CSE 725 - Computability and unsolvability

Lectures: MWF 10:30am–11:18am, Caldwell Lab 0133
Instructor: Luis Rademacher
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Textbook: Michael Sipser, Introduction to the Theory of Computation, 2nd edition. Other books: C. Papadimitriou, Complexity Theory. S. Arora and B. Barak, Complexity Theory, a Modern Approach.

Prerequisites

CSE 625 or equivalent or consent of instructor. Automata theory, mathematical background/maturity (Chapter 0 of Sipser's book: mathematical proof, by contradiction, by induction, sets, relations, functions, cardinality).

Topics (tentative)

Computation, algorithm, models. Definition of Turing machines. Languages. Recognizable, decidable. Variants of TM, equivalences, Church-Turing thesis. Non-determinism. Decidability. Diagonalization method. The halting problem. Universal Turing machine. Reductions. More undecidable problems. Rice's theorem. The recursion theorem.

Complexity measures. Complexity classes. Class P. Class NP. The P vs NP question. More reductions. Polynomial time reductions. NP-hardness. NP-completeness. Cook-Levin theorem. SAT, 3-SAT. Additional NP-complete problems. vertex-cover, hamiltonian-path, subset-sum, knapsack, coloring, IP.

Space complexity. Savitch's theorem. PSPACE.

Grading (tentative)

Three problem sets. For homework, collaboration is allowed, but every student must write and submit his or her own solutions, and include an explanation of any such collaboration. Looking for solutions from external sources (books, the web, etc.) is prohibited.

One midterm and one final exam.

Formula (tentative): 30% homework, 30% midterm, 40% exam.