CS 535 — Analysis of Algorithms
Syllabus (final except for correcting typos)

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1 Course Summary

Welcome to CS 535 Analysis of Algorithms. This is a theoretical computer science graduate course. We will learn to design more efficient algorithms by being able to rigorously analyze their time and space requirements. Some material overlaps with CS 430 (Introduction to Algorithms), but our treatment will be more abstract and mathematically correct.

2 Textbook

The required textbook is *Introduction to Algorithms* (third edition) by Cormen, Leiserson, Rivest, and Stein, MIT Press, 2009. ISBN-10: 0262033844 — ISBN-13: 978-0262033848 It should be available at the bookstore, and the library has a copy on reserve (available only inside the building). Other editions of the book will be fine for learning, but there may be differences in the assigned exercises and problems.

Our library has on-line access to the third edition of this book:
from `http://http://www.gl.iit.edu/database/database.htm` look for Books 24x7, login and search for "Cormen".

A reference (optional) book is *Computers and Intractability* by M. R. Garey and D. S. Johnson, For a concise but hard treatment of the subject, I recommend the books "Data Structures and Network Algorithms", by Tarjan, and "The Design and Analysis of Algorithms" by Kozen.

3 Prerequisites

CS 430 is listed as prerequisite. In particular, the following topics are assumed and can appear on homeworks and exams:

1. Mathematical Background (Appendices A, B, C.1, D)
2. Pseudocode, Notations, and Mergesort (Chapters 1 and 2)
3. Growth of Functions (Chapter 3) and Recurrence including the master method (Chapter 4 except 4.6)

4. Heap, Heapsort (Chapter 6) and Quicksort (Chapter 7 except 7.4)
5. Elementary Data Structures (stacks, queues, linked lists, trees - Chapter 10)
6. Binary Search Trees (Chapter 12) and some balanced version of search trees
7. Greedy Algorithms (Chapter 16)
8. Dynamic Programming (Chapter 15)
9. Graph Algorithms: BFS, DFS (Chapter 22 except 22.5), Minimum Spanning Trees (Chapter 23), Shortest Paths: Dijkstra's algorithm (Subchapter 24.3) and the Floyd-Warshall algorithm (Subchapter 25.2)

Familiarity (or a desire and ability to learn) mathematical proofs is also necessary.

4 Getting Help

Office hours are Monday 11:00 - 12:00 and Wednesday 12-1, in room SB 228D, or by appointment. For an appointment send e-mail to `calinescu@iit.edu`. You can also call me at 312-567-5273. Please spend a little time trying to understand yourself a homework problem before asking for help.

The handouts (including this syllabus and homeworks) will be available at `http:// www.cs.iit.edu/~cs535`. Partial homework solutions will be posted on blackboard. Notes will be posted on either of these two platforms.

The TAs for this class are Xiaolang Wang and Mohit Hota. Xiaolang (xwang122@hawk.iit.edu) has office hours Thursdays 12-2, in SB 004 (basement of Stuart Building), phone 312-567-5149, and Fridays 7-8 AM online only. Mohit (mhota@hawk.iit.edu) has office hours Fridays 11-1, in SB 004 (basement of Stuart Building), phone 312-567-5149.

Students are expected to check email every week day of the semester. Clarifications on assignments or other important announcements might be sent by email - and will also be posted on the web page.

5 Grading

The grading allocation is given below.

Homework	54%
Midterm	16%
Final exam	30%

The midterm will be on October 18, in class. The final exam will be held as scheduled by the Registar's office, during the week December 6-11.

Six homeworks will be assigned. You can discuss the problems with each other, but must write the solutions individually. Seek help from me or the TA if you are having difficulties with the

homework. Except for extraordinary circumstances, homeworks will be accepted at latest one week late. The penalty for late submission is 10% for one lecture late and 20% for one week late.

The midterm and the final exam are closed books, closed notes, no electronic devices - altough I will likely provide some of my handouts to you during the exam. At least one week in advance, I will hand in and post an additional list of candidate problems for each exam. The midterm may contain variants (same solution ideas) of the problems from the first three homeworks and this additional list. The final will follow the same pattern (with homeworks 4-6, and another additional list of candidate problems). All exams will be proctored. The student in the PhD section will take an additional exam, counting for 12% of their grade, while the homework weight will decrease to 42%.

The final grades will be assigned by comparison with the students who took this class in seven previous semesters. There were in total 101 A's, 206 B's, 21 C's, and one E. As a guideline, about 78% will be needed for an A, and 58% for a B (but I might modify these thresholds to ensure fairness).

Standard departmental policy regarding academic (dis)honesty applies. This includes
`https://www.iit.edu/student-affairs/student-handbook/fine-print/code-academic-honesty`

In particular, homework solutions copied from the Internet are not allowed. If I have evidence that the work submitted is not your own, I will report to `academichonesty@iit.edu` and make a decision in consultation with the Designated Dean for Academic Honesty. In the past, this likely meant zero points on the specific problem and a record in the Dean's database, for the first occurence, Whenever in doubt, ask first if some action is allowed or not. Moreover, the students must submit the signed Academic Integrity Pledge together with the first homework.

Students in Sections 01 and 02 must submit hard coppies of their homeworks AND upload a scan on Blackboard. Electronic devices must be off during the lecture.

6 Topics to be covered

1. Lower Bounds for sorting (Subchapters 8.1, 8.2), Medians (Subchapter 9.3)
2. Splay Trees (not in the textbook)
3. Advanced Data Structures (Chapters 17, 19, 21)
4. Graph Algorithms (the parts of chapters 22, 23, 24, 25, 26 not listed as prerequisite): Strongly Connected Components, Shortest Paths with negative weights, Network Flows
5. NP-Completeness (Chapter 34) and (if time permits) Approximation Algorithms (Chapter 35)
6. possibly Dynamic Programming (Chapter 15, even it is a prerequisite)
7. If time permits: Pattern Matching (Chapter 32, KMP – 32.4) and/or Geometric Algorithms (Chapter 33)

7 Administrative Matters

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources and make an appointment to speak with me [the instructor] as soon as possible. The Center for Disability Resources (CDR) is located in Life Sciences Room 218, telephone 312-567-5744 or `disabilities@iit.edu`.

Illinois Techs Sexual Harassment and Discrimination Information:

Illinois Tech prohibits all sexual harassment, sexual misconduct, and gender discrimination by any member of our community. This includes harassment among students, staff, or faculty. Sexual harassment of a student by a faculty member or sexual harassment of an employee by a supervisor is particularly serious. Such conduct may easily create an intimidating, hostile, or offensive environment.

Illinois Tech encourages anyone experiencing sexual harassment or sexual misconduct to speak with the Office of Title IX Compliance for information on support options and the resolution process.

You can report sexual harassment electronically at `iit.edu/incidentreport`, which may be completed anonymously. You may additionally report by contacting the Title IX Coordinator, Virginia Foster at `foster@iit.edu` or the Deputy Title IX Coordinator at `eespeland@iit.edu`.

For confidential support, you may reach Illinois Techs Confidential Advisor at (773) 907-1062. You can also contact a licensed practitioner in Illinois Techs Student Health and Wellness Center at verb+student.health@iit.edu+ or (312)567-7550

For a comprehensive list of resources regarding counseling services, medical assistance, legal assistance and visa and immigration services, you can visit the Office of Title IX Compliance website at `https://www.iit.edu/title-ix/resources`.