

Question 4  
Chady Aboulhosn  
CMSC\_409

This was a hard Activation function neuron with a 3 layer architecture. Below are pictures of the layout as well as tables with the biases and neuron definitions . With the current architecture there were 11 neurons over 3 layers needed to acquire the square patterns. The neuron

$$o = \begin{cases} 1, & \text{if } net \geq 0 \\ 0, & \text{if } net < 0 \end{cases}$$

definition was on the third layer. Everything was designed to select positively.

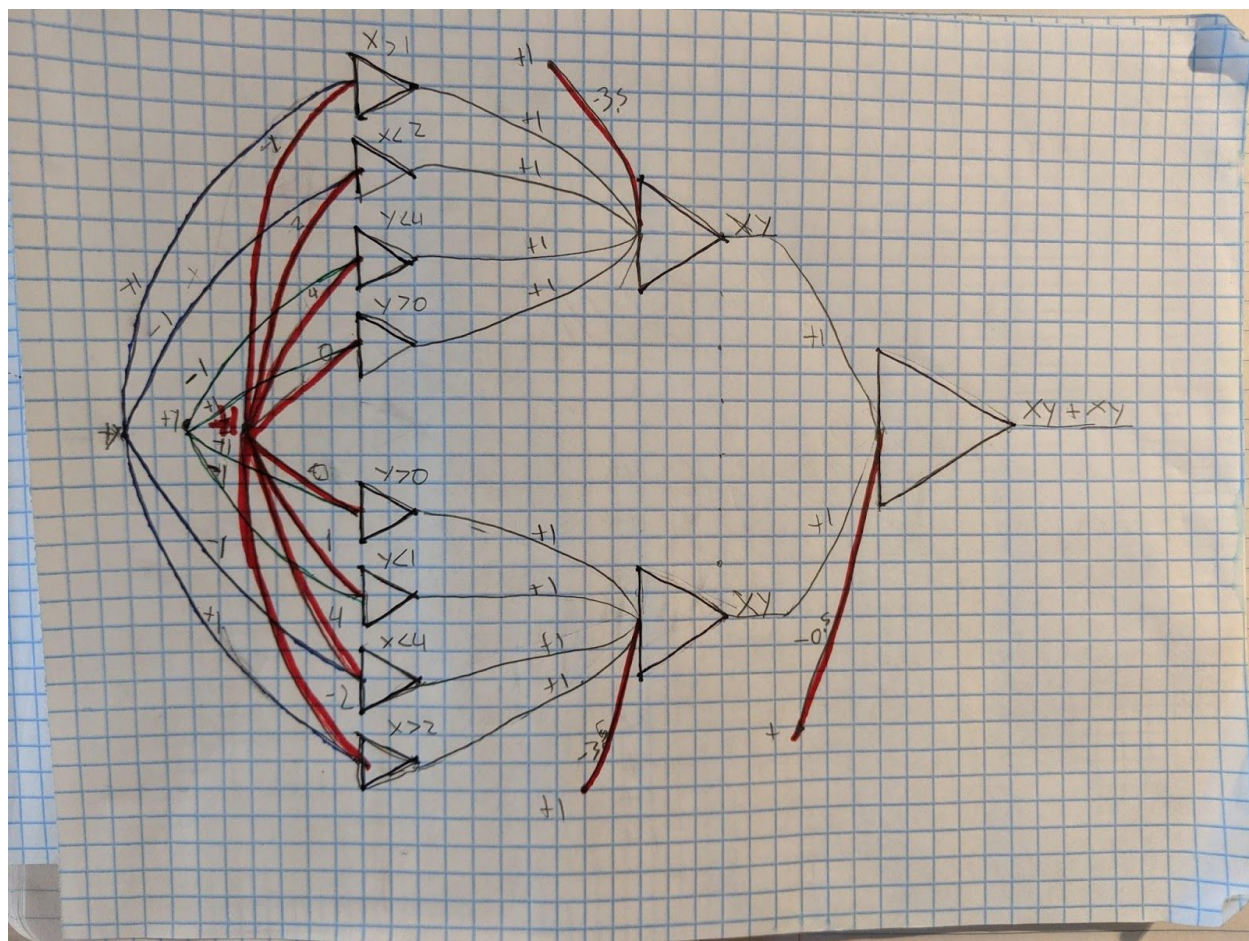
The first layer consists of two boxes that were selected by 4 individual neurons each. Each neuron had an individual bias that required the neuron to pass true for the neuron to activate

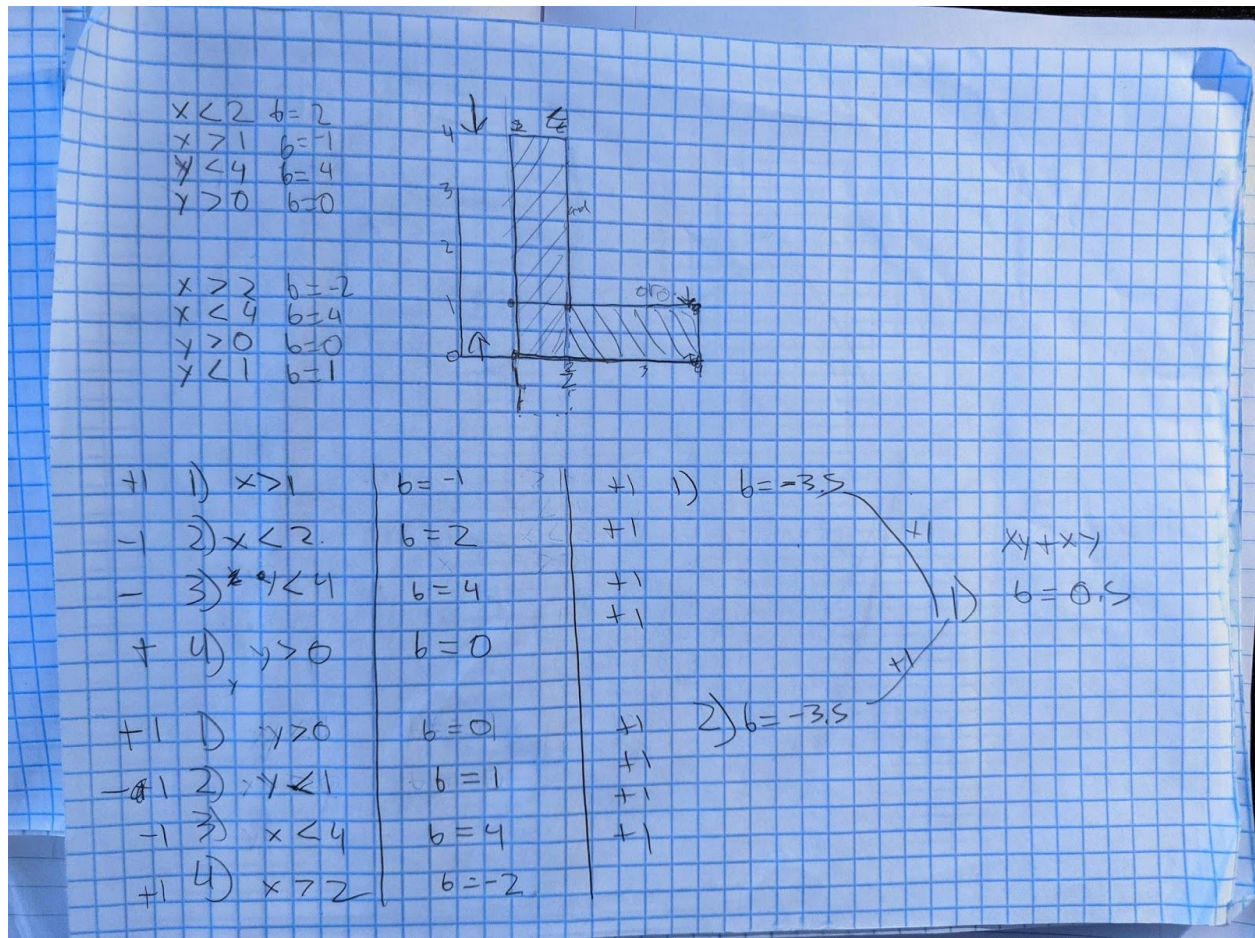
Layer 2 was combining the neurons with an and operator so all 4 neurons had to activate for the box to be and neuron to be selected. The bias for that operator was a -3.5 as if any one of those inputs did not have a positive signal then the neuron would not cross the threshold.

The 3rd Layer was combining the two previous neurons with an “or” operator so only one of the previous neurons had to pass for the 3rd layer to activate with a Bias of -0.5

There were several ways to design this architecture. The L shape could have been split on different box lengths with the bottom box going horizontal all the way through the whole shape. This would have only changed some weights and thresholds for the neurons so not that big of a variant.

Another architecture could have subtracted the rectangle from a bigger rectangle to form an L shape. Or even simple do all x inputs on one layer and or the operators first before performing an and.





Neuron Equations:

Layer 1

Input	Weight	Bias	Neuron Equation
X	+1	-1	$-X + 2 > 0$
X	-1	2	$X - 1 > 0$
Y	-1	4	$-Y + 4 > 0$
Y	+1	0	$Y > 0$

Input	Weight	Bias	Neuron Equation
Y	+1	0	$Y > 0$
Y	-1	1	$-Y + 2 > 0$

X	-1	4	$-X + 4 > 0$
X	+1	2	$X - 2 > 0$

Layer 2

Input	Weight	Bias	Neuron Equation	
XY	1	-3.5	$XY - 3.5 > 0$	
XY	1	-3.5	$XY - 3.5 > 0$	
$Y < 4$	1			

Layer 3

Input	Weight	Bias	Neuron Equation	
XY	+1	-0.5	$XY + XY - 0.5 > 0$	
XY				