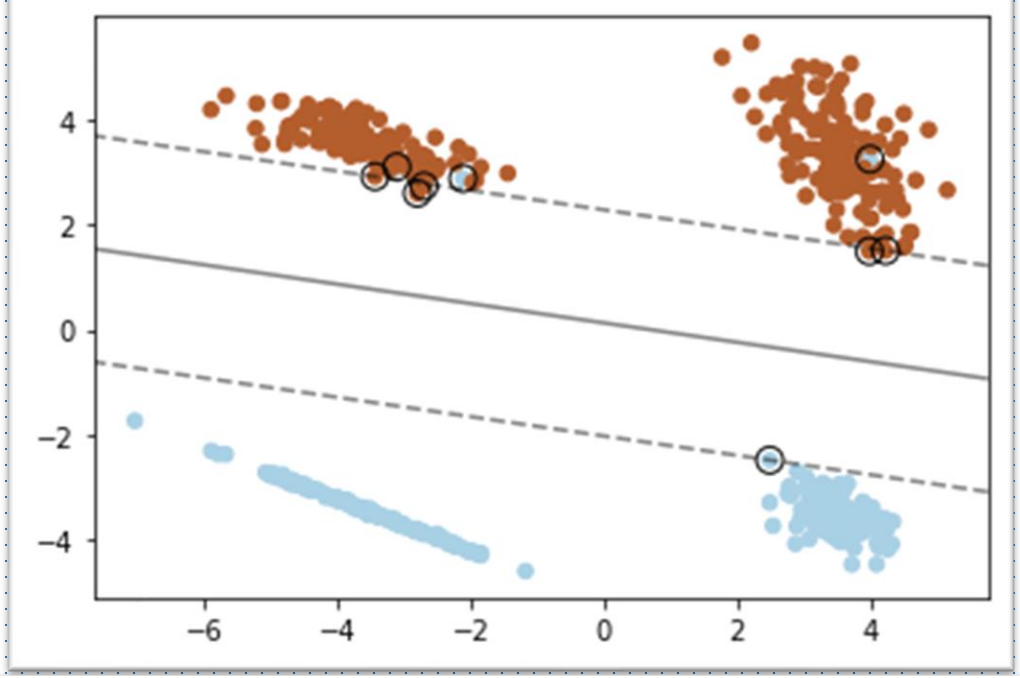

SVC with linear kernel
LinearSVC (linear kernel)
SVC with RBF kernel
SVC with polynomial (degree 3) kernel
Sepal width
Sepal length
Sepal width
Sepal length
Sepal width
Sepal length
Sepal width
Sepal length

CODE:

```python
import numpy as np
import matplotlib.pyplot as plt
from sklearn import svm
from sklearn.datasets import make_classification


# we create 40 separable points
X, y= make_classification(n_samples=500,n_features=2,n_classes=2,n_informative=2,n_redundant=0,n_repeated=0,random_state=50,class_sep=3.5)
# from sklearn.model_selection import train_test_split
# X,X_t,y,y_t=train_test_split(X1,y1,test_size=0.25,random_state=42)
# fit the model, don't regularize for illustration purposes
clf = svm.SVC(kernel="linear", C=1000)
clf.fit(X, y)

plt.scatter(X[:, 0], X[:, 1], c=y, s=30, cmap=plt.cm.Paired)

# plot the decision function

ax = plt.gca()
xlim = ax.get_xlim()
ylim = ax.get_ylim()

# create grid to evaluate model
xx = np.linspace(xlim[0], xlim[1], 30)
yy = np.linspace(ylim[0], ylim[1], 30)
YY, XX = np.meshgrid(yy, xx)
xy = np.vstack([XX.ravel(), YY.ravel()]).T
Z = clf.decision_function(xy).reshape(XX.shape)

# plot decision boundary and margins
ax.contour(
    XX, YY, Z, colors="k", levels=[-1, 0, 1], alpha=0.5, linestyles=["--", "-", "--"]
)
# plot support vectors
ax.scatter(
    clf.support_vectors_[:, 0],
    clf.support_vectors_[:, 1],
    s=100,
    linewidth=1,
    facecolors="none",
```

```
    edgecolors="k",
)

plt.show()
#%%

from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
clf = svm.SVC(kernel='linear', C=2)
kf=KFold(n_splits=70)
score=cross_val_score(clf, X, y, cv=kf)
print("Cross Validation Scores are {}".format(score))
print("Average Cross Validation score :{}".format(score.mean()))


#%%
from sklearn.model_selection import GridSearchCV
tuned_parameters = [{'kernel':["linear"], 'C':[100]},
                    {'kernel':["rbf"], 'C':[90]},


                    ]
clf=GridSearchCV(svm.SVC(),tuned_parameters,scoring=('accuracy'))
clf.fit(X,y)
print("Best parameters set found on development set:")
print()
print(clf.best_params_)
print()
print("Best Score:",clf.best_score_)
z=clf.cv_results_

#%% kfold cross validation with hyperparameter tuning
from sklearn.model_selection import KFold
k = 5
kf = KFold(n_splits=k, random_state=None)
model = GridSearchCV(svm.SVC(),tuned_parameters,scoring=('accuracy'))

for train_index , test_index in kf.split(X):
    X_train , X_test = X[train_index,:],X[test_index,:]
    y_train , y_test = y[train_index] , y[test_index]

    model.fit(X_train,y_train)
    pred_values = model.predict(X_test)
print("Best parameters set found on development set:")
print()
print(model.best_params_)
print()
print("Best Score:",model.best_score_)
z2=model.cv_results_

#%%
```

OUTPUT:




```
Cross Validation Scores are [1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         0.85714286 1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         0.85714286 1.         1.         1.         1.
 1.         0.85714286 1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.        ]
Average Cross Validation score :0.9938775510204081
Best parameters set found on development set:

{'C': 100, 'kernel': 'linear'}

Best Score: 0.994
Best parameters set found on development set:

{'C': 100, 'kernel': 'linear'}

Best Score: 0.9924999999999999
```