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Examples and Intuitions II

The $\Theta^{(1)}$ matrices for AND, NOR, and OR are:

$$\begin{aligned} AND&:\\ \Theta^{(1)} &= \begin{bmatrix}-30 & 20 & 20\end{bmatrix} \\ NOR&:\\ \Theta^{(1)} &= \begin{bmatrix}10 & -20 & -20\end{bmatrix} \\ OR&:\\ \Theta^{(1)} &= \begin{bmatrix}-10 & 20 & 20\end{bmatrix} \end{aligned}$$

We can combine these to get the XNOR logical operator (which gives 1 if x_1 and x_2 are both 0 or both 1).

$$\begin{bmatrix}x_0 \\ x_1 \\ x_2\end{bmatrix} \rightarrow \begin{bmatrix}a_1^{(2)} \\ a_2^{(2)}\end{bmatrix} \rightarrow \begin{bmatrix}a^{(3)}\end{bmatrix} \rightarrow h_\Theta(x)$$

For the transition between the first and second layer, we'll use a $\Theta^{(1)}$ matrix that combines the values for AND and NOR:

$$\Theta^{(1)} = \begin{bmatrix}-30 & 20 & 20 \\ 10 & -20 & -20\end{bmatrix}$$

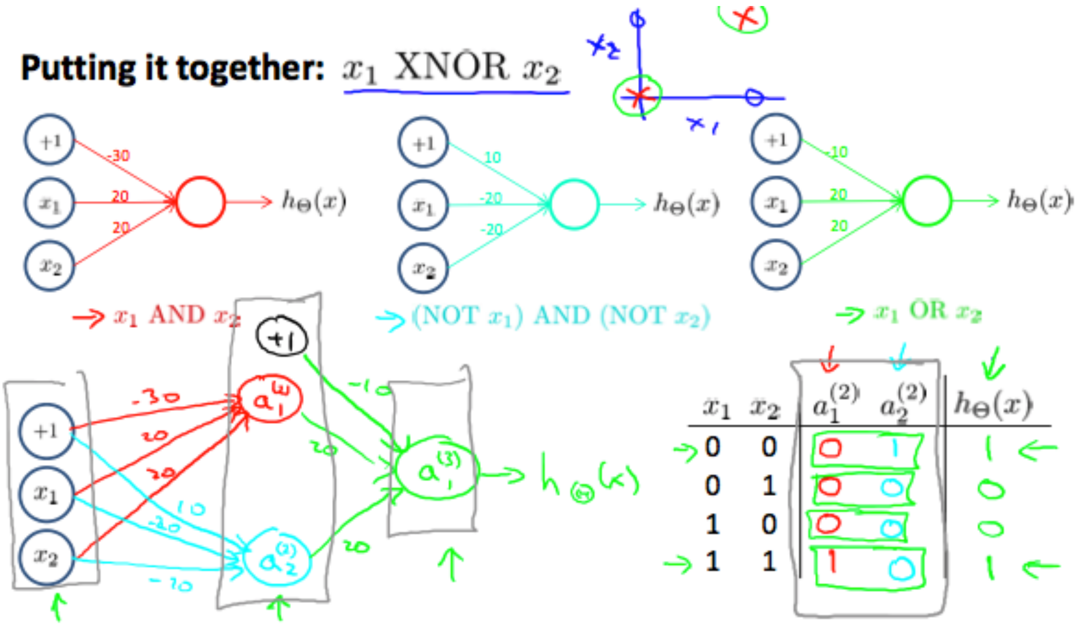
For the transition between the second and third layer, we'll use a $\Theta^{(2)}$ matrix that uses the value for OR:

$$\Theta^{(2)} = \begin{bmatrix}-10 & 20 & 20\end{bmatrix}$$

Let's write out the values for all our nodes:

$$a^{(2)} = g(\Theta^{(1)} \cdot x)$$
$$a^{(3)} = g(\Theta^{(2)} \cdot a^{(2)})$$
$$h_\Theta(x) = a^{(3)}$$

And there we have the XNOR operator using a hidden layer with two nodes! The following summarizes the above algorithm:



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