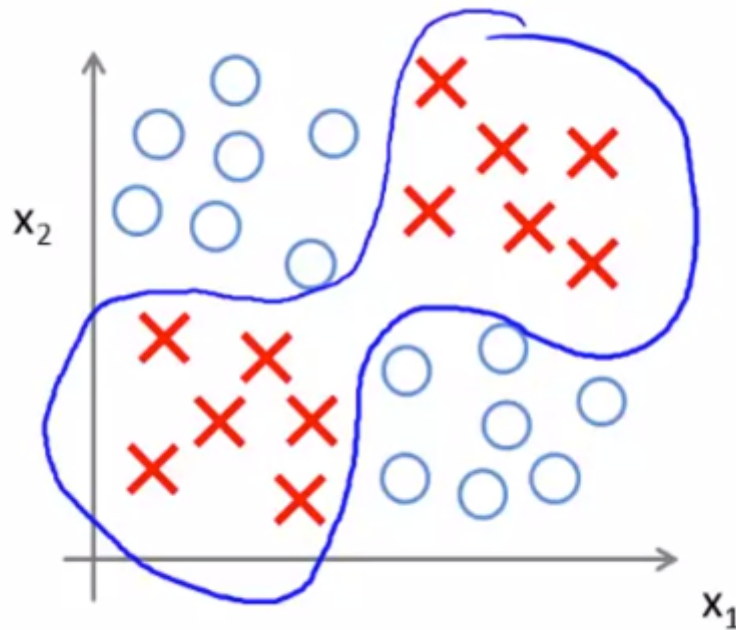


Applications and Intuition

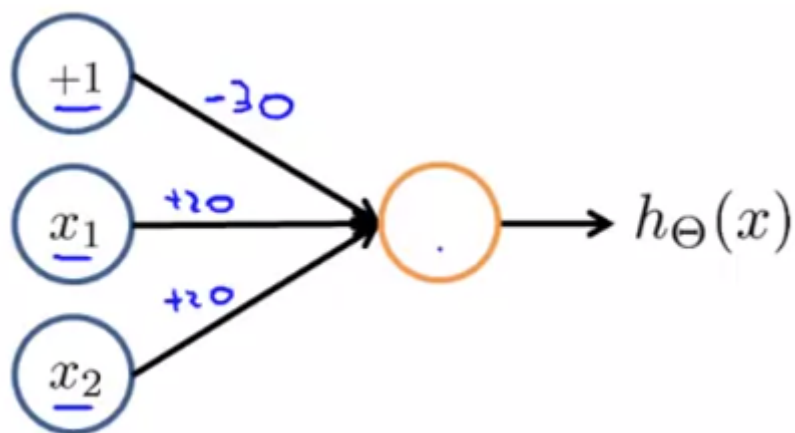


Consider the example, where x_1 and x_2 are binary (0 or 1). We'll try to come up with a neural network that can fit this set. Let's consider a one unit neural network as follows:

$$x_1, x_2 \in \{0, 1\}$$

$$y = x_1 \text{ AND } x_2$$

Intuition 1

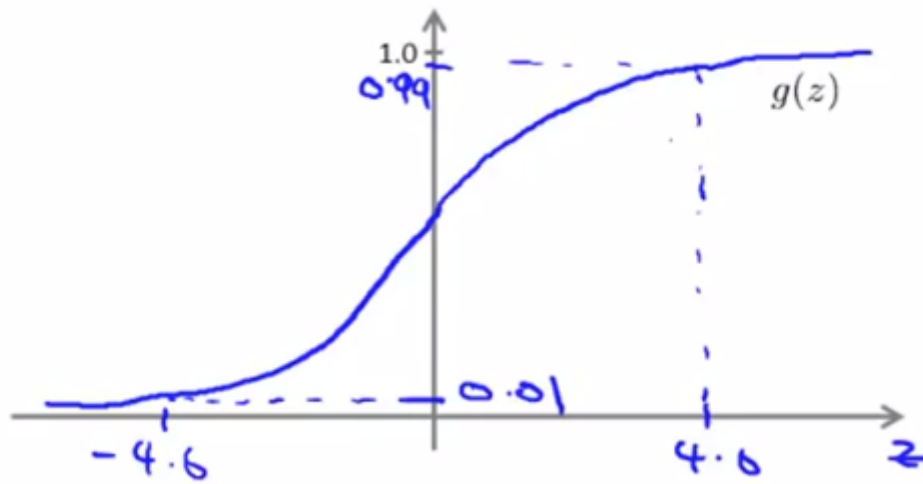


Selected Parameters are:

$$\theta_{10}^{(1)} = -30 \quad \theta_{11}^{(1)} = 20 \quad \theta_{12}^{(1)} = 20$$

$$\text{Therefore, } h_{\theta}(x) = g(-30 + 20x_1 + 20x_2)$$

Our sigmoid function will be:



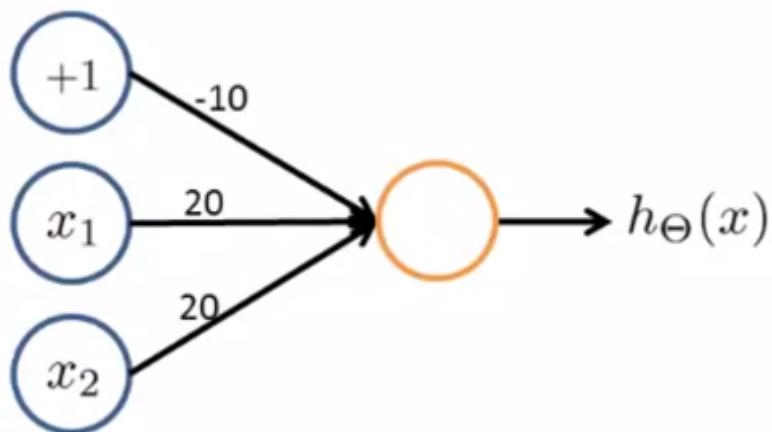
x_1	x_2	$h_{\theta}(x)$ [Logical AND]
0	0	$g(-30) \approx 0$
0	1	$g(-10) \approx 0$
1	0	$g(-10) \approx 0$
1	1	$g(10) \approx 1$

Our $h_{\theta}(x)$ above is computing logical AND function.

Let's create another single unit neural network for computing the OR function. We'll assign the parameters as:

$$\theta_{10}^{(1)} = -10 \quad \theta_{11}^{(1)} = 20 \quad \theta_{12}^{(1)} = 20$$

$$\text{Therefore, } h_{\theta}(x) = g(-10 + 20x_1 + 20x_2)$$



x_1	x_2	$h_{\theta}(x)$ [Logical OR]
0	0	$g(-10) \approx 0$
0	1	$g(10) \approx 1$
1	0	$g(10) \approx 1$
1	1	$g(30) \approx 1$

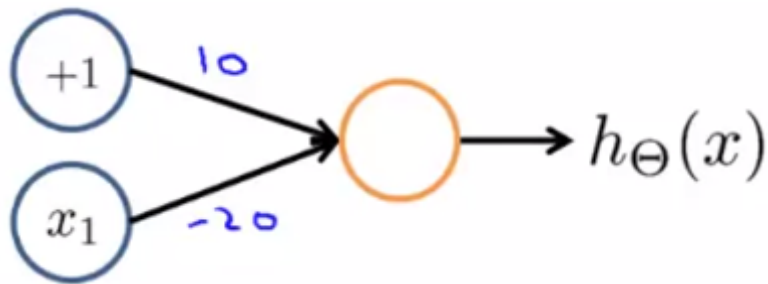
Intuition 2

We can come up with a small network for performing negation. We'll assign the parameters:

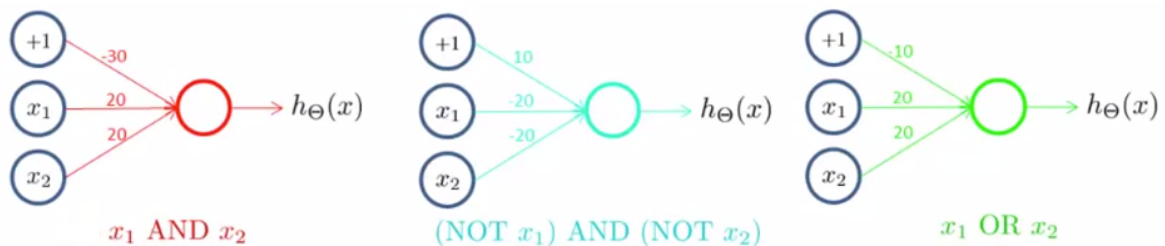
$$\theta_{10}^{(1)} = 10 \quad \theta_{11}^{(1)} = -20$$

$$\text{Therefore, } h_{\theta}(x) = g(10 - 20x_1)$$

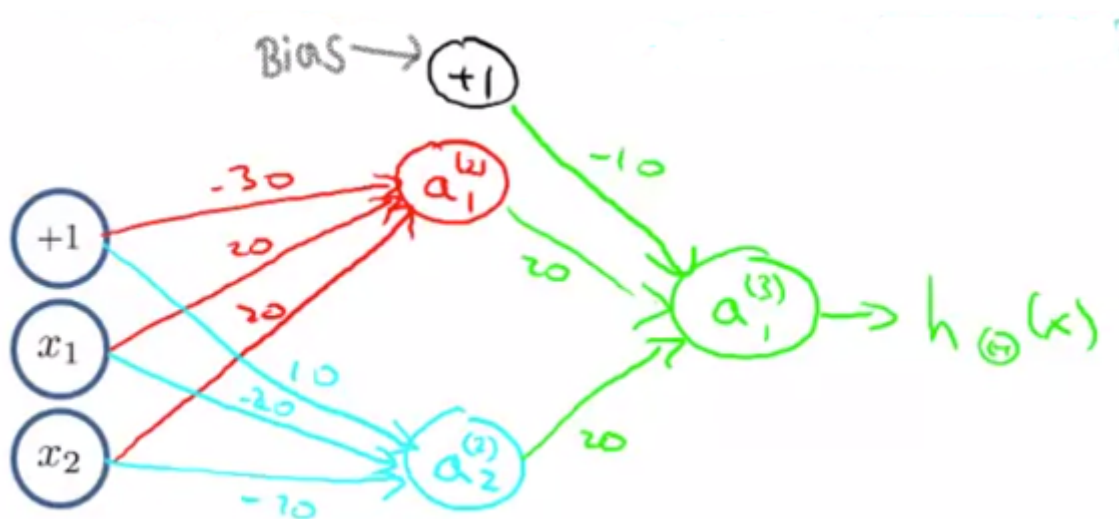
x_1	$h_{\theta}(x)$
0	$g(10) \approx 1$
1	$g(-10) \approx 0$



Merging the Neural Networks

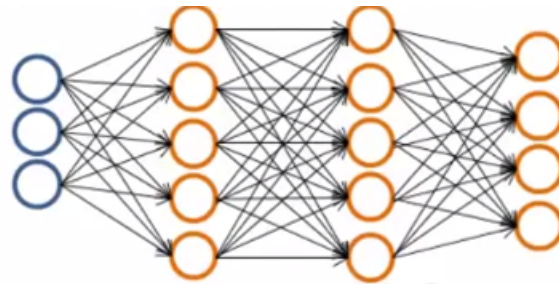


Putting the above three together to compute x_1 XNOR x_2 ,



x_1	x_2	$a_1^{(2)}$	$a_2^{(2)}$	$h_\theta(x)$
0	0	0	1	1
0	1	0	0	0
1	0	0	0	0
0	1	1	0	1

Multiclass Classification



$$h_\Theta(x) \in \mathbb{R}^4$$

Want $h_\Theta(x) \approx \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$, $h_\Theta(x) \approx \begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, $h_\Theta(x) \approx \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$, etc.
when pedestrian when car when motorcycle

Training set: $(x^{(1)}, y^{(1)}), (x^{(2)}, y^{(2)}), \dots, (x^{(m)}, y^{(m)})$

$y^{(i)}$ one of $\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$, $\begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$
pedestrian car motorcycle truck