PROBLEM: CALCULATE $\frac{\partial P}{\partial \omega_3}$ & $\frac{\partial P}{\partial \omega_2}$

NOTE #1: IT DOES NOT MATTER WHETHER $P = -\frac{1}{2}(\alpha - s_3)^2$ OR $P = -\frac{1}{2}(s_3 - \alpha)^2$ BECAUSE

$$\frac{\partial}{\partial s_3}\left(-\tfrac{1}{2}(\alpha - s_3)^2\right) = -(\alpha - s_3)\frac{\partial}{\partial s_3}(\alpha - s_3)$$

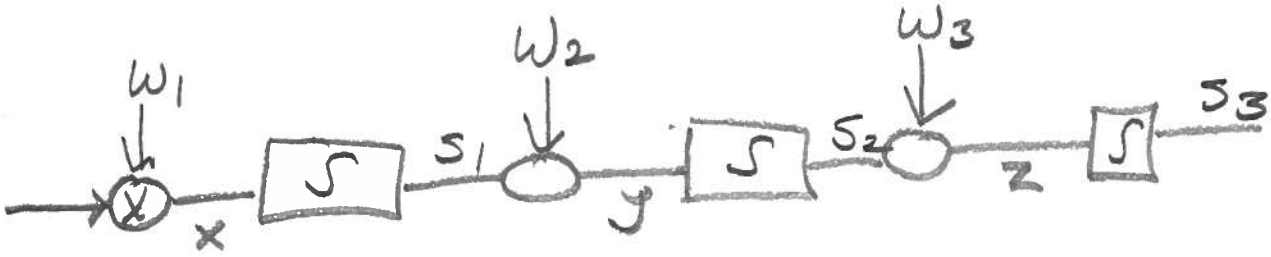
$$= +(\alpha - s_3) = -(s_3 - \alpha)$$

$$= \frac{\partial}{\partial s_3}\left(-\tfrac{1}{2}(s_3 - \alpha)^2\right)$$

SO, EITHER WAY, THE RESULT CAN BE WRITTEN AS

$$\alpha - s_3$$

NOTE #2: IT IS MUCH EASIER TO THINK THROUGH THE PROBLEM WHEN THE NET IS DRAWN THIS WAY



NOTE THE ADDITION OF x, y, z, WHICH DO NOT APPEAR IN THE SOLUTIONS, BUT ARE NEEDED IN DEVELOPING THE SOLUTIONS.

NOTE #3: USE CHAIN RULE TO FIND ANSWERS

$$\frac{\partial P}{\partial w_3} = \frac{\partial P}{\partial s_3}\,\frac{\partial s_3}{\partial z}\,\frac{\partial z}{\partial w_3}$$

$$\frac{\partial P}{\partial s_3} = (a - s_3) \quad \frac{\partial s_3}{\partial z} = s_3(1 - s_3) \quad \frac{\partial z}{\partial w_3} = s_2$$

$$\delta s_3$$

BECAUSE $z = w_3 s_2$

MISSING FROM ON-LINE SOLUTIONS

$$\frac{\partial P}{\partial \omega_2} = \boxed{\frac{\partial P}{\partial S_3}\ \frac{\partial S_3}{\partial x}}\ \boxed{\frac{\partial x}{\partial S_2}}\ \boxed{\frac{\partial S_2}{\partial y}}\ \boxed{\frac{\partial y}{\partial \omega_2}}$$

ALREADY DONE

$(\alpha - S_3)\, S_3 (1 - S_3)$ ω_3 $S_2(1-S_2)$ S_1

δ_{S_3}

δ_{S_2}

NOTE # 4: BEYOND THE PROBLEM,

$$\Delta \omega_3 = \alpha\ S_2\ \delta_{S_3}$$

$$\Delta \omega_2 = \alpha\ S_1\ \delta_{S_2}$$

$$\delta S_2 = S_2 (1 - S_2)\, \omega_3\ \delta S_3$$

NOTE #5: BACK TO PROBLEM

IF YOU HAVE 100 NEURONS,

AND AT SOME POINT ALL

THE WEIGHTS AND OUTPUTS

ARE THE SAME, WHAT IS

$\frac{\partial P}{\partial w_1}$? BY LOOKING AT

$\frac{\partial P}{\partial w_2}$ OR MAYBE $\frac{\partial P}{\partial w_1}$ IN PREVIOUS

PART, YOU CAN INFER THE

RECURSION, WHICH YIELDS

$$\frac{\partial P}{\partial w_1} = w^{99}\, \sigma^{100}(1-\sigma)^{100}(Q-\sigma)\, \dot{=}$$

MISSING

FROM SOLUTIONS

ON LINE