CS306: Computability and Complexity
Fall 2025

Faculty Contact Information

Instructor: Wenlu Du
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Office Hours:[1] Tuesday 11:00 AM - 12:30 PM Thursday 11:00 AM - 12:30 PM

Class Information

Monday 10:10 AM - 11:05 AM CIS 328
Tuesday Thursday 9:40 AM - 11:00 AM CIS 328

Course Description

This course explores the theoretical foundations of computation, focusing on computability and computational complexity. It examines how computational problems are categorized based on their difficulty and investigates the boundaries of what machines can and cannot solve. Topics include finite automata, regular and context-free languages, Turing machines, decidable and undecidable problems, reducibility, recursive function theory, NP-completeness, time and space complexity, hierarchy theorems, and strategies for addressing intractable problems. If time permits, the course may also cover advanced topics such as approximation algorithms, heuristic methods, probabilistic computation, interactive proof systems, and experimental approaches to solving complex computational challenges. Through these topics, the course provides a framework to understand the limits and capabilities of computation.

Tentative Schedule:

1. Decision problems
2. Finite State Machines
3. Context Free Languages
4. Turing Machines
5. Poly Time Reducibility
6. NP-complete Problems
7. Approximation Algorithms
8. Heuristics for Hard Problems
9. Hierarchy Theorems

Recommended Textbook and Materials

There is no required textbook for the course. However, there are two recommended books:

[1] Office hours might be available online by appointment via Zoom:https://skidmore.zoom.us/j/6414634727

Sipser, Michael. *Introduction to the Theory of Computation.* 3rd ed. Cengage Learning, 2012.
What is a Computer and What Can it Do? by Thomas O'Connell, College Publications, 2013.

Prerequisites

Note: This is a **theory-intensive** course.

It is recommended that students have completed CS305 or an equivalent course. To succeed in this course, students should also possess a solid foundation in mathematical concepts, theorems, and proofs, as these are integral to the material. Please be advised that the course will progress at a fast pace.

Student Learning Goals

Students will develop an understanding of the limits of computation, reinforce the algorithm design skills they developed in CS305, improve their mathematical reasoning skills as well as their writing skills, and learn to recognize the relationships between seemingly dissimilar computational problems.

Attendance

Attendance is mandatory. I will take physical attendance as well as "attentiveness" attendance.
Any exams given cannot be made up. Those students who are absent when an exam is given are given a zero for that exam. This policy is strict.

Coursework and Evaluation

• Assignments:

There will be approximately **4 homework assignments** according to the course schedule.

Collaboration Policy. While collaboration on assignments is allowed and may be helpful, you are **strongly encouraged** to spend time thinking about each problem on your own before discussing it with others. Developing your individual problem-solving skills is crucial for success in this course.

Submission Guidelines. Submit your solutions online via **Spring**. Assignments are due by **midnight** on the date specified in the course schedule. Unexcused late submissions will be accepted until **11:59 PM on the following day**, with a **1-point penalty per problem** (out of a maximum of 10 points). If an assignment consists of multiple parts, individual parts may be submitted late and will incur a **pro-rated 10% point penalty** per part. After this grace period, assignments may only be submitted via **email**, but they **may not be graded** and will only be kept for reference. Solutions will be posted shortly after the late submission deadline, so plan your work accordingly.

Optional Problems. Some assignments may include **one or two optional problems** designed to challenge advanced students. While solving these problems will **not directly affect your course grade**, your solutions may be considered for: 1), Awarding **A+ grades** in exceptional cases, and 2)

Writing **recommendation letters** for future opportunities.

• Project:

The course will have **a final project**. Students will implement some of the algorithms discussed in class and perform experiments to determine the quality of these algorithms. These projects will be assessed based on the correctness of the implementation and the presentation of the experimental results.

• Exams:

The course will have **a midterm exam** during the semester in addition to a final exam. You are required to take the exams at the scheduled place and time. Any exams given cannot be made up. Those students who are absent when an exam is given are given a zero for that exam. However, if there is a compelling reason for you to need to miss an exam, you MUST contact the instructor in advance. This policy is strict.

Grading Scale

Grade	GPA	Percentile
A	4.0	$\leq 25\%$
B+	3.5	$\leq 25\%$
B	3.0	$\leq 25\%$
C+	2.5	$\leq 15\%$
C	2.0	$\leq 10\%$
D/F	N/A	$\sim$

Note: At the discretion of the instructor, the grading may be done on a curve.

Grading

The course grade is determined by the following components:

Exams	40%
Assignments	40%
Project	20%

Academic Integrity

Students are expected to follow the Skidmore College Honor Code and code of conduct to the fullest extent. If you cheat, you fail. If you are having trouble in the course, just talk to me so we can work something out. Otherwise, you get reported to the Dean of Student Affairs who conducts an investigation, and you end up with a permanent mark on your record that is accessible to graduate schools and potential employers. It is just not worth it. In my classes, you will do fine if you just try and if you ask me for help when you need it.

Students with Disabilities

Skidmore College is committed to supporting the learning needs of all students in our diverse community. If you have a documented barrier to learning or think you may have a disability, please consult with Meg Hegener, Associate Director of SAS and Coordinator of Student Access Services (mhegener@skidmore.edu). Accommodations are approved by the coordinator following a review of students' documentation. If you are approved for academic accommodations, please provide your letter of accommodations to me early in the semester or as soon as you are approved so that we can proactively coordinate implementation. Academic accommodations based on disability cannot be granted by individual faculty. For further information, please call (518) 580-8150 to contact Student Academic Services in Starbuck Center.

Conscientious Religious Observance Policy

Skidmore College acknowledges that our community is one of many faiths with a diverse range of practices and observances important to each tradition. In order to fulfill our mission to educate a diverse population of talented students and our commitment to inclusion regardless of religious and spiritual tradition, we seek to practice an equitable and consistent approach in providing religious accommodations. If religious observance requires absence from class or you anticipate a conflict with assignments or due dates, please notify your instructor prior to the absence or conflict so that accommodations can be arranged. Although not required, please provide notification about a pending religious holiday at the start of the semester or at least one week before the holiday. As an option, you may use the form available at www.skidmore.edu/religious-life/calendar.php [or here]. Accommodations for your absence should not reduce the overall expectations of a course nor unduly burden you for requesting accommodation. Students shall not suffer academic, athletic, or employment penalties because of the conscientious observance of any religious day or days. Faculty must permit students to take a makeup examination without any penalty if they have to miss an examination due to religious observances. Similarly, faculty must permit students to submit missed assignments by an agreed upon due date, without penalty. If a student, supervisor, coach, or faculty member feels the policy is being violated, they should contact the Dean of Faculty Office at 518-580-5705 (Palamountain 416), the Dean of Students Office at 518-580-5760 (Case Center 313), or Human Resources at 518-580-5800 (Barrett Center first floor). The full policy can be found at https://www.skidmore.edu/religious-life/calendar.php.

Title IX and Sexual and Gender-based Misconduct

Skidmore College considers sexual and gender-based misconduct to be one of the most serious violations of the values and standards of the College. Unwelcome sexual contact of any form is a violation of students' personal integrity and their right to a safe environment and therefore violates Skidmore's values. Sexual and gender-based misconduct is also prohibited by federal and state regulations. Skidmore College faculty are committed to supporting our students and upholding gender equity laws as outlined by Title IX. If a student chooses to confide in a member of Skidmore's faculty or staff regarding an issue of sexual or gender-based misconduct, that faculty or staff member is obligated to tell Skidmore's Title IX Coordinator or Title IX Deputy Coordinator. The Title IX Coordinator or Deputy Coordinator will assist the student in connecting with all possible resources for support and options for reporting both on and off campus. Identities and details will be shared only with those who need to know to support the student and to address the situation through the college's processes. If the student wishes to confide in a confidential resource, the Counseling Center Staff, Health Services, and Victim Advocates (anonymous) are all options available. More information can be found at the Sexual and Gender-Based Misconduct website or by contacting the Title IX Coordinator, Joel Aure (jaure@skidmore.edu), 580-5708.

Diversity and Inclusion

Skidmore College is committed to fostering a diverse and inclusive community in which members develop their abilities to live in a complex and interconnected world. Consistent with our educational mission, we recognize ourselves as a community that respects individual identities based on varying sociocultural characteristics such as race, ethnicity, gender identity and expression, sexual orientation, national origin, first language, religious and spiritual tradition, age, ability, socioeconomic status and learning style. We strive to create a socially just world that honors the dignity and worth of each individual, and we seek to build a community centered on mutual respect and openness to ideas—one in which individuals value cultural and intellectual diversity and share the responsibility for creating a welcoming, safe and inclusive environment. We recognize that our community is most inclusive when all members participate to their full capacity in the spirited and sometimes challenging conversations that are at the center of the college's educational mission.