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T4: Analysis

input	unit1	unit2	unit3	output
00000001	**0**	**0**	**1**	**00000001**
00000010	**0**	**0**	**0**	**00000010**
00000100	**1**	**1**	**1**	**00000100**
00001000	**0**	**1**	**0**	**00001000**
00010000	**1**	**0**	**0**	**00010000**
00100000	**1**	**1**	**0**	**00100000**
01000000	**1**	**0**	**1**	**01000000**
10000000	**0**	**1**	**1**	**10000000**

What observations can you make about the machine's hidden value encodings of the input values?

After doing 5000 epochs of learning, the outputs of the hidden units converged. The neural network was supposed to learn the identity function. Therefore, we expected the hidden units to generate a unique encoding for a unique input. However, we discovered that the hidden unit encodings for the inputs 00001000 and 10000000 were the same. This suggested that our neural network had not been able to learn the identity function well. We verified this fact by checking the predictions of the learner after it did 5000 epochs of learning.

One time, we tried to use 4 hidden units and the neural network learned the identity function successfully. This made us realize that we could incorporate a bias node for an input and hidden unit layer in our neural network. We conducted independent research and found that neural networks typically include "hidden" bias nodes (see figure 1). Therefore, we decided to incorporate bias nodes in our neural network.

After creating bias nodes, our neural network was able to learn the identity function. After 5000 epochs, the hidden units were able to generate a unique encoding from a unique input. It makes sense that the three hidden units are adequate to represent the identity function in $\mathbb{R}^8$ because three binary bits are sufficient to represent eight different values.

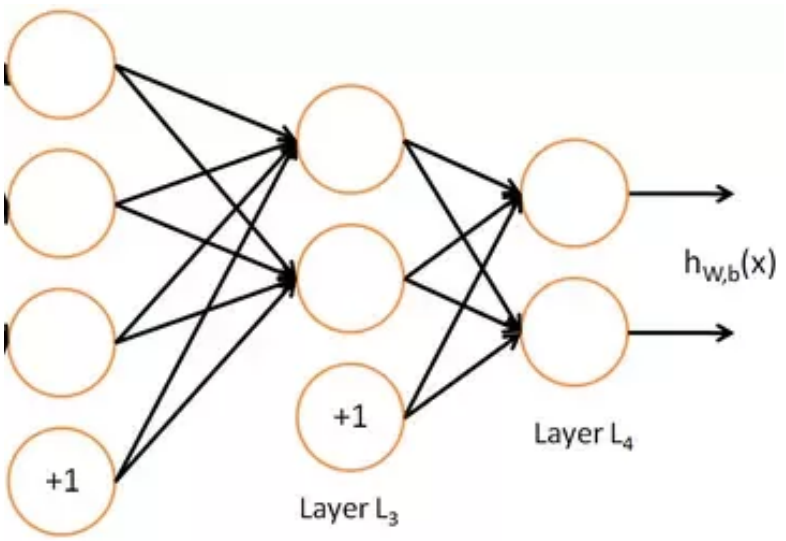

Figure 1: a graphic depiction of an ANN with bias units

Description: The nodes with +1 written represent bias nodes.