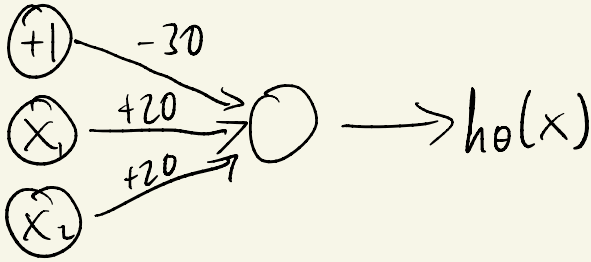



eg. Logical AND function

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

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

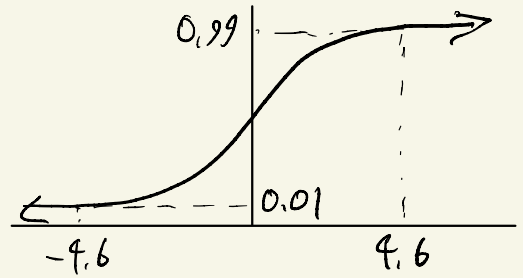


$$h_0(x) = g(-30 + 20x_1 + 20x_2)$$

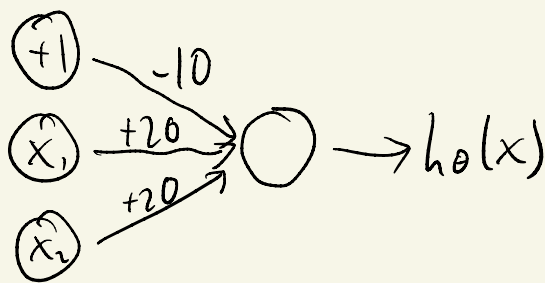
x_1	x_2	$h_0(x)$
0	0	$g(-30) \approx 0$
0	1	$g(-10) \approx 0$
1	0	$g(-10) \approx 0$
1	1	$g(10) \approx 1$

$$\therefore h_0(x) \approx x_1 \text{ AND } x_2$$

May 19, 2021



e.g. Logical OR function

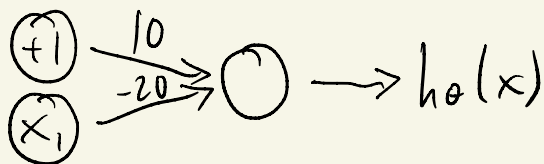


x_1	x_2	$h_0(x)$
0	0	$g(-30) \approx 0$
0	1	$g(-10) \approx 1$
1	0	$g(-10) \approx 1$
1	1	$g(10) \approx 1$

$$h_0(x) = g(-10 + 20x_1 + 20x_2)$$

$$\therefore h_0(x) \approx x_1 \text{ OR } x_2$$

e.g. Negation (i.e. NOT x_1)

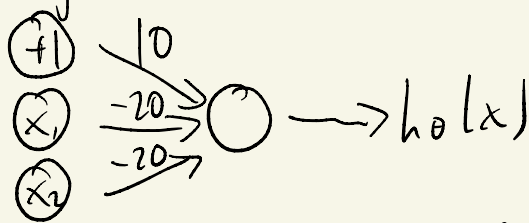


x_1	$h_0(x)$
0	$g(10) \approx 1$
1	$g(-10) \approx 0$

$$h_0(x) = g(10 - 20x_1)$$

$$\therefore h_0(x) = \text{NOT } x_1$$

e.g. (NOT x_1) AND (NOT x_2)

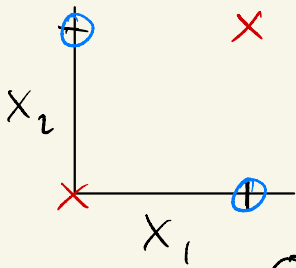


x_1	x_2	$h_0(x)$
0	0	$h_0(10) \approx 1$
0	1	$h_0(-10) \approx 0$
1	0	$h_0(-10) \approx 0$
1	1	$h_0(-30) \approx 0$

$$h_0(x) = g(10 - 20x_1 - 20x_2)$$

$$\therefore h_0(x) = (\text{NOT } x_1) \text{ AND } (\text{NOT } x_2)$$

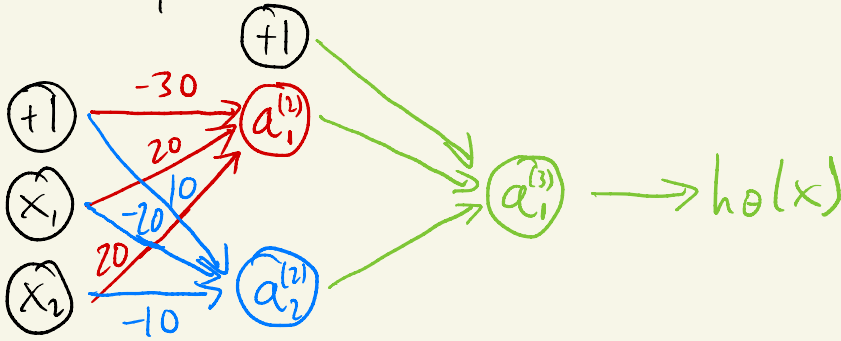
Putting It Together (x_1 XOR x_2):



~~111~~ x_1 AND x_2

111 (NOT x_1) AND (NOT x_2)

111 x_1 OR x_2



x_1	x_2	$a_1^{(2)}$	$a_2^{(2)}$	$h(a_3^{(3)})$
0	0	0	1	1
0	1	0	0	0
1	0	0	0	0
1	1	1	0	1

✱ Each layer can compute more complex features.

Multiple Output Units (One-vs-all):

eg. $y^{(i)}$ is 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

We want $h(x) \approx \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$ when pedestrian, etc.