CIS 419/519: Homework 5

Jiatong Sun

03/13/2020

Although the solutions are entirely my own, I consulted with the following people and sources while working on this homework:
https://stackoverflow.com/questions/50994504/how-to-put-figure-between-items-on-enumerate-list

1 Logical Functions with Neural Nets

a.

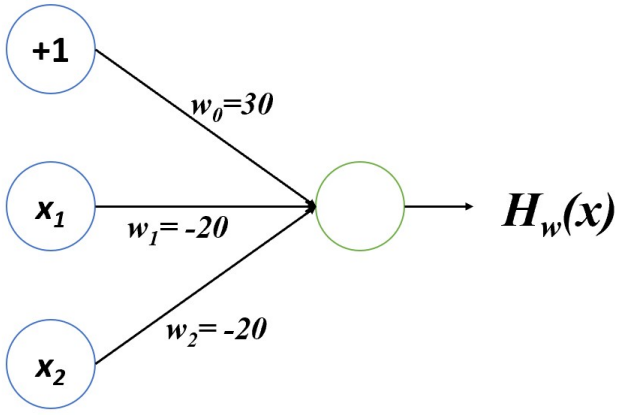

Figure 1: NAND

Truth Table		
x_1	x_2	$H(x)$
0	0	$\sigma(30) = 1$
0	1	$\sigma(10) = 1$
1	0	$\sigma(10) = 1$
1	1	$\sigma(-10) = 0$

Table 1: NAND

b.

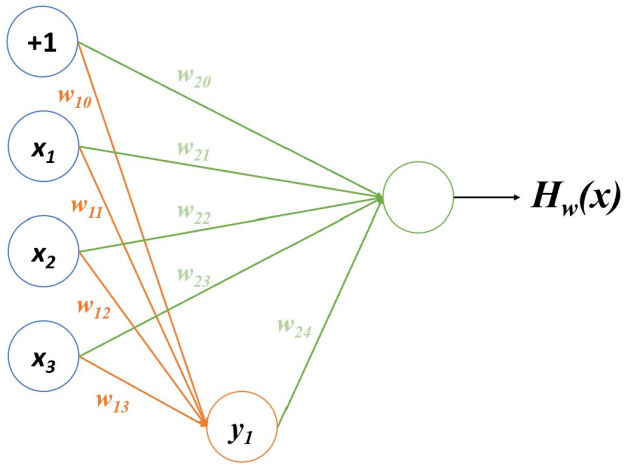

Figure 2: NAND

Truth Table								
w_{10}	w_{11}	w_{12}	w_{13}	w_{20}	w_{21}	w_{22}	w_{23}	w_{24}
-30	20	20	20	-10	20	20	20	-40

Table 2: Weight table

Truth Table				
x_1	x_2	x_3	y_1	$H(x)$
0	0	0	$\sigma(-30) = 0$	$\sigma(-10) = 0$
0	0	1	$\sigma(-10) = 0$	$\sigma(10) = 1$
0	1	0	$\sigma(-10) = 0$	$\sigma(10) = 1$
0	1	1	$\sigma(-10) = 0$	$\sigma(10) = 1$
1	0	0	$\sigma(10) = 1$	$\sigma(-10) = 0$
1	0	1	$\sigma(10) = 1$	$\sigma(-10) = 0$
1	1	0	$\sigma(10) = 1$	$\sigma(-10) = 0$
1	1	1	$\sigma(30) = 1$	$\sigma(10) = 1$

Table 3: Parity

2 Calculating Backprop by Hand

Assume the loss function utilizes mean square error:

$$L(H(X), y) = \frac{1}{n}\sum_{i=1}^{n}(H(x_i) - y_i)^2$$

3 Neural Nets in SuperTuxKart