

Institut for Matematik og Datalogi
Syddansk Universitet

FF500 Take Home Re-exam — Computer Science 2015

This is the re-exam of your FF500 take home exam. You should only do this if your FF500 take home exam was not approved (if you did not turn it in, it was not approved).

This project is based on your courses DM549, DM550, and DM534, though most directly on DM534 since it overlaps with both of the other two. It covers stating algorithms precisely and being able to follow the execution of an algorithm (as is required in programming), circuit design (Boolean algebra and logic), and \LaTeX . The project will be graded on a Pass/Fail basis.

The project is due at **8:15 on Tuesday, November 3**.

You may write it either in Danish or English, but write it clearly. It must be made in \LaTeX , though you may draw some circuits by hand, scan them in to make PDF files, and then include the PDF files in your \LaTeX code. Write your full name, your section number (D1, D2, or D3), and your “instruktør”’s name (Kristine Vitting Klinkby Knudsen, Mathias W. Svendsen, or Jesper With Mikkelsen) clearly on the first page of your project (on the top, if it is not a cover page). You should turn in your project as a PDF file via Blackboard. The assignment/project hand-in is in the menu for the course DM534 and is called “SDU Assignment”. Keep the receipt it gives you proving that you turned your project in on time. **Blackboard will not allow you to turn in an assignment/project late.**

You will be able to pick up your graded re-exam from Joan Boyar in her office, starting at 10:30 on Monday, November 9.

Note that it is important to always pick up your projects (or later in the course, assignments), since this is how you will find out if they have been approved and there will generally be useful comments on them to help you improve your performance.

In order to have this project approved, you must do all parts of the assignment, making only minor errors. Your answers must be written so that they are complete and easy to understand. **There will be no redo allowed on this re-exam**, so get it right the first time.

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 or your “instruktor” for DM534.

The Project

Do the following problems and write your solutions in \LaTeX . Do not include the statements of the problems or other information not asked for. Write complete, clear, easy to read, concise answers.

1. The version of Figure 0.2 from the textbook which was presented on the slides for DM534 is as follows:

GCD(M, N):
{ Input: two positive integers M, N }
{ Output: $\text{gcd}(M, N)$ }

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A := max(M, N)
B := min(M, N)

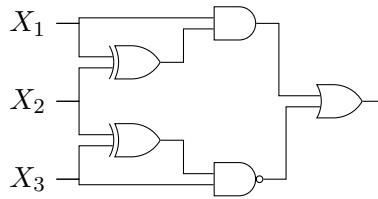
Q := A div B
R := A - (Q · B)
while R ≠ 0 do
    A := B
    B := R
    Q := A div B
    R := A - (Q · B)
return(B)
```

Note that “div” is integer division, so the result in this case is the largest nonnegative integer, Q , such that $A \geq Q \cdot B$.

- (a) Suppose that the input to this is $M = 33$ and $N = 24$. Show the sequence of values for A , B , and Q that are computed by the algorithm and also the result.
- (b) Give an example of two inputs which will give the following sequence of values for Q during the execution: “1,1,1,2”.

- (c) Using pseudocode represent the original algorithm in another way by removing the **while** structure and using a **repeat-until** structure instead. Your new pseudocode should produce the same result as the original in all cases.

2. Consider the following circuit:



- (a) Give a truth table for this circuit, including the outputs of all five gates as separate columns. Use \LaTeX code for this (do not import a file).
- (b) Express the output of this circuit as a Boolean formula. Use math mode in \LaTeX .
- (c) Draw another circuit which would produce the same output without using any XOR gates, without increasing the number of gates. This may be drawn neatly by hand, scanned in to make a PDF file, and imported to \LaTeX as a PDF file.
- (d) Give a truth table for your circuit from above, including the outputs of all of your gates as separate columns. Use \LaTeX code for this part (do not import a file).
3. Explain your solutions (a truth table, including the outputs of the most important gates, not just the output, may help in doing this; and if you use Disjunctive Normal Form or some of De Morgan's Laws, state that). The circuits themselves may be drawn neatly by hand, scanned in to make PDF files, and included in your \LaTeX code as PDF files.
- (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 011, 101, 110 or 111, and a 0 otherwise. (In the student resources for the DM534 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.) The circuit you create should be clearly marked as to which input goes where. Call the inputs a , b , and c , going from left to right.

- (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 0101, 0011 or 1011, and a 0 otherwise. The circuit you create should be clearly marked as to which input goes where. Call the inputs a , b , c , and d , going from left to right.
4. What is the hexadecimal number 2AE in binary? What is it in decimal? Show your calculations.
 5. Include your \LaTeX code for this project. Make sure lines are broken properly so it can be read.