

# EECE 6036: Intelligent Systems

## Homework 4: Given 4/11/16; Due 4/21/16

**Problem 1.** (100 points) Consider the contextual map example (taken from Haykin, 1999) that we looked at in class where a  $10 \times 10$  self-organized feature map learns to cluster 16 animals according to a set of 13 attributes. Implement the system as described in the original experiment, keeping the following in mind:

- The input vectors in the original experiment were normalized after they were generated. You can decide to do this or not.
- You might consider varying the learning rate as  $\eta(t) = \eta_0 e^{-t/\tau}$ , where  $\eta_0$  and  $\tau$  are fixed parameters. If you use this, make sure  $\tau$  is large enough to allow real learning.
- The original experiment trained for 2000 passes over the whole data set (so 32,000 steps).

After learning, check the network's response in the two ways used in the original experiment, i.e., probe the network with inputs with all the attribute bits set to zero (so only the animal's identifier is non-zero) and:

1. Identify the neuron with the highest response for each of the 16 animals.
2. For each of the 100 neurons, identify the animal for which it has the highest response.

Summarize your results using the same types of grid plots as in the original case (the matrices showing animal names or dots) and compare with the results in Haykin (1999). Comment on any differences. You should *not* expect results identical to that in the chapter because of different initial weights, learning rate, etc., but do the results make sense?

*Note: A copy of the SOFM chapter from Haykin is in the UnsupervisedNeuralNets subfolder in the Readings II folder on Blackboard. It is also attached here.*

**Problem 2.** (50 points) Having obtained a map of animals and attributes in Problem 1, you now want to check how it responds to new animals described in terms of only their attributes. For this, you use the following six probes with attribute strings:

- a) 0100111000000 (goat)
- b) 0010111000000 (pig)
- c) 1000110001000 (badger)
- d) 0011000010100 (ostrich)
- e) 1001010001010 (bat)
- f) 0010000000001 (blue whale) g) 0010000001001 (killer whale)

In each case, probe with a 29-dimensional vector where all identifiers are 0 (since these animals were not on the training set), but the 13 attribute bits are set as above. Identify the neuron that has the greatest response (winner) in each case and indicate what animal you think the network is identifying these new cases as.

Comment on whether the result does/does not make sense, and why. What does this tell you about the limitations of this system?