

# William M. Farmer

## Curriculum Vitae

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### Addresses and Phone Number

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### Area of Specialty

*Applied Logic.*

### Areas of Expertise

*Mechanized Mathematics* (interactive theorem proving, rigorous symbolic computation, specification/verification environments, mathematical knowledge management).

*Logic* (higher-order logic, undefinedness and partial functions, theory interpretation, definition principles, practical versions of set theory, quotation/evaluation).

*Formal Methods in Software Development* (little theories method).

### Education

Ph.D., Mathematics, University of Wisconsin-Madison, Madison, Wisconsin, USA, 1984. (Specialty: *Logic*; Ph.D. Thesis: *Length of Proofs and Unification Theory*; Advisor: *Kenneth Kunen*.)

M.S., Computer Sciences, University of Wisconsin-Madison, Madison, Wisconsin, USA, 1983.

M.A., Mathematics, University of Wisconsin-Madison, Madison, Wisconsin, USA, 1980.

B.A., Mathematics, *summa cum laude*, University of Notre Dame, Notre Dame, Indiana, USA, 1978.

## Employment

2005 – present: Professor, Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada.

1999 – 2005: Associate Professor, Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada. (Awarded tenure July 2002.)

1997 – 1999: Assistant Professor, Microcomputer Studies Program, Department of Statistics, St. Cloud State University, St. Cloud, Minnesota, USA.

1991 – 1997: Lead Scientist, The MITRE Corporation, Bedford, Massachusetts, USA.

1985 – 1991: Member of Technical Staff, The MITRE Corporation, Bedford, Massachusetts, USA.

1978 – 1984: Teaching Assistant, Department of Mathematics, University of Wisconsin-Madison, Madison, Wisconsin, USA.

## Major Administrative Positions

- 2011 – 2016: Chair, Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada.
- 2005 – 2009: Associate Chair for Undergraduate Studies, Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada.

## Licenses

- 2007 – present: Licensed Professional Engineer, Professional Engineers Ontario (PEO).

## Teaching Experience at McMaster

- In 2017–18, I will teach a first-year computer science course on computational thinking, a second-year computer science and software engineering course on discrete mathematics, and a foundational graduate course on logic and discrete mathematics.
- In 2016–17, I was on administrative leave.
- In the fall and winter terms of 2015–16, I taught a first-year engineering course on engineering computation.

- In the fall and winter terms of 2014–15, I taught a first-year engineering course on engineering computation.
- In the winter term of 2013–14, I taught a first-year engineering course on engineering computation and a graduate research course on formalized mathematics.
- In the winter term of 2012–13, I taught a first-year engineering course on engineering computation.
- In the winter term of 2011–12, I taught a first-year engineering course on engineering computation.
- In the fall term of 2010–11, I taught a first-year engineering course on engineering computation. I was on research leave during the winter term of 2010–11.
- In 2009–10, I taught an undergraduate computer science and software engineering course on principles of programming, a first-year engineering course on engineering computation, and a graduate research course on logic for practical use.
- In 2008–09, I taught undergraduate computer science and software engineering courses on (1) principles of programming and (2) computer networks and security and a graduate foundational software engineering course on logic and discrete mathematics.
- In 2007–08, I taught undergraduate computer science and software engineering courses on (1) information security and (2) computer networks and security and a graduate research course on formalized mathematics.
- In 2006–07, I taught undergraduate software engineering courses on (1) software design and (2) computer networks and security and a graduate research course on formalized mathematics.
- In 2005–06, I taught undergraduate software engineering courses on (1) logic and (2) computer networks and security and a graduate foundational software engineering course on logic and discrete mathematics.
- In 2004–05, I taught an undergraduate software engineering course on communication skills, a graduate foundational software engineering course on logic and discrete mathematics, and a graduate research course on formalized mathematics.
- In 2003–04, I was on research leave.
- In 2002–03, I taught undergraduate software engineering courses on (1) software design and (2) computer networks and security and a graduate foundational software engineering course on logic and discrete mathematics.

- In 2000–02, I taught undergraduate software engineering courses on (1) software design and (2) computer networks and security and a graduate computer science course on formalized mathematics.
- In 1999–00, I taught undergraduate software engineering courses on (1) software design, (2) concurrent programming, and (3) communication skills.

### Other Teaching Experience

- In 1998–99 at St. Cloud State University, I taught semester courses on beginning programming based on Visual Basic (2 semesters), internet protocols (2), network security (1), and web site management (1).
- In 1997–98 at St. Cloud State University, I taught quarter courses on beginning programming based on Visual Basic (3 quarters), network security (1), and web site management (1).
- In 1997–99 at the Oak Hill Community School in St. Cloud, I taught two mathematics enrichment courses (16 and 12 lessons) for selected second grade and third grade students.
- For 12 semesters and one summer session I taught mathematics as a teaching assistant in the Department of Mathematics at the University of Wisconsin-Madison (August 1978 to December 1984). The courses included calculus I, II, III, pre-calculus, and remedial mathematics.

### Doctoral Students at McMaster

1. Pouya Larjani  
“Software Specialization as Applied to Computational Algebra”  
Ph.D. in Computer Science  
Department of Computing and Software  
April 2013
2. Jian Xu  
“Mei — A Module System for Mechanized Mathematics Systems”  
Ph.D. in Computer Science  
Department of Computing and Software  
January 2008

### Master’s Students at McMaster

1. Qian Hu  
“Reasoning about Definedness — A Definedness Checking System for an Implemented Logic”  
M.Sc. in Computer Science  
Department of Computing and Software  
October 2011

2. Quang Minh Tran  
“Algebraic Constructions Applied to Theories”  
M.Sc. in Computer Science  
Department of Computing and Software  
June 2011
3. Han Yin (Chris) Zhang  
“Simplification Infrastructure for an Implementation of the Chiron Logic”  
M.Sc. in Computer Science  
Department of Computing and Software  
September 2010
4. Mehwish Abbasi  
“Development of a Portion of a Theory Library for Mechanized Mathematics Systems” M.Sc. in Computer Science  
Department of Computing and Software  
September 2009
5. Orlin Grigorov  
“Panoptes: An Exploration Tool for Formal Proofs”  
M.Sc. in Computer Science  
Department of Computing and Software  
June 2008
6. Pouya Larjani  
“Algebraic Processors”  
M.Sc. in Computer Science  
Department of Computing and Software  
August 2007
7. Ramez Mousa  
“An Implementation of the Snoop Protocol for the Linux 2.6 Kernel Series”  
M.Eng. in Software Engineering  
Department of Computing and Software  
April 2006
8. Zhihui Dong  
“A Formal Theory of Financial Contracts”  
M.Sc. in Computer Science  
Department of Computing and Software  
August 2004
9. Dianne Miller  
“Two Formal Theories of Character Strings”  
M.Sc. in Computer Science  
Department of Computing and Software  
September 2002

10. Ping Tan (cosupervisor: J. I. Zucker)  
“Mechanical Verification of Machine Integer Programs in a Fragment of C”  
M.Sc. in Computer Science  
Department of Computing and Software  
September 2002
11. Yan Li  
“IMPS to OMDoc Translation”  
M.Sc. in Computer Science  
Department of Computing and Software  
August 2002

### Postdoctoral Fellows at McMaster

1. Russell O’Connor (cosupervisor: Jacques Carette)  
MathScheme Project  
September 2009 – September 2012
2. Jérémie Wajs (cosupervisor: M. v. Mohrenschildt)  
MathScheme Project  
October 2002 – September 2003

### Research Experience at McMaster

- In 2015, I received an NSERC Individual Discovery Grant for a period of five years for a project entitled “Reasoning about Syntax-Based Mathematical Algorithms within a Formal Logic”.
- In 2010, I received an NSERC Individual Discovery Grant for a period of five years for a project entitled “MathScheme: Integrating Axiomatic and Algorithmic Mathematics”.
- In 2009, I began receiving 5-years of funding under the MRI Ontario, Ontario Research Fund (ORF) Research Excellence (RE) grant entitled “Certification of Safety Critical Software Intensive Systems” (principal investigators are T. Maibaum, M. Lawford, A. Wassyn) to develop a software knowledge repository for the McMaster University Centre for Software Certification (McSCert).
- In 2007, Tom Maibaum, Alan Wassyn, and I received a CFI Leaders Opportunity Fund research infrastructure grant entitled “Visual Design and Analysis Laboratory (VIDALAB)”.
- In 2005, I received an NSERC Individual Discovery Grant for a period of five years for a project entitled “MathScheme: A Mechanized Mathematics System that Integrates Formal Deduction and Symbolic Deduction”.

- In 2001, Dr. M. v. Mohrenschildt and I started the “MathScheme” project to develop a formal framework that integrates and generalizes symbolic computation and formal deduction. The project received seed funding from Bell Canada and MITACS in 2001 and an additional seed funding from MITACS in 2002.
- In 2000, I received an NSERC Individual Research Grant for a period of five years for a project entitled “Mechanized Mathematics”.

## Research Experience at MITRE

At MITRE I was a leading member of a research group composed of 8–10 Ph.D. logicians, mathematicians, and computer scientists. The group did work primarily in formal methods (the use of logical and mathematical techniques to improve the development and analysis of computer software and hardware), automated reasoning, and information security. The following are the major projects I worked on:

- 1995 – 1997: I worked on a project, sponsored by the National Security Agency (NSA), to develop an prototype interactive system for specifying, analyzing, and implementing network security policies. The system was primarily implemented in Java. A central component of the system was a mathematical model of packet filtering in computer networks.
- 1995 – 1997: I also worked on a MITRE-Sponsored Research project to design a security architecture for mobile computing agents. The architecture addressed the problem that, as an agent traverses multiple hosts that are trusted to different degrees, its state may change in ways that adversely impact its functionality.
- 1993 – 1995: I was a member of the VMACH project sponsored jointly by MITRE and NSA. The project’s objective was to develop high assurance versions of critical portions of the Mach operating system microkernel. My main task on the project was to formulate a denotational semantics for a multithreaded version of the PreScheme programming language.
- 1993 – 1994: Under an NSA-funded project, a colleague and I devised a method for formally analyzing numerical programs and a software system that implements the method. The software system translates a purely functional PreScheme program that manipulates machine integers into a representation that can be analyzed using the IMPS theorem proving facility (see under **Released Software** below).
- 1990 – 1993: I was the principal investigator of a MITRE-Sponsored Research project to develop the IMPS Interactive

Mathematical Proof System (see under **Released Software** below). The project produced a new logic and methodology for formalizing mathematics as well as the design and implementation of the IMPS system itself. I was responsible for a total budget of \$887,000 US. Some additional funding for the development and application of IMPS was received from NSA and the U.S. Army.

- 1989 – 1992: I was a member of the VLISP project sponsored jointly by MITRE and the U.S. Air Force (Rome Laboratory). The project produced a comprehensively verified implementation of the Scheme programming language, the first verified implementation of any programming language in actual use (see under **Selected Technical Reports** below).
- 1988 – 1989: I participated on a MITRE-Sponsored Research project that produced an implementation of a fault-tolerant functional programming system on a parallel computing machine. With my colleagues I wrote a formal specification of the system’s theoretical model of computation. We also completed, for the U.S. Navy, a preliminary formal verification of the correctness of one component of the system—a combinator reduction machine fabricated in hardware called the Curry Chip. While studying the Curry Chip we were led to several interesting questions about graph-rewriting.
- 1987 – 1989: I was a principal member of a MITRE-Sponsored Research project that studied the design and verification of software module interfaces. The project developed a specification language and software for processing specifications. Many of the ideas and much of the code produced on this project were incorporated into the IMPS theorem proving system.
- 1985 – 1987: I worked on a series of projects sponsored jointly by MITRE and the U.S. Air Force (Rome Laboratory) whose common objective was to design and build a state-of-the-art program verification system. I played a key role in the design of system’s theorem prover.
- 1985 – 1986: I helped review for NASA the formal design verification of the Restricted Access Processor (RAP).

In addition to the research mentioned above, I also did research at MITRE in federated databases, concurrency, logic programming, higher-order unification, and complexity of proofs.

### Papers in Refereed Journals

1. W. M. Farmer, “The seven virtues of simple type theory”, *Journal of Applied Logic*, 6:267–286, 2008. DOI: 10.1016/j.jal.2007.11.001. Review: MR 2437315.



2. W. M. Farmer and M. v. Mohrenschildt, “An overview of a Formal Framework for Managing Mathematics”, in: B. Buchberger, G. Gonnet, and M. Hazewinkel, eds., *Mathematical Knowledge Management*, special issue of *Annals of Mathematics and Artificial Intelligence*, 38:165–191, 2003. Review: MR 1990419. Preliminary version entitled “A Formal Framework for Managing Mathematics”, in: B. Buchberger and O. Caprotti, eds., *Electronic Proceedings of the First International Workshop on Mathematical Knowledge Management: MKM 2001*, 37 pp., 2001.
3. W. M. Farmer, “STMM: A Set Theory for Mechanized Mathematics”, *Journal of Automated Reasoning*, 26:269–289, 2001. Review: MR 1817802 (2001m:03028). Preliminary version entitled “STMM and partial functions”, in: M. Kerber, ed., *Proceedings of the Workshop on the Mechanization of Partial Functions*, pp. 3–14, CADE-15, Lindau, Germany, July 5, 1998.
4. W. M. Farmer and J. D. Guttman, “A set theory with support for partial functions”, in: E. Thijsse, F. Lepage, and H. Wansing, eds., *Partiality and Modality*, special issue of *Studia Logica*, 66:59–78, 2000. Review: MR 1805961 (2001m:03027).
5. W. M. Farmer, J. D. Guttman, and F. J. Thayer, “Contexts in mathematical reasoning and computation”, *Journal of Symbolic Computation*, 19:201–216, 1995. Review: MR 1339118 (96d:68106). Preliminary version entitled “Reasoning with contexts” in: A. Miola, ed., *Design and Implementation of Symbolic Computation Systems (International Symposium, DISCO '93, Gmunden, Austria, September 1993, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 722, pp. 216–228, Springer, 1993.
6. W. M. Farmer, “Reasoning about partial functions with the aid of a computer”, *Erkenntnis*, 43:279–294, 1995. Review: MR 1396839 (98g:03035). Abbreviated version entitled “Mechanizing the traditional approach to partial functions”, in: W. Farmer, M. Kerber, and M. Kohlhase, eds., *Proceedings of the Workshop on the Mechanization of Partial Functions*, pp. 27–32, CADE-13, Rutgers University, New Brunswick, New Jersey, USA, July 30, 1996.
7. W. M. Farmer, J. D. Guttman, and F. J. Thayer, “IMPS: An Interactive Mathematical Proof System”, *Journal of Automated Reasoning*, 11:213–248, 1993. **Received MITRE 1993 Best Paper Award.**
8. W. M. Farmer, “A simple type theory with partial functions and subtypes”, *Annals of Pure and Applied Logic*, 64:211–240, 1993. Review: MR 1253830 (95c:03022).

9. W. M. Farmer, “The Kreisel length-of-proof problem”, in: *Logic and Combinatorics*, J. Franco, J. M. Dunn, and W. H. Wheeler, eds., special issue of *Annals of Mathematics and Artificial Intelligence*, 6:27–55, 1992. Review: MR 1279419 (95a:03075).
10. W. M. Farmer, “A unification-theoretic method for investigating the  $k$ -provability problem”, *Annals of Pure and Applied Logic*, 51:173–214, 1991. Review: MR 1098781 (92g:03081).
11. W. M. Farmer, “Simple second-order languages for which unification is undecidable”, *Theoretical Computer Science*, 87:25–41, 1991. Review: MR 1130144 (93h:03061).
12. W. M. Farmer and R. J. Watro, “Redex capturing in term graph rewriting”, *International Journal of the Foundations of Computer Science*, 1:369–386, 1990. Review: MR 1103236 (92m:68055). Concise version in: R. V. Book, ed., *Rewriting Techniques and Applications (4th International Conference, RTA-91, Como, Italy, April 1991, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 488, pp. 13–24, Springer, 1991. Review: MR 1104466 (92b:68018).
13. W. M. Farmer, “A partial functions version of Church’s simple theory of types”, *Journal of Symbolic Logic*, 55:1269–1291, 1990. Review: MR 1071328 (91k:03017).
14. W. M. Farmer, J. D. Ramsdell, and R. J. Watro, “A correctness proof for combinator reduction with cycles”, *ACM Transactions on Programming Languages and Systems*, 12:123–134, 1990. Review: CR 9012-0972.
15. W. M. Farmer, “A unification algorithm for second-order monadic terms”, *Annals of Pure and Applied Logic*, 39:131–174, 1988. Review: MR 0955521 (89k:03010).

### Papers in Refereed Books

1. W. M. Farmer and Q. Hu, “FCL: A formal language for writing contracts”, in: S. H. Rubin and T. Bouabana-Tebibel, eds., *Quality Software Through Reuse and Integration, Advances in Intelligent Systems and Computing*, Vol. 561, 20 pp., Springer, 2018 (forthcoming). Preliminary version entitled “A formal language for writing contracts”, in: *2016 IEEE 17th International Conference on Information Reuse and Integration (IRI 2016)*, pp. 134–141, IEEE, 2016.
2. W. M. Farmer, “Mathematical knowledge management”, in: D. G. Schwartz, ed., *Encyclopedia of Knowledge Management*, Information Science Reference, pp. 599–604, 2005. Republished in: (1) M. E. Jen- nex, ed., *Knowledge Management: Concepts, Methodologies, Tools and*

*Applications*, Chapter 7.3, pp. 2976–2983, Information Science Reference, 2007 and (2) D. G. Schwartz and D. Te’eni, eds., *Encyclopedia of Knowledge Management, Second Edition*, IGI Global, pp. 1082–1089, 2011.

3. W. M. Farmer, “Theory interpretation in simple type theory”, in: J. Heering et al., eds., *Higher-Order Algebra, Logic, and Term Rewriting (First International Workshop, HOA ’93, Amsterdam, The Netherlands, September 1993, Selected Papers)*, *Lecture Notes in Computer Science*, Vol. 816, pp. 96–123, Springer, 1994. Review: MR 1321380 (95m:03011).

### Papers in Refereed Conference Proceedings

1. J. Carette and W. Farmer, “Formalizing Mathematical Knowledge as a Biform Theory Graph: A Case Study”, in: H. Geuvers, M. England, O. Hasan, F. Rabe, and O. Teschke, eds., *Intelligent Computer Mathematics (10th International Conference, CICM 2017, Edinburgh, UK, 2017, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 10383, pp. 9–24, Springer, 2017 (without appendices). Preprint with appendices: arXiv: 1704.02253 (43 pp.), 2017.
2. W. M. Farmer, “Theory Morphisms in Church’s Type Theory with Quotation and Evaluation”, in: H. Geuvers, M. England, O. Hasan, F. Rabe, and O. Teschke, eds., *Intelligent Computer Mathematics (10th International Conference, CICM 2017, Edinburgh, UK, 2017, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 10383, pp. 147–162, Springer, 2017. Preprint: arXiv:1703.02117, 2017.
3. W. M. Farmer, “Incorporating quotation and evaluation into Church’s type theory: Syntax and semantics”, in: M. Kohlhase, M. Johansson, B. Miller, L. de Moura, F. Tompa, eds., *Intelligent Computer Mathematics (9th International Conference, CICM 2016, Bialystok, Poland, July 25–29, 2016, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 9791, pp. 83–98, Springer, 2016. Preprint: arXiv:1605.07068, 2016.
4. J. Carette, W. M. Farmer, and M. Kohlhase, “Realms: A structure for consolidating knowledge about mathematical theories”, in: S. Watt, J. Davenport, A. Sexton, P. Sojka, and J. Urban, eds., *Intelligent Computer Mathematics (CICM 2014 Joint Events: Calculemus, DML, MKM, and Systems and Projects 2014, Coimbra, Portugal, July 7–11, 2014, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 8543, pp. 252–266, Springer, 2014. Preprint: arXiv:1405.5956, 2014. **Received MKM Track Best Paper Award.**
5. W. M. Farmer, “The formalization of syntax-based mathematical algorithms using quotation and evaluation”, in: J. Carette, D. Aspinall,

- C. Lange, P. Sojka, and W. Windsteiger, eds., *Intelligent Computer Mathematics (MKM, Calculemus, DML, and Systems and Projects 2013, held as Part of CICM 2013, Bath, UK, July 8–12, 2013, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 7961, pp. 35–50, Springer, 2013. Preprint: arXiv:1305.6052, 2013.
6. J. Carette, W. M. Farmer, and R. O'Connor, "MathScheme: Project description", in: J. H. Davenport, W. M. Farmer, F. Rabe, and J. Urban, eds., *Intelligent Computer Mathematics (18th Symposium, Calculemus 2011 and 10th International Conference, MKM 2011, Bertinoro, Italy, July 18–23, 2011, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 6824, pp. 287–288, Springer, 2011. Preprint: arXiv:1106.1862, 2011.
  7. J. Carette, W. M. Farmer, F. Jeremic, V. Maccio, R. O'Connor, and Q. M. Tran, "The MathScheme Library: Some preliminary experiments", in: A. Asperti, J. H. Davenport, W. M. Farmer, F. Rabe, and J. Urban, eds., *Conference on Intelligent Computer Mathematics Work-in-Progress Papers Proceedings*, Technical Report UBLCS-2011-04, pp. 10–22, University of Bologna, 2011.
  8. J. Carette and W. M. Farmer, "A review of Mathematical Knowledge Management", in: J. Carette, L. Dixon, C. Sacerdoti Coen, and S. M. Watt, eds., *Intelligent Computer Mathematics (16th Symposium, Calculemus 2009; 8th International Conference, MKM 2009; Grand Bend, Canada, July 2009; Proceedings)*, *Lecture Notes in Computer Science*, Vol. 5625, pp. 233–246, Springer, 2009.
  9. W. M. Farmer and O. Grigorov, "Panoptes: An exploration tool for formal proofs", in: S. Autexier and C. Benzmüller, eds., *Proceedings of the 8th International Workshop on User Interfaces for Theorem Provers (UITP'08) (TPHOLs 2008, Concordia University, Montréal, Québec, Canada, August 22, 2008)*, *Electronic Notes in Theoretical Computer Science (ENTCS)*, 226:39–48, 2009. DOI: 10.1016/j.entcs.2008.12.096.
  10. J. Carette and W. M. Farmer, "High-level theories", in: A. Autexier, J. Campbell, J. Rubio, M. Suzuki, and F. Wiedijk, eds., *Intelligent Computer Mathematics (9th International Conference, AISC 2008; 15th Symposium, Calculemus 2008; 7th International Conference, MKM 2008; Birmingham, UK, July/August 2008; Proceedings)*, *Lecture Notes in Computer Science*, Vol. 5144, pp. 232–245, Springer, 2008.
  11. W. M. Farmer, "Biform theories in Chiron", in: M. Kauers, M. Kerber, R. R. Miner, and W. Windsteiger, eds., *Towards Mechanized Mathematical Assistants*, *Lecture Notes in Computer Science*, Vol. 4573, pp. 66–79, Springer, 2007.

12. J. Carette, W. M. Farmer, and V. Sorge, “A rational reconstruction of a system for experimental mathematics”, in: M. Kauers, M. Kerber, R. R. Miner, and W. Windsteiger, eds., *Towards Mechanized Mathematical Assistants, Lecture Notes in Computer Science*, Vol. 4573, pp. 13–26, Springer, 2007.
13. W. M. Farmer and M. v. Mohrenschildt, “Simple type theory: Simple steps towards a formal specification”, in: *Proceedings of the 34th Annual Frontiers in Education (FIE 2004)*, CD-ROM, IEEE, pp. F1C-1–F1C-6, 2004.
14. W. M. Farmer, “Formalizing undefinedness arising in calculus”, in: D. Basin and M. Rusinowitch, eds., *Automated Reasoning (Second International Conference, IJCAR 2004, Cork, Ireland, July 2004, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 3097, pp. 475–489, Springer, 2004. Review: MR 2140379.
15. J. Carette, W. M. Farmer, and J. Wajs, “Trustable communication between mathematics systems”, in: T. Hardin and R. Rioboo, eds., *Calculus 2003 (11th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning, Rome, Italy, September 2003)*, pp. 58–68, Aracne, Rome, Italy, 2003.
16. W. M. Farmer, “An infrastructure for intertheory reasoning”, in: D. McAllester, ed., *Automated Deduction — CADE-17 (17th International Conference on Automated Deduction, Pittsburgh, PA, USA, June 2000, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 1831, pp. 115–131, Springer, 2000.
17. W. M. Farmer and M. v. Mohrenschildt, “Transformers for symbolic computation and formal deduction”, in: S. Colton, U. Martin and V. Sorge, eds., *Proceedings of the Workshop on the Role of Automated Deduction in Mathematics*, pp. 36–45, CADE-17, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, June 20–21, 2000.
18. W. M. Farmer, “A proposal for the development of an interactive mathematics laboratory for mathematics education”, in: E. Melis, ed., *Proceedings of the Workshop on Deduction Systems for Mathematics Education*, pp. 20–25, CADE-17, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, June 16, 2000.
19. W. M. Farmer, “A scheme for defining partial higher-order functions by recursion”, in: A. Butterfield, ed., *3rd Irish Workshop on Formal Methods (Galway, Ireland, July 1999)*, 13 pp., *Electronic Workshops in Computing*, Springer, <http://www.bcs.org/server.php?show=ConWebDoc.4226>, 1999.
20. W. M. Farmer, J. D. Guttman, and V. Swarup, “Security for mobile agents: Issues and requirements”, in: S. Wakid and J. Davis, eds.,

*Proceedings of the 19th National Information Systems Security Conference*, Vol. 2, pp. 591–597, Baltimore Convention Center, Baltimore, Maryland, USA, October 22–25, 1996.

21. W. M. Farmer, J. D. Guttman, and V. Swarup, “Security for mobile agents: Authentication and state appraisal”, in: E. Bertino et al., eds., *Computer Security — ESORICS 96 (4th European Symposium on Research in Computer Security, Rome, Italy, September 1996, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 1146, pp. 118–130, Springer, 1996.
22. W. M. Farmer, J. D. Guttman, and F. J. Thayer, “IMPS: An updated system description”, in: M. McRobbie and J. Slaney, eds., *Automated Deduction — CADE-13 (13th International Conference on Automated Deduction, New Brunswick, New Jersey, USA, July/August 1996, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 1104, pp. 298–302, Springer, 1996.
23. W. M. Farmer, J. D. Guttman, M. E. Nadel, and F. J. Thayer, “Proof script pragmatics in IMPS”, in: A. Bundy, ed., *Automated Deduction — CADE-12 (12th International Conference on Automated Deduction, Nancy, France, June/July 1994, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 814, pp. 356–370, Springer, 1994.
24. W. M. Farmer, J. D. Guttman, and F. J. Thayer, “Little theories”, in: D. Kapur, ed., *Automated Deduction — CADE-11 (11th International Conference on Automated Deduction, Saratoga Springs, New York, USA, June 1992, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 607, pp. 567–581, Springer, 1992.
25. W. M. Farmer, J. D. Guttman, and F. J. Thayer, “IMPS: system description”, in: D. Kapur, ed., *Automated Deduction — CADE-11 (11th International Conference on Automated Deduction, Saratoga Springs, New York, USA, June 1992, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 607, pp. 701–705, Springer, 1992.

### Invited Nonrefereed Papers

1. W. M. Farmer, “Andrews’ type system with undefinedness”, in: C. Benzmüller, C. Brown, J. Siekmann, and R. Statman, eds., *Reasoning in Simple Type Theory: Festschrift in Honor of Peter B. Andrews on his 70th Birthday*, *Studies in Logic*, pp. 223–242, College Publications, 2008. Preprint: arXiv:1406.7492, 2014. Review: MR 2867839.
2. W. M. Farmer, “Chiron: A multi-paradigm logic”, in: R. Matuszewski and A. Zalewska, eds., *From Insight to Proof: Festschrift in Honour of Andrzej Trybulec*, *Studies in Logic, Grammar and Rhetoric*, 10(23):1–19, 2007.

3. W. M. Farmer, “IMPS”, in: F. Wiedijk, ed., *The Seventeen Provers of the World, Lecture Notes in Computer Science*, Vol. 3600, pp. 72–87, Springer, 2006.
4. W. M. Farmer, “MKM: A new interdisciplinary field of research”, *ACM SIGSAM Bulletin*, 38:47–52, 2004.

### Theses, Books, and Monographs

1. W. M. Farmer, *Incorporating Quotation and Evaluation Into Church’s Type Theory*, technical report, 72 pp., McMaster University, 2017 (extended version of the paper by the similar name listed above). Preprint: arXiv:1612.02785, 2016.
2. W. M. Farmer, *Simple Type Theory with Undefinedness, Quotation, and Evaluation*, McSCert Report 13, 87 pp., McMaster University, 2014 (revised 2016). Preprint: arXiv:1406.6706, 2014 (revised 2016).
3. W. M. Farmer, *Chiron: A Set Theory with Types, Undefinedness, Quotation, and Evaluation*, SQRL Report No. 38, 154 pp., McMaster University, 2007 (revised 2012). Preprint: arXiv:1305.6206, 2013.
4. W. M. Farmer, J. D. Guttman, and F. J. Thayer, *The IMPS User’s Manual*, Technical Report M-93B138, 289 pp., The MITRE Corporation, November 1993.
5. W. M. Farmer, *Length of Proofs and Unification Theory*, Ph.D. Thesis, 228 pp., University of Wisconsin-Madison, 1984.

### Edited Books

1. J. H. Davenport, W. M. Farmer, F. Rabe, and J. Urban, eds., *Intelligent Computer Mathematics (18th Symposium, Calculemus 2011 and 10th International Conference, MKM 2011, Bertinoro, Italy, July 18–23, 2011, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 6824, Springer, 2011. DOI: 10.1007/978-3-642-22673-1.
2. A. Asperti, J. H. Davenport, W. M. Farmer, F. Rabe, and J. Urban, eds., *Conference on Intelligent Computer Mathematics Work-in-Progress Papers Proceedings*, Technical Report UBLCS-2011-04, University of Bologna, 2011.
3. J. M. Borwein and W. M. Farmer, eds., *Mathematical Knowledge Management (5th International Conference, MKM 2006, Wokingham, UK, August 2006, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 4108, pp. 1–295, Springer, 2006.

4. J. Carette and W. M. Farmer, eds., *Proceedings of the 12th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calcuemus 2005)* (Newcastle-upon-Tyne, UK, July 18–19, 2005), *Electronic Notes in Theoretical Computer Science (ENTCS)*, 151:1–178, 2006. Review: MR 2229246.
5. W. Farmer, M. Kerber, and M. Kohlhase, eds., *Proceedings of the Workshop on the Mechanization of Partial Functions, CADE-13*, Rutgers University, New Brunswick, New Jersey, USA, July 30, 1996.

### Other Publications

1. W. M. Farmer and R. E. Mowe, “Network instructional units”, in: *Proceedings of the 32nd Annual Midwest Instruction and Computing Symposium (MICS '99)*, 9 pp., <http://www.micsymposium.org/>, La Crosse, Wisconsin, USA, April 15–17, 1999.
2. W. M. Farmer, “The Interactive Mathematics Laboratory”, in: *Proceedings of the 31st Annual Midwest Instruction and Computing Symposium (MICS '98)*, pp. 84–94, <http://www.micsymposium.org/>, Fargo, North Dakota and Moorhead, Minnesota, USA, April 16–18, 1998.
3. W. M. Farmer and F. J. Thayer, “Two computer-supported proofs in metric space topology”, *Notices of the American Mathematical Society*, 38:1133–1138, 1991.
4. W. M. Farmer, D. M. Johnson, and F. J. Thayer, “Towards a discipline for developing verified software”, in: J. H. Burrows and P. R. Gallagher, Jr., eds., *Proceedings of the 9th National Computer Security Conference*, pp. 91–98, National Bureau of Standards, Gaithersburg, Maryland, USA, September 15–18, 1986. Republished in: R. Turn, ed., *Advances in Computer System Security, Vol. III*, Artech House, Norwood, Massachusetts, USA, pp. 176–183, 1988.

### Selected Technical Reports

1. W. M. Farmer and P. Larjani, “Frameworks for reasoning about syntax that utilize quotation and evaluation”, McSCert Report 9, 38 pp., McMaster University, 2013 (revised 2014). Preprint: arXiv:1308.2149, 2013 (revised 2014).
2. J. Carette, W. M. Farmer, and J. Wajs, “Trustable communication between mathematics systems”, SQRL Report No. 41, 22 pp., McMaster University, 2004 (longer, revised version of the paper by the same name listed above).



3. W. M. Farmer, “A basic extended simple type theory”, SQRL Report No. 14, 12 pp., McMaster University, 2003 (revised 2004).
4. W. M. Farmer and J. D. Ramsdell, “A verified compiler for Multi-threaded PreScheme”, Technical Report, 180 pp., The MITRE Corporation, 1996. <http://repository.readscheme.org/ftp/papers/vlisp/mtps.pdf>
5. W. M. Farmer and M. E. Nadel, “A simple framework for contracts in federated database systems”, Technical Report, 40 pp., The MITRE Corporation, 1995.
6. W. M. Farmer and F. J. Thayer, “Formal numerical program analysis”, Technical Report, 52 pp., The MITRE Corporation, 1994.
7. W. M. Farmer, “A general method for safely overwriting theories in mechanized mathematics systems”, Technical Report, 21 pp., The MITRE Corporation, 1994.
8. W. M. Farmer, J. D. Guttman, L. G. Monk, J. D. Ramsdell, and V. Swarup, series of 8 papers on the VLISP verified programming language implementation, Technical Reports M-92B91, . . . , M-92B98, 487 pp., The MITRE Corporation, September 1992. An extensive report on the results of the VLISP project has been published as a special journal issue: J. D. Guttman and M. Wand, eds., *Lisp and Symbolic Computation*, 8:1–182, 1995. Several Vlisip papers are available in: Internet Scheme Repository, <ftp://ftp.cs.indiana.edu/pub/scheme-repository/doc/pubs/vlisp/>.
9. W. M. Farmer, J. D. Ramsdell, and R. J. Watro, “Computing with the Curry Chip”, Technical Report M89-59, 89 pp., The MITRE Corporation, September 1989.
10. W. M. Farmer, “The  $k$ -provability problem for Gentzen-style sequent systems”, Technical Report M89-20, 13 pp., The MITRE Corporation, February 1989.
11. W. M. Farmer, “Abstract data types in many-sorted second-order logic”, Technical Report M87-64, 29 pp., The MITRE Corporation, October 1987.

### Published Abstracts

1. W. M. Farmer, “We need a better style of proof”, in: G. Dowek, C. Dubois, B. Pientka, and F. Rabe, *Universality of Proofs (Dagstuhl Seminar 16421)*, *Dagstuhl Reports*, 6:82, 2017.
2. W. M. Farmer, “Breakout session on theory graph based reasoning”, in: G. Dowek, C. Dubois, B. Pientka, and F. Rabe, *Universality of Proofs (Dagstuhl Seminar 16421)*, *Dagstuhl Reports*, 6:92, 2017.

3. W. M. Farmer, “Meaning formulas for syntax-based mathematical algorithms”, in: T. Kutsia and A. Voronkov, eds., *SCSS 2014 (6th International Symposium on Symbolic Computation in Software Science), EasyChair Proceedings in Computing (EPiC)*, 30:10–11, 2014.
4. W. M. Farmer, “Modules for a large library of formalized mathematics”, *AMS Special Session on Formal Mathematics for Mathematicians: Developing Large Repositories of Advanced Mathematics*, JMM 2011 (New Orleans, Louisiana, USA, January 8–9, 2011), JMM abstract 1067-03-1782, 2011.
5. W. M. Farmer, “The use of formal reasoning technology in mathematics education: Opportunities and challenges”, in: P. Courtieu and H. Geuvers, eds., *Proceedings of the International Workshop on Proof Assistants and Types in Education (PATE 2007)*, Paris, France, June 25, 2007.
6. J. Carette, W. M. Farmer, and V. Sorge, “A rational reconstruction of a system for experimental mathematics”, in: S. Colton, ed., *Proceedings of the Fourteenth Workshop on Automated Reasoning: Bridging the Gap between Theory and Practice*, Imperial College, London, UK, April 19–20, 2007.
7. W. M. Farmer, “A set theory for mechanized mathematics”, *Special Session on Computer Proofs in Set Theory and Logic*, AMS 1997 Fall Southeast Sectional Meeting (Atlanta, Georgia, USA, October 17–19, 1997), 926th AMS Meeting Program, abstract 926-04-103, p. 481, 1997.
8. W. M. Farmer, “Perspective switching using theories and interpretations”, in: J. Albus, A. Meystel, and R. Quintero, eds., *Intelligent Systems: A Semiotic Perspective (Proceedings of the 1996 International Multidisciplinary Conference)*, Vol. I, pp. 206–207, National Institute of Standards and Technology, Gaithersburg, Maryland, USA, October 20–23, 1996.
9. W. M. Farmer, “A general method for safely overwriting theories in mechanized mathematics systems”, in: D. Basin, F. Giunchiglia, and M. Kaufmann, eds., *Proceedings of the Workshop on the Correctness and Metatheoretical Extensibility of Automated Reasoning Systems*, pp. 46–48, CADE-12, Nancy, France, June 26, 1994.
10. W. M. Farmer and J. D. Guttman, “A simple theory of types with partial functions and subtypes”, *Journal of Symbolic Logic*, 58:754, 1993. Originally published in: *Abstracts of the 9th International Congress of Logic, Methodology and Philosophy of Science*, Vol. I, p. 77, Uppsala, Sweden, August 7–14, 1991.

11. W. M. Farmer, “Theory interpretations in computerized mathematics”, *Journal of Symbolic Logic*, 57:356, 1992.
12. W. M. Farmer, J. D. Guttman, and F. J. Thayer, “IMPS: An Interactive Mathematical Proof System (system description)”, in: M. E. Stickel, ed., *10th International Conference on Automated Deduction (Kaiserslautern, Germany, July 1990, Proceedings)*, *Lecture Notes in Computer Science*, Vol. 449, pp. 653–654, Springer, 1990.
13. W. M. Farmer, J. D. Ramsdell, and R. J. Watro, “A correctness proof for combinator reduction with cycles”, *Journal of Symbolic Logic*, 55:373–374, 1990.
14. W. M. Farmer, “Some results on the  $k$ -provability problem”, *Journal of Symbolic Logic*, 53:1003, 1988.
15. W. M. Farmer, “An algorithm for the unification of second-order monadic terms”, *Journal of Symbolic Logic*, 51:841–842, 1986.

### Published Reviews

1. W. M. Farmer, review of [Jan Krajíček, “On the number of steps in proofs”, *Annals of Pure and Applied Logic*, 41:153–178, 1989], *Journal of Symbolic Logic*, 56:334–335, 1991.
2. W. M. Farmer, review of [Jan Krajíček and Pavel Pudlák, “The number of proof lines and the size of proofs in first order logic”, *Archive for Mathematical Logic*, 27:69–84, 1988], *Journal of Symbolic Logic*, 54:1107–1108, 1989.
3. W. M. Farmer, review of [Larry Wos, *Automated Reasoning: 33 Basic Research Problems*, Prentice Hall, Englewood Cliffs, New Jersey, USA, 1988], *Journal of Symbolic Logic*, 53:1258–1259, 1988.

### Miscellaneous Publications

1. W. M. Farmer and A. J. Kfoury, “Minutes of the 4th annual LICS business meeting (June 7, 1989, Asilomar, California, USA)”, *SIGACT NEWS*, 20:43–47, 1989.

### Text Interviews

1. “MathScheme: Mechanising Mathematics”, in: *International Innovation North America*, May 2013, pp. 20–22, Research Media, 2013.

## Released Software

1. W. M. Farmer, J. D. Guttman, and F. J. Thayer, IMPS formal mathematical reasoning system and interactive theorem prover.
  - Applications areas include mathematics education, symbolic computation, and formal methods of computing.
  - The theory library contains significant portions of logic, algebra, and analysis with over 1300 replayable proofs.
  - The source code of the system (minus the theory library) consists of over 70,000 lines of Lisp code (Common Lisp and GNU Emacs).
  - Demonstrated at 14 conferences and 25 universities and research institutes in Europe and the United States.
  - Available without fee by public license (first released June 11, 1993).
  - The IMPS web site is at <http://imps.mcmaster.ca/>.

## Invited Conference Presentations

1. “We need a better style of proof”, *Dagstuhl Seminar 16421: Universality of Proofs*, Dagstuhl, Germany, October 16–21, 2016.
2. “A comparison of approaches for incorporating syntax-based mathematical algorithms into proof assistants”, *Workshop on Algebra, Geometry and Proofs in Symbolic Computation*, Fields Institute, Toronto, Ontario, Canada, December 13–15, 2015.
3. “Meaning formulas for syntax-based mathematical algorithms”, *6th International Symposium on Symbolic Computation in Software Science*, Gammarth, La Marsa, Tunisia, December 7–8, 2014.
4. “The formalization of syntax-based mathematical algorithms using quotation and evaluation”, *Foundation of Mathematics for Computer-Aided Formalization (FOMCAF 2013)*, Padova, Italy, January 9–11, 2013.
5. “A logic engineered for practical use: Requirements and design”, *Celebration of Peter Andrews’ Career*, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, April 5, 2012.
6. “Modules for a large library of formalized mathematics”, *AMS Special Session on Formal Mathematics for Mathematicians: Developing Large Repositories of Advanced Mathematics*, JMM 2011, New Orleans, Louisiana, USA, January 8–9, 2011.

7. “Formalizing the context in computational mathematics”, *Algorithmic Challenges in Polynomial and Linear Algebra*, Scientific Session at the Canadian Mathematical Society (CMS) Winter 2007 Meeting, London, Ontario, Canada, December 8–10, 2007.
8. “The use of formal reasoning technology in mathematics education: Opportunities and challenges”, *Workshop on Proof Assistants and Types in Education (PATE 2007)*, Paris, France, June 25, 2007.
9. “A formal framework for managing mathematics”, *First International Workshop on Mathematical Knowledge Management (MKM 2001)*, RISC, Hagenberg, Austria, September 24–26, 2001.
10. “STMM and partial functions”, Morning Session Invited Lecture, *Workshop on the Mechanization of Partial Functions*, CADE-15, Lindau, Germany, July 5, 1998.
11. “A set theory for mechanized mathematics”, *American Mathematical Society Southeast Sectional Meeting*, Special Session on Computer Proofs in Set Theory and Logic, Georgia Institute of Technology, Atlanta, Georgia, USA, October 19, 1997.
12. “Perspective switching using theories and interpretations”, *Intelligent Systems: A Semiotic Perspective* (international multidisciplinary conference), National Institute of Standards and Technology, Gaithersburg, Maryland, USA, October 21, 1996.
13. “A set theory with support for partial functions”, *International Workshop on Dynamic Logic, Epistemic Logic, and Partial Logic*, University of Montreal, Montreal, Quebec, Canada, June 9–12, 1995.
14. “Reasoning about partial functions with the aid of a computer”, *Conference on Partial Functions and Programming: Foundational Questions*, Program in the History and Philosophy of Science, University of California, Irvine, California, USA, February 17, 1995.
15. “Theorem proving in IMPS”, *Workshop on Types for Proofs and Programs*, Båstad, Sweden, June 6–9, 1994.
16. “The IMPS theory library”, *Formal Methods in Software Engineering: Automated Reasoning* (workshop sponsored by the Army Research Office and the Office of Naval Research), University of Pennsylvania, Philadelphia, Pennsylvania, USA, May 10–11, 1993.
17. “Formal methods and verification”, *Security Technology Technical Exchange Meeting*, Goddard Space Flight Center, Greenbelt, Maryland, USA, July 15, 1992.

**Invited Seminar Presentations**

1. “Formalizing Syntax-Based Mathematical Algorithms: Challenges and Approaches”, School of Computer Science, University of Guelph, Guelph, Ontario, Canada, April 26, 2017.
2. “Computing at McMaster University”, Hatch, Mississauga, Ontario, Canada, April 15, 2013.
3. “The traditional approach to undefinedness”, School of Computer Science, University of Birmingham, England, UK, July 25, 2005.
4. “MathScheme: A new approach to mechanized mathematics”, Ontario Research Centre for Computer Algebra (ORCCA) Joint Lab Meeting, University of Western Ontario, London, Ontario, Canada, January 14, 2005.
5. “MathScheme: A new approach to mechanized mathematics”, Centre for Intelligent Systems and their Applications (CISA), University of Edinburgh, Edinburgh, Scotland, UK, July 1, 2004.
6. “Biform theories: A basis for integrating and generalizing computer theorem proving and computer algebra”, Pure and Applied Logic Colloquium, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, February 22, 2002.
7. “Some techniques for constructing sound deduction and computation rules”, Seminar on Automated Deduction, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, February 19, 2002.
8. “STMM, A Set Theory for Mechanized Mathematics”, Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada, January 18, 1999.
9. “The motivation and rationale for the IMPS design”, Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada, August 14, 1998.
10. “IMPS, a prototype of an interactive mathematics laboratory”, Department Colloquium, Department of Statistics, St. Cloud State University, St. Cloud, Minnesota, USA, March 31, 1998.
11. “The little theories method for specifying complex systems”, Department Colloquium, Department of Computer Science and Engineering, The Pennsylvania State University, University Park, Pennsylvania, USA, February 27, 1997.
12. “The little theories method for specifying complex systems”, Department of Computer Science and Engineering, Oakland University, Oakland, Michigan, USA, June 28, 1996.

13. “Denotational semantics for Multithreaded PreScheme”, Semantics Seminar, College of Computer Science, Northeastern University, Boston, Massachusetts, USA, October 25, 1995.
14. “Rigorous software description”, Software Engineering Research Group, McMaster University, Hamilton, Ontario, Canada, October 19, 1995.
15. “IMPS: Little theories and macetes”, Kestrel Institute, Palo Alto, California, USA, February 16, 1995.
16. “IMPS: A human-oriented mechanized mathematics system”, Computer Science Department, Ohio University, Athens, Ohio, USA, March 18, 1994.
17. “IMPS: A human-oriented mathematical reasoning system”, Department Colloquium, Computer Science Department, Boston University, Boston, Massachusetts, USA, December 8, 1993.
18. “A mechanized development of portions of real analysis” (with F. Javier Thayer), Department Colloquium, Department of Mathematical Sciences, University of Massachusetts Lowell, Lowell, Massachusetts, USA, October 27, 1993.
19. “The IMPS theory library”, Logikseminar, University of Saarland, Saarbrücken, Germany, March 16, 1993.
20. “IMPS: An Interactive Mathematical Proof System”, Bell Communications Research, Morristown, New Jersey, USA, February 22, 1991.
21. “IMPS: An Interactive Mathematical Proof System”, Logic Colloquium, School of Computer Science, Carnegie Mellon University, November 1, 1990.
22. “PF: The basis of the IMPS logic”, Types and Logic Seminar, Laboratory for Computer Science, M.I.T., Cambridge, Massachusetts, USA, April 4, 1990.
23. “IMPS: An Interactive Mathematical Proof System”, Department Colloquium, Computer Science Department, State University of New York at Albany, Albany, New York, USA, November 30, 1989.
24. “Redex capturing in term graph rewriting”, Department Colloquium, Computer Science Department, Boston University, Boston, Massachusetts, USA, April 26, 1989.
25. “Second-order monadic unification”, Seminar in Applications of Logic in Computer Science, New York City Graduate Center, New York, New York, USA, March 17, 1987.

26. “Length of proofs and unification theory”, Department of Mathematics, University of Notre Dame, Notre Dame, Indiana, USA, February 19, 1985.

### Contributed Conference Presentations

1. “Incorporating quotation and evaluation into Church’s type theory: Syntax and semantics”, *9th Conference on Intelligent Computer Mathematics (CICM 2014)*, Białystok, Poland, July 25–29, 2016.
2. “Can computer proving replace traditional proving?”, *Workshop on The Notion of Proof, 2014 Conferences on Intelligent Computer Mathematics (CICM 2014)*, Coimbra, Portugal, July 7–11, 2014.
3. “Realms: A structure for consolidating knowledge about mathematical theories”, *2014 Conferences on Intelligent Computer Mathematics (CICM 2014), MKM Track*, Coimbra, Portugal, July 7–11, 2014.
4. “The formalization of syntax-based mathematical algorithms using quotation and evaluation”, *2013 Conferences on Intelligent Computer Mathematics (CICM 2013), Calculemus Track*, Bath, UK, July 8–12, 2013 (presentation given as a video).
5. “A review of Mathematical Knowledge Management”, *9th International Conference on Mathematical Knowledge Management (MKM 2009)*, Grand Bend, Ontario, Canada, July 10–12, 2009.
6. “High-level theories”, *15th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2008)*, Birmingham, UK, July 30 – August 1, 2008.
7. “Biform theories in Chiron”, *14th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2007)*, RISC, Hagenberg, Austria, July 27–30, 2007.
8. “Formalizing undefinedness arising in calculus”, *2nd International Joint Conference on Automated Reasoning (IJCAR 2004)*, University College Cork, Cork, Ireland, July 4–8, 2004.
9. “MathScheme: A framework for integrating computer algebra and computer theorem proving”, *4th Annual MITACS IT-Theme Meeting*, Banff, Alberta, Canada, November 2–3, 2002.
10. “The MathScheme project”, *10th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2002)*, Marseilles, France, July 1–5, 2002.
11. “The MathScheme project”, *NA-MKM 2002: A North American Workshop On Mathematical Knowledge Management*, McMaster University, Hamilton, Ontario, Canada, June 12–13, 2002.



12. “Transformers for symbolic computation and formal deduction”, *Workshop on the Role of Automated Deduction in Mathematics*, CADE-17, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, June 20–21, 2000.
13. “An infrastructure for intertheory reasoning”, *17th International Conference on Automated Deduction (CADE-17)*, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, June 17–20, 2000.
14. “A proposal for the development of an interactive mathematics laboratories for mathematics education”, *Workshop on Deduction Systems for Mathematics Education*, CADE-17, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, June 16, 2000.
15. “A scheme for defining partial higher-order functions by recursion”, *3rd Irish Workshop on Formal Methods (IWFMM’99)*, National University of Ireland, Galway, Ireland, July 1–2, 1999.
16. “IMPS: An updated system description”, *13th International Conference on Automated Deduction (CADE-13)*, Rutgers University, New Brunswick, New Jersey, USA, July 30 – August 3, 1996.
17. “Mechanizing the traditional approach to partial functions”, *Workshop on the Mechanization of Partial Functions*, CADE-13, Rutgers University, New Brunswick, New Jersey, USA, July 30, 1996.
18. “Proof script pragmatics in IMPS”, *12th International Conference on Automated Deduction (CADE-12)*, Nancy, France, June 28 – July 1, 1994.
19. “A general method for safely overwriting theories in mechanized mathematics systems”, *Workshop on Correctness and Metatheoretic Extensibility of Automated Reasoning Systems*, CADE-12, Nancy, France, June 26, 1994.
20. “A technique for safely extending axiomatic theories”, *46th Meeting of IFIP Working Group 2.1*, Renkum, The Netherlands, January 10–14, 1994.
21. “Theory interpretation in simple type theory”, *First International Workshop on Higher Order Algebra, Logic, and Term Rewriting (HOA ’93)*, Amsterdam, The Netherlands, September 23–24, 1993.
22. “A simple theory of types with partial functions and subtypes”, *9th International Congress of Logic, Methodology and Philosophy of Science*, Uppsala, Sweden, August 7–14, 1991.
23. “Redex capturing in term graph rewriting”, *4th International Conference on Rewriting Techniques and Applications (RTA-91)*, Como, Italy, April 10–12, 1991.

24. “Theory interpretations in computerized mathematics”, *1989–90 Annual Meeting of the Association of Symbolic Logic*, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA, January 10–13, 1990.
25. “A correctness proof for combinator reduction with cycles”, *1988–89 Annual Meeting of the Association of Symbolic Logic*, U.C.L.A., Los Angeles, California, USA, January 14–17, 1989.
26. “Some results on the  $k$ -provability problem”, *1986–87 Annual Meeting of the Association for Symbolic Logic*, San Antonio, Texas, USA, January 23–24, 1987.
27. “An algorithm for the unification of second-order monadic terms”, *Meeting of the Association for Symbolic Logic*, Stanford University, Stanford, California, USA, July 15–19, 1985.

### Seminar Presentations at McMaster

1. “Chiron: A set theory with types, undefinedness, quotation, and evaluation”, Department of Computing and Software, November 1, 2006.
2. “The seven virtues of simple type theory”, Logic Colloquium, January 27, 2004.
3. “The seven virtues of simple type theory”, MathScheme Project, April 3, 2003.
4. “Partial First-Order Logic”, Logic Colloquium, April 10, 2002.
5. “An integrated framework for computer algebra and computer theorem proving”, Department of Computing and Software, December 12, 2001
6. “Logic and mathematical knowledge management”, Logic Colloquium, October 10, 2001.

### Refereed Tutorials

1. W. M. Farmer, *Logics with Undefinedness: How to Modify a Traditional Logic so that It handles Undefinedness in Accordance with Mathematical Practice*, a half-day tutorial at the 22nd International Conference on Automated Deduction (CADE-22), McGill University, Montreal, Quebec, Canada, August 2–7, 2009.

### Nonrefereed Tutorials

1. W. M. Farmer, *What Every IMPS User Needs to Know*, a half-day tutorial presented to the Department of Computing and Software, McMaster University, Hamilton, Ontario, Canada, August 13, 1998.

2. W. M. Farmer, J. D. Guttman, and F. J. Thayer, *IMPS: An Interactive Mathematical Proof System*, a three-day “hands-on” course for introducing the IMPS theorem proving system to prospective users. In 1992–1993, the course was given three times at MITRE, once at the National Security Agency (NSA), and once at the Defence Research Agency in the United Kingdom.

### Poster Presentations

1. “MathScheme: Project description”, *2011 Conference on Intelligent Computer Mathematics (CICM 2011)*, Bertinoro, Italy, July 18–23, 2011 (with J. Carette).

### Workshop and Conference Organization

1. W. M. Farmer, MKM Track Chair, *2018 Conference on Intelligent Computer Mathematics (CICM 2018)*, Linz, Austria, 2018.
2. W. M. Farmer, Calculemus Track Chair and member of the CICM Organizing Committee, *2011 Conference on Intelligent Computer Mathematics (CICM 2011)*, Bertinoro, Italy, July 18–23, 2011.
3. J. M. Borwein and W. M. Farmer, Program Chairs, *Fifth International Conference on Mathematical Knowledge Management (MKM 2006)*, Wokingham, UK, August 10–12, 2006.
4. W. M. Farmer, Facilities Coordinator, *Formal Methods 2006 (FM’06)*, McMaster University, Hamilton, Ontario, Canada, August 21–27, 2006.
5. W. M. Farmer and J. Carette, Program and Conference Chairs, *12th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2005)*, Newcastle, UK, July 18–19, 2005.
6. W. M. Farmer, Tutorial Chair, *2nd International Joint Conference on Automated Reasoning (IJCAR 2004)*, Cork, Ireland, July 4–8, 2004.
7. W. M. Farmer (leader), M. Kohlhase, D. Scott, and B. Wegner, organizers, *Second North American Workshop On Mathematical Knowledge Management (NA-MKM 2004)*, JMM 2004, Phoenix, Arizona, USA, January 6, 2004.
8. W. M. Farmer and M. v. Mohrenschildt, organizers, *A North American Workshop On Mathematical Knowledge Management (NA-MKM 2002)*, McMaster University, Hamilton, Ontario, Canada, June 12–13, 2002.

9. W. M. Farmer, M. Kerber, and M. Kohlhase, organizers, *Mechanization of Partial Functions*, CADE-13 workshop, Rutgers University, New Brunswick, New Jersey, USA, July 30, 1996.

## Panel Sessions

1. Member of the joint ARW 2008 and Doctoral Programme panel “What should make successful research in automated reasoning” (composed of S. Colton, Ullrich Hustadt, Andrew Ireland, and myself) at CICM 2008, Birmingham, UK, July 27 – August 1, 2008.
2. Chair of the joint Calculemus 2007 and MKM 2007 panel “Future directions for Calculemus and MKM” (composed of B. Buchberger, T. Coquand, F. Kamareddine, M. Kohlhase, A. Trybulec, and myself) at RISC, Hagenberg, Austria, July 27–30, 2007.
3. Chair of the panel “What are the characteristics of mathematical knowledge that make managing it different from managing other kinds of knowledge?” (composed of G. Chaitin, P. Ion, M. Kohlhase, A. Youssef, and myself) at the *Fifth International Conference on Mathematical Knowledge Management (MKM 2006)*, Wokingham, UK, August 10–12, 2006.
4. Member of the Colognet panel “Open challenges for computerized mathematics” (composed of J. Calmet, J. Davenport, R. Rioboo, J. Schumann, S. Watt, and myself) at the joint 2003 Calculemus, Tableaux and TPHOLs conference, Rome, Italy, September 9–12, 2003.
5. Member of the panel at the *First International Workshop on Mathematical Knowledge Management (MKM 2001)*, chaired by Michiel Hazewinkel at RISC, Hagenberg, Austria, September 24–26, 2001.
6. Member of the workshop panel (composed of P. Andrews, A. Armando, C. Benzmüller, J. Cunningham, M. Fisher, H. Mantel, and myself) at *Future Directions in Automated Reasoning*, IJCAR 2001 workshop, Siena, Italy, June 18, 2001.
7. Member of the workshop panel (composed of M. Beeson, D. Kapur, D. Scott, and myself) at *Mechanization of Partial Functions*, CADE-15 workshop, Lindau, Germany, July 5, 1998.
8. Member of the panel “Experiences in integrating automated reasoning tools” chaired by C. Landwehr at the *Workshop on Effective Use of Automated Reasoning Technology in System Development*, Naval Research Laboratory, Washington, D.C., USA, April 6–7, 1992.

### Invited Workshop Participation

1. *Semantic Representation of Mathematical Knowledge Workshop*, Fields Institute, Toronto, Ontario, Canada, February 3–5, 2016.
2. *Changing Culture: Mathematics Education in the Research Community*, Mathematicians and Education Reform Network (MER) workshop, Berkeley, California, USA, March 4–7, 1993.

### External Committee Participation

1. Program Committee, Systems and Projects Track, *10th Conference on Intelligent Computer Mathematics (CICM 2017)* (Edinburgh, Scotland, UK, July 17–21, 2017), 2016–17.
2. Program Committee, *5th IEEE International Workshop on Formal Methods Integration (FMi 2017)* (San Diego, California, USA, August 4–6, 2017), 2016–17.
3. Program Committee, *Certified Programs and Proofs (CPP 2013)* (Melbourne, Australia, December 11–13, 2013), 2013.
4. Program Committee, *6th Logical and Semantic Frameworks (LSFA 2011)* (Belo Horizonte, Minas Gerais, Brazil, August 27, 2011), 2011.
5. Program Committee, *18th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calcuemus 2011)* (Bertinoro, Italy, July 18–23, 2011), 2010–11.
6. Steering Committee, *CICM (Conference on Intelligent Computer Mathematics)*, *MKM Interest Group* delegate (2010–11) and Treasurer (2011–17).
7. Program Committee, *9th International Conference on Mathematical Knowledge Management (MKM 2010)* (Paris, France, July 5–10, 2010), 2009–10.
8. Program Committee, *17th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calcuemus 2010)* (Paris, France, July 5–10, 2010), 2009–10.
9. Program Committee, *10th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2010)* (Paris, France, July 2010), 2009–10.
10. Organizing Committee, *2009 Conferences on Intelligent Computer Mathematics (CICM 2009)* (Grand Bend, Ontario, Canada, July 5–12, 2009), 2008–09.

11. Program Committee, *16th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2009)* (Grand Bend, Ontario, Canada, July 6–7, 2009), 2008–09.
12. Program Committee, *4th Logical and Semantic Frameworks (LSFA 2009)* (RDP 2009 conference, Brasília, Brazil, June 28, 2009), 2008–09.
13. Program Committee, *Knowledge Exchange: Automated Provers and Proof Assistants (KEAPPA 2008)* (LPAR 2008 workshop, Doha, Qatar, November 22, 2008), 2008.
14. Program Committee, *Doctoral Programme at CICM 2008* (Birmingham, UK, July 2008), 2008.
15. Program Committee, *7th International Conference on Mathematical Knowledge Management (MKM 2008)* (Birmingham, UK, July 28–30 2008), 2007–08.
16. Program Committee, *15th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2008)* (Birmingham, UK, July 30 – August 1, 2008), 2007–08.
17. Program Committee, *9th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2008)* (Birmingham, UK, July 31 – August 1, 2008), 2007–08.
18. Program Committee, *Sixth International Conference on Mathematical Knowledge Management (MKM 2007)* (RISC, Hagenberg, Austria, June 27–30, 2007), 2006–07.
19. Program Committee, *14th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2007)* (RISC, Hagenberg, Austria, June 27–30, 2007), 2006–07.
20. Program Committee, *Fifth International Conference on Mathematical Knowledge Management (MKM 2006)* (Wokingham, UK, August 10–12, 2006), 2005–06.
21. Program Committee, *13th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2006)* (Genova, Italy, July 7–8, 2006), 2005–06.
22. Program Committee, *8th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2006)* (Beijing, China, September 20–22, 2006), 2005–06.
23. Program Committee, *Fourth International Conference on Mathematical Knowledge Management (MKM 2005)* (International University Bremen, Germany, July 15–17, 2005), 2005.

24. Program Committee, *12th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2005)*, (Newcastle, UK, July 18–19, 2005), 2004–05.
25. Board of Trustees, *MKM Interest Group* (for the management of mathematical knowledge), elected position (2004–07, 2012–15) and Treasurer (2006–11).
26. Board of Trustees, *Calculemus Interest Group* (for the integration of computer algebra systems and deduction systems), elected position (2003–06) and PC chair position (2004–07, 2010–13).
27. Program Committee, *Workshop on Computer-Supported Mathematical Theory Development* (IJCAR 2004 workshop, Cork, Ireland, July 4–5, 2004), 2004.
28. Program Committee, *Third International Conference on Mathematical Knowledge Management (MKM 2004)* (Białowieża, Poland, September 19–21, 2004), 2003–04.
29. Program Committee, *7th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2004)* (RISC, Hagenberg, Austria, September 22–24, 2004), 2003–04.
30. Program Committee, *Mathematical Knowledge Management Symposium* (Heriot-Watt University, Edinburgh, Scotland, November 25–30, 2003), 2003.
31. Program Committee, *11th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2003)* (Rome, Italy, September 10–12, 2003), 2002–03.
32. Program Committee, *Second International Conference on Mathematical Knowledge Management (MKM 2003)* (Bertinoro, Italy, February 16–18, 2003), 2001–03.
33. Program Committee, *10th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning (Calculemus 2002)* (Marseilles, France, July 1–5, 2002), 2001–02.
34. Program Committee, *1997 International Conference on Theorem Proving in Higher Order Logics (TPHOLs97)* (Bell Labs, Murray Hill, New Jersey, USA, August 18–22, 1997), 1996–97.
35. Program Committee, *14th International Conference on Automated Deduction (CADE-14)* (Townsville, Australia, July 13–17, 1997), 1996–97.
36. Program Committee, *13th International Conference on Automated Deduction (CADE-13)* (Rutgers University, New Brunswick, New Jersey, USA, July 30 – August 3, 1996), 1995–96.

37. *International Federation for Information Processing (IFIP) Working Group 2.1 — Algorithmic Languages and Calculi*, observer, 1993–94.
38. Program Committee, *12th International Conference on Automated Deduction (CADE-12)* (Nancy, France, June 28 – July 1, 1994), 1993–94.
39. *High School Advisory Board*, Department of Mathematics, Northeastern University, Boston, Massachusetts, USA, 1993.

## Referee

1. *Advances in Intelligent Systems and Computing*
2. *Annals of Mathematics and Artificial Intelligence*
3. *Annals of Pure and Applied Logic*
4. *Austrian Science Fund (FWF)*
5. *Bulletin of the Interest Group in Pure and Applied Logics (IGPL)*
6. *Formal Methods in System Design*
7. *Indian Journal of Pure and Applied Mathematics*
8. *Information and Computation*
9. *35th International Symposium on Symbolic and Algebraic Computation (ISSAC 2010)*
10. *Journal of Automated Reasoning*
11. *Mathematics in Computer Science*
12. *Nordic Journal of Computing*
13. *Notre Dame Journal of Formal Logic*
14. *Studia Logica*
15. *Theoretical Computer Science*
16. *23rd Annual ACM Computer Science Conference (ACM CSC'95)*
17. *14th Annual Computer Science Logic Conference (CSL 2000)*
18. *2002 Calculemus Symposium: 10th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*
19. *2003 Calculemus Symposium: 11th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*



20. *2006 Calculemus Symposium: 13th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*
21. *2007 Calculemus Symposium: 14th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*
22. *2008 Calculemus Symposium: 15th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*
23. *2009 Calculemus Symposium: 16th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*
24. *2010 Calculemus Symposium: 17th Symposium on the Integration of Symbolic Computation and Mechanized Reasoning*
25. *4th Conference on Intelligent Computer Mathematics (CICM 2011), Calculemus Track*
26. *10th Conference on Intelligent Computer Mathematics (CICM 2017), Systems and Projec Track*
27. *Computer-Supported Mathematical Theory Development (IJCAR 2004 workshop)*
28. *Conference on Applications of Logic (1995)*
29. *FASE'09: Fundamental Approaches to Software Engineering*
30. *5th IEEE International Workshop on Formal Methods Integration (FMI 2017)*
31. *7th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2004)*
32. *8th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2006)*
33. *9th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2008)*
34. *10th International Conference on Artificial Intelligence and Symbolic Computation (AISC 2010)*
35. *11th International Conference on Automated Deduction (CADE-11)*
36. *12th International Conference on Automated Deduction (CADE-12)*
37. *13th International Conference on Automated Deduction (CADE-13)*
38. *14th International Conference on Automated Deduction (CADE-14)*
39. *16th International Conference on Automated Deduction (CADE-16)*

40. *20th International Conference on Automated Deduction (CADE-20)*
41. *22th International Conference on Automated Deduction (CADE-22)*
42. *3rd International Conference on Certified Programs and Proofs (CPP 2013)*
43. *International Conference on Formal Engineering Methods (ICFEM 2004)*
44. *Second International Conference on Mathematical Knowledge Management (MKM 2003)*
45. *Third International Conference on Mathematical Knowledge Management (MKM 2004)*
46. *Fourth International Conference on Mathematical Knowledge Management (MKM 2005)*
47. *Fifth International Conference on Mathematical Knowledge Management (MKM 2006)*
48. *Sixth International Conference on Mathematical Knowledge Management (MKM 2007)*
49. *Seventh International Conference on Mathematical Knowledge Management (MKM 2008)*
50. *Ninth International Conference on Mathematical Knowledge Management (MKM 2010)*
51. *1997 International Conference on Theorem Proving in Higher Order Logics (TPHOLs97)*
52. *Joint Meeting of the Twenty-Third EACSL Annual Conference on Computer Science Logic (CSL) and the Twenty-Ninth Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) (CSL-LICS 2014)*
53. *Latin American Theoretical Informatics 2002 (LATIN 2002)*
54. *4th Logical and Semantic Frameworks with Applications (LSFA 2009)*
55. *6th Logical and Semantic Frameworks with Applications (LSFA 2011)*
56. *Mathematical Knowledge Management Symposium 2003*
57. *Cambridge University Press*
58. *McGraw-Hill*
59. *Idaho State Board of Education*

60. *Natural Sciences and Engineering Research Council (NSERC)*

61. *Netherlands Organisation for Scientific Research (NWO)*

### **Membership in Professional Organizations**

1. American Mathematical Society (AMS)
2. Association for Automated Reasoning (AAR)
3. Association for Computing Machinery (ACM)
4. Association for Symbolic Logic (ASL)
5. Professional Engineers Ontario (PEO)
6. Calculemus Interest Group
7. Mathematical Knowledge Management (MKM) Interest Group

### **Honors and Awards**

1. CICM 2014 MKM Track Best Paper Award for “Realms: A structure for consolidating knowledge about mathematical theories” (with Jacques Carette and Michael Kohlhase), 2014.
2. Nominee, McMaster Student Union (MSU) Teaching Award, 2009.
3. MITRE 1993 Best Paper Award for “IMPS: An Interactive Mathematical Proof System” (with Joshua D. Guttman and F. Javier Thayer), 1994.
4. MITRE Special Recognition Award for the successful completion of the VLISP project (with Joshua D. Guttman, John D. Ramsdell, Vipin Swarup, and Leonard G. Monk), 1993.
5. Sigma Xi, 1988.
6. Phi Beta Kappa, 1978.
7. Notre Dame Scholar, 1974–78.
8. Hoosier (Indiana) Scholar, 1974–78.
9. Valedictorian, Clay High School, South Bend, Indiana, USA, 1974.