<u>HW - 18</u>

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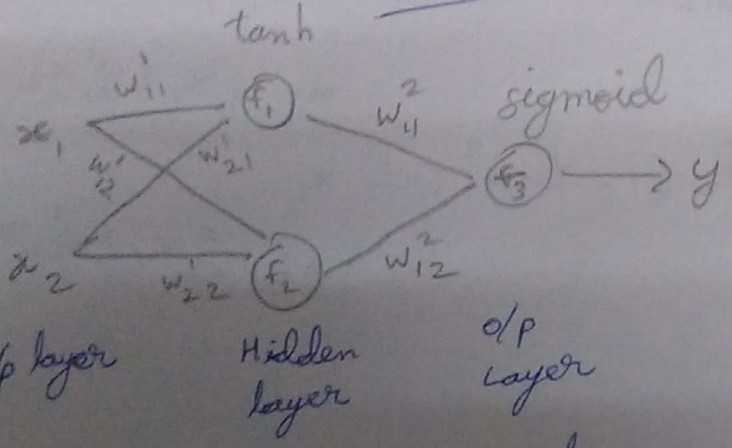

$$\frac{\partial \tanh(x)}{\partial x} = 1 - \tanh^2(x)$$

$$\frac{\partial\, \text{sigmoid}(x)}{\partial x} = s(x)(1 - s(x))$$

- y is the output signal.

$y_1 = \tanh(w_{11}^1 x_1 + w_{21}^1 x_2)$ $\quad y_2 = \tanh(w_{12}^1 x_1 + w_{22}^1 x_2)$

$$y_{output} = \sigma(w_{11}^2 y_1 + w_{12}^2 y_2).$$

- Next step,
  Calculate loss (error) & pass it backward.

$$\delta(\text{error}) = (\underset{\text{actual}}{z} - \underset{\text{predicted}}{y})$$

$\delta_1 = w_{11}^2\, \delta_{output}$

$\delta_2 = w_{12}^2\, \delta_{output}.$

- Use computed error to update weight co-efficients.

$$w_{11}^{1'} = w_{11}^1 + \eta\, \delta_1 \frac{\partial y_1}{\partial w_{11}^1} x_1$$

$$= w_{11}^1 + \eta\, \delta_1 \frac{\partial}{\partial w_{11}^1} \tanh(w_{11}^1 x_1 + w_{21}^1 x_2)\, x_1$$

$$= w_{11}^1 + \eta\, \delta_1 (1 - \tanh^2(k))\, x_1, \quad \text{where } k = w_{11}^1 x_1 + w_{21}^1 x_2$$

Similarly,

$$w_{12}^{1'} = w_{12}^1 + \eta\, \delta_2 (1 - \tanh^2(l))\, x_1, \quad \text{where } l = w_{12}^1 x_1 + w_{22}^1$$

$$w_{21}^1 = w_{21}^1 + \eta\, \delta_1 \left(1 - \tanh^2(m)\right) x_1 ,$$

$m: w_{11}^1 x_1 + w_{21}^1 x_2$

$$w_{22}^1 = w_{22}^1 + \eta\, \delta_2 \left(1 - \tanh^2(n)\right) x_1 ,$$

$n: w_{12}^1 x_1 + w_{22}^1 x_2$

For Layer hidden,

$$w_{11}^2 = w_{11}^2 + \eta\, \delta_{output} \frac{\partial y_{output}}{\partial w_{11}^2}\, y_1$$

$$= w_{11}^2 + \eta\, \delta_{output} \frac{\partial\left(\sigma(w_{11}^2 y_1 + w_{12}^2 y_2)\right)}{\partial w_{11}^2}\, y_1$$

$$= w_{11}^2 + \eta\, \delta_{output}\, \sigma(a)\left(1 - \sigma(a)\right) y_1 ,$$ where

$a = w_{11}^2 y_1 + w_{12}^2 y_2$

$$w_{12}^2 = w_{12}^2 + \eta\, \delta_{output}\, \sigma(a)\left(1 - \sigma(a)\right) y_2$$