Artificial Intelligence

CSC 475

Programming Assignment

Due Date: October 23, 2012 beginning of class
Total Points: 100

Write a console application that generates (and checks) the parity of a 5-bit binary number using an artificial neural network (ANN). This program has two phases, (1) Training phase and (2) Testing phase. Use the back-propagation update rule to train your neural network. The input for the training phase is the name of the file containing a set of initial weights (you can define your own format for storing the weights in this file) and the data set provided in Table 1 (you can hard code the data set in your program). The input for the testing phase is a 5-bit binary number. The output is 1 if the number of 1s in the input is odd and 0 if the number of 1s is even. The architecture of your ANN consists of five nodes in the input layer and one node at the output layer. Making a decision on the number of hidden layers in your ANN is a part of this assignment.

Serial No.	5-Bit Binary Data	Parity
D_0	00000	0
D_1	00001	1
D_2	00010	1
D_3	00011	0
D_4	00100	1
D_5	00101	0
D_6	00110	0
D_7	00111	1
D_8	01000	1
D_9	01001	0
D_{10}	01010	0
D_{11}	01011	1
D_{12}	01100	0
D_{13}	01101	1
D_{14}	01110	1
D_{15}	01111	0

Table 1

Note that the training data is not complete. So you have to do two runs: One with the training data given in Table 1, and second with the complete training data, that is $2^5=32$ possible combinations of input. Test the NN. Compare and contrast your results.

Report and Submission Guidelines

There are several parameters of interest for the training portion of your program. These parameters are (1) the initial set of weights, (2) the learning rate (generally represented by the Greek letter eta "η"), and (3) *the number of iterations required for the ANN to produce the results you submit*. Train your ANN using three different sets of initial weights, with two different values of eta for each set and report (for each trail) the number of iterations required for your ANN.

- You need to submit a one to three pages report that contains results of your simulations. The report should also describe the architecture of your ANN. Also submit a one page "User Manual" describing how to run your code. I have provided a set of guidelines in [Phoha 1997] to help you write the user manual.

- You need to submit a well-documented softcopy of the program along with the report.

- Do not forget to write your name, last four digits of your student id, and the course name on each file. Zip all the files into a single file; name the zipped file as "Userid-Prg1.zip"for example if your user-id is *smith001* then you should name the zipped file as *smith001-Prg1.zip*.

- Upload the report and the (program or programs) as a zipped file to the Moodle system. I will talk about alternative ways of submitting programs, should you have difficulty zipping your files.

Reference

[Phoha 1997]. Phoha, V.V., *A Standard for Software Documentation.* IEEE Computer, 1997: p. 97-98. (Posted on the Moodle system.)