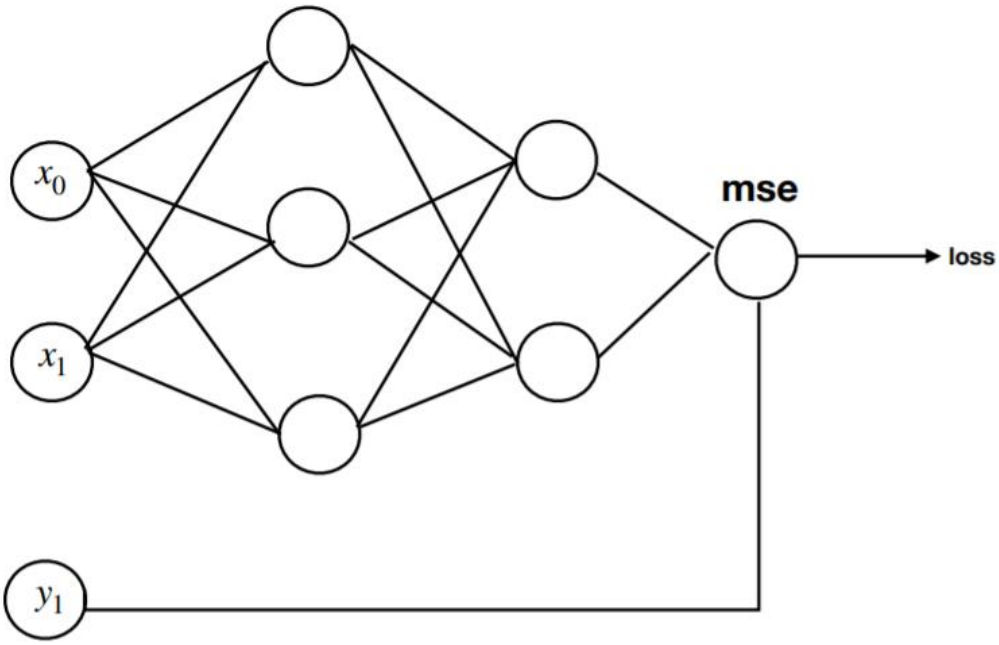
아래 그림에서 모든 w 에 대한 $\frac{\partial loss}{\partial w}$ 을 구하시오



$$\frac{\partial \text{loss}}{\partial pred} = (pred - true) \quad s.t. mse = \frac{(pred - true)^2}{2}$$

$$pred = a_1^2 w_{11}^3 + a_2^2 w_{12}^3$$

$$\frac{\partial loss}{\partial w_{11}^3} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial w_{11}^3} = (pred - true) \cdot a_1^2$$

$$\frac{\partial loss}{\partial w_{12}^3} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial w_{12}^3} = (pred - true) \cdot a_2^2$$

$$\frac{\partial loss}{\partial a_1^2} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial a_1^2} = (pred - true) \cdot w_{11}^3$$

$$\frac{\partial loss}{\partial a_2^2} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial a_2^2} = (pred - true) \cdot w_{12}^3$$

$$\frac{\partial loss}{\partial z_1^2} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial a_1^2} \cdot \frac{\partial a_1^2}{\partial z_1^2} = (pred - true) \cdot w_{11}^3 \cdot a_1^2(1 - a_1^2)$$

$$\frac{\partial loss}{\partial z_2^2} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial a_2^2} \cdot \frac{\partial a_2^2}{\partial z_2^2} = (pred - true) \cdot w_{12}^3 \cdot a_2^2(1 - a_2^2)$$

$$\frac{\partial loss}{\partial w_{11}^2} = \frac{\partial loss}{\partial z_1^2} \cdot \frac{\partial z_1^2}{\partial w_{11}^2} = (pred - true) \cdot w_{11}^3 \cdot a_1^2(1 - a_1^2) \cdot a_1^1$$

$$\frac{\partial loss}{\partial w_{12}^2} = \frac{\partial loss}{\partial z_1^2} \cdot \frac{\partial z_1^2}{\partial w_{12}^2} = (pred - true) \cdot w_{11}^3 \cdot a_1^2(1 - a_1^2) \cdot a_2^1$$

$$\frac{\partial loss}{\partial w_{13}^2} = \frac{\partial loss}{\partial z_1^2} \cdot \frac{\partial z_1^2}{\partial w_{13}^2} = (pred - true) \cdot w_{11}^3 \cdot a_1^2(1 - a_1^2) \cdot a_3^1$$

$$\frac{\partial loss}{\partial w_{21}^2} = \frac{\partial loss}{\partial z_2^2} \cdot \frac{\partial z_2^2}{\partial w_{21}^2} = (pred - true) \cdot w_{12}^3 \cdot a_2^2(1 - a_2^2) \cdot a_1^1$$

$$\frac{\partial loss}{\partial w_{22}^2} = \frac{\partial loss}{\partial z_2^2} \cdot \frac{\partial z_2^2}{\partial w_{22}^2} = (pred - true) \cdot w_{12}^3 \cdot a_2^2(1 - a_2^2) \cdot a_2^1$$

$$\frac{\partial loss}{\partial w_{23}^2} = \frac{\partial loss}{\partial z_2^2} \cdot \frac{\partial z_2^2}{\partial w_{23}^2} = (pred - true) \cdot w_{12}^3 \cdot a_2^2(1 - a_2^2) \cdot a_3^1$$

$$\frac{\partial loss}{\partial a_1^1} = \frac{\partial loss}{\partial z_1^2} \cdot \frac{\partial z_1^2}{\partial a_1^1} + \frac{\partial loss}{\partial z_2^2} \cdot \frac{\partial z_2^2}{\partial a_1^1} = \frac{\partial loss}{\partial z_1^2} \cdot w_{11}^2 + \frac{\partial loss}{\partial z_2^2} \cdot w_{21}^2$$

$$\frac{\partial loss}{\partial a_2^1} = \frac{\partial loss}{\partial z_1^2} \cdot \frac{\partial z_1^2}{\partial a_2^1} + \frac{\partial loss}{\partial z_2^2} \cdot \frac{\partial z_2^2}{\partial a_2^1} = \frac{\partial loss}{\partial z_1^2} \cdot w_{12}^2 + \frac{\partial loss}{\partial z_2^2} \cdot w_{22}^2$$

$$\frac{\partial loss}{\partial a_3^1} = \frac{\partial loss}{\partial z_1^2} \cdot \frac{\partial z_1^2}{\partial a_3^1} + \frac{\partial loss}{\partial z_2^2} \cdot \frac{\partial z_2^2}{\partial a_3^1} = \frac{\partial loss}{\partial z_1^2} \cdot w_{13}^2 + \frac{\partial loss}{\partial z_2^2} \cdot w_{23}^2$$

$$\frac{\partial loss}{\partial z_1^1} = \frac{\partial loss}{\partial a_1^1} \cdot \frac{\partial a_1^1}{\partial z_1^1} = \left(\frac{\partial loss}{\partial z_1^2} \cdot w_{11}^2 + \frac{\partial loss}{\partial z_2^2} \cdot w_{21}^2\right) \cdot a_1^1(1 - a_1^1)$$

$$\frac{\partial loss}{\partial z_2^1} = \frac{\partial loss}{\partial a_2^1} \cdot \frac{\partial a_2^1}{\partial z_2^1} = \left(\frac{\partial loss}{\partial z_1^2} \cdot w_{12}^2 + \frac{\partial loss}{\partial z_2^2} \cdot w_{22}^2\right) \cdot a_2^1(1 - a_2^1)$$

$$\frac{\partial loss}{\partial z_3^1} = \frac{\partial loss}{\partial a_3^1} \cdot \frac{\partial a_3^1}{\partial z_3^1} = \left(\frac{\partial loss}{\partial z_1^2} \cdot w_{13}^2 + \frac{\partial loss}{\partial z_2^2} \cdot w_{23}^2\right) \cdot a_3^1(1 - a_3^1)$$

$$\frac{\partial loss}{\partial w_{11}^1} = \frac{\partial loss}{\partial z_1^1} \cdot \frac{\partial z_1^1}{\partial w_{11}^1} = \frac{\partial loss}{\partial z_1^1} \cdot x_0$$

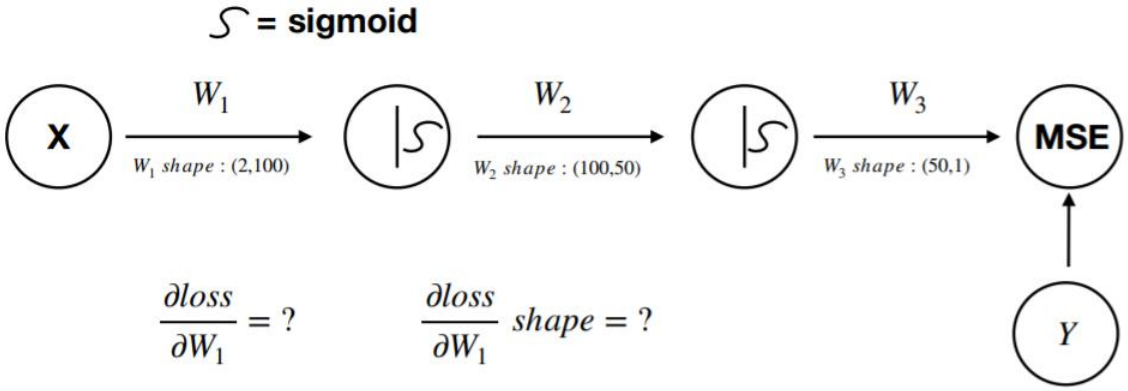
$$\frac{\partial loss}{\partial w_{12}^1} = \frac{\partial loss}{\partial z_1^1} \cdot \frac{\partial z_1^1}{\partial w_{12}^1} = \frac{\partial loss}{\partial z_1^1} \cdot x_1$$

$$\frac{\partial loss}{\partial w_{21}^1} = \frac{\partial loss}{\partial z_2^1} \cdot \frac{\partial z_2^1}{\partial w_{21}^1} = \frac{\partial loss}{\partial z_2^1} \cdot x_0$$

$$\frac{\partial loss}{\partial w_{22}^1} = \frac{\partial loss}{\partial z_2^1} \cdot \frac{\partial z_2^1}{\partial w_{22}^1} = \frac{\partial loss}{\partial z_2^1} \cdot x_1$$

$$\frac{\partial loss}{\partial w_{31}^1} = \frac{\partial loss}{\partial z_3^1} \cdot \frac{\partial z_3^1}{\partial w_{31}^1} = \frac{\partial loss}{\partial z_3^1} \cdot x_0$$

$$\frac{\partial loss}{\partial w_{32}^1} = \frac{\partial loss}{\partial z_3^1} \cdot \frac{\partial z_3^1}{\partial w_{32}^1} = \frac{\partial loss}{\partial z_3^1} \cdot x_1$$



$$\frac{\partial loss}{\partial W_1} = ? \qquad \frac{\partial loss}{\partial W_1}\ shape = ?$$

$$\frac{\partial loss}{\partial W_2} = ? \qquad \frac{\partial loss}{\partial W_2}\ shape = ?$$

$$\frac{\partial loss}{\partial W_3} = ? \qquad \frac{\partial loss}{\partial W_3}\ shape = ?$$

$$\frac{\partial loss}{\partial W_1} = \frac{\partial loss}{\partial pred} \cdot \frac{\partial pred}{\partial W_1} = X^T \cdot \delta \qquad \frac{\partial loss}{\partial W_1} shape = (2,1)$$

$$\frac{\partial loss}{\partial W_2} = \frac{\partial loss}{\partial Z_2} \cdot \frac{\partial Z_2}{\partial W_2} = {A_1}^T \cdot \delta \qquad \frac{\partial loss}{\partial W_2} shape = (100,1)$$

$$\frac{\partial loss}{\partial W_3} = \frac{\partial loss}{\partial Z_3} \cdot \frac{\partial Z_3}{\partial W_3} = {A_2}^T \cdot \delta \qquad \frac{\partial loss}{\partial W_3} shape = (50,1)$$