Period 21 ECE 532 Ayan Deep Hazra

1. $\sigma(z) = \{0, z\}$

Thus, $u_1 = 4$, $u_2 = -2$

$2 \times 1 + u_1 \times 1 + u_2(-1)$ is the input of h_1

$2 + u_1 - u_2 =$ input of h_1

$2 + 4 - (-2) =$ input of h_1

$8 =$ input of h_1

$\boxed{\sigma(h_1) = 8}$

$-2 \times 1 + 3u_1 + 4u_2 =$ input of h_2

$-2 + 3u_1 + 4u_2 =$ input of h_2

$-2 + 12 - 8 =$ input of h_2

$2 =$ input of h_2

$\boxed{\sigma(h_2) = 2}$

Input of $y_1 = 0.5\,h_1 - 0.5\,h_2$

$= 0.5(8) - 0.5(2)$

$= 4 - 1$

$= 3$

$\boxed{\sigma(y_1) = 3}$

Scanned with CamScanner

Input of y_2 = $-0.5h_1 + 0.5h_2$

Input of y_2 = $-4 + 1$

$= -3$

$\boxed{\sigma(y_2) = 0}$

$\therefore$ $y_1 = 3$ $y_2 = 0$

Scanned with CamScanner

2. a) $\hat{y}_i = \sigma(x_i^T w + w_0)$

$$= \begin{cases} x_i^T + w_0 & \text{if } x_i^T w + w_0 \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

$$= \sigma\left(\sum_{j=1}^{p} x_j^i w_j + w_0\right)$$

b) i) $l(w) = \sum_{j=1}^{n} l_i(w) = \sum_{i=1}^{n} \frac{1}{2}(\hat{y}^i - y^i)^2$

$$\frac{\partial l(w)}{dw_n} = \sum_{i=1}^{n} \frac{\partial l_i(w)}{\partial w_k} = \sum_{i=1}^{N} \frac{dl_i(w)}{d\hat{y}^i} \cdot \frac{d\hat{y}^i}{dw_n}$$

$$= \sum_{i=1}^{N} (\hat{y}_i^i - y_i^i) \cdot \frac{d\hat{y}}{dw^n}$$

$$\nabla l(w) = \sum_{i=1}^{N} (\hat{y}^i - y^i) x^i = \begin{cases} 1 & \text{if } x^{iT} w + w_0 \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

ii) $w^{(k+1)} = w^{(k)} - \tau \nabla l_{i_k}(w^{(k)})$

$$w^{(k+1)} = \begin{cases} w^{(k)} - \tau & x^{iT} w + w_0 \geq 0 \\ w^{(k)} & \text{otherwise} \end{cases}$$

c) $w^{(k+1)} = w^{(k)} - \tau \nabla l_{ik}(w^{(k)})$

$$f'(w) = \frac{\frac{1}{2}(y^i - \hat{y}^i)^2}{dw_0} + \frac{d\lambda\sum_{i=0}^{p} w_i^2}{dw_i}$$

$\cancel{= 2\lambda w_i}$

$$= \frac{1}{2}\frac{d(\hat{y}^i - y)}{d\hat{y}^i} \cdot \frac{d\hat{y}^i}{dw_0}$$

$$= (\hat{y}^i - y)^2 \cdot \frac{d(1+e^{-z})}{dz} \cdot \frac{dz}{dw_0}$$

$$= (\hat{y}^i - y^i)^2 \frac{(-1)e^{-z}(-1)}{(1+e^{-z})} \cdot \frac{d\sum_{i=0}^{p} w_0 x_0}{dw_i}$$

$$= -(\hat{y}^i - y^i) \cdot \hat{y}_i(1-\hat{y}^i) \cdot x_0^i$$

Thus, $w^{(k+1)}_{k,l} = w^t_{k,l} - \tau_t \left((\hat{y}^i_k - y^i_k) \cdot \hat{y}^i_k (1 - \hat{y}^i_k) + \lambda 2w_{k,l} \right)$