

ECE/CS 559 Neural Networks, Fall 2019 - Homework #8

Due: 12/03/2019, 11pm.

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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, including libraries for the k -means algorithm. As usual, please include the computer codes in your report. We will use the same sun-mountain setup as in Homework #7.
 - (a) Redo steps (a) and (b) of Homework #7.
 - (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).