Custom exercise for a better understanding of classification problems
Subject - B3B33VIR

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Neuron network as a logic gate.

- Given a following computational graph of a simple neural network, decide which logic gate it represents.
  Features $\mathbf{x} = [x_1, x_2]$. Weights and biases of each neuron are: $\mathbf{w_1} = [20, 20]$, $\mathbf{w_2} = [-20, -20]$, $\mathbf{w_3} = [20, 20]$ a $b_1 = -10$, $b_2 = 30$, $b_3 = -30$.
  Tip: For easier calculations, consider input value $\mathbf{x}$ to have binary values (0 or 1). Also don't hesitate to approximate the $\sigma(x)$ function to 0 or 1, if the inputs are big enough.

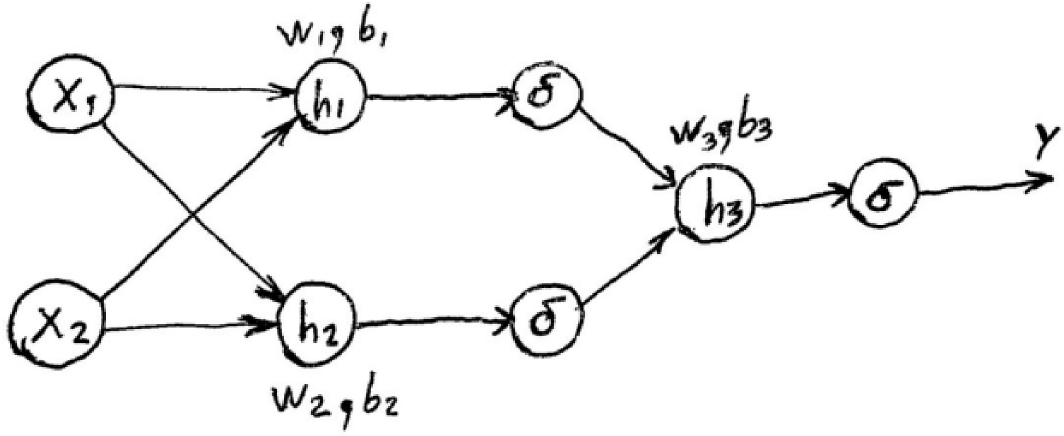

Figure 1: Computational graph.

a). AND gate
b). OR gate
c). NAND gate
d). NOR gate
e). XOR gate
f). XNOR gate

Solution.

It can actually be used as an **e**). XOR logic gate. Performing forward pass for at least three different permutations of $\mathbf{x} \in (00, 11, 01, 10)$ will give results compared to a gate that outputs a value close to 1 for different inputs(10, 01).

Input		Output
A	B	A xor B
0	0	0
0	1	1
1	0	1
1	1	0

Figure 2: XOR gate.

The sigmoid functions will take care of assigning values to either 0 or 1.

This kind of neural network can be used for binary classification problems that cannot be solved with a linear classifier, for example the type on Fig.3.

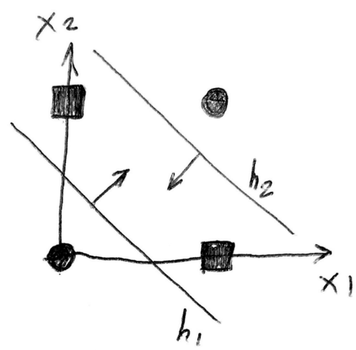

Figure 3: Binary classification problem.