Course Information

Course Overview

Are there "laws of physics" in computing? Are there fundamental restrictions to what computers can and cannot do? If so, what do these restrictions look like? What would make one problem intrinsically harder to solve than another? And what would such restrictions mean for our ability to solve meaningful problems with computing power? In CS103, we'll explore the answers to those questions.

We'll begin with an introduction to mathematical proofs and discrete structures, which will enable us to model the sorts of systems that arise in computer science. In the course of doing so, we'll explore mathematical logic, linked structures, and the mathematical nature of infinity.

We'll continue by exploring finite automata (mathematical models of computers with finite memory) and from there will explore context-free grammars and Turing machines (mathematical models of computers with unbounded memory). As we explore these models, we'll see their strengths and their weaknesses and will explore questions like "what does it mean to solve a problem?" and "why does this problem seem to resist a solution?" Finally, we'll conclude with a quick introduction to complexity theory and explore what we know – and what we don't – about efficient computation.

In the course of the quarter, you'll see some of the most impressive (and intellectually beautiful) mathematical results of the last 150 years. You'll see what proof-based mathematics is all about and will gain more confidence using mathematics to model and solve problems. You'll learn about various discrete structures that arise throughout computer science. You'll learn how to think about computation itself and how to show that certain problems are impossible to solve. Finally, you'll get a sense of what lies on the frontier of computer science, especially with regards to the **P** $\stackrel{?}{=}$ **NP** problem.

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Website

The course website is cs103.stanford.edu and it's loaded with resources for this course. There, you'll find all the handouts for this course, lecture slides, and additional links that you may find useful. I would suggest periodically polling the website to stay on top of any important developments in the course.

Email

The course staff can be reached at cs103-aut1516-staff@lists.stanford.edu. Please don't hesitate to send us emails! We're here because we genuinely love this material and want to share it with you. If you have any questions on the material, or if you're interested in exploring more advanced content, please get in touch with us. We'd be happy to help out.

Lectures

Mondays, Wednesdays, and Fridays, 3:00 – 4:20 in Hewlett 200. Although some other offerings of CS103 are videotaped, lectures will not be recorded this quarter.

Units

If you are an undergraduate, you should be enrolled for five units. If you are a graduate student, you may enroll for anywhere between three and five units, depending on what best fits into your schedule. Regardless of how many units you are enrolled for, the course content and requirements will be the same. The unit flexibility is simply to make life easier for graduate students.

Five-unit courses at Stanford vary greatly in their difficulty. Based on past student experiences, you should expect that this course probably will require a time investment proportional to its unit load. Expect to put in a total of 15 hours each week – including lecture time – working on CS103. We'll offer a lot of support through office hours, extra practice problems, and practice exams, though, so if you're willing to put in the effort to learn the material, the course staff will be behind you every step of the way.

Prerequisites

CS103 is a theory course, but doesn't actually have any math prerequisites. You should feel comfortable with high-school algebra (i.e. factoring and multiplying polynomials), but you do not need to have taken precalculus or calculus prior to taking CS103; we'll build up all the mathematical machinery we need as we go. If you're interested in taking this course but feel that you might not have a sufficient mathematical background, you may want to check out our new add-on course, CS103A, which is discussed later in this handout.

CS103 has CS106A formally listed as a prerequisite because we want you to have at least a basic familiarity with computer programming before taking the course. Many of the results we'll explore will be intimately connected to computers, computing, and programming, and we'll often use programming metaphors to help guide your understanding. There will only be a small amount of programming in this course, primarily localized around the final topics. As a result, if you have any programming background at all, you're in the right place! If you haven't programmed before, I would suggest dropping by office hours so that we can chat about whether the course is a good fit for you.

Office Hours

The TAs and I will be holding *lots* of office hours during the week so that you can stop by and ask questions about the material. We find that many students visit office hours on a somewhat regular basis and encourage you to stop by if you need any help. We'll post a schedule later this week.

CS103A

CS103A is an optional, one-unit add-on course for CS103. CS103A meets once a week for two hours and offers extra review and practice problems related to the current course content. If you're interested in taking CS103 but feel like you might need a little bit of extra practice and review, I'd strongly recommend checking out CS103A. The course has limited enrollment this quarter, so we'd highly recommend signing up as soon as you can.

CS103A meets on Tuesdays from 3:00PM – 5:00PM in Lathrop 282, with optional extra office hours meeting immediately afterwards.

Piazza

We have a class Piazza forum you can use to ask questions about the material and to get help and advice on the problem sets and discussion problems. Our policies regarding Piazza use will be covered in an upcoming handout on problem set policies.

Readings

There are online course notes for the first few weeks of material. They go into a *lot* more depth than what we're going to end up covering in CS103, but hopefully you'll find them useful for getting a deeper understanding of the material. The course notes are still a work in progress, so please feel free to contact us with corrections of all sorts – logic errors, grammatical issues, formatting problems, etc.

We *recommend* that you pick up a copy of ***Introduction to the Theory of Computation, Third Edition*** by Michael Sipser. You might find this book useful in the second half of the quarter. Some of the readings in the syllabus are taken from this book, but we will not directly test you on any material in Sipser that is not covered as well in lecture or the problem sets. Although the readings are taken from the third edition of Sipser, you should be able to use the second edition as well. There are several copies of the Sipser textbook on reserve in the engineering library.

Problem Sets

There will be nine total problem sets in CS103 given out about once per week. You are welcome to work on them individually or in groups of up to three people. Our full policies with regards to problem sets (late policy, regrades, etc.) will be given in a separate handout later this week.

Exams

In addition to problem sets, there will be a two midterm exams and a final exam. The first midterm exam will be held on Monday, October 26 from 7PM – 10PM and the second on Monday, November 16 from 7PM – 10PM, both locations TBA. The final exam will be held on Wednesday, December 9 from 3:30PM – 6:30PM, location TBA.

Unfortunately, due to Honor Code problems in the past, we will not offer alternate exam times except for students with OAE accommodation letters. In particular, this means that there will be no alternate final exam.

Grading

Overall, your grade for this course will be determined as follows. The problem sets are collectively worth one-third of your grade. Each midterm is worth one-sixth of your grade. The final exam is worth the remaining one-third of your grade.

We do *not* curve grades on individual assignments or exams. Rather, we use raw point totals weighted by the amounts given above to compute everyone's raw total score, then curve raw total scores.

Unlike some other courses, we do not drop the lowest problem set or midterm score and do not offer any make-up work. Your raw score will be computed purely based on the above formula, and we will determine final grades based on those raw scores. However, we will offer extra credit questions on the problem sets.

Honor Code

We take the Stanford Honor Code very seriously in this course and will pursue any infractions. Details about our Honor Code procedures are described in the upcoming handout "CS103 and the Stanford Honor Code," which we'll release along with the first problem set.

Incomplete Policy

If you have a serious medical or family emergency and cannot complete the work in this course, you may contact Keith to request an incomplete. Our policy is to reserve incompletes only for emergencies, so we do not grant incomplete grades for poor performance on the assignments or exams, nor do we offer incompletes for busy work schedules. In order to be eligible for an incomplete, you must have completed all of the assignments (except possibly the most-recently-due assignment) and must have a performance that is roughly on par with a B- overall grade.