DATA 221
Homework 3 (rev 2)

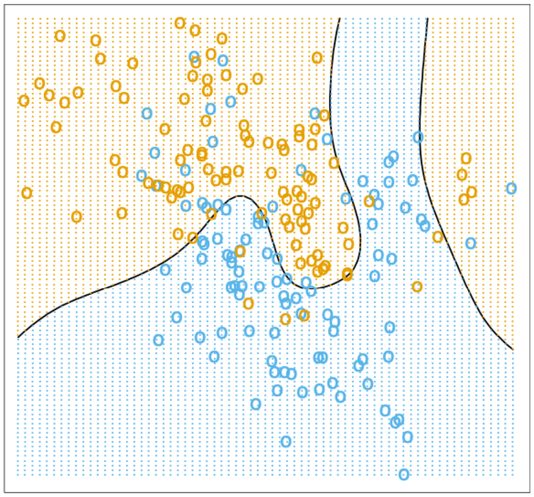
W. Trimble

Due: Friday 2022-04-22

This question asks to you reproduce the graph of overfitting given in Hastie Elements of Statistical Learning Chapter 2.4. The underlying source of the points in the graph was a lumpy mixture of isotropic (same variance in all directions) normal distributions. We will have to generate the parameters of this distribution, generate samples from the distribution, and use k-nearest-neighbors to classify and overfit.

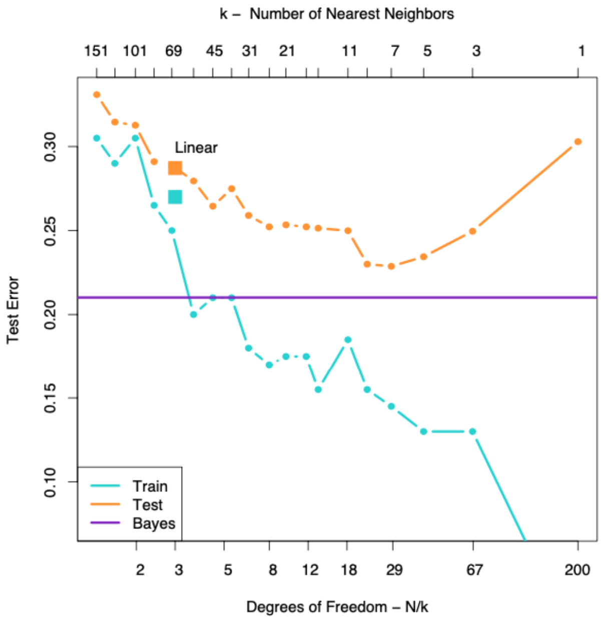
10 means for class 1 and 10 means for class 2 were drawn from a normal distribution in two dimensions centered at (0,1) and (1,0) and a standard deviation of (1,1) and no correlation between x_1 and x_2. Points from each class are realized by choosing one of the subclusters randomly and drawing a random 2d normal with standard deviation 1/5 and no correlation. This is now a lumpy distribution in two dimensions with 10 clusters for class 1 and 10 clusters for class 2.

1. Visualize the Bayes decision boundary between the two classes, the surfaces where the (true) density in class 1 equals the density in class 2. Approximations are fine. Plot a sample of 100 points from each class and present the sample as a scatter plot.



2. Perform K-nearest-neighbor classification for at least six values of k ranging from 1 to 100; use the neighbors of each point to predict the class identity. Evaluate accuracy as a function of k for the training set (with 200 points).

3. Generate a large sample of 10,000 points from each class. Evaluate the accuracy of KNN classification (trained on the 200-point training set) as a funciton of k for the 20,000 points in the test set and plot the accuracy vs. k for the training and the testing data on the same graph. (You could use these points, a sample from the distribution, to estimate the Bayes error rate using the probabilities from Q1, but you don't need to for full credit.)



4. Apply the same technique to the UCI ”default of credit card clients Data Set” of 30,000 credit card customers in Taiwain in 2005. (Yeh & Lien, doi://10.1016/j.eswa.2007.12.020)

   Split the dataset 50/50 into training and test, and try to predict the `default.payment.next.month` using KNN classifiers for four different values of k. Report accuracy on the testing and training datasets.

   You have to choose how to measure distance in a vector space that includes indicator variables and payment amounts. Try to choose something reasonable.

   `https://archive.ics.uci.edu/ml/datasets/default+of+credit+card+clients`