

Sample Answers to Chapter 4

4.1

Suppose the decision surface function is $w_0 + w_1x_1 + w_2x_2 = 0$. And the surface crosses two points $(-1, 0)$, $(0, 2)$. So we have,

$$w_0 + w_1(-1) + w_2 \cdot 0 = 0, \text{ and}$$

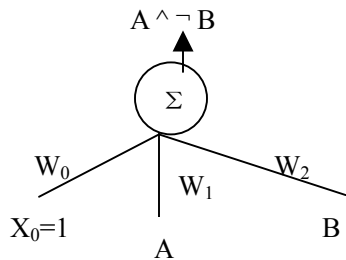
$$w_0 + w_1 \cdot 0 + w_2 \cdot 2 = 0.$$

Therefore, $w_0 = -2$, $w_1 = -2$, $w_2 = 1$.

4.2

(a)

A	B	$A \wedge \neg B$
0	0	0
0	1	0
1	0	1
1	1	0



Therefore,

$$w_0 < 0,$$

$$w_0 + w_2 < 0,$$

$$w_0 + w_1 > 0,$$

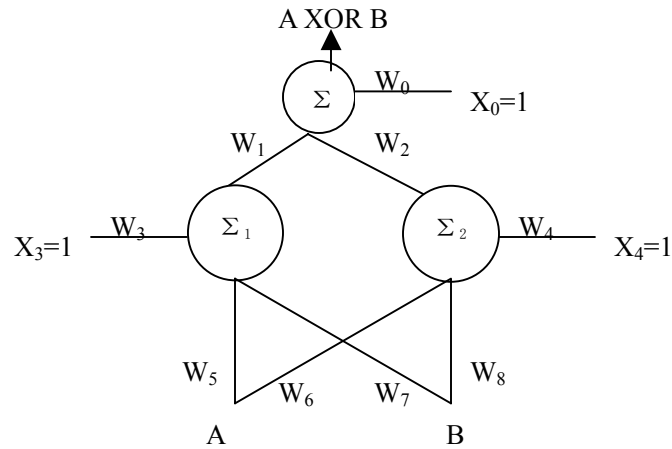
$$w_0 + w_1 + w_2 < 0.$$

Let $w_0 = -1$, $w_1 = 2$, $w_2 = -2$.

(b)

One possible two-layer network of perceptrons is as follows, but it's not unique.

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0



Let $W_0 = -0.5$, $W_1 = 1$, $W_2 = -1$, $W_3 = -0.25$, $W_4 = -0.75$, $W_5 = W_6 = W_7 = W_8 = 0.5$.

4.5

$$\begin{aligned}
 \frac{\partial E}{\partial w_i} &= \frac{\partial}{\partial w_i} \frac{1}{2} \sum_{d \in D} (t_d - o_d)^2 \\
 &= \frac{1}{2} \sum_{d \in D} \frac{\partial}{\partial w_i} (t_d - o_d)^2 \\
 &= \frac{1}{2} \sum_{d \in D} 2(t_d - o_d) \frac{\partial}{\partial w_i} (t_d - o_d) \\
 &= \sum_{d \in D} (t_d - o_d) \frac{\partial}{\partial w_i} (t_d - o_d) \\
 &= \sum_{d \in D} (t_d - o_d) (-x_{id} - x_{id}^2)
 \end{aligned}$$

Therefore,

$$\Delta w_i = \eta \sum_{d \in D} (t_d - o_d) (x_{id} + x_{id}^2)$$

4.9 Yes.

4.11 Refer to solution done by Mark Sharp and Lu Liu. Thanks!