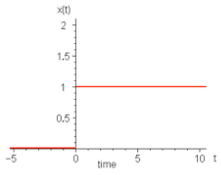
Given an input of x_1 and x_2 for the two input neurons, calculate the value of the output neuron Y1 in the artificial neural network shown in Figure 1. Use a step function with transition value at 0 to calculate the output from a neuron.

Calculate the value of Y1 for values of x1 and x2 equal to (0,0), (1,1), (1,0), and (0,1) and fill out the table below.

The calculation for 0,0 is as follows. The input o_1 to the left hidden neuron is 0*4+0*4 = 0. The output O_1 from the left hidden neuron is then O(0) = 0. Likewise the input to the right hidden neuron is 0*6+0*6 = 0, and the output O_2 is 0. The input to the output neuron y_1 is 0*(-9)+0*9=0, and the output from the network Y_1 is $O(y_1) = 0$. The calculation for the input (0,1) goes like. The input o_1 to the left hidden neuron is 0*4+1*4 = 4. The output O_1 from the left hidden neuron is then O(4) = 1. Likewise the input to the right hidden neuron is 0*6+1*6 = 6, and the output O_2 is 1. The input to the output neuron y_1 is 1*(-9)+1*9=0, and the output from the network Y_1 is $O(y_1) = 0$.

Can this network describe higher order sequence correlations (like the XOR function)? No

$$O(o) =$$



$$o = \sum x_i \cdot w_i$$

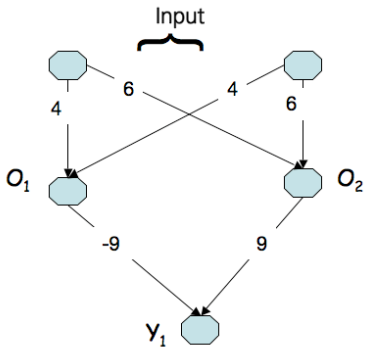


Figure 1. Artificial neural network with two input neurons, one hidden layer with two neurons, and one output neuron. The artificial neural network uses a step function with transition value at 0 to calculate the output from the neurons. The step function is given by O(o) = 1 if o>0 otherwise 0.

X_1	X_2	O
0	0	0
0	1	0
1	0	0
1	1	0

Now, we include the "bias" for the input to each neuron. This can be implemented as an addition input neuron to each layer that always has the value 1 (see figure 2).

With this additional bias, calculate the value of Y1 for values of x1 and x2 equal to (0,0), (1,1), (1,0), and (0,1) and fill out the table below.

The calculation for 0,0 is as follows. The input o_1 to the left hidden neuron is 0*4+0*4+1*(-6) = -6. The output O_1 from the left hidden neuron is then O(0) = 0. Likewise the input to the right hidden neuron is 0*6+0*6+1*(-2) = -2, and the output O_2 is 0. The input to the output neuron y_1 is 0*(-9)+0*9+1*(-4.5)=-4.5, and the output from the network Y_1 is $O(y_1)$ = 0. The calculation for the input (0,1) goes like. The input o_1 to the left hidden neuron is 0*4+1*4+1*(-6) = -2. The output O_1 from the left hidden neuron is then O(4) = 0. Likewise the input to the right hidden neuron is 0*6+1*6+1*(-2)= 4, and the output O_2 is 1. The input to the output neuron y_1 is 0*(-9)+1*9+1*(-4.5)=4.5, and the output from the network Y_1 is $O(y_1)$ = 1. The calculation for the input (1,1) goes. The input o_1 to the left hidden neuron is 1*4+1*4+1*(-6) = 2. The output O_1 from the left hidden neuron is then O(2) = 1. Likewise the input to the right hidden neuron is 1*6+1*6+1*(-2)= 10, and the output O_2 is 1. The input to the output neuron y_1 is 1*(-9)+1*9+1*(-4.5)=-4.5, and the output from the network Y_1 is $O(y_1)$ = 0.

Can this network describe higher order sequence correlations (like the XOR function)? Yes

$$O = \frac{1}{1+\exp(-o)}$$

$$o = \sum x_i \cdot w_i$$

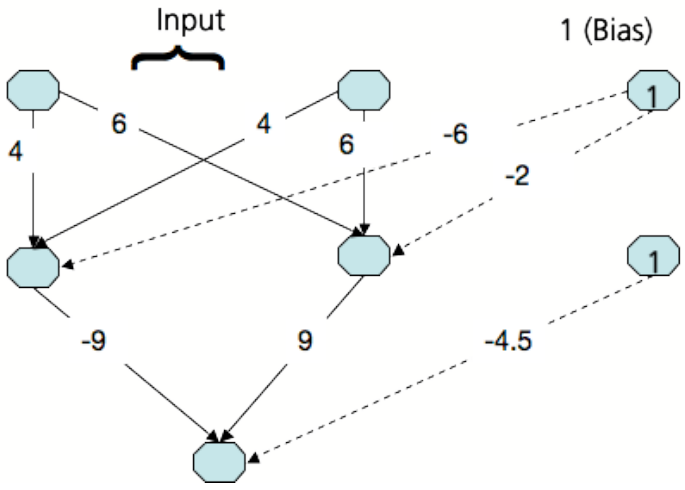


Figure 2. Artificial neural network with two input neurons, one hidden layer with two neurons, and one output neuron. The artificial neural network uses a step function with transition value at 0 to calculate the output from the neurons. The step function is given by O(o) = 1 if o>0 otherwise 0.

X_1	X_2	O
0	0	0
0	1	1
1	0	1
1	1	0