

CS353 - Theory of Computation (Fall 2018)

Logistics:

TTh 11:00-12:30, GDC 6.202

Unique Number: 51605

Course web page: <http://www.cs.utexas.edu/~diz/353>

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Who should take this? Students interested in the science of computation, who like mathematics and proofs, and who like a challenge. This course is excellent preparation for graduate school.

Text: Michael Sipser, *Introduction to the Theory of Computation*

Course Overview: This undergraduate course develops a theoretical framework to understand computation. Perhaps the most important concept in the class is that there are limits to computation. Some languages are uncomputable; others are "complete" for certain hard classes, such as NP. Sometimes these limitations prove useful, as in the case of cryptography. We will also explore tradeoffs and relationships between different computational resources, such as time and space.

Prerequisites: CS 331 or 331H. Naturally, you also need the prerequisites and corequisites for CS 331, including Discrete Math (CS 311 or 311H), Probability (SDS 321 or M 362K), and Linear Algebra (SDS 329C, Math 340L, or Math 341).

Grading:

25%: Midterm

45%: Final Exam

25%: Homework

5%: Participation

Exams: The midterm will be held in class on Thursday, October 18. The final exam will be held in a room to be determined on Saturday, December 15 from 7-10pm. No make-up exams will be given, so plan accordingly. You may bring a single, 8.5x11 inch, handwritten sheet of paper (you may use both sides). No calculators are allowed (they won't be necessary).

Participation and Attendance: Your participation grade is based on the quality and quantity of your participation. While attendance is not required, poor attendance will be reflected in your participation grade.

Class Schedule:

| Date | Topic |
|--------|---|
| Aug 30 | Introduction, Finite Automata |
| Sep 4 | Nondeterminism |
| Sep 6 | Nonregular Languages |
| Sep 11 | Turing Machines |
| Sep 13 | Decidable Languages |
| Sep 18 | Diagonalization, Undecidability |
| Sep 20 | Reductions, More Undecidable Languages |
| Sep 25 | Mapping Reductions |
| Sep 27 | Time Complexity, the class P |
| Oct 2 | Nondeterminism, the Class NP |
| Oct 4 | Polynomial-Time Reductions, NP-Completeness |
| Oct 9 | SAT is NP-Complete |
| Oct 11 | Basic NP-Complete Problems |
| Oct 16 | Review |
| Oct 18 | Midterm |
| Oct 23 | More NP-Complete Problems |
| Oct 25 | Space Complexity, the classes L, NL, PSPACE |
| Oct 30 | Savitch's Theorem, PSPACE-Completeness |
| Nov 1 | Games, PSPACE-Complete Problems |
| Nov 6 | NL = coNL |
| Nov 8 | Hierarchy Theorems |
| Nov 13 | Circuit Complexity |
| Nov 15 | Parallel Computation |
| Nov 20 | Approximation and Randomization |
| Nov 27 | Randomized Computation |
| Nov 29 | Cryptography |
| Dec 4 | Interactive Proofs and Zero Knowledge |
| Dec 6 | Class Summary, Review |

Homework: Most weeks a problem set will be assigned.

Collaboration policy: While you should first think about the problems on your own, you are encouraged to discuss the problems with your classmates. Please limit your collaborations on any particular homework to at most three other students. Discussion of homework problems may include brainstorming and verbally walking through possible solutions, but should not include one person telling the others how to solve the problem. In addition, each person must write up their solutions independently, and these write-ups should not be checked against each other or passed around or emailed. You must acknowledge any collaboration by writing your collaborators' names on the front page of the assignment. You don't lose points by having collaborators.

Citation policy: Try to solve the problems without reading any published literature or websites, besides the class text and links off of the class web page. If, however, you do use a solution or part of a solution that you found in the literature or on the web, you must cite it. Furthermore, you must write up the solution in your own words. You will get at most half credit for solutions found in the literature or on the web.

Late policy: No late homeworks will be accepted.

Laptops/Phones: The use of laptops and mobile devices is generally prohibited; however, I will allow use of tablets if you sit in the first row and only use them for class-related purposes. Other exceptions may be made in unusual circumstances. All phones must be silenced.

Students with Disabilities: Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Office of the Dean of Students at 471-6259 (voice) or 471-4641 (TTY for users who are deaf or hard of hearing) as soon as possible to request an official letter outlining authorized accommodations.

Last updated August 29, 2018.