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CSE 4309 – 001

#### **Assignment – 4:**

##### **Task 1:**

- a) Training and testing on pendigits dataset, with 2 layers, 10 training rounds.

Output:

Classification accuracy=0.8659

- b) Training and testing on pendigits dataset, with 3 layers, 20 units per hidden layer, 20 training rounds.

Output:

Classification accuracy=0.9220

##### **Task 2:**

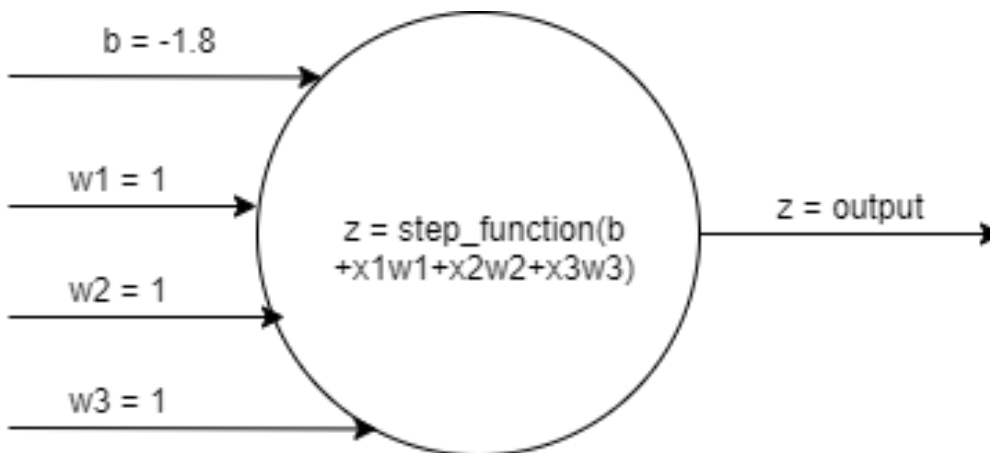
The three Boolean inputs are  $x_1$ ,  $x_2$ , and  $x_3$ .

The three weights are  $w_1$ ,  $w_2$ , and  $w_3$ .

Also, the bias is  $b$ .

Then, weighted sum:  $y = b + w_1x_1 + w_2x_2 + w_3x_3$

The activation function:  $z = \text{step\_function}(y)$



Let's consider  $b = -1.8$ ,  $w_1 = 1$ ,  $w_2 = 1$ ,  $w_3 = 1$

Then, weighted sum =  $-1.8 + 1 \cdot x_1 + 1 \cdot x_2 + 1 \cdot x_3$

Check:

Case – I:

If  $x_1 = 1$ ,  $x_2 = 0$ ,  $x_3 = 0$  (T, F, F)

$z = (-1.8) + 1 + 0 + 0 = 0.8$  (which is false)

Case – II:

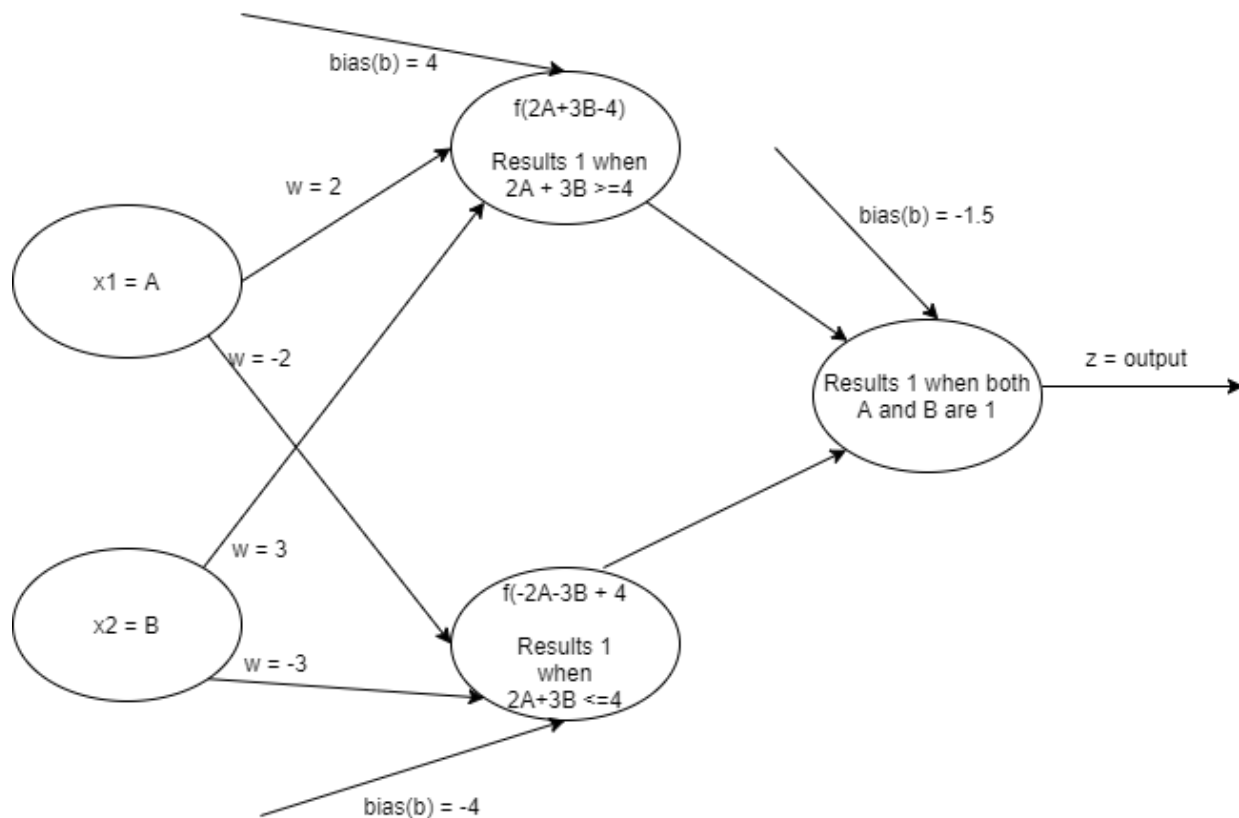
If  $x_1 = 1$ ,  $x_2 = 1$ ,  $x_3 = 0$  (T, T, F)

$z = (-1.8) + 1 + 1 + 0 = 0.2$  (which is True).

Thus, the perception does satisfy the requirement of the problem.

### Task 3:

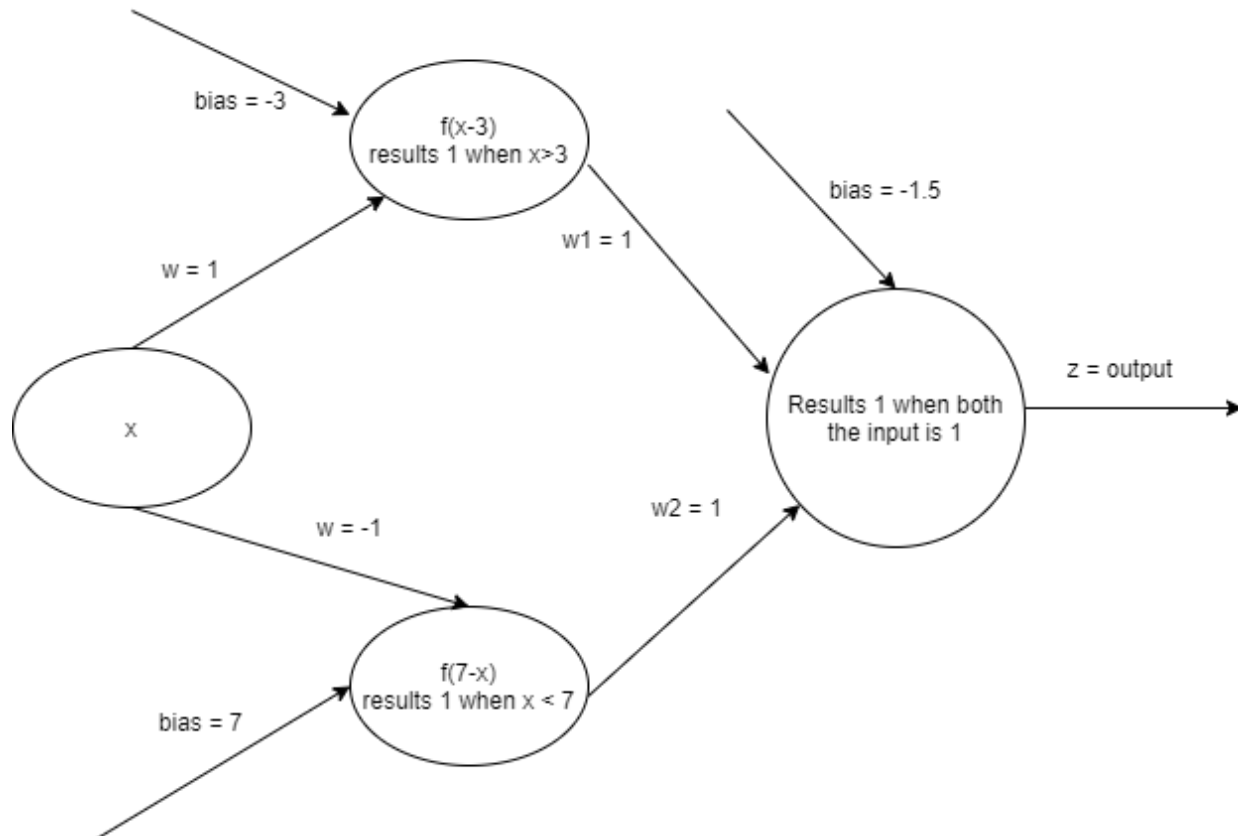
The output is 1 for  $2A + 3B = 4$  and 0 for all other values. The second layer would result in 0 or 1 as the output, and in the last layer we get output as 1 for those values that satisfies  $2A + 3B = 4$  (i.e., if it satisfies both conditions:  $2A + 3B \geq 4$  and  $2A + 3B \leq 4$ ) and 0 for other values.



#### Task 4:

It is possible to design such neural network.

The output for  $3 < x < 7$  is 1 and is 0 for any other value. In the second layer, values greater than 3 and values less than 7 would result output as 1. The final output can be obtained by combining the values from second layer using AND.



#### Task 5:

If all the weights were initialized to be zero instead of some random value (in my case: - between - 0.045 to 0.045), then the classification accuracy will be changed.

During the training stage, we subtract some value from the weight to get more accurate result. If the weights are initialized to zero in the beginning, then at the end of the training stage, the weights will be negative. The argmax will also result in smallest negative number. This will change the classification accuracy to **[1 – previous (correct) accuracy]**.