Introduction to Computer Science
E03 – Lecture 14

Lecture, December 1

Brian Vinter lectured on Grid computing.

Lecture, December 8

Klaus Meer will lecture on neural networks from section 10.4 in the textbook and some notes. He will introduce some basic questions related to neural networks and explain how neural networks in principle could be used for tasks such as pattern recognition. We shall deal with a most basic example of a one-layer, feedforward network called a perceptron (or McCulloch-Pitts network). A few ideas behind the famous Perceptron Learning Algorithm will be explained.

Lecture, December 15

Lene Monrad Favrholdt will lecture on on-line algorithms, and we will discuss the course.

Discussion section: week 50

Discuss the following in groups of three or four. In both problems we are going to construct a network that will recognize specific (simple) patterns. Our basic model for an image is a 5×5 grid whose different positions are numbered from 1 to 25. Thus, we can think about these positions as 25 input values to our network, denoted by $x_1, \ldots, x_{25}$. These inputs can take the values 0 or 1, only. A 0 value corresponds to a white grid point, a 1 value codes a black grid point.

Problem 1: Construct a perceptron taking the 25 input values $x_1, \ldots, x_{25} \in \{0, 1\}$ that precisely recognizes the following pattern of the number 3:

Here, to construct means that you should find suitable real values $w_1, \ldots, w_{25}$ and b such that the resulting perceptron network gives output 1 if and only if the input values $x_1, \ldots, x_{25}$ precisely represent the above pattern.

Problem 2: Now we consider another set of patterns. We would like to build a network that is able to recognize the two diagonals in our grid, i.e. the network should precisely give result 1 for the input patterns

   a) Why is it impossible to solve that problem by just using a single perceptron network? In your answer, suppose that a perceptron network exists that solves the problem. Then argue about how that network has to arrange its weights in order to accept the two above patterns and in order to reject the following two patterns:

   b) Solve the above pattern recognition problem by using a more advanced network structure. The network should still consist of perceptron neurons. However, now there is a first layer with two perceptrons in it, each

of which is connected to the 25 inputs and has its own set of weights and its own threshold. Then, the results of these two perceptron neurons are connected in a second layer by a third perceptron neuron, again taking new weight values that linearly combine the results of the first two neurons and computing its result using a third threshold value.

All edges in the above network get their own (may be similar) weight values.

Assignment due 8:15, December 16

Late assignments will not be accepted. Working together is not allowed. (You may write this either in English or Danish, but write clearly if you do it by hand.)

1. Do problem 28 on page 449 of the textbook.