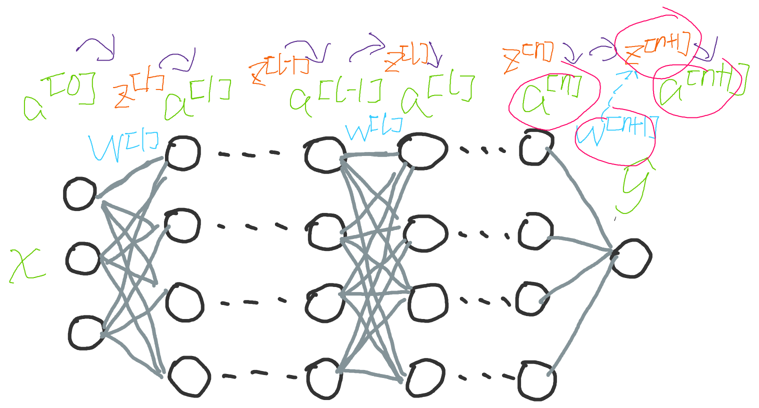


$$x = [x_1, \cdots x_d]^T$$

$$①^l \quad z^{[l]} = W^{[l]} a^{[l-1]} + b^{[l]}$$

$$②^l \quad a^{[l]} = \sigma(z^{[l]})$$

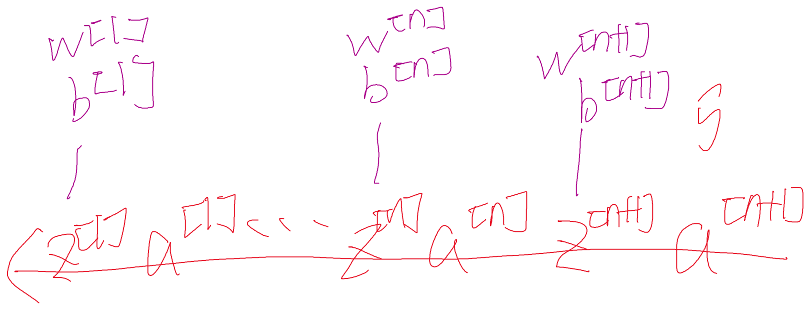
$$l = 2, \cdots, n, n+1 \quad a^{[0]}$$

$$①^1 \quad z^{[1]} = W^{[1]} x + b^{[1]}$$

$$②^1 \quad a^{[1]} = \sigma(z^{[1]})$$

$$①^{n+1} \quad z^{[n+1]} = W^{[n+1]} a^{[n]} + b^{[n+1]}$$

$$②^{n+1} \quad \underbrace{\hat{y}}_{a^{[n+1]}} = \sigma(z^{[n+1]})$$



$$J = \frac{1}{2}(\hat{y} - y)^2$$

$$\frac{\partial J}{\partial \underbrace{\hat{y}}_{a^{[n+1]}}} = \hat{y} - y$$

$$\frac{\partial a^{[n+1]}}{\partial z^{[n+1]}} = \hat{y}(1 - \hat{y})$$

$$\frac{\partial J}{\partial z^{[n+1]}} = \frac{\partial J}{\partial \hat{y}} \times \frac{\partial \hat{y}}{\partial z^{[n+1]}} \qquad \frac{\partial J}{\partial z^{[l]}} = \frac{\partial J}{\partial a^{[l]}} \times \frac{\partial a^{[l]}}{\partial z^{[l]}}$$

$$\frac{\partial z^{[n+1]}}{\partial W^{[n+1]}} = (a^{[n]})^T$$

$$\frac{\partial z^{[n+1]}}{\partial b^{[n+1]}} = 1$$

$$\frac{\partial z^{[n+1]}}{\partial a^{[n]}} = (W^{[n+1]})^T$$

$$\frac{\partial J}{\partial W^{[n+1]}} = \frac{\partial J}{\partial z^{[n+1]}} \times \frac{\partial z^{[n+1]}}{\partial W^{[n+1]}} \qquad \frac{\partial J}{\partial W^{[l]}} = \frac{\partial J}{\partial z^{[l]}} \times \frac{\partial z^{[l]}}{\partial W^{[l]}}$$

$$\frac{\partial J}{\partial b^{[n+1]}} = \frac{\partial J}{\partial z^{[n+1]}} \times \frac{\partial z^{[n+1]}}{\partial b^{[n+1]}}$$

$$\frac{\partial J}{\partial a^{[n]}} = \frac{\partial J}{\partial z^{[n+1]}} \times \frac{\partial z^{[n+1]}}{\partial a^{[n]}} \qquad \frac{\partial J}{\partial a^{[l-1]}} = \frac{\partial J}{\partial z^{[l]}} \times \frac{\partial z^{[l]}}{\partial a^{[l-1]}}$$

$$l = 1, \cdots, n+1$$