

Syllabus 15-354:

Computation and Discrete Math

Fall 2023

1 The Course

1.1 Description

The main idea behind *Computation and Discrete Math (15-354)* is that the development of the digital computer, together with the theory of computation, is one of the most important developments in mathematics in the 20th century. Consequently, this course takes a fresh look at some of the standard concepts of discrete mathematics (relations, functions, logic, graphs, algebra, automata), with strong and consistent emphasis on computation and algorithms. Another key concern is knowledge transfer: we need to realign traditional mathematical concepts with our new computational universe and find ways to apply ideas from one realm to the other. We begin with a brief introduction to computability and computational complexity.

1.2 Objectives

- Develop a basic understanding of computability and complexity.
- Apply this knowledge to tackle problems arising in discrete mathematics and theoretical computer science.
- Exploit computational resources to extend your ability to successfully solve problems in these areas.
- Partially reverse the flow of information from mathematics to computer science.

1.3 Prerequisites

A word on prerequisites: the only formal prerequisite for CDM is 15-251, Great Theoretical Ideas in CS. This should be understood as being fully acquainted with all the basic machinery of theoretical computer science, including all the mathy parts. In particular the ability to

construct (semi-)formal proofs¹ of some sophistication is critical. A good understanding of probability theory is also most helpful for some parts of the course, as is some modest amount of graph theory, number theory and automata theory. If you have gotten a bit rusty, now is a good time to review old course material.

This course is typically taken by CS and/or math majors; contact me if you do not fit this profile.

1.4 Schedule

See [Schedule](#). There may be small local changes, overall things are fairly stable at this point.

2 Communication

2.1 Website

Our course website is

<http://www.cs.cmu.edu/~cdm>

Syllabus, course schedule, slides, lecture notes, papers, homework are all posted there. Acquaint yourself with the material at this site.

2.2 Ed

We use edstem as our bboard:

[Ed](#)

If you are enrolled in the course, you will get an invitation before class starts.

Always post in the right *category/sub-category* (such as Assignments/HW1) and use descriptive titles:

Q 2: why is f primitive recursive?

Provide all the necessary information like screenshots or links. Also, make a real effort to read other posts first, someone else may well have asked the same question. The course staff gets increasingly grumpy when questions repeat.

¹Real formal proofs require the use of a theorem prover or proof checker, we are not going to get involved. But your arguments should be lucid and compelling.

Lastly, try to answer questions of your peers; it is often better to get a response from a student than from someone like me.

2.3 Course Personnel

- Prof: Klaus Sutner, sutner@cs.cmu.edu
- TA: Joey Yu joeyyu@cmu.edu
- Course secretary: Rosie Battenfelder, rosemary@cs.cmu.edu

For office hours see the website and Ed.

3 Bureaucracy

3.1 Assessments

We (actually: yinz) will have to jump through the usual hoops.

- homework 30%
- midterm (take-home) 30%
- final (take-home) 40%

The percentages may change slightly depending on outcomes.

There will be about 10 homeworks in total. You have 6 (six) late days at your disposal; use them prudently (in particular not early in the course). A late day is a discrete atom, with no smaller parts. Mention lateness in the header of your HW.

The (rather too low) 30% weight of homework is caused by the sad fact that a lot of solutions are available on the internets. Don't search for any of this stuff; it took years to develop these questions, you will get nothing out of them if you copy solutions.

Lastly, I may ask you to sit for an oral exam if your grade distribution is disconcerting.

3.2 Policies

Attendance

CMU is a university, not a kindergarten.

Academic Integrity

You are allowed to collaborate with other current CDM students on homework, but you must submit your own, independent work. Do not take notes during your conversations, do not discuss homework with anyone other than these students and the course staff. Explicitly name all collaborators and other resources you may have used (online or printed).

No collaboration whatsoever is allowed on exams. On rare occasions I will accept groups of two working on a final project (this only makes sense for some projects, make sure to talk to me way ahead of time).

General CMU policy can be found at [Academic Integrity](#).

Accommodations

It seems we are out of covid mode, so only standard accommodations apply. Make sure to contact the Office of Disability Resources in a timely manner, don't wait till the last minute to make arrangements (they do run out of space). See [Disability Resources](#).

4 Wellness

Counseling and Psychological Services (CaPS):
412-268-2922, [CaPS](#).

If the situation is life threatening, call the police:

On campus: CMU Police: 412-268-2323; off campus: 911.

For what it's worth: my own, personal approach to maintaining sanity as a student was to practice martial arts. A lot. Works well later in life, too.

5 Diversity

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

Center for Student Diversity and Inclusion: csdi@andrew.cmu.edu, (412) 268-2150

Report-It online anonymous reporting platform: <http://www.reportit.net> username: tartans, password: plaid.