Homework 3

Due: December 10

IMPORTANT: Assignments must be written on a computer, and delivered by email. You should also include your code and guidelines about how to run it.

A. Reinforcement Learning.
1. [10%] Prove that, that if initialized to 0, the values of $\hat{Q}$ function always increase and always are below the values of the ‘actual’ $Q$ function (chapter 13).
2. [25%] Solve exercise 13.2 from the textbook.

B. VC dimension and PAC Learning.
1. [10%] Give a definition for the VC dimension. Why is the VC dimension useful?
2. [25%] Consider the space of instances $X$ corresponding to all points in the $x, y$ plane. Give the VC dimension of the following hypotheses spaces:
   1. $H_r$, the set of all rectangles in the plane.
   2. $H_c$, the set of circles in the plane. Points inside the circle are classified as positive.
   3. $H_t$, the set of triangles in the plane. Points inside the triangle are classified as positive.

C. The EM algorithm.
1. [10%] Use MATLAB to generate a vector containing $n$ numbers drawn from the gaussian distribution with mean $a$, where $a$ is a parameter. This is a very small command in MATLAB. (Hint: help rand). Alternatively you can use your language of preference.
2. [20%] Implement the EM algorithm (section 6.12.1) for estimating the means of 2 Gaussians.
3. [10%] Generate training data, that is numbers drawn randomly from two Gaussian distributions with the same variance and different means. The two means should be your choice. Apply the EM algorithm to them to estimate the two means. Report on your findings.