Institut for Matematik og Datalogi
Syddansk Universitet – Odense Universitet

August 31, 1999
JFB

DM19 – E99 – Lectures 1 and 2

Textbook and notes

Introduction to Algorithms by T. Cormen, C. Leirserson, and R. Rivest, MIT Press, 1996.

Extra notes (available in the bookstore):

- Errata to the textbook.
- *Noter til DM19 - I, Efterårssemestret 1999.* From *Computer Algorithms: Introduction to Design and Analysis*, second edition, by S. Baase, Addison-Wesley, 1987.
- *Noter til DM19 - II, Efter årssemestret 1999.* From *Combinatorial Optimization: Algorithms and Complexity*, by C.H. Papadimitriou and K. Steiglitz, Prentice-Hall, 1982.

Format

Lectures will be on Wednesdays and Fridays, and the weekly notes will generally be available on Fridays. Please read the appropriate sections in the textbook or notes before coming to class and bring your textbook with you. There will be weekly assignments (which are not obligatory) which you should be prepared to discuss in the discussion section (øvelserne) ten days after the problems are assigned. The instructor is Lene Monrad Favrholdt, and the discussion sections will be held in U49E at 10:15 on Mondays. The problems to be discussed in the first discussion section (which should mainly be review) are on this weekly note, as are those for the second discussion section.

There will be an oral exam in January. The exam questions from last year are attached to this weekly note. Some changes are likely for this year.

The weekly notes and other information about the course are available through the WorldWideWeb. Use the URL:

http://www.imada.sdu.dk/~joan/dm19/index.html

Lecture, September 1

We begin with an introduction to the course, touching on the topics covered in the first 4 chapters in the textbook. Merge-Sort will be the running example.

Lecture, September 3

We will discuss upper and lower bounds for sorting. Quicksort will be quickly reviewed (and the expected running time of Randomized-Quicksort will be presented), as will radix sort. Counting sort will be presented. Then lower bounds from section 2.4 of the first set of notes will be discussed.

Lectures, Week 36

We will finish with lower bounds for sorting, and look at upper and lower bounds for some selection problems. This will mostly be from sections 3.1, 3.2, 3.3, and 3.5 from the first set of notes, but also from chapter 10 in the textbook.

Problems to be discussed in week 36

1.2-2, 1.2-3, 1.2-4 (assume that it takes constant time to do one multiplication), 2.1-1, 2.1-2, 2.1-3, 2.1-4, 2.2-3, 4-1g, 4-4d.

Give an example of two functions, f and g, such that $f \neq O(g)$ and $g \neq O(f)$.

Problems to be discussed in week 37

2.1-7, 2.2-4, 2-2 (all parts), 2-4 (b-e), 4-1 (a,b,f,h), 8.3-1, 8.3-4.

Past Exam Questions

1. Information-theoretic lower bounds (lower bounds proven by counting leaves in decision trees), especially the worst case and average case bounds for sorting by comparisons.
2. Adversary arguments – technique, examples.
3. Matroids – definitions, examples.
4. All-pairs shortest paths.
5. Flows in networks – Ford-Fulkerson and Edmonds-Karp methods.
6. Flows in networks – Preflow-push algorithms.
7. Matching – bipartite and nonbipartite.
8. Proof that SATISFIABILITY is NP-complete.
9. NP-completeness proofs – examples.

10. Approximation algorithms for NP-complete problems.
11. RSA public-key cryptosystem and primality testing (Miller-Rabin).
12. Sorting networks.
13. Circuits for addition and multiplication.
14. Parallel algorithms – examples and techniques.
15. Parallel algorithms – CRCW vs. EREW, and Brent's theorem.
16. Fast Fourier Transform.
17. String matching.
18. Computational geometry – algorithms and techniques.

The form of the exam You will draw a topic from the list of topics listed above. You will have 30 minutes to prepare your presentation. During this time you can use the book and your notes. You can make short notes that will help you to organize your presentation, but that will have no other technical content. The exam will take about 30 minutes per person. Prepare you presentation so that it takes about 20 minutes. Make sure you cover the most important ideas from your topic, though this may mean that you need to skip some details. Your presentation may be interupted with questions or cut short to go on to other topics. Towards the end of the 30 minute period, you will typically also be asked short questions not related to the material you talked about.

The **preferred** language of the exam is English. However if you have any problems with that, feel free to speak Danish.