

CS4102, Algorithms

Final Beginning of Course Memo (Spring 2010)

Class Web site: <http://www.cs.virginia.edu/~horton/cs4102>

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Office hours: M Tu Th 11am-noon, and by appointment

Teaching Assistants: Sonali Parthasarthy. Office hours to be announced on the website.

Class time and location: TR 9:30-10:45 pm, THN E316

Prerequisite: CS216 / CS2150 with grade of C- or higher.

Description from the Undergraduate Record: Introduces the analysis of algorithms and the effects of data structures on them. Algorithms selected from areas such as sorting, searching, shortest paths, greedy algorithms, backtracking, divide- and-conquer, and dynamic programming. Data structures include heaps and search, splay, and spanning trees. Analysis techniques include asymptotic worst-case, expected time, amortized analysis, and reductions between problems.

Course Objectives: Upon successful completion of this course, students will:

1. Comprehend *fundamental ideas in algorithm analysis*, including: time and space complexity; identifying and counting basic operations; order classes and asymptotic growth; lower bounds; optimal algorithms.
2. *Apply* these fundamental ideas to *analyze and evaluate important problems and algorithms* in computing, including search, sorting, graph problems, and optimization problems.
3. *Apply appropriate mathematical techniques in evaluation and analysis*, including limits, logarithms, exponents, summations, recurrence relations, lower-bounds proofs and other proofs.
4. *Comprehend, apply and evaluate the use of algorithm design* techniques such as divide and conquer, the greedy approach, dynamic programming, and exhaustive or brute-force solutions.
5. Comprehend the fundamental ideas related to the *problem classes NP and NP-complete*, including their definitions, their theoretical implications, Cook's theorem, etc. Be exposed to the design of polynomial reductions used to prove membership in NP-complete.

Textbooks Required and Readings:

Required text: *Algorithms*, by Richard Johnsonbaugh and Marcus Schaefer.

References:

Data Structures & Algorithm Analysis in C++, by Mark Allen Weiss. The CS2150 text.

Introduction to Algorithms (2nd or 3rd edition) by Cormen, Leiserson, Rivest, and Stein, McGraw-Hill. This has been used as the text in the past. It is frequently used by graduate courses and it's an excellent and useful a reference.

A few other readings will be assigned, either through handouts, on the web, or PDFs on-line.

Grading Information and Criteria:

- Exam 1, 22%. Tuesday, Feb. 25 (tentative)
- Exam 2, 22%. Thursday, April 13 (tentative)
- Exam 3, 22%. Thursday, May 6, 2-4pm (first day of exam week).
 - Half of the final will be on material after Exam 2. Half will be on earlier material.
- Homework sets, programs, and experiments. 34%. See details below.
- Class participation. Up to a 5% penalty on the final grade total. See below.
- In the event of very high absenteeism related to H1N1 flu or other circumstances, class policies regarding attendance, homework submission, and the dates of exams are subject to change.

Class participation. There will be a number of class participation activities that count towards this. They may include out-of-class activities (on-line surveys, not-for-grade quizzes) or participation in in-class activities. These will be announced in advance. Legitimate absences from class will not count against you if you inform me. 100% participation is not required.

Homework etc.

There will be 6 or 7 homeworks (a few of them “smaller” and worth less). Students may work alone or in pairs. Papers will be due at the start of class, but may be submitted electronically up to 24 hours late but with a 10% penalty. Students working alone are allowed to talk to one other person or pair, but otherwise collaboration is not allowed.

Expectations:

I may post topics that I expect you to understand along with a set of problems that represent what I would expect you to be able to do. Sometimes I will announce what I expect you to do before coming to lecture (read something, work a problem, etc.) and the class meeting will reflect this. I may ask you to read pages in the textbook as background before lecture so that I don't have to lecture on basic material or things that are review from earlier courses. One goal this term is to make the course less lecture-oriented and instead have students be more active in our class meetings.

When in class: We're meeting together in class so you can learn something from me, so it is important that you pay attention. Use of electronic devices (laptops etc.) during class can be used for class purposes or used in a way that does not detract from learning – or not! I may call upon students etc. who I think may not be paying enough attention in order to make sure learning is happening. Don't be offended, please.

Outline of Topics:

- Basics of algorithm analysis and design. Asymptotic growth rate. Lower bounds. Recurrence relations. Mathematical techniques. (Chap. 1 and parts of 2 and 3)
- Search (some) and graph searching. Depth-first search, breadth-first search, exhaustive search (Chap. 4 and notes)
- Divide and Conquer. (Chap. 5)
- Sorting, Selection, more on lower bounds (Chap. 6)
- Greedy algorithms. Spanning trees, shortest paths. (Chap. 7)
- Algorithms and intellectual property. (Perhaps!)
- NP-complete problems (Chap 10)
- Dynamic programming. (Chap 8)
- Possibly other topics, if we have time.

More details will be provided on the Web site. This is subject to change.

In the event of very high absenteeism related to H1N1 flu or other circumstances, many of the class policies regarding attendance, homework submission, and the dates of exams are subject to change.

Honor Policy: The UVa Honor Policy will be in effect in this class. Each assignment will describe allowed collaborations, and deviations from these will be considered Honors violations. Unless otherwise noted, exams and individual assignments will be considered pledged that you have neither given nor received help. An academic irregularity on any exam may result in failure of the course.

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