

This assignment involves using backpropagation (BP) learning procedure to train a multi-layer feedforward network to compute the 4-bit parity function. The bipolar representation (plus biases) is recommended. There are total of sixteen training samples  $\mathbf{x} : t$  where vector  $\mathbf{x}$  is a unique 4-bit input pattern and  $t$  is its corresponding target function value. It is well known that  $t = 1$  if  $\mathbf{x}$  contains odd number of 1's, and  $t = -1$ , otherwise.

You are asked to implement two versions of BP learning, one using the standard BP procedure and the other with a momentum term, and compare their respective learning performance.

You should report the following.

1. The architecture of your network (number of hidden layers and their size, the sigmoid function you choose, etc.)
2. The parameters you selected for the network, such as the learning rate, the initial weight matrix.
3. Criteria used for termination (e.g., acceptable error.
4. Whether learning is conducted in sequential or batch mode.
5. For each of the two versions, report
  - 1) The number of training pattern presentations (or the number of epochs) the learning process takes to its termination.
  - 2) The learned weights and biases.
  - 3) The output value of the output node when each of the sixteen input patterns is applied to the learned network.
6. Any other issues you wish to report and discuss.

To highlight the linear inseparability nature of this problem, you are also asked to apply Adaline learning procedure to the same parity function. After the training is terminated, report the decision boundary found by the learning process, and which of the sixteen inputs are correctly classified and which are not.

You can use any language for this project. However, any existing BP learning package is not allowed. You should submit the written report, together with the source code and the computer output.

The due day for this project is March 29 (before the end of that day's class).

Policy for late submission: 20 points off within one week of the due day. No project will be accepted after one week.