Homework 1

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Problem 1

If $f(.)$ is chosen as a linear function, it could be written as $f(x) = ax + b$

$$g_k(\mathbf{x}) = y_k = f\left(\sum_j w_{kj}\left[a\left(\sum_i w_{ji}x_i + w_{j0}\right) + b\right] + w_{k0}\right)$$

$$= f(\sum_j aw_{kj}\sum_i w_{ji}x_i + \sum_j (aw_{j0} + b)w_{kj} + w_{k0})$$

$$= f(\sum_i x_i \sum_j aw_{kj}w_{ji} + (\sum_j (aw_{j0} + b)w_{kj} + w_{k0}))$$

Let $c = \sum_j (aw_{j0} + b)w_{kj} + w_{k0}$ and $w_i' = \sum_j aw_{kj}w_{ji}$, then

$$= f\left(\sum_i w_i'x_i + c\right) = \sum_i aw_i'x_i + (ac + b)$$

Which is also a linear function.

Problem 2

(1)

Let $\alpha = W^T X$

$$w_i' = w_i - \lambda \cdot \frac{\partial E}{\partial w_i} = w_i - \lambda \cdot \frac{\partial E}{\partial y}\frac{\partial y}{\partial \alpha}\frac{\partial \alpha}{\partial w_i}$$
$$= w_i - \lambda \cdot -(g - y)y(1 - y)x_i$$
$$= w_i + \lambda y(1 - y)(g - y)x_i$$

(2)

$$y = s(W^T X) = \frac{1}{1 + e^{-3}} = 0.95$$

Hence,

$$w' = (0.5,1,1) + (2.375 * 10^{-4}, 4.75 * 10^{-4}, 1.19 * 10^{-4})$$