Course: Logic in Computer Science

Time and Place: Tuesday & Thursday 10:00-11:45 am, Crown College Classroom 202.

Instructor: Phokion G. Kolaitis; office: E2 345A; phone: x9-4768, e-mail: kolaitis@cs.ucsc.edu; web: http://users.soe.ucsc.edu/~kolaitis/

Office Hours: Tuesday 3:30-4:30 pm and Thursday 4:30-5:30 pm, E2 345A.

Textbook:

Required Logic for Computer Scientists, by Uwe Schöning, Birkhauser.

Recommended Logic for Mathematics and Computer Science, by Stanley N. Burris, Prentice-Hall.

Overview and Goals: Logic plays a fundamental role in many core areas of computer science, including computer architecture (circuit design), programming languages (semantics, language design, logic programming), theory of computation (automata and formal languages, computability, computational complexity), artificial intelligence (automated theorem proving, knowledge representation), software engineering (formal methods for specification and verification), and relational database systems (SQL is a query language based on first-order logic).

The main goal of this course is to present the basic concepts, methods, and results of propositional and first-order logic, and to prepare the students for using logic as a tool in computer science. The course will be taught from a computer science perspective with particular emphasis on algorithms and computational complexity.

Syllabus: The following is a tentative list of topics.

Propositional Logic: Syntax and semantics, disjunctive and conjunctive normal forms, complete sets of connectives, the compactness theorem, resolution in propositional logic, the Davis-Putnam procedure, propositional satisfiability and NP-completeness, efficient algorithms for satisfiability of Horn formulas and 2CNF formulas (four weeks).

Fundamentals of First-Order Logic: Syntax and semantics, prenex normal form, first-order logic as a specification language, first-order logic as a database query language (two to three weeks).

Resolution, Unification, and Completeness: Skolem normal form, the Herbrand universe, Herbrand’s theorem, resolution in first-order logic, unification, efficient algorithms for unification, Gödel’s completeness theorem for first-order logic (two to three weeks).

Additional Topics: Algorithmic aspects of the completeness theorem, the compactness theorem, limitations of first-order logic, second-order logic and other extensions of first-order logic (one to two weeks).

Evaluation: Performance will be evaluated on the basis of a take-home final examination, a written term project or paper accompanied by an oral presentation, written homework assignments, and class participation.

Important Dates:

- The take-home final examination will be handed out on Thursday June 6, 2013 (which is the last day of classes) and will be due via email by 9:00 am on Monday June 10, 2013.
- The oral presentations of the term projects and papers will take place from 12 noon to 3:00 pm on Tuesday June 11, 2013 (which is the designated time for the in-class final examination).