Assignment #6

Linear classifiers

How TA evaluates your assignments:

Report: half of your score will be graded proportional to the quality of your report. You should provide a distinct section for each problem, include the desired outputs and explain what you've done. Don't forget to discuss your results as well. It is not necessary to accommodate your source codes in your reports unless you want to refer to them. Compactness, expressiveness and neatness are of high importance.

Source Code: create an m-file for any problem and write all your codes there. If a problem consists of several sub-problems, separate them by comments in your code. Finally, name your m-files according to the number of the problems.

As you have to upload your submission electronically, it is of high interest to prepare your reports using Microsoft Office tools or Latex. However, scanned handwritten solutions are also acceptable as long as they are readable, neat and expressive.

What to hand in:

You must submit your report (.pdf) and source codes (m-files) for each assignment. Zip all your files into an archive file and use the following template to name it:

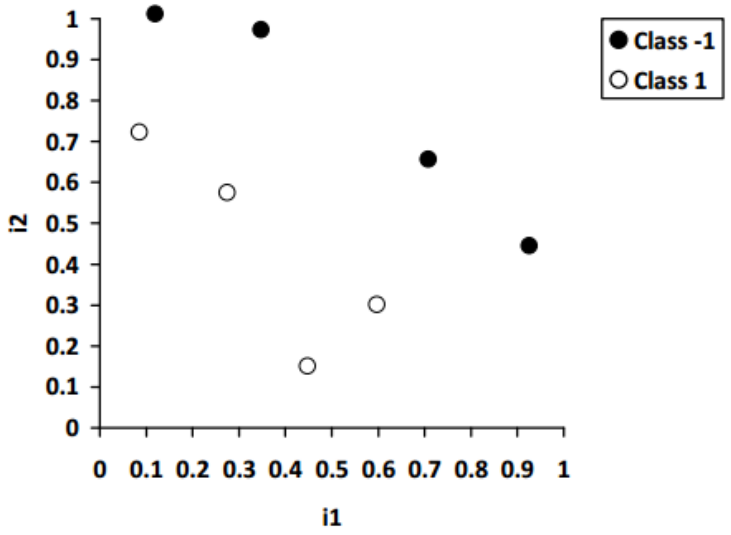
HW6_XXXXX.zip

where XXXXX must be replaced with your student ID. Your file size must not be bigger than 20MB. Send your files to *mohammadhme@gmail.com* with a subject of PR961_HW6_ XXXXX (replace XXXXX with your student number).

The Due Date for This Assignment is: Dey. 14th

Bonus Problems:

1. Consider the samples below:



a. Starting from a random perceptron with weights w0 = 0.2, w1 = 1, w2 = -1, draw the initial separating line of the model on the chart. How many samples are misclassified?

b. Select a misclassified samples and describe how the weights must be updated. Compute the updated weights and draw the new separating line in the same figure (keeping the previous line). You can use any value for learning rate.

c. Repeat part b for 4 steps and sketch the lines in a same figure. Try to keep the resulting figure as clean as possible.

2. You must wrestle with LDA in this exercise. Consider the following 2-D dataset:

$$X_1 = \{(4,1),(2,4),(2,3),(3,6),(4,4)\}$$

$$X_2 = \{(9,10),(6,8),(9,5),(8,7),(10,8)\}$$

   a. Plot the data points (You can use Matlab to plot points, and not for computations)
   b. Compute and plot the LDA projection line.
   c. Project all data points into the resulting subspace. Plot the projected data points.
   d. Discuss the separability of classes in the projected subspace.

3. Consider the standard two class SVM with the hinge loss. Argue that under a given value of regularization parameter:

$$\text{Leave-one-out Error} < \frac{\#SV_s}{l}$$

   Where l is the size of training data and $\#SV_s$ is the number of support vectors obtained by training SVM on the entire set of training data.

Bonus Computer Projects:

Implement the following projects. Make sure that your codes are well-commented. Code-only submissions will gain at most 33/100 pts. So, do not forget to provide a compact, well-documented and informative submission.

1. Implement the following computer exercises from the reference book [1]

Chapter 6:
Q1, Q2, Q3

Reference:

[1] Duda, Richard O., Peter E. Hart, and David G. Stork. Pattern classification. John Wiley & Sons, 2nd Edition.