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Project # 3

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Rough Running Time Analysis

The primary basic operation of this program is computing the Euclidean distance between a node's internal weight vector and an input vector. These are three-dimensional vectors, so the calculation is as follows:

$$d(\boldsymbol{t}, \boldsymbol{w}) = \sum_{i=0}^{3} (t_i - w_i)^2$$

Where **t** is the target vector and **w** is the weight vector.

This calculation is done for every single node in the SOM, for every single vector in the training data. The grid is 21x21, and therefore has 441 nodes. There are 121 vectors in the training data. Therefore, in one epoch, this calculation is performed 441 * 121 = 53,361 times. The program runs for 40 epochs, meaning this calculation is performed a total of 2,134,440 times.

There is also the matter of adjusting weights. The formula for adjusting weight is:

$$\boldsymbol{w} = \sum_{i=0}^{3} w_i + (t_i - w_i) * 0.2$$

This operation is called 13 times per training vector. Once for the winner node, and once for each of the neighbors and step neighbors (12 in total). So, the total times called in the program: 121*13*40 = 62,920.

If the training data increases by 1, the number of operations goes up only by a constant factor. Thus, the Big-O complexity of this program is simple O(n).