Sheet 1

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CS dep

* for output Layer (w_5, w_6, w_7, w_8)

By applying chain rule we get

$$\frac{\partial E(w)}{\partial w_5} = \frac{\partial E(w)}{\partial out_{o_1}} * \frac{\partial out_{o_1}}{\partial net_{o_1}} \times \frac{\partial net_{o_1}}{\partial w_5}$$

$w_5 \rightarrow net_{o_1} \rightarrow out_{o_1} \rightarrow \frac{\partial E_{total}}{\partial out_{o_1}}$

target (Actual) → predicted

$$J(w) = \frac{1}{2}(o_1 - out_{o_1})^2 + \frac{1}{2}(o_2 - o_2)$$

$$\frac{J(w)}{\partial out_{o_1}} = 2 * \frac{1}{2}(o_1 - o_2)^{2-1} * -1 + 0 = (Actual_{o_1} - out_{o_1})$$

$$\boxed{\frac{J(w)}{\partial out_{o_1}} = 0.7413} \rightarrow (1)$$

By derivative of the Logistic function

$$out_{o_1} = \frac{1}{1+e^{net_{o_1}}}$$

$$\frac{\partial out_{o_1}}{\partial net_{o_1}} = out_{o_1}(1 - out_{o_1}) = 0.7513(1 - .7513) = \boxed{0.1868} \rightarrow (2)$$

total input of o_1

$$\frac{net_{o_1}}{\partial w_5} = w_5 * out_{h_1} + w_6 * out_{h_2} + b_2 * 1 = out_{h_1} = \boxed{0.0821} \rightarrow (3)$$

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بالتعويض في (eq1)

$$\frac{J(w)}{\partial w_5} = 0,0821$$

- update $w \leftarrow w - n \frac{\partial J(w)}{\partial w}$

فرضاً $n = 0,5$

$$w'_5 = w_5 - n \times \frac{\partial J(w)}{\partial w_5}$$

$$w'_5 = 0,4 - 0,5 \times 0,821 = 0,3589 \rightarrow w_5$$

وبتطبيق نفس الخطوات السابقة لـ w_6, w_7, w_8 نجد أن

$w'_6 = 0.4086 \rightarrow w_6$

$w'_7 = 0,5113 \rightarrow w_7$

$w'_8 = 0,5613 \rightarrow w_8$

For Hidden Layer (w_1, w_2, w_3, w_4)

$$\frac{J(w)}{\partial w_1} = \frac{J(w)}{\partial out_{h_1}} \times \frac{\partial out_{h_1}}{\partial net_{h_1}} * \frac{\partial net_{h_1}}{\partial w_1} \rightarrow eq_2$$

ومن الـ output Layer أقدر أقول أن

$$\frac{\partial J(w)}{\partial out_{h_1}} = \frac{\partial J(w)_{o1}}{\partial out_{h_1}} + \frac{\partial J(w)_{o2}}{\partial out_{h_1}} \rightarrow (1)$$

$$\frac{\partial J(w)_{o1}}{\partial out_{h_1}} = \frac{\partial J(w)_{o1}}{\partial net_{o1}} * \frac{\partial net_{o1}}{\partial out_{h_1}}$$

$$\frac{\partial J(w)_{o1}}{\partial out_{h_1}} = \frac{\partial J(w)_{o1}}{\partial out_{o1}} \times \frac{\partial out_{o1}}{\partial net_{h_1}} = 0,7413 \times 0,1868 = 0,1384$$

وأنا عندي ال $\frac{\partial net_{o1}}{\partial out_{h1}} = w_5 = 0.40$

$$\frac{\partial J(w)_{o1}}{\partial out_{h1}} = \frac{\partial J(w)_{o1}}{\partial net_{o1}} \times \frac{\partial net_{o1}}{\partial out_{h1}} = .1384 \times 0.40 = \boxed{0.0554}$$

ومن نفس الخطوات السابقة أقدر احصل على

$$\frac{\partial J(w)_{o2}}{\partial out_{h1}} = \boxed{-0.0191}$$

يبقى دلوقتي اقدر أعوض في ①

$$\frac{\partial J(w)_{total}}{\partial out_{h1}} = 0.0554 - 0.0191 = \boxed{0.0364}$$

دلوقتي عايزاحسب $\frac{\partial out_{h1}}{\partial net_{h1}}$ و $\frac{\partial net_{h1}}{\partial w}$ لكل w

$$\frac{\partial out_{h1}}{\partial net_{h1}} = out_{h1}(1 - out_{h1}) = 0.5932(1 - 0.5932) = \boxed{0.2413}$$

(أفرحاجة)

$$\frac{\partial net_{h1}}{\partial w_1} = w_1 \times I_1 + w_3 I_2 + b \times 1 = I_1 = \boxed{0.05}$$

وبالتعويض في ② هنجيبه

$$\frac{\partial J(w)_{total}}{\partial w_1} = \boxed{0.00044}$$

وبعدها أقدر احسب w_1'

update $w \leftarrow w - \eta \frac{\partial J(w)}{\partial w_1}$

$$w_1' = 0.15 - 0.5 * 0.00044 = \boxed{0.1499} \rightarrow w_1$$

وهنكرر الخطوات السابقة لـ w_2, w_3, w_4 نجد أنه

$\boxed{w_2' = 0.1996}$ $\quad w_3' = \boxed{0.2498}$ $\quad w_4 = \boxed{0.2995}$

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عشان نحسب forward error هنلاقي أني

$net\ h_1 = w_1 * I_1 + w_2 \times I_2 + b_1 * 1$

$net\ h_1 = 0,13775$

$out\ h_1 = \frac{1}{1+e^{net\ h_1}} = 0,5933$

وبنفس الخطوات هنلاقي أن

$out\ h_2 = 0,59688$

ولو كملنا نفس الخطوات ل output Layer هنلاقي أن

$out\ o_1 = ,75136$

$out\ o_2 = 0,7729$

$E_{total} = \sum_{i=1}^{2} \frac{1}{2} (trget - output)^2$

$E_1 = 0,2748$

$E_2 = 0,02356$

$E_{total} = E_1 + E_2 = 0,298371$

بعد ما عملنا update ل كل widget تقدر تحسب error

In case forward (Before first iteration)

$E_{total} = 0,298371$

In case Backpregation (After first iteration)

$E_{total} = 0,291027$

هو المفروض يبقى الفرق كبير بس مش واضح هنا عشان أحنا عملنا one loop ... وساعتها هيظهر فايدة ال backpragation