

CMSC 652- Complexity Theory

TEXT: Notes will be handed out.

PREREQUISITE: The prerequisite is CMSC 451 or CMSC 452 or permission of the instructor.

GRADING: One Midterm, One Final, Approx 10 HWs. HW is 30% of the grade. MIDTERM is 30% of the grade. Final is 40% of the grade. Some of the HW will be oral assignments done in teams.

EXAM DAYS : The Midterm will be Tuesday Oct 30 AT NIGHT, 7:00PM-9:00PM in CSI 2118, our usual classroom. The Final will be Tuesday Dec 18, 8:00AM-10:00AM in CSI 2118, our usual classroom.

STAFF, OFFICE HOURS, CLASS HOURS: Course meets MWF 12-1 in CSI 2118. Gasarch's office hours will be M 1-2, W 2-3, or by appt. The TA is Tom DuBois, office hours will be 11-noon on TuTh in AVW 1112.

COURSE WEBSIE: www.cs.umd.edu/~gasarch/652/652.html

THEME: Theory is the question 'given a problem, how hard is it?' Algorithms tries to show that problems are easy. Complexity theory tries to show that problems are hard. In this class we will emphasize results that show that certain problems are hard or are hard to classify. We intend to give self-contained proofs of results that tell you things about real problems like Graph Isomorphism or PARITY-SAT.

Syllabus: We will be covering the following topics.

1. Are there problems that are actually unsolvable? Basic Computability theory. Turing Machines, HALT, reductions.
2. Do we actually know anything? Time-hierarchy theorems, Savitch's theorem, and the Immerman-Szelepcsenyi Theorem.
3. Why do we think SAT and other problems are hard? NP completeness and Reductions. Why do we think Quantified SAT is even harder? The Polynomial Hierarchy and PSPACE.
4. Does randomization help? Randomized Complexity Classes. R , BPP , $BPP \subseteq \Sigma_2^P$.
5. Why do we think PARITY-SAT is much harder than SAT?
6. Why do we think Sparse sets are NOT NP-Complete? NP-hard under various reductions? Advice classes.
7. Why do we think Graph Isomorphism is NOT NP-complete?
8. Why do we think Clique and many other problems are hard to approximate? Applications of the PCP theorem (We will not prove the PCP theorem. That would be an entire course.)