CS4510 Automata & Complexity

Fall 2026

Instructor:	Dr. Zvi Galil
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Administrative Information:

- In-person lectures
- Graded Assignments, such as homeworks and exams, will be turned in through Gradescope
- Ask questions and answer questions on Piazza!
- Canvas is the central hub of communication and information for this course. Links to Piazza, video lectures, and more can be found there.
- The main textbook will be "Introduction to the Theory of Computation" by Michael Sipser (3rd edition).

Course Description:

- Design and manipulate deterministic and nondeterministic finite automata and regular expressions, convert between them, and use them to prove that a language is regular
- Design and manipulate pushdown automata and context-free grammars, convert between them, and use them to prove that a language is context-free
- Use the appropriate pumping lemma to prove that a language is not regular/context free
- Design Turing machines and use them to prove that a language is decidable
- Use reductions from undecidable problems to show that a language is undecidable
- Use reductions from NP-complete problems to show that a problem is NP-complete
- Analyze the time and space complexity of a decision problem

Course Structure:

This is a synchronous in-person course. All of the lectures will be held in the assigned classroom and will not be recorded. The homeworks and exams will be released and due on the dates listed on the schedule. The exams will be take-home and students will have at least 24 hours to complete them. Prior to each exam there will be a review session in class. We feel that these sessions will be a valuable opportunity to get a deeper understanding of the material, to ask for clarifications, etc, and we encourage you to take advantage of them. We have pre-recorded lecture videos in the media gallery on Canvas from a previous semester. These videos are not perfect. There are many minor mistakes which have been corrected in the mistakes.pdf file on Canvas. This semester will follow a similar format to the previous semester, but it may not follow exactly. These videos can be used as a reference but should not be used as a replacement to in-person lecture.

Pre/Corequisites: The official prerequisites for this course are a course in each of algorithms, combinatorics, and probability/statistics. That being said, the absolute minimum baseline of knowledge required for this course is CS2050 or a similar discrete mathematics course. This is a math course. You will be introduced to the fundamental proofs of automata and complexity theory, and you will be expected to write your own proofs on the homeworks and exams.

Section X: CS4510-X is intended for students with a strong mathematical background who want a deeper dive into the field of theoretical computer science. Students in CS4510-X will attend the same lectures as the normal A section. However, the homeworks and exams will contain additional, more challenging problems that are only assigned to the X section students. Also, there will be some number (6-8) of worksheets for the X section students that will serve as an introduction to a variety of topics that will not be covered in the main class, such as primitive recursive functions, the Myhill-Nerode theorem, Rice's theorem, etc. Students must opt into the X section by emailing Head TA Kasra Sohrab. The X section will have a maximum of 15 students. Therefore, only the first 15 students to request to join will be added to the X section. After the first week of classes the section X and B rosters will be fixed and no further changes will be made. Students who join the X section will have their final grades calculated according to an alternate grading scheme.

Grading Policy:

A: Homeworks (25%), Exams (3) (15% each), Final Project (10%), Participation (20%).

X: Homeworks (20%), Exams (3) (13% each), Final Project (10%), Participation (20%), Worksheets (11%).

Your lowest homework grade will be dropped from the first 5 homeworks if and only if it is beneficial for you. Homework 6 is required for all students. For section X, we will drop your two lowest worksheet grades.

For all students, letter grades will be computed from final grades according to the following scale:

A 90%-100%

B 80%-89%

C 70%-79%

D 60%-69%

F 0%-59%

Class Participation: Participation is earned by through lecture attendance. Students are encouraged to attend all lectures; though, attending 10 lectures is required for full credit on the participation section and at least one lecture for each chapter. Each lecture is worth 2/20 towards the final participation score. If a chapter is missed, then the maximum possible participation score is reduced by 2/20. Institute approved absences do not count towards participation, since there are many chances to miss lecture without losing points, but if the number of institute approved absences is such that it would not have been possible to attend 10 classes, then reach out to the Head TA and Professor. Only lectures count towards class attendance: each class before an exam day is a review session, which is optional but encouraged.

Collaboration: Collaboration is allowed on homeworks, but anything you turn in must be your own work. You may not collaborate on exams.

Piazza Participation: Our course will make use of Piazza as a resource for asking, answering and discussing questions related to the course and course content. You can earn up to 4% extra credit on each homework by asking and answering questions on Piazza! Asking a question is worth 2% (can receive credit once per homework), and answering a question is worth 2% (can receive credit once or twice per homework), with a total cap of 4% per homework. Thus for the full bonus, each week, you can either ask one question and answer one question, or you can answer two questions.

For credit, questions must be relevant to the current assignment, not a repetition of a previously asked question, and must be about course content rather than logistics. ('What is the sun?'and 'What day is hw6 due?' would both earn no points.)

For credit, answers must be mostly correct, relevant, and detailed (one-word or even one-sentence answers may get no points.) You CAN answer a previously answered question if you are adding new information to the previous answer.

To submit your piazza participation, you MUST attach a screenshot of the relevant Piazza post to your homework submission. Your name MUST be visible in the screenshot and associated with the piazza post in question to receive credit. Answer screenshots MUST include the question they are answering. Submissions which do not follow these guidelines will not receive the bonus. The bonus will be graded on an all or nothing basis. There is no "partial bonus" if only some of the guidelines are followed.

Regrade Requests: Any regrade request should be submitted on Gradescope, with an explanation of the reason, within one week of the date the graded assessment has been returned to you. Papers submitted for regrading could be adjusted up or down. Regrades are intended for cases where the grading rubric was applied incorrectly. They are not for complaining about the rubric itself.

Late Work: Homework turned in on time will receive 3% extra credit. Homework may be turned in up to two days past the deadline.

Make-up Exams: If you have an institute approved absence, you may request a make-up exam. Please schedule in advance if possible.

Final Project:

In place of a final exam, we have a final project. You will be working in groups of 3 to 4 to make a small 8-10 minute presentation on any topic related to the course material. We will provide to you a list of suggested topics, but you may do your own, with approval.

Georgia Tech Covid Policies and Procedures: Please see here:
https://health.gatech.edu/tech-moving-forward

Academic Integrity:

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's academic honor code, please visit https://catalog.gatech.edu/policies/honor-code/ or https://catalog.gatech.edu/rules/18/

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities:

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)-894-2563 or https://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also email me as soon as possible in order to set up a time to discuss your learning needs.

Student Faculty Expectations Agreement:

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See https://catalog.gatech.edu/rules/22/ for an articulation of some basic expectations that you can have of me, and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Resources for Students:

In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you both as a student and as a person.

Academic Support

- Center for Academic Success http://success.gatech.edu
  - 1-to-1 tutoring success.gatech.edu/1-1-tutoring
  - Peer-Led Undergraduate Study (PLUS) https://sucess.gatech.edu/tutoring/plus
- OMED: Educational Services http://omed.gatecvh.edu/programs/academic-support
  - Group study sessions and tutoring programs
- Communication Center http://www.communicationcenter.gatech.edu
  - Individualized help with writing and multimedia projects
- Advising and Transition https://advising.gatech.edu
  - Study Strategies Seminar course https://advising.gatech.edu/gt2801-study-strategies-seminar

  - Academic coaching https://advising.gatech.edu/academic-coaching
  - Advising in your major https://advising.gatech.edu/

Personal Support

- The Office of the Dean of Students https://studentlife.gatech.edu/content/get-help-now (404)-894-6367, Smithgall Student Services Building 2nd floor
  - You may also request assistance at https://gatech-advocate.symplicity.com/care_report/index.php/pid152442?
- Center for Assessment, Referral and Education (CARE) http://care.gatech.edu (404)-894-3498
  - Smithgall Student Services Building 1st floor
  - Students seeking assistance from the Counseling Center or Stamps Psychiatry need to visit CARE first for a primary assessment and referral to on and off campus mental health and well-being resources
  - Students in crisis may walk in during business hours (8AM-4PM M-F) or contact the counselor on call after hours at (404)-894-2575 or (404)-894-3498.
  - Other crisis resources: https://counseling.gatech.edu/content/students-crisis
- Students Temporary Assistance and Resources (STAR) https://studentlife.gatech.edu/content/star-services
  - Can assist with interview clothing, food, and housing needs.
- Stamps Health Services https://health.gatech.edu (404)-894-1420
  - Primary care, pharmacy, women's health, psychiatry, immunization and allergy, health promotion, and nuitrition.
- OMED Educational services http://www.omed.gatech.edu
- Women's Resource Center http://www.womenscenter.gatech.edu (404)-385-0230
- LGBTQIA Resource Center http://lgbtqia.gatech.edu (404)-385-2679
- Veteran's Resource Center http://veterans.gatech.edu (404)-385-2067
- Georgia Tech Police http://www.police.gatech.edu (404)-894-2500

Statement of Inclusivity:

As a member of the Georgia Tech community, I am committed to creating a learning environment in which all of my students feel safe and included. Because we are individuals with varying needs,I am reliant on your feedback to achieve this goal. To that end,I invite you to enter into dialogue with me about the things I can stop, start, and continue doing to make my classroom an environment in which every student feels valued and can engage actively in our learning community.