

CSI 538: Computational Logic — Course outline

This course is on computational issues in logic, with emphasis on *automated reasoning* and applications. The prerequisites are (a) Departmental examination in discrete mathematics, and (b) ICSI 503 (Algorithms and Data Structures)

Core material:

- Propositional Logic
 - satisfiability, the Davis-Putnam procedure
 - Horn clauses
- First-Order Predicate Calculus (FOPC)
 - Skolem functions
 - Herbrand's theorem
 - Clause form
 - unification, resolution
- First-Order Predicate Calculus with equality ($FOPC_{=}$)
 - Equational theories, the Knuth-Bendix completion procedure
 - Paramodulation

Additional topics may include:

- induction
- Gröbner bases and geometric reasoning
- ordered paramodulation
- other logics like propositional temporal logic, logics of knowledge
- nonclausal methods, prime implicates
- tableaux-based methods

There are several (text)books in the area. A few are given below:

References

- [1] Franz Baader and Tobias Nipkow. **Term Rewriting and all that**. Cambridge University Press, 1998.

Focusses on term rewrite systems; very comprehensive and rigorous.

- [2] Alan Bundy. *The Computer Modelling of Mathematical Reasoning*. Academic Press, 1983.

- [3] Chin-Liang Chang and Richard Char-Tung Lee. *Symbolic Logic and Mechanical Theorem Proving*. Academic Press, New York, 1973.

Classic textbook.

- [4] Melvin Fitting. *First-Order Logic and Automated Theorem Proving*. Springer-Verlag, 1990.

- [5] Jean Gallier. *Logic for Computer Science: Foundations of Automatic Theorem Proving*. Wiley, 1986.

Available online at www.cis.upenn.edu/~jean/gbooks/logic.html

- [6] Alexander Leitsch. *The Resolution Calculus*. Springer, 1997.

- [7] Anil Nerode and Richard Shore. *Logic for Applications*. Springer-Verlag New York, Inc., Secaucus, NJ, USA, 1997.

There are chapters on PROLOG, Modal logic and Intuitionistic logic. The bibliography is extensive.

- [8] Uwe Schöning. *Logic For Computer Scientists*. Birkhaeuser Verlag, 1989.

There is a review of this book in SIGACT News 36 (3) (Sept. 2005).

- [9] Larry Wos, Ross Overbeek, Rusty Lusk, and Jim Boyle. *Automated Reasoning: Introduction and Applications*. McGraw-Hill, 1992.