COS 487: Theory of Computation

Course Announcement

Monday, September 18

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This objective in this course is to study two kinds of questions at a theoretical level. First, what computations can be performed on a computer? (This is the subject of computability theory.) Second, how efficiently can they be performed? (This is the subject of complexity theory.) These questions will ultimately be studied with respect to an idealized model of the computer, namely, the Turing machine. But we will start off by studying weaker models of computation: finite automata and grammars.

The issues studied in this course constitute the logical foundations of computer science. Time permitting, we will explore how they touch upon current areas of research, including AI, robotics, quantum computation, computer security and cryptography.

Both grads and undergrads are welcome to take the course. Some minimal level of mathematical sophistication will be assumed; COS 341 (or an equivalent course) is adequate preparation.

The text will be *Theory of Computation* by Michael Sipser, printed by PWS publishing.

Grading: 50% of the grade will be based upon assignments, which will be handed out every two weeks. Only 80% of the assignment problems count towards your grade (i.e., at the end of the semester you get a full score if you correctly answer four out of every five problems assigned in homeworks).

There will be two takehome exams (in October and December). The exams are open-book.

There might also be a small project to do at the end of the semester.

Tentative course contents: Finite automata and regular languages. Context-free grammars and push-down automata. Computability theory: halting problem, computability, and Gödel's incompleteness theorem. Complexity theory: time and space hierarchy theorems, polynomial time computations, P v/s NP, NP-completeness and PSPACE-completeness. Connections to applications areas.

Honor Code for this class:

Collaborating with your **classmates** on assignments is OK and even encouraged. You must, however, list your collaborators for each problem. The assignment questions have been carefully selected for their pedagogical value and may be similar to questions on problem sets from past offerings of this course or courses at other universities. Using any preexisting solutions from these other sources is **strictly prohibited**.