Institut for Matematik og Datalogi
Syddansk Universitet

3 ECTS Project — Computer Science 2011

This project is based on your courses DM526, DM527, and DM502, though most directly on DM526 since it overlaps with both of the other two. It covers stating algorithms precisely (as is required in programming) and circuit design (Boolean algebra and logic). The project will be graded on a Pass/Fail basis. In order to have your project approved, your answers must be correct, with only very minor errors.

The assignment is due at 12:15 on Thursday, September 8. You may write this either in Danish or English, but write clearly if you do it by hand. Write your full name and your section number clearly on the first page of your assignment. In addition, to turning in a paper copy of your project, you should turn it in as a PDF file via Blackboard for your DM526 course. Note that in the upper left hand corner of the screen, there is an icon which you can click on to expand the menu for the course. It is just to the left of the code for and name of the course. Change the menu to full screen to see the result of whatever item you choose. The assignment hand-in is under "Tools". Keep the receipt it gives you proving that you turned your assignment in on time. Blackboard will not allow you to turn in an assignment late. If you have written your project by hand, you will need to scan it. (Ask for help early if you need help for submitting.)

You will be able to pick up your graded project at 12:30 on Thursday, September 15, from Joan Boyar, in her office.

Cheating on this project is viewed as cheating on an exam. You are allowed to talk about course material with your fellow students, but working together on this project is cheating. If you have questions about the project, come to Joan Boyar, your "faglig tutor", or your "instruktor" for DM526.

Please note that this assignment is a compulsory part of your first-year examination. If you fail to hand in the assignment, you will not be able to continue your university studies.

The Project

1. Write down the algorithms for the "magic trick" described in class in DM526 (and practiced in discussion section), where one performer passes four of five playing cards to the other, so that the other can tell what the fifth card is. (Note that you must use the algorithm presented in class, not one you know of or make up yourself.) There should be one algorithm for each of the two performers. Write these as algorithms, so that all steps are completely specified, without ambiguity.

2. Either do the first two problems below or the third one. The third one is somewhat more challenging. In all cases, explain your solutions.

   (a) Design and draw a circuit containing only AND, OR and NOT gates (each gate having at most two inputs) which takes three bits as input and outputs a 1 if the input is 101, 011, 001 or 110, and a 0 otherwise. (In the student resources for the DM526 textbook, under the Activities for Chapter 1, there is a simulator for logic circuits which you could use to check your circuit. It is time consuming to use, though.)

   (b) Design and draw a circuit containing only AND, OR and NOT gates (each gate having at most two inputs) which takes four bits as input and outputs a 1 if the input is 1001, 0101 or 1110, and a 0 otherwise. (Challenging)

   (c) Design and draw a circuit containing only AND and XOR gates (each gate having two inputs) which takes six bits as input and outputs a 1 if the input has at least four ones, and a 0 otherwise. Use only four AND gates. How many XOR gates do you need? Hint: Look at (and use) the problem from the discussion section where you were asked to minimize the number of AND gates. Then consider how to count in binary how many ones there are in a set of three bits, and then add two numbers, each of which has two bits.