

Motivations

Neural Networks

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Applications

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📖 **Reading:** Multiclass Classification
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Review



Examples and Intuitions II

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

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

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).

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

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:

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

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

