Institut for Matematik og Datalogi
Syddansk Universitet

November 29, 2010
JFB

Introduction to Computer Science
E10 – Lecture 18

Lecture, November 29, 8:15–10, U37

We covered the first four sections of chapter 7 in the textbook and dataflow diagrams from section 7.5.

Lecture, December 6, 8:15–10, U37

We will finish section 7.5 and cover section 7.6 in the textbook. Then we will begin on chapter 11.

Lecture, December 9, 14:15–16, U71

We will continue with chapter 11 in the textbook.

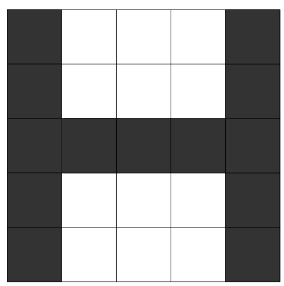
Discussion section: December 17, 12:15-14, in U27a

In groups of three or four, discuss the following problems (some are from the textbook):

In the first two 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.

x_1	x_2	x_3	x_4	x_5
x_6	$\dots$	$\dots$	$\dots$	$\dots$
$\dots$	$\dots$	$\dots$	$\dots$	$\dots$
$\dots$	$\dots$	$\dots$	$\dots$	$\dots$
$\dots$	$\dots$	$\dots$	$\dots$	x_{25}

- Construct a perceptron taking the 25 input values $x_1, \dots, x_{25} \in \{0, 1\}$ that precisely recognizes the following pattern of the latter **H**:

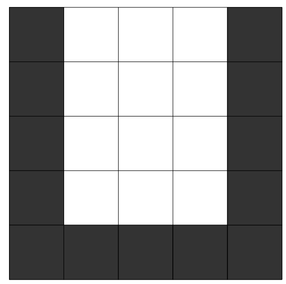
  

  Here, to construct means that you should find suitable real values $w_1, \dots, w_{25}$ and b such that the resulting perceptron network gives output 1 if and only if the inputted values $x_1, \dots, x_{25}$ precisely represent the above pattern.

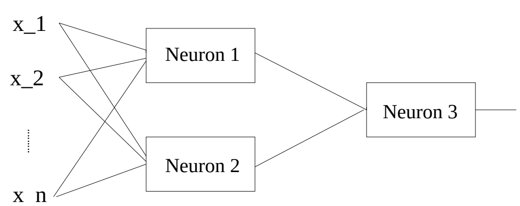
- Now we consider a second pattern. We would like to build a ne twork that is able to recognize the letter **H** from before and the letter **U**:

  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 but not any other pattern.

  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 having 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.

- Questions 1, 2, 3, 4, and 7 on page 533.
- Questions 4, 5, and 6 on page 546.
- Questions 1, 2 and 3 on page 560.