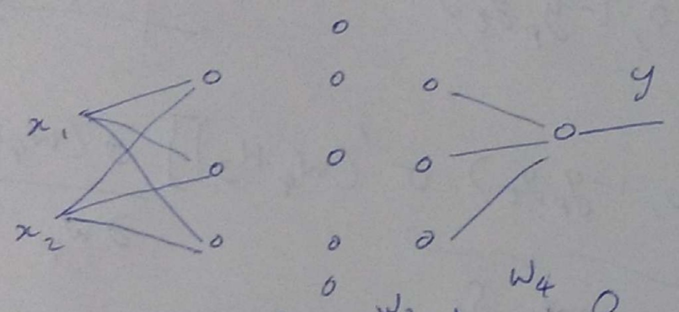
HW - 19

2. Network



$x_0 \quad W_1 \quad H_1 \quad W_2 \quad H_2 \quad W_3 \quad H_3 \quad W_4 \quad O$

$(3,2) \quad (5,3) \quad (3,5) \quad (1,3)$

i) MSE Loss - $\Sigma (y_p - y_t)^2$

Equation for feedforward.

$H_i = \sigma(W_i H_{i-1})$, assuming $H_0 = X_0$ & $H_5 = 0$

Backprop,

Update: $W = W - \eta \frac{\partial L}{\partial W}$

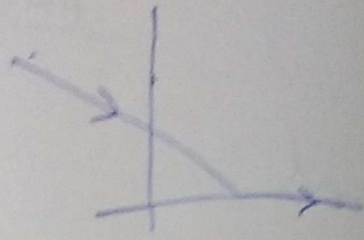
$$\frac{\partial L}{\partial W_4} = (O - y_t)\frac{\partial O}{\partial W_4} = [(O - y_t) * \sigma'(W_4 H_3)] \frac{\partial W_4 H_3}{\partial W_4}$$

Similarly, $\frac{\partial L}{\partial W_3} = [\delta_4 W_4^T \cdot \sigma'(W_3 H_2)] \cdot H_2^T$, where $\delta_4 = (O - y_t) \cdot \sigma'(W_4 H_3)$

$$\frac{\partial L}{\partial W_2} = [\delta_3 W_3^T \sigma'(W_2 H_1)] . H_1^T$$

$\frac{\partial L}{\partial W_1} = [\delta_1 X_1]$, where $\delta_1 = \delta_2 W_2^T \cdot \sigma'(W_1 X_1)$

ii) Hinge Loss



$$Loss = \max(0, 1 - y_p y_t)$$

$$\frac{\partial L}{\partial W_4} = \Big[\underbrace{\max(0, 1 - y_p y_t) \cdot \sigma'(W_4 H_3)}_{\text{Assume } \delta_4}\Big] \frac{\partial (W_4 H_3)}{\partial W_4}$$

$$\frac{\partial L}{\partial W_4} = \delta_4 \frac{\partial (W_4 H_3)}{\partial W_4} = \delta_4 H_3^T$$

$$\frac{\partial L}{\partial W_3} = \max(0, 1 - y_p y_t) \frac{\partial O}{\partial W_3}$$

$$= \left[\delta_4 W_4^T \cdot \sigma'(W_3 H_2)\right] H_2^T$$

$$= \delta_3 H_2^T$$

Similarly,

$$\frac{\partial L}{\partial W_2} = \Big[\underbrace{\delta_3 W_3^T \cdot \sigma'(W_2 H_1)}_{\delta_2}\Big] H_1^T$$

$$\frac{\partial L}{\partial W_1} = \left[\delta_2 W_2^T \cdot \sigma'(W_1 X)\right] X.$$