Qn. 1. Answer.

$$\sigma(z) = \frac{1}{1+e^{-z}} \qquad h_1 = \frac{1}{1+e^{-w_1 x_1 - w_2 x_2}}$$

$$L(y, \hat{y}) = \|\hat{y} - y\|^2$$

$x_1 = 0.7$ $\quad x_3 = 1.1$

$x_2 = 1.2$ $\quad x_4 = 1.2$

$y = 0.5$

$$S_1 = x_1 w_1 + x_2 w_2$$
$$= (0.7)(-1.7) + (1.2)(0.1)$$
$$= (-1.19) + (0.12)$$
$$= -1.07$$
$$\Rightarrow S_1 = -1.07$$

$$S_2 = x_3 w_3 + x_4 w_4$$
$$= (1.1)(-0.6) + (2)(-1.8)$$
$$= (-0.66) + (-3.6)$$
$$= -4.26$$

$$h_1 = \frac{1}{1+e^{1.07}}$$
$$\Rightarrow h_1 = 0.255$$

$$S_3 = h_1 w_5 + h_2 w_6$$
$$= (0.255)(-0.2) + (0.0139)(0.5)$$
$$= -0.0441$$

$$\hat{y} = \frac{1}{1+e^{-S_3}} = \frac{1}{1+e^{0.0441}} = 0.4889$$

Back Propagation

$$\frac{\partial E}{\partial w_1} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial s_3} \cdot \frac{\partial s_3}{\partial h_1} \cdot \frac{\partial h_1}{\partial s_1} \cdot \frac{\partial s_1}{\partial w_1}$$

$$= 2\|\hat{y} - y\| \cdot \sigma'(s_3) \cdot w_5 \cdot \sigma'(s_1) \cdot x_1$$

$$= 2 \times \|0.4889 - 0.5\| \times \sigma'(-0.441) \cdot (-0.2)$$

$$\sigma'(s_3) = \frac{1}{1+e^{-(-0.044)}} = 0.4884$$

$$\sigma'(s_1) = \frac{1}{1+e^{-(-1.07)}} = 0.2554$$

$$\Rightarrow \frac{\partial E}{\partial w_1} = -0.0014$$

$$\frac{\partial s_3}{\partial h_1} = w_5$$

$$\frac{\partial s_1}{\partial w_1} = x_1$$