

CMPU 240

Theory of Computation

Fall 2022

Tuesday 12:00–1:15 p.m.

Thursday 12:00–1:15 p.m.

Sanders Physics 105

Professor Gordon

cs.vassar.edu/~cs240

Overview

Are there fundamental restrictions to what computers can and cannot do? If so, what do these restrictions look like? And what would such restrictions mean for our ability to computationally solve meaningful problems?

In CMPU 240, we'll explore the answers to these important questions. We'll consider what is an appropriate mathematical model of a computer and what types of computations are and are not possible in such a model. During the course, you will gain an understanding of the intimate connection between computation and language recognition as we study several classes of abstract machines, including finite automata, pushdown automata, and Turing machines, along with several classes of languages, such as regular and context-free languages.

We'll see the strengths and weaknesses of these models, and you'll learn how to think about computation itself and how to show that certain problems are impossible to solve.

Prerequisites

CMPU 102: Data Structures and Algorithms

CMPU 145: Foundations of Computer Science

To do well in CMPU 240, you should be comfortable with sets, tuples, functions, relations, graphs, proof by contradiction, and proof by induction.

Course goals

By the end of the semester, you should understand:

- the relationships between languages (problems) and machines
- the inherent limits of what can be computed
- the application of theoretical topics to practical problems
- how to create rigorous arguments using various proof techniques

This course provides theoretical foundations for CMPU 331 Compilers and CMPU 366 Computational Linguistics.

Course format

The class sessions are intended to augment and support the material in your readings by providing an opportunity for in-depth discussion, working through examples, and the chance for you to ask questions.

The material covered each week builds on what was covered in prior weeks. As such, it's essential that you attend or watch every lecture and keep up with the reading assignments.

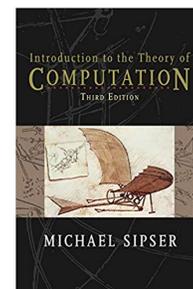
The calendar with lecture notes, assigned readings and exercises, and exams is on the [course website](#) and will be updated throughout the semester.

Textbook

Introduction to the Theory of Computation, third edition

Michael Sipser

The textbook is on reserve at the library, and additional copies are available to borrow outside the instructor's office (SP 306).



I'm expensive!

Coursework and grades

To develop and assess your understanding of the ideas presented in CMPU 240, there will be a variety of elements to the course, weighted approximately as follows:

Assignments	40%
Exam 1	20%
Exam 2	20%
Exam 3	20%

Final grades take into account each component. You must achieve a passing grade in all components to pass this course, and to receive an A, you must have high performance in all categories.

Remember that success in the course is more than just good grades. It means that you are being challenged to grow as a learner, that you are engaging actively with tasks that feed your growth, and that you are creating excellent work by completing challenging tasks with an appropriate level of support. It also means that you are building your lifelong learning skills so that once the course is over, you are better and stronger as a learner and can continue to learn new things independently.

Assignments

There will be 9–10 assignments during the semester. Assignments and due dates will be listed on the course calendar on the website. Unless otherwise noted, all assignments are due at the beginning of class and should be submitted on Gradescope.

Additional instructions will be provided with the first assignment.

Exams

During the semester, there will be three exams, the last of which will be a regularly scheduled final exam. Each exam will focus on material from the immediately preceding segment of the course, but will build on – and may explicitly ask about – material from earlier in the course.

For each exam, you may refer to an 8.5×11-inch piece of paper, double-sided, with anything written (or typed) on it that you want.

Grading

We will be using Gradescope this term to provide feedback on your work. Homework will be submitted through Gradescope, and both homework and exam grades will be returned through Gradescope. As soon as grades are posted, you will be notified immediately so that you can log in and see your feedback.

Preparing this sheet of notes is an excellent way to study, forcing you to consider what's important that you will want to refer to.

Late work

In general, due to the course schedule and the format for assignments, late work can't be accepted. However, if you know you won't be able to submit an assignment or exam on time, talk to me.

If you're experiencing a major problem – medical, psychological, family, etc. – that is interfering with your ability to complete your class work, you should talk to your class advisor, the Dean of Studies, Counseling Services, or Health Services, who will recommend appropriate accommodations to all of your professors, who genuinely want you to succeed.

Collaboration policy

The goal of the course is to gain an understanding of theoretical computer science, not to compete with each other. Indeed, in real research, collaboration is the norm. As such, you're encouraged to discuss class material with other CMPU 240 students when reading, when studying, and when thinking about exercises.

Assignments: Permitted collaboration

You have the option to complete the assignments individually or with one classmate. If you work in a group of two, you will submit a single assignment with both names on it and will receive the same grade for the assignment.

When you work with a partner, you are both expected to work on each exercise, and you are responsible for completely understanding all of your answers. Submitting work you have not contributed to fairly or do not understand is *academic dishonesty*.

Whether you submit on your own or with a partner, discussing homework with your classmates is encouraged – but your write-up must be your own work and your own words. Do not copy all or part of anyone else's write-up.

You are not required to work with the same person on each assignment – in fact, it's a good idea to mix it up!

Exams: No collaboration

Exams must be completed individually. Do not discuss the content of the exam with anyone but the professor until the exams are graded or example solutions are released.

Academic integrity

Receiving and copying solutions from any source (a classmate, a friend, a previous semester of this course, a published text, an online source, etc.) is not allowed. Note that using material from sources (other than those explicitly given as course resources) as “inspiration” and submitting derivative solutions is considered plagiarism.

If you haven’t already done so, you should read “[Going to the Source](#)”, available from the Dean of the College website. Quoting from Chapter X, “In suspected cases of plagiarism, the instructor prepares a written statement of complaint to the Academic Panel.” Please don’t put yourself or your professor in that position. When in doubt, *stop* and ask me first.

Communication and getting help

I encourage all students to participate in class discussions. In return, I will make myself available to answer questions, listen to concerns, and talk to any student about topics related to the class. I welcome your feedback throughout the semester about how the course is going.

Our course uses [Ed](#) for online discussions.¹ You can use it to ask questions about course concepts, assignments, and logistics. It is also used for discussions among students, including for any work to be done in groups.

The quickest way to get feedback and help will be via Ed. We expect you to read Ed every day or two for announcements and clarifications to assignments; you are responsible for all clarifications made at least 48 hours before an assignment is due.

Posts on Ed can be either public or private. Public posts are visible to everyone, while private posts are visible only to course staff. Any questions having to do with your particular solution to an assignment should be private; all other posts should be public. (If you have a question about something, it’s very likely that other students do, too!)

Because Ed is an extension of our classroom discussion, we expect everyone to behave accordingly: No disrespect, rudeness, or abuse will be tolerated.

¹ You’ll receive an invitation to the site after class starts.

Ed is a discussion forum, so please feel free to respond to questions and comments – it’s great when students can learn from each other!

Instructor availability

Office hours will be listed on the [instructor's website](#). If you need to meet at a different time, send me a message.

Please come to office hours! Coming to office hours does not send a signal that you are behind or need “extra help”; on the contrary, the most successful students are usually those who come to office hours early and often.

I typically only check email and other messages between 9 a.m. and 9 p.m. on weekdays. If you send a message that needs a response during those times, you can expect to get a response within six hours (often much sooner). Otherwise, you can expect one when I'm back online.

Academic accommodations

Academic accommodations are available for students registered with the Office for Accessibility and Educational Opportunity (AEO). Students in need of disability (ADA/504) accommodations should schedule an appointment with me early in the semester to discuss any accommodations for this course that have been approved by the Office for Accessibility and Educational Opportunity, as indicated in your AEO accommodation letter.

Diversity and inclusion

In an ideal world, science would be objective. However, much of science is subjective and is historically built on a small subset of privileged voices. There may be both overt and covert biases in the material due to the lens with which it was written, even though the material is primarily of a scientific nature. Since integrating a diverse set of experiences is important for a more comprehensive understanding of science, please contact me if you have any suggestions to improve the quality of the course materials.

I would like to create a learning environment that supports diversity of thoughts, perspectives, and experiences, and honors your identities.

- If you have a name and/or set of pronouns that differ from those that appear in your official records, please let me know!
- If you feel that your performance in the class is being impacted by your experiences outside of class, please don't hesitate to contact me.

If you prefer to speak with someone outside of the course, you can contact your class advisor or the Dean of Studies.

- I (like many people) am still in the process of learning about diverse perspectives and identities. If something was said in class (by anyone) that made you feel uncomfortable, please talk to me about it.

Title IX

Vassar College is committed to providing a safe learning environment for all students that is free of all forms of discrimination and sexual harassment, including sexual assault, relationship abuse, and stalking. If you (or someone you know) has experienced or experiences any of these incidents, know that you are not alone. Vassar College has staff members trained to support you in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more.

Please be aware all Vassar faculty members are “responsible employees,” which means that if you tell me about a situation involving sexual harassment, sexual assault, relationship abuse, or stalking, I must share that information with the Title IX Coordinator. Although I have to make that notification, the Title IX office will only provide outreach by email. You will control how your case will be handled – you don’t have to read or respond to the email, and it is completely up to you whether to pursue a formal complaint. Our goal is to make sure you are aware of the range of options available to you and have access to the resources you need.

If you wish to speak to someone privately, you can contact any of the following on-campus resources:

- Counseling Service (counselingservice.vassar.edu, 845-437-5700)
- Health Service (healthservice.vassar.edu, 845-437-5800)
- Rachel Gellert, Director of Support Advocacy and Violence Prevention (savp.vassar.edu, 845-437-7863)
- SART (Sexual Assault Response Team) advocate, available 24/7 by calling the CRC at 845-437-7333 and asking for SART

The SAVP website (savp.vassar.edu) and the Title IX section of the EOAA website (eoaa.vassar.edu/title-ix) have more information, as well as links to both on- and off-campus resources.

Acknowledgments

This course – and this syllabus – is based in large part on work by other professors, especially Nancy Ide and Keith Schwarz. The policy on asking and answering questions and on communication on Ed is adapted from Laney Strange. The statement on diversity and inclusion is adapted from Monica Linden.