

CS 340 - Analysis of Algorithms

Fall 2020

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Online course, Lectures MTh 2:30-4pm
<http://www.cs.haverford.edu/courses/cmssc340>

Qualitative and quantitative analysis of algorithms and their corresponding data structures from a precise mathematical point of view. Performance bounds, asymptotic and probabilistic analysis, worst case and average case behavior. Correctness and complexity. Particular classes of algorithms such as sorting and searching will be studied in detail.

Content Warning: Class discussions will also focus on the responsibility of computer scientists in designing solutions to real-world problems. This will include discussions of the environmental impact of computing, the impact of algorithmic choices on marginalized groups around the world including within the criminal justice system, and other potentially sensitive societal topics. This includes discussion of the current global COVID-19 pandemic.

Textbook

Required: Algorithm Design by Jon Kleinberg and Eva Tardos

Class Time and Office Hours

- Class meets MTh 2:30-4pm on Zoom (see GCal entry).
- Labs meet M 9:30-10:30am and M 1:30 - 2:30pm on Zoom (see GCal entry).
- Office hours are TBD and will also include TA office hours and lecture review hours. See the Google Calendar for the up to date information. Office hours are also available by appointment.
- Add the class Google Calendar to keep up to date with any scheduling changes. Deadlines and Zoom links will also be listed there.

Navigating an online class

This class will be entirely remote, so wherever you are in the world I hope you will be able to fully participate in it. While many aspects of the class will be the same as in past in-person semesters, there will be a few important changes / additions to normal procedure:

Zoom attendance Students will be expected to attend all labs and lecture sessions “in person” (on Zoom). Students who can not attend a specific class or lab during a week are expected to email the professor in advance - illness is a common and reasonable reason not to be able to attend.

Zoom etiquette When attending class via zoom, students should pay attention to the below aspects of their presence in the course:

video Students should keep their video on so that the class can feel as much like a group gathering as possible. However, this may not be possible for all students at all times given bandwidth, surroundings, and comfort given that the class sessions will be recorded. Students who are not able to have their video on during full class meetings should consider turning them on when in small breakout rooms (which are not recorded).

audio Students should remain on mute unless they would like to speak. We'll use the "raise hand" feature when students have questions.

name Students should change their names to be the name they would like to be called during class (e.g., the nickname they go by) as well as enough information so that this name can be matched to the name on the class list easily (e.g., including a last name). Students should also include their desired pronouns. For example, the professor's name on Zoom should be listed as: Sorelle Friedler (she/her). Please change this in your settings so that you do not need to remember to change it for each class.

Lecture review hours TAs will host lecture review hours. These will be available online to all students, and are especially designed to allow students in time zones where the class time makes it impossible to attend in person to join a discussion about the lecture material (see below).

Study groups Students will be expected to form time-zone-compatible study groups of 4-5 students and will be required to meet as a study group for at least an hour a week to work on the weekly problem set.

Slack The QuaCS slack instance will be used regularly for short questions. A private class channel will be set up and class announcements will be posted there. Students are expected to monitor this slack channel at least daily so that any announcements are seen within *24 hours*.

Email Longer announcements may be sent to the class via email. Students are expected to check email at least daily so that any announcements are seen within *24 hours*.

Office hours The professor and/or TAs will enter the Zoom room for office hours if contacted by a student via slack. The procedure for office hours is that the professor / TAs will notify the class slack channel when office hours begin and after that students who would like to meet should message the professor / TAs (either via DM or in the class slack channel) to indicate that they would like to talk.

Prompt Responses We will not be able to track each other down in person this semester - I will not be traveling to campus, and many of you are also remote. That means that prompt responses to slack or email messages are especially important. Students are expected to respond to any (direct) message (via slack or email) from the professor *within 24 hours* (or on the next weekday) and the professor will also make every effort to do so. Responses that indicate receipt of the message with a longer (also prompt) response to follow are a reasonable way to respond immediately if a longer response is not yet possible.

Be on time Since all interaction with the professor and TAs will be remote, it's especially important to be on time! Sitting in a zoom room by yourself is sad. Please respect our time by being on time if you schedule an appointment. You should also be on time for all class and lab sessions.

For students not in the Eastern U.S. time zone

Zoom attendance Students who can not attend *any* weekly lecture sessions because they are in a time zone where the class meets in the middle of the night must email the professor and will be excused from class attendance; such students will be required to attend TA lecture review sessions (see below). All students are *required* to attend

their weekly lab (barring illness, etc.), as these have been scheduled with international time zones in mind.

Lecture review hours TA-hosted lecture review hours will be held at times that are convenient for many different time zones. The goal of these sessions is to give students a chance to ask questions about the lecture as well as a chance to work through some of the problems done in lecture together. Students are expected to watch the lecture recording before attending these sessions. Plans for these sessions may change based on attendance and student feedback. All sessions will be posted on the class Google Calendar.

Late work policy

All extensions must be requested **at least 24 hours in advance** of the deadline. Extensions will be granted based on individual circumstances. Work handed in late without a previously granted extension may not be accepted and will likely receive *zero* credit. Extensions should be requested *via email* and should indicate 1) the reason for the extension request and 2) the new proposed deadline. Answers to 1) can reasonably include illness, exams in other courses, or poor time management. Answers to 2) should request 24 or 48 hour extensions except for in unusual circumstances. Students should feel free to request extensions as needed, but students who do so regularly will spark the professor's concern and will be expected to have a longer meeting with the professor and/or their dean about how to manage assignments and any mitigating circumstances.

Schedule of Topics

This schedule is *tentative*. Homework is **due at 10am every Friday** and should be submitted via Moodle. **Submission via Moodle is required** - any assignments missing a hard copy by the 10am ET Friday deadline will not be accepted, and submission via individual email is not allowed. Students should expect **at least 10 hours of work each week**. For the most up-to-date dates and deadlines see the CS 340 Google Calendar.

Week 1. Sept 7. Introduction, Basics of Algorithms Analysis, Complexity

- **Class held on Sept 7 (Labor Day), no class on Sept 14.**
- Reading: Chapters 1 and 2

Week 2. Sept 14. Graphs

- Reading: Chapter 3
- Homework 1 (matching) Due Sept. 18

Week 3. Sept 21. Greedy Algorithms

- Reading: Chapter 4
- Homework 2 (graphs) Due Sept. 25
- Project assigned (Thursday, Sept. 24)

Week 4. Sept 28. Greedy Algorithms and Divide and Conquer

- **No class or labs: Sept 28 (Yom Kippur)**

- Reading: Chapters 4 and 5
- Homework 3 (greedy) Due Oct. 2

Week 5. Oct 5. Divide and Conquer

- Reading: Chapter 5
- Homework 4 (greedy / divide & conquer) Due Oct. 9
- Project checkpoint 1 (Tuesday by 10am)

Week 6. Oct 12. Dynamic Programming

- Reading: Chapter 6
- Homework 5 (divide & conquer) Due Oct 16

Week 7. Oct 19. Midterm week

- Review in class on Monday
- Homework 6 (dynamic programming) Due **Tuesday**, Oct 20 by 10am
- Midterm during class time on Thursday.

Week 8. Oct 26. Network Flow

- Reading: Chapter 7
- Monday lab: group work on the project.
- Project checkpoint 2 due Friday by 10am
- No homework due this week.

Week 9. Nov 2. Intractability, Reductions, NP-Completeness

- Reading: Chapter 8.1 - 8.4
- Homework 7 (network flow) Due Nov 6

Week 10. Nov 9. NP-Complete Problems

- Reading: Chapter 8.5 - 8.10
- Homework 8 (reductions) Due Nov 13

Week 11. Nov 16. Project presentations.

- Monday lab: group work on the project and work on homework.
- Tuesday, Nov 17: project write-up due by 10am.
- Thursday, Nov 19: in class project presentations.
- Homework 9 (NP-completeness) due Friday, Nov 20

Week 12. Nov 23. Thanksgiving break!

Week 13. Nov 30. Approximation Algorithms

- Reading: Chapter 11.1 - 11.5
- No homework due this week.

Week 14. Dec 7. Approximation Algorithms and Review

- Reading: Chapter 11.6 - 11.8
- Thursday: final exam review
- Homework 10 (approximation algorithms) Due Dec 11

Week 15. Final exams.

Total grade breakdown

Grades will be awarded based on the number of points earned and according to the percentage breakdowns shown. Students will not be graded on a curve.

Homework	25%
Group Project	15%
Midterm	25%
Final exam	35%

Attendance and Participation

Attendance at, and active participation in, all class sessions is expected of all students. Participation will be taken into account in awarding of final grades for students who are “on the edge” between two grades. For example, a student with a B+/A- average and a strong attendance and participation record would receive an A-, while a student with a weak record would receive a B+.

Collaboration

It is your responsibility to understand and follow the Computer Science Department Collaboration Policy in this class. It is available at:

<https://www.haverford.edu/computer-science/resources/collaboration-policy>

The goal of the policy is to encourage collaboration while ensuring that you and your classmates engage in really learning how to solve the challenging problems you’ll see in this course. No outside sources (the internet, other textbooks, students not in this class, etc.) are allowed in this course. If you are ever uncertain if collaboration or certain sources are allowed, you should ask the professor.

Learning Accommodations

Haverford College is committed to supporting the learning process for all students. Please contact me as soon as possible if you are having difficulties in the course. There are also many resources on campus available to you as a student, including the Office of Academic Resources (<https://www.haverford.edu/oar/>) and the Office of Access and Disability Services (<https://www.haverford.edu/access-and-disability-services/>). If you think you may need accommodations because of a disability, you should contact Access and Disability Services at hc-ads@haverford.edu. If you have already been approved

to receive academic accommodations and would like to request accommodations in this course because of a disability, please meet with me privately at the beginning of the semester (ideally within the first two weeks) with your verification letter.