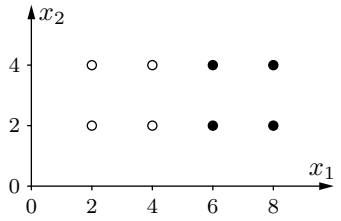
Exercise Sheet 10

Exercise 39 Competitive Learning / Learning Vector Quantization

Consider the eight training data points that are shown on the right, which belong to two classes A (empty circles) and B (filled circles). This pattern set is to be quantized with the help of two reference vectors. Which final positon will be reached by these two reference vectors in an ideal case, if



a) only the "attraction rule" (patterns of the same class attract reference vectors),
b) both the "attraction rule" and the "repulsion rule" (patterns of different class repell reference vectors)

are used to change the positions of the reference vectors? (Hint: You need not calculate the steps of the procedure in detail. The solution can be read directly from the structure of the training patterns.)

Exercise 40 `xlvq/wlvq`: Competitive Learning / Learning Vector Quantization

The programs that are available at `http://www.borgelt.net/lvqd.html` visualize learning vector quantization for two-dimensional data. (Higher-dimensional data may be loaded. In this case the program offers the option to select the two of the input variables that are to be used — see menu entry `Settings > Attributes`.) Apply the program to the Iris data with the input quantities petal length and petal width and let the program determine three reference vectors! (An input file in the appropriate format is contained in the source package.) Compare using the class information (one reference vector per class) with not using it (three reference vectors)!

Exercise 41 `xsom/wsom`: Self-organizing Maps

The programs that are available at `http://www.borgelt.net/somd.html` visualize the development of a self-organizing map, which is trained with points that are chosen randomly from a two-dimensional shape. Execute several training runs with this program! Vary the parameters, especially the shape of the area, from which the data points are chosen, the learning rate and the size of the neighborhood. What happens if the learning rate or the neighborhood radius is reduced too quickly ? (The learning rate is computed according to the formula $\eta(t) = \eta_0 t^{-\kappa}$. The values for η_0 (initial learning rate) and κ (learning rate decay exponent) can be entered in the parameter dialog box. The neighborhood radius is computed with an analogous formula.)

Exercise 42 `xhfn/whfn`: Pattern Recognition

The programs that are available at `http://www.borgelt.net/hfnd.html` visualize pattern recognition by a Hopfield network. Use this program to store a few patterns in

the represented Hopfield network (for example, the seven digits and one block symbol used in the lecture, which are also avaliable in the file `hfnd/ex/numbers.hfn` in the source package). Afterward initialize the network randomly and observe which of the stored patterns is recognized. Are only the stored patterns recognized? Which other patterns are recognized as well/instead? How many patterns can be stored before reliable recognition breaks down?