# Activity – Working with Perceptrons

Activity One – Understanding Perceptrons with provided inputs

Remember from your reading in the book that a perceptron takes in several input values (two in the example below) and weights each one independently of the other.  In the simplest version of the perceptron, if the sum of the weighted inputs exceeds the threshold value, then the output from the perceptron is 1.  Otherwise, the output of the perceptron is 0.

$I_1$
$W_1$
Threshold
$W_2$
$I_2$
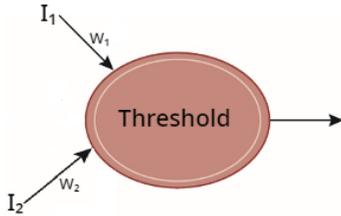
Given that, we can consider the following perceptron.

1
0.8
1.3
0.7
1
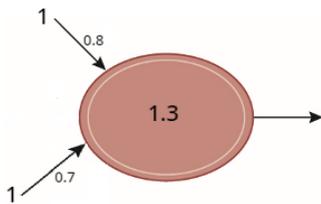
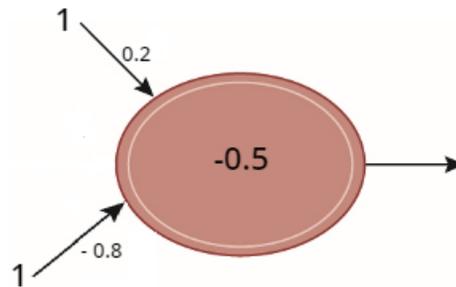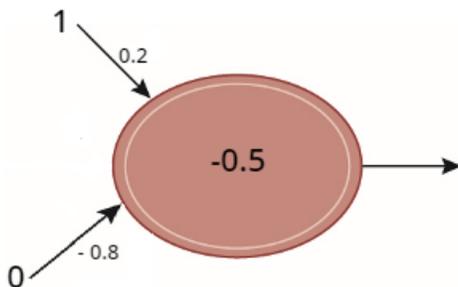 It has input values of 1 on both of its inputs and weights of 0.8 and 0.7.  The sum of the weighted inputs is:

$$1*0.8 + 1*0.7 = 1.5$$

Since this sum is greater than the threshold value of 1.3, this perceptron will have an output value of 1.
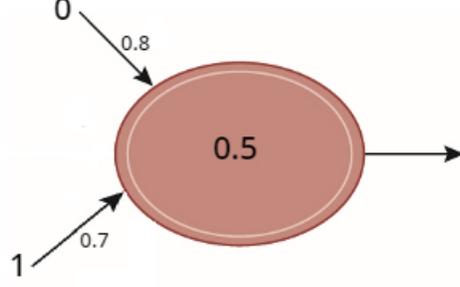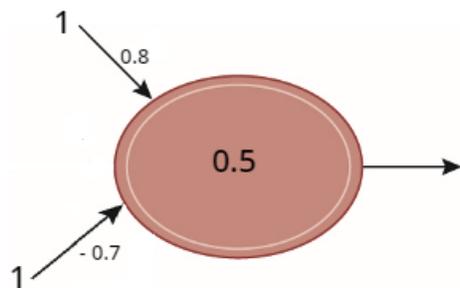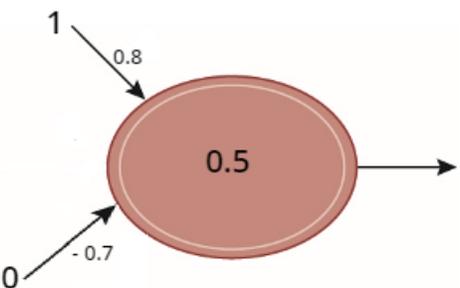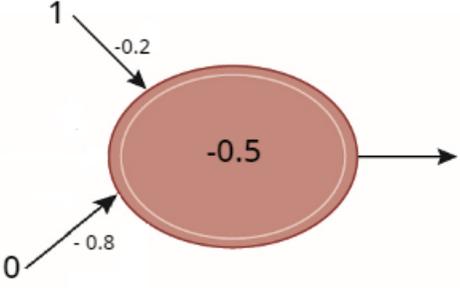
Note that it is possible to have weights and thresholds that are both positive and negative.  Consider the following perceptrons.

1
0.2
-0.5
- 0.8
0

1
0.2
-0.5
- 0.8
1

The first perceptron has a sum of 0.2 which exceeds the threshold weight of -0.5, so it will have an output of 1.

The second perceptron has a sum of -0.6 which does not exceed the threshold weight of -0.5, so it will have an output of 0.

What are the output values of the following perceptrons?
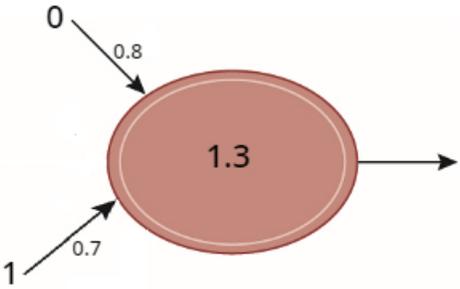
| | |
|---|---|
|  | 0*0.8 + 1*0.7 = 0.7<br><br>This is less than 1.3 so the output is 0. |
|  | 0*0.8 + 1*0.7 = 0.7<br><br>This is more than 0.5 so the output is 1 |
|  | 1*0.8 + 1*(-0.7) = 0.1<br><br>This is less than 0.5 so the output is 0. |
|  | 1*0.8 + 0*(-0.7) = 0.8<br><br>This is more than 0.5 so the output is 1. |
|  | 1*(-0.2) + 0*(-0.8) = -0.2<br><br>This is more than -0.5 so the output is 1. |

Activity Two – Understanding Perceptrons without provided inputs

When considering perceptrons, it is sometimes helpful to be able to consider all four combinations of inputs – (0,0), (0,1), (1,0), (1,1) – and determine how the perceptron behaves overall.

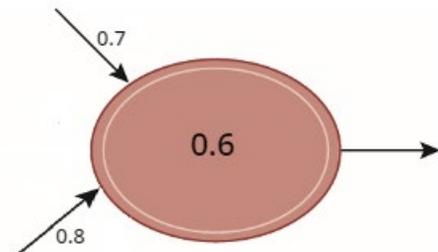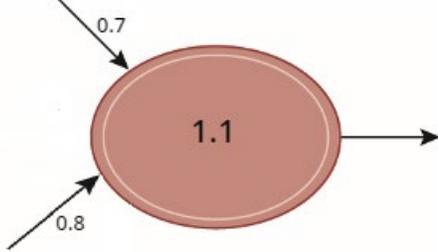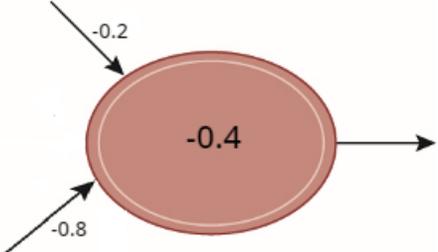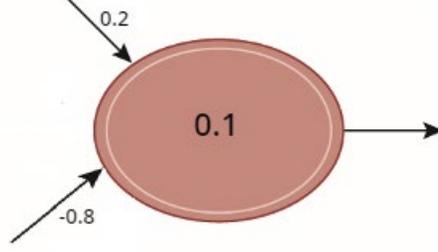For example, consider the following perceptron.
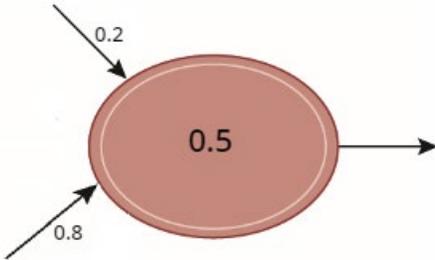


The four combinations of inputs to this perceptron produce the following outputs:

| Top Input | Bottom Input | Output |
|-----------|--------------|--------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

When you look closely at the output from this perceptron you will notice that it matches the second/bottom input perfectly.  We might describe this perceptron as matching Input 2.

How would you describe the outputs from the following perceptrons?

| | |
|---|---|
| 0.7 → 0.6 ← 0.8 | This perceptron will have an output of 1 if at least one of the inputs has a value of 1. In other words, it behaves like an OR gate. I1 OR I2 |
| 0.7 → 1.1 ← 0.8 | This perceptron will have an output of only if both inputs have a value of 1. In other words, it behaves like an AND gate. I1 AND I2 |
| -0.2 → -0.4 ← -0.8 | This perceptron will have an output of 1 if input 2 has an input of 0 and an output of 0 if input 2 has an input of 1. In other words, it behaves like a NOT gate. NOT I2 |
| 0.2 → 0.1 ← -0.8 | This perceptron will have an output of 1 ONLY if input 1 is 1 and input 2 is 0. I1 AND (NOT I2) |