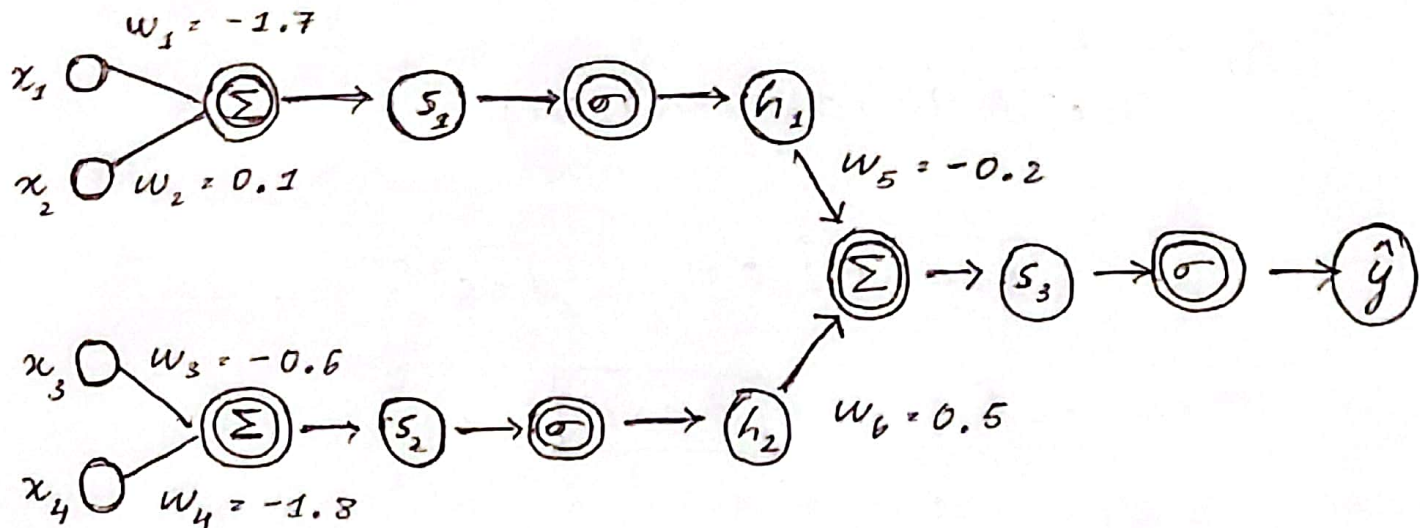


Solution 1 >



>> Logistic function $\sigma(x) = \frac{1}{1+e^{-x}}$

$$h_1 = \frac{1}{1+e^{-x_1 w_1 - x_2 w_2}}$$

Given $(x_1, x_2, x_3, x_4) = (0.7, 1.2, 1.1, 2)$

$$\Rightarrow w_1 = -1.7$$

$$w_2 = 0.1$$

$$\boxed{s_1 = ?}$$

We compute the following

$$\therefore s_1 = x_1 w_1 + x_2 w_2$$

$$= 0.7 \times (-1.7) + (1.2) \times (0.1)$$

$$s_1 = -1.19 + 0.12 = \boxed{-1.07}$$

$$s_2 = x_3 w_3 + x_4 w_4$$

$$= (1.1) (-0.6) + (2) (-1.6)$$

$$= (-0.66) + (-3.6)$$

$$\therefore \boxed{s_2 = -4.26}$$

$$h_1 = \frac{1}{1 + e^{-w_1 x_1 - x_2 w_2}}$$

$$h_1 = \frac{1}{1 + e^{-(0.7)(-1.7) - (1.2)(0.1)}}$$

$$h_1 = \frac{1}{1 + e^{(1.19) - 0.12}} = \frac{1}{1 + e^{1.07}}$$

$$= \frac{1}{3.915} = \boxed{0.255}$$

$$h_2 = \frac{1}{1 + e^{-x_3 w_3 - x_4 w_4}}$$

$$= \frac{1}{1 + e^{-(1.1)(-0.6) - (2)(-1.4)}}$$

$$= \frac{1}{1 + e^{0.66 + 2.8}}$$

$$= \frac{1}{1 + e^{4.26}} = \frac{1}{1 + 7.65}$$

$$= \boxed{0.0139}$$

$$S_3 = h_1 w_5 + h_2 w_6$$

$$= 0.25(-0.2) + (0.0139)(0.5)$$

$$= -0.051 + 0.00695$$

$$\boxed{S_3 = 0.0445}$$

$$\hat{y} = \frac{1}{1 + e^{-h_1 w_5 - h_2 w_6}}$$

$$= \frac{1}{1 + e^{-(0.255)(-0.2) - (0.0139)(0.5)}}$$

$$= \frac{1}{1 + e^{0.051 - 0.00695}} = \frac{1}{1 + e^{0.405 - x}}$$

$$\boxed{\hat{y} = 0.4887}$$

Gradient of the loss function

$$\| \hat{y} - y \|^2 \cdot \kappa = 2 \| \hat{y} - y \| = \frac{\partial L}{\partial y}$$

Backward propagation

$$\frac{\partial \mathcal{E}}{\partial w_1} = \frac{\partial \mathcal{E}}{\partial \hat{y}} \times \frac{\partial \hat{y}}{\partial s_3} \times \frac{\partial s_3}{\partial u_2} \times \frac{\partial u_2}{\partial s_1} \times \frac{\partial s_1}{\partial w_1}$$

$$\frac{\partial \mathcal{E}}{\partial w_1} = 2 \| \hat{y} - y \| \times \sigma'(s_3) \times w_5 \times \sigma'(s_1) \times (x_1)$$

$$\frac{\partial \mathcal{E}}{\partial w_1} = [2 \| 0.4887 - 0.5 \|] \times [\sigma(s_3) (1 - \sigma(s_3))] \times [0.2] \times \sigma(s_1) [(1 - \sigma(s_1)) \times 0.7]$$

$$\sigma(s_3) = \frac{1}{1 + e^{-(-0.04405)}} = 0.4884$$

$$\sigma(s_1) = \frac{1}{1 + e^{-(1-0.25)}} = 0.255$$

$$= [2 \| 0.4887 - 0.5 \|] \times [0.4884 (1 - 0.4884)] \times 0.7 \times [10.25 (1 - 0.255)] \times 0.2$$

$$= [2 (0.0113)] \times [(0.4887) (0.5116)]$$

$$\frac{\partial \mathcal{E}}{\partial w_1} = 0.0014$$