CS 530 — Theory of Computation Syllabus (version 1.1)

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1 Course Summary

Welcome to CS 530 Theory of Computation. This is a theoretical computer science graduate course. The main thrust is to identify the limitations of the computers through formalizing computation (by introducing several models including Turing Machines) and applying mathematical techniques to the formal models obtained. There is significant overlap with CS 532 (Formal Languages). I recommend you do not take both courses.

Further study of Complexity Theory shows that a large set of practical problems, while solvable in exponential time, seem to not have efficient algorithms. This part of CS 530 can be seen as a counterpart to CS 535 - Analysis of Algorithms.

Complexity Theory can also be applied to show that certain problems do not allow "parallel" algorithms. But sometimes we are looking for hard problems! When designing a cryptographic code, we would like that breaking the code to be hard. We may investigate this subject towards the end of the semester.

2 Textbook

The required textbook is Introduction to Theory of Computation by Michael Sipser, third edition. Other editions of the book will be fine for learning, and the library has a copy on reserve (available only inside the building).


3 Lecture Format

I will use notes from the textbook (with minor adjustments, and posted) and prove the theorems, as well as provide examples. The textbook has different, very good examples.
Best is if you follow and ask questions for clarifications during the class. Taking detailed notes does not help much.

4 Prerequisites

CS 430 is listed as prerequisite. Familiarity (or a desire and ability to learn) mathematical proofs is also necessary.

5 Getting Help

Office hours are Tuesday 2-3 and Thursday 3-4, 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 TAs for the class are Xiaolang Wang (xwang122@hawk.iit.edu) Shuichi Maruyama (smaruyam@hawk.iit.edu), and Sameer Gadne (sgadne@hawk.iit.edu). Xiaolang and Shuichi have office hours in room SB 004 (basement of Stuart Building), phone 312-567-5149. Xiaolang has office hours Friday 1-3, and Shuichi has office hours Monday and Wednesday, both 12:45-1:45. Sameer has office hours Wednesday, 3:30-5:30, in front of the offices SB 229 or 228.

The handouts (including this syllabus and homeworks) are available at http://www.cs.iit.edu/~cs530. Partial solutions will be posted on blackboard. 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.

6 Grading

The grading allocation is given below.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>50%</td>
</tr>
<tr>
<td>Midterm</td>
<td>18%</td>
</tr>
<tr>
<td>Final exam</td>
<td>32%</td>
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The midterm will be on Tuesday March 6, in class. The final exam will be held as scheduled by the registrar, during the exam week April 30 - May 5. The exact date should be known mid-March. Five homeworks will be assigned. You can discuss the problems with each other, but must write the solutions individually. Seek help from me if you are having difficulties with the homework. Except for extraordinary circumstances, homeworks will be accepted one lecture late with 10% penalty, and at latest one week late, with a 20% penalty. Students in sections 01 and 02 are expected to turn in hard copies.

The midterm and the final exam are closed books and the only notes allowed will be unmodified versions of the notes distributed in class. Both exams will contain homework problems, maybe modified slightly (the ideas for solving would be easy to adopt).
PhD students who want to use the result of this class for passing the qualifier exam must register for Section 02. They will get an extra assignment: read and present in class a research paper (per team). Their HW grade will only count for 40% of the grade, and this assignment will count for 10% of the grade.

The final grades will be assigned by comparison to the students who took this class with me in previous semesters. As a guideline, about 78% will be needed for an A, and 56% for a B. The totals over eight previous semesters are 115 A’s, 251 B’s, 18C, and 2F.

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. It may also be reported to academichonesty@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. This happened once last time I was a CS 530 instructor. 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.

Electronic devices must be off during the class. 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.

7 Topics to be covered

1. Finite Automata and Regular Languages (chapter 1)
2. Context-Free Languages (chapter 2)
3. Turing Machines and Algorithms (chapter 3)
4. Decidability and Reducibility (chapters 4 and 5)
5. Time Complexity and NP-Completeness (chapter 7)
6. Space Complexity (chapter 8, time permitting)
7. Advanced topics in complexity theory (selection of topics), Parallel Computation and Cryptography (chapters 10.5 and 10.6)