

Welcome To CS 378 — Theory of Computation Colby College, Fall '24

Course: CS 378 — Theory of Computation
Lecture: M / W 2:30–3:45 PM, meetings in Davis 117
Website URL: <https://cs.colby.edu/courses/F24/cs378>

Course Description

Focuses on formal languages, automata, computability, and undecidability. Languages discussed include regular languages, context-free languages, and recursively enumerable languages. Both deterministic and non-deterministic machines (finite automata, push-down automata, and Turing machines) are also discussed. Undecidable and semi-decidable problems are addressed. Students will learn through problem sets.

Prerequisites: CS231 and Math 274 (or equivalent).

Your Professor: Eric Aaron

Website: <https://cs.colby.edu/eaaron>

Office: Davis 113

Office Hours: M 4:00–5:00pm, Tu 3:30–4:30pm, W 1:00–2:00pm, F **TBD**,
and by email appointment.

Please feel free to come by and chat—I look forward to talking with you!

Phone/Voicemail: 207-859-5857

E-mail: eaaron@colby.edu

NB: The above email address is the best way to contact me.

Your textbook

- *Introduction to the Theory of Computation, 3rd Edition* by Michael Sipser.

Grading: Grades for the course will be computed (roughly) based on

- Exams (one midterm, one regularly scheduled final): 30–40%
- Problem sets: 40–50%
- Smaller assignments and class participation: 10–20%

The above percentages may be changed slightly if administrative concerns demand it.

Course Outline

The course will focus on formal languages and automata theory, learning about and analyzing models of the mechanisms that underlie computation. We will study regular expressions and the associated finite automata, context-free grammars and the associated pushdown automata, and Turing machines. These various automata have many applications in areas of computer science, such as compiler design and analysis of algorithms, some of which we will address in the course.

Homework assignments will be of two kinds: longer *problem sets*, which will due at least 1 week after being assigned; and other *smaller assignments*, which will typically be due by the beginning of the next class meeting. The smaller assignments may include short exercises to preview or review course concepts, and they may be discussed during the class meeting on the day they are due.

Desired Course Outcomes

- Students understand and can employ rigorous methodology and notation to design and describe computational processes and their specifications, in a variety of models of computation.
- Students understand and can employ rigorous approaches to prove properties of a variety of models of computation, including classic notions of computational expressiveness and relationships among the models.
- Students understand concepts underlying undecidable problems and can apply rigorous techniques to prove problems undecidable.
- Students are familiar with applications of classic models of computation to a variety of areas of computer science.

Lectures, Classroom Discussions, and Classroom Accountability

All students are responsible for **ALL** information given in class, whether or not it is presented in any other form (handout, course website, textbook, etc.). Thus, although lecture attendance is not mandatory, it is strongly encouraged, and it is essential that students who miss lecture consult classmates and find out about any information—academic, administrative, or other—that they missed. There may be severe, unintended consequences for students who do not keep up with all information from class. It is your responsibility to see that this does not happen to you. The easiest way to ensure it: Attend every lecture.

Before each class, students are expected to review material from the previous class meeting—the new material will build upon previously covered material, so review is important for understanding new material as it is presented. It is also expected that, before each class, you will read (though not necessarily completely understand) sections of material to be covered in the next class. Please use class lecture notes and the course textbook as complementary sources of information; in cases of discrepancy, please notify your professor immediately.

There will be many opportunities for discussion and participation during class meetings; reviewing old material and reading new material can give these discussions more value for everyone in the class. An important part of the value of these discussions is *explanation*: It is *absolutely not expected* that every response in a class discussion will be correct; it is important, however, that students try to give reasons for their answers. (Note that participation is part of the course grade, which requires actively contributing to in-class discussion; the lecture notes of the first day's class meeting contain additional details about ways to contribute to in-class discussion.)

Use of Computers / Devices during Class Meetings: Scientific studies (e.g., Sana et al., 2013) demonstrate that the use of phones, computers, tablets, wearables, or other electronic devices during class meetings negatively affects the learning environment in the classroom—not just for the user of the device, but for classmates around them as well. To improve our learning environment, and as a courtesy to your classmates, the use of such devices is prohibited. If for any reason it is important that you use such a device during a class meeting, please talk with me about how best to accommodate you.

Homework Policies

Homeworks should be typewritten using L^AT_EX (see L^AT_EX resources linked from our course homepage!) and submitted as PDFs; detailed submission instructions will be provided. Problem sets and smaller assignments are typically due at the beginning of class (2:30pm) on the due date; assignments received after the beginning of class may be considered late. For purposes of having a consistent lateness policy that applies equally to everybody, please do not consider deadlines as “soft”—unless there are extenuating circumstances, deadlines will be applied exactly as posted.

As always, indicate all resources used / sources of assistance and collaborators (including anyone with whom you discussed the assignment) on every submitted assignment; if none, indicate that in writing. Not doing so may result in significant delays in grading your work or penalties for not following instructions.

Both the larger problem sets and smaller assignments serve important purposes for the course, but because of their differences, different policies apply to each.

Smaller assignments Although smaller assignments do not have as much weight in the final course grade as problem sets, it is nonetheless very important for learning and reinforcing concepts in the course that each assignment be completed on time—for example, we may go over the exercises in class the day they’re due, which substantially diminishes the value of late submitted work. These smaller assignments will be graded on a $\checkmark+$ / $\checkmark$ / $\checkmark-$ / 0 scale; they may be graded on effort even more than correctness. The lateness policy is that if an assignment is handed in up to 1 week late, the maximum grade it can receive is a $\checkmark-$; after that, an automatic grade of 0 is given.

When computing your final grade, your lowest score **from among the smaller assignments that were submitted (on time or late) and show substantial effort** will be dropped (see below for additional deadline information).

Problem sets Problem sets are essential for learning CS378 course material, and because course material builds on what preceded it in the class, it is extremely important for progress in the course that each assignment be completed on time. Problem sets submitted up to one week late will typically receive a 10% deduction; every student will get one free “lateness day” for problem sets in the course, however, enabling a problem set to be submitted up to 24 hours late without penalty—you do not need to ask for this extension, it will just be granted.

Problem sets will receive a 25% deduction if they are submitted more than one week late or they are submitted after feedback on the assignment has been given to the class in any form (email, discussion during a class meeting, returning graded work, etc.). **NOTE: It is possible that, for pedagogical reasons, we will go over all or part of a problem set in class on the day it is submitted—please submit work on time to avoid lateness penalties!** I will try to give advance notice if we’ll be going over a problem set within one week after it is submitted, so students can avoid the extra lateness penalty, but that may not always be possible.

If late problem set submissions become problematic, your professor reserves the right to tighten this policy. Given the interconnections among components of CS378 course material, on-time submission of problem sets is extremely important for the learning experience in this course!

When computing your final grade, your lowest score **from among the problem sets that were turned in (on time or late) and show substantial effort** will be dropped.

No homework (Problem Set or Smaller Assignment) will be accepted for credit—even as a lowest grade to be dropped—after the last day of classes.

As with all policies, homework and grading policies are intended to be fair to everyone involved. They will be enforced fairly. (Extenuating circumstances will of course be considered.) Please feel free to ask me any questions about specific cases that may emerge over the semester!

Policy on Collaboration and Academic Integrity

There may be assignments on which collaboration is forbidden or restricted to a particular group working together; such exercises will be explicitly noted by your professor. In general, however, collaboration will be permitted—indeed, you are encouraged to work with classmates on problem sets and smaller assignments!

On homework exercises where collaboration is permitted, you are encouraged to discuss *approaches* to solving problems *on a general level* with your classmates (as well as your professor, of course!). Unless permission has been explicitly given by your professor, however, you may not discuss specifics with your classmates, and the expression of your answer and your written work—including the specific wording / syntax used to express and explain your answers—must be entirely your own. As part of this, in cases of collaboration, if you know the answer and a classmate does not, telling them the answer is a violation of class policy; if a classmate needs further assistance, they should see your professor or TA (if applicable).

In general, **assignments should be completed without consulting resources other than your textbook (and other explicitly permitted resources), classmates, TAs (if applicable), and Prof.** Using any resources (electronic or print, online or otherwise) other than those explicitly permitted as course resources is prohibited; if you'd like to use a resource that has not been explicitly permitted, consult your Prof. before using it to avoid any unintended violations of course policies. Receiving and copying complete or partial solutions from any source (a classmate, a friend, a family member, a tutor, a published text, an online source, generative AI, etc.) is disallowed, and using such material as “inspiration” and submitting highly derivative solutions is viewed as copying. Furthermore, on each submitted assignment, you should always cite and acknowledge (i.e., write down on the submitted assignment) everyone with whom you discussed the assignment and all sources you consulted or from which you received assistance, including your textbook, classmates, TAs, or other people.

Your professor reserves the right to ask students to verbally explain the reasoning behind any work that they submit and to modify assignment grades based on the answers; such explanations should be from primary foundations or first principles to receive full credit. (Merely observing that some other presentation did something so you did too, without demonstrating an understanding the foundations and reasons why, will not receive full credit.) It is vitally important that you turn in work that is your own! Please also see the **Statement on usage of generative AI** below; in CS378, content created or significantly inspired by generative AI is not considered work that is your own.

Reports of academic dishonesty are handled by an academic review board. A finding of academic dishonesty may result in significant sanctions. From Colby's Academic Integrity Coordinator:

If a student is found responsible for academic dishonesty, the sanctions range from failing the assignment and receiving up to a one letter grade reduction in the course (typical for minor assignments) to failing the course (typical for a major assignment) for a first infraction. Subsequent infractions can lead to suspension and expulsion. Furthermore, regardless of the severity of the infraction, all students found responsible for dishonesty will have a disciplinary letter placed in their file for 6 years after they leave Colby. Disciplinary infractions are reported upon request to graduate programs, medical/dental/law schools, and employers. Thus, the consequences of even minor infractions can be significant.

For more details on Colby's Academic Integrity policies and procedures, see <https://www.colby.edu/academics/academic-integrity/>

In general, the highest level of academic integrity is expected of every student in this class. If there are any questions about collaboration or related policies, please come talk with me!

Statement on usage of generative AI for CS378 The use of generative AI tools (ChatGPT, GitHub Copilot, etc.) for language, algorithms, pseudocode, or code generation is considered inappropriate collaboration and **prohibited for this class** unless explicit permission is given from your Prof. The primary goals of CS378 focus on learning and demonstrating command of concepts and techniques useful for logical reasoning, communicating, and understanding Computer Science from first principles / foundations; in general, the use of generative AI is inconsistent with this focus. If you have questions about this policy, or specific cases where you think using generative AI would improve the learning of course content from first principles / foundations, please ask me!

Statement regarding Academic Accommodations *The following is standard suggested language regarding Academic Accommodations at Colby. It applies to this course.*

I am committed to creating a course that is inclusive in its design. If you encounter barriers, please let me know immediately so we can determine if there is a design adjustment that can be made. I am happy to consider creative solutions as long as they do not compromise the intent of the assessment or learning activity.

If you are a student with a disability, or think you may have a disability, you are also welcome to initiate this conversation with the Dean of Students Office. The Dean of Students Office works with students with disabilities and faculty members to identify reasonable accommodations. Please visit their website for contact and other information:

<https://life.colby.edu/get-support/access-disability-services/>

If you have already been approved for academic accommodations, please connect within the two weeks of the start of the semester so the office can develop an implementation plan.

The Colby Affirmation

(<https://www.colby.edu/academics/academic-integrity/the-colby-affirmation/>)

Colby College is a community dedicated to learning and committed to the growth and well-being of all its members.

As a community devoted to intellectual growth, we value academic integrity. We agree to take ownership of our academic work, to submit only work that is our own, to fully acknowledge the research and ideas of others in our work, and to abide by the instructions and regulations governing academic work established by the faculty.

As a community built on respect for ourselves, each other, and our physical environment, we recognize the diversity of people who have gathered here and that genuine inclusivity requires active, honest, and compassionate engagement with one another. We agree to respect each other, to honor community expectations, and to comply with College policies.

As a member of this community, I pledge to hold myself and others accountable to these values.

Title IX Statement *The following is standard suggested language regarding Sexual Misconduct/Title IX at Colby. It applies to this course.*

Colby College prohibits and will not tolerate sexual misconduct or gender-based discrimination of any kind. Colby is legally obligated to investigate sexual misconduct (including, but not limited to, sexual assault and sexual harassment) and other specific forms of behavior that violate federal and state laws (Title IX and Title VII, and the Maine Human Rights Act). Such behavior also requires the College to fulfill certain obligations under two other federal laws, the Violence Against Women Act (VAWA) and the Jeanne Clery Disclosure of Campus Security Policy and Campus Statistics Act (Clery Act). To learn more about what constitutes sexual misconduct or to report an incident, see: <https://life.colby.edu/your-safety/sexual-violence-title-ix/>

I am committed to all Colby students feeling safe, accepted, and included in all aspects of their college experiences, including this course. Colby prohibits and will not tolerate sexual misconduct or gender based discrimination of any kind and is obligated, by federal and state laws, to respond to reports and provide resources to students. As your professor I am considered a “responsible employee” which requires me to report incidence of sexual assault, sexual harassment, dating violence, or stalking to the Title IX Coordinator.

If you wish to access confidential support services, you may contact:

1. Counseling Services: 207-859-4490
2. Dean of Religious and Spiritual Life, Kate Smanik: 207-859-4272, kesmanik@colby.edu
3. Director of Student Access and Disability Services, Kevin Murray: 207-859-5166, kjmurray@colby.edu
4. Assistant Dean of Student Success, Kay Shirley: 207-859-4560, kshirley@colby.edu
5. Colby Health Services: 207-861-6860, healthservices@colby.edu
6. Maine’s 24/7 Sexual Assault Helpline: 1-800-871-7741

To learn more, visit <https://life.colby.edu/your-safety/sexual-violence-title-ix/>

Mental and Emotional Health *The following is standard suggested language regarding Mental and Emotional Health at Colby. It applies to this course.*

I am invested in the mental and emotional health of my students. Even as I establish and maintain the academic standards of my course, I value each of you as individuals with complex lives, identities, and challenges.

Throughout the semester, the responsibilities of your Colby education may interact with situational as well as ongoing mental and emotional challenges in foreseeable and unforeseeable ways. If you are in need of reasonable flexibility due to an emotional situation or an ongoing mental health issue, please communicate as openly as possible with your Class Dean, and/or members of the office of Access and Disability Services, preferably in advance of the need, so that we can discuss how your circumstances interface with course requirements. Together, we will consider what is needed and what is possible. If we can discuss the situation, we can manage the situation together.

Please do not allow academic responsibilities to prevent you from getting help you need. Our Colby Counseling Services staff (207-859-4490) and the staff in the Dean of Studies office (207-859-4560) are available to connect with you. The safety of my students and every member of this community is paramount. If you or someone you know is struggling with thoughts of suicide or may be a danger to themselves or others, please call the on-call counselor immediately (207-859-4490, press “0”).

Respect for Diversity *The following is standard suggested language regarding Respect for Diversity and Religious Holidays at Colby. It applies to this course.*

It is my intent that students from diverse backgrounds and perspectives be well-served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. I expect you to feel challenged and sometimes outside of your comfort zone in this course, but it is my intent to present materials and activities that are inclusive and respectful of all persons, no matter their gender, sexual orientation, disability, age, socioeconomic status, ethnicity, race, culture, perspective, and other background characteristics.

I have attempted to avoid scheduling exams during major religious holidays. If, however, I have inadvertently scheduled an exam or major deadline that creates a conflict with your religious observances, please let me know within two weeks of the start of classes so that we can make other arrangements. Colby College is supportive of the religious practices of its students, faculty, and staff. The College is committed to ensuring that all students are able to observe their religious beliefs without academic penalty.

Class rosters are provided to each instructor with the student's legal name. I will gladly honor your request to address you by an alternate name and/or gender pronoun. Please advise me of this early in the semester so that I may make appropriate changes to my records.