Instructor: Michael Sipser, 2–438, 3–4992, sipser@mit.edu, office hours: Tu 4:10–6:00.
Homepage: http://math.mit.edu/~sipser/18404/

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Course Outline

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


– Midterm Exam: Thursday, October 27, 2016.

III Complexity Theory (7 weeks). Time and space measures, hierarchy theorems, complexity classes P, NP, L, NL, PSPACE, BPP and IP, complete problems, P versus NP conjecture, quantifiers and games, provably hard problems, relativized computation and oracles, probabilistic computation, interactive proof systems.

– Final Exam: 3 hours, emphasizing second half of the course.

Prerequisites

Official: 18.200 or 18.062J/6.042J. Real: You need to be comfortable working with mathematical theorems and proofs. Most of the assignments in this course require proving some statement, and creativity in finding proofs will be necessary.


Recitations

Recitations are primarily for going over lecture material in more detail, for answering questions and for reviewing homework and exams. Recitation attendance is optional, and you may attend any recitation you wish. BUT, if you are having trouble with the course, we expect you to attend recitations weekly, and attendance may help you pass.

No recitations during the first week.

Grading

• Homework: 40% of grade. Will be 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 due in the boxes near 4-174 by 2:30pm sharp. Unexcused late homework will be accepted in those boxes the following day up to 1:00pm, but will be charged a 1 point per problem (out of the 10 point maximum) late penalty. Homework submitted after that time 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 http://web.mit.edu/uaap/s3/.

• Exams: One midterm (20% of grade) during a class session and one final (40% of grade) during finals week. Both open book.
2016 Schedule for 18.404/6.840

1. Sep 8  Introduction, finite automata, regular expressions
2. 13 Tu  Nondeterminism, closure properties, regular expressions ↔ FA
3. 15 Tu  Regular pumping lemma, context free languages
4. 20 Tu  Pushdown automata, CFG ↔ PDA
5. 22 hw 1 CF pumping lemma, Turing machines
6. 27 Tu  TM variants, Church–Turing thesis
7. 29 Tu  Decision problems for automata and grammars
8. Oct 4 Tu  Undecidability
9. 6 hw 2  Reducibility
10. 13 Tu  NO CLASS — Columbus Day
11. 18 Tu  Linearly bounded automata, PCP
12. 20 hw 3 Time complexity
13. 25 Tu  P and NP, SAT, poly-time reducibility
14. 27 Midterm Exam
15. Nov 1 Tu  NP-completeness
16. 3 Tu  Cook–Levin theorem
17. 8 Tu  Space complexity, PSPACE, Savitch’s theorem
18. 10 hw 4 PSPACE-completeness
19. 15 Tu  Games, Generalized geography
20. 17 Tu  L and NL, NL=coNL
21. 22 Tu  Hierarchy theorems
24. NO CLASS — Thanksgiving
22. 29 Tu  hw 5 Provably intractable problems, oracles
23. Dec 1 Tu  Probabilistic computation, BPP
24. 6 Tu  Probabilistic computation, contd.
25. 8 hw 6 Interactive proof systems, IP
26. 13 Tu  IP contd.