

CS 561 Class Syllabus

Course Web Page

Contact Info for Instructor and TA, office hours, assignments, tests, and general information is all on the course web page.

Course Description

The advanced study of data structures and algorithms and the mathematics needed to analyze their time and space complexity.

Text:

Our text is **Introduction to Algorithms, third edition** by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Another good reference is **Algorithm Design** by Kleinberg and Tardos

Prerequisites

CS361/362 or an equivalent undergraduate algorithms class is a prerequisite for this class. You should be familiar with the following topics: asymptotic notation; recurrence relations and simple techniques for solving recurrences; proofs and basic proof techniques such as induction; basic probability; basic logic; basic graph theory; and algorithms and data structures as covered in an undergraduate class. If you have taken and done well in an undergraduate class that uses our required textbook, or the textbook "Algorithm Design" by Kleinberg and Tardos, then you should be ok. If not, then you should take CS361 and CS362 (or equivalent) prior to taking this class.

Assignments:

- Assignments are due at the **beginning** of class on the due date. Assignment deadlines are strict: late homeworks will automatically receive a grade of zero, without *prior* approval. Prior approval is generally given only in the case of a medical problem or family emergency.
- Group collaboration is encouraged on the homeworks, provided that you write at the top of your homework the names of all the other students that you collaborated with. Note that although collaboration is encouraged, **the solutions must always be written up individually**. You should not look at or copy another student's solution **and should not copy**

solutions from the Internet. In particular, when *writing up* your solutions, you should not be looking at any other solution. A rule of thumb here is the "Star Trek" Rule. After working with your group, go watch a half hour of Star Trek on TV, or your favorite mindless (sorry Trekkies) but fun TV show, before you write up the solutions. You may consult other textbooks or the Internet as you would another student (i.e. cite your source and use the "Star Trek" rule).

Remember **Copying solutions from another student or from the Internet is cheating.** In case a student presents a solution that is essentially identical in whole or in part to solutions from another student or other source, that student will receive a 0 on the assignment, may be reported to the University Administration and may not be permitted to continue in the class.

- Put pages of hw **in order.** We don't care what order you solve the hw in, but before you turn it in, you must put the problems in order (this makes grading much easier)
- Homeworks and exams will be submitted and graded online via GradeScope. Stay tuned for instructions.
- Regrades: if you feel a mistake was made grading your hw, please let the TA know about it (if you still feel there is a problem, then please talk to Prof. Saia). Please ask for a regrade within one week of receiving the graded assignment.

Notes on Grading Hws

Your hws and test answers should have the following properties. We will be looking for these when we grade:

- **Clarity:** Make sure all of your work and answers are clearly legible and well separated from other problems. If we can't read it, then we can't grade it. Likewise, if we can't immediately find all of the relevant work for a problem, then we will be more likely to grade only what we see at first.
- **Completeness:** Full credit for all problems is based on both sufficient intermediate work (the lack of which often produces a 'justify' comment) and the final answer. There are many ways of solving most problems, and we need to understand exactly how YOU chose to solve each problem. Here is a good rule of thumb for deciding how much detail is sufficient: if you were to present your solution to the class and everyone understood the steps, then you can assume it is sufficient.
- **Succinctness:** The work and solutions which you hand-in should be long enough to convey exactly why the answer you get is correct, yet short enough to be easily digestible by someone with a basic knowledge of this material. If you find yourself writing more than half a page of dense algebra, or using more than a page or two to writeup your solution, you're probably on the wrong track. Don't turn in pages with scratch work or multiple answers - if you need

to do scratch work, do it on separate scratch paper. Clearly indicate your final answer (circle, box, underline, etc.). Note: It's usually best to rewrite your solution to a problem before you hand it in. If you do this, you'll find you can usually make the solution much more succinct, and you will learn more for next time.

Topics

Topics will likely include:

- Probability and Expectation: linearity of expectation, birthday paradox, coupon collector's problem. Applications: Hashing, Quicksort, Bucketsort, Skip Lists, maybe Rabin-Karp Algorithm? (fingerprinting) (2.5 weeks, Chapter 5)
- Divide and Conquer: Recurrence Relations, Annihilators, Recursion and Strong Induction (2 weeks, Chapter 3 and 4 and notes; Chapters 6 and 12)
- Dynamic Programming: String Alignment, Matrix Multiplication, Longest Common Subsequence (1.5 weeks, Chapter 15)
- Greedy Algorithms (1 week, Chapter 16)
- Amortized Analysis: Dynamic Tables and Union Find (1 week, Chapter 17)
- Graph Algorithms with Proofs: Minimum Spanning Tree, Single-Source Shortest Path, All-Pairs Shortest Paths (2 weeks, Chapters 22,23,24,25)
- Linear Programming and Duality (1 weeks, Chapter 29)
- Advanced Topic from: Gradient Descent, Network Flow, Convex Optimization, Fast Fourier Transform, Shor's Algorithm (~2 weeks (time permitting), Chapter 30)
- NP-Hardness and Approximation Algorithms (2 weeks, notes)

Course Assessment

Approximate weighting:

- Participation, via Piazza, and Zoom lectures and office hours (preferably with camera on): 10%
- Homework and Quizzes, 50%
- Midterm, 20%
- Final, 20%

Grading Policies

"No deals, Mr. Bond.": Grades assigned at the end of the semester are final. You will not be able to do any additional projects, papers, etc. to change your grade.