**Q.** CONSIDER THE MLP GIVEN BELOW. FIND THE FOLLOWING:

NETWORK ERROR, $E_N = ?$

$\Delta W_{14} = ?$

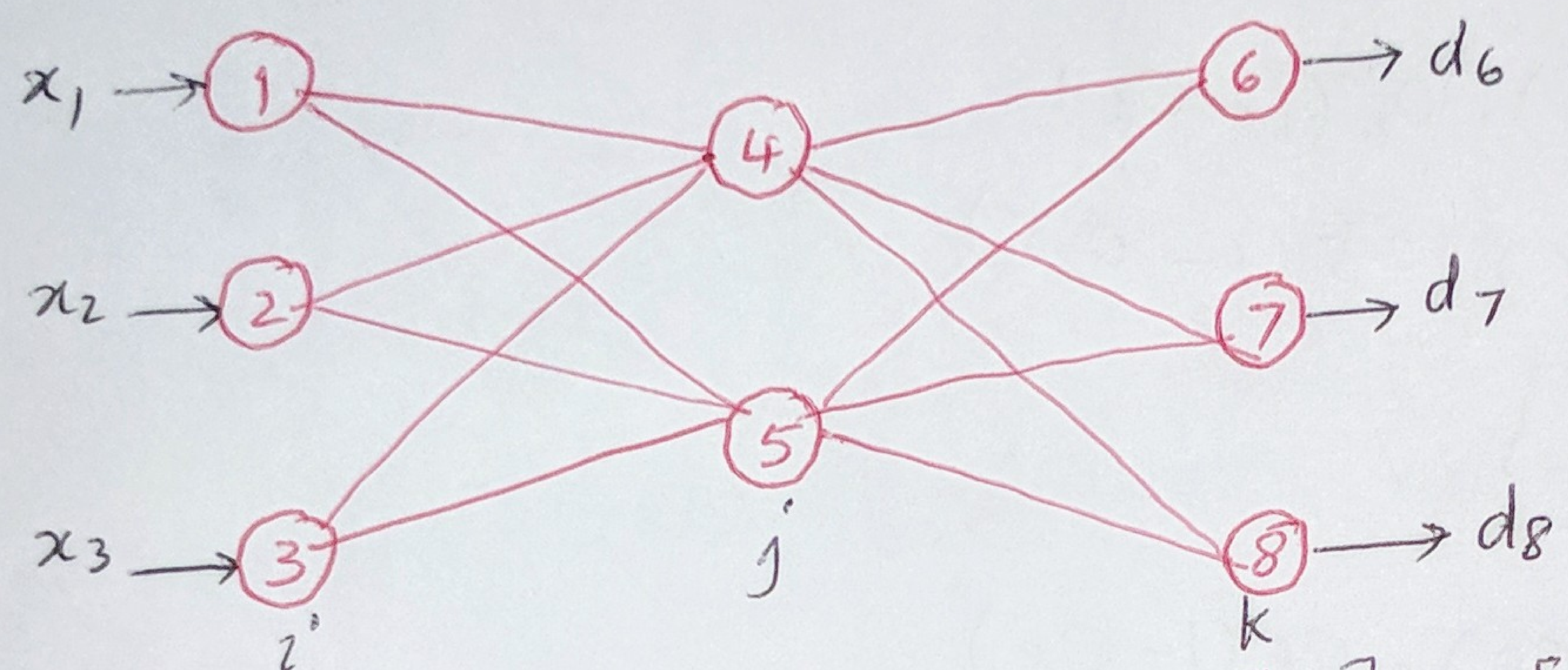
ERROR GRADIENT AT NODE '7', $\delta_7 = ?$

ERROR GRADIENT AT NODE '4', $\delta_4 = ?$

ASSUME LEARNING CONSTANT $C = 0.1$, OUTPUT FN. = LOG-SIGMOID FOR ALL LAYERS

ERROR FUNCTION IS 'MEAN SQUARED ERROR'

DATA FOR THE PROB. & NETWORK ARE GIVEN BELOW:




$$D = \begin{bmatrix} d_6 \\ d_7 \\ d_8 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \; ; \; X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$$

$$W = [W_{14}, W_{15}, W_{24}, W_{25}, W_{34}, W_{35}, W_{46}, W_{47}, W_{48}, W_{56}, W_{57}, W_{58}, W_4, W_5, W_6, W_7, W_8]^T$$

$$= [0.1, -0.2, 0.25, -0.25, 0.25, -0.25, 0.25, -0.5, 1.0, 0.25, -0.5, 1.0, -0.5, 0.5, -0.25, 0.5, -1]^T$$

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**SOLN.**

FORWARD PROPAGATION OF SIGNALS

$$net_4 = \sum_{i=1}^{3} O_i W_{ij} + W_4 = 0 \times 0.1 + 1 \times 0.25 + 1 \times (+0.25) + (-0.5) = 0$$

$$net_5 = \sum_{i=1}^{3} O_i W_{ij} + W_5 = 0 \times (-0.2) + 1 \times (-0.25) + 1 \times (-0.25) + (0.5) = 0$$

$$O_4 = \frac{1}{1 + e^{-net_4}} = \frac{1}{1+1} = 0.5$$

$$O_5 = \frac{1}{1 + e^{-net_5}} = \frac{1}{1+1} = 0.5$$

$$net_6 = \sum_{j=4}^{5} O_j W_{jk} + W_6 = 0.5 \times 0.25 + 0.5 \times 0.25 + (-0.25) = 0$$

$$net_7 = \sum_{j=4}^{5} O_j W_{jk} + W_7 = 0.5 \times (-0.5) + 0.5 \times (-0.5) + (+0.5) = 0$$

$$net_8 = \sum_{j=4}^{5} O_j W_{jk} + W_8 = 0.5 \times (1.0) + 0.5 \times (1.0) + (-1.0) = 0$$

$$O_6 = \frac{1}{1 + e^{-net_6}} = \frac{1}{1+1} = 0.5$$

$$O_7 = 0.5 \; ; \; O_8 = 0.5$$

$$E_N = \frac{1}{2}\sum_{k=6}^{8}(d_k - O_k)^2 = \frac{1}{2}\left((1-0.5)^2+(0-0.5)^2+(0-0.5)^2\right)$$

$$\boxed{E_N = \frac{1}{2}(0.25+0.25+0.25) = 0.375}$$

$$\delta_7 = (d_7 - O_7) \cdot O_7(1-O_7)$$

$$\delta_7 = (0-0.5) \times 0.5 \times (1-0.5)$$

$$\boxed{\delta_7 = -0.125}$$

FOR '$\delta_4$', WE NEED TO FIND '$\delta_6$' & '$\delta_8$' AS WELL,

$$\delta_6 = (d_6 - O_6) \cdot O_6(1-O_6)$$

$$\delta_6 = (1-0.5) \cdot 0.5(1-0.5)$$

$$\boxed{\delta_6 = 0.125}$$

$$\delta_8 = (d_8 - O_8) \cdot O_8(1-O_8)$$

$$\delta_8 = (0-0.5) \cdot 0.5(1-0.5)$$

$$\boxed{\delta_8 = -0.125}$$

NOW '$\delta_4$' CAN BE ROUND AS FOLLOWS:

$$\delta_4 = \left(\sum_{k=6}^{8} \delta_k W_{4k}\right) O_4(1-O_4)$$

$$\delta_4 = [\delta_6 W_{46} + \delta_7 W_{47} + \delta_8 W_{48}]\ O_4(1-O_4)$$

$$\delta_4 = [0.125 \times 0.25 + (-0.125)\times(-0.5) + (-0.125)\times 1]\ 0.5(1-0.5)$$

$$\boxed{\delta_4 = (-0.0312)(0.25) = -0.0078}$$

$$\boxed{\Delta W_{14} = c \times \delta_4 \times O_1 = 0.1 \times (-0.0078) \times 0 = 0}$$