In Class Activity – Self Organizing Maps (ICA 17) - Solutions

Please enter your responses to the questions at https://tinyurl.com/AIF19-ICA17

You've worked through the first two epochs on the 2 cluster self organizing map example in class. For reference, here are the input vectors:

(1, 1, 0, 0); (0, 0, 0, 1); (1, 0, 0, 0); (0, 0, 1, 1).

Questions:

1) The learning rate geometrically decreases at a rate of 0.5. The initial value was 0.6 for epoch 1. For epoch 2 it decreased to 0.3. What is the learning rate ***α*** for the next epoch?

Solution:

$\alpha(t+1) = 0.5 * \alpha(t)$

$\alpha(3) = 0.5 * 0.3 = 0.15$

2) For the third epoch, we obtained the following weight matrix after processing the first three inputs.

W =

[0.013 0.989
0.04 0.387
0.538 0.04
0.993 0.017]

What is the final weight matrix after processing the last input $I_4 = (0, 0, 1, 1)$?

Solution:

Calculate the euclidean distance between input I_4 and cluster 1:

$D(1) = \Sigma(Wij - Ii)^2 = (0.013 - 0)^2 + (0.04 - 0)^2 + (0.538 - 1)^2 + (0.993 - 1)^2 = 0.22$

Calculate the euclidean distance between input I_4 and cluster 2:

$D(2) = \Sigma(Wij - Ii)^2 = (0.989 - 0)^2 + (0.387 - 0)^2 + (0.04 - 1)^2 + (0.017 - 1)^2 = 3.02$

Since D(1) is closer we update the weights for that cluster:

$W_1 = W_1 + \alpha * (I_4 - W_1) = [0.013, 0.04, 0.538, 0.993] + 0.15 * ([0, 0, 1, 1] - [0.013, 0.04, 0.538, 0.993])$

$W_1 = [0.011, 0.034, 0.6073, 0.994]$

Thus the final weights are:

W =

[0.011 0.989
0.034 0.387
0.607 0.04

0.994 0.017]

3) What cluster (output node) is the input vector (1, 1, 0, 0) assigned to after the third epoch?
Note: the left column of weights is node 1, the right column is node 2.

Solution:
Calculate the euclidean distance from the input to each cluster's weights and take the minimum to decide which to classify.

$D(1) = \Sigma(Wij - Ii)^2 = (0.01 - 1)^2 + (0.03 - 1)^2 + (0.60 - 0)^2 + (0.99 - 0)^2 = 3.3$
$D(2) = \Sigma(Wij - Ii)^2 = (0.99 - 1)^2 + (0.39 - 1)^2 + (0.04 - 0)^2 + (0.01 - 0)^2 = 0.38$
Since D(2) < D(1) **Input (1,1, 0, 0) is classified in cluster 2.**

The following are the results for the other input vectors if you are curious:
Input 2:
D(1) = 0.37
D(2) = 2.1
Since D(1) < D(2) **Input 2 is classified in cluster 1.**
Input 3:
D(1) = 2.3
D(2) = 0.15
Since D(2) < D(1) **Input 3 is classified in cluster 2.**
Input 4:
D(1) = 0.16
D(2) = 3.02
Since D(1) < D(2) **Input 4 is classified in cluster 1.**