$$y = f(x, a) = \frac{1}{1 + e^{-ax}}$$

ω_1

x

a

$\omega_3 = -\omega_1 \cdot \omega_2$

$\omega_4 = 1 + exp^{\omega_3}$

$\omega_5 = \frac{1}{\omega_4}$

$-*$ $exp \cdot +1$ $\frac{1}{\circ}$ $\rightarrow y$

$$y = f(x, a) = \frac{1}{1 + e^{-ax}}$$

ω_1

x

$\omega_3 = -\omega_1 \cdot \omega_2$ $\omega_4 = 1 + exp^{\omega_3}$ $\omega_5 = \frac{1}{\omega_4}$

a

ω_2

$\frac{\partial \omega_i}{\partial x}$ $\dot\omega_i$

$\dot\omega_3 = \frac{-\dot\omega_1 \cdot \omega_2}{-\omega_1 \cdot \dot\omega_2}$
$= -\omega_2 = -a$

$\dot\omega_4 = \dot\omega_3 \, exp^{\omega_3}$
$= -a \, exp(-ax)$

$\dot\omega_5 = -\frac{\dot\omega_4}{\omega_4^2} = \frac{+a \, exp(-ax)}{(1 + e^{-ax})^2}$

$\rightarrow y$

$$\frac{+a\exp(-ax)}{(1+e^{-ax})^2} \leftarrow$$
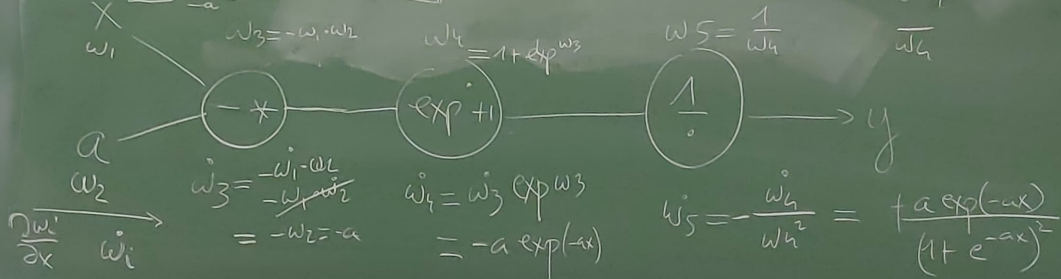
$$y = f(x,a) = \frac{1}{1+e^{-ax}}$$

$$\frac{\partial y}{\partial w_5} = 1$$

$$\frac{\partial y}{\partial w_1} = \frac{\partial y}{\partial w_3} \times \frac{\partial w_3}{\partial w_1} \qquad \frac{\partial y}{\partial w_3} = \boxed{\frac{\partial y}{\partial w_4}} \times \frac{\partial w_4}{\partial w_3} = \frac{1}{w_4^2} \times \exp(w_3)$$

$$\frac{\partial y}{\partial w_4} = -\frac{1}{w_4^2}$$

$$\times\; w_1$$

$$w_3 = -w_1 \cdot w_2 \qquad w_4 = 1 + \exp^{w_3} \qquad w_5 = \frac{1}{w_4} \qquad \overline{w_4}$$

$$\overline{w} = \overline{w}' - \alpha \boxed{\frac{\partial bss}{\partial w}}$$

taux
d'apprentissage

$$a$$
$$w_2$$

$$\dot{w}_3 = \frac{-w_1 \cdot w_2}{-w_1 \dot{w}_2} = -w_2 = -a$$

$$\dot{w}_4 = \dot{w}_3 \exp^{w_3} = -a \exp(-ax)$$

$$\dot{w}_5 = -\frac{\dot{w}_4}{w_4^2} = \frac{+a\exp(-ax)}{(1+e^{-ax})^2}$$

$$\frac{\partial w_i}{\partial x} \quad \dot{w}_i \longrightarrow$$

(-*) (exp +1) (1/.) $\longrightarrow y$

$$a_1 = \omega_{1A} x_A + \omega_{1B} x_B + b_1 = 1.0$$
$$h_1 = \sigma(a_1) = 0.73$$

ω_{1A}

(0.1)

①

ω_{31}

(0.3)

$$a_3 = \omega_{31} h_1 + \omega_{32} h_2 + b_3$$
$$h_3 = \tanh(a_3)$$
$$\longrightarrow \text{sortie} = h_3$$

$$loss = \frac{1}{2}(y - h_3)^2 \approx 0.03 \quad 35$$

X_A

1 ω_{2A}

(0.8) $\dfrac{0.1}{b_1}$

③

$\downarrow \qquad \downarrow$

$0.5 \qquad 0.759$

ω_{1B}

(0.9) 0.1

1 X_B

ω_{2B}

(0.4)

(0.6) ②

ω_{32}

b_3

$$a_2 = \omega_{2A} x_A + \omega_{2B} x_B + b_2$$
$$h_2 = \sigma(a_2)$$
$$h_2 = 0.75$$

$\dfrac{0.1}{b_2}$

1.1

$$\begin{bmatrix} a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} \omega_{1A} & \omega_{1B} \\ \omega_{2A} & \omega_{2B} \end{bmatrix} \begin{bmatrix} x_A \\ x_B \end{bmatrix} + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

$$\frac{\partial loss}{\partial w_{31}} = \overbrace{\underbrace{\frac{\partial loss}{\partial h_3} \times \frac{\partial h_3}{\partial a_3}}_{} \times \frac{\partial a_3}{\partial w_{31}}}^{\delta_3}$$

$$\underbrace{(h_3 - 0.5) \times (1 - h_3^2)}_{} \times h_1 = 0.080$$
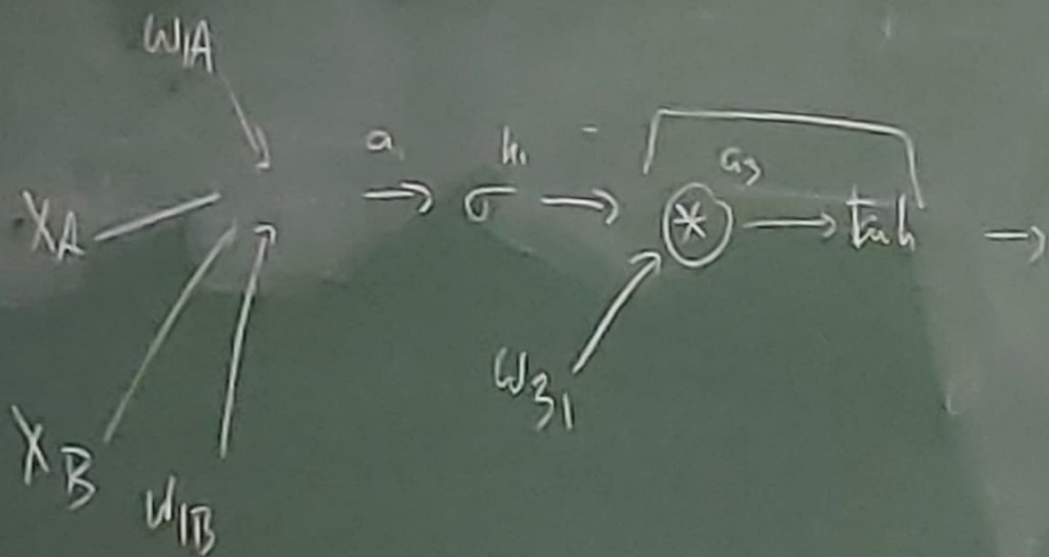
$$w_{31} = w_{31} - \frac{\partial loss}{\partial w_{31}} = 0.22$$

$$\frac{\partial loss}{\partial w_{32}} = \delta_3 \times \frac{\partial a_3}{\partial_{32}} = \delta_3 \times h_2 = 0.081$$

$$w_{32} = w_{32} - \frac{\partial loss}{\partial w_{32}} \approx 0.819$$

$$\frac{\partial loss}{\partial b_3} = \delta_3 \times \frac{\partial a_3}{\partial b_3} = \delta_3 = 0.109 \qquad b_3 = b_3 - 0.105 = -0.09$$

$$\frac{\partial bss}{\partial W_{1A}} = \boxed{\frac{\partial bss}{\partial a_3}} \times \frac{\partial a_3}{\partial h_1} \times \frac{\partial h_1}{\partial a_1} \times \frac{\partial a_1}{\partial W_{1A}}$$

W_{1A}

X_A

X_B W_{1B}

a h_1 $\boxed{a_3}$

σ $\longrightarrow$ $\circledast$ $\longrightarrow$ tanh $\longrightarrow$

W_{31}

$$\frac{\partial bss}{\partial w_{1A}} = \overbrace{\frac{\partial bss}{\partial a_3}}^{\delta_3} \times \overbrace{\frac{\partial a_3}{\partial h_1}}^{w_{31}} \times \overbrace{\frac{\partial h_1}{\partial a_1}}^{h_1(1-h_1)} \times \overbrace{\frac{\partial a_1}{\partial w_{1A}}}^{X_A}$$

$$\frac{\partial bss}{\partial w_{13}} = \delta_3 \times w_{31} \times h_1(1-h_1) \times X_B$$

$$\frac{\partial bss}{\partial w_{2A}} = \delta_3 \times \frac{\partial a_3}{\partial h_2} \times \frac{\partial h_2}{\partial a_2} \times \frac{\partial a_2}{\partial w_{2A}}$$

$$\delta_3 \times w_{32} \times \underbrace{h_2(1-h_2)}_{} \quad \frac{}{X_A}$$

$$\frac{\partial bss}{\partial w_{2B}} = \frac{}{X_B}$$