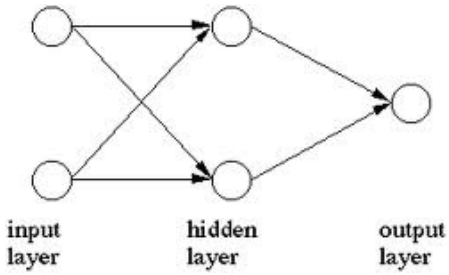
Homework 5

Question 1:

Given a multilayer neural network of the following structure, use Backpropagation (with gradient descent) to write a program to learn the Exclusive-OR (XOR $\oplus$) function.



The initial weights are random numbers between -1 and 1. The activation function of all the neurons is set to be:

$$f(x) = \frac{1}{1+\exp(-x)}$$

You should allow user to input the learning rate η, and the target error ε. (That is, your program can stop if the error E becomes less than ε.)

Your training of the network should be done in batches – the training patterns of each batch can be, for example:

$\{ (x_1, x_2, t) \mid x_1, x_2 \in \{0, 1\}$, and $t = x_1 \oplus x_2 \} = \{(0, 0, 0), (0, 1, 1), (1, 0, 1), (1, 1, 0)\}$

or repeating some of these elements for several times in each batch (multi-set).

When your program stops, the output should contain:

(1) the initial weights
(2) the first-batch error
(3) the final weights
(4) the final error, and
(5) the total number of batches run through in the training.

Your submission should include:

(1) Source code of your program.
(2) The screen-shot(s) of the running results of your program for learning rate $\eta = 0.5$ and 1, with target error $\varepsilon = 0.1$.
    Also, try a few different learning rates and include the best one you can find.
(3) Do the same for target error $\varepsilon = 0.02$.

(Note: You must write your own program and cannot use other software.
The updated class slides on the course homepage contain a description of the Backpropagation algorithm.
Additional references on Backpropagation are posted on Sakai under Resources.)

Question 2:

This assignment is to get you familiar with forms and form validation. Design a very basic HTML web page with both form tags and a JavaScript code that will allow the user to calculate the Volume for a cylinder, sphere or cone and output the results in either English or SI units. The web page should:

(1) Allow the user to select either English or SI units with the use of a radio button selection.
(2) Allow the user to select the shape with a pull down menu.
(3) Allow the user to enter the radius and height values in separate text box.
(4) Once the data is collected have a button tag that will activate a javascript that will read the form data and return the input data. The units and shape selection should be displayed as shown below. (Your display should be dynamic depending on the selections.)
(5) The shape, radius and height data must be displayed in a table.
(6) The script should calculate the volume based on the input data and display these results in the table.

Here is a sample printout as a guide: