Assignment 4 EECS545

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1 SVM classifier

1.1 The number of support vector

Linear kernel(identity kernel,C =1), SVs for each class[6 6]
Linear kernel(identity kernel,C =100),SVs for each class[5 5]
Gaussian kernel C=1, SVs for each class:[12 12]
Gaussian kernel C=3, SVs for each class:[11 10]

1.2 Plots

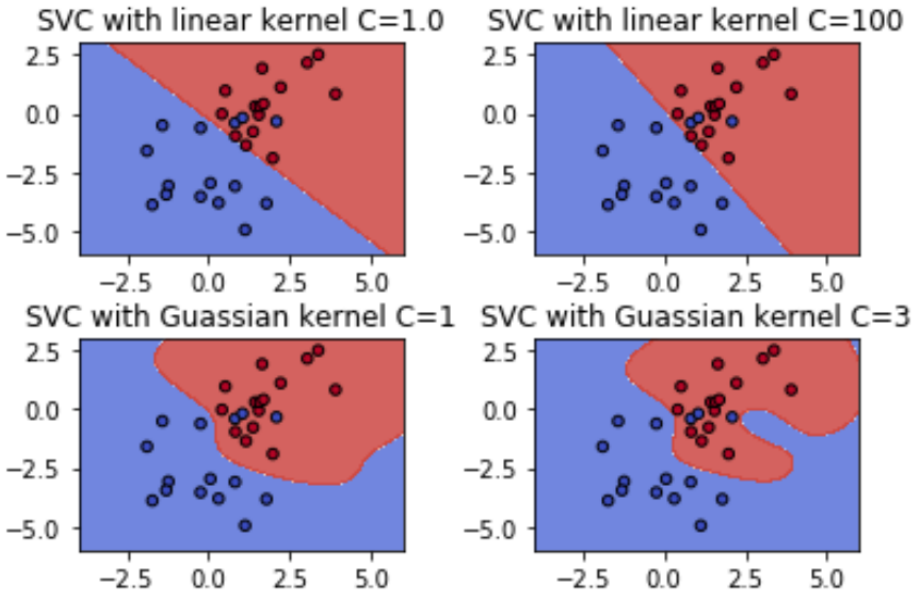

Figure 1: SVC for each kernel

2 SVM classifier on MNIST dataset

2.1 Guesses the class label uniformly at random

The accuracy will be 10% since there are 10 choices of labels for each one. Given one sample, the classifier can classify it in its right label. However,when the labels are randomly assigned, there are 1/10 probability that assigned label equals classified label.

2.2 C = 1 γ = 1 with an RBF kernel

Accuracy = 16.18%

2.3 γ parameter influence

A classifier with high γ has low bias and high variance.

In this RBF kernel,when γ is large meaning the width of normal distribution(σ) is small.So we care about the nearby points more than far away points(lower probability).In this case, it will cause over-fitting (fits this particular training set well, but does bad in other training set or test set). This results in low bias meaning that fit this data set well and high variance meaning sensitive to training set.

On contrast, if we have low γ, we will have high bias and low variance.

2.4 Fold cross-validation

The best cross-validation is:
C=3,γ=0.05, accuracy =96.57 %
C=5,γ=0.05, accuracy =96.57%

2.5 Improvement

We can use more cross validation pairs (C and γ). We can use larger data set in order to reduce the variance of model.