CS771:Machine learning: tools, techniques, applications
Assignment #2: Linear discriminants

Due on: 30-9-2013   22-9-2013

MM: 150

1. In this assignment you can use the JSci package that provides an API for mathematical, scientific and statistical calculations. You can use the matrix and vector APIs. It is available at: http://jsci.sourceforge.net/

   You must first generate an artificial data set of 1000 vectors divided equally into two classes ω_1 (500 vectors) and ω_2 (500 vectors). You can start with 50 dimensional vectors where the separation is based on the first m dimensions (try with 5, 10 and 20) as follows: generate values for these dimensions randomly in the range $-2a \leq x_i \leq -a$ for ω_1 and $a \leq x_i \leq 2a$ for ω_2 where a is some positive constant. For example, if $a = 1$ we get $-2 \leq x_i \leq -1$ for ω_1 and $1 \leq x_i \leq 2$ for ω_2. For the other dimensions generate random values between $-2a \leq x_j \leq 2a$.

   (a) Implement the batch and incremental perceptron algorithms and try them on the above data set. Try with two types of $\rho(t)$ and report the hyper-plane and number of iterations when perfect classification is achieved.

   (b) Implement the pocket algorithm. You should generate a non-separable data set by generating some vectors (say 10 to 50) where the separating dimensions are generated using the generator for the wrong class. That is use the generator of ω_1 but give it label ω_2 and vice versa. Report the hyper-plane and number of vectors classified correctly (or incorrectly).

   (c) Implement the least mean square algorithm using stochastic gradient descent for both separable and non-separable sets. Report the hyper-plane and the number of vectors classified correctly (or incorrectly).

   You should experiment with different number of separating dimensions to see how it affects convergence.

[50,50,50]