

1. Task 1

$$\varphi(x) = \frac{1}{1 + \exp(-ax)}$$

$$\varphi'(x) = \frac{1}{(1 + \exp(-ax))^2} \cdot -a \cdot \exp(-ax)$$

$$= \frac{a \cdot \exp(-ax)}{[1 + \exp(-ax)]^2} = \frac{1}{1 + \exp(-ax)} \cdot a \cdot \left[1 - \frac{1}{1 + \exp(-ax)}\right] = a \cdot \varphi(x) [1 - \varphi(x)]$$

$$\text{when } x=0, \varphi'(0) = \frac{a}{(1+1)^2} = \frac{a}{4}$$

2. Task 2

$$h(z) = cz \quad g(z) = \frac{1}{1 + \exp(-z)}$$

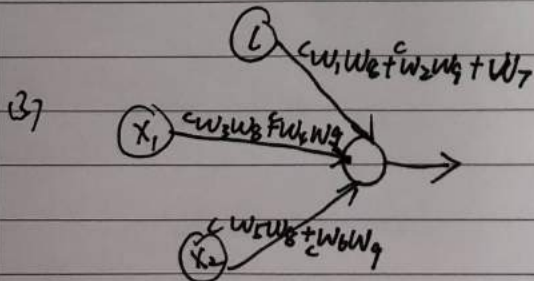
$$(1) \quad x_3 = cw_3x_1 + cw_5x_2 + cw_1l, \quad x_4 = cw_4x_1 + cw_6x_2 + cw_2l$$

$$x_5 = w_8x_3 + w_9x_4 + w_7l = cw_3w_8x_1 + cw_5w_8x_2 + cw_1w_8l + cw_4w_9x_1 + cw_6w_9x_2 + cw_2w_9l$$

$$= (cw_3w_8 + cw_4w_9)x_1 + (cw_5w_8 + cw_6w_9)x_2 + (cw_1w_8 + cw_2w_9 + w_7)l$$

$$\therefore \text{output} = \frac{1}{1 + \exp[-(cw_3w_8 + cw_4w_9)x_1 - (cw_5w_8 + cw_6w_9)x_2 - (cw_1w_8 + cw_2w_9 + w_7)l]}$$

$$(2) \quad h(x_1, x_2) = \begin{cases} 0, & g(z) < 0.5 \\ 1, & g(z) > 0.5 \end{cases} \quad (cw_3w_8 + cw_4w_9)x_1 + (cw_5w_8 + cw_6w_9)x_2 + (cw_1w_8 + cw_2w_9 + w_7)l = 0$$



$$(4) \quad cw_1w_8 + cw_2w_9 + w_7$$

$$cw_3w_8 + cw_4w_9$$

$$cw_5w_8 + cw_6w_9$$

3. Task 3

$$\text{layer 1: } (300 - 7 + 1) / 2 = 147$$

$$h = 147 \times 147 \times 30 = 648270$$

$$\text{layer 2: } (147 - 3 + 1) / 2 = 73$$

$$w = 73 \times 73 \times 30 = \cancel{155520} 159870$$

$$\text{layer 3: } (73 + 6 - 3 + 1) / 1 = 77$$

$$c = \cancel{76 \times 76 \times 50 = 288800}$$

$$77 \times 77 \times 50 = 296450$$

$$(\cancel{648270, 155520, 288800})$$

$$(\cancel{648270, 159870, 296450})$$

$$\text{layer 1: } (147, 147, 30)$$

$$\text{layer 2: } (73, 73, 30)$$

$$\text{layer 3: } (77, 77, 50)$$