Homework # 11: Support Vector Machines (Chap. 9)

Due May 3.

1. (**Chap. 9, # 3, p. 368**) Here we explore the maximal margin classifier on a toy data set.

   (a) We are given $n = 7$ observations in $p = 2$ dimensions. For each observation, there is an associated class label.

Obs.	X_1	X_2	Y
1	3	4	Red
2	2	2	Red
3	4	4	Red
4	1	4	Red
5	2	1	Blue
6	4	3	Blue
7	4	1	Blue

   Sketch the observations.

   (b) Sketch the optimal separating hyperplane, and provide the equation for this hyperplane such as in exercise #1.

   (c) Describe the classification rule for the maximal margin classifier. It should be something along the lines of "Classify to Red if $\beta_0 + \beta_1 X_1 + \beta_2 X_2 > 0$, and classify to Blue otherwise". Provide the values for β_0, β_1, and β_2.

   (d) On your sketch, indicate the margin for the maximal margin hyperplane.

   (e) Indicate the support vectors for the maximal margin classifier.

   (f) Argue that a slight movement of the seventh observation would not affect the maximal margin hyperplane.

   (g) Sketch a hyperplane that is not the optimal separating hyper- plane, and provide the equation for this hyperplane.

   (h) Draw an additional observation on the plot so that the two classes are no longer separable by a hyperplane.