Institut for Matematik og Datalogi
Syddansk Universitet

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Peter Schneider-Kamp

Introduction to Computer Science
E09 – Week 1

Textbook

J. Glenn Brookshear: *Computer Science: An Overview*. Pearson Education, 10th Edition.
The textbook will be supplemented with notes.

Format

The course is being coordinated by Peter Schneider-Kamp. You will meet most of the computer science faculty in the department during this course, since they will alternate giving lectures.

The discussion sections will sometimes be exercises and sometimes labs (always have a close look at the weekly notes or the web site). Labs will be held in IMADA's "Terminalrum". The "instruktor" (teaching assistant) for the first six weeks (first quarter) will be Uffe Thorsen, and the "instruktor" for the remainder (second quarter) will be Christian Kudahl. They will be teaching the discussion sections. The first lab will be the first discussion section in week 37.

The weekly notes and other information about the course are available through the e-learning system BlackBoard:

> http://e-learn.sdu.dk/

You can access the course home page directly using the following URL:

> http://www.imada.sdu.dk/~petersk/DM526/

You are responsible for finding all weekly notes (either in Blackboard or on the course home page) yourself. Please read the appropriate sections in the textbook or notes before coming to class and bring your textbook with you. Preparing for discussion sections (and labs) is important, too.

Peter Schneider-Kamp has no fixed office hours, but his door is always open for you (if it should be closed, knock loudly and wait a few seconds before trying to enter). If you like, you can also schedule an appointment by email, jabber or phone (see the course home page for contact details).

The weekly notes usually contain a description of the upcoming lectures, questions and tasks for discussion sections, and the assignments.

Lecture: Tuesday, September 1, 12-14 (U140)

Rolf Fagerberg will lecture. He will begin with an introduction to the course, covering Chapter 0 in the textbook, but skipping Section 0.2. He will also begin on Chapter 1.

Lecture: Wednesday, September 2, 14-16 (U28)

Rolf Fagerberg will lecture. He will cover more of Chapter 1 in the textbook.

The textbook's interpretation of the mantissa in floating-point representations is not the same as the IEEE-standard and hence somewhat outdated: The book says that the mantissa 1010 means 0.1010 and that the first bit is always 1 in normalized numbers. IEEE-standard says that 1010 means 1.1010, meaning that the fixed normalization bit is a “hidden bit” or “implicit bit” before the radix point. In calculating the value represented by the mantissa, an extra 1 is added. This way the first bit in the mantissa may be 0. Notes about the IEEE standard can be found at http://steve.hollasch.net/cgindex/coding/ieeefloat.html. (For problems in this course, we will use the format described in the textbook, using the same number of bits, but the mantissa will have this IEEE-standard form, with the implicit bit.)

Lecture: Monday, September 7, 12-14

Peter Schneider-Kamp will lecture. He will cover large parts of Chapter 2.

Lecture: Thursday, September 10, 10-12

Daniel Merkle will lecture. He will begin Chapter 3.

Discussion section: September 3, 14:15-16, U20

Discussion in groups:

1. Divide into groups of three people (or four). One person will choose five cards to give to the first "performer", the first performer will give four of them to the second "performer", one at a time, and the second performer will announce what the fifth card is. Each person should practice each "performer" part at least three times.

2. Discuss (in your groups) various methods for improving the magic trick. For example, if the second card determines the suit, after seeing the trick repeated several times, the audience might find it easier to guess how it is done. Define an algorithm for a modification of the trick which makes this harder to see.

3. Discuss how to do a magic trick, where one performer is thinking of a number between 1 and 24, tells the audience the number, gets some cards from the audience, and passes some cards to the second performer, who announces the number.

4. Discuss how to extend this to larger numbers than 24. When might it be better to only use the color on the card (red / black or spades / hearts / diamonds / clubs), rather than some permutation (ordering) of the cards?

5. Find a "bad" pair of integers for the greatest common divisor algorithm, where a pair is bad if the algorithms must perform a lot of steps relative to how large the numbers are. (One expects more steps for larger numbers.)

6. Do problem 3 on page 91 of the textbook.

7. Design a circuit, using only AND, OR and NOT gates which takes three bits as input and outputs a 1 if the input has at least two zeros, and a 0 otherwise.

8. Design and draw a circuit containing only AND and XOR gates (with at most two inputs) which takes three bits as input and outputs a 1 if the input has at least two ones, and a 0 otherwise. (In the student resources for the course 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.) As an extra challenge, try to do it so that there is only one AND gate, though more XOR gates. (Minimizing the number of AND gates can be useful in some cryptographic applications.)

9. Discuss questions 2 and 4 on pages 34–35 of the textbook.

Assignment due 14:15, September 10

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

1. Write down the algorithms for the "magic trick" described in class, where one performer passes four of five playing cards to the other, so that the other can tell what the fifth card is. There should be one algorithm for each of the two performers. Write these as algorithms, so that all steps are clearly specified, without ambiguity.

2. Either do the first two problems below or the third one. The third one is somewhat more challenging. As with all problems in this course, explain your results.

   (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 001, 111 or 110, and a 0 otherwise. (In the student resources for the course 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 1101, 0111 or 1110, and a 0 otherwise.

(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 adding two numbers, each of which has two bits.

Important Information about the Assignments

The course will be graded on a Pass/Fail basis, and satisfactory completion of all 10 assignments is required to pass. "Satisfactory completion" means that the answers are correct, with only very minor errors, and that they have been turned in on time.

You can turn in your assignments by submitting a PDF file through Blackboard's assignment hand-in system or by sending an email to Peter Schneider-Kamp (`petersk@imada.sdu.dk`). Note that, if you send them by e-mail, you are responsible for them actually getting to Peter Schneider-Kamp on time. Sending from IMADA's computers will help ensure that your e-mail is not delayed at an intermediate computer for many hours. Note that you can turn in handwritten assignments as PDF files by scanning them.

You are allowed to retry on at most 3 assignments which were not approved. Each assignment can only be retried once. If you turn in an assignment late (regardless of the reason), it will not be approved, and you will have to use one of your 3 retries on it.

The 10 assignments count as the exam in the course, so cheating on these assignments is viewed as cheating on an exam. You are allowed to talk about course material with your fellow students, but working together on assignments is cheating. If you have questions about the assignment, come to the relevant lecturer or your "instruktor".