**Problem 4**

1. The perceptron rule is

Now multiply all weights and biases by c, where c > 0,

Therefore, if , then , thus output = 0. Likewise, if , then , thus output = 1.

The behavior of the network doesn’t change.

1. The output of a sigmoid neuron is

Now multiply all weights and biases by c, where c > 0,

As , if , then , thus output = 0.

Likewise, if , then , thus output = 1.

The behavior of the network of sigmoid neurons is exactly the same as the network of perceptrons.

When , always, thus it differs from a perceptron neuron.

1. See notebook.
2. See notebook.

**5.**

Output (sum bit)

(carry bit)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  | output |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 |

Using perceptrons and the perceptron rule, with the following weights and biases:

, and

The sum bit is the output of an XOR gate, and the carry bit is the output of an AND gate.