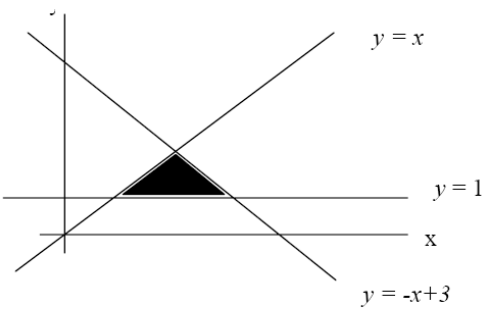
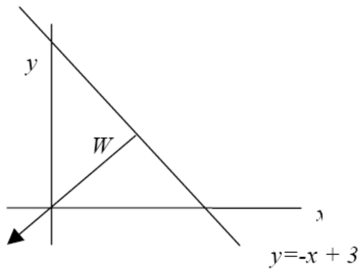
EE4305 Fuzzy/Neural Systems for Intelligent Robotics

SOLUTION FOR PB 4

(1)



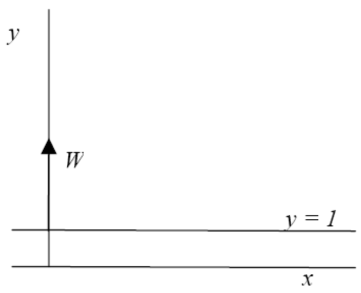
Each of the straight lines in the figure can be implemented as a neuron with weight vector orientations as shown below:



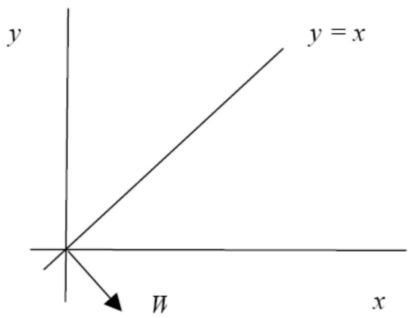
$m = -1, c = 3$

$y = -\frac{w_1}{w_2}x - \frac{w_0}{w_2}$

$\frac{w_1}{w_2} = 1$ and seeing the weight vector orientation w_1 = w_2 = -1. $\Rightarrow$ $w_0 = 3$



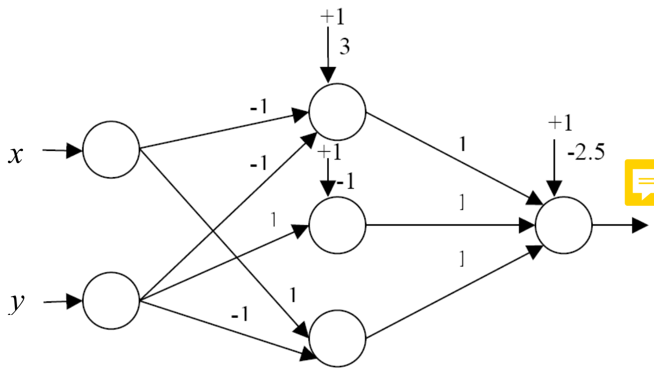
m = 0, c = 1 $\Rightarrow$ w_1 = 0. Choose w_2 = 1, w_0 = -1 by looking at the desired orientation.



m = 1, c = 0.

$\frac{w_1}{w_2} = -1$. By looking at the desired orientation, choose w_1 = 1, w_2 = -1 and w_0 = 0.

The final network is



(2)

$$E = \frac{1}{2}\sum_{j=1}^{N}\left(e_j\right)^2$$

$$e_j = d_j - y(\boldsymbol{x}_j) = d_j - \sum_{i=0}^{M} w_i \varphi_i(\boldsymbol{x}_j, \boldsymbol{\mu}_i, \sigma_i)$$

$$\begin{aligned} \frac{\partial E}{\partial w_i} &= \frac{\partial}{\partial w_i}\left[\frac{1}{2}\sum_j e_j^2\right] \\ &= \sum_j e_j \frac{\partial e_j}{\partial w_i} \end{aligned} \qquad (1)$$

The error signal e_j is $e_j = d_j - \sum_{i=0}^{M} w_i \varphi_i(\cdot)$

Therefore,

$$\frac{\partial e_j}{\partial w_i} = -\varphi_i(\cdot)$$

Or rewrite eqn. (1), $\frac{\partial E}{\partial w_i} = -\sum_j e_j \varphi_i(\cdot)$