ANSWER SHEET FOR EXERCISES 4.1 AND 4.2

4.2.4 EXERCISE 4.1

1. **What is the total SSE when training ends?**

   Total SSE is equal to 0.00

2. **Describe the appearance of the graph of SSE as a function of training epoch.**

   The graph starts at a value of 8, and decreases to 0 at 10 epochs. The rate of decrease is linear or near linear – the curve might be exponentially decreasing, but only slightly.

3. **What can be said about these errors?**

   At the end of training, the network is making a correct response to every pattern for every output unit. It is likely that all of the patterns are being treated equally by the network during learning.

4. **What is the relationship between the set of connection weights, and the input and output patterns whose associations are stored in the weights? (To answer this question, remember you can take a look at the set of input patterns and the set of output patterns, because this information is stored in the spreadsheet as well.)**

   The connection weight matrix is diagonal: all of its entries are equal to 0 except those going from bottom left to top right on the diagonal. These diagonal entries are equal to 1. This pattern of connections follows directly from the relationship between the processing units for each pattern pair. For example, for the first pattern pair, input unit 1 is active, output unit 8 is active, and all other input and output units are set to zero. The only connection weight that would be modified from this pattern pair is the connection from input unit 1 to output unit 8, which is exactly the case in the connection weight matrix. A similar story can be told for the other 7 pattern pairs, each of which alters one – and only one – connection weight.

EXERCISE 4.2

1. **What is the total SSE when training ends?**

   The total SSE was equal to zero.

2. **How does this compare to the total SSE from Exercise 4.1?**

   This value is exactly the same as was the case in the previous exercise.

3. **Describe the appearance of the graph of SSE as a function of training epoch.**

   The graph starts at a value of 8, and decreases to 0 at 10 epochs. The rate of decrease is linear or near linear – the curve might be exponentially decreasing, but only slightly.

4. **How does this appearance compare to the graph that was obtained in Exercise 4.1?**

   The appearance of the graph is identical to the appearance in the previous exercise.

5. What can be said about network errors, and how does this relate to what was found in Exercise 4.1?

There are no network errors, as was the case in the previous exercise.

6. Examine the connection weights that resulted from this training. How do they relate to the weights that were observed in Exercise 4.1?

All of the connection weights appear to be set to some nonzero value, some negative, some positive. In other words, and in contrast to the previous exercise, all of the connection weights appear to have been modified as a result of learning this new training set. In the previous exercise, only 8 of the 64 weights were changed by the training.

7. If one were to examine the connection weights of this network in an attempt to determine how the memory stored its knowledge, would this be a straightforward task to accomplish? If not, then speculate on what approach one might be forced to take to interpret the internal structure of this kind of network.

This would not be a straightforward task, because all of the connection weights are involved, and at first glance there is no obvious relationship between connection weights and training patterns. With the other training set, the relationship between weights and patterns was much more obvious. To interpret the internal structure of this network, one would be forced to adopt some statistical approach – for instance, maybe a factor analysis of the connection weights would reveal how the network is storing these associations.