Topics for the exam in DM551

The topics are:

1. Basic counting problems (pigeonhole principle, generalized permutations and combinations, etc.)

2. Inclusion-exclusion with applications (hatcheck problem, Sieve of Eratosthenes)

3. Recurrence relations (definitions, solution form, (non-)homogeneous recurrence relations, applications in counting problems)

4. Discrete probability, random variables and bounds (expected value, variance, Bayes' Theorem, Markov's inequality, Chebyshev's inequality and Chernoff bounds)

5. Randomized algorithms (Quicksort, median finding and selection, min-cut in graphs, generating a random permutation, the hiring problem, etc.)

6. The probabilistic method, Monte Carlo algorithms, the Birthday Problem

7. Probabilistic analysis (using (indicator) random variables, coupon collector, expected running time of quicksort and selection, randomized approximation for max k-SAT)

8. Examples of applications of indicator random variables (you can also find some yourselves)

9. Universal hashing

10. String matching (naive algorithm, Rabin-Karp algorithm, Finite automaton based string matching, KMP algorithm)

The oral exam will take place on January 23, 24 and 25 (also using January 22 possibly). Please send Joan an email saying when you would like your exam (please send an email to say you do not have any preference if you do not). If you have a very good reason for your preference, please state it in your email (another exam the same day is a much better excuse than having trouble getting out of bed in the morning). You will receive a list through Blackboard of the order students in DM551 will take the exam along with a starting time for the first student to draw a question. These lists cannot be used to exactly calculate an exam time since some students may not show up. If a student is not there, the next student on the list who is present will be taken. When there are no more students ready to be taken, the external examiner may leave, so show up plenty early to make sure you are examined. Two hours before your expected exam time is probably safe enough. The first first few students should show up at the start time.

You will draw a topic from the list of topics listed above. The suggestions listed in parentheses are not part of the topic, but merely meant as inspiration; there may be other possibilities to talk about. Remember that if you choose the easiest material then it is harder to get a top grade, so if you aim high (which many of you should), then choose something where you

can show your qualities. If you just want to pass/get a decent grade, you may choose some of the easier material. In any case do not choose something which you are not sure you can handle.

You will have almost 30 minutes to prepare your presentation. During this time you may use the book and your notes. You may also make short notes that will help you to organize your presentation, but that will have no other technical content. At the exam itself you are not allowed to look at anything but these short notes. You will be asked to stop looking if we feel this is necessary.

The exam will take about 30 minutes per person. Prepare your presentation so that it takes about 10 to 15 minutes. Make sure you cover what you consider the most important ideas from your topic, though this may mean that you need to skip some details. Your presentation may be interrupted 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 censor and I may ask about your solutions for the two assignments, so you must be able to explain that. You are welcome to use examples from the two assignments to illustrate the topic you are covering in the question you got.

The main focus is on demonstrating understanding and usage of concepts and methods and to a lesser extent whether you can derive complicated formulas, such as deriving the Chernoff bound formulas. Of course, you must be able show that you understand the basic formulas and how to use them. You are welcome to choose a small example and use that to illustrate the topic you got. Remember to write a lot on the blackboard and to only talk about the question asked (to avoid wasting time).

You may do your presentation in either Danish or English (though Danish is strongly recommended if it is your native language).

Come ask Joan if you have any questions.