

ECE/CS 559 Neural Networks, Fall 2017 - Homework #9

Due: 12/03/2017, the end of class.

Erdem Koyuncu

All the notes in the beginning of Homework #1 apply.

1. **(100pts)** In this computer project, we will design an RBF network. You cannot use any existing machine learning library. As usual, please include the computer codes in your report. We will use the same sun-mountain setup as in HW8.
 - (a) Redo steps (a) and (b) of HW8.
 - (b) The goal is to design an RBF network $g(\mathbf{x}) = \sum_{i=1}^{20} \omega_i \phi(\|\mathbf{x} - \mathbf{c}_i\|) + \theta$ with 20 centers. Run the k -means algorithm for 10 centers for class \mathcal{C}_1 . Set these as centers $\mathbf{c}_1, \dots, \mathbf{c}_{10}$, and sketch them. Run the k -means algorithm for 10 centers for class \mathcal{C}_{-1} . Set these as centers $\mathbf{c}_{11}, \dots, \mathbf{c}_{20}$. Sketch these as well, but use different markers compared to ones you used for centers of class \mathcal{C}_1 .
 - (c) Now, run the perceptron training algorithm to determine the weights $\omega_1, \dots, \omega_{20}$ and the bias θ . If you are doing everything correctly, your PTA should converge, and you should be able to separate the two classes perfectly. Provide a rough sketch of the corresponding decision boundary $\{\mathbf{x} : g(\mathbf{x}) = 0\}$.
 - (d) Repeat (b) and (c) for the case of a total of 4 centers. Again use half of the centers for one class, and the other half for the other. Comment on the differences (if any).