CS 530 — Theory of Computation Syllabus
version 1.11

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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.

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, any edition. The library has a copy on reserve (available only inside the building).

Reference (optional) books are *Computers and Intractability* by M. R. Garey and D. S. Johnson, and the more hard-core *Introduction to Automata Theory, Languages, and Computation* by J. E. Hopcroft, R. Motwani, and J. D. Ullman, and *Computational Complexity* by C. H. Papadimitriou. An important web reference is `https://www.csc.kth.se/tcs/compendium/` .

3 Lecture Format

I will use notes from the textbook (with minor adjustments, and posted) and used the board to 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 11-12 and Thursday 12-1 in room SB 228D, or by appointment. For the first two weeks, I will be available for these times in Blackboard Collaborate. 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 TA for the class is TBD.

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.

Homework	50%
Midterm	18%
Final exam	32%

The midterm will be on Thursday March 3, during class. The final exam will be held as scheduled by the registrar, during the exam week May 2 - 7. 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. The instructor reserves the right to limit collaboration in respect to homeworks, up to requiring individual work. 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 coppies as well as submit on Blackboard.

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 may 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 exam. Their HW grade will only count for 40% of the grade, and this extra exam 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 77% will be needed for an A, and 55% for a B. The totals over ten previous semesters are 148 A's, 389 B's, 23C, and 2F.

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. Please always write with blue or black pens on plain white paper (or type black on white background), and always submit in the pdf format. Electronic devices must be off in the classroom.

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.

8 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)