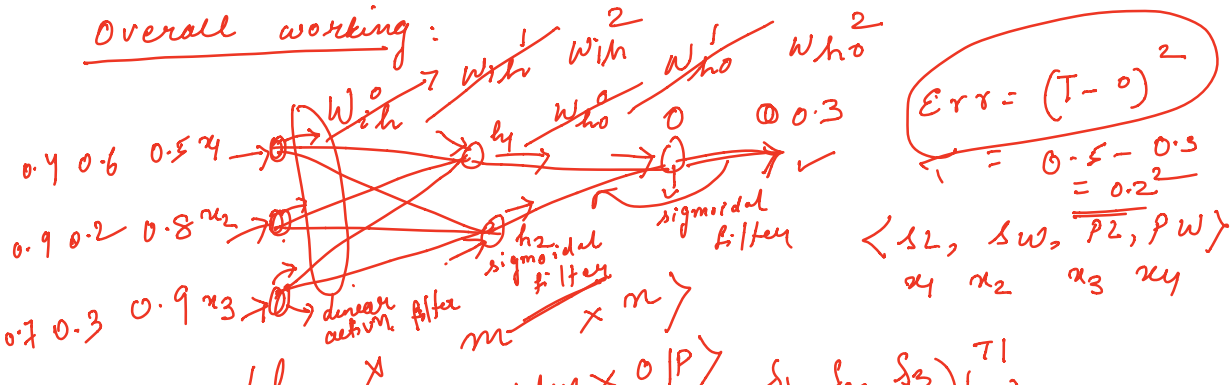
Dec-25 | 09/03/21

Feed forward NN : (MLP)

(Train use Back propagation algo)

Overall working :



$Err = (T - O)^2$

$= 0.5 - 0.3$

$= 0.2^2$

$\langle \delta_2, \delta w, p_2, p w \rangle$

$x_1 \; x_2 \; x_3 \; x_4$

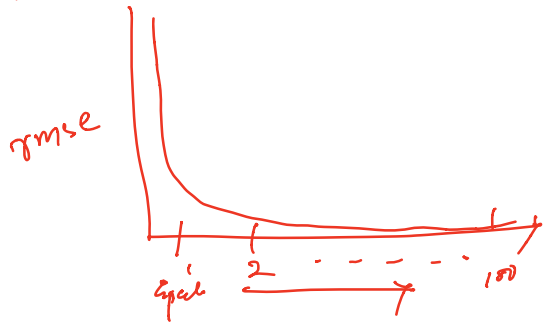
$\langle l \times$ i/p $\times$ hidden $\times$ o/p $\rangle$

	S_1	S_2	S_3	T1
S_1	0.5	0.8	0.9	0.5
S_2	0.6	0.2	0.3	0.8
S_3	0.4	0.9	0.7	0.7

3x3

$$rmse = \sqrt{\frac{Err_1 + Err_2 + Err_3}{3}}$$

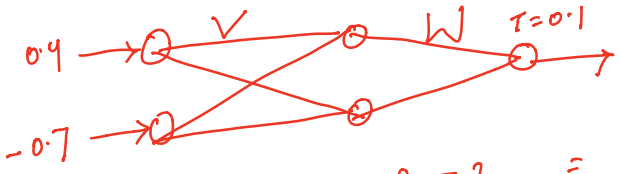
1 Epoch



Numerical :

I/P :

			T
1	0.4	-0.7	0.1
2	0.3	-0.5	0.05
3	0.6	0.1	0.3
4	0.2	0.4	0.25
5	0.1	-0.2	0.12



step1 ⟩ $\{O\}_I = \{I\}_I = \begin{Bmatrix} 0.4 \\ -0.7 \end{Bmatrix}$

step2 :⟩ Initialize the wts:

$$V^0 = \begin{pmatrix} 0.1 & 0.4 \\ -0.2 & 0.2 \end{pmatrix}_{2\times 2} \qquad W^0 = \begin{pmatrix} 0.2 \\ -0.5 \end{pmatrix}_{2\times 1}$$

step3 : find $\{I\}_H = [V]^T \{O\}_I$

$$= \begin{pmatrix} 0.1 & -0.2 \\ 0.4 & 0.2 \end{pmatrix}_{2\times 2} \begin{pmatrix} 0.4 \\ -0.7 \end{pmatrix}_{2\times 1} = \begin{pmatrix} 0.18 \\ 0.02 \end{pmatrix}$$

step4 : $\{O\}_H = \begin{Bmatrix} \frac{1}{1+e^{-0.18}} \\ \frac{1}{1+e^{-0.02}} \end{Bmatrix}$

$$= \begin{Bmatrix} 0.544 \\ 0.505 \end{Bmatrix}$$

step5 : $\{I\}_O = [W]^T \{O\}_H$

$$= \underset{1\times 2}{\langle 0.2 \quad -0.5 \rangle} \begin{Bmatrix} 0.544 \\ 0.505 \end{Bmatrix}_{2\times 1}$$

$$= -0.1435$$

step6 : $\{O\}_O = \frac{1}{1+e^{-(-0.1435)}}$

$$= \frac{1}{1+e^{0.1435}} = 0.464$$

$$\begin{Bmatrix} \frac{1}{1+e^{-\lambda I}} \\ (\lambda = 1) \end{Bmatrix}$$

step7 : $Err = (T-O)^2 = (0.1 - 0.464)^2$

$$= 0.1324$$

Step 8: Let us adjust the weight (in back propagation)

$$d = (T - O)(O)(1 - O)$$

$$= (0.1 - 0.464)(0.464)(1 - 0.464)$$

$$= -0.0905$$

Step 9: $[Y] = \{O\}_H \langle d \rangle$

$$= \begin{Bmatrix} 0.544 \\ 0.505 \end{Bmatrix}_{2\times 1} \langle -0.0905 \rangle$$

$$= \begin{pmatrix} -0.049 \\ -0.045 \end{pmatrix}$$

Step 10: $(\Delta W)^1 = \alpha [\Delta W]^0 + \eta [Y]$

α → momentum, η → learning rate ($\eta = 0.6$)

$$W^1 = W^0 + (\Delta W)^1$$

$$= \begin{pmatrix} -0.029 \\ -0.027 \end{pmatrix}$$

$$W^1 = W^0 + (\Delta W^1)$$

$$V^1 = V^0 + (\Delta V)^1$$

$$(\Delta W)^0 = W^1 - W^0$$

$$(\Delta W)^1 = W^1 - W^0$$

Step 11: $\{e\} = [w]\{d\}$

$$= \begin{Bmatrix} 0.2 \\ -0.5 \end{Bmatrix} \langle -0.0905 \rangle$$

$$= \begin{Bmatrix} -0.0181 \\ 0.04522 \end{Bmatrix}$$

Step 12: $\{d^*\} = \begin{Bmatrix} \vdots \\ e_i \\ \vdots \end{Bmatrix} (OH_i)(1 - OH_i)$

$$= \begin{Bmatrix} (-0.0181)(0.544)(1-0.544) \\ (0.0452)(0.505)(1-0.505) \end{Bmatrix}$$

$$= \begin{Bmatrix} -0.0044 \\ 0.0112 \end{Bmatrix}$$

step 13 : $[x] = \{o\}_I \langle d^* \rangle^T$

$$= \begin{pmatrix} 0.4 \\ -0.7 \end{pmatrix} \langle -0.0044 \quad 0.0112 \rangle$$

2×1 $\quad$ 1×2

$$= \begin{pmatrix} -0.00179 & 0.00452 \\ 0.00314 & -0.00792 \end{pmatrix}_{2\times2}$$

step 14 : $[\Delta V]^1 = \alpha \cancel{[\Delta V]^0}^{\,0} + \eta [x]$ $\quad (\eta = 0.6)$

$$= \begin{pmatrix} -0.001077 & 0.002716 \\ 0.001885 & -0.004754 \end{pmatrix}_{2\times2}$$

step 15 : $\langle i \rangle \; V^1 = V^0 + (\Delta V)^1 \rightarrow$ (step 14)

$\langle ii \rangle \; W^1 = W^0 + (\Delta W)^1 \rightarrow$ (step 10)

$$V^1 = \begin{pmatrix} 0.1 & 0.4 \\ -0.2 & 0.2 \end{pmatrix} + \begin{pmatrix} -0.001077 & 0.002716 \\ 0.001885 & -0.004754 \end{pmatrix}$$

$$= \begin{pmatrix} 0.0989 & 0.04027 \\ -0.1981 & 0.19524 \end{pmatrix}$$

$$w^1 = \begin{Bmatrix} 0.2 \\ -0.5 \end{Bmatrix} + \begin{Bmatrix} -0.09958 \\ -0.02742 \end{Bmatrix} = \begin{Bmatrix} 0.17042 \\ -0.52742 \end{Bmatrix}$$

Ans.