Introduction to Analysis of Algorithms

Course Number: CMPS 102
Time: T, Th, 1:30-3:05pm
Location: Media Theater M110

Prof. Abhradeep Guha Thakurta
Email: aguhatha@ucsc.edu
Class webpage: https://canvas.ucsc.edu/courses/10809
Office Location: Engineering 2, 339B
Office Hours: 3:15-5:15pm on Tuesdays, or by appointment

Staff for the class: Kuan-Sung Huang kuhuang@ucsc.edu, Andrei Ignat andrei@ucsc.edu, Joe Matzeika jmazeika@soe.ucsc.edu, and TBD tbd@ucsc.edu.

Course overview: This is a "theory" course. This means that there is no programming. On the other hand, there is a lot of proof writing and the course is homework-heavy. It is required that the homework submissions must be typed in and submitted in electronic format. You are strongly encouraged to typeset your homework using LATEX, but you can use MS Word or any other word-processing software too, but the submission should be in .pdf form.

Prerequisites: All students must have successfully completed CMPS 101. Transfer students must have credit for this course approved by the CIS/CE board office.

Text book (required): *Algorithm Design* by Klienberg and Tardos.

Materials covered: We will cover Chapters 1, 2, 5, 4, 6, 7 of the textbook (in that order). If time permits, we will also cover some of Chapter 8.

- **Chapter 1:** Introduction to algorithm analysis with a few representative problems, focusing on the stable marriage problem.
- **Chapter 2 (brief overview):** Computational tractability, and asymptotic order of growth.
- **Chapter 5, Divide and Conquer:** Finding recurrence relations, merge sort algorithm, counting inversions, finding closest pair of points, integer and matrix multiplication, and selection in linear time.
- **Chapter 4, Greedy Algorithms:** Three style of arguments: i) Greedy stays ahead (with interval scheduling as a representative problem), ii) Exchange argument (with minimizing lateness and Kruskal's algorithm as representative problems) and iv) Others (with Dijkstra, minimum spanning tree and coin changing as representative problems).

- **Chapter 6, Dynamic Programming:** Focus on deriving the optimal substructure, with the following example problems: Fibonacci sequence, weighted interval scheduling, segmented least squares, sequence alignment, and knapsack and Bellman-Ford algorithm.
- **Chapter 7, Network Flow:** Max-flow and min-cut duality theorem, Ford-Fulkerson algorithm, bipartite matching, disjoint paths in directed and undirected graphs, survey design and project selection problems.
- **Chapter 8, Computational Intractability and NP-completeness:** Polynomial-time reduction (e.g., using gadgets), definitions of the complexity classes P and NP, NP-completeness and circuit satisfiability.

Course work: You will have 4 written assignments, an in-class midterm, and a final exam. Following is the distribution of grade across these modules.

Module	Weightage
Homeworks	30%
Midterm	30%
Final Exam	40%

Note: I will give an incomplete grade only if there has been a medical/family emergency and you have been doing at least average work.

Homeworks: There will be bi-weekly assignments, due on the date mentioned at the top of the homework. All submissions are due on *C*anvas. Late homework will generally not be accepted. If there are extenuating circumstances, you should make arrangements at least 48 hours in advance with the instructor. Only serious excuses will be considered in cases where prior arrangements were not made.

Optional Problems: Some homework assignments will include optional problems, marked by $*$. Later, if you ask me for a recommendation or express an interest in working on a research project with me, I will definitely check how well you did on the optional problems.

Exams: The mid-term exam is scheduled on *February 12th, 2018, in class*, and the final exam is scheduled on *TBD from TBD (Pacific time) in Media Theater 110*. There are no scheduled make-up exams. A student who will miss an exam must inform the instructor prior to the start of the exam and must provide written documentation of an excuse meeting university policies.

Collaboration and Honesty Policy: Collaboration on homework problems is permitted, but not encouraged. You are allowed to collaborate with *at most two students enrolled in the class.* You must mention the name of your collaborators clearly on the first page of your submission. Even if you collaborate, you are *expected to write and submit your own solution independent of others*, and your collaboration should be restricted to discussions only. Also, you should be able to explain your solution verbally to the course staff if required to do so. *Collaborating with any one not enrolled in the class, or taking help from any online resources for the homework problems is strictly forbidden.*

The Computer Science Department of UCSC has a zero tolerance policy for any incident of academic dishonesty. If cheating occurs, consequences within the context of the course may range from getting zero on a particular assignment, to failing the course. In addition, every case of academic dishonesty will be referred to the student's college Provost, who sets in motion an official disciplinary process. Cheating in any part of the course may lead to failing the course and suspension or dismissal from the university.

Note: The instructor(s) may, at his/her/their discretion, change any part of the course before or during the term, including assignments, grade breakdowns, due dates, and schedule. Such changes will be communicated to students via the course web site. This web site should be checked regularly and frequently for such changes and announcements.

Disability Statement to Students in Class

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access to this course, please submit your Accommodation Authorization Letter" from the Disability Resource Center (DRC) to me privately during my office hours or by appointment, as soon as possible in the academic quarter, preferably within 1 week. I also am open to and want to encourage you to discuss with me ways in which I/we can ensure your full participation in this course. If you have not already done so, I encourage you to learn more about the many services offered by the DRC. You can visit their website (`http://drc.ucsc.edu/index.html`), make an appointment, and meet in-person with a DRC staff member. The phone number is `831-459-2089` or email `drc@ucsc.edu`.