ECE/CS 559 Neural Networks, Fall 2018 - Homework #8
Due: 11/27/2018, the end of class.

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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 $\mathbf{c}_1, \ldots, \mathbf{c}_{10}$, and sketch them. Run the k-means algorithm for 10 centers for class $\mathcal{C}_{-1}$. Set these as centers $\mathbf{c}_{11}, \ldots, \mathbf{c}_{20}$. 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 $\omega_1, \ldots, \omega_{20}$ 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).