# Chapter 11: Backpropagation

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## E11.3

We can convert the Two Layer Linear Network found in Figure E11.3 in the book by converting it into a network with only one layer. From the network, we see that we have the following weight and bias matrices for the first layer:

$$w_1 = \begin{bmatrix} -2 & -1 \\ -1 & 3 \end{bmatrix}, b_1 = [-1, -0.5]$$

This can be reduced down the following form:

$$a_1^1 = n_1^1 = -2p_1 - p_2 - 0.5$$

$$a_2^1 = n_2^1 = p_1 + 3p_2 - 0.5$$

We have that $a^1 = n^1$ because we are using a linear transfer function.

The last layer of the network just sums the inputs and adds 0.5. Thus we get $w_2 = [1, 1]$ and $b_2 = 0.5$. This can be reduced down to the following form

$$a_1^2 = n_1^2 = a_1^1 + a_2^1 + 0.5$$

$$a_1^2 = n_1^2 = -2p_1 - p_2 - 0.5 + p_1 + 3p_2 - 0.5 + 0.5$$

$$a_1^2 = n_1^2 = -p_1 + 2p_2 - 0.5$$

Thus, we can turn this two layer linear network into a one layer network with the weight and bias matrices:

$$w^T = \begin{bmatrix} -1 & 2 \end{bmatrix}, b = -0.5$$