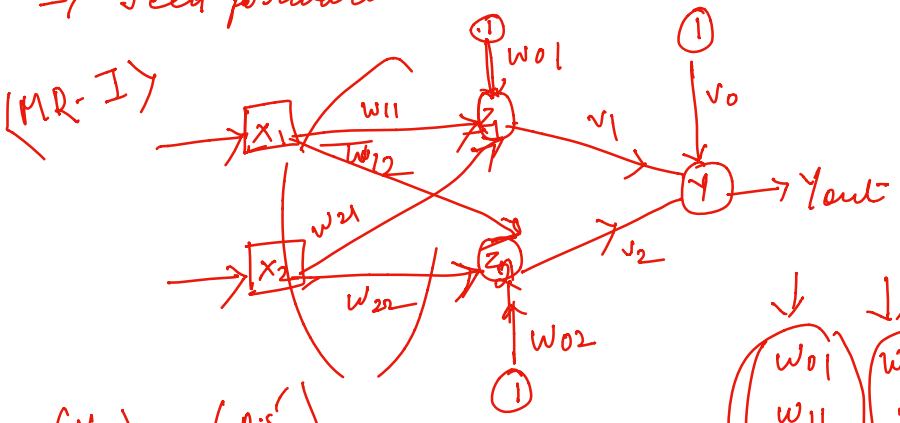
→ Madaline (numerical)

→ Feed forward NN

(MR-I)



Given:

I/P:

bias x_0	x_1	x_2	T
1	1	1	-1
1	1	-1	1
1	-1	1	1
1	-1	-1	-1

$\eta = 0.5$

$$\begin{pmatrix} w_{01} \\ w_{11} \\ w_{21} \end{pmatrix} \quad \begin{pmatrix} w_{02} \\ w_{12} \\ w_{22} \end{pmatrix} = \begin{pmatrix} 0.2 & 0.3 \\ 0.3 & 0.2 \\ 0.2 & 0.1 \end{pmatrix}$$

$$\begin{pmatrix} v_0 \\ v_1 \\ v_2 \end{pmatrix} = \begin{pmatrix} 0.5 \\ 0.5 \\ 0.5 \end{pmatrix}$$

(Epoch 1: Iterⁿ. 1)

$$z_{in1} = x_0 w_{01} + x_1 w_{11} + x_2 \times w_{21}$$

$$= 0.7 \quad (1 \times 0.2 + 1 \times 0.3 + 1 \times 0.2)$$

$$z_{in2} = x_0 w_{02} + x_1 w_{12} + x_2 w_{22}$$

$$= 0.6$$

$$z_{out} = \begin{cases} 1 & \text{if } z_{in} \geq 0 \\ -1 & \text{if } z_{in} < 0 \end{cases} \longrightarrow \quad z_{out1} = 1, \quad z_{out2} = 1$$

$$y_{in} = 1 \times v_0 + v_1 \times z_{out1} + v_2 \times z_{out2}$$

$$= 1.5$$

$$y_{out} = 1$$

Now $\langle y_{out} = 1, \ T = -1 \rangle \Rightarrow$ training is needed.

case 2 (b) is applied → wts attached to those hidden units having +ve net I/P are updated.

$w_{01}(new) = w_{01}(old) + \eta(-1 - z_{in1})x_0$

$= -0.65$

$w_{11}(new) = w_{11}(old) + \eta(-1 - z_{in1})x_1$

$= -0.55$

$w_{21}(new) = w_{21}(old) + \eta(-1 - z_{in1})x_2$

$= -0.65$

$w_{02}(new) = w_{02}(old) + \eta(-1 - z_{in2})\cdot x_0$

$= -0.5$

$w_{12}(new) = w_{12}(old) + \eta(-1 - z_{in2})\cdot x_1$

$= -0.6$

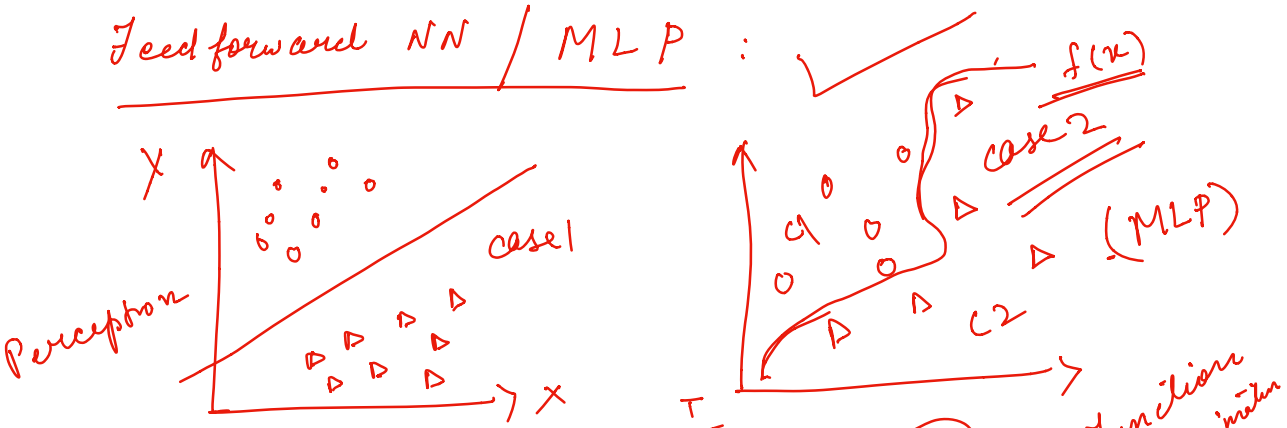
$w_{22}(new) = w_{22}(old) + \eta(-1 - z_{in2})x_2$

$= -0.7$

After 4 epoch :

$$w = \begin{pmatrix} -0.88 & -0.84 \\ -1.54 & -1.52 \\ -0.88 & -1.52 \end{pmatrix}$$ Ans.

Feed forward NN / MLP :



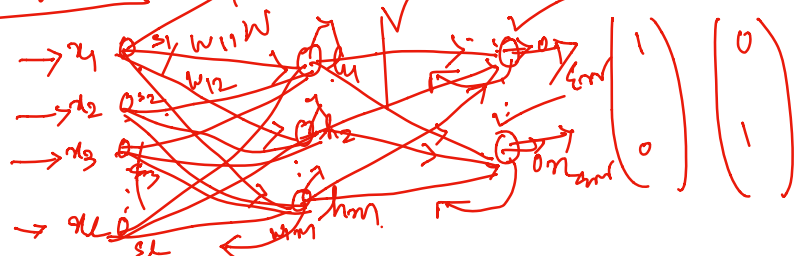
$$f(x) = \begin{cases} 1 & \text{if } x \geq 0 \\ -1 & \text{if } x < 0 \end{cases}$$

	x	y_1	y_2	T
50	C1	+ve		
51				
100	C2	-ve		

100×2

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \begin{pmatrix} +1 \\ -1 \end{pmatrix}$$

Architecture of MLP :



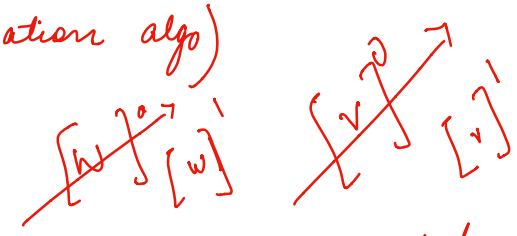
$l \times m \times n$

$$\begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

(Trained using Backpropagation algo)

I/p → hidden: W

hidden → o/p → V



hidden neurons (non-linear activation fun.) sigmoidal

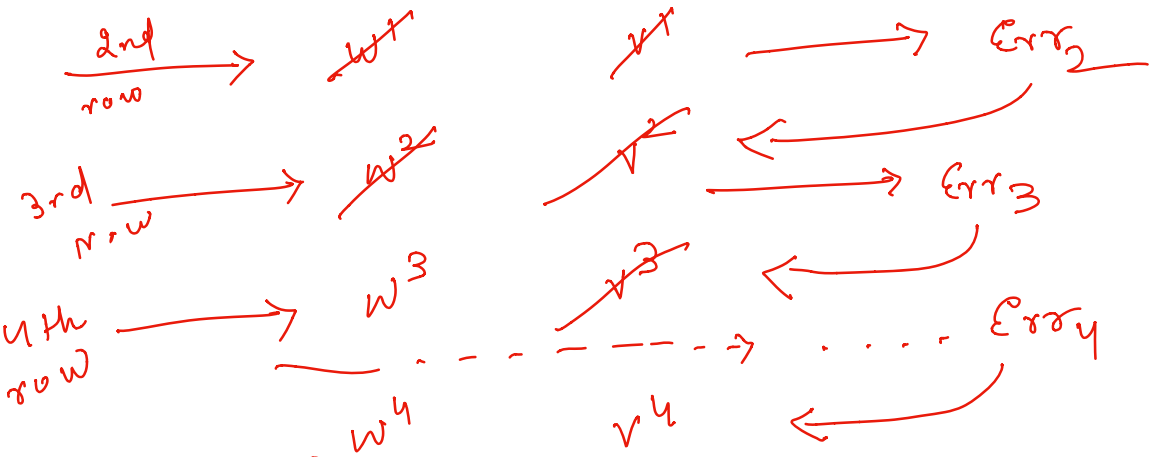
λ : sigmoidal gain : $f(x) = \frac{1}{1+e^{-\lambda I}}$

O/p neuron: sigmoidal → $\frac{1}{1+e^{-\lambda I}}$

Target vector: $[1 \;\; 0]$

$T_1 \begin{pmatrix} 1 \\ 0 \end{pmatrix} \begin{matrix} O_1 \\ O_2 \end{matrix}$ → $\left(\frac{1}{2} (O_1 - 1)^2 + (O_2 - 0)^2 \right) = Err_1$ (LOS)

backward computation : (Err - back-prop)



(Epoch 1, 4th itrn) → 1st Epoch is over

$$rmse = \sqrt{\frac{Err_1 + Err_2 + Err_3 + Err_4}{4}}$$