Sample Answers to Chapter 4

4.1
Suppose the decision surface function is $w_0 + w_1 x_1 + w_2 x_2 = 0$. And the surface crosses two points (-1, 0), (0, 2). So we have,

$w_0 + w_1(-1) + w_2(0) = 0$, and

$w_0 + w_1(0) + w_2(2) = 0$.

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

4.2
(a)

\[
\begin{array}{|c|c|c|}
\hline
A & B & A \land \neg B \\
\hline
0 & 0 & 0 \\
0 & 1 & 0 \\
1 & 0 & 1 \\
1 & 1 & 0 \\
\hline
\end{array}
\]

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.
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

$$
\frac{\partial E}{\partial W_i} = \frac{\partial}{\partial W_i} \frac{1}{2} \sum_{d \in D} (t_d - o_d)^2
$$

$$=rac{1}{2} \sum_{d \in D} \frac{\partial}{\partial W_i} (t_d - o_d)^2
$$

$$=rac{1}{2} \sum_{d \in D} 2(t_d - o_d) \frac{\partial}{\partial W_i} (t_d - o_d)
$$

$$= \sum_{d \in D} (t_d - o_d) \frac{\partial}{\partial W_i} (t_d - o_d)
$$

$$= \sum_{d \in D} (t_d - o_d)(-x_d^2)
$$

Therefore,

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

4.9 Yes.

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