Computer Science
Dartmouth College

Computer Science 31
Algorithms

Spring 2013

Amit Chakrabarti

[Announcements | Administrative Basics | Schedule and Homeworks | Exams | Grades Database]

Course Description

This course is about the *art* of designing *efficient* algorithms for a wide range of fundamental computational tasks and the *science* of proving the correctness of such algorithms and formally analyzing their time complexity.

The course will introduce the following basic design paradigms: divide-and-conquer, greedy algorithms, dynamic programming, amortized analysis, and randomization. The computational tasks studied will span several domains. These include sorting and order statistics, computing with integers and number-theoretic algorithms, algorithms on graphs, and geometric algorithms.

Writing mathematical proofs will be required throughout this course. Students are expected to have *previous experience with writing proofs*. Taking CS 30 will provide this experience.

Students will be expected to be experienced programmers before taking this course, so that they are able to reason about algorithms/code at a high level without seeing actual lines of code in front of them. Taking the CS 1 – CS 10 sequence will provide this experience.

Announcements

- [May 29] The final exam has been posted. See the bottom of the schedule table below.
- [May 18] Slides on Fibonacci heaps have been posted. See table below.
- [Apr 10] Details of the exams have just been announced.
- [Apr 9] If you have not done so yet, please send the instructor an email stating your first and last name (omit middle initials and suffixes) and a chosen password for this course's grades database.

Administrative Basics

Important! Please also read and familiarize yourself with the administrative details not covered in the outline below. Pay special attention to the section that describes how the honor code applies to this course; violations of the honor code *will* be treated seriously.

Lectures	LSC 205 | 10 hour | Mon-Wed-Fri 10:00-11:05, X-hr Thu 12:00-12:50
Instructor	Amit Chakrabarti Sudikoff 107 | 6-1710 | Office hours: Mon 1:30–2:30, Fri 11:15–12:15, or by appointment
Teaching Assistants	Hanh Nguyen Sudikoff 114 | Office hours: Sun 2:00–4:00, or by appointment

Elaine Levey
Sudikoff 114 | Office hours: Mon 3:00–5:00, or by appointment

Textbook Required:
"Introduction to Algorithms", Third Edition. Cormen, Leiserson, Rivest, and Stein.
Suggested additional:
"Algorithm Design", Kleinberg and Tardos.

Prerequisites Both CS 10 and CS 30.
The reasons are explained in the Course Description.
You must meet the professor in person to request a prerequisite waiver.

Work One homework per week. [20 points]
Two in-class quizzes. [20 points]
Two in-class evening midterms. [30 points]
One take-home final exam. [30 points]

Please take note of the late homework policy. It will be enforced, strictly.

Schedule, Homeworks, Exams

This is a work in progress. The dates for the quizzes, the evening midterms and due dates for the homework sets and the final exam are now fixed as shown below. This schedule will be updated frequently. Please check back often, and please remember to RELOAD to get the latest schedule.

The schedule is subject to change, with minimal notice. Especially, greyed-out entries should be considered tentative.

Please be sure to read and understand the Homework Grading Guidelines and the Late Submission Policy.

Official solutions to homeworks and exams (hard-copy only) will be given out when graded work is returned.

Lecture Number and Date			Textbook Sections	Homework Due	Topics Covered in This Lecture
Week 1	1	Mar 25	—	—	Welcome; Administrivia; Historical examples: Euclid, Gauss, Gale-Shapley
	2	Mar 27	2.1, 2.2	—	Basic analysis: bubble sort and insertion sort; Mathematical induction
	3	Mar 28 (X-hr)	2.2, 3.1, 3.2	—	RAM model; Asymptotic notation
	4	Mar 29	2.3	—	Merge sort and analysis; More mathematical induction
Week 2	5	Apr 1	—	—	Divide-and-Conquer; Binary search; Inversions; Majority
	6	Apr 3	4.2	HW1	Karatsuba integer multiplication; Strassen matrix multiplication
	7	Apr 4	4.3–4.6	—	Master theorem; Akra-Bazzi theorem

		(X-hr)			
	8	Apr 5	9.3	—	Selection
	9	Apr 8	33.4	—	Closest pair
	10	Apr 10	16.1, 16.2	HW2	Greedy algorithms: interval selection
Week 3	11	Apr 11 (X-hr)	—	—	Formal proof of correctness for greedy interval selection
	12	Apr 12	22.1	—	Graph, trees, and their representations
	12	Apr 15	23.1, 23.2	—	Kruskal MST **[Evening Midterm #1, 5:00–7:00 in LSC 200]**
Week 4	13	Apr 17	23.1, 23.2	HW3	Kruskal proof of correctness; Importance of data structures
		Apr 18 (X-hr)	—	—	Not used | Video homework: Lecture 5 "GRAPH SEARCH & DIJKSTRA'S ALGORITHM"
	14	Apr 19	22.2, 24.3	—	DFS; BFS; Dijkstra
	15	Apr 22	Ch. 6	—	Heaps; Heap sort; Priority queues
Week 5		Apr 24	—	HW4	Cancelled by Administration | Video homework: Lecture 8 "MINIMUM SPANNING TREES"
		Apr 25 (X-hr)	—	—	**[Quiz 1, in class]**
	16	Apr 26	—	—	Heap sort; Correctness of Dijkstra
	17	Apr 29	23.2, 24.1	—	Prim MST; Bellman-Ford
Week 6	18	May 1	Ch. 25	HW5	Dynamic programming: weighted interval selection; Floyd-Warshall
	19	May 2 (X-hr)	15.2, 15.3	—	Matrix chain product
	20	May 3	15.4	—	Longest common subsequence (LCS)
	21	May 6	7.1 – 7.3	—	Randomization; Quicksort and Selection **[Evening Midterm #2, 5:00–7:00 in LSC 200]**
Week 7	22	May 8	9.2	HW6	Conditional expectation; Analysis of Selection
	23	May 9 (X-hr)	7.4	—	Linearity of expectation; Analysis of Quicksort
	24	May 10	—	—	Min cut; Karger's algorithm
	25	May 13	17.1--17.3	—	Amortized analysis: multi-pop stacks, binary counters
Week 8	26	May 15	19.1--19.3	HW7	Fibonacci heaps (slides)
		May 16 (X-hr)	—	—	**[Quiz 2, in class]**
	27	May 17	19.4, 21.1	—	Fibonacci heaps (continued); Union-find; Path compression
	28		21.2-		

		May 20	-21.4	—	Analysis of path compression
Week 9	29	May 22	—		Max flow; Ford-Fulkerson
		May 23 (X-hr)	—	—	Not used
	30	May 24	—	HW8	Analysis of Ford-Fulkerson; Edmonds-Karp
Week 10	31	May 27	—	—	Memorial Day
		May 29	—	—	Review and discussion of unresolved Homework problems
		Deadline Jun 3			**Take-home 48-hour final exam, due at 5:00pm sharp The final exam website is now closed.**

About the Exams

Quizzes will be held in class. They will be closed-book and closed-notes. Students must not consult any sources at all when working on a quiz.

Evening Midterms will be held from 5:00 to 7:00 p.m. on the days and at the locations marked in the above schedule. These will be open book and open notes. A student may consult the official textbook, any materials handed out in class, his or her *own* notes, and his or her *own* graded homework and previous exams/quizzes. No other sources may be consulted. Pay attention to the honor code.

The Final Exam will be available on this website (login required) on the last day of classes. It will be a take-home exam and must be submitted within 48 hours of downloading (very specific instructions will be included in the exam). This exam will be open book and open notes. A student may consult the official textbook, any materials handed out in class, his or her *own* notes, and his or her *own* graded homework and previous exams/quizzes. No other sources may be consulted. Pay attention to the honor code.

Grades Database

If you are a registered student, you may verify your grades as entered in our database using the form below.

Your name, without initials or suffixes:

Your CS 31 password:

Check scores
