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Online Course Format [this year only (hopefully) and subject to change]

Lectures will be offered live online via Zoom. The lectures will also be recorded for viewing at a later time to accommodate students who cannot participate in the live lectures due to time-zone differences or other reasons. Weekly TA-led recitations will be offered both live online and in-person, at various times on Fridays (see the registrar’s schedule).

Following student recommendations, we will de-emphasize (but not eliminate) the midterm and final exams by adding graded live mini-quizzes for credit during the lectures, to be conducted via Zoom’s polling feature. For students viewing a recorded lecture, an alternate timed and graded recorded mini-quiz will be available but it must be completed within 24 hours of the original live lecture. Students may choose whether to take the live mini-quiz or the recorded mini-quiz on a lecture by lecture basis, and if both are taken for any given lecture, the higher score will be used. We expect that all students will complete the exams and mini-quizzes on their own individually, without assistance from others.

Course Outline

I Automata and Language Theory (2 weeks). Finite automata, regular expressions, push-down automata, context free grammars, pumping lemmas.


III Complexity Theory (7 weeks). Time and space measures of complexity, complexity classes P, NP, L, NL, PSPACE, BPP and IP, complete problems, P versus NP conjecture, quantifiers and games, hierarchy theorems, provably hard problems, relativized computation and oracles, probabilistic computation, interactive proof systems.
   – Final Exam: 3 hours, emphasizing second half of the course.

Prerequisites

To succeed in this class you need a good facility with mathematical concepts, theorems, and proofs. If you did reasonably well in 6.042, 18.200, or any other proof-oriented mathematics class, you should be fine. The class moves quickly, covering about 90% of the textbook. The homework assignments generally require proving some statement, and creativity in finding proofs will be necessary.

Note that 6.045 has a significant overlap with 18.404, depending on who is teaching 6.045, and it often uses the same book though it generally covers less, with less depth, and with easier problem sets. Taking 6.045 before 18.404 isn’t required or recommended.
Should I register for 18.404, 18.4041, or 6.840?

Course 18 and 18C majors may register only for 18.404 which carries undergraduate (U) credit. All other majors, including double majors with Course 18 and 18C, should register for 18.4041 or 6.840 which carry graduate (G) credit (may be useful in MEng programs). Besides the above, the subject number doesn’t affect the course material or grading.

Textbook

You may use the second edition, but it is missing some additional practice problems.
We will cover Chapters 1, 2 (except 2.4), 3, 4, 5, 6.1, 7, 8, 9.1, 9.2, 10.2 (except the part on Primality), and 10.4 through Theorem 10.33.

Recitations

Recitations are primarily for going over lecture material in more detail with additional examples and for answering questions. Recitation attendance is optional, and you may attend any recitation you wish. BUT, if you are having trouble, we expect you to attend recitations weekly, and active participation may improve low grades.

Grading

- **Homework**: 40% of grade, based on 6 biweekly problem sets. Cooperating on homework is allowed and may be helpful, but you are strongly encouraged to spend some time thinking about each problem yourself first. Solutions must be written up individually (not copied). *Using course bibles or other outside or online materials is not permitted.* Homework is submitted online via Gradescope, due by 2:30pm Cambridge time on days given by the Course Schedule (see homepage). Unexcused late homework will be accepted on the following day up to 11:59pm, but will be charged a 1 point per problem (out of the 10 point maximum) late penalty. After that date, homework may be submitted by email only. It will not be graded but will be kept for reference. If personal or medical problems interfere with your work, please contact Student Support Services at studentlife.mit.edu/s3.

- **Quizzes**: 25% of grade. Given during each live lecture and following each recorded lecture.

- **Exams**: One midterm (15% of grade) on October 15, 2020, and one final (20% of grade) during finals week. Both are open book. My current plan is to have each exam set for a fixed amount of time (midterm 90 minutes, final 180 minutes) that can begin at any time during the designated day, according to student preference. Once a student downloads the exam, they will have the set time (plus some extra time for printing it) before they must return it by email.

We expect that all students will complete the exams and quizzes on their own individually, without assistance from others.