CENG 506 Spring 2023 Assignment #2 solutions

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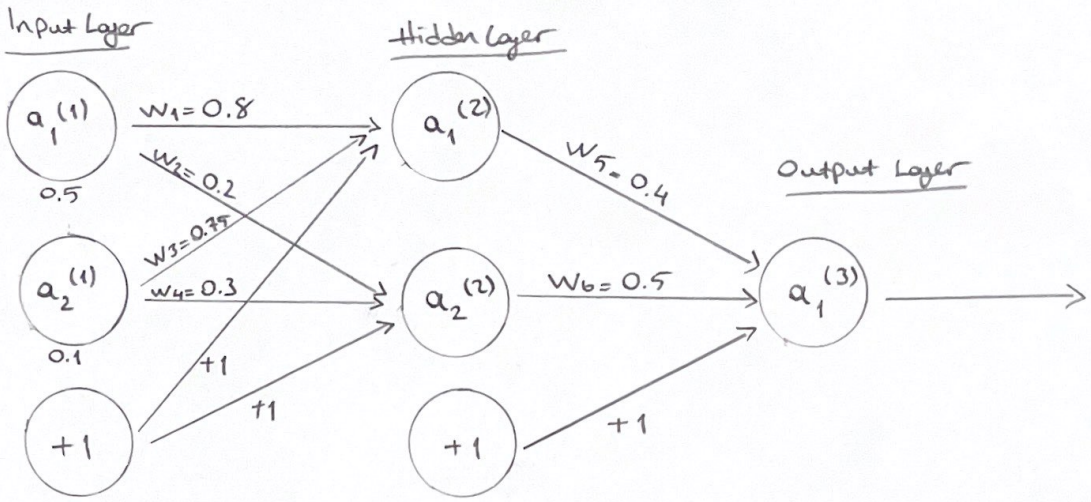


Answers:

a-) $a_1^{(2)} = \sigma(w_1 . a_1^{(1)} + w_3 . a_2^{(1)} + b_1) = \sigma(0,8 . 0,5 + 0,75 . 0,1 + 1) = \sigma(1,475)$

$= \underline{0,81} \Rightarrow$

$a_2^{(2)} = \sigma(w_2 . a_1^{(1)} + w_4 . a_2^{(1)} + b_1) = \sigma(0,2 . 0,5 + 0,3 . 0,1 + 1) = \sigma(1,13)$

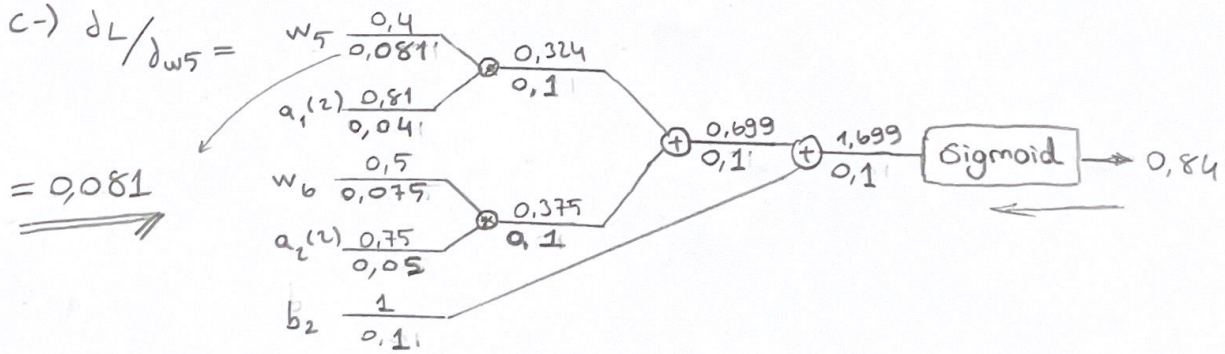
$= \underline{0,75} \Rightarrow$

$a_1^{(3)} = \sigma(w_5 . a_1^{(2)} + w_6 . a_2^{(2)} + b_2) = \sigma(0,4 . 0,81 + 0,5 . 0,75 + 1) = \sigma(1,699)$

$= \underline{0,84} \Rightarrow$

b-) $L = a_1^{(3)} - y \Rightarrow 0,84 - 0,1 = \underline{0,74} \Rightarrow$

c-) $\partial L / \partial w_5 =$



$= \underline{0,081} \Rightarrow$

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C (Alternative Solution) -)

$$\frac{\partial L}{\partial w_5} = \frac{\partial L}{\partial a_1^{(3)}} \cdot \frac{\partial a_1^{(3)}}{\partial z_1^{(3)}} \cdot \frac{\partial z_1^{(3)}}{\partial w_5} = 0,74 \cdot 0,1344 \cdot 0,81 = \underline{0,081}$$

$\frac{\partial L}{\partial a_1^{(3)}} = 0,74$

$\frac{\partial a_1^{(3)}}{\partial z_1^{(3)}} = a_1^{(3)} \cdot (1 - a_1^{(3)})$

$0,84 \cdot (1 - 0,84) = 0,1344$

$\frac{\partial z_1^{(3)}}{\partial w_5} = a_1^{(2)} = \frac{\partial (a_1^{(2)} \cdot w_5 + a_2^{(2)} \cdot w_6 + b_2)}{\partial w_5}$

d-) $w_5' = w_5 - \alpha \cdot \frac{\partial L}{\partial w_5} = 0,4 - (0,1 \cdot 0,0081) = \underline{0,39919}$

e-) $\frac{\partial L}{\partial w_1} = \frac{\partial L}{\partial a_1^{(3)}} \cdot \frac{\partial a_1^{(3)}}{\partial z_1^{(3)}} \cdot \frac{\partial z_1^{(3)}}{\partial a_1^{(2)}} \cdot \frac{\partial a_1^{(2)}}{\partial z_1^{(2)}} \cdot \frac{\partial z_1^{(2)}}{\partial w_1}$

$\frac{\partial L}{\partial a_1^{(3)}} = 0,74$

$\frac{\partial a_1^{(3)}}{\partial z_1^{(3)}} = 0,1344$

$\frac{\partial z_1^{(3)}}{\partial a_1^{(2)}} = w_5 = 0,4$

$\frac{\partial a_1^{(2)}}{\partial z_1^{(2)}} = a_1^{(2)} \cdot (1 - a_1^{(2)}) = 0,81 \cdot 0,19 = 0,1539$

$\frac{\partial z_1^{(2)}}{\partial w_1} = a_1^{(1)} = 0,5$

$= 0,74 \cdot 0,1344 \cdot 0,4 \cdot 0,1539 \cdot 0,5 = \underline{0,00306}$