1.1 a

Assignment 2

Donghwan An
07/14/24

$$O = w_0 + \sum_{i=1}^{n} w_i (x_i + x_i^2) \qquad E = \frac{1}{2}(t-o)^2$$

$$\frac{do}{dw_i} = \frac{do}{dw_i}\left(\cancel{w_0} + \sum_{i=1}^{n} w_i (x_i + x_i^2)\right) \qquad \frac{dE}{dw_i} = \frac{1}{2}\frac{d}{dw_i}(t-o)^2$$

$$= \frac{do}{dw_i} w_i (x_i + x_i^2) \qquad = -(t-o)\left(\frac{do}{dw_i}\right)$$

$$= x_i + x_i^2$$

$$\boxed{\frac{dE}{dw_i} = -(t-o)(x_i + x_i^2)}$$

bias weight:

$$\frac{do}{dw_0} = \frac{do}{dw_0}\left(w_i (x_i + x_i^2)\right)$$

$$= 1$$

$$\frac{dE}{dw_0} = \frac{1}{2}\frac{d}{dw_0}(t-o)^2$$

$$= -(t-o)\left(\frac{do}{dw_0}\right)$$

$$= -(t-o)(1)$$

$$= -(t-o)$$

$$\frac{dE}{dw_0} = -(t-o)$$

~~let be~~

let η be the step

$$W_{i_{new}} = W_{i_{old}} + \left[+ (t-o)(x_i + x_i^2)\right]\eta$$

$$\boxed{W_{i_{new}} = W_{i_{old}} + (t-o)(x_i + x_i^2)\eta}$$ ☆

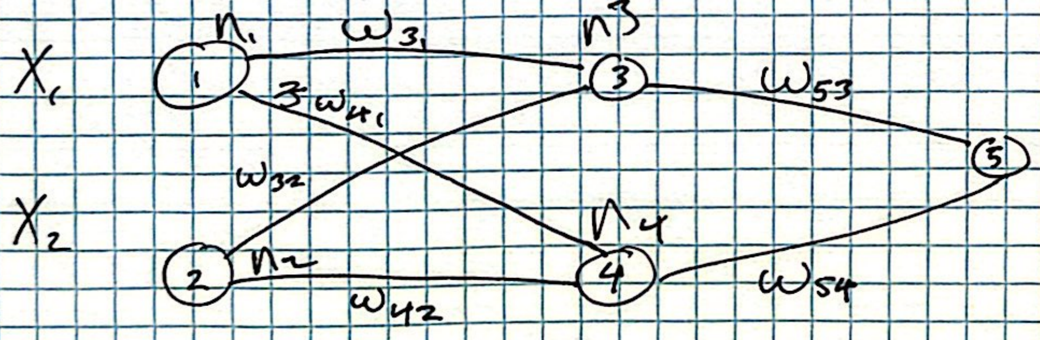
$$W_{0_{new}} = W_{0_{old}} - \left[- (t-o)\right]$$

$$\boxed{W_{0_{new}} = W_{0_{old}} + (t-o)\eta}$$ ☆

1.2 Comparing Activation Function

let n_i = the i^{th} neuron

a.)



$$n_3 = (w_{31}x_1 + w_{32}x_2)h$$

$$n_4 = (w_{41}x_1 + w_{42}x_2)h$$

$$n_5 = w_{53}h_3 + w_{54}h_4$$

$$= h\,w_{53}\cancel{h_3}(w_{31}x_1 + w_{32}x_2) + h\,w_{54}(w_{41}x_1 + w_{42}x_2$$

1.2 b

$$Z_1 = W_1 X$$

$$H = h(Z_1)$$

$$Z_2 = W_2 H$$

$$y_s = h(Z_2)$$

$$= h(W_2 H)$$

$$\boxed{= h(W_2 h(W_1 X))}$$

1.2 c

$$h_s(x) = \frac{1}{1+e^{-x}} \cdot e \qquad h_t(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

$$\cancel{= \sigma(x) =}$$

$$\cancel{= \frac{e}{e\left(1+\frac{1}{e^x}\right)}}$$

$$\cancel{= \frac{e}{e+\frac{e}{e^x}}}$$

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

1.2 c

$$\theta(x) = \frac{1}{1+e^{-x}}$$

$$\theta(x) - \frac{1}{2} = \frac{1}{1+e^{-x}} - \frac{1}{2}$$

$$= \frac{(2)(1)}{(2)(1+e^{-x})} - \frac{1+e^{-x}}{(2)(1+e^{-x})}$$

$$= \frac{1-e^{-x}}{2(1+e^{-x})} \cdot \frac{e^{x}}{e^{x}}$$

$$= \frac{e^{x} - \frac{1}{\cancel{e^{x}}} \cdot \cancel{e^{x}}}{2e^{x} + 2\frac{1}{\cancel{e^{x}}} \cdot \cancel{e^{x}}}$$

$$= \frac{e^{x}-1}{2e^{x}+2}$$

$$\boxed{\theta(x) - \frac{1}{2} \therefore = \frac{e^{x}-1}{2(e^{x}+1)}}$$

$$\tanh(x) = \frac{e^{x}-e^{-x}}{e^{x}+e^{-x}}$$

$$\tanh\left(\frac{x}{2}\right) = \frac{e^{x/2}-e^{-\frac{x}{2}}}{e^{x/2}-e^{-x/2}} \cdot \frac{e^{x/2}}{e^{x/2}}$$

$$= \frac{e^{x/2+x/2} - e^{-x/2+x/2}}{e^{x/2+x/2} - e^{-x/2+x/2}}$$

$$\tanh\left(\frac{x}{2}\right) = \frac{e^x - 1}{e^x + 1}$$

$$\sigma(x) - \frac{1}{2} = \frac{e^x - 1}{2(e^x + 1)}$$

$$= \frac{1}{2}\left(\frac{e^x - 1}{e^x + 1}\right)$$

$$= \frac{1}{2}\left(\tanh\left(\frac{x}{2}\right)\right)$$

$$\sigma(x) - \frac{1}{2} = \frac{1}{2}\left(\tanh\left(\frac{x}{2}\right)\right)$$

$$\sigma(x) = \frac{1}{2}\left(\tanh\left(\frac{x}{2}\right)\right) + \frac{1}{2}$$

$$\cancel{= \frac{1}{2}\left(\tanh\left(\frac{x}{2}\right)\right)}$$

$$\cancel{= \frac{1}{2}\left(\mathrm{ta}\right.}$$

$$\boxed{\therefore \sigma(x) = \frac{1}{2}\left(\tanh\left(\frac{x}{2}\right) + 1\right)}$$

$$\cancel{h(n_5) =}$$

$$\cancel{h_5(n_5) = h_5 w_{53}(w_{31}x_1 + w_{32}x_2) + h_5 w_{54}(w_{41}x_1 + w_{42}x_2)}$$

"

$$y_5 = h_5(n_5) =$$