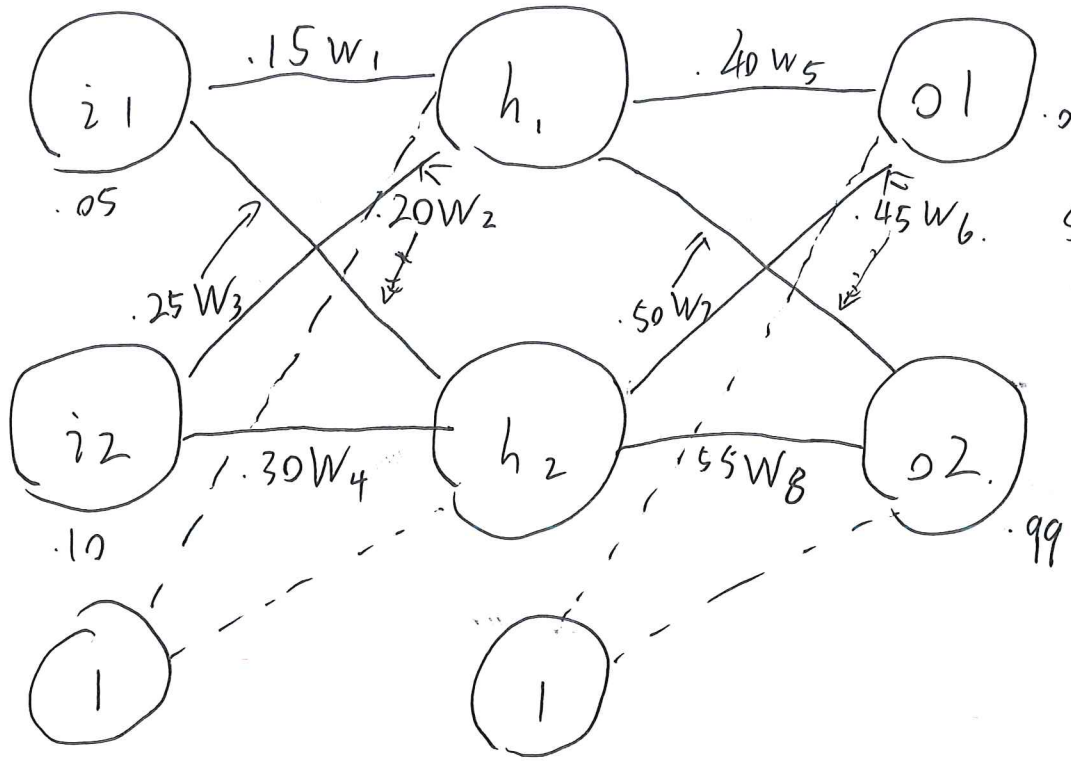

$$sigmod = \frac{1}{1+e^{-x}}$$

一. 正向传播.

$$zh_1 = i1 \times w_1 + i2 \times w_2 + b_1 \times 1$$

$$= 0.05 \times 0.15 + 0.1 \times 0.2 + 0.35 \times 1$$

$$= 0.3775$$

经过激活函数:

$$h_1 = \frac{1}{1+e^{-0.3775}} = 0.5932.$$

$$zh_2 = i1 \times w_3 + i_2 \times w_4 + b_1 \times 1$$

0.0125

$$= 0.05 \times 0.25 + 0.1 \times 0.3 + 0.35 \times 1$$

$$= 0.3925.$$

经过激活函数:

$$h_2 = \frac{1}{1+e^{-0.3925}} = 0.5968$$

$$zo_1 = h_1 \times w_5 + h_2 \times w_6 + 1 \times 0.6$$

$$= 0.5932 \times 0.4 + 0.5968 \times 0.45 + 0.6$$

$$= 1.1059$$

经过激活函数:

$$O_1 = \frac{1}{1+e^{-1.1059}} = 0.7513$$

下同: $O_2 = 0.7729$.

二. 计算损失函数. $\sum \frac{1}{2}(target - output)^2$.

$E_{O_1} = \frac{1}{2}(0.01 - 0.7513)^2 = 0.2746$.

$E_{O_2} = \frac{1}{2}(0.99 - 0.7729)^2 = 0.0235$.

$E = E_{O_1} + E_{O_2} = 0.2983$.

三. 反向传播(更新权重)求偏导

①W_5的影响:

$$\frac{\partial E}{\partial w_5} = \frac{\partial E}{\partial O_1} \times \frac{\partial O_1}{\partial zO_1} \times \frac{\partial zO_1}{\partial w_5}$$

$E = \frac{1}{2}(0.01 - O_1)^2 + \frac{1}{2}(0.99 - O_2)^2$.

$\frac{\partial E}{\partial O_1} = -(0.01 - O_1) = O_1 - 0.01 = 0.7413$.

$O_1 = \frac{1}{1+e^{-zO_1}} = (1 + e^{-(h_1 \times w_5 + h_2 \times w_6 + 0.6)})^{-1}$

$\frac{\partial O_1}{\partial zO_1} = O_1 \times (1 - O_1) = 0.7513 \times (1 - 0.7513) = 0.1868$.

$zO_1 = h_1 \times w_5 + h_2 \times w_6 + 0.6$

$\frac{\partial zO_1}{\partial w_5} = h_1 = 0.5932$. 即 $\frac{\partial E}{\partial w_5} = 0.7413 \times 0.1868 \times 0.5932$.

$= 0.0821$.

$$w_5^+ = w_5 - \eta \times \frac{\partial E}{\partial w_5} = 0.4 - 0.5 \times 0.0821 = 0.3589$$

同理 $w_6^+ = 0.4086$

$w_7^+ = 0.5113$

$w_8^+ = 0.5613$

② w_1 的影响

$$\frac{\partial E}{\partial w_1} = \frac{\partial E}{\partial h_1} \times \frac{\partial h_1}{\partial z h_1} \times \frac{\partial z h_1}{\partial w_1}$$

$$\frac{\partial E}{\partial h_1} = \frac{\partial E_{o_1}}{\partial z_1} + \frac{\partial E_{o_2}}{\partial h_1}$$

$$\frac{\partial E_{o_1}}{\partial h_1} = \frac{\partial E_{o_1}}{\partial o_1} \times \frac{\partial o_1}{\partial z o_1} \times \frac{\partial z o_1}{\partial h_1} = 0.0553$$

$$\frac{\partial E_{o_2}}{\partial h_1} = \frac{\partial E_{o_2}}{\partial o_2} \times \frac{\partial o_2}{\partial z o_2} \times \frac{\partial z o_2}{\partial h_1} = -0.0190$$

$$\frac{\partial E}{\partial h_1} = 0.0363$$

$$\frac{\partial h_1}{\partial z h_1} = h_1 \times (1 - h_1) = 0.2413$$ 同理得

$$\frac{\partial z h_1}{\partial w_1} = i_1 = 0.05$$

即 $\frac{\partial E}{\partial w_1} = 0.0363 \times 0.2413 + 0.05 = 0.0004$

$$w_1^+ = w_1 - \eta \times \frac{\partial E}{\partial w_1} = 0.1497$$

$w_2^+ = 0.1995$

$w_3^+ = 0.2497$

$w_4^+ = 0.2995$