

Homework 1
CS273A Machine Learning
Fall 2015
Due: Tuesday October 6 11:59pm on EEE

Allowed: Reading (but not copying) pseudocode and code in the recommended/optional books listed in the class Syllabus. Also, reading external pseudocode after you have tried to write your own code.

Not allowed: Other outside/external code reading or code use (eg. copying or execution).

Turn in: 1-page written description of your approach and results, together with source code and I/O files proving your results.

Programming language: Your choice. (If this gets hard to grade we may limit it in later HWs.)

1. Perceptron learning

- (a) Create 9-dimensional input vectors in two classes by drawing two cluster centers from a spherical Gaussian distribution, then scaling down the width of that Gaussian by a factor of α in $(0,1)$ to create N cluster members for each cluster by adding in noise.
- (b) Use a formula to devise a single perceptron to discriminate between the classes. Numerically evaluate its accuracy, by averaging over draws of cluster centers and cluster members, and by systematically varying α and N (make tables or plots). All reported results should have numerically estimated error bars arising from stated probability distributions.
- (c) Use the Perceptron Learning Algorithm to do the same, and evaluate its results the same way but fix α and N from 1(b) and instead vary as parameters the number of iterations of the algorithm and the size of the test set. (Report performance on a test set, not the training set.)

2. Toy OCR.

- (a) create two patterns of 3×3 binary images with the same number of on and off pixels. Add real-valued noise in a controlled way as in 1a, independently for each pixel.
- (b) as in 1b.
- (c) as in 1c.