Computer Science 773

Formalized Mathematics

Winter 2002

Course Outline

Revised: 3 January 2002

Instructor

Dr. William M. Farmer
Office: ITB 163
Extension: 27039
E-mail: `wmfarmer@mcmaster.ca`
Web: `http://imps.mcmaster.ca/wmfarmer`
Tentative office hours: MT 14:30–15:20, WR 10:30–11:20

Course Web Site

`http://www.cas.mcmaster.ca/~wmfarmer/CS-773-02`

Lecture Schedule

M	9:30 - 11:20	ITB 222
F	8:30 - 10:20	ITB 222

Calendar Description

Computer-supported, formalized mathematical reasoning for practical applications. Specification and verification in higher-order logic. Interactive theorem proving systems. Techniques for developing axiomatic theories.

Mission

The mission of this course is to teach students how to use formalized mathematics in the specification and analysis of complex systems such as software systems. Mathematical models will be expressed in higher-order logic and set theory, and mathematical reasoning will be performed with the aid of interactive theorem proving systems.

Required Text

Imre Lakatos, *Proofs and Refutations*, Cambridge University Press, 1976. ISBN 0-521-29038-4

Work Plan

There will be two 75-minute lectures per week by the instructor. Students will be expected to attend the lectures, complete assigned exercises, and give short presentations to the class. Most of the exercises will require the use of an interactive theorem proving system. Students are required to learn how to use at least two interactive theorem proving systems, one being the IMPS Interactive Mathematics Proof System.

Tentative Schedule

00. Preliminaries

01. What is Formalized Mathematics?

02. What is Mathematics?

    - The mathematics process
    - Mathematical proof

03. Review of Logic

    - Languages, models, formal systems
    - Examples: propositional logic, first-order logic
    - Axiomatic theories

04. What is Missing from First-Order Logic?

    - Higher-order quantification
    - Undefined terms
    - Support for functions
    - Types

05. Alternative Logics

    - Partial logics
    - Higher-order logics
    - Set theories

06. Mechanized Mathematics Systems

    - Computer theorem proving systems
    - Computer algebra systems

07. Introduction to IMPS

08. The Axiomatic Method

    – Little theories method
    – Lakatos's method of proofs and refutations

09. Theory Development

    – Theory creation
    – Conservative theory extension
    – Theory exploration
    – Theory connection

10. Conjecture Proving Techniques

Policy Statements

1. Significant study and reading outside of class is required.
2. Regular class attendance is expected.
3. The student is expected to ask questions during class.
4. The student is welcome to discuss exercises with other students, but exercises must be the student's own work.
5. Exercises may not be turned in late without *prior* approval from the instructor.
6. "The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact their Department Chair, the Sexual Harassment/Anti-Discrimination Officer (SHADO), as soon as possible."
7. "Students are reminded that they should read and comply with the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available in the Senate Office" (see Senate Secretariat, Gilmour Hall, Room 104, 525-9140 or 529-7070, ext. 24337).
8. Suggestions on how to improve the course and the instructor's teaching methods are always welcomed.

Grading

The course grade will be based on the student's performance on the exercises and presentations. The exercises will be worth a total of 200 points. Presentations will be graded on a pass/fail basis. A student's grade for the course will be awarded on the basis of how many points the student receives on the exercises and how many passing presentations the student gives according to the table below.

Exercise Points	Presentations	Course Grade
170–200	2 or more	A^+
140–169	2 or more	A
120–139	2 or more	A^-
120–200	1	B^+
110–119	1 or more	B^+
100–109	1 or more	B
90–99	1 or more	B^-
90–200	0	C
70–89	0 or more	C
50–69	0 or more	D
0–49	0 or more	F