Computer Science 152, Fall 2006
Assignment 2
Due Thursday 16 September 2006

Create a self-contained executable program for training an adaline using the same input data sets as in Assignment 1. Use on-line training. Use the adaline as a classifier in operation (but not training), in the sense that if the output is greater than 0.5 treat it as 1, otherwise treat it as 0. Again, this is just for operation; the 0-1 value does not get used at all in adjusting the weights.

The program should accept between three and five command-line arguments:

- a float indicating the learning rate. (If there is no first argument, use .01 as the rate.)
- a float indicating the goal for the mean-squared error. (If there is no second argument, use .0001 as the goal.)
- an integer limit on the number of epochs used in training. (If there is no third argument, use 500 as the limit.)
- [Extra credit] an integer indicating the transfer function type (0 for linear (ordinary adaline), 1 for logistic sigmoid (i.e. a generalized adaline))
- [Optional, for debugging] 1 if you want detailed trace, 0 otherwise.

For substantially more extra credit, provide an option for batch vs. on-line training.

Training should terminate if *any* of the following conditions holds:

- All samples correctly classified.
- The MSE goal is reached.
- The epoch limit is reached.

Your program should run on all of the data sets that are provided on turing in /cs/cs152/data/, with the following parameter variations:

MSE goal = 0.0001 in all cases
Learning rates of 0.5, 0.1, 0.01, 0.001 [only 0.1 and 0.01 for the logistic case]
500 Epochs limit in all cases

For an input file (`test05.in`) with the following content:

```
1 2
1 1 1
0 0 1
0 1 0
0 0 0
```

my program behaves as follows:

```
adaline 0.1 0.0001 500 0 0 < test05.in
Function is linear.
Learning rate is: 0.1
MSE goal is: 0.0001
Input dimension (not counting bias) is: 2
Samples (with desired output first) are:
desired: 0, inputs: 1 0 0
desired: 0, inputs: 1 1 0
desired: 0, inputs: 1 0 1
desired: 1, inputs: 1 1 1
Initial weights:
0 0 0

MSE in epoch 1: 0.25, 1/4 wrong (25%)

MSE in epoch 2: 0.171794, 1/4 wrong (25%)

MSE in epoch 3: 0.150768, 0/4 wrong (0%)

Final weights:
0.132556 0.198089 0.202581
All 4 samples correctly classified in 3 epochs at rate 0.1 using
linear.
```

You will probably want to refine your program from assignment 1 to do this assignment, but retain a copy of the program before modification for posterity (using version control would be good).

You might want to use a shell script to run through all of the different cases. For example, I used C-shell script, which I've left in the data directory with the name 'runall'.

Your write-up should tabulate final number incorrect and epochs required for each variation. Address the following qualitatively:

- Epochs required to train vs. learning rate
- Comparison to perceptron training in assignment 1
- [Extra credit] Linear vs. logistic behavior
- [Extra credit] Batch vs. on-line behavior