Exercise Set 1:

Perceptron Logic Gates

# Instructions

**Find the correct weight and bias values for each logic gate.**

|  |
| --- |
| **⚠️An Important Note on sign()**  These exercises use the simplified **sign()** function described in our blog post, where **sign()** returns a **1** for values greater than zero and **0** for all other values. |

## 

## 1. OR



Remember that because of the way our simplified **sign()** function works, the output of the network will be **1** if *either* of the inputs is **1**. Otherwise the network will output **0**.

### Truth Table: OR Gate

|  |  |  |
| --- | --- | --- |
| Input 1 | Input 2 | Output |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

**What values do , and need to satisfy the truth table?**

|  |  |
| --- | --- |
| **Weight1** | ? |
| **Weight2** | ? |
| **Bias** | ? |

## 2. AND

Use the same perceptron layout as the previous question, solve for the AND gate shown below. The output of the network will be **1** if *both* inputs are **1**. Otherwise the network will output **0**.

### Truth Table: AND Gate

|  |  |  |
| --- | --- | --- |
| Input 1 | Input 2 | Output |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

**What values do , and need to satisfy the truth table?**

|  |  |
| --- | --- |
| **Weight1** | ? |
| **Weight2** | ? |
| **Bias** | ? |

# 

## 3. NOT



The NOT operation accepts a single input and gives a single output, so this time we’ll use the formula above to solve for the truth gate.

### Truth Table: NOT Gate

|  |  |
| --- | --- |
| Input | Output |
| 0 | 1 |
| 1 | 0 |

**What values do and need to satisfy the truth table?**

|  |  |
| --- | --- |
| **Weight** | ? |
| **Bias** | ? |

# 

# 4. XOR

XOR or “exclusive or” works as described in the table below. The output of the network will be **1** if exactly one of the inputs is **1**. Otherwise the network will output **0**. It is not possible to make a perceptron that acts as XOR using the same perceptron layout as OR and AND.

### Truth Table: XOR Gate

|  |  |  |
| --- | --- | --- |
| Input 1 | Input 2 | Output |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

**There are no values for , and that can satisfy the truth table.**Feel free to try it yourself and see.

|  |  |
| --- | --- |
| **Weight1** | ? |
| **Weight2** | ? |
| **Bias** | ? |

It is possible to make a perceptron evaluate XOR by adding a hidden layer, however.









**See if you can find values of the weights and biases that can make this perceptron perform XOR.**

Looking at the large number of terms in the three equations can be daunting, but one way to approach this problem is to think of the path from the input neurons to being one logic gate, the path from the input neurons to being a second logic gate, and the path from the hidden neurons to the neuron being a third logic gate.

|  |  |
| --- | --- |
| **Input1Hidden1Weight** | ? |
| **Input2Hidden1Weight** | ? |
| **Hidden1Bias** | ? |
| **Input1Hidden2Weight** | ? |
| **Input1Hidden2Weight** | ? |
| **Hidden2Bias** | ? |
| **Hidden1OutputWeight** | ? |
| **Hidden2OutputWeight** | ? |
| **OutputBias** | ? |