02/26/03

1st Homework – Solutions

E2-3 $W = [3 \;\; 2] \quad p = [-5 \;\; 7]^T \quad a = 0.5$

i. $n = Wp + b = [3 \;\; 2] \begin{bmatrix} -5 \\ 7 \end{bmatrix} + b = -1 + b$

If $b = 0$, $n = -1$. No.

ii. Yes, $b = 1.5 \quad n = -1 + 1.5 = 0.5 \quad a = \text{purelin}(0.5) = 0.5$

iii. Yes. $a = \text{logsig}(n) = 1/(1+e^{-n})$

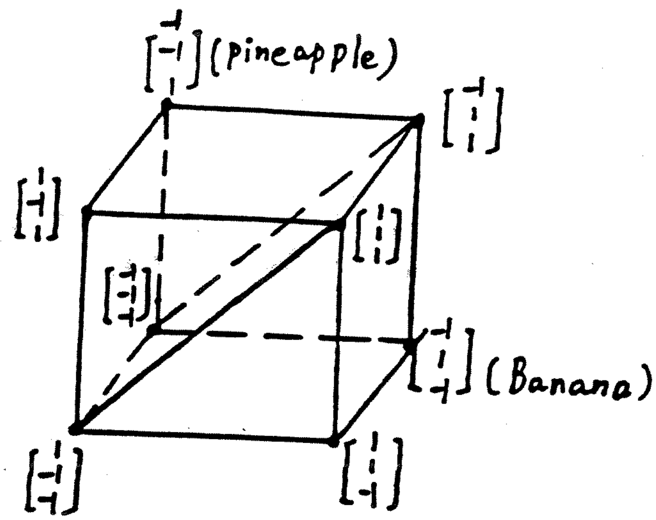
$0.5 = 1/(1+e^{-n})$

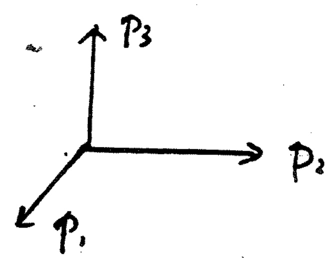
$1 + e^{-n} = 2 \quad e^{-n} = 1 \quad n = 0$

So. $n = -1 + b = 0 \quad b = 1$

iv. No, the output of symmetrical hard limit transfer function can only be -1 and 1.

E3.1





i. perceptron design:

decision boundary: $p_2 = p_3$ or $p_2 - p_3 = 0$

Choose $W = [0 \;\; 1 \;\; -1] \quad b = 0$

Then $Wp = p_2 - p_3$

For banana:

$a = \text{hardlims}\left([0 \;\; 1 \;\; -1] \begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}\right) = \text{hardlims}(2) = 1$

For Pineapple:

$a = \text{hardlims}\left([0 \;\; 1 \;\; -1] \begin{bmatrix} -1 \\ -1 \\ 1 \end{bmatrix}\right) = \text{hardlims}(-2) = -1$

iii. Hopfield Network Design:

choose $W = \begin{bmatrix} 0.2 & 0 & 0 \\ 0 & 1.2 & -0.5 \\ 0 & -0.5 & 1.2 \end{bmatrix}$ $\quad b = \begin{bmatrix} -0.9 \\ 0 \\ 0 \end{bmatrix}$

$a_1(t+1) = \text{Satlins}(0.2\, a_1(t) - 0.9)$

$a_2(t+1) = \text{Satlins}(1.2\, a_2(t) - 0.5\, a_3(t))$

$a_3(t+1) = \text{Satlins}(1.2\, a_3(t) - 0.5\, a_2(t))$

For banana: $p = [-1 \;\; 1 \;\; -1]^T = a(0)$

$$a(1) = \text{Satlins}\left(\begin{bmatrix} 0.2(-1) - 0.9 \\ 1.2(1) - 0.5(-1) \\ 1.2(-1) - 0.5(1) \end{bmatrix}\right) = \text{Satlins}\left(\begin{bmatrix} -1.1 \\ 1.7 \\ -1.7 \end{bmatrix}\right) = \begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$$

$$a(2) = \begin{bmatrix} -1 \\ 1 \\ -1 \end{bmatrix}$$

For pineapple: $p = [-1 \;\; -1 \;\; 1]^T = a(0)$

$$a(1) = \text{Satlins}\left(\begin{bmatrix} 0.2(-1) - 0.9 \\ 1.2(-1) - 0.5(1) \\ 1.2(1) - 0.5(-1) \end{bmatrix}\right) = \text{Satlins}\left(\begin{bmatrix} -1.1 \\ -1.7 \\ 1.7 \end{bmatrix}\right) = \begin{bmatrix} -1 \\ -1 \\ 1 \end{bmatrix}.$$

$$a(2) = \begin{bmatrix} -1 \\ -1 \\ 1 \end{bmatrix}$$