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In-Class Problems

Assume:

- We want to cluster a data set with SOM.
- Data set contains 200 samples
- Each sample has 3 features
- Maximum iterations (k) = 100
- Initial learning rate (L_0) = 0.9

Problems:

1. Remembering that we want a square map (D X D), what is a good value for D?
2. What is the radius of the map (σ_0)?
3. The first step in the SOM learning process is to find the BMU, which requires calculating the distance between the sample and each neuron. If a sample's features are (0.1,0.3,0.4), what is the distance between that sample and the map neuron with the weights (0.2,0.5,0.6)?
4. What is the radius value for iteration 9, i.e., σ(9)?
5. What is the learning rate for iteration 9, i.e., L(9)?
6. If the BMU is located at (1,1) in the map, what is distBMU for its neighbor located at (2,2)?
7. For the BMU and neighbor in 6 above, what is Θ(t) for iteration 9 (t)?
8. If the neighbor in 7 is the map neuron in 3 (0.2,0.5,0.6) and the input is the sample in 3 (0.1,0.3,0.4), what are the new weights of the map neuron for iteration 10 (t+1)?

1. Remembering that we want a square map (D X D), what is a good value for D?

D = round[sqrt(M)], where M = 5sqrt(N) and N = # of samples.
N = 200, so M = 5sqrt(200) = 70.71, so D = round[sqrt(70.71)] = round(8.408) = 8.
Hence, D = 8

2. What is the radius of the map (σ_0)?

σ_0=D-1=7

3. The first step in the SOM learning process is to find the BMU, which requires calculating the distance between the sample and each neuron. If a sample's features are (0.1,0.3,0.4), what is the distance between that sample and the map neuron with the weights (0.2,0.5,0.6)?

   $Distance^2$ = SUM from i=0 to n $(input_i - weight)^2$

   $Distance^2 = [(0.1-0.2)^2 + (0.3-0.5)^2 + (0.4-0.6)^2] = [0.01 + 0.04 + 0.04] = 0.09$ Distance = sqrt(0.09) = 0.3

4. What is the radius value for iteration 9, i.e., σ(9)?

   $\sigma(t)=\sigma_0 e^{-t/\lambda}$,$\lambda=k/\sigma_0$ => $\lambda = 100/7$

   $\sigma(9) = 7*e^{-9/(100/7)} = 3.73$

5. What is the learning rate for iteration 9, i.e., L(9)?

   $L(t) = L_0 e^{-t/\lambda}$

   $\lambda = 100/7$
   $L(9) = 0.9*e^{-9/(100/7)} = 0.479$

6. If the BMU is located at (1,1) in the map, what is distBMU for its neighbor located at (2,2)?

   $sqrt[(x_{BMU}-x_{neighbor})^2+(y_{BMU}-y_{neighbor})^2] = sqrt[(1-2)^2+(1-2)^2] = sqrt[1+1] = sqrt[2] = 1.414$

7. For the BMU and neighbor in 6 above, what is Θ(t) for iteration 9 (t)?

   $\Theta(t) = e^{(-distBMU^2)/(2*[\sigma(t)]^2)} = \Theta(9) = e^{(-2)/(2*[3.73]^2)} = 0.93$

8. If the neighbor in 7 is the map neuron in 3 (0.2,0.5,0.6) and the input is the sample in 3 (0.1,0.3,0.4), what are the new weights of the map neuron for iteration 10 (t+1)?

   weight(t+1) = weight(t) + Θ(t)L(t)[input(t)-weight(t)]
   weight(9+1) = weight(9) + Θ(9)L(9)[input(9)-weight(9)]
   weight(10) = (0.2,0.5,0.6) + 0.930*.479[(0.1,0.3,0.4)-(0.2,0.5,0.6)]
   weight(10) = (0.2,0.5,0.6) + 0.930*.479[(-0.1,-0.2,-0.2)]
   weight(10) = (0.2,0.5,0.6) + 0.930*.479[(-0.1,-0.2,-0.2)]
   weight(10) = (0.2,0.5,0.6) + [(-0.045,-0.089,-0.089)] weight(10) = (0.155, 0.411, 0.511)