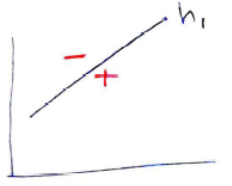
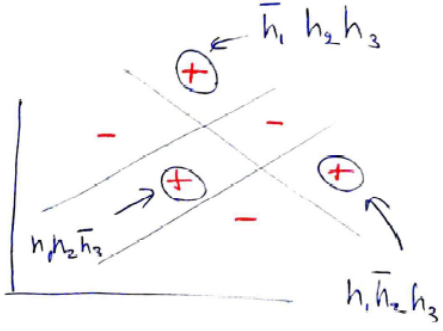
Exercise 7.1

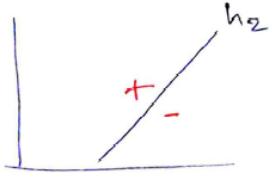
(a)



+ ⇔ True

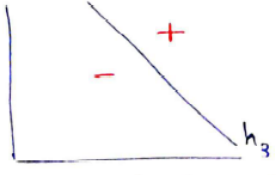
− ⇔ False.





Want "True" if any of ⊕ regions are True.

⇒ Table "OR"



$$f = \bar{h}_1 h_2 h_3 + h_1 \bar{h}_2 h_3 + h_1 h_2 \bar{h}_3$$

(b) In general, form f as a sum of product terms over each (+) region

Q2

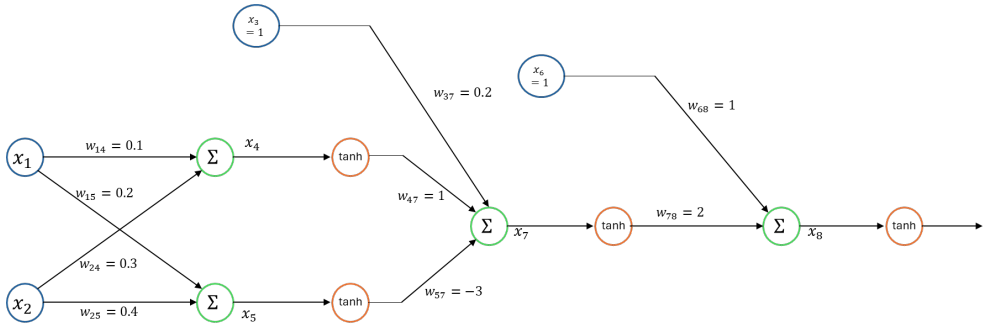
Feed forward:

$$x_4 = w_{14} x_1 + w_{24} x_2$$

$$x_5 = w_{15} x_1 + w_{25} x_2$$

$$x_7 = w_{37} x_3 + w_{47} \theta(x_4) + w_{57} \theta(x_5)$$

$$x_8 = w_{68} x_6 + w_{78} \theta(x_7)$$



Output unit error derivatives:

$$\frac{\partial E}{\partial x_8} = -2(y - \theta(x_8))\,\theta'(x_8)$$

Backpropagation:

$$\frac{\partial E}{\partial x_7} = \frac{\partial E}{\partial x_8} w_{78}\,\theta'(x_7), \quad \frac{\partial E}{\partial x_5} = \frac{\partial E}{\partial x_7} \cdot w_{57}\,\theta'(x_5), \quad \frac{\partial E}{\partial x_4} = \frac{\partial E}{\partial x_7} \cdot w_{47}\,\theta'(x_4)$$

weight derivatives:

$$\frac{\partial E}{\partial w_{14}} = \frac{\partial E}{\partial x_4} \cdot x_1 \quad , \quad \frac{\partial E}{\partial w_{15}} = \frac{\partial E}{\partial x_5} \cdot x_1$$

$$\frac{\partial E}{\partial w_{24}} = \frac{\partial E}{\partial x_4} x_2 \quad , \quad \frac{\partial E}{\partial w_{25}} = \frac{\partial E}{\partial x_5} \cdot x_2$$

$$\frac{\partial E}{\partial w_{37}} = \frac{\partial E}{\partial x_7} \times 1 \quad , \quad \frac{\partial E}{\partial w_{47}} = \frac{\partial E}{\partial x_7} \times \theta(x_4) \quad , \quad \frac{\partial E}{\partial w_{57}} = \frac{\partial E}{\partial x_7} \cdot \theta(x_5)$$

$$\frac{\partial E}{\partial w_{68}} = \frac{\partial E}{\partial x_8} \times 1 \quad , \quad \frac{\partial E}{\partial w_{78}} = \frac{\partial E}{\partial x_8} \cdot \theta(x_7)$$