CST/MATH 337 Theory of Computation (Spring 2008)

Time and location

- Thursday 6:00-8:30
- Teleconferenced, SCH 614 (every odd week), GB 407 (every even week)

Instructor

Dr. Evgeny Dantsin

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- Webpage: cs.roosevelt.edu/~dantsin/
- Office hours: Thursday 3:00-6:00, SCH 632 (every odd week), GB 506B (every even week)

Course description

Foundations of computing with emphasis on questions of what can and cannot be computed in principle, what can and cannot be computed efficiently. Models of computation, decidable and undecidable problems, computational complexity.

Course objectives

The course provides students with an understanding of basic concepts, methods, and results of theory of computation. Upon successful completion of the course, students will be able to apply them to evaluate the computability and complexity of computational problems.

Textbooks

- ***Primary book:*** Michael Sipser. *Intorduction to the Theory of Computation*. 2nd edition. Thomson Course Technology, 2005. ISBN-10: 0534950973.
- ***Recommended book:*** Christos H. Papadimitriou. *Computational Complexity*. Addison-Wesley, 1994.

Prerequisites

Math 245 - Discrete Structures

Tentative schedule

Week	Topics	Homework	Textbook
1	Course introduction. Computational problems. Decision problems, search problems, and optimization problems. Encoding of instances. Languages. Equivalence between languages and decision problems.		xi-xii, 1-16
2	The Church-Turing thesis. Definition of a Turing machine. Examples of languages decided by Turing machines. Variants of Turing machines. Random access machines.	HW-1	137-150, 153-163
3	Recognizable and decidable languages. Undecidability. The diagonalization method. Countable and uncountable sets. Existence of unrecognizable languages.		142, 152-153, 165, 173-178
4	Examples of problems that are recognizable and undecidable (the	HW-2	179-189

	acceptance problem). Reduction of the acceptance problem to the halting problem.		
5	Time complexity of algorithms. Asymptotic notation. Examples of measuring the time complexity.		247-256
6	Complexity relationships among models of computation. Polynomial time and class P. Examples of problems in P.	HW-3	256-263
7	Examples of problems for which no polynomial-time algorithms are known. The class NP: definition in terms of polynomial-time verification and in terms of nondeterministic Turing machines.		264-269
Spring Break			
8	Midterm exam		
9	The P versus NP problem. Polynomial-time reductions. NP-hard and NP-complete problems. The Cook-Levin theorem.		269-283
10	Examples of NP-complete problems. Examples of polynomial-time reductions.	HW-4	283-302
11	Quantified Boolean formulas. The class PSPACE and PSPACE-complete problems. Winning strategies for games.		309-320
12	Probabilistic algorithms. Monte Carlo and Las Vegas algorithms. The class BPP. Examples of probabilistic algorithms.	HW-5	368-380
13	Optimization problems and approximation algorithms. Examples of approximation algorithms. Limits on polynomial-time approximation.		365-367
14	Review of the course. Preparation for the final exam.		
15	Final exam		

Homework assignments and exams

There will be five take-home assignments and two class exams (open books, open notes). All homework assignments are due on the next class session. They must be turned in on time; late assignments will not be accepted without prior consent of the instructor.

Grading

The final grade will be based on the total number of points earned on five homework assignments (total maximum: 60 points), a midterm exam (maximum: 20 points), and a final exam (maximum: 20 points). Overall grades will be assigned on the following scale:

A	B	C	D	F
≥ 90%	≥ 75%	≥ 60%	≥ 45%	< 45%

Statement on cheating and plagiarism: Instances of academic dishonesty will be handled as described in University policies. Depending on the severity of the violation, an instructor may fail a student on the individual assignment or test, may lower the student's grade in the course, or may fail the student in the course. More details on the University's policies on academic honesty may be found in the Student Handbook.

Lecture notes

Lecture notes, slides, homework assignments, and other course materials will be posted on the Blackboard website after every lecture.