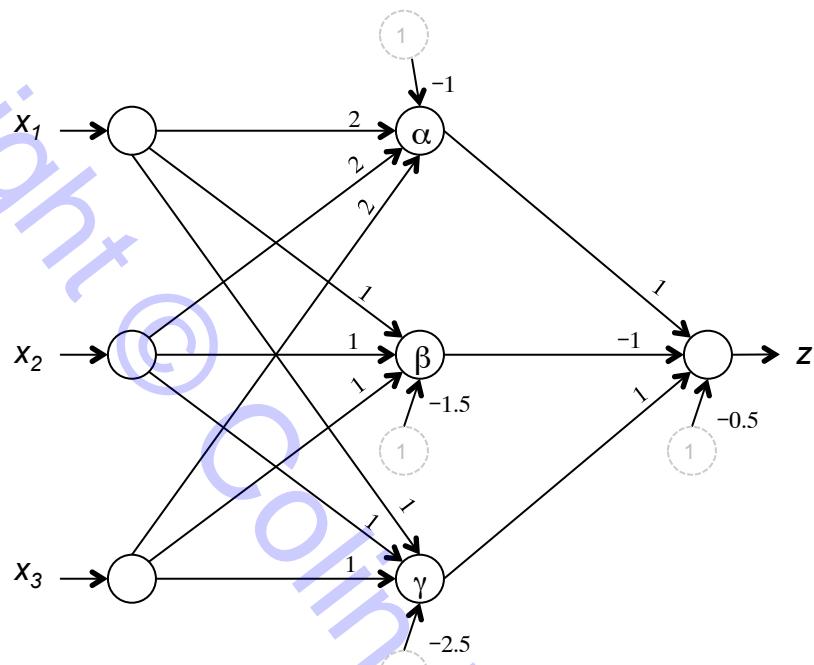


1. Consider the following multi-layer perceptron network, where the connection weights and biases have been determined manually, inputs are Boolean, and the network employs hard-limiting threshold units.



- (a) What Boolean function does this network generate? Explain.  
(b) Is a multi-layer network needed to calculate this function? Explain.  
(c) What roles do the nodes  $\alpha$ ,  $\beta$  and  $\gamma$  play in the function construction?  
(d) Can you design a set of weights for a 4-input version of the Boolean function produced by this network? Explain, and give suitable weights if possible.

2. Consider an Adaline attempting to solve a 3-input XOR problem. Find the optimal weight vector. Does this represent a solution? Comment.

3. An Adaline has an error surface defined by

$$E_{tot} = 18(w_1^2 + w_1w_2 + w_2^2) - 12w_1 + 3.$$

Find the location in weight space of its minimum error point, and its associated residual error.

Noting that the error surface is the result of three training examples, find the maximum and minimum values of  $\eta$  that will guarantee convergence of pure gradient descent for this Adaline.