10. Classifying Tetrachords

10.1 Issue

The issue to be faced with this exercise is this: attempting to look inside a trained multilayer perceptron in order to determine what sorts of representations it uses, and to determine how it solves a musical problem.

10.2 Task

The task is to use the Rumelhart program to train a network to identify four different types of tetrachords as described in Sections 7.2 and 7.3 of the supplementary reading. After a network has converged, we will use Excel to plot its weights and attempt to see what sorts of musical properties are being exploited to solve the task.

10.3 Materials

We will use the Rumelhart software package, and download the netfile FourTetras.net from the course website. This netfile is used to train a network almost identical to the one illustrated in Figure 7-16 of the supplementary reading with the exception that we will begin by exploring networks that use four hidden value units instead of three.

10.4 Procedure

Students will download the required netfile and train the Rumelhart program with it. To begin, use all value units and set μ (thresholds) to zero throughout training. A learning rate of 0.01 should produce convergence in short order.

After the network has converged, use the appropriate buttons to generate an Excel spreadsheet that holds the properties of a trained network. Go to the worksheet that contains the connection weights of the hidden units, and use Excel to plot a bar graph of the weights. Inspect the bar graph for each hidden unit. What properties is each unit paying attention to? Some inspiration for this search may be necessary; an interpreted network is discussed in detail in the supplementary reading. At least look at the figures there!

After exploring one network for a while, consider changing things up a bit. Do different networks solve the problem in the same way? What happens when unit biases are allowed to be trained? Can you successfully train a network with fewer hidden units? Can you train a network that uses different processors?

Explore these questions with the software, taking a look at the internal structure of each network. We are expecting lots of discussion between students and instructors as this task progresses.

As a supplementary activity, the instructor will move through the class, talking to each student individually, in order to get some sense of progress on the term paper for the course.