1 Course Summary

Welcome to CS 430 Introduction to Algorithms. In this course we study basic techniques for algorithm design. We also use basic analysis methodology of the complexity of algorithms, with worst case and average case bounds on time and space usage. For this, we use the “Big Oh”, “Theta”, and “Omega” notation.

We start with data structures, and their application for efficient algorithmic solutions. Then we concentrate on efficient sorting techniques, followed by general techniques such as Greedy, Divide-and-Conquer, and Dynamic Programming. We continue with basic graph algorithms, followed by specific examples from string matching and computational geometry.

We will also discuss a practical case study, including identifying the situations when the theory of algorithms is necessary, and the search for an appropriate algorithm.

Finally, we look at the notion of NP-Completeness as a defining characteristic of the hardness of a problem.

All CS 403 - 01 students are expected to attend a recitation session or lab Fridays 11:25-12:15.

2 Textbook

The required textbook is Introduction to Algorithms (third edition) by Cormen, Leiserson, Rivest, and Stein, MIT Press, 2009. It should be available at the bookstore and on the web. The first and second edition would be O.K. for learning, but not for assigned homework.


3 Prerequisites

CS 330 and CS 331, or CS 401. To be precise, I assume familiarity with:

1. Elementary data structures: stacks, queues, arrays, linked lists and trees. Recursive algorithms.

2. Discrete structures: sets, trees, directed and undirected graphs.
3. From calculus: functions, polynomials, matrices, and logarithms.

4. "Big Oh", Ω and Θ notions regarding growth of functions.

4 Getting Help

Office hours are Monday 2-3 PM and Wednesday 1-2 PM, in room SB 228D (312-567-5273), or by appointment. I will also be available up to 15 minutes after the class, in the class. For an appointment send email to calinescu@iit.edu. You can also call me at 312-567-5273.

The TA for this class is Taeho Jung, who will guide you during the recitation hours Fridays, 11:25-12:15. Taeho (tjung@hawk.iit.edu) has office hours Tuesdays and Thursdays 1-3PM, in SB 019B (312-567-5869).

Handouts (including this syllabus, homeworks, quizzes) will be available at http://www.cs.iit.edu/~cs430. Partial homework solutions will be posted on blackboard. Students are expected to read their email (the “official” email address we have on their file) every weekday. Announcements will also be posted on the web page.

5 Grading

The grading allocation is given below.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homeworks</td>
<td>36%</td>
</tr>
<tr>
<td>Project</td>
<td>15%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>9%</td>
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<tr>
<td>Midterm</td>
<td>15%</td>
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<tr>
<td>Final Exam</td>
<td>25%</td>
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Students in the TV or Internet sections (other than Main-Campus Internet), will get an extra homework instead of quizzes.

The midterm and the final exams are closed books and closed notes, and will contain, among other problems, modified homework problems. The midterm will be on Oct. 19, in class. The final exam will be held as scheduled by the Registrar’s office, during the week Dec. 5-10. Makeup exams will be only for emergency situations.

There will be up to seven (possibly, short unannounced) individual quizzes, during either class or recitation. Lowest quiz score will be dropped (so don’t ask for excuses, except for emergencies). Six homeworks will be assigned, and are to be solved individually. Seek help from me if you are having any difficulties with the homework. Many homeworks and exam problems will ask for designing an algorithm to solve a typical problem. Unless specified otherwise in the description of the problem, the problem includes arguing correctness, and giving and justifying good upper bounds on the running time of the algorithm. Each of these two reasonings (for correctness and running time) will be worth 10% of the grade on that particular problem.

The penalty for late assignments is: 10% one lecture late and 20% one week late. No assignment will be accepted if more than one week late.

A composite score will be computed according to the scale above. This score will be adjusted such that your final score percentage is at most 10% more than your composite exam score. For
example, with 67% on exams, and 91% on homework, project, quizzes, the final score will be 77%, which is lower than the weighted average. The official grade will follow the following scale, which I might adjust by + or - 2% to ensure consistency with the previous four semesters I offered the class (in total, there were circa 21 A’s, 48 B’s 43 C’s 14 D’s and 7 F’s). Be aware that graduate students cannot get a D and instead will get an E/F. There is no prescribed curve and you are not competing with each other.

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90 - 100%</td>
<td>A</td>
</tr>
<tr>
<td>80 - 89%</td>
<td>B</td>
</tr>
<tr>
<td>70 - 79%</td>
<td>C</td>
</tr>
<tr>
<td>60 - 69%</td>
<td>D</td>
</tr>
<tr>
<td>0 - 59%</td>
<td>E</td>
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Standard departmental policy regarding academic (dis)honesty applies. This includes https://web.iit.edu/student-affairs/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 assign a score of zero on that particular assignment at the first occurrence. This happened several times in the last five years. It may also be reported to academic.honesty@iit.edu. The second occurrence will be reported and an appropriate sanction will be applied after consultation with the office of the Associate Provost for Academic Affairs. Whenever in doubt, ask first if some action is allowed or not. Moreover, the students must submit the signed College of Science Academic Integrity Pledge together with the first homework. The project(s) will probably be a team effort, and guidelines regarding use of other resources will be included in the description of the project.

Those taking notes on laptops (why else bring them in): sit starting with the last row. Turn off all other electronic devices. 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.

6 Topics to be covered

1. Algorithm Analysis and Mathematical Background (Chapters 2, 3)
2. Heaps, Heapsort (Chapter 6)
3. Divide-and-Conquer method and Quicksort, Medians (Chapters 4, 7, 9.2)
4. Hash Tables (Chapter 11)
5. Binary Search and Red-Black Trees (Chapters 12, 13)
6. Data Structure for Disjoint Sets (Chapter 21)
7. The Greedy Method (Chapter 16)
8. Dynamic Programming (Chapter 15)
9. Elementary Graph Algorithms (Chapter 22)
10. Minimum Spanning Trees (Chapter 23)
11. Shortest Paths (Chapters 24 and 25)
12. Pattern Matching (Chapter 32, time permitting)
13. Convex Hulls (Chapter 33, time permitting)
14. NP-Completeness (Chapter 34)