COMP 590: Computational Complexity

Bulletin Description

(Comp 590 Description) This course has variable content and may be taken multiple times for credit. Different sections may be taken in the same semester. Honors version available.

General Course Info

Term:	Spring 2026
Department:	COMP
Course Number:	590
Section Number:	171
Time:	TTh, 2pm – 3:15pm
Location:	FB007
Website:	https://www.cs.unc.edu/~saba/complexity_class

Instructor Info

Name:	Saba Eskandarian
Office:	Brooks 346
Email:	saba@cs.unc.edu
Web:	https://cs.unc.edu/~saba
Office Hours:	See course website

Textbooks and Resources

We will primarily use Canvas for course announcements, sharing lecture notes, and submitting assignments. Assignments will be available on the course website linked above. If you have any questions, comments, or suggestions regarding the course organization and policies, please feel free to reach out via email. An anonymous feedback form is linked on the course website if you would like to give feedback anonymously.

We will be using the textbook Computational Complexity: A Modern Approach by Sanjeev Arora and Boaz Barak.

Course Description

Computation is a powerful tool that has reshaped human life and solved centuries-old problems. But what are its limits? Are there some technical problems that simply cannot be solved by a combination of more ingenuity and silicon? Do we live in a world where the very structure of information in the universe prohibits efficient solutions to certain computational problems?

Motivated by these questions, this course explores the theory of Computational Complexity, an area of computer science concerned with understanding how computational resources allow us to solve problems of greater and greater complexity. Picking up where COMP 455 leaves off -- the widely-known but rarely understood P versus NP problem -- we will study various classes of computational problems, focusing on the techniques used to reason about the relationships between them.

Topics covered include time and space complexity classes, circuit complexity, randomized complexity classes, interactive proofs, and hardness of approximation. Along the way, we will find that the world of computational complexity is full of surprises and unexpected results that challenge our mathematical intuitions and preconceived notions of computation, randomness, and proof.

Target Audience

This course is intended for advanced undergraduate students or beginning graduate students with an interest in theory of computation or fields that rely heavily on it, e.g., cryptography.

Prerequisites

Prerequisites for this course are COMP 283 and COMP 455, or equivalents.

COMP 311, STOR 435, and COMP 550 may also be helpful but are not required.

Goals and Key Learning Objectives

The goals of this course are threefold:

- Practice formal thinking and reasoning
- Become familiar with fundamental techniques and tools that are useful across many areas of computer science, especially those in theoretical computer science.
- Gain an understanding of important computational complexity classes and the relationships between them.

Course Requirements

Classes will primarily be lectures, although a few group problem solving sessions will be included as well. In addition to attending lectures, students will solve problem sets and complete other assignments that involve independent reading and technical communication, both in writing and via presentations.

Key Dates

See course website for a listing of assignment deadlines and exam dates.

Grading Criteria

- Problem sets: 20%
- Lecture scribing assignments (2): 20%
- Presentation assignment: 10%
- Quizzes (2): 30%
- Final exam: 20%

Letter grades will be assigned on a standard 10 point scale, with the upper and lower 3 points of each letter grade receiving a + or – designation, respectively. Assigned grades may be higher than those established under this system, but they will not be lower.

See the course website for homework assignments and a description of the lecture scribing and presentation assignments.

Course Policies

You must use LaTeX to write up your problem sets using the provided templates. All assignments are due at 11:59pm on the listed day and must be submitted via Canvas.

Each problem set will have one of five points deducted for each late day, after a one day grace period, with holidays excluded from the count. Problem sets are primarily graded for effort and completion rather than detailed technical accuracy.

Honor Code

You may (and are strongly encouraged to) discuss the problem sets with other students, and you may work together to come up with solutions to the problems. If you do so, you must list the names of your collaborators on the first page of your submission.

Each student must write up their problem set solutions independently, even if they collaborated with others in solving the problems.

You may use the course textbook, or any other textbook of your choosing, as a reference. If you use a result from a textbook or other resource in the course of solving a problem, please cite the resource you used in your write up.

I expect all students to follow the guidelines of the UNC honor code. In particular, students are expected to refrain from "lying, cheating, or stealing" in the academic context. You can read more about the honor code at honor.unc.edu. Please see me if you are unsure about what may or may not violate the honor code in this class.

Course Schedule

See course website for schedule of topics

Attendance and Participation

Class meetings will be held in person, and attendance is strongly encouraged. Some assignments also require student presence in class, e.g., lecture scribing.

Please let me know in advance if you will miss an exam date or other scheduled assignment, so you can be scheduled to complete the work at an alternative time.

Grade Appeal Process

If you feel you have been awarded an incorrect grade, please discuss with me. If we cannot resolve the issue, you may talk to our departmental director of undergraduate studies or appeal the grade through a formal university process based on arithmetic/clerical error, arbitrariness, discrimination, harassment, or personal malice. To learn more, go to the Academic Advising Program website.

Syllabus Changes

I reserve the right to make changes to the syllabus, including assignment due dates and test dates. These changes will be announced as early as possible.

UNC System Required Statement

This course engages diverse scholarly perspectives to develop critical thinking, analysis, and debate, and inclusion of a reading does not imply endorsement.