Sheet 3

Q1 :- Consider the Prototypes :-

$$P_1 = \begin{bmatrix} 1 \\ 1 \\ -1 \\ 1 \\ -1 \\ -1 \end{bmatrix} \qquad P_2 = \begin{bmatrix} -1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \end{bmatrix} \qquad P_t = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \end{bmatrix}$$

By use of Hebb rule :-

i- $P_1^T P = 0$ $\therefore$ they are orthogonal

ii- $T = \begin{bmatrix} 1 & -1 \\ 1 & 1 \\ -1 & 1 \\ 1 & 1 \\ -1 & 1 \\ -1 & -1 \end{bmatrix} * P^T = \begin{bmatrix} 1 & 1 & -1 & 1 & -1 & -1 \\ -1 & 1 & 1 & 1 & 1 & -1 \end{bmatrix}$

$$\therefore TP^T = \begin{bmatrix} 2 & 0 & -2 & 0 & -2 & 0 \\ 0 & 2 & 0 & 2 & 0 & -2 \\ -2 & 0 & 2 & 0 & 2 & 0 \\ 0 & 2 & 0 & 2 & 0 & -2 \\ -2 & 0 & 2 & 0 & 2 & 0 \\ 0 & -2 & 0 & -2 & 0 & 2 \end{bmatrix} = W$$

iii- to apply test :

$$a = \text{hardlims}(WP_t) = \text{hardlims}\left(W \times \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \end{bmatrix}\right) = \begin{bmatrix} -2 \\ 6 \\ 2 \\ 6 \\ 2 \\ -6 \end{bmatrix}$$

$$= \begin{bmatrix} -1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \end{bmatrix} = P_2 \ \#$$

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Q_2 : Consider the Prototypes :-

$$P_1 = \begin{bmatrix} -1 \\ -1 \\ 1 \\ 1 \end{bmatrix} \qquad P_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \\ 1 \end{bmatrix} \qquad P_t = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

iv_ $P P^T = \begin{bmatrix} -1 \\ -1 \\ 1 \\ 1 \end{bmatrix} \begin{bmatrix} 1 & 1 & -1 & 1 \end{bmatrix} = -2$ ∴ not orthognal

v_ By using Hebb rule , $W = TP^T$

$$W = T = \begin{bmatrix} -1 & 1 \\ -1 & 1 \\ 1 & -1 \\ 1 & 1 \end{bmatrix} * P^T \begin{bmatrix} -1 & -1 & 1 & 1 \\ 1 & 1 & -1 & 1 \end{bmatrix}$$

$$W = \begin{bmatrix} 2 & 2 & -2 & 0 \\ 2 & 2 & -2 & 0 \\ -2 & -2 & 2 & 0 \\ 0 & 0 & 0 & 2 \end{bmatrix}$$

to test Pattern :

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

$$= \begin{bmatrix} 2 \\ 2 \\ -2 \\ 2 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -1 \\ 1 \end{bmatrix} = P_2 \ \#$$

Q_3 :- Consider the Prototypes -

$$P_1 = \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \\ 1 \\ -1 \end{bmatrix} \qquad P_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \\ 1 \\ -1 \\ 1 \end{bmatrix}$$

$\therefore$ let $t_1 = [-1]$, $t_2 = [1]$

$$P_1 P_2^T = \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \\ 1 \\ -1 \end{bmatrix} \begin{bmatrix} 1 & 1 & -1 & 1 & -1 & 1 \end{bmatrix} = 0$$

then they are orthogonal Butt not normalized

$$P_1 P_1^T = P_2 P_2^T = 6$$

$$W = TP^T = \begin{bmatrix} -1 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 & -1 & 1 & 1 & -1 \\ 1 & 1 & -1 & 1 & -1 & 1 \end{bmatrix}$$

$$a_1 = \text{hardlims}(W P_1) = \text{hardlims}\left(\begin{bmatrix} 0 & 2 & 0 & 0 & -2 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \\ 1 \\ -1 \end{bmatrix} \right)$$

$$= \text{hardlims}(-6) = -1 = t_1 \ \#$$

$$a_2 = \text{hardlims}(W P_2) = \text{hardlims}\left(\begin{bmatrix} 0 & 2 & 0 & 0 & -2 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ -1 \\ 1 \\ -1 \\ 1 \end{bmatrix} \right)$$

$$= \text{hardlims}(6) = t_2 \ \#$$

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* Answer the following MCQ :-

1. (b) It requires labelled data
2. (b) Weights are adjusted based on error Signal.
3. (b) near to Zero
4. (b) Purelin
5. (a) Purelin (WP)
6. (a) $W = TP^{+}$
7. (a) $P^T P = 1$
8. (a) $E = T - WP$
9. (c) the input data and the target output.
10. (a) Labeled data For training.