EE538 Neural Networks

Homework 1

Let's assume N_1 samples are randomly distributed with a probability density $p_1(x, y)$, N_2 samples with $p_2(x, y)$, and N_3 samples with $p_3(x, y)$ in a (x,y) 2-dimensional space.

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1. For the case of $p_1(x, y) = 1/\pi$ for $x^2 + y^2 < 1$, $p_2(x, y) = 1/4\pi$ for $(x - 3)^2 + y^2 < 4$, and $p_3(x, y) = 4/\pi$ for $x^2 + (y - 1.5)^2 < 0.25$ and also $N_1 = N_2 = N_3 = 100$,
   (a) Generate the data and make scatter plots (one dot for each sample on a 2-dimensional space) of all samples. (5 points)
   (b) Develop a computer code for the clustering with Competitive learning and try to cluster into 3 clusters. You may use any programming language with simple mathematical and vector-matrix operations, but NOT allowed to use high-level packages. Show the learning curve, i.e., error values as a function of the learning epoch (5 points), and the final clustered results (5 points) [Hint: You may use different color for each cluster in the 2-dimensional scatter plot.]
   (c) Repeat (b) with 2 clusters. (5 points)
   (d) Repeat (b) with 4 clusters. (5 points)

2. Repeat Problem 1 for the case of $p_1(x, y) \propto \exp[-(x^2 + y^2)/2]$, $p_2(x, y) \propto \exp[-((x - 3)^2 + y^2)/8]$, and $p_3(x, y) \propto \exp[-2(x^2 + (y - 1.5)^2)]$. (25 points)

3. Repeat Problem 1 with $N_1 = N_3 = 100$ and $N_2 = 200$. (25 points)

4. Repeat Problem 2 with $N_1 = N_3 = 100$ and $N_2 = 200$. (25 points)