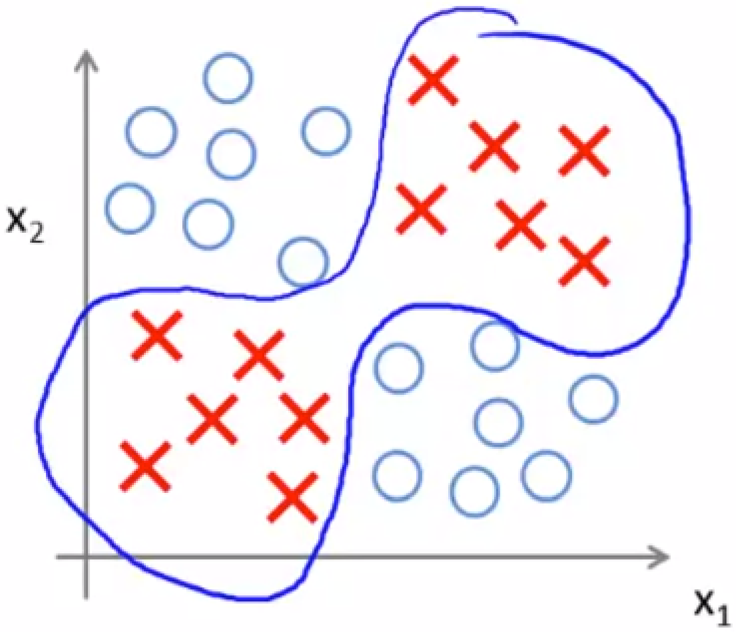
Applications and Intuition

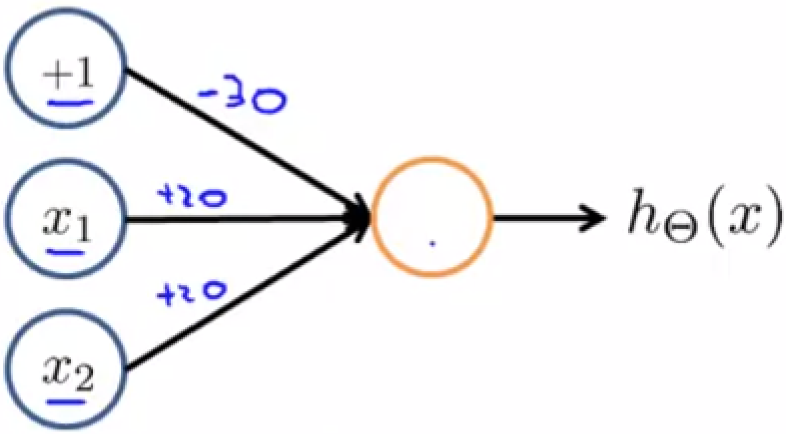


Consider the example, where x_1 and x_2 are binary (0 or 1). We'll try to come up with a neural network that can fit this set. Let's consider a one unit neural network as follows:

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

$y = x_1 \text{ AND } x_2$

Intuition 1

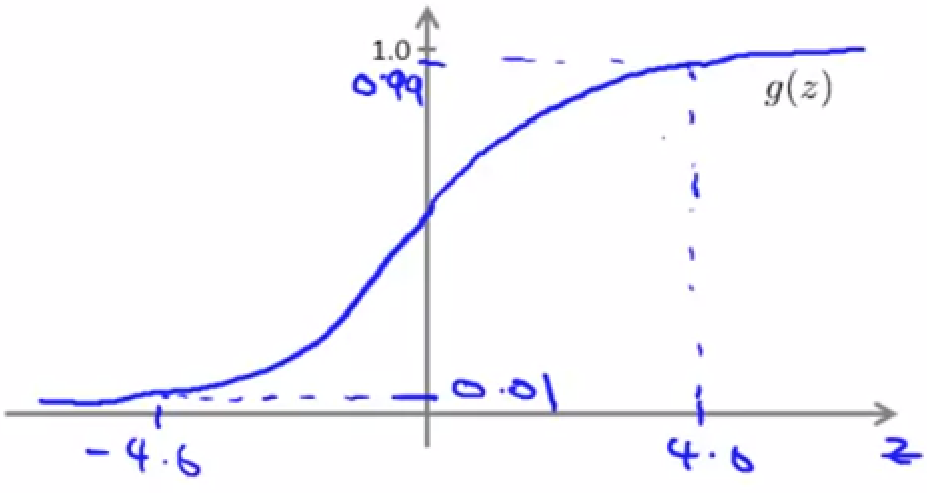


Selected Parameters are:

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

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

Our sigmoid function will be:

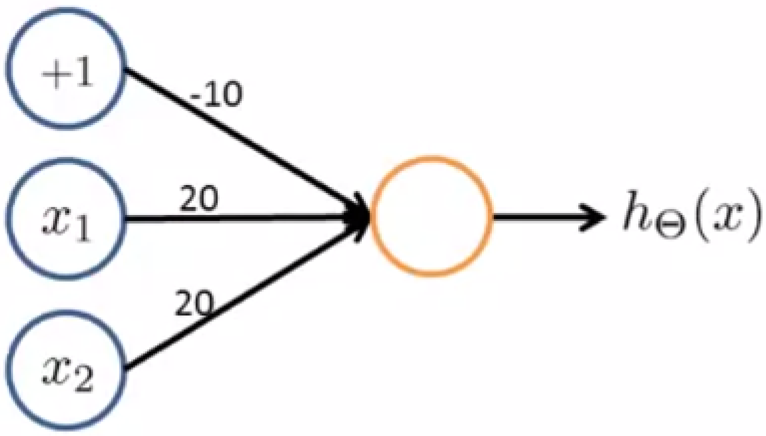


x_1	x_2	$h_\theta(x)$ **[Logical AND]**
0	0	$g(-30) \approx 0$
0	1	$g(-10) \approx 0$
1	0	$g(-10) \approx 0$
1	1	$g(10) \approx 1$

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:

$$\theta_{10}^{(1)} = -10 \quad \theta_{11}^{(1)} = 20 \quad \theta_{12}^{(1)} = 20$$
$$\text{Therefore,} \quad h_\theta(x) = g(-10 + 20x_1 + 20x_2)$$



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	$g(30) \approx 1$

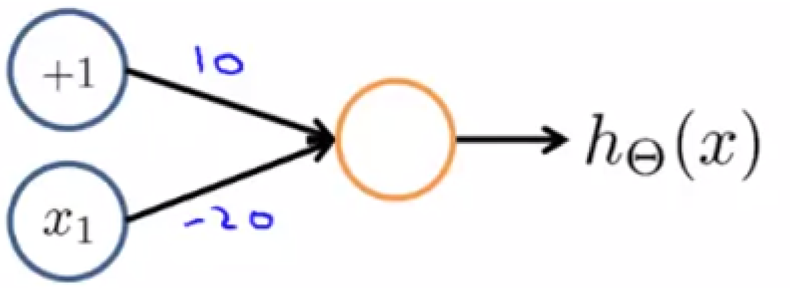
Intuition 2

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

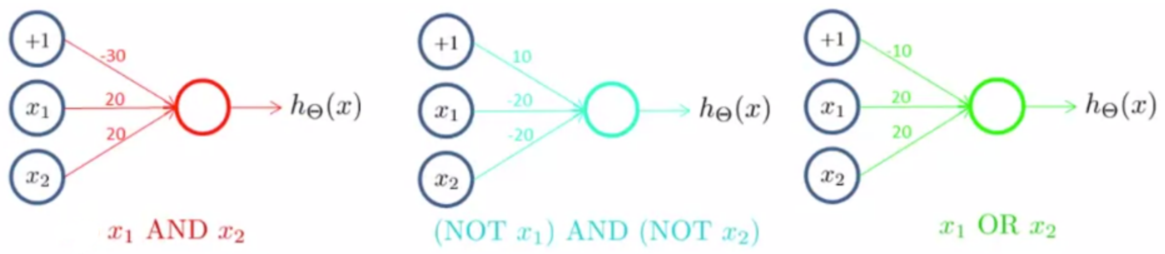
$$\theta_{10}^{(1)} = 10 \quad \theta_{11}^{(1)} = -20$$

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

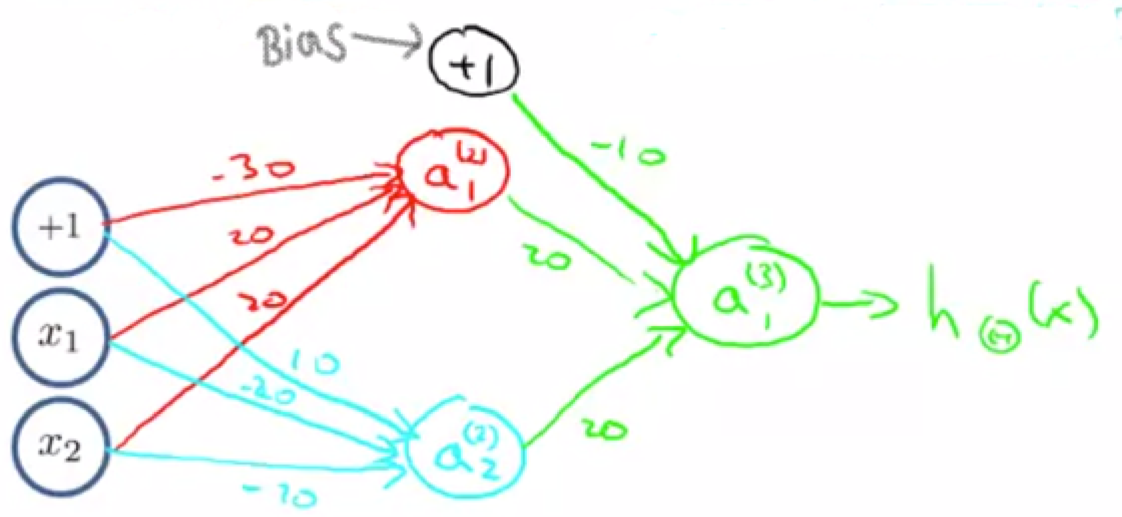
x_1	$h_\theta(x)$
0	$g(10) \approx 1$
1	$g(-10) \approx 0$



Merging the Neural Networks



Putting the above three together to compute $x_1 \text{ XNOR } x_2$,



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