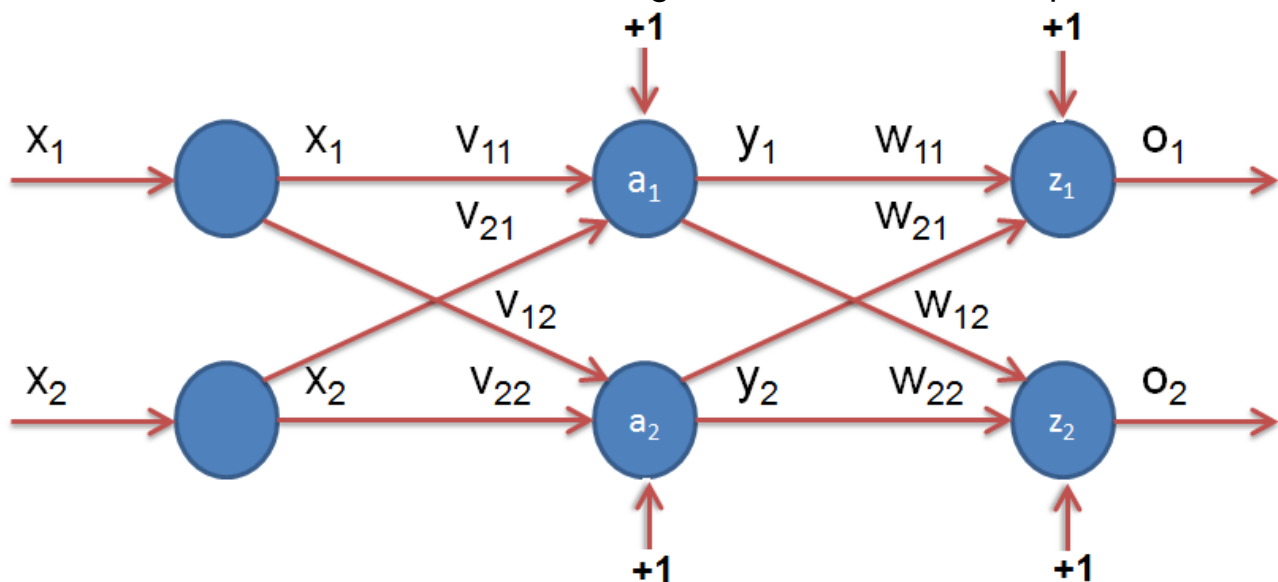


- 1- Consider a multilayer perceptron whose hidden units use  $x^3$  and whose output units use  $\sin(3x)$  as the transfer function. Derive the formulas for the weight updates (from input node  $k$  to hidden node  $j$ ) and (from hidden node  $j$  to output node  $i$ ). Your final formulas should be purely algebraic, i.e., they should not contain partial derivatives.
- 2- Consider a multilayer feedforward network, all the neurons have the identity activation function. Justify the statement that such a network is equivalent to a single-layer feedforward network.
- 3- Given the neural network shown below, carry out one iteration using the back propagation algorithm using a learning rate of 0.5 and a sigmoid activation function. Your network is supposed to learn a pattern  $x_1=1$  and  $x_2=0.1$  with a desired output  $o_1=0.6$  and  $o_2=0.01$ . Assume random weights for the initialization process.



- 4- Derive the learning rule for the network of problem 3 but using a tanh activation function.