Problem 1.4

Due on October 12th

Generate a dataset of two-dimensional points, and choose a random line in the plane as your target function f, where one side of the line maps to $+1$ and the other side to -1. Let the inputs $\mathbf{x}_n \in \mathbb{R}^2$ be random points in the plane, and evaluate the target function f on each $\mathbf{x}_n$ to get the corresponding output $y_n = f(\mathbf{x}_n)$.

Experiment with the perceptron algorithm in the following settings:

a. Generate a dataset of size 20. Plot the examples $\{(\mathbf{x}_n, y_n)\}$ as well as the target function f on a plane.

b. Run the perceptron algorithm on the dataset. Report the number of updates that the algorithm takes before converging. Plot the examples $\{(\mathbf{x}_n, y_n)\}$, the target function f, and the final hypothesis g in the same figure.

c. Repeat everything in b) with another randomly generated dataset of size 20, and compare the result to b).

d. Repeat everything in b) with another randomly generated dataset of size 100, and compare the result to b).

e. Repeat everything in b) with another randomly generated dataset of size 1000, and compare the result to b).

f. Modify the experiment such that $\mathbf{x}_n \in \mathbb{R}^{10}$ instead of $\mathbb{R}^2$. Run the algorithm on a randomly generated dataset of size 1000. How many updates does the algorithm take to converge?

g. Summarize your conclusions regarding the accuracy and running time of the algorithm as a function of N (the number of data points) and d (the number of dimensions).