CS570: Analysis of Algorithms — Course Overview

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May 25, 2007

All of the information in this document is also on the course web site `http://www-rcf.usc.edu/~dkempe/CS570/`.

1 Course Overview, Textbook, Prerequisites

The course is intended as a first graduate course in the design and analysis of algorithms. While the main focus is on known and well-established results in the literature, there will be many times when the course will touch on uncharted territory, or suggest directions for research. The course will give an overview of common techniques, and applications of these techniques in different settings.

The textbook is

Jon Kleinberg/Éva Tardos: Algorithm Design (available at the campus store)

The class will be relying mostly on the textbook, but additional material will occasionally be drawn from the following books (which will be placed on reserve, as will a copy of the textbook):

- Cormen/Leiserson/Rivest/Stein: Introduction to Algorithms (2nd edition)
- Garey/Johnson: Computers and Intractability
- Motwani/Raghavan: Randomized Algorithms
- Vazirani: Approximation Algorithms
- Borodin/El-Yaniv: Online Algorithms

Students in the class are expected to have a reasonable degree of mathematical sophistication, and to be familiar with the basic notions of algorithms and data structures, discrete mathematics, and probability. Specifically, the following will be assumed:

- Mathematical Proofs, in particular induction and contradiction.
- Big-Oh notation (Big-O, Omega, Theta), how to apply them.
- Basic data structures: arrays, linked lists, trees, balanced trees, heaps (priority queues), graphs.
- Basic graph algorithms: connected components, BFS, DFS.
- Other algorithms: binary search, sorting.
- Discrete mathematics: evaluating sums and simple recurrences.

Undergraduate classes in these subjects should be sufficient. If you have doubts about meeting these prerequisites, please contact the instructor. Notice that these prerequisites will actually be verified with a quiz during the second week of classes. The first chapters of the course textbook as well as the book by Cormen/Leiserson/Rivest/Stein listed above may be good sources to review the prerequisites, if necessary.

There are two parallel sessions, taught by Dr. Shawn Shamsian and Prof. Leana Golubchik. These two sessions will be significantly different from this one. The material covered in the session taught by Prof. Kempe will be more advanced, and strictly assume knowledge of the prerequisites. Dr. Shamsian's and Prof. Golubchik's sessions will place more emphasis on a review of the basic material, and will be altogether easier. Computer science Ph.D. students are required to enroll in Prof. Kempe's section. Master's students and Ph.D. students from other departments have a choice of which session to enroll in.

2 Syllabus

This syllabus is meant as an outline. Depending on progress, material may be added or removed. Also, there will often be interesting tangents to follow.

1. Introduction, Overview, Example: Stable Marriage
2. Greedy Algorithms: Shortest Paths and Minimum Spanning Trees
3. Dynamic Programming
4. Max-Flow/Min-Cut and its applications
5. NP-hardness
6. Linear Programming: Properties and Applications
7. Approximation Algorithms
8. Randomized Algorithms
9. Online Algorithms

3 Homework, Grading

Students' grades in the class will be based on the class final, two midterms, the initial prerequisites quiz, and homwork. The final will count for 40%, each of the midterms for 20%, the homework for 15%, and the quiz for 5%. Among the homeworks, the worst one will be dropped. There is also an important additional constraint: if the homework score is below 45% of the attainable total, then the final grade cannot be better than a C.

The grading will not be done to a curve. Instead, the grading scale will be as follows. If H denotes your percentage of points on all homeworks (except your worst one), M_1 and M_2 denote your percentages on the first and second midterm, F your percentage on the final, and Q your percentage on the quiz, then we calculate $p = 5\%Q + 15\%H + 20\%M_1 + 20\%M_2 + 40\%F$. Then, if H is at least 45%, you get the grade from the table below. If H is less than 45%, you get the worse of C and the grade dictated by the table.

p	75%	67%	60%	55%	50%	42%	35%
Grade	A	A-	B+	B	B-	C+	C

The homeworks will also contain specifically marked extra credit problems. These will be significantly more difficult than the other problems. In order to obtain a grade of A+, you will need to satisfy all requirements for an A, and also obtain at least 40% of the points on extra credit problems. Extra credit problems do not help you improve your grade if you are not already in the A range. (They are meant for student seeking a personal challenge.)

3.1 Homework Overview

Homework is assigned roughly every 1–2 weeks from the textbook. Usually, homework either asks you to "give an algorithm", or to give a proof for some fact. When you are asked to give an algorithm, it also means proving your algorithm's correctness, and giving a (brief) analysis of its running time. The latter two are at least as important as the algorithm itself, and failing to include these parts will give you only partial credit.

Solutions to the homeworks will be handed out on paper in class about one week after the submission deadline. We will not make any solutions available in electronic formats. When returning homework, we also post some cumulative statistics about the class performance.

We will announce upon returning homework which TA graded which problems. If you think that we deducted points from your solution unfairly, you have two weeks after we return your homework to ask the corresponding TA for a regrade. After those two weeks, we will not consider regrade requests. (If you know that you want a regrade and cannot make the TA's office hours for two weeks, you can notify the TA early, and schedule a later meeting.) If during the regrading process, we discover that your score was in fact too high, your score may also get lowered. If the TA's answer is not satisfying, you can contact the instructor. On the other hand, if your complaint is about grading policy rather than any particular decision of a grader, you should contact the instructor directly.

3.2 Homework Submission, Late Days

Homework should normally be submitted in class, on paper. If you cannot submit your homework in class, or are submitting late, you have three options: (1) submit it to the instructor in person, (2) submit it to a TA in person, (3) slide it under the instructor's door. No other means of submission are acceptable (unless you have explicit permission from the instructor) - in particular, please do not leave homework in the instructor's mailbox. (In exceptional cases, such as travel, you can contact the instructor to obtain permission to submit electronically.)

Every student in the class has a total of **5** late days of homework (business days) that can be arbitrarily spread out among homework assignments without the need to provide a reason. These are meant as an unbureaucratic way of dealing with legitimate reasons for late submission. You may use them for other reasons if you choose, but this does not mean you are entitled to 5 late days in addition to any legitimate ones.

No solution will ever be accepted more than 5 business days (one week) late. Occasionally, we will set a tighter homework submission deadline, usually so we can return sample solutions in time before an exam. If a submission is late, and the 5 total late days are exceeded, then 20% of the original score on the homework are deducted for each excessive late day.

For counting late days, a solution counts as submitted on a certain day if it was submitted in one of the above three ways by 6pm on that day. Homework submissions after 6pm count as the next day. If a solution is submitted in multiple parts on different days, then the official submission date is that of the last part that was submitted.

4 Academic Integrity, Collaboration

All students are expected to maintain the utmost level of academic integrity. Passing off anyone else's (whether it be a fellow student or someone outside the university) work as your own is a serious infraction, and will lead to appropriate sanctions. Similarly, any collaboration during exams is prohibited. Please consult the USC Student Conduct Code for details on what is and is not appropriate, and for the possible consequences of infractions.

However, as research is usually a joint effort, students are encouraged to collaborate on general solution strategies for homework. The writeup, however, must be your own - you may not copy someone else's solution. In addition, your homework should list all the fellow students with whom you discussed the solutions.