

# Barbara H. Liskov

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## Education

**University of California at Berkeley, Berkeley, CA**, Department of Mathematics, Bachelor of Arts, June 1961.

**Stanford University, Stanford, CA**, Department of Computer Science, Master of Science, June 1965, Doctor of Philosophy, August 1968, Dissertation: "A Program to Play Chess Endgames."

## Research Interests

Programming methodology, distributed computing, programming languages, operating systems.

## Professional Experience

**Massachusetts Institute of Technology, Cambridge, MA**, Dept. of Electrical Engineering and Computer Science. Institute Professor, 2008 - , Ford Professor of Engineering, 1997-2008, Associate Head for Computer Science, 2001-2004, NEC Professor of Software Science and Engineering, 1986-1997, Assistant Professor, 1972-1976, Associate Professor, 1976-1980, Professor, 1980-Present, Associate Provost for Faculty Equity, 2007-Present.

**The Mitre Corporation, Bedford, MA**, Member of Technical Staff, Computer Science Research and Development, 1968-1972.

**Stanford University, Stanford, CA**, Graduate Research Assistant in Artificial Intelligence, 1963-1968.

**Harvard University, Cambridge, MA**, Programmer, Language Translation Project, 1962 - 1963.

**The Mitre Corporation, Bedford, MA**, Applications Programmer, 1961 - 1962.

## Awards

2008 Turing Award

2007 ACM SIGSOFT Impact Paper Award for "Abstraction Mechanisms in CLU"

2007 ACM SIGPLAN Programming Languages Lifetime Achievement Award

2005 Honorary Doctorate, ETH Zurich

IEEE 2004 John von Neumann Medal

Society of Women Engineers 1996 Achievement Award

Member National Academy of Engineering

Member American Academy of the Arts and Science

Fellow of the ACM

Named one of 50 most important women in science by Discover Magazine in 2003

Named one of top 100 women in Computing by Open Computing Magazine in 1996

## **Professional Activities**

Professor Liskov is a fellow and member of the Association for Computing Machinery, a member of the IEEE, and also is a member of the ACM Special Interest Groups on Programming Languages, Operating Systems, and Databases, and has served on the executive committee of the ACM Special Interest Group on Programming Languages, and on the IEEE Technical Committees on Operating Systems and on Software Engineering. Prof. Liskov has served as chair and as a member of numerous program committees and as an associate editor for ACM, Transactions on Programming Languages and Systems. She has also served on numerous advisory committees, including the Computer Science and Telecommunications Board of the National Research Council, and the Computer and Information Science and Engineering Advisory Committee for the NSF.

## **Consulting Experience**

Prof. Liskov has acted as a consultant for numerous companies on computer related issues including Bolt, Beranek, and Newman, Cadence, Digital Equipment Corporation, Hewlett-Packard, Intermetrics, NCR, and Prime Computer.

## Books

1. CLU Reference Manual. Springer-Verlag, 1984 with R. Atkinson, T. Bloom, E. Moss, J. C. Schaffert, R. Scheifler, and A. Snyder. Also published as *Lecture Notes in Computer Science 114*, G. Goos and J. Hartmanis, Eds., Springer-Verlag, 1981.
2. Abstraction and Specification in Program Development. *MIT Press and McGraw Hill*, 1986, with J. Guttag.
3. Program Development in Java: Abstraction, Specification, and Object-Oriented Design. *Addison-Wesley*, 2001, with J. Guttag.

## Publications

1. The Design of the Venus Operating System. *Comm. of the ACM* 15, 3 (March 1972). Also published in *Software Systems Principles: A Survey*, P. Freeman, SRA Associates, Inc., Chicago 1975, 542-553.
2. Design Methodology for Reliable Software Systems. *Proc. of the Fall Joint Computer Conference 41*, Part 1, December 1972. Also published in *Tutorial on Software Design Techniques*, P. Freeman and A. Wasserman, IEEE, 1977, 53-61.
3. SPIL: A Language for Construction of Reliable System Software. *SIGPLAN Notices* 8, 9 (September 1973) (with L. Smith).
4. Report on ACM SIGPLAN-SIGOPS Interface Meeting, Structured Programming Session. *SIGPLAN Notices* 8, 9 (September 1973).
5. Programming With Abstract Data Types. *Proc. of the ACM Conference on Very High Level Languages, SIGPLAN Notices* 9, 4 (April 1974), 50-59 (with S. Zilles).
6. Specification Techniques for Data Abstractions. *IEEE Trans. on Software Engineering SE-1*, 1 (March 1975). Also published in *Proc. of the First International Conference on Software Reliability*, April 1975, 72-88. Also published in *Tutorial on Software Design Techniques*, P. Freeman and A. Wasserman, IEEE, 1977, 114-126 (with S. Zilles).
7. Data Types and Program Correctness. *AFIPS Conference Proceedings 44*, 1975 National Computer Conference, 285-286.
8. An Introduction to Formal Specifications of Data Abstractions. *Current Trends in Programming Methodology 1* (R. Yeh, Ed.), Prentice-Hall, Englewood Cliffs, NJ, January 1977, 1-32 (with S. Zilles).
9. Introduction to CLU. *New Directions in Algorithmic Languages - 1975* (S. A. Schuman, Ed.), IRIA, May 1976.
10. A Language Extension for Controlling Access to Shared Data. *IEEE Trans. on Software Engineering SE-2*, 4 (December 1976), 277-285 (with A. K. Jones).
11. Abstraction Mechanisms in CLU. *Comm. of the ACM* 20, 8 (August 1977), 564-576 (with A. Snyder, R. Atkinson and C. Schaffert).
12. A Language Extension for Expressing Constraints on Data Access. *Comm. of the ACM* 21, 5 (May 1978), 358-367 (with A. K. Jones).

13. Practical Benefits of Research in Programming Methodology. *Proc. of the 1978 National Computer Conference*, June 1978.
14. Aspects of Implementing CLU. *Proc. of the ACM 1978 Annual Conference*, December 1978 (with R. Atkinson and R. Scheifler).
15. An Appraisal of Program Specifications. *The Impact of Research on Software Technology* (P. Wegner, Ed.), MIT Press, Cambridge, MA, June 1979 (with V. Berzins).
16. Remarks on the Construction of Large Programs. *The Impact of Research on Software Technology* (P. Wegner, Ed.), MIT Press, Cambridge, MA, June 1979.
17. Exception Handling in CLU. *IEEE Trans. on Software Engineering SE-5*, 6 (November 1979), 546-558 (with A. Snyder).
18. Primitives for Distributed Computing. *Proc. of the Seventh Symposium on Operating Systems Principles*, December 1979, 33-41.
19. Modular Program Construction Using Abstractions. *Abstract Software Specifications, 1979 Copenhagen Winter School Proceedings*, Lecture Notes in Computer Science 86, Springer-Verlag, 1980, 354-389.
20. CLU Reference Manual. Technical Report TR-225, MIT Laboratory for Computer Science, Cambridge, MA, October 1979 (with R. Atkinson, T. Bloom, E. Moss, J. C. Schaffert, R. Scheifler, and A. Snyder).
21. On Linguistic Support for Distributed Programs. *Proc. of the IEEE Symposium on Reliability in Distributed Software and Database Systems*, Pittsburgh, PA, July 1981, 53-60. Also *IEEE Trans. on Software Engineering SE-8*, 3 (1982), 203-210.
22. Report on the Workshop on Fundamental Issues in Distributed Computing. *ACM Operating Systems Review 15*, 3 (July 1981), 9-38; *ACM SIGPLAN Notices 16*, 10 (October 1981), 20-49.
23. A Value Transmission Method for Abstract Data Types. *ACM Trans. on Programming Languages and Systems 4*, 4 (October 1982), 527-551 (with M. Herlihy).
24. Guardians and Actions: Linguistic Support for Robust, Distributed Programs. *Proc. of the 9th Annual ACM Symposium on Principles of Programming Languages*, January 1982, 7-19 (with R. Scheifler). Also published in *ACM Trans. on Programming Languages and Systems 5*, 3 (July 1983), 381-404.
25. Issues in Process and Communication Structure for Distributed Programs. *Proc. of the Third Symposium on Reliability in Distributed Software and Database Systems*, October 1983. Also in *Computer Systems for Process Control* (Ed., R. Guth), Plenum Press, 1986, 213-238 (with M. P. Herlihy).
26. Specification and Implementation of Resilient, Atomic Data Types. *Proc. of the SIGPLAN '83: Symposium on Programming Language Issues in Software Systems*, June 1983 (with W. Wehl).
27. The Argus Language and System. *Distributed Systems – Methods and Tools for Specification, an Advanced Course*, Lecture Notes in Computer Science 190, Springer-Verlag, 1985, 343-430.
28. Implementation of Resilient, Atomic Data Types. *ACM Trans. on Programming Languages and Systems 7*, 2 (April 1985), 244-269 (with W. E. Wehl).
29. Limitations of Synchronous Communication with Static Process Structure in Languages for Distributed Computing. *Proc. of the 13th ACM SIGACT/SIGPLAN Symposium on Principles of Programming Languages*, January 1986 (with M. P. Herlihy and L. Gilbert).
30. Reliable Object Storage to Support Atomic Actions. *Proc. of the ACM Tenth Symposium on Operating Systems Principles*, December 1985 (with B. M. Oki and R. W. Scheifler).
31. Specifications of Distributed Programs. *Distributed Computing 1*, 1986, 102-118 Springer International (with W. E. Wehl).

32. Highly-Available Distributed Services and Fault-Tolerant Distributed Garbage Collection. *Proc. of the 5th ACM Symposium on the Principles of Distributed Computing*, August 1986 (with R. Ladin).
33. Orphan Detection. *17th International Symposium on Fault-Tolerant Computing*, July 1987 (with R. W. Scheifler, E. Walker, and W. E. Weihl).
34. Implementation of Argus. *11th ACM Symposium on Operating Systems Principles*, November 1987 (with D. Curtis, P. Johnson and R. Scheifler).
35. "Guardians and Actions: Linguistic Support for Robust, Distributed Programs." In "Concurrency Control and Reliability in Distributed Systems," B. Bhargava, Ed., Van Nostrand Reinhold, NY, 1987, 124-153 (with R. Scheifler).
36. Communication in the Mercury System. *Proc. of the Twenty First Annual Hawaii International Conference on System Sciences*, Jan. 1988, 178-187 (with T. Bloom, D. Gifford, R. Scheifler and W. Weihl).
37. Distributed Programming in Argus. *Comm. of the ACM* 31, 3 (March 1988), 300-312.
38. A Technique for Constructing Highly-Available Services. *Algorithmica* 3, 1988, 393-420 (with R. Ladin and L. Shrira).
39. Data Abstraction and Hierarchy. Addendum to the Proceedings of OOPSLA '87, *SIGPLAN Notices* 23, 5 (May 1988), 17-34.
40. Promises: Linguistic Support for Efficient Asynchronous Procedure Calls in Distributed Systems. *Proc. of the ACM SIGPLAN '88 Conference on Programming Languages Design and Implementation*, June 1988 (with L. Shrira).
41. Viewstamped Replication: A New Primary Copy Method to Support Highly-Available Distributed Systems. *Proc. of the Seventh ACM Symposium on Principles of Distributed Computing*, August 1988. (with B. Oki).
42. Heterogeneous Computing: A High-Level Communication Mechanism. *Proc. of CIPS Edmonton '88 Chaos Into Order*, Edmonton, Alberta, Canada, November 1988, 214-222 (with T. Bloom, D. Gifford, R. Scheifler and W. Weihl).
43. Implementation of Resilient, Atomic Data Types. In *Readings in Object-Oriented Databases*, Morgan-Kaufman, Publishers (S. Zdonik and D. Maier, Eds.), 1989 (with W. Weihl).
44. Design for a Fault-Tolerant, Distributed Implementation of Linda. *Proc. of the Nineteenth International Symposium on Fault-Tolerant Computing*, June 1989 (with A. Xu).
45. Efficient At-Most-Once Messages Based on Synchronized Clocks. *Proc. of the Second Workshop on Workstation Operating Systems (WWOS-II)*, IEEE, September 1989, 73-81. (with L. Shrira and J. Wroclawski).
46. Computer Systems. *Computer Science: Achievements and Opportunities*, Report of the NSF Advisory Committee for Computer Research. Published by the Society for Industrial and Applied Mathematics, 1989, 29-39 (with F. Baskett, A. N. Habermann, F. B. Schneider, D. Clark and B. Smith).
47. Atomic Garbage Collection: Managing a Stable Heap. In *1989 SIGMOD Conference*, Portland, OR, 1989 (with E. Kolodner and W. Weihl).
48. Lazy Replication: Exploiting the Semantics of Distributed Services (Preliminary Version). *Proc. of the Ninth ACM Symposium on Principles of Distributed Computing*, Quebec, Canada, August 1990 (with R. Ladin and L. Shrira).
49. Efficient At-Most-Once Messages Based on Synchronized Clocks. *Proc. of ACM SIGCOMM '90 Symposium*, Philadelphia, PA, September 1990 (with L. Shrira and J. Wroclawski).

50. A Replicated Unix File System (Extended Abstract). *Proc. of the European Workshop on Fault Tolerance Support in Distributed Systems*, Bologna, Italy, September 1990 (with R. Gruber, P. Johnson, and L. Shrira).
51. Lazy Replication: Exploiting the Semantics of Distributed Services (Extended Abstract). *Proc. of the European Workshop on Fault Tolerance Support in Distributed Systems*, Bologna, Italy, September 1990 (with R. Ladin and L. Shrira).
52. A Replicated Unix File System (Extended Abstract). *Proc. of the IEEE Workshop on the Management of Replicated Data*, Houston, TX, November 1990 (with R. Gruber, P. Johnson, and L. Shrira).
53. Lazy Replication: Exploiting the Semantics of Distributed Services (Extended Abstract). *Proc. of the IEEE Workshop on the Management of Replicated Data*, Houston, TX, November 1990 (with R. Ladin and L. Shrira).
54. A Highly Available Object Repository for Use in a Heterogeneous Distributed System. *Implementing Persistent Object Bases – Principles and Practice*, Morgan Kaufmann, 1991 (with R. Gruber, P. Johnson, and L. Shrira).
55. Lazy Replication: Exploiting the Semantics of Distributed Services (Extended Abstract). *ACM Operating Systems Review* 25, 1 (January 1991) (with R. Ladin and L. Shrira).
56. Challenges in Distributed Systems. In *Research Directions in Computer Science: An MIT Perspective*, A. Meyer, J. Guttag, R. Rivest, and P. Szolovits, Eds., MIT Press, Cambridge, MA, 1991.
57. Efficient At-Most-Once Messages Based on Synchronized Clocks. *ACM Trans. on Computer Systems* 9, 2 (May 1991), 125-142. (with L. Shrira and J. Wroclawski).
58. Replication in the Harp File System. *Proc. of the 13th ACM Symposium on Operating Systems Principles*, October 1991 (with S. Ghemawat, R. Gruber, P. Johnson, L. Shrira, and M. Williams).
59. Practical Uses of Synchronized Clocks in Distributed Systems, *Proc. of the Tenth Annual ACM Symposium on Principles of Distributed Computing*, August 1991. Also in *Distributed Computing* 6, 211-219, August 1993. Also in *Global States and Time in Distributed Systems*, by Zhonghua Yang and T. Anthony Marsland.
60. Connecting Thor Worlds Together. *Proc. of the Second International Workshop on Intelligent and Cooperative Information Systems*, Como, Italy, October 1991.
61. Preliminary Design of the Thor Object Oriented Data Base System. *Proc. of the DARPA Software Technology Conference*, Los Angeles, CA, April 1992.
62. Escaping the Disk Bottleneck in Fast Transaction Processing. *Proc. of IEEE Third Workshop on Workstation Operating Systems*, Key Biscayne, FL, April 1992 (with L. Shrira).
63. Garbage Collection of a Distributed Heap. *Proc. of the 12th International Conference on Distributed Computing Systems*, Yokohama, Japan, June 1992 (with R. Ladin).
64. Naming and Locating Objects in Thor. *Proc. of the Second Workshop on Objects in Large Distributed Applications*, Vancouver, British Columbia, October 1992 (with M. Day, U. Maheshwari, and A. Myers).
65. Report on Workshop on Research in Experimental Computer Science. *Computing Research News* 4, 5, November 1992 (Part 1); *Computing Research News* 5, 1, January 1993 (Part 2).
66. Efficient Recovery in Harp. In *Proc. of the Second Workshop on Management of Replicated Data*, Monterey, CA, November 1992 (with S. Ghemawat, R. Gruber, P. Johnson and L. Shrira).
67. Providing High Availability Using Lazy Replication. *ACM Trans. on Computer Systems* 10, 4 (November 1992), 360-391. (with R. Ladin, L. Shrira, and S. Ghemawat).

68. Distributed Object Management in Thor. In *Distributed Object Management*, ed. M.T. Ozsu, U. Dayal, and P. Valduriez, Morgan Kaufmann, San Mateo, CA, 1993 (with M. Day, and L. Shriram).
69. A History of Data Abstraction and CLU. *Proc. of the Second ACM SIGPLAN History of Programming Languages Conference*, Cambridge, MA, Sigplan Notices 28:3, pp. 133-147, March, 1993.
70. A New Definition of the Subtype Relation. In *Object oriented programming. Proceedings of the 7th European Conference: ECOOP '93*. pages 118-141, Springer-Verlag LNCS 707, Kaiserslautern, Germany, July 1993 (with J. Wing).
71. Specifications and their Use in Defining Subtypes. In *Proceedings of OOPSLA '93: Eighth Annual Conference on Object-Oriented Programming Systems, Languages, and Applications*. Pages 16-28, Washington, DC, September–October 1993 (with J. Wing).
72. Replication Algorithms for Highly-Available Systems. In *Proc. of the European Informatics Congress on Computing Systems Architecture Euro-Arch '93*, pages 211-224, Munich, Germany, October 1993.
73. References to Remote Mobile Objects in Thor. In *ACM Letters on Programming Languages and Systems*, Vol.2, No.1, pages 115-126, March 1994 (with M. Day, U. Maheshwari, and A. Myers).
74. Reducing Cross Domain Call Overhead using Batched Futures. In *Proceedings of OOPSLA '94*, Sigplan Notices 29:10, pp. 341-354, Portland, OR, October, 1994, (with P. Bogle).
75. Program Structure in Distributed Systems (extended abstract). In *Proceedings of ACM Japan Symposium*, pages 323-324, Tokyo, Japan, March 1994.
76. The Language-Independent Interface of the Thor Persistent Object System. In *Object-Oriented Multidatabase Systems*. O. Bukhres and A. Elmagarmid, editors, Prentice Hall, 1994 (with M. Day, S. Ghemawat, R. Gruber, U. Maheshwari, A. Myers and L. Shriram).
77. Fault-tolerant Garbage Collection in a Client-Server, Object-oriented Database System. In *Proceedings of the Third International Conference on Parallel and Distributed Information Systems*. Austin, TX, pp. 239-248, September 1994 (with U. Maheshwari).
78. A Behavioral Notion of Subtyping. In *ACM Transactions on Programming Languages and Systems* 16:6, November 1994, pp. 1811-1841 (with J. Wing).
79. Disconnected Operation in the Thor Object-Oriented Database System. In *Proceedings of the IEEE Workshop on Mobile Computing Systems and Applications*, Santa Cruz, CA, Dec. 1994, pp. 51-56 (with R. Gruber, F. Kaashoek, and L. Shriram).
80. Efficient Optimistic Concurrency Control using Loosely-synchronized Clocks. In *Proceedings of the 1995 ACM SIGMOD International Conference on Management of Data*, San Jose, CA, May, 1995, SIGMOD Record, Vol. 24, No. 2, June 1995, pp. 23-34 (with A. Adya, R. Gruber, and U. Maheshwari).
81. A History of CLU, in *History of Programming Languages*, Thomas J. Bergin and Rick G. Gibson, Editors, ACM Press Books/Addison-Wesley, Reading, MA, 1996.
82. Collecting Cyclic Distributed Garbage by Controlled Migration. In *Proceedings of the 14th Annual ACM Symposium on Principles of Distributed Computing*, pp. 57-63, Ottawa, Ont., Canada, August 1995 (with U. Maheshwari).
83. Subtypes vs. Where Clauses: Constraining Parametric Polymorphism. In *Proceedings of OOPSLA '95*, Sigplan Notices Vol. 30, No. 10, pp 156-168, Austin, Texas (with M. Day, R. Gruber, and A. Myers).
84. Type-Safe Heterogeneous Sharing can be Fast. In *Proceedings of 7th International Workshop on Persistent Object Systems*, Cape May, NJ, May 1996 (with A. Adya, M. Castro, and Q. Zondervan).
85. Fragment Reconstruction: A New Cache Coherence Scheme for Split Caching Storage Systems. In *Proceedings of 7th International Workshop on Persistent Object Systems*, Cape May, NJ, May 1996 (with L. Shriram, A. Adya, and M. Castro).

86. Safe and Efficient Sharing of Persistent Objects in Thor. In *Proceedings of the 1996 SIGMOD International conference on Management of Data*. Montreal, Canada. SIGMOD Record, Vol. 25, No. 2, pp. 318-329, June 1996 (with A. Adya, M. Castro, M. Day, S. Ghemawat, R. Gruber, U. Maheshwari, A. Myers, and L. Shriram).
87. How to Scale Transactional Storage Systems. In *Proceedings of the ACM SIGOPS European Workshop*, pp. 121-127, Connemara, Ireland, September 1996 (with L. Shriram, A. Adya, and M. Castro).
88. Partitioned Garbage Collection of a Large Stable Heap. In *Proceedings of IWOOS '96*, pp. 117-121, Seattle, WA, October 1996 (with U. Maheshwari and T. Ng).
89. Parameterized Types for Java. In *Proceedings ACM Symposium on Principles of Programming Languages*, pp 132-145, Paris, France, January 1997 (with A. Myers and J. Bank).
90. Partitioned Garbage Collection of a Large Object Store. In *Proceedings of SIGMOD International Conference on Management of Data*, pp. 313-323, Tuscon, Arizona, May 1997 (with U. Maheshwari)
91. Fragment Reconstruction: Providing Global Cache Coherence in a Transactional Storage System. In *Proceedings of the 17th International Conference on Distributed Computing Systems*, pp. 2-11, Baltimore, Maryland, May 1997 (with A. Adya, M. Castro, U. Maheshwari, and L. Shriram).
92. Collecting Cyclic Distributed Garbage by Controlled Migration. In *Distributed Computing*, **10:2** (79-86), 1997 (with U. Maheshwari).
93. Safe Heterogeneous Sharing in the Thor Object-Oriented Database System. In *Proceedings 1996 NEC Symposium*, 1997.
94. Lazy Consistency Using Loosely Synchronized Clocks. In *Proceedings of the 16th Annual ACM Symposium on Principles of Distributed Computing*, Santa Barbara, California, August 1997, 73-82 (with A. Adya)
95. Collecting Cyclic Distributed Garbage using Back Tracing. In *Proceedings of the 16th Annual ACM Symposium on Principles of Distributed Computing*, Santa Barbara, California, August 1997, 239-248 (with U. Maheshwari)
96. HAC: Hybrid Adaptive Caching for Distributed Storage Systems. In *Proceedings of the 17th Symposium on Operating Systems Principles*, St. Malo, France, October 1997, 102-115 (with M. Castro, A. Adya, and A. Myers).
97. A Decentralized Model for Information Flow Control. In *Proceedings of the 17th Symposium on Operating Systems Principles*, 129-147, St. Malo, France, October 1997 (with A. Myers).
98. Complete Safe Information Flow with Decentralized Labels. In *IEEE Symposium on Security and Privacy*, 185-197, Oakland, CA, May 1998 (with A. Myers).
99. Practical Byzantine Fault Tolerance. In *Proceedings of 3rd Symposium on Operating systems Design and Implementation*, New Orleans, LA, February 1999, 173-186 (with M. Castro).
100. Providing Persistent Objects in Distributed Systems. In *Proceedings of European Conference on Object-Oriented Programming (ECOOP) '99* (with M. Castro, L. Shriram, and A. Adya).
101. Behavioral Subtyping Using Invariants and Constraints. In *Formal Methods for Distributed Processing, an Object Oriented Approach*, Cambridge University Press (with J. Wing).
102. Protecting Privacy in a Decentralized Environment. In *Proceedings of DISCEX 2000*, 266-280, (with A. Myers).
103. Generalized Isolation Level Definitions. In *Proceedings of the IEEE Conference on Data Engineering*, San Diego, CA, March 2000 (with A. Adya).

104. Protecting Privacy using the Decentralized Label Model. In *Transactions on Software Engineering and Methodology*, 9(4), pp. 410-442, October 2000 (with A. Myers).
105. Proactive Recovery in a Byzantine-Fault-Tolerant System. In *Proceedings of the 4th Symposium on Operating System Design and Implementation*, 273-288, October 2000 (with M. Castro).
106. Using Abstraction to Improve Fault Tolerance. In *Proceeding of the 2001 Workshop on Hot Topics in Operating Systems*, 27-32, (with M. Castro and R. Rodrigues).
107. BASE: Using Abstraction to Improve Fault Tolerance. In *Proceedings of the Symposium on Operating Systems Principles*, 15-28, October, 2001 (with R. Rodrigues and M. Castro). Received Best Student Paper Award.
108. Byzantine Fault Tolerance can be Fast. In *DSN 2001*, 513-518 (with M. Castro).
109. Practical Byzantine Fault Tolerance and Proactive Recovery. In *Transactions on Computer Systems*, 20(4), 398-461, 2002 (with M. Castro).
110. The Design of a Robust Peer-to-Peer System. In *Proceedings of the Tenth ACM SIGOPS European Workshop*. 117-124, Saint-Emilion, France, October 2002 (with R. Rodrigues and L. Shrira)
111. Ownership Types for Object Encapsulation. In *Proceedings of POPL 2003*. 213-223, New Orleans, LA, January 2003 (with C. Boyapati and L. Shrira).
112. One Hop Lookups in Peer to Peer Overlays. In *Proceedings of HOTOS 2003*. 7-12, May 2003, Lihue, Kauai, HI (with A. Gupta and R. Rodrigues).
113. Scheduling and Simulation: How to Upgrade Distributed Systems. In *Proceedings of HOTOS 2003*. 43-48, May 2003, Lihue, Kauai, HI (with S. Ajmani and L. Shrira).
114. BASE: Using Abstraction to Improve Fault Tolerance. In *ACM Transactions on Computer Systems (TOCS)*, 21(3), 236-269, August 2003. (with R. Rodrigues and M. Castro).
115. Lazy Modular Upgrades in Persistent Object Stores. In *Proceedings of OOPSLA 2003*. 403-417, Anaheim, CA, October 2003 (with C. Boyapati, L. Shrira, C-H Moh, S. Richman).
116. TimeLine: A High Performance Archive for a Distributed Object Store. In *Proceedings of NSDI 2004*. 351-364, San Francisco, California, March 2004. (with C-H Moh).
117. Efficient Routing for Peer-to-Peer Overlays. In *Proceedings of NSDI 2004*. 113-126, San Francisco, California, March 2004. (with A. Gupta and R. Rodrigues).
118. Brief Announcement: Reconfigurable Byzantine-Fault-Tolerant Atomic Memory. In *Proceedings of PODC 2004*. St. John's, Newfoundland, Canada, July 2004. (with R. Rodrigues).
119. Transactional File Systems can be Fast. In *Proceedings of 2004 ACM SIGOPS European Workshop*. Leuven, Belgian, September 2004. (with R. Rodrigues).
120. Epichord: Parallelizing the Chord Lookup Algorithm with Reactive Cache Management. In *Proceedings of the 12th International Conference on Networks 2004 (ICON 2004)*, Singapore. November 2004. (with B. Leong and E. Demaine). Received Best Student Paper Award.
121. High Availability in DHTs: Erasure Coding vs. Replication. In *Proceedings of IPTPS 05*. Ithaca, NY. February 2005. (with R. Rodrigues).
122. Byzantine Clients Rendered Harmless. In *Proceedings of of the 19th International Symposium on Distributed Computing (DISC 2005)*, Cracow, Poland. September 2005. (with R. Rodrigues).
123. Path Vector Face Routing: Geographic Routing with Local Face Informaton. In *Proceedings of the 13th IEEE International Conference on Network Protocols (ICNP 2005)*. Boston, Massachusetts, November 2005. (with B. Leong and S. Mitra).

124. Geographic Routing without Planarization. In *Proceedings of the 3rd Symposium on Network Systems Design and Implementation (NSDI 2006)*. San Jose, California. April 2006. (with B. Leong and R. Morris).
125. Tolerating Byzantine Faulty Clients in a Quorum System. In *Proceedings 26th International Conference on Distributed Computing Systems (ICDCS 2006)*. Lisbon, Portugal. July 2006. (with R. Rodrigues).
126. Automatic Software Upgrades for Distributed Systems. In *Proceedings of the European Conference on Object-oriented Programming (ECOOP 2006)*. Nantes, France. July 2006. (with S. Ajmani and L. Shrira).
127. HQ Replication: A Hybrid Quorum Protocol for Byzantine Fault Tolerance. In *Proceedings of the Conference on Operating Systems Design and Implementation (OSDI-06)*. Seattle, WA, November 2006. (with J. Cowling, D. Myers, R. Rodrigues, and L. Shrira).
128. MapJAX: Data Structure Abstractions for Asynchronous Web Applications. In *Proceedings of the 2007 USENIX Annual Technical Conference*, Santa Clara, CA, June 2007. (with D. Myers, J. Carlisle, and J. Cowling).
129. Greedy Coordinates for Geographic Routing. in *Proceedings of the 15th IEEE International conference on Network Protocols (ICNP 2007)*, Beijing, China, Oct. 2007. (with B. Leong and R. Morris).
130. Tolerating Byzantine Faults in Databases using Commit Barrier Scheduling. In *Proceedings of the Conference on Operating Systems Principles (SOSP 2007)*, Portland, OR, October 2007. (with B. Vandiver, H. Balakrishnan, and S. Madden).
131. Short Paper: Mobile Proactive Secret Sharing. In *Proc. of PODC 08*, Toronto, Canada. August 2008. (with D. Schultz and M. Liskov).
132. Census: Location-Aware Membership Management for Large Scale Distributed Systems. in *Proc. of Usenix 2009*, San Diego, CA. June 2009. (with J. Cowling, D. R. K. Ports, R. Popa, and A. Gaikwad).
133. Tolerating Latency in Replicated State Machines through Client Speculation. In *Proc. NSDI 2009*, Boston MA, April 2009. (with B. Wester, J. Cowling, E. Nightingal, P. M. Chen, and J. Flinn)
134. MPSS: Mobile Proactive Secret Sharing. accepted for publication in TISSEC. (with D. Schultz and M. Liskov).
135. Full Information Lookups for Peer to Peer Overlays. Accepted for Publication in TDSC. (with P. Fonseca, A. Gupta, and R. Rodrigues).
136. From Viewstamped Replication to Byzantine Fault Tolerance. To appear in *Replication: Theory and Practice*. Springer Verlag.
137. Automatic Reconfiguration for Large-scale Distributed Storage Systems. Submitted for Publication. (with R. Rodrigues, K. Chen, M. Liskov, and D. Schultz).

## Reports

1. *The Advice Taker and GPS*. Stanford University, A.I. Memo 33, Stanford, CA, June 1965.
2. *A Program to Play Chess End Games*. Stanford University, Technical Report CS 106, Stanford, CA, August 1968 (Thesis).
3. *The Venus Multiprogramming System*. The Mitre Corporation, M69-69, Bedford, MA, November 1969.
4. *Principles of Operation of the Venus Microprogram*. The Mitre Corporation, MTR 1843, Bedford, MA, May 1970.
5. *The Venus Multiprogramming System – Year End Summary*. The Mitre Corporation, MTR 2004, Bedford, MA, August 1970.
6. *The Proof of Correctness Approach to Reliable Systems*. The Mitre Corporation, MTR 2073, Bedford, MA, March 1971 (with E. Towster).
7. *Guidelines for the Design and Implementation of Reliable Software Systems*. The Mitre Corporation, MTR 2345, Bedford, MA, April 1972.
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9. *The Highly Reliable Programming Task: Year End Summary*. The Mitre Corporation, MTR 2444, Bedford, MA, June 1972.
10. *SPIL: A Language for Systems Design and Implementation*. Computation Structures Group Memo 80, MIT Laboratory for Computer Science, Cambridge, MA, May 1973.
11. *An Approach to Abstraction*. Computation Structures Group Memo 88, MIT Laboratory for Computer Science, Cambridge, MA, September 1973 (with S. Zilles).
12. *Proposed Research on Semantic Foundations for Structured Programming*. Computation Structures Group Memo 97, MIT Laboratory for Computer Science, Cambridge, MA, February 1974 (with J. Dennis).
13. *Programming with Abstract Data Types*. Computation Structures Group Memo 99, MIT Laboratory for Computer Science, Cambridge, MA, March 1974 (with S. Zilles).
14. *A Note on CLU*. Computation Structures Group Memo 112, MIT Laboratory for Computer Science, Cambridge, MA, November 1974.
15. *Data Types and Program Correctness*. Computation Structures Group Memo 114, MIT Laboratory for Computer Science, Cambridge, MA, January 1975.
16. *Specification Techniques for Data Abstractions*. Computation Structures Group Memo 117, MIT Laboratory for Computer Science, Cambridge, MA, 1975 (with S. Zilles).
17. *An Introduction to CLU*. Computation Structures Group Memo 136, MIT Laboratory for Computer Science, Cambridge, MA, February 1976.
18. *An Access Control Facility for Programming Languages*. Computation Structures Group Memo 137, MIT Laboratory for Computer Science, Cambridge, MA, April 1976 with A. K. Jones.
19. *An Appraisal of Program Specifications*. Computation Structures Group Memo 141-1, MIT Laboratory for Computer Science, Cambridge, MA, April 1977 (with V. Berzins).

20. *Abstraction Mechanisms in CLU*. Computation Structures Group Memo 144-1, MIT Laboratory for Computer Science, Cambridge, MA, January 1977 (with A. Snyder, R. Atkinson and C. Schaffert).
21. *A Language Extension for Expressing Constraints on Data Access*. Computation Structures Group Memo 146-1, MIT Laboratory for Computer Science, Cambridge, MA, June 1977 (with A. K. Jones).
22. *Programming Methodology Group Progress Report 1975-76*. Computation Structures Group Memo 150, MIT Laboratory for Computer Science, Cambridge, MA, July 1977.
23. *Structured Exception Handling*. Computation Structures Group Memo 155, MIT Laboratory for Computer Science, Cambridge, MA, December 1977 (with A. Snyder).
24. *The CLU Reference Manual*. Computation Structures Group Memo 161, MIT Laboratory for Computer Science, Cambridge, MA, July 1978 (with E. Moss, J. C. Schaffert, R. W. Scheifler and A. Snyder).
25. *Practical Benefits of Research in Programming Methodology*. Computation Structures Group Memo 166, MIT Laboratory for Computer Science, Cambridge, MA, August 1978.
26. *Aspects of Implementing CLU*. Computation Structures Group Memo 167, MIT Laboratory for Computer Science, Cambridge, MA, October 1978 (with R. Atkinson and R. Scheifler).
27. *Semantics of Distributed Computing - Progress Report on the Distributed Systems Group 1977-78*. Computation Structures Group Memo 171, MIT Laboratory for Computer Science, Cambridge, MA, October 1978 (with D. Clark, I. Greif and L. Svobodova).
28. *Distributed Computer Systems: Structure and Semantics*. Technical Report TR-215, MIT Laboratory for Computer Science, Cambridge, MA, March 1979 (with L. Svobodova and D. Clark).
29. *Primitives for Distributed Computing*. Computation Structures Group Memo 175, MIT Laboratory for Computer Science, Cambridge, MA, May 1979.
30. *Modular Program Construction Using Abstractions*. Computation Structures Group Memo 184, MIT Laboratory for Computer Science, Cambridge, MA, September 1979.
31. *Programming Methodology Group Progress Report 1978-1979*, Computation Structures Group Memo 186, MIT Laboratory for Computer Science, Cambridge, MA, November 1979.
32. *A Value Transmission Method for Abstract Data Types*. Computation Structures Group Memo 200, MIT Laboratory for Computer Science, Cambridge, MA, October 1980 (with M. Herlihy).
33. *On Linguistic Support for Distributed Programs*. Computation Structures Group Memo 201, MIT Laboratory for Computer Science, Cambridge, MA, October 1980.
34. *Programming Methodology Group Progress Report 1979-1980*, Computation Structures Group Memo 202, MIT Laboratory for Computer Science, Cambridge, MA, December 1980.
35. *Guardians and Actions: Linguistic Support for Robust, Distributed Programs*. Computation Structures Group Memo 210, MIT Laboratory for Computer Science, Cambridge, MA, November 1981 (with R. Scheifler).
36. *Specification and Implementation of Resilient, Atomic Data Types*, Computation Structures Group Memo 223, MIT Laboratory for Computer Science, Cambridge, MA, December 1982 (with W. Weihl).
37. *Issues in Process and Communication Structure for Distributed Programs*, Programming Methodology Group Memo 38, MIT Laboratory for Computer Science, Cambridge, MA, July 1983 (with M. Herlihy).
38. *Preliminary Argus Reference Manual*, Programming Methodology Group Memo 39, MIT Laboratory for Computer Science, Cambridge, MA, October 1983 (with M. Herlihy, P. Johnson, G. Leavens, R. Scheifler and W. Weihl).

39. *Overview of the Argus Language and System*, Programming Methodology Group Memo 40, MIT Laboratory for Computer Science, Cambridge, MA, February 1984.
40. *Limitations of Synchronous Communication with Static Process Structure in Languages for Distributed Computing*, Programming Methodology Group Memo 41-1, MIT Laboratory for Computer Science, Cambridge, MA, October 1985 (with M. Herlihy and L. Gilbert).
41. *Programming Methodology Group Progress Report, July 1, 1983 - June 30, 1984*, Programming Methodology Group Memo 42, MIT Laboratory for Computer Science, Cambridge, MA, November 1984.
42. *Reliable Object Storage to Support Atomic Actions*, Programming Methodology Group Memo 45, MIT Laboratory for Computer Science, Cambridge, MA, September 1985 (with B. M. Oki and R. W. Scheifler).
43. *Specifications of Distributed Programs*, Programming Methodology Group Memo 46, MIT Laboratory for Computer Science, Cambridge, MA, September 1985 (with W. E. Weihl).
44. *Highly-Available Distributed Services and Fault-Tolerant Distributed Garbage Collection*, Programming Methodology Group Memo 48, MIT Laboratory for Computer Science, Cambridge, MA, May 1986 (with R. Ladin).
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47. *Orphan Detection*, Programming Methodology Group Memo 53, MIT Laboratory for Computer Science, Cambridge, MA, February 1987 (with R. Scheifler, E. Walker, and W. Weihl).
48. *Argus Reference Manual*, Programming Methodology Group Memo 54, MIT Laboratory for Computer Science, Cambridge, MA, March 1987 (with M. Day, M. Herlihy, P. Johnson, G. Leavens, R. Scheifler, and W. Weihl).
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51. *Communication in the Mercury System*, Programming Methodology Group Memo 59, MIT Laboratory for Computer Science, Cambridge, MA, October 1987 (with T. Bloom, D. Gifford, R. Scheifler, and W. Weihl).
52. *A Technique for Constructing Highly Available Services*, Technical Report MIT/LCS/TR-409, MIT Laboratory for Computer Science, Cambridge, MA, January 1988 (with R. Ladin and L. Shrira).
53. *Promises: Linguistic Support for Efficient Asynchronous Procedure Calls in Distributed Systems*, Programming Methodology Group Memo 60-1, MIT Laboratory for Computer Science, Cambridge, MA, March 1988 (with L. Shrira).
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55. *Viewstamped Replication: A New Primary Copy Method to Support Highly-Available Distributed Systems*, Programming Methodology Group Memo 62, MIT Laboratory for Computer Science, Cambridge, MA, May 1988 (with B. Oki).
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61. *Efficient At-Most-Once Messages Based on Synchronized Clocks*. Technical Report MIT/LCS/TR-476, MIT Laboratory for Computer Science, Cambridge, MA, April 1990 (with L. Shriram, and J. Wroclawski).
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70. *Report on Workshop on Research in Experimental Computer Science*, Technical Report MIT/LCS/TR-540, MIT Laboratory for Computer Science, Cambridge, MA, June 1992.
71. *A History of CLU*, Technical Report MIT/LCS/TR-561, MIT Laboratory for Computer Science, Cambridge, MA, April 1992.
72. *Family Values: A Semantic Notion of Subtyping*, Technical Report MIT/LCS/TR-562, MIT Laboratory for Computer Science, Cambridge, MA, December 1992 (with J. M. Wing).
73. *A New Definition of the Subtype Relation*, Programming Methodology Group Memo 76, MIT Laboratory for Computer Science, Cambridge, MA, May 1993 (with J. Wing).
74. *Distributed Object Management in Thor*, Programming Methodology Group Memo 77, MIT Laboratory for Computer Science, Cambridge, MA, June 1993 (with M. Day and L. Shriram).

75. *References to Remote Mobile Objects in Thor*, Programming Methodology Group Memo 79, MIT Laboratory for Computer Science, Cambridge, MA, December 1993 (with M. Day, U. Maheshwari, and A. Myers).
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79. *Fault-Tolerant Distributed Garbage Collection in a Client-Server Object-Oriented Database*. Programming Methodology Group Memo 83, MIT Laboratory for Computer Science, Cambridge, MA, September 1994. (with U. Maheshwari).
80. *A Behavioral Notion of Subtyping*. Programming Methodology Group Memo 84, MIT Laboratory for Computer Science, Cambridge, MA, November 1994 (with J. Wing).
81. *Efficient optimistic concurrency control using loosely synchronized clocks*. Programming Methodology Group Memo 85. MIT Laboratory for Computer Science, Cambridge, MA, November 1994 (with A. Adya, R. Gruber, and U. Maheshwari).
82. *Index Maintenance for Object-Oriented Databases Using Semantic Information*. Programming Methodology Group Memo 86, MIT Laboratory for Computer Science, Cambridge, MA. (In preparation) (with Deborah Hwang).
83. *Disconnected operation in the Thor Object Database System*, Programming Methodology Group Memo 87, MIT/Lab of Computer Science, Cambridge, MA, November 1994 (with R. Gruber, M.F. Kaashoek and L. Shriram).
84. *Theta Reference Manual (Preliminary Version)*, Programming Methodology Group Memo 88, MIT Laboratory for Computer Science, Cambridge, MA, November 1994 (with D. Curtis, M. Day, S. Ghemawat, R. Gruber, P. Johnson, A.C. Myers).
85. *Disk Management Policies for Object-Oriented Databases*. Programming Methodology Group Memo 90, MIT Laboratory for Computer Science, Cambridge, MA, June 1994. (with S. Ghemawat and M.F. Kaashoek).
86. *Efficient Implementation of Parametric Polymorphism*, Programming Methodology Group Memo 91. MIT/Lab for Computer Science, Cambridge, MA. (with A. Myers).
87. *Subtypes vs. Where Clauses: Constraining Parametric Polymorphism*. Programming Methodology Group Memo 93, MIT Laboratory for Computer Science, Cambridge, MA, MIT Lab for Computer Science, Cambridge, MA, 1995. (with M. Day, R. Gruber, and A. Myers).
88. *Theta Reference Manual*. MIT Laboratory for Computer Science TR-668, Cambridge, MA, 1995 (with D. Curtis, M. Day, S. Ghemawat, R. Gruber, P. Johnson, and A. Myers).
89. *Partitioned Garbage Collection in a Large Object Store*. MIT Laboratory for Computer Science TR-699, Cambridge, MA, 1996 (with U. Maheshwari and T. Ng).
90. *Parameterized Types and Java*. MIT Laboratory for Computer Science TM-553, Cambridge, MA, 1996 (with A. Myers and J. Bank).
91. *Lazy Reference Counting for Transactional Storage Systems*. MIT Laboratory for Computer Science TM-567 Cambridge, MA, 1996 (with M. Castro and A. Adya).

92. *Authenticated Byzantine Fault Tolerance without Public-Key Cryptography*. MIT Laboratory for Computer Science TM-595, Cambridge, MA, 1999 (with M. Castro)
93. *A Correctness Proof for a Practical Byzantine-Fault-Tolerant Replication Algorithm*. MIT Laboratory for Computer Science TM-597, Cambridge, MA, 1999 (with M. Castro).
94. *A Trusted Third-Party Computation Service*. MIT Laboratory for Computer Science TR-847, Cambridge, MA, 2001 (with S. Ajmani and R. Morris).
95. *Safe Lazy Software Upgrades in Object-Oriented Databases*. MIT Laboratory for Computer Science TR-851, Cambridge, MA, 2001 (with C-H. Moh, S. Richman, L. Shrira, Y. Chueng, C. Boyapati).
96. *Ownership Types and Safe Lazy Upgrades in Object-Oriented Databases*. MIT Laboratory for Computer Science TR-858, Cambridge, MA, 2002 (with C. Boyapati and L. Shrira).
97. *A Correctness Proof for a Byzantine-Fault-Tolerant Read/Write Atomic Memory with Dynamic Replica Membership*. MIT CSAIL Technical Report TR/920. September 2003. (with R. Rodrigues).
98. *Rosebud: A Saclable Byzantine-Fault-Tolerant Storage Architecture*. MIT CSAIL Technical Report TR/932. December 2003. (with Rodrigo Rodrigues).
99. *Byzantine Fault Tolerance in Long-Lived Systems*. Presented at 2nd Bertinoro Workshop on Furtuer Directions in Distributed Computing (FuDiCo II). Bertinoro, Italy, June 2004. MIT-CSAIL-TR/962. (with R. Rodrigues).
100. *EpiChord: Parallelizing the Chord Lookup Algorithm with Reactive Routing State Management*. MIT-CSAIL-TR-963. August 2004. (with B. Leong and E. Demaine).
101. *Byzantine Clients Rendered Harmless*. MIT CSAIL TR 994. July 2005. (with R. Rodrigues).
102. *HQ Replication: Properties and Optimizations*. MIT-CSAIL-TR-2007-009. Feb. 2007. (with J. Cowling, D. Myers, R. Rodrigues, and L. Shrira.).

## Public Lectures and Contributions to Conferences (since July 1974)

### *Programming with Abstract Data Types*

University of Connecticut; Syracuse University; IBM, Yorktown Heights;  
State University of New York at Stonybrook;  
Intermetrics, Cambridge, MA. (September 1974 - May 1975).

### *Specification Techniques for Data Abstractions*

First International Conference on Software Reliability, Anaheim, CA, March 1975.

*Discussant*, First International Conference on Software Reliability, Anaheim, CA, March 1975.

### *Data Types and Program Correctness*

National Computer Conference, Los Angeles, CA, May 1975.

### *Practical Benefits of Program Verification*

First National Conference on Reliable Software, Washington, DC, September 1975.

*Session Chairman*, First National Conference on Reliable Software, Washington, DC, September 1975.

### *Data Abstractions*

Industrial Liaison Office Seminar, M.I.T., Cambridge, MA, March 1976.

### *Data Bases and Data Abstraction*

Conference on Data, Salt Lake City, March 1976.

### *Data Abstractions in CLU*

Italian Computer Society Meeting, Pisa, Italy, March 1976.

### *Abstract Model Specifications of Data Abstractions*

IFIP Working Group 5.2, France, May 1976.  
Italian Computer Society Meeting, Pisa, Italy, May 1976.

### *CLU Semantics*

Quality Software Working Group Meeting, April 1976.

*Member of Panel, Session on Reliable Software*, National Computer Conference, New York, NY, June 1976.

*Discussant on Data Abstractions*, Tinman Workshop, Cornell University, Ithaca, NY, September 1976.

### *A Language Extension for Controlling Access to Shared Data*

2nd Annual Conference on Software Engineering, San Francisco, CA, October 1976.

*Session Chairman*, 2nd Annual Conference on Software Engineering, San Francisco, CA, October 1976.

### *Data Abstraction and Software Reliability*

Control Data Corporation, St. Paul, MN, October 1976.  
Codex Corp., Watertown, MA, December 1976.  
Sylvania - GTE, Needham, MA, December 1976.

### *An Introduction to CLU*

Tufts University, Medford, MA, November 1976.  
University of Wisconsin, Madison, WI, March 1977.

### *Abstraction Mechanisms in CLU*

Conference on Language Design for Reliable Software, Raleigh, NC, March 1977.

- Chairman of Panel Session on Program Specification Techniques*  
IFIP Congress, Toronto, Canada, August 1977.
- An Appraisal of Program Specifications*  
Conference on Research Directions in Software Technology, Providence, RI, October 1977.
- CLU Abstraction Mechanisms and Their Implementation*  
SIGPLAN Meeting, Boston, MA, November 1977.  
Cornell University, Ithaca, NY, December 1977.
- Abstraction Mechanisms in CLU*  
University of Waterloo, Canada, November 1977.  
Bell Labs., Indian Hill, IL, November 1977.
- Primitives for Distributed Computing*  
IFIP Working Group 2.3, Warwick, England, April 1978.
- Session Chairman, History of Programming Languages Conference, Los Angeles, June 1978.*
- Issues in Distributed Computing*  
Quality Software Workshop, Salt Lake City, October 1978.
- Implementation Aspects of CLU*  
*Use of Data Abstractions in Data Bases*  
ACM National Conference, Washington, DC, December 1978.
- Linguistic Support for Distributed Computing*  
Eidgenossische Technische Hochschule, Zurich, Switzerland, January 1979.
- Introduction to CLU*  
*An Example of Modular Program Development*  
*Embedding Data Abstraction in Programming Languages*  
Copenhagen Winter School on Abstract Software Specifications, Copenhagen, Denmark, January 1979.
- Introduction to CLU*  
*An Example of Modular Program Development*  
Bell Laboratories, Piscataway, NJ, March 1979.
- Linguistic Support for Distributed Programs*  
University of Rochester, Rochester, NY, April 1979.
- Message Passing Primitives*  
Quality Software Workshop, Amherst, MA, April 1979.
- Communicating Abstract Values*  
National Computer Conference, New York, NY, June 1979.
- Primitives for Distributed Computing*  
Xerox PARC, Palo Alto, CA, August 1979.  
7th Symposium on Operating Systems Principles, Pacific Grove, CA, December 1979.
- Introduction to CLU*  
2nd Advanced Course on Computing Systems Reliability, Toulouse, France, September 1979.
- An Example of Modular Program Development*  
2nd Advanced Course on Computing Systems Reliability, Toulouse, France, September 1979.
- Embedding Data Abstraction in Programming Languages*  
2nd Advanced Course on Computing Systems Reliability, Toulouse, France, September 1979.

*Semantics of Remote Invocation*

Quality Software Workshop, Carmel, CA, December 1979.

*Abstraction Mechanisms in CLU*

College of William and Mary, Williamsburg, VA, March 1980.

*Primitives for Distributed Computing*

Carnegie-Mellon University, Distinguished Lecture, Pittsburgh, PA, March 1980.

*Linguistic Support for Distributed Computing*

Capri, Italy, October 1980.

*Modular Program Construction Using Abstractions*

Wang Institute, Tyngsboro, MA, April 1981.

Oxford University, England, May 1981.

*On Linguistic Support for Distributed Programs*

IEEE Symposium on Reliability in Distributed Software and Database Systems, Pittsburgh, PA, July 1981.

University of Washington, Seattle, WA, August 1981.

Invited Lecture at the Inaugural Symposium, Cross Currents in Computer Science.

University of New Hampshire, Durham, NH, October 1981.

Quality Software Meeting, Rockport, MA, October 1981.

General Electric Co., Schenectady, NY, November 1981.

Wang Institute, Tyngsboro, MA, December 1981.

*Argus: Linguistic Support for Distributed Computing*

Boston University, Boston, MA, February 1982.

Harvard University, Cambridge, MA, March 1982.

Yale University, New Haven, CT, April 1982.

Prime Computer, Framingham, MA, April 1982.

University of Maryland, College Park, MD, September 1982.

Stanford University, Stanford, CA, October 1982.

IBM, San Jose, CA, October 1982.

Harvard University, Cambridge, MA, December 1982.

University of Massachusetts, Amherst, MA, December 1982.

IBM, MIT Meeting, Cambridge, MA, January 1983.

Greater Boston SIGPLAN, Cambridge, MA, January 1983.

Digital Equipment Corp., Marlboro, MA, March 1983.

University of Toronto, Canada, March 1983.

Honeywell, Inc., Bloomington, MN, April 1983.

Brown Boveri, Baden, Switzerland, August 1985.

*Argus: The Programming Language and System*

Xerox Palo Alto Research Center, Palo Alto, CA, August 1983.

Cornell University, Ithaca, NY, November 1983.

Brown University, Providence, RI, May 1984.

State University of New York, Stony Brook, NY, October 1984.

Wang Institute of Graduate Studies, Tyngsboro, MA, October 1984.

University of Pennsylvania, Philadelphia, PA, November 1984.

University of Delaware, Newark, DE, April 1985.

*Programming Methodology*

*Introduction to CLU*

*Specifying Data Abstractions*

*Program Construction Using Abstractions*

*Using Abstractions in Programming Languages*

*The Argus Language and System –  
Concepts and Issues  
Argus Features  
Example  
Subsystems  
Implementation  
User-defined Atomic Data Types  
Discussion*

International Professorship in Computer Science, Katholieke  
Universiteit Leuven, Leuven, Belgium, January 23-27, 1984.

*The Argus Language and System  
Concepts and issues  
Argus Features  
Example  
Subsystems  
Implementation  
User-defined Atomic Data Types  
Discussion*

Advanced Course on Distributed Systems—Methods and Tools for  
Specification, Munich, Germany, April 1984: also in April 1985.

*Software Engineering*

Panel Discussion, Wang Institute of Graduate Studies, Tyngsboro, MA, October 1985.

*Implementation of Resilient, Atomic Data Types*

Stanford University, Stanford, CA, January 1986.

*Specifications of Distributed Programs*

Forsythe Lecture, Stanford University, Stanford, CA, January 1986  
IBM Research Center, San Jose, CA, March 1986.

*Overview of Argus; 2-Phase Commit Protocol*

Asilomar Workshop on Fault Tolerant Distributed Computing, Monterey, CA, March 1986.

*Argus and Support for Distributed Systems*

NEC Corporation, Tokyo, Japan, October 1986.

*Support for Heterogeneous Computing*

NEC Corporation, Tokyo, Japan, October 1986.

*Argus: The Programming Language and System*

Bell Communications Research, Morristown, NJ, April 1987.

Yale University, Dept. of Computer Science, New Haven, CT, October 1987.

University of Connecticut, Dept. of Computer Science & Engineering, Storrs, CT, April 1988.

Keynote Lecture, The Third Israel Conference on Computer Systems and Software Engineering, Tel  
Aviv, Israel, June 1988.

Northeastern University, Boston, MA, April 1988.

*Linguistic Support for Parallel and Distributed Software*

DARPA, Washington, DC, June 1988.

*Argus and Mercury*

DARPA, Washington, DC, September 1988.

*Communication in a Heterogeneous System*

Texas Instruments, Dallas, TX, February 1987.

M.I.T. Laboratory for Computer Science, Cambridge, MA, March 1987.

Stanford University, Stanford, CA, March 1987.  
Georgia Institute of Technology, Atlanta, GA, April 1987.  
University of California, Irvine, Dept. of Information and Computer Science, May 1987.  
Harvard University, Cambridge, MA, February 1988.

*Data Abstraction and Hierarchy*

Keynote Speaker, Second Annual Conference on Object Oriented Programming Systems, Languages, and Applications, Orlando, FL, October 1987.  
Carnegie Mellon University, Dept. of Computer Science, Pittsburgh, PA, November 1987.  
The Technion, Haifa, Israel, June 1988.  
AT&T Bell Laboratories, Warren, NJ, January 1988.

*Specifications of Distributed Systems*

Televerket, Stockholm, Sweden, June 1988.

*Heterogeneous Computing: A High Level Communication Mechanism*

National Science Foundation, Washington, DC, December 1988.

*Communication in the Mercury System*

Televerket, Stockholm, Sweden, June 1988.  
Tektronix, Inc., Beaverton, OR, August 1988.  
CIPS Edmonton '88 Conference, Edmonton, Alberta, Canada, November 1988.  
Hewlett Packard Laboratories, Palo Alto, CA, January 1989.  
Boston University, Boston, MA, February 1989.  
University of Michigan, Ann Arbor, MI, April 1989.  
Data General Corp., Westboro, MA, April 1989.

*Challenges in Distributed Systems*

Project MAC 25th Anniversary, Cambridge, MA, October 1988.

*Challenges in Distributed Systems*

*Programming Methodology*

*Introduction to CLU*  
*Specifying Data Abstractions*  
*Program Construction Using Abstractions*  
*Using Abstractions in Programming Languages*  
Hewlett-Packard, Palo Alto, CA, January 1989.

*Introduction to Mercury*

Siemens, Munich, Germany, February 1989.

*High Level Communication in Heterogeneous Systems*

Lotus Development Corp., Cambridge, MA, July 1989.  
Hewlett Packard, Paris, France, September 1989.  
Brown University, Providence, RI, September 1989.  
Distinguished Lecture, George Mason University, Fairfax, VA, October 1989.  
Digital Equipment Corp., Cambridge Research Lab., Cambridge, MA, November 1989.  
Distinguished Lecture, University of Arizona, Tucson, AZ, January 1990.  
BBN, Cambridge, MA, January 1990.

*Mercury and the Object Repository*

DARPA Visit, Laboratory for Computer Science, M.I.T., October 1989.  
Arcadia Design Group. M.I.T., August 1990.

*The Mercury Communication System*

Open Software Foundation Member Meeting, Cambridge MA, November 1989.  
MIF Design Meeting, Cambridge, MA, June 1990.

*At-Most-Once Message Protocol*

University of Arizona, Tucson, AZ, January 1990.

*Structure of Distributed Systems*

Purdue University, W. Lafayette, IN, April 1990.

American Express Corp. visit at the Laboratory for Computer Science, M.I.T., January 1990.

Keynote Address, 12th International Conference on Software Engineering, Nice, France, March 1990.

Distinguished Lecture, George Washington Univ., Washington, DC, October 1990.

University of Massachusetts, Amherst, MA, December 1990.

*Using Synchronized Clocks in Distributed Systems*

Ninth ACM Symposium on Principles of Distributed Computing Keynote Address Quebec, Canada, August 1990.

Distinguished Lecture, University of Washington, Seattle, WA, October 1990.

*A Replicated Unix File System*

Fourth ACM SIGOPS European Workshop on Fault Tolerant Support in Distributed Systems, Bologna, Italy, September 1990.

University of Washington, Seattle, WA, October 1990.

*A Highly Available Object Repository for use in a Heterogeneous Distributed System*

Fourth International Workshop on Persistent Object Systems Design, Implementation and Use, Martha's Vineyard, MA, September 1990.

DARPA Meeting, Washington, DC, December 1990.

DARPA/ISTO PI Meeting, Providence, RI, February 1991.

*Issues in Distributed Systems*

Microsoft Corp., Seattle, WA, April 1991.

*Preliminary Design of the Thor Object Oriented Data Base System*

Digital Equipment Corp. Systems Research Center, Palo Alto, CA, April 1991.

IBM Almaden Research Center, San Jose, CA, April 1991.

Stanford University, Stanford, CA, April 1991.

*Replication in Harp*

Digital Equipment Corp. Systems Research Center, Palo Alto, CA, April 1991.

*Research Issues in Distributed Systems*

DSD Technical Symposium, IBM, Poughkeepsie, NY, October 1991.

*Combining Databases*

Second International Workshop on Intelligent and Cooperative Information Systems, Como, Italy, October 1991.

*Thor: An Object-Oriented Database System*

Distinguished Lecture, Cornell University, Ithaca, NY, November 1991.

Solomon Bros., New York, NY, December 1991.

Distinguished Lecture, University of Illinois, Urbana, IL, April 1992.

Distinguished Lecture, University of Toronto, Toronto, Canada, April 1992.

Distinguished Lecture, University of California, San Diego, CA, May 1992.

University of Utah, Salt Lake City, UT, May 1992.

Mitsubishi Cambridge Laboratory, Cambridge, MA, May 1992.

*Replication Algorithms*

Keynote Lecture, HICSS Conference, Kauai, Hawaii, January 1992.

SAC Meeting, Cadence Labs., San Jose, CA, May 1992.

*Issues in Heterogeneous Object-Oriented Databases*

DARPA Software Technology Conference, Los Angeles, CA, April 1992.

*Heterogeneous Object-Oriented Databases*

DARPA Open OODB Workshop III, Boulder, CO, March 1992.

*Improving the Software Development Process*

SAC Meeting, Cadence Labs., San Jose, CA, November 1992. 2 talks

*Overview of Thor, An Object-Oriented Database System*

NEC Corp., Kawasaki, Japan, March 1992.

Mitsubishi Electric Corp., Tokyo, Japan, March 1992.

Fujitsu Laboratories Ltd. Kawasaki, Japan, March 1992.

Hitachi, Ltd., Tokyo, Japan, March 1992.

Singapore National Computer Board visit to Laboratory for Computer Science, MIT, April 1992.

National Security Agency visit to Laboratory for Computer Science, MIT, May 1992.

Distinguished Lecture, University of Wisconsin, Madison, WI, October 1992.

IBM Research Center, Yorktown Heights, NY, December 1992.

JP Morgan, New York, NY, December 1992.

*Communication Paradigms in Distributed Systems*

2nd International Workshop on Objects in Large Distributed Applications, Vancouver, Can., Oct. 1992.

*Uses of Synchronized Clocks in Distributed Systems*

University of Wisconsin, Madison, WI, October 1992.

*Using Abstraction and Specification in Software Development*

SAC Meeting, Cadence Labs, San Jose, CA, November 1992.

*The Subtype Relation*

DARPA Workshop On Persistent Object Bases, Salt Lake City, UT, March 1993.

*The History of CLU*

History of Programming Languages Conference, Cambridge, MA, April 1993.

*Replication Algorithms for Highly Available Systems*

Distinguished Lecture, University of Tulsa, Tulsa, OK, November 1993.

*Thor: An Object-Oriented Database System*

University of Tulsa, Tulsa, OK, November 1993.

Distinguished Lecture, Carnegie Mellon University, Pittsburgh, PA, November 1993

. Duke University, November 1993.

*Integrating Persistent Object Bases with Communication: A New Direction for Object-Oriented Databases*

Fujitsu Laboratories, Shizouka, Japan, March 1994.

NEC, Tokyo, Japan, March 1994.

University of Washington, Seattle, WA, April 1994.

Microsoft Corporation, Redmond, WA, April 1994.

*Thor: An Object-Oriented Database System*

University of Wisconsin, Madison, WI, May 1994.

UC Berkeley, Berkeley, CA, March 1994.

*Program Structure in Distributed Systems*

ACM Japan Symposium, Tokyo, Japan, March 1994.

*Reducing Cross Domain Overhead Using Batched Futures*

ARPA Persistent Object Bases Program: 1994 Workshop, Madison, WI, May 1994.

MIT Laboratory for Computer Science Annual Review Meeting, Chatham, MA, June 1994.

*The Structure of Distributed Programs*

Grace Hopper Celebration of Women in Computing, Washington, DC, June 1994.

*Interoperability for Large and Small Objects*

Workshop on Persistent Objects Bases, LaJolla, CA, October 1994.

*The Meaning of Subtypes*

University of Texas/Austin, October 1994.

*Integrating Persistent Object Bases with Communication*

Bell Labs, Murray Hill, New Jersey, October 1994.

Distinguished Lecture, University of Texas, October 1994.

Distinguished Lecture, University of California/Santa Barbara, October 1994.

Harvard University, February 1995.

Keynote Address, 15th International Conference on Distributed Computing Systems, Vancouver, BC, June 1995.

*Integrating Persistent Object Bases with Communication:*

*A New Direction for Object-Oriented Systems*

Distinguished Lecture, University of Michigan, October 1995.

Dartmouth University, November 1995.

*Safe Heterogeneous Sharing in the Thor Object-Oriented Database System*

Distinguished Lecture, Northeastern University, Boston MA, April 1996

Distinguished Lecture, University of Kentucky, Lexington KY, April 1996

Invited Lecture, 1996 NEC Symposium, Princeton NJ, May 1996.

*Safe Heterogeneous Computing can be Fast*

Workshop on Persistent Object Systems, Cape May NJ, May 1996.

*Safe and Efficient Sharing of Persistent Objects in Thor*

International SIGMOD Conference, Montreal Canada, June 1996.

*Achieving High Performance and Scalability in Thor*

Laboratory for Computer Science Annual Meeting, Nantucket MA, June 1996.

*Efficient and Reliable Storage in the Interactive World-Wide Metacomputer*

DARPA, Washington DC., June 1996

*Research Issues in Distributed Object Storage Systems*

Distinguished Lecture, Brown University, October 1996.

Distinguished Lecture, University of Pennsylvania, November 1996.

*Thor: A Persistent Object Storage System*

DARPA Quorum Meeting, Dallas TX, December 1996.

*Survivability in Distributed Systems*

DARPA, Washington DC., May 1997.

*PolyJ: Parameterized Types for Java*

Keynote Lecture, IBM Symposium, Yorktown Heights, NY, Nov. 1997.

*A Decentralized Model of Information Flow Control*

Distinguished Lecture, University of Virginia, Charlottesville VA, Nov. 1997.

Distinguished Lecture, INRIA, Rocquencourt, France, May, 1998.

*Software Updates*

NEC Corporation, Tokyo, Japan, March 1999.

*Safe yet Efficient Sharing in Wide-Area Distributed Systems*

Keynote Address, 13th International parallel processing Symposium, San Juan, Puerto Rico, April 1999.

Keynote Address, Conference on Object-Oriented Technologies and Systems, San Diego, CA, May 1999.  
Keynote Address, European Conference on Object-Oriented Programming, Lisbon, Portugal, June 1999.

*A Decentralized Model for Information Flow Control*  
DARPA Presentation, Cambridge MA, June 1999.

*Providing Persistent Objects in a Distributed Environment*  
Distinguished Lecture, Duke University, Raleigh NC, Nov. 1999.  
Distinguished Lecture, Rice University, Houston TX, Nov. 1999.  
Distinguished Lecture, University of Minnesota, St. Paul, MN, April 2000.  
Distinguished Lecture, University of Illinois, Urbana-Champaign IL, April 2000.  
Distinguished Lecture, University of California at Berkeley, Berkeley CA, Nov. 2000.  
Distinguished Lecture, University of Toronto, Toronto, Canada, Mar. 2001.

*Practical Byzantine Fault Tolerance with Proactive Recovery*  
University of California at Berkeley, Berkeley CA, Nov. 2000.

*Practical Byzantine Fault Tolerance*  
EPOCH Conference, Taipei, Taiwan, May 2001.

*Software Upgrades in Distributed Systems*  
Keynote Address, Symposium on Operating Systems Principles,  
Lake Louise, Ontario, Canada, October 2001.

*Byzantine Fault Tolerance in Distributed Systems*  
EECS Lecture Series, December 2001.

*Ownership Types for Object Encapsulation*  
Invited Talk, Symposium on Principles of Programming Languages,  
New Orleans, LA, January 2003

*Issues in Peer-to-Peer Computing*  
Plenary Talk, Federated Computing Conference,  
San Diego, CA, June 2003

*Large Scale BFT Storage in a Dynamic Environment*  
Distinguished Lecture, Cornell University, Ithaca, NY, October 2003.

*Magnificent Pathways*  
Cornell University, Ithaca, NY, October 2003.

*Lazy Modular Upgrades in Persistent Object Stores*  
Opsla 2003, San Diego, CA, October 2003.

*TimeLine: A High Performance Archive for a Distributed Object Store*  
NSDI 2004, San Francisco, California, March 2004.

*Data Replication*  
Treasury Department,  
Washington DC., March 2005.

*Providing Secure Storage on the Internet*  
Saul Gorn Memorial Lecture, University of Pennsylvania,  
Philadelphia, Pennsylvania, April 2005.

*Global Storage Challenges*  
Max Planck Institute on Computer Systems,  
Kaiserslautern, Germany, September 2005.

*Global Storage*

ETH, Zurich,  
Zurich, Switzerland, November 2005.

*Software Upgrades in Distributed Systems*

Distinguished Lecture, College of William and Mary, Williamsburgh, Virginia, February 2006.

Sun Microsystems,  
Woburn, Massachusetts, March 2006.  
Robert Stewart Distinguished Lecture,  
Iowa State University,  
Ames, Iowa, April 2006.

*From ViewStamped Replication to BFT*

Workshop on Replication,  
Monte Verita, Switzerland, March 2007.  
Distinguished Lecture,  
University of Waterloo,  
Waterloo, Ontario, Canada., April 2007.

*Systems Research*

SOSP Womens' Workshop,  
Stevenson WA, Oct. 2007.

*Security of Online Storage*

Symposium on Computing Research the Changed the World,  
Library of Congress,  
Washington DC, March 2009.

## PhD Dissertations Supervised

1. Laventhal, Mark S. Synthesis of Synchronization Code for Data Abstractions. (June 1978).
2. Snyder, L. Alan. A Machine Architecture to Support an Object-Oriented Language. (September 1978).
3. Berzins, Valdis. Abstract Model Specifications for Data Abstractions. (September 1979).
4. Atkinson, Russell R. Automatic Verification of Serializers. (June 1980).
5. Kapur, Deepak. Towards a Theory for Abstract Data Types. (June 1980).
6. Moss, J. Eliot B. Nested Transactions: An Approach to Reliable Distributed Computing. (June 1981).
7. Schaffert, Justin C. Specification and Verification of Programs using Data Abstractions and Sharing. (February 1982).
8. Bloom, T. Dynamic Module Replacement in a Distributed System. (June 1983).
9. Chiu, Sheng-Yang. A Debugging System for Argus, a Guardian and Transaction-Based Language for Distributed Computations. (February 1984).
10. Herlihy, Maurice P. Modular Composition of Fault-Tolerant Systems (June 1984).
11. Weihl, William E. A Method for the Construction of Modular, Reliable, Concurrent Systems. (June 1984).
12. Oki, Brian M. Viewstamped Replication for Highly Available Distributed Systems. (June 1988).
13. Ladin, Rivka. Methods for Managing Distributed Object Spaces. (June 1989).
14. Hwang, Deborah J. Indexing for Fast Associative Access to Large Object Sets. (June 1994).
15. Day, Mark. Managing a Cache of Swizzled Objects and Surrogates. (February 1995).
16. Ghemawat, Sanjay. The Modified Object Buffer: A Storage Management Technique for Object-Oriented Databases. (February 1996).
17. Gruber, Robert. Optimism vs. Locking: A Study of Concurrency Control for Client-Server Object-Oriented Databases. (February 1997).
18. Maheshwari, Umesh. Garbage Collection in a Large, Distributed, Object Store. (September 1997).
19. Myers, Andrew C. Mostly-Static Decentralized Information Flow Control. (January 1999).
20. Adya, Atul. Weak Consistency: A Generalized Theory and Optimistic Implementations for Distributed Transactions. (March 1999).
21. Castro, Miguel. Practical Byzantine Fault Tolerance. (November 2000).
22. Ajmani, Sameer. Automatic Software Upgrades for Distributed Systems. (September 2004).
23. Rodrigues, Rodrigo. Robust Services in Dynamic Systems. (February 2005).
24. Leong, Ben. New Techniques in Geographic Routing. (May 2006).
25. Vandiver, Ben. Detecting and Tolerating Byzantine Faults in Database Systems. (May 2007).
26. Cheng, Winnie Wing-Yee, Information Flow for Secure Distributed Applications. (Sept. 2009).

## MS Dissertations Supervised

1. Ellis, David J. Data Structures and References in the Base Language. (September 1973).
2. Laventhal, Mark S. Verification of Programs Operating on Structured Data. (February 1974).
3. Aiello, Jack M. An investigation of Current Language support for the Data Requirements of Structured Programming. (June 1974).
4. Snyder, L. Alan. A Portable Compiler for the Language C. (June 1974).
5. Atkinson, Russell R. Optimization Techniques for a Structured Programming Language. (June 1976).
6. Moss, J. Eliot B. An Abstract Data Type Facility for a Programming Language. (February 1978).
7. Schaffert, Justin C. Specifying Meaning in Object-Oriented Languages. (February 1978).
8. Principato, Robert N. A Formalization of the Parnas Module Specification Technique. (June 1978).
9. Scheifler, Robert W. A Denotational Semantics of CLU. (June 1978).
10. Bloom, Toby. Synchronization of Data Abstractions. (February 1979).
11. Herlihy, Maurice. Communicating Abstract Values in Messages. (June 1980).
12. Humphries, Thorna. Overloading in Programming Languages with Data Abstractions. (June 1981).
13. Ng. Pui. Distributed Compilation and Recompile of Database Queries. (February 1982).
14. Henderson, Cecilia E. Locating Migratory Objects in an Internet. (June 1982).
15. Oki, Brian M. A Stable Storage System for Argus. (June 1983).
16. Gilbert, Lucy. The Task Construct in the Programming Language Ada. (September 1983).
17. Lancaster, Julia N. A Non-Procedural Approach to Program Composition for CLU. (September 1983).
18. Dirks, Patrick W. Control and Management of Distributed Computation Using Remote Procedure Call-based Protocols. (June 1984).
19. Walker, Edward F. Orphan Detection in the Argus System. (June 1984).
20. Wagner, Richard M. Integrating Animation into a Programming Environment. (February 1985).
21. Restivo, James P. Addition of Type Information to the Argus Debugger. (June 1985).
22. Kolodner, Elliot W. Recovery from Garbage Collected Virtual Memory. (September 1986).
23. Day, Mark S. Replication and Reconfiguration in a Distributed Mail Repository. (February 1987).
24. Hwang, Deborah J. Constructing a Highly-Available Location Service for a Distributed Environment. (February 1988).
25. Xu, Andrew. A Fault-Tolerant Network Kernel for Linda. (February 1989).
26. Cohen, Jeffrey I. Atomic Stable Storage Across A Network. (June 1989).
27. Gruber, Robert E. Nested Optimistic Actions in a Distributed System. (June 1989).
28. Ben-Zvi, Boaz. Disconnected Actions: An Asynchronous Extension to a Nested Atomic Action System, (February 1990).

29. Ghemawat, Sanjay. Automatic Replication for Highly Available Services. (February 1990).
30. Friedman, Paul. An Environment for Debugging Concurrent Software in Trellis. (June 1990).
31. Markowitz, Steven C. Central-Server-Based Orphan Detection for Argus. (June 1990).
32. Stata, Raymie. Block Assignment Problem. (September 1990).
33. Cathey, George. Performance Evaluation of Sun Microsystems' Network File System Protocol. (February 1991).
34. LeBlanc, Marc A. Fine-grained Disk Space Accounting in Object-Oriented Databases. (June 1991).
35. Gleason, James A. A Reverse Engineering Tool for a Computer Aided Software Engineering (CASE) System. (June 1992).
36. Maheshwari, Umesh. Distributed Garbage Collection in a Client-Server, Transactional System. (February 1993).
37. Medina, Alejandro J. Software Requirements Analysis: How Adaptable to Changes is Structured Analysis. (June 1993).
38. Myers, Andrew C. Optimizing Method Dispatch in a Heterogeneous Object Repository. (June 1993).
39. Stephens, Anne. Converting from C to C++: A Case Study. (June 1993).
40. Adya, Atul. Transaction Management in a Client-Server Model Using Optimistic Concurrency. (February 1994).
41. Bogle, Phillip. Principle-Based Parsing of Verb Second Languages. (June 1994).
42. Barchak, Christopher. Supporting Reuse with Configuration Management and the World Wide Web. (June 1995).
43. Kirmse, Andrew. Implementation of the Two-Phase Commit Protocol in Thor. (June 1995).
44. Zondervan, Quinton. Batched Control Structures. (June 1995).
45. Liang, Winnie. Managing Information Overload on the Web with Collaborative Filtering (February 1996).
46. Ng, Tony. Efficient Garbage Collection for Large, Object-Oriented Databases. (June 1996).
47. Bendiek, Sabine. Modeling the Deutsche Bank Technical Repository in Thor – A Study of the Benefits, Shortcomings, and Development Process Implications of Using the Distributed Object-Oriented Database System Thor in an Industrial Application. (June 1996).
48. Bank, Joseph. Code Importing Techniques for Fast, Safe Client/Server Access. (June 1996).
49. Coffman, Thayne. A Framework for Automated System Testing. (June 1996).
50. Hunter, Jason. Zephyr Extensibility in Small Workstation-Oriented Networks. (June 1997).
51. Sun, Peter. A Distributed Messaging System Based on a Distributed, Object-Oriented Database. (May 1998).
52. Parthasarathi, Arvind. The NetLog: An Efficient, Highly Available Stable Storage Abstraction. (June 1998).
53. Boyapati, Chandrasekhar. JPS: A Distributed Persistent Java System. (September 1998).
54. Schneider, William. Enforcing Honest Behavior in Agent Economies. (June 1999).

55. Warshawsky, Nimrod. Extending the Metaglove Multi-Agent System. (June 1999).
56. Yang, Zheng. Byzantine-Fault-Tolerant Secure DNS Infrastructure. (June 1999).
57. Woo, Shan Ming. Lazy Type Changes in Object-Oriented Databases. (January 2000).
58. Wijeyekoon, Arjuna C. Domino Spaces. (May 2000).
59. Mathewson, Nick. Verifying Information Flow Control in Java. (May 2000).
60. Rohrs, Christopher H. Adaptive Type-Partitioned Garbage Collection. (May 2000).
61. Ajmani, Sameer. A Trusted Execution Platform for Multiparty Computation. (September 2000).
62. Tang, Ziqiang. Dynamic Reconfiguration of Component-Based Applications in Java. (September 2000).
63. Ahmed, Sarah. A Scalable Byzantine Fault Tolerant Secure Domain Name System. (January 2001).
64. Rodrigues, Rodrigo. Combining Abstraction with Byzantine Fault Tolerance. (May 2001).
65. Lustbader, Steven. Feasibility of GNU/Linux as the OS for a PC-based Medical Product. (December 2002).
66. Schmidt, Justin. A Framework for Peer-to-Peer Applications. (May 2003).
67. Moh, Chuang-Hue. Snapshots in a Distributed Persistent Object Storage System. (May 2003).
68. Gupta, Anjali. Efficient Routing for Peer-to-Peer Systems. (May 2004).
69. McNurlen, Austin C. Petscope: A Standardized System for Ballistic Missile Guidance Data Analysis. (May 2004).
70. Schalck, Richard C. Object Evolution: Adding Runtime Class Mutability to the JVM. (January 2005).
71. Liang, Joanna. The Application of the Value-added Activity Model for the Mark-6 LE Integration Project. (June 2005).
72. Chau, David C. Authenticated Messages for a Real-Time Fault-Tolerant Computer System. (June 2006).
73. Sterling, Reuben M., A Synchronous Communication system for a Software-Based Byzantine Fault Tolerant Computer. (September 2006).
74. Schultz, David. Mobile Proactive Secret Sharing. (Jan. 2007).
75. Cowling, James. HQ Replication. (May 2007).
76. Zhou, You. Computing Network Coordinates in the Presence of Byzantine Faults. (May 2008).
77. Dryjanski, David. Practical Mobile Proactive Secret Sharing. (May 2008).
78. Tang, Melinda. Wireless Reconfigurability of Fault-Tolerant Processing Systems. (Sept. 2008).

## Reader for Doctoral Theses

1. Henderson, Dugald Austin. The Binding Model: A Semantic Base for Modular Programming Systems. (February 1975).
2. Rumbaugh, James E. A Parallel Asynchronous Computer Architecture for Data Flow Programs. (June 1975).

3. Greif, Irene. Semantics of Communicating Parallel Processes. (September 1975).
4. Janson, Philippe A. Using Type Extension to Organize Virtual Memory Mechanisms. (September 1976).
5. Okrent, Howard F. Synthesis of Data Structures from their Algebraic Description. (February 1977).
6. Yonezawa, Akinori. Meta-Evaluation of Actor Programs with Side-Effects and Parallelism. (February 1978).
7. Baker, Henry G., Jr. Actor Systems for Real-Time Computation. (June 1978).
8. Isaman, David L. Data-Structuring Operations in Concurrent Computations. (September 1979).
9. Luniewski, Allen W. The Architecture of an Object Based Personal Computer. (February 1980).
10. Kopec, Gary E. A Modular Signal Processing Programming Language System. (June 1980).
11. Srivas, M. K. Automatic Synthesis of Implementations for Abstract Data Types from Algebraic Specifications. (February 1982).
12. Wing, Jeannette M. Bridging Algebraic Specifications and their Implementations Via Interfaces. (June 1983).
13. Gramlich, Wayne C. Checkpoint Debugging. (December 1983).
14. Stark, Eugene W. Foundations of a Theory of Specification for Distributed Systems. (June 1984).
15. Stamos, James W. Remote Evaluation. (June 1985).
16. Leavens, Gary. Verifying Object-Oriented Programs That Use Subtypes. (February 1989).
17. Yelick, Katharine. Utilizing Abstraction in Explicitly Parallel Program. (February 1991).
18. Kolodner, Elliot W. Atomic Incremental Garbage Collection and Recovery for a Large Stable Heap. (June 1991).
19. Waldin, Earl D. III. Flexible Communications in Heterogeneous Distributed Systems. (September 1992).
20. Troxel, Gregory D. Computer Clock Synchronization over Packet Networks. (June 1994).
21. Sheldon, Mark. Content Routing: A Scalable Architecture for Network-Based Information Discovery. (June 1995).
22. Johnson, Kirk. High Performance All-Software Distributed Shared Memory. (September 1995).
23. O'Toole, James. Effective Information Sharing Using Update Logs. (February 1996).
24. Stata, Raymie. Modularity in the Presence of Subclassing. (May 1996).
25. Velez-Rivera, Bienvenido. Query Lookahead for Query-Based Document Categorization. (September 1999).
26. Yao Sun. Information Exchange between Medical Databases through Automated Identification of Concept Equivalence. (October 2001).
27. Boyapati, Chandra. SafeJava: a Unified Type System for Safe Programming. (January 2004).
28. Witchel, Emmett. Mondriaan Memory Protection. (January 2004).
29. Kulik, Joanna. The Design of a Fast and Flexible Internet Subscription System Using Content Graphs. (May 2004).

30. Chen, Benjie. A Serverless Wide-Area Version Control System (May 2004).
31. Balazinska, Magdalena. Fault-Tolerance and Load Management in a Distributed Stream Processing System (December 2005).
32. Li, Ji. Organization in the Knowledge Plane. (May 2008).
33. McCamant, Stephen. Quantitative Information-Flow Tracking for Real Systems. (May 2008).
34. Muthitacharoen, Athicha. The Expandable Network Disk. (Sept. 2008).
35. Yip, Alex. Improving Web Site Security with Data Flow Management. (Sept. 2009).