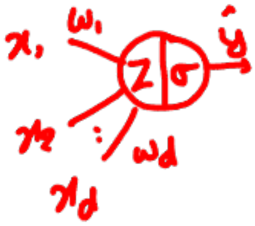
Assign-3

Q5)



$z = \sum_j w_j x_j$, $\hat{y} = \sigma(z)$

Decision rule: $\sigma(z) > \frac{1}{2}$, decide 1 .5

$< \frac{1}{2}$, " -1

$$\frac{1}{1+e^{-z}} > \frac{1}{2} \Rightarrow -z < 0 \text{ or } z > 0$$ .5

Since we decide $+1$, when $\sigma(z) > \frac{1}{2}$, i.e., $z > 0$

we can write decision as $\text{sign}(z)$

or $\text{sign}\left(\sum_j w_j x_j\right)$ which is Rosenblatt's perceptron.

If we train using this cost function, the update will be same as that of Rosenblatt's perceptron.

Q5-b) $\phi(\beta,\beta_0) = -\sum_j y_j(\beta^T x_j + \beta_0)$ s.t. $\|\beta\|_2 = 1$

Since $\|\beta\|_2 = 1$, $\Rightarrow \|\beta\|_2^2 = 1$

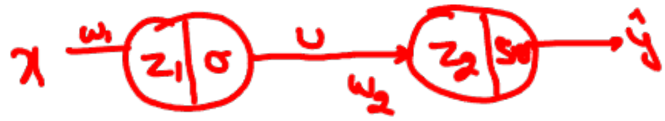
Using Lagrange's formulation.

$$\min_{\beta,\beta_0} \; -\sum_j y_j(\beta^T x_j + \beta_0) - \lambda(\beta^T\beta - 1)$$ .5

$$\beta \leftarrow \beta - \eta\left\{-\sum_j y_j x_j\right\} - 2\lambda\beta$$ .5

$$\beta_0 \leftarrow \beta_0 - \eta\left\{-\sum_j y_j\right\}$$

Q-6)



Another one mark for code

$z_1 = w_1 x + \beta_1$

$u = \sigma(z_1)$

$z_2 = w_2 u + \beta_2$

$\hat{y} = \text{sign}(z_2)$

$$\min_{\substack{w_1,w_2\\ \beta_1,\beta_2}} \; -y[z_2] =$$

$$\min_{\substack{w_1,w_2\\ \beta_1,\beta_2}} \; -y[w_2\sigma(w_1x+\beta_1)+\beta_2]$$ .25

$$w_1 \leftarrow w_1 - \eta\left[-yw_2\sigma(w_1x+\beta_1)\{1-\sigma(w_1x+\beta_1)\}\right]x$$

$$w_2 \leftarrow w_2 - \eta\left[-y\sigma(w_1x+\beta_1)\right]$$ .25

$$\beta_1 \leftarrow \beta_1 - \eta\left[-yw_2\sigma(w_1x+\beta_1)\{1-\sigma(w_1x+\beta_1)\}\right]$$ .25

$$\beta_2 \leftarrow \beta_2 - \eta[-y]$$ .25