Homework 3

Homework rules:

- Homeworks are due one week after they are handed out, unless otherwise specified. *No late homeworks accepted!*
- Feel free to talk to other members of the class in doing your homework. I'm more concerned that you learn how to solve the problem, than that you demonstrate that you solved it entirely on your own. You should, however, write up your solution yourself. Please try to keep solutions brief and clear. You may refer to the literature, but do not refer to handouts from previous years' classes (in case I repeat some problems from previous years).

Due Wednesday, October 5

Problem 1.

In this problem, you will show an alternate convergence proof for the perceptron algorithm given in class (under slightly less restrictive assumptions). Assuming that:

- $(\exists M)\ \|x^i\|^2 < M\ (\forall i)$ ($\|x\|$ is not necessarily 1)
- $(\exists \delta > 0)(\exists v \in \mathcal{R}^n)\ v \cdot x^i > \delta\ (\forall i)$ ($\|v\|$ is not necessarily 1)

(a) Give a lower bound for $\|w\|^2$ after k updates have been made. (Hint: The lower bound will depend on k, δ and $\|v\|$).

(b) Give an upper bound for $\|w\|^2$ after k updates have been made. (Hint: The upper bound will depend on k and M.)

(c) Combining (a) and (b), show that the perceptron algorithm converges. What is your upper bound on the number of updates which can occur?

Problem 2.

Do Problem 2.2 (pages 44-45) from the Kearns/Vazirani text, on rank r decision trees.