

## MARTHA E. POLLACK

**Provost and Executive Vice President for Academic Affairs**  
**Professor of Computer Science & Engineering, College of Engineering**  
**Professor of Information, School of Information**  
**University of Michigan**  
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### Education

Ph.D.	University of Pennsylvania (Computer and Information Science)	1986
M.S.E.	University of Pennsylvania (Computer and Information Science)	1984
A.B.	Dartmouth College (Linguistics)	1979

### Professional Experience

University of Michigan		
	Provost and Executive Vice President for Academic Affairs	2013-present
	Vice Provost for Academic and Budgetary Affairs	2010-2013
	Dean, School of Information	2007-2010
	Professor of Information	2007-present
	Associate Chair for Computer Science and Engineering, Dept. of Electrical Engineering and Computer Science	2004-2007
	Professor of Computer Science and Engineering	2000-present
University of Pittsburgh		
	Professor of Computer Science and Intelligent Systems	1999-2000
	Director, Intelligent Systems Program	1998-2000
	Associate Professor with Tenure, Computer Science and Intelligent Systems	1994-1998
	Fellow, Center for the Philosophy of Science	1993-2000
	Associate Professor, Computer Science and Intelligent Systems	1991-1994
SRI International		
	Senior Computer Scientist, Artificial Intelligence Center	1991-1992
	Computer Scientist, Artificial Intelligence Center	1985-1991
	Senior Researcher, Center for the Study of Language and Information	1985-1991

### **ADMINISTRATIVE RECORD**

#### Key University Administrative Roles

*Provost and Executive Vice President for Academic Affairs, University of Michigan* May, 2013 – present

Chief academic officer and chief budget officer of the University of Michigan—Ann Arbor, a leading public research university. Responsible for the academic enterprise, which serves more than 43,000 students with over 26,000 faculty and staff, and includes 19 schools and colleges and a number of free standing research units, libraries and museums. The University occupies over 16M square feet of space and supported by a \$2.9 billion operating fund budget, including \$1.6 billion in general funds. Administers the academic programs, including both education and research, and ensures that the university's administrative functions and resources allocations are aligned with its academic mission. Also focuses on resource development, educational quality, faculty and staff personnel concerns, university and faculty governance, and academic strategic vision.

*Vice Provost for Academic and Budgetary Affairs*, University of Michigan

July, 2010—May, 2013

Responsible for administrative and policy decisions across a wide range of academic and budgetary areas at the University of Michigan. Serves as the Provost's senior staff member in setting budgetary policy and allocating resources, including the University's general fund budget (~\$1.6 billion), University support for major capital projects, and general fund space and facilities. Works with deans and directors and their senior staff on matters related to budget, space and facilities, management and planning, and the development of financial support for academic programs and initiatives. Assists the Provost in presenting the general funds budget to the executive officers of the university and in seeking approval for the budget from the Board of Regents. Helps craft communications and acts as a University spokesperson on matters related to the budget; chairs the Enrollment Working Group, the committee that oversees undergraduate enrollment management; and leads strategic assessments of schools, colleges, and other units reporting to the Provost. Has direct reporting authority for several units (the Office of Budget and Planning, the Graham Environmental Sustainability Institute, the Knight-Wallace Fellows Program, and the Information Systems Shared Support Unit). Participates in planning activities for the university's capital campaign. Negotiated and leads the University participation in the Coursera open-access education program.

*Dean*, School of Information, University of Michigan

July, 2007—June, 2010

Responsible for budget, development, policy, and intellectual leadership of the School of Information, an interdisciplinary school that offers a professional masters and a doctoral degree, as well as an undergraduate major jointly administered with the College of Engineering and the College of Literature, Science, and the Arts. Direct responsibility for an annual budget of \$23.3 million (\$17.5 million general funds). Oversight of approximately 35 full-time and about a dozen part-time faculty plus 40 staff, and of a research portfolio of \$4 million in annual expenditures. Key accomplishments during tenure as dean include the launch of a new interdisciplinary undergraduate major in informatics; a 25% increase in Masters' enrollment without loss of student quality; successful planning for and move to a new building; reinvigoration of the the school's development program; and improvement of the school's financial situation from a structural deficit to a structural surplus.

*Associate Chair for Computer Science and Engineering*,  
Department of Electrical Engineering and Computer Science, University of Michigan

July, 2004-June, 2007

Responsible for hiring, promotion and tenure, curricular matters, and general oversight of the CSE division within the EECS department. The CSE division has a significant degree of autonomy within the department, including its own executive committee; the Associate Chair serves as a full member of the Dean's Department Chairs' committee along with the chairs of the other departments in the College of Engineering.

*Director*, Intelligent Systems Program, University of Pittsburgh

1998-2000

Oversight of the Intelligent Systems Program, an interdisciplinary, free-standing, Ph.D.-granting program that serves as the center of advanced education and research on Artificial Intelligence at the University of Pittsburgh.

### **Selected Other Administrative Experience**

University of Michigan:

<i>Board of Directors</i> , University of Michigan Hospitals and Health Center	2013-present
<i>Board of Directors</i> , UM-Shanghai Jiao Tong University Joint Institute	2013-present
<i>Board of Advisors</i> , UM-MSU Atlas Tier 2 Computing Center	2013-present
<i>Board of Advisors</i> , Teaching Works	2013-present
<i>Co-Chair</i> , University of Michigan United Way Campaign	2013-present
<i>Advisory Board</i> , ADVANCE Project	2009-present
<i>Executive Committee</i> , Institute for Social Research	2009-2010
<i>Chair</i> , Provost's Task Force on Creative Staffing and Shared Services	2009-2010
<i>Search Advisory Committee</i> ,	2007-2008

Dean of the Taubman College of Architecture and Urban Planning <i>Chair, Search Advisory Committee,</i>	2005-2006
Dean of the College of Engineering <i>ADVANCE Project Committee on Science and Technology Recruiting for Increased Diversity and Excellence (STRIDE)</i>	2002-2007
<i>College of Engineering Dean's Advisory Committee on Female Faculty Chair, Search Advisory Committee,</i>	2000-2006 2002
Chair of Electrical Engineering and Computer Science	
Coursera:	
<i>University Advisory Board</i>	2013-present
Computing Research Association:	
<i>Secretary</i>	2010-2013
<i>Board of Directors</i>	2007-2013
<i>Government Affairs Committee</i>	2009-2012
<i>Habermann Awards Committee (Chair in 2009-2010)</i>	2007-2010
Other activities include organizing several sessions at the biannual Snowbird meetings; co-author of a CRA Best Practices white paper on interdisciplinary tenure; and member of the CRA Deans' Committee.	
National Science Foundation:	
<i>Advisory Committee,</i>	2006-2010
Computer and Information Science and Engineering (CISE) Directorate <i>Committee of Visitors,</i>	2009
CISE Information and Intelligent Systems Division <i>Co-Organizer (with Jeannette Wing, NSF CISE Assistant Director)</i>	2008
CISE Workshop on "Computing Outside the Box" <i>Steering Committee</i>	2007-2008
2nd US/China Computer Science Leadership Summit	
Association for the Advancement of Artificial Intelligence (AAAI):	
<i>President</i>	2009-2010
<i>Chair, Publications Access Committee</i>	2007-2008
<i>Strategic Planning Board and Strategic Planning Working Group</i>	2007-2008
<i>Editorial Board, "AI Magazine"</i>	2000-2005
<i>Fellows Selection Committee</i>	2000
<i>Executive Committee</i>	1994-1997
Other activities include serving on program committees and as program committee area chair for multiple conferences; and on the workshop grants committee.	
International Joint Conferences on Artificial Intelligence (IJCAI):	
<i>Program Chair</i>	1997
<i>Executive Committee</i>	1993-1997
<i>Tutorial Chair</i>	1991
Other activities include serving on the program and/or awards committee for multiple conferences.	
National Research Council:	
<i>Steering Committee, Adaptive Aging: Gerontology to Technology</i>	2002-2003
Journal of Artificial Intelligence Research:	
<i>Editor-in-Chief</i>	2001-2005

<i>Advisory Board</i>	2000-2001, 2005-present
<i>Associate Editor</i>	1996-1999
<i>Editorial Board</i>	1993-1996
Artificial Intelligence Journal: <i>Editorial Board</i>	1993-2002
International Journal of Autonomous Agents and Multi-Agent Systems: <i>Editorial Board</i>	2000-2007
Association for Computational Linguistics: <i>Executive Committee</i>	1992-1993
<i>Editorial Board</i> , "Computational Linguistics Journal"	1989-1992
<i>Tutorial Chair</i>	1989
Other activities include serving on the program committee for multiple conferences.	
Selected Other Activities:	
<i>Scientific Advisory Committee</i> , Intel Science and Technology Center on Pervasive Computing, University of Washington	2011-2013
<i>Selection Committee</i> , Computing Innovations Fellowship Program	2009
<i>Chair</i> , External Review Committee, Univ. of Texas Dept. of Computer Science	2009
<i>Microsoft Faculty Fellow Selection Committee</i>	2008
<i>ACM Athena Lecture Selection Committee</i>	2007-2010

## ACADEMIC RECORD

### Honors and Awards

<i>Phi Kappa Phi</i> Honor Society Faculty Member	2013
<i>Fellow</i> , Association for Computing Machinery (ACM)	2012
<i>Fellow</i> , American Association for the Advancement of Science (AAAS)	2012
<i>Gerald Salton Lecturer</i> , Cornell University	2009
<i>Influential Paper Award</i> , International Foundation on Autonomous Agents and Multi-Agent Systems, for the 1988 paper: "Plans and Resource-Bounded Practical Reasoning," M. E. Bratman, D. J. Israel, and M. E. Pollack, <i>Computational Intelligence</i> 4(4):349-355. Sometimes called a "test of time" award, this recognizes past papers that have had a significant impact on the field of agents and multi-agent systems.	2008
<i>Grace Hopper Lecturer</i> , University of Pennsylvania	2007
<i>Sarah Goddard Power Award</i> , University of Michigan	2007
<i>Senior Fellow</i> , Michigan Society of Fellows	2006-2007
<i>Best Student Paper Award</i> , M. D. Moffitt and M. E. Pollack, "Optimal Rectangle Packing: A Meta-CSP Approach," <i>Proceedings of the 16th International Conference on AI Planning and Scheduling</i> , June, 2006. (Michael Moffitt completed his Ph.D under my supervision.)	2006
<i>Academic Leadership Program Fellow</i> , Committee on Institutional Cooperation of the Big Ten Universities	2003-2004
<i>Outstanding Achievement Award</i> , Dept. of EECS, University of Michigan	2003
<i>Chancellor's Distinguished Research Award</i> , University of Pittsburgh	2000
<i>Outstanding Student Paper Award</i> , I. Tsamardinos, M. E. Pollack, and J. F. Horty, "Merging Plans with Quantitative Temporal Constraints, Temporally Extended Actions, and Conditional Branches," <i>Proceedings of the 5th International Conference on AI Planning Systems</i> , April, 2000. (Ioannis Tsamardinos completed his Ph.D. under my supervision.)	2000
<i>Best Paper Award</i> ,	1999

A. Memon, M. E. Pollack, and M. L. Soffa, "Using a Goal-driven Approach to Generate Test Cases for GUIs," <i>Proceedings of the 21st International Conference on Software Engineering</i> , May 1999.	
<i>Fellow</i> , American Association for Artificial Intelligence	1996
<i>Teaching Awards</i> , Department of Computer Science, Univ. of Pittsburgh	1995-1999
Instituted in the CSD during the 1995-1996 academic year.	
Best performance in an Undergraduate core course (1995-1996)	
Best performance in a Graduate elective (1995-1996)	
Best performance in an Undergraduate elective (1996-1997)	
Best performance in a Graduate elective (1998-1999)	
<i>National Science Foundation Young Investigator Award</i>	1992
<i>Computers and Thought Award</i> ,	1991
Trustees of the International Joint Conferences on Artificial Intelligence. The Computers and Thought Award is given every other year to an outstanding young scientist in the field of AI.	
<i>Rubinoff Dissertation Prize</i> , University of Pennsylvania	1986
<i>IBM Graduate Fellowship</i>	1983—1986
<i>Phi Beta Kappa</i>	1979
<i>Bachelor's Degree awarded summa cum laude</i> , and with <i>Highest Distinction in the major</i>	1979
<i>Rufus Choate Scholar</i> , Dartmouth College (First academic honors)	1975—1979

### **Visiting Positions**

University of Ulm, Dept. of Computer Science	1999
Guest Researcher	
Carnegie Mellon University, Dept. of Computer Science	1997-1998
Visiting Faculty	
Stanford University, Dept. of Computer Science	1990-1991
Consulting Assistant Professor	

### **Publications**

#### *Journal Articles and Conference Papers*

*In Computer Science, conference papers are rigorously reviewed, with top conferences having low acceptance rates; publications in conferences are considered archival and comparable to journal papers.*

1. J. Hu, M. E. Pollack, H. Katebi, K. Sakallah, and N. L. Kirsch, "Incorporating User Control in Automated Interactive Scheduling Systems," ACM DIS 2010 (ACM Conference on Designing Interactive Systems), Aug. 2010. <http://doi.acm.org/10.1145/1858171.1858226>
2. M. R. Hodges, N. L. Kirsh, M. W. Newman, and M. E. Pollack, "Automatic Assessment of Cognitive Impairment through Electronic Observation of Object Use," 8th International Conference on Pervasive Computing, May 2010.
3. J. M. Weber, M. Newman, and M. E. Pollack, "Multi-Format Notifications for Multi-Tasking," 12th Conference on Human-Computer Interaction: INTERACT-2009, Aug. 2009.
4. R. E. Korf, M. D. Moffitt, and M. E. Pollack, "Optimal Rectangle Packing," *Annals of Operations Research*, Online First Version Nov., 2008 (DOI: 10.1007/s10479-008-0463-6); Print version, 179(1):261-295, 2010.
5. M. D. Moffitt, J. A. Roy, I. L. Markov, and M. E. Pollack, "Constraint-Driven Floorplan Repair," *ACM Transactions on Design Automation of Electronic Systems*, 13(4), 2008.

6. J. S. Weber and M. E. Pollack, "Evaluating User Preferences for Adaptive Reminding," 26th Computer-Human Interaction Conference (Work-in-Progress paper), Apr. 2008.
7. M. R. Hodges and M. E. Pollack, "An 'Object-Use Fingerprint:' The Use of Electronic Sensors for Human Identification," 9th International Conference on Ubiquitous Computing, Sept. 2007.
8. J. S. Weber and M. E. Pollack, "Entropy-Driven Active Learning for Interactive Calendar Management," 10th International Conference on Intelligent User Interfaces, Jan. 2007.
9. M. D. Moffitt and M. E. Pollack, "Generalizing Temporal Controllability," 20th International Joint Conference on Artificial Intelligence, Jan. 2007.
10. K. Myers, P. Berry, J. Blythe, K. Conley, M. Gervasio, D. McGuinness, D. Morely, A. Pfeffer, M. Pollack, and M. Tambe, "An Intelligent Personal Assistant for Task and Time Management," *AI Magazine* 28(2):47-61, 2007.
11. M. E. Pollack, "Autominder: A Case Study of Assistive Technology for Elders with Cognitive Impairment," *Generations: The Journal of the American Society on Aging*, 30(2), 2006.
12. M. D. Moffitt and M. E. Pollack, "Temporal Preference Optimization as Weighted Constraint Satisfaction," Proceedings of the 21st National Conference on Artificial Intelligence, July 2006. (Also appears in ICAPS 2006 Workshop on Preferences and Soft Constraints in Planning, June 2006. )
13. M. D. Moffitt, A. N. Ng, I. L. Markov, and M. E. Pollack, "Constraint-Driven Floorplan Repair," Proceedings of the 43rd Design Automation Conference, July 2006.
14. M. D. Moffitt and M. E. Pollack, "Optimal Rectangle Packing: A Meta-CSP Approach," Proceedings of the 16th International Conference of Automated Planning and Scheduling, June 2006. Winner of the Best Student Paper Award.
15. J. S. Weber and M. E. Pollack, "Simulating Users to Support the Design of Activity Management Systems," Proceedings of the 2005 Winter Simulation Conference, Dec. 2005.
16. H. Sheini, B. Peintner, K. Sakallah, and M. E. Pollack, "On Solving Soft Temporal Constraints using SAT Techniques," 11th International Conference on Principles and Practice of Constraint Programming, Oct. 2005.
17. M. D. Moffitt and M. E. Pollack, "Applying Local Search to Disjunctive Temporal Problems," 19th International Joint Conference on Artificial Intelligence, Aug. 2005.
18. M. Liffiton, M. D. Moffitt, M. E. Pollack, and K. Sakallah, "Identifying Conflicts in Overconstrained Temporal Problems," 19th International Joint Conference on Artificial Intelligence, Aug. 2005.
19. M. D. Moffitt, B. Peintner, and M. E. Pollack, "Augmenting Disjunctive Temporal Problems with Finite-Domain Constraints," 20th National Conference on Artificial Intelligence (AAAI), July 2005.
20. B. Peintner and M. E. Pollack, "Anytime, Complete Algorithm for Finding Utilitarian Optimal Solutions to STPPs," 20th National Conference on Artificial Intelligence (AAAI), July 2005.
21. B. Peintner, M. D. Moffitt, and M. E. Pollack, "Solving Over-constrained DTPs with Preferences," 15th International Conference on Automated Planning and Scheduling, June 2005.
22. M. D. Moffitt and M. E. Pollack, "Partial Constraint Satisfaction of Disjunctive Temporal Problems," 18th International FLAIRS Conference, May 2005. 2nd Place Best Paper Award.
23. M. E. Pollack, "Intelligent Technology for an Aging Population: The Use of AI to Assist Elders with Cognitive Impairment," *AI Magazine*, 26(2):9-24, 2005.

24. M. T. Gervasio, M. D. Moffitt, M. E. Pollack, J. M. Taylor, and T. E. Uribe, "Active Preference Learning for Personalized Calendar Scheduling Assistance," International Conference on Intelligent User Interfaces, Jan., 2005.
25. M. Rudary, S. Singh, and M. E. Pollack, "Adaptive Cognitive Orthotics: Combining Reinforcement Learning and Constraint-Based Temporal Reasoning," 21st International Conference on Machine Learning, July 2004.
26. B. Peintner and M. E. Pollack, "Low-cost Addition of Preferences to DTPs and TCSPs," 19th National Conference on Artificial Intelligence (AAAI), July 2004.
27. M. E. Pollack, L. Brown, D. Colbry, C. E. McCarthy, C. Orosz, B. Peintner, S. Ramakrishnan, and I. Tsamardinos, "Autominder: An Intelligent Cognitive Orthotic System for People with Memory Impairment," Robotics and Autonomous Systems, 44(3-4):273-282, 2003.
28. J. Pineau, M. Montemerlo, M. Pollack, N. Roy, and S. Thrun, "Towards Robotic Assistants in Nursing Homes: Challenges and Results," Robotics and Autonomous Systems 42(3-4):271-281, 2003.
29. I. Tsamardinos and M. E. Pollack, "Efficient Solution Techniques for Disjunctive Temporal Reasoning Problems," Artificial Intelligence, 151(1-2):43-89, 2003.
30. I. Tsamardinos, T. Vidal, and M. E. Pollack, "CTP: A New Constraint-Based Formalism for Conditional, Temporal Planning," Constraints: An International Journal, 8(4): 365-383, 2003.
31. C. E. McCarthy and M. E. Pollack, "A Plan-Based Personalized Cognitive Orthotic," 6th International Conference on AI Planning and Scheduling, Apr., 2002.
32. D. Colbry, B. Peintner, and M. E. Pollack, "Execution Monitoring with Quantitative Temporal Bayesian Networks," 6th International Conference on AI Planning and Scheduling, Apr., 2002.
33. M. E. Pollack, "Planning Technology for Intelligent Cognitive Orthotics," 6th International Conference on AI Planning and Scheduling, Apr., 2002.
34. M. E. Pollack, C. E. McCarthy, S. Ramakrishnan, I. Tsamardinos, L. Brown, S. Carrion, D. Colbry, C. Orosz, and B. Peintner, "Autominder: A Planning, Monitoring, and Reminding Assistive Agent," 7th International Conference on Intelligent Autonomous Systems (IAS), March, 2002.
35. A. Berfield, P. Chrysanthis, I. Tsamardinos, M. E. Pollack, and S. Banerjee, "A Scheme for Integrating e-Services in Establishing Virtual Enterprises," 12th IEEE International Workshop on Research Issues in Data Engineering, Feb. 2002.
36. J. F. Horty and M. E. Pollack, "Evaluating New Options in the Context of Existing Plans," Artificial Intelligence, 127(2):199-220, 2001.
37. A. Memon, M. E. Pollack, and M. L. Soffa, "Hierarchical GUI Test Case Generation using Automated Planning," IEEE Transactions on Software Engineering, 27(2): 144-155, 2001.
38. I. Tsamardinos, M. E. Pollack, and P. Ganchev, "Flexible Dispatch of Disjunctive Plans," 6th European Conference on Planning, Oct. 2001.
39. A. Memon, M. L. Soffa, and M. E. Pollack, "Coverage Criteria for GUI Testing," 9th ACM International Symposium on the Foundations of Software Engineering, Sept. 2001.
40. C. E. McCarthy and M. E. Pollack, "Towards Focused Plan Monitoring: A Technique and an Application to Mobile Robots," Autonomous Robots, 9:71-81, 2000. (A preliminary version of this paper appeared in the

- IEEE International Symposium on Computational Intelligence in Robotics and Automation (CIRA), November 1999.)
41. A. Memon, M. E. Pollack, and M. L. Soffa, "Automated Test Oracles for GUIs," 8th International Symposium on the Foundations of Software Engineering, Nov. 2000.
  42. S. Ramakrishnan and M. E. Pollack, "Intelligent Monitoring in a Robotic Assistant for the Elderly," (Student Abstract), Proceedings of the 16th National Conference on Artificial Intelligence (AAAI), Aug. 2000.
  43. I. Tsamardinos, M. E. Pollack, and J. F. Horty, "Merging Plans with Quantitative Temporal Constraints, Temporally Extended Actions, and Conditional Branches," Proceedings of the 5th International Conference on AI Planning Systems, Breckenridge, CO, April, 2000. Winner of the Outstanding Student Paper Award.
  44. A. Memon, M. E. Pollack, and M. L. Soffa, "Plan Generation for GUI Testing," Proceedings of the 5th International Conference on AI Planning Systems, Breckenridge, CO, April, 2000.
  45. M. E. Pollack and J. F. Horty, "There's More to Life than Making Plans: Plan Management in Dynamic, Multi-Agent Environments," *AI Magazine* 20(4):71-84, 1999.
  46. N. Onder and M. E. Pollack, "Conditional, Probabilistic Planning: A Unifying Algorithm and Effective Search Control Mechanisms," 15th National Conference on Artificial Intelligence (AAAI), July 1999.
  47. D. Mosse', M. E. Pollack, and Y. Ronen "Value-Density Algorithms to Handle Transient Overloads in Scheduling," Proceedings of the 11th Euromicro Conference on Real-Time Systems, June 1999.
  48. A. Memon, M. E. Pollack, and M. L. Soffa, "Using a Goal-driven Approach to Generate Test Cases for GUIs," Proceedings of the 21st International Conference on Software Engineering, May 1999. Winner of Best Paper Award. (A revised and extended version of this paper appears in *Transactions on Software Engineering*, as listed above.)
  49. J. F. Horty and M. E. Pollack, "Evaluating Options in a Context," Proceedings of the 7th Conference on Theoretical Aspects of Rationality and Knowledge (TARK), Chicago, IL, July 1998.
  50. M. E. Pollack, "Plan Generation, Plan Management, and the Design of Computational Agents (Abstract)" Proceedings of the 3rd International Conference on Multi-Agent Systems, Paris, France, July, 1998.
  51. M. M. Veloso, M. E. Pollack, and M. T. Cox, "Rationale-Based Monitoring for Planning in Dynamic Environments," Proceedings of the 4th International Conference on AI Planning Systems, Pittsburgh, PA, June, 1998.
  52. C. Bicchieri, M. E. Pollack, C. Rovelli, and I. Tsamardinos, "The Potential for the Evolution of Cooperation among Web Agents," *International Journal of Computer-Human Systems* 48(1):9-29, 1998.
  53. N. Onder and M. E. Pollack, "Contingency Selection in Plan Generation," Proceedings of the 4th European Conference on Planning, Toulouse, France, September 1997.
  54. C. F. Aliferis, G. F. Cooper, M. E. Pollack, B. G. Buchanan and M. M. Wagner "Representing and Developing Temporally Abstracted Knowledge as a Means Towards Facilitating Time Modeling in Medical Decision-Support Systems," *Computers in Biology and Medicine*, 27(5):411-434, 1997.
  55. M. E. Pollack, D. Joslin, and M. Paolucci, "Flaw Selection Strategies for Partial-Order Planning," *Journal of Artificial Intelligence Research*, 6:223-262, 1997.
  56. Y. Ronen, D. Mosse', and M. E. Pollack, "Value-Density Algorithms for the Deliberation Scheduling Algorithm," *SIGART Bulletin*, 7(2), 1996.



57. D. Joslin and M. E. Pollack, "Is 'Early Commitment' in Plan Generation Ever a Good Idea?," Proceedings of the 14th National Conference on Artificial Intelligence (AAAI), Portland, OR, August 1996.
58. E. Ephrati, M. E. Pollack, and M. Milshtein, "A Cost-Directed Planner: Preliminary Report" Proceedings of the 14th National Conference on Artificial Intelligence (AAAI), Portland, OR, August, 1996.
59. D. Joslin and M. E. Pollack, "Active and Passive Postponement of Decisions in Plan Generation," Proceedings of the 3rd European Conference on Planning, September 1995.
60. E. Ephrati, M. E. Pollack, and S. Ur, "Deriving Multi-Agent Coordination through Filtering Strategies," Proceedings of the 14th International Joint Conference on Artificial Intelligence, August 1995.
61. E. Ephrati, M. E. Pollack, and J. S. Rosenschein, "A Tractable Heuristic that Maximizes Global Utility through Plan Combination," Proceedings of the 1st International Conference on Multi-Agent Systems, June, 1995.
62. M. E. Pollack, "How Commitment Leads to Coordination: The Effect of Individual Reasoning Strategies on Multi-Agent Behavior," Proceedings of the 4th International Colloquium on Cognitive Science, May 1995. (Also appears in X. Arrazola, K. Korta and F. Jeffry Pelletier, eds. *Discourse, Interaction, and Communication*, Kluwer Academic Publishers, 1998, pp. 157-163.)
63. D. Joslin and M. E. Pollack, "Least-Cost Flaw Repair: A Plan Refinement Strategy for Partial-Order Planning," Proceedings of the 12th National Conference on Artificial Intelligence (AAAI), Boston, MA, August 1994.
64. M. Young, J. D. Moore, and M. E. Pollack, "Towards a Principled Representation of Discourse Plans," Proceedings of the Cognitive Science Society," August 1994.
65. M. Young, M. E. Pollack, and J. D. Moore, "Decomposition and Causality in Partial-Order Planning," Proceedings of the 2nd International Conference on AI Planning Systems, Chicago, IL, June 1994.
66. T. Znati and M. E. Pollack, "DIPART, An Interactive Simulation Platform for Plan Development and Monitoring in Dynamic Environments," Proceedings of the 27th International Simulation Conference, April 1994.
67. K. Konolige and M. E. Pollack, "A Representationalist Theory of Intention," Proceedings of the 13th International Joint Conference on Artificial Intelligence, Chambery, France, August, 1993.
68. S. Hanks, M. E. Pollack, and P. Cohen, "Benchmarks, Testbeds, Controlled Experimentation, and the Design of Agent Architectures," *AI Magazine*, 14(4):17-42, 1993.
69. J. D. Moore and M. E. Pollack, "A Problem for RST: The Need for Multi-Level Discourse Analysis," *Computational Linguistics*, 18(4):537-544, 1992.
70. M. E. Pollack, "The Uses of Plans," *Artificial Intelligence*, 57(1):43-69, 1992.
71. D. E. Appelt and M. E. Pollack, "Weighted Abduction for Plan Ascription," *User Modeling and User-Adapted Interaction*, 2(1-2):1-25, 1992.
72. M. E. Pollack, "Overloading Intentions for Efficient Practical Reasoning," *Noûs*, 25(4):513-536, 1991.
73. C. N. Pereira and M. E. Pollack, "Incremental Interpretation," *Artificial Intelligence*, 50(1):37-82, 1991.
74. M. E. Pollack and M. Ringuette, "Introducing the Tileworld: Experimentally Evaluating Agent Architectures," Proceedings of the 8th National Conference on Artificial Intelligence (AAAI), Boston, MA, August, 1990.

75. D. E. Appelt and M. E. Pollack, "Weighted Abduction as an Inference Method for Plan Recognition and Evaluation," 2nd International Workshop on User Modeling, Honolulu, HI, March, 1990.
76. K. Konolige and M. E. Pollack, "Ascribing Plans to Agents," Proceedings of the 11th International Joint Conference on Artificial Intelligence, Detroit, MI, August, 1989.
77. M. E. Bratman, D. J. Israel and M. E. Pollack, "Plans and Resource-Bounded Practical Reasoning," Computational Intelligence, 4(4):349-355, 1988. (A slightly revised version appears in J. Pollock and R. Cummins, eds., Philosophy and AI: Essays at the Interface, MIT Press, Cambridge, MA, 1991, pp. 7-22.)
78. M. E. Pollack and F. C. N. Pereira, "An Integrated Framework for Semantic and Pragmatic Interpretation," Proceedings of the 26th Meeting of the Association for Computational Linguistics, Buffalo, NY, June 1988.
79. M. E. Pollack, "A Model of Plan Inference that Distinguishes between the Beliefs of Actors and Observers," Proceedings of the 24th Meeting of the Association for Computational Linguistics, New York, NY, June 1986. (Also appears in M. Georgeff and A. Lansky, eds., The 1986 Workshop on Reasoning about Actions and Plans, Morgan Kaufmann Publishers, Los Altos, CA, 1987).
80. M. E. Pollack, "Information Sought and Information Provided: An Empirical Study of User/Expert Dialogues," Proceedings of the Conference on Human Factors in Computing Systems, San Francisco, CA, April 1985.
81. M. E. Pollack, "Good Answers to Bad Questions: Goal Inference in Expert Advice-Giving," Proceedings of the Conference of the Canadian Society for Computational Studies of Intelligence, London, Ontario, May 1984.
82. M. E. Pollack, J. Hirschberg, and B. Webber, "User Participation in the Reasoning Process of Expert Systems," Proceedings of the 2nd National Conference on Artificial Intelligence (AAAI), Pittsburgh, PA, August 1982.

Books and Book Chapters

83. J. S. Weber, M. E. Pollack, B. Clippingdale, and M. Hodges, "Intelligent Assistive Technology," in M. Kutz, ed., Biomedical Engineering and Design Handbook, Vol. 2: Applications, McGraw-Hill, New York, 2009.
84. M. E. Pollack and B. Peintner, "Computer Science Tools and Techniques," in J. Bardram, A. Mihailidis, and D. Wan, eds, Pervasive Computing in Healthcare, CRC Press, 2006.
85. M. E. Pollack and I. Tsamardinos, "Efficiently Dispatching Plans Encoded as Simple Temporal Problems," in I. Vlahavas and D. Vrakas, editors, Intelligent Techniques for Planning, Idea Group, Inc. Hershey, PA, 2005.
86. R. Pew, S. VanHemel, et al., Report of the NRC Committee, in R. Pew and S. vanHemel, eds., Technology for Adaptive Aging, National Academies Press, Washington, D.C., 2003.
87. M. Beetz, M. Ghallab, J. Hertzberg, and M. E. Pollack, editors, Plan-Based Control of Robotic Agents, LNCS/LNAI #2466, Springer-Verlag, 2002.
88. M. E. Pollack, C. E. McCarthy, S. Ramakrishnan, and I. Tsamardinos, "Execution-Time Plan Management for a Cognitive Orthotic System," in M. Beetz et al., editors, Plan-Based Control of Robotic Agents, 2002.
89. M. Georgeff, B. Pell, M. E. Pollack, M. Tambe, and M. Wooldridge, "The Belief-Desire-Intention Model of Agency," J. P. Muller, M. P. Singh, and A. S. Rao, eds. Intelligent Agents V, Springer Publishers, New York, 1999.
90. M. E. Pollack, editor, Proceedings of the 15th International Conference on Artificial Intelligence, (2 Volumes), Morgan Kaufmann Publishers, San Mateo, CA 1997.
91. M. E. Pollack, "Planning in Dynamic Environments: The DIPART System," in Austin Tate, ed., Advanced

Planning Technology, AAAI Press, Cambridge, MA, 1996.

92. M. E. Pollack, "Plans as Complex Mental Attitudes," in P. R. Cohen, J. Morgan, and M. E. Pollack, eds., *Intentions in Communication*, MIT Press, Cambridge, MA, 1990.
93. P. R. Cohen, J. Morgan and M. E. Pollack, editors, *Intentions in Communication*, MIT Press, Cambridge, MA, 1990.
94. P. R. Cohen, J. Morgan and M. E. Pollack, "Introduction," in P. R. Cohen, J. Morgan, and M. E. Pollack, eds., *Intentions in Communication*, MIT Press, Cambridge, MA, 1990.
95. B. J. Grosz, M. E. Pollack and C. L. Sidner, "Discourse," in M. Posner, ed., *Foundations of Cognitive Science*, Bradford Books, MIT Press, Cambridge, MA, 1989.
96. M. E. Pollack, "Some Requirements for a Model of the Plan-Inference Process in Conversation," in R. Reilly, ed., *Communication Failure in Dialogue and Discourse*, North-Holland, Amsterdam, 1987.

Reviews and Short Pieces

97. M. E. Pollack, "Reflections on the Future of iSchools from a Dean Inspired by Some Junior Faculty," *ACM Interactions*, Jan. 2010.
98. M. E. Pollack, *Intelligent Assistive Technology (Extended Abstract)*, 11th International Conference on User Modeling, 2007.
99. M.E. Pollack, *Foreword to Automated Planning: Theory and Practice*, M. Ghallab, D. Nau, and P. Traverso, Morgan Kaufmann Press, 2004.
100. M. E. Pollack, *Foreword to Intelligent Planning*, Q. Yang, Springer, 1997.
101. M. E. Pollack, "Review of 'Artificial Intelligence: A Modern Approach' *AI Magazine*, 16(3): 73-74 1995.
102. M. E. Pollack, "Evaluating Plans, Planners, and Planning Agents," *SIGART Bulletin*, 6(1), 1995.
103. M. E. Pollack, "Review of 'Agency in Action,'" *Computational Linguistics*, 19(3), 1993.
104. M. E. Pollack, "Review of 'Readings in Planning'", *Minds and Machines* 2(1):102-104, 1992.

Refereed Workshop Papers and Conference Posters

105. M. R. Hodges, N. L. Kirsch, M. W. Newman, and M. E. Pollack, "Automatic Assessment of Cognitive Impairments," 11th International Conference on Ubiquitous Computing: *UBICOMP-2009 (Poster)*, Sept. 2009.
106. B. Clippingdale, M. W. Newman, M. E. Pollack, and M. A. Fauman, "Reflecting on Mood and Movement," *CHI 2009 Workshop on Designing for Reflection on Experience*, April 2009.
107. M. R. Hodges, M. W. Newman and M. E. Pollack, "Object-Use Activity Monitoring: Feasibility for People with Cognitive Impairments," *AAAI 2009 Spring Symposium on Human Behavior Modeling*, March 2009.
108. J. S. Weber, B. Clippingdale, and M. E. Pollack, "The Michigan Autonomous Guidance System," *Proceedings of the 2nd International Conference on Technology and Aging*, June 2007.
109. J. S. Weber and M. E. Pollack, "Effective Interaction Strategies for Adaptive Reminding," *AAAI 2007 Spring Symposium on Interaction Strategies for Intelligent Assistants*, March 2007.

110. J. J. Estelle, N. L. Kirsch, and M. E. Pollack, "Enhancing Social Interaction in Elderly Communities," Workshop on Designing Technology for People with Cognitive Impairment, Conference on Human Factors in Computing Systems (CHI), April 2006.
111. P. Schwartz and M. E. Pollack, "Two Approaches to Semi-Dynamic Disjunctive Temporal Problems," ICAPS Workshop on Constraint Programming for Planning and Scheduling, June 2005.
112. P. M. Berry, M. Gervasio, T. E. Uribe, M. E. Pollack, and M. E. Pollack, "A Personalized Time Management Assistant," in AAAI Spring Symposium on Persistent Assistants: Living and Working with AI, March 2005.
113. J. T. Matthews, S. J. Engberg, J. Glover, M. E. Pollack, and S. Thrun, "Robotic Assistants for the Elderly: Designing and Conducting Field Studies," 10th IASTED International Conference on Robotics and Applications, Aug. 2004
114. M. Rudary, S. Singh, and M. E. Pollack, "Reinforcement Learning for Adaptive Cognitive Orthotics (Extended Abstract)," in AAAI Workshop on Supervisory Control of Learning and Adaptive Systems, July 2004.
115. P. Schwartz and M. E. Pollack, "Planning with Disjunctive Temporal Constraints," in ICAPS Workshop on Integrating Planning into Scheduling, June 2004.
116. I. Tsamardinos, M. E. Pollack, and S. Ramakrishnan, "Assessing the Probability of Legal Execution of Plans with Temporal Uncertainty," ICAPS Workshop on Planning under Uncertainty and Incomplete Information, June 2003.
117. M. E. Pollack, "An Intelligent, Adaptive Cognitive Orthotic (Abstract)," *Gerontechnology*, 2(1):110, 2002.
118. M. E. Pollack, S. Engberg, J. T. Matthews, S. Thrun, L. Brown, D. Colbry, C. Orosz, B. Peintner, S. Ramakrishnan, J. Dunbar-Jacob, C. E. McCarthy, M. Montemerlo, J. Pineau, and N. Roy, "Pearl: A Mobile Robotic Assistant for the Elderly," AAAI Workshop on Automation as Caregiver, Aug. 2002.
119. D. Colbry, B. Peintner, and M. E. Pollack, "Quantitative Temporal Relationships in Dynamic Bayesian Models," AAAI Spring Symposium on Information Refinement and Revision for Decision Making, March 2002.
120. N. Onder and M. E. Pollack, "Generating Alternative Conditional Plans," AIPS Workshop on Decision-Theoretic Planning, April 2000.
121. A. Kott, M. E. Pollack, and B. Krogh, "The Situation Assessment Problem: Towards a Research Agenda," DARPA Symposium on Advanced on Enterprise Control, November 1999.
122. M. E. Pollack, I. Tsamardinos, and J. F. Horty, "Adjustable Autonomy for a Plan Management Agent," AAAI Spring Symposium on Adjustable Autonomy, March, 1999.
123. J. F. Horty and M. E. Pollack, "Plan Management Issues for Cognitive Robotics: Project Overview," AAAI Fall Symposium on Cognitive Robotics, Orlando, FL, October, 1998.
124. N. Onder, M. E. Pollack, and J. F. Horty, "A Unified Algorithm for Conditional and Probabilistic Planning," AIPS Workshop on Integrating Planning, Scheduling, and Execution in Dynamic and Uncertain Environments, June, 1998.
125. N. Onder and M. E. Pollack, "Handling Contingency Selection Using Goal Values," 1997 AAAI Workshop on Abstractions, Decisions, and Uncertainty, Providence, RI, July, 1997.
126. N. Onder and M. E. Pollack, "Contingency Selection in Plan Generation," 1996 AAAI Fall Symposium on Plan Execution. Boston, MA, Nov. 1996.

127. C. Bicchieri, M. E. Pollack, and C. Rovelli, "The Potential for Cooperation among Web Agents," 1996 AAAI Spring Symposium on Adaptation, Co-evolution, and Learning in Multiagent Systems. Stanford, CA, Mar. 1996.
128. Y. Ronen and M. E. Pollack, "Value-Density Algorithms for Deliberation Scheduling," IJCAI Workshop on Deliberation Scheduling and Anytime Algorithms, Aug., 1995.
129. M. E. Pollack, T. Znati, E. Ephrati, D. Joslin, S. Lauzac, A. Nunes, N. Onder, Y. Ronen, and S. Ur, "The DIPART Project: A Status Report," Proceedings of the Annual ARPA Planning Initiative Meeting, Tucson, AZ, Feb. 1994.
130. E. Ephrati, M. E. Pollack, and J. S. Rosenschein, "Exploiting Decision Theory Techniques in Multi-Agent Plan Merging," AAAI Spring Symposium on Decision-Theoretic Planning, March 1994.
131. M. E. Pollack, "Filtering as a Reasoning-Control Strategy," Proceedings of SOAR '93 (Space Operations and Applications Research Symposium), August 1993.
132. M. E. Pollack and M. Ringuette, "Introducing the Tileworld: Experimentally Evaluating Agent Architectures" (Extended Abstract), AAAI Symposium on Planning in Uncertain, Unpredictable, or Changing Environments, Stanford, CA, March, 1990.
133. M. E. Pollack, "Plan Recognition Beyond STRIPS" (Extended Abstract), Workshop on Plan Recognition, 11th International Joint Conference on Artificial Intelligence, Detroit, MI, August, 1989.
134. M. E. Pollack, "On Deciding What to Say (When You're Asked How to Perform Some Action)," Third Annual Workshop on Language Generation, Stanford, CA, July 1984.
135. M. E. Pollack, "A Way to Talk About Propositions," Penn Review of Linguistics, Vol. 7, Philadelphia, PA, January 1983.

Other Abstracts, Papers and Reports

136. E. Lazowska, M. E. Pollack, D. Reed, and J.M. Wing, "Boldly Exploring the Endless Frontier," Computing Research Association News, 21(1), Jan. 2009.
137. M. E. Pollack, "Opportunities and Challenges in Assistive Technology for Elders," Written version of testimony presented to the U.S. Senate Committee on Aging, Apr. 27, 2004.
138. M. E. Pollack and J. F. Horty, "An Information Dynamics Research Exploration Framework: Briefing Agents," DARPA/TASK Workshop, Santa Fe, NM, April, 2001.
139. A. Memon, M. E. Pollack, and M. L. Soffa, "A Planning-Based Approach to GUI Testing," 13th International Software/Internet Quality Week, San Francisco, CA, June 2000.
140. M. E. Pollack, D. Joslin, A. Nunes, S. Ur, and E. Ephrati, "Experimental Investigation of an Agent Commitment Strategy," University of Pittsburgh Tech. Report TR 94-31, 1994.
141. D. Joslin, A. Nunes and M. E. Pollack, "TileWorld Users' Manual," University of Pittsburgh Tech. Report TR 93-12, August, 1993.
142. M. E. Pollack and J. D. Moore, "Towards a Process-Based Analysis of Referring Expressions," University of Pittsburgh Tech. Report TR 92-14, May, 1992.
143. M. E. Pollack, "Plan Recognition." Videotape Lecture given at Stanford University, June, 1991. Morgan

Kaufmann Publishers, San Mateo, CA.

- 144.A. Pearl, M. E. Pollack, E. Riskin, B. Thomas, E. Wolf and A. Wu, "Becoming a Computer Scientist: Report of the Committee on the Status of Women in Computer Science," *Communications of the Association for Computing Machinery*, 33(11):48-57, 1990.
- 145.M. E. Pollack, "Natural-Language Processing." Videotape lectures given at Stanford University, June, 1989. Morgan Kaufmann Publishers, San Mateo, CA.
- 146.F. C. N. Pereira and M. E. Pollack, "A Brief Overview of the Candide Project," SRI International Tech. Report No. 450, Menlo Park, CA, September 1988.
- 147.M. E. Bratman, D. J. Israel and M. E. Pollack, "Toward an Architecture for Resource-Bounded Agents," Tech. Report No. CSLI-87-104, Center for the Study of Language and Information, Stanford, CA, August 1987.
- 148.M. E. Pollack, "Inferring Domain Plans in Question-Answering," University of Pennsylvania Doctoral Thesis, Philadelphia, PA, May 1986.

### **Invited Talks and Presentations**

*Not including conference paper presentations*

"*Assistive Technology for People with Cognitive Impairment: A Retrospective*,"  
University of Pittsburgh Dept. of Computer Science, Apr. 2011.

"*Computing Outside the Box*,"

University of Illinois at Chicago Dept. of Computer Science, **Distinguished Lecture Series**, Feb. 2010.  
Cornell University, **Gerald Salton Lecture**, Dec. 2009. (Also listed under "Honors and Awards" above).  
Grace Hopper Conference, Invited Speaker, Oct. 2009  
Indiana University School of Informatics , **Distinguished Colloquium Speaker**, Mar. 2009

Panelist, "*Interdisciplinarity in Computing and Information Science Research*,"  
Grace Hopper Conference (Celebration of Women in Computing), Oct. 2009.

"*Intelligent Assistive Technology: The Present and the Future*,"

Dartmouth College Dept. of Computer Science, Nov. 2008.  
Osher Lifelong Learning Institute, Ann Arbor, MI, Apr. 2008.  
Bioinformatics Grand Rounds, University of Michigan Medical School, Jan. 2008.  
**Grace Hopper Lecture**, University of Pennsylvania Department of Computer and Information Science  
Distinguished Lecture, October, 2007. (Also listed under "Honors and Awards" above).  
11th International Conference on User Modeling, **Invited Plenary Talk**, June, 2007.  
University of Southern California Dept. of Computer Science **Distinguished Lecture Series**, March 2007.  
Monterey Bay Aquarium Research Institute (MBARI) Research Seminar, March 2007.  
20th International Joint Conference on Artificial Intelligence (IJCAI-07), **Invited Plenary Talk**, January 2007.  
University of Massachusetts **Distinguished Lecture Series**, November 2006.

"*Intelligent Technology for an Aging Population: Using AI to Assist People with Cognitive Impairment*,"

University of Michigan Dept. of Psychology Cognition and Perception Forum, Sept. 2005;  
18th International Florida AI Research Symposium (FLAIRS), Invited Plenary Talk, May 2005;  
Computer Science Colloquium, Harvard University, Apr. 2005;  
Columbia University Computer Science **25th Anniversary Distinguished Lecture Series**, Feb. 2005;  
Dept. of Biostatistic and Medical Informatics Seminar, University of Wisconsin, Feb. 2005.

"*Intelligent Technology to Support Older Adults*,"

**Testimony before the United States Senate Special Committee** on Aging, 2004.

*“Intelligent Technology for Adaptive Aging,”*

19th National Conference on Artificial Intelligence, **Invited Plenary Talk**, July 2004.

*IEEE Working Group on Geriatric Care IT Symposium*, Panelist, Washington, DC, May 2004.

*Commentary on “Evolving Telemedicine/eHealth Technology—21st Century,”* by Frank Ferrante,

2004 Telemedicine Symposium, University of Michigan, May 2004.

*“Assistive Technology for Cognition”*, demonstration as part of the Technology Demo on Capitol Hill—Solutions to the Aging Services Crisis, sponsored by the Center for Aging Services Technology (CAST), Dirksen Senate Office Building, Washington, D.C, March 2004.

*“Assistive Technology for Cognition,”* demonstration as part of the University of Michigan State Legislature Research Exhibit, Lansing Capitol Rotunda, Lansing, MI, March 2004.

*“Technology to Assist Individuals with Cognitive Impairment,”*

Workshop on Adaptive Aging through Technology, Gerontological Society of America, San Diego, CA, Nov. 2003.

*“An Intelligent, Adaptive Cognitive Orthotic,”*

Department of Computer Science **Distinguished Speakers Series**, University of Rochester, Rochester, NY, Mar., 2003;

Department of Biomedical Informatics Seminar, Vanderbilt University, Nashville, Tn, Dec. 2002;

Workshop on Web Intelligence for Functionally Illiterate and Cognitively Impaired Populations; Joint Session with the 5th Annual Symposium on the Treatment of Alzheimer’s Disease, Dalhousie University, Halifax, Nova Scotia, Canada, Nov. 2002;

4th International Conference on Gerontechnology, Miami Beach, FL, Nov. 2002;

Intel Corp. Conference on Computing, Cognition, and Caring for Future Elders, Invited Talk

Intel Campus, Hillsboro, Oregon, Aug., 2002.

*“Plan-Management Assistants: From Homework Helpers to Cognitive Orthotics,”*

6th International Conference on AI Planning and Scheduling, **Invited Plenary Talk**, Toulouse, France, April, 2002.

*“Autominder: The Use of AI Techniques in a Cognitive Orthotic System,”*

Cognitive Science Colloquium, Georgia Institute of Technology, Atlanta, GA, November 2001.

*“Plan Management Technology for Automated Personal Assistants,”*

11th Univ. of Michigan IPoCSE Seminar (Industrial Partners of Computer Science and Engineering), October, 2000.

*“Reasoning about Actions in Context: Computational Techniques for Plan Management,”*

NCARAI Seminar Series, Naval Research Laboratory, Washington, D.C., April 2000.

*“Plan Management Requirements for Agent-Based Computing,”* National Institute of Standards and Technology, Gaithersburg, MD, April 2000.

*“Plan Management for Continual Computation,”*

University of Michigan Department of Electrical Engineering and Computer Science Colloquium, November, 1999.

*“Intelligent Workflow Management beyond Business”*,

IJCAI99 Workshop on Intelligent Workflow and Process Management, Invited Talk, Stockholm, Sweden, Aug., 1999.

*“Experiences with Adjustable Autonomy in a Mixed-Initiative System,”*

IJCAI99 Workshop on Adjustable Autonomy, Invited Talk, Stockholm, Sweden, Aug., 1999.

“*Computational Techniques for Plan Management: Merging Richly Expressive Plans,*” and “*Computational Techniques for Plan Management: Assessing Alternative Plans in Context,*”  
University of Ulm Dept. of Computer Science, Ulm, Germany, May, 1999.

“*Reasoning about Actions in Context: Computational Techniques for Plan Management,*”  
University of Michigan Department of Electrical Engineering and Computer Science Colloquium, March, 1999.

“*Plan Generation, Plan Management, and the Design of Computational Agents,*”  
University of Maryland Agents Speakers Series, Department of Computer Science, University of Maryland, December, 1998.

“*Plan Management for Cognitive Robotics,*”  
AAAI Fall Symposium on Cognitive Robotics, Invited Overview Talk, Orlando, FL, October, 1998.

“*There's More to Life than Making Plans: Plan Management in Dynamic, Multi-Agent Environments,*”  
AAAI Fall Symposium on Distributed, Invited Talk, Continual Planning, Orlando, FL, October, 1998.

“*Rationality and Planning: A Computational Perspective,*”  
Utrecht Artificial Intelligence Institute Colloquium on Artificial Intelligence, to honor the 10th anniversary of the Cognitive Artificial Intelligence Program and the opening of the Technical Artificial Intelligence Program, Invited Plenary Talk, Utrecht, Holland, October, 1998.

“*Plan Generation, Plan Management, and the Design of Computational Agents,*”  
3rd International Conference on Multi-Agent Systems, **Invited Plenary Talk**, Paris, France, July, 1998.

“*The Future of BDI Models,*”  
5th International Workshop on Agent Theories, Architectures, and Languages, Invited Panel Member, Paris, France, July 1998.

“*There's More to Life than Making Plans: Plan Management in Dynamic Environments,*”  
AIPS'98 Workshop on Integrating Planning, Scheduling, and Execution in Dynamic and Uncertain Environments, Invited Talk, June 1998.

“*Plan Management in Dynamic Environments,*”  
Carnegie Mellon University Department of Computer Science AI Seminar Series, Apr. 1998.

“*Rationality and Planning: A Computational Perspective,*”  
University of Pittsburgh Center for Philosophy of Science Annual Lecture Series, Feb., 1998

“*Towards Faster/Better Planners,*”  
University of Rochester Dept. of Computer Science Colloquium, Sept. 1997;  
University of Minnesota Dept. of Computer Science Colloquium, Apr., 1997.

“*Talking to Computers: Why Don't They Understand?,*”  
University of Pittsburgh Founder's Day Symposium, Feb., 1997.

“*Planning Algorithms and Planning Problems,*”  
AI'96, The Annual Meeting of the Canadian Society for Artificial Intelligence, Invited Talk, May, 1996.

“*Planning in Distributed, Dynamic Environments,*”  
STISS-95. Invited Talk. Washington, D.C., Aug. 1995.

“*How and Why Artificial Agents Plan,*”  
Society for Philosophy and Psychology Annual Meeting, Invited Talk, June 1995.



“*Commentary on ‘The Significance or Insignificance of Representations in the Cognitive Architecture’*,”  
Conference on Philosophy and the Sciences of Mind, University of Konstanz, Konstanz, Germany May 1995.

“*The Effects of Single-Agent Reasoning Strategies on Multi-Agent Systems*,”  
Fourth International Colloquium on Cognitive Science, Invited Talk, San Sebastian, Spain, May 1995.

“*Planning in Dynamic, Multi-Agent Domains: Issues and Experiments*,”  
University of Waterloo Cognitive Science Series, February 1995.

“*Resource-Bounded Rationality with Representation: An AI Perspective*,”  
3 Invited Lectures presented at the Center for Rationality, Department of Philosophy, University of Arizona, January 1995.

“*Commentary on ‘Cognition and Tool Use’*,”  
3rd In-House Conference, University of Pittsburgh Center for the Philosophy of Science, Sept. 1994.

“*Planning in Dynamic, Multi-Agent Domains: Issues and Experiments*,” Rome Laboratory, May 1994.

“*Control of Reasoning in Dynamic Environments*,”  
Division of Applied Sciences, Harvard University, December 1993;  
Department of Computer Science, University of Washington, November 1993;  
Center for the Philosophy of Science, University of Pittsburgh, September 1993;  
SOAR '93: Space Operations, Applications and Research Symposium, NASA Johnson Space Center, August 1993.

“*All My Autopsies Have Been Performed on Dead People: Issues in Knowledge Representation for Discourse Processing*,”  
Third International Conference on Principles of Knowledge Representation and Reasoning, Invited Talk, October 1992.

“*Experimental Methods in Artificial Intelligence*,”  
First International Conference on Artificial Intelligence Planning Systems, Invited Panel Member, College Park, MD, June, 1992.

“*Strategies for Resource-Limited Reasoning*,”  
Department of Computer Science, University of Toronto, May 1992;  
Department of Computer and Information Science, University of Pennsylvania, May 1992;  
Department of Computer Science, University of Chicago, April 1992.

“*Plan Recognition for Discourse: A Survey*,”  
Computational Linguistics Research Seminar, Carnegie Mellon University, October 1991;  
Topics in Artificial Intelligence Series, Stanford University, June 1991.

“*The Uses of Plans*,”  
Learning Research and Development Center, University of Pittsburgh, October 1991;  
**Computers and Thought Lecture**, 12th International Joint Conference on Artificial Intelligence, Sydney, Australia, August, 1991

“*Experimental Evaluation of an Architecture for Resource-Bounded Reasoning*,”  
Wright-Patterson Air Force Base, April 1991;  
Department of Computer Science, Johns Hopkins University, March 1991;  
Department of Computer Science, University of Maryland, March 1991;  
Department of Computer Science, Brown University, March 1991;  
Department of Computer Science, Rutgers University, February 1991;  
Knowledge Systems Laboratory, Stanford University, February 1991;  
Department of Computer Science, Duke University, January 1991;

Department of Computer Science, Univ. of Pittsburgh, January 1991.

*“Tunable Benchmarks for Agent Evaluation”*

DARPA/NASA Workshop on Benchmarks and Metrics for Evaluating Agent Architectures, Invited Talk, NASA Ames Research Center, Mountain View, CA, June, 1990.

*“The Tileworld System,”* NASA/Ames, May 1990.

*“The Role of Intentions in Agency,”*

American Association for Artificial Intelligence (AAAI) Symposium on Planning in Uncertain, Unpredictable, or Changing Environments, Invited Panel Member, Stanford, CA, March 1990.

*“Plans and Resource-Bounded Practical Reasoning,”*

Cognitive Science Group, Northwestern University, October 1989.

*“Plan Recognition Beyond STRIPS,”*

American Association for Artificial Intelligence (AAAI) Workshop on Plan Recognition, Detroit, MI, August 1989.

*“An Integrated Framework for Semantic and Pragmatic Interpretation,”*

Unisys, November 1988;

Department of Computer Science, University of Pennsylvania, November, 1988;

Department of Computer Science, Cambridge University, October, 1988.

*“Inferring Domain Plans in Question-Answering,”* AT & T Bell Laboratories, May, 1986.

### **Research Grants**

Principal Investigator, “Contextual Investigation of Constraint-Based Dynamic Scheduling,” National Science Foundation, \$801,893, 2007-2010.

Subcontractor (PI for the Michigan subcontract), “Plan Management Support for the EPCA Project,” DARPA, through a subcontract from SRI International, \$1,281,896 (University of Michigan portion), 2003-2008.

Principal Investigator, “Temporal Planning for Automatic Service Composition,” Air Force Office of Scientific Research, \$557,825, 2007-2010

(After being awarded this grant, I transferred it to Prof. Edmund Durfee, because my move to the position of Dean of the School of Information precluded my continuing to serve as PI on it.)

Co-Investigator, “Multiagent Plan Management for Sociocognitive Orthotics,” National Science Foundation (PI: E. Durfee), \$539,626, 2005-2007.

Principal Investigator, “Mixed-Initiative Development of Plans with Expressive Temporal Constraints,” Air Force Office of Scientific Research, \$299,817, 2004-2007.

Co-Investigator, “An Infrastructure for Wide Area Pervasive Computing,” National Science Foundation (PI: H. V. Jagadish), 2003-2006.

Principal Investigator, “Preliminary Studies and Feasibility Analysis of Location-Aware Assistive Technology,” University of Michigan Office of Vice President for Research, \$14,993, 2005-2006.

Principal Investigator, “Adaptive Interfaces for Cognitive Orthotics,” Intel Corp. (Co-PI: Satinder Singh). \$248,793, 2003-2005.

Principal Investigator/Subcontractor, “Personal Robotic Assistants for the Elderly,” National Science Foundation (ITR Program), \$1,412,000 (Univ. of MI component: \$439,240), 2000-2005.

(I was initially PI when the proposal was submitted and selected. After moving to Univ. of Michigan, we decided to leave the Univ. of Pittsburgh as the prime contractor, creating a new PI there, and bring my funding to Michigan in the form of a subcontract.)

Principal Investigator, “Increasing the Efficiency and Functionality of Plan Management Agents,” Air Force Office of Scientific Research, \$509,034, 2000-2004.

Principal Investigator, “Development of a Formal Theory of Agent-Based Computing for System Evaluation and System-Design Guidance,” DARPA/AFRL (TASK Program), \$712,727, 2000-2003.

Principal Investigator, “Plan Management Capabilities for Autonomous Agents: Extending the Basic Capabilities,” DARPA/AFRL (CoABS Program), \$199,633, 2000-2001.

Principal Investigator, “Agents for Dynamic Plan Management,” Air Force Office of Scientific Research Contract F49620-98-1-0436, \$307,653, 1998-2000.

Principal Investigator, “Plan Management in Dynamic Environments,” National Science Foundation, IRI-9619579, \$188,233, 1997-2000.

Principal Investigator (with D. Chiarulli), “Mobile Robots for Teaching Undergraduate Computer Science,” University of Pittsburgh Innovation in Education Awards, \$29,710, 2000-2001.

Principal Investigator (with D. Chiarulli and S. Levitan), “Voice Input Interfaces to Embedded Systems,” Pittsburgh Digital Greenhouse, \$ 175,509, 2000.

Principal Investigator (with D. Chiarulli), “Mobile Robots for Computer Science Instruction,” University of Pittsburgh Advanced Instructional Technology Program, \$22,500, 1998-1999.

Co-Principal Investigator (with K. VanLehn, J. Anderson, K. Ashley, M. Chi, G. Cooper, K. Corbett, M. Druzdel, K. Koedinger, A. Lesgold, L. Levin, and J. Moore), “CIRCLE: Center for Interdisciplinary Research on Constructive Learning,” National Science Foundation, IRI-9720359, \$4,997,797, 1997-2002.

Co-Principal Investigator (with K. Ashley, M. Chi, and R. Pinkus), “Modeling Learning to Reason with Cases in Engineering Ethics: A Test Domain for Intelligent Assistance,” National Science Foundation, IRI- 9720341, \$499,983, 1997-2000.

Principal Investigator, “Supplement: Agents for Dynamic Plan Management,” DARPA funding to augment AFOSR contract F49620-98-1-0436, \$102,740, 1999.

Principal Investigator, “Supplement: Plan Management in Dynamic Environments,” National Science Foundation, IRI-9619579, \$35,066, 1997-1998.

Principal Investigator, “Search Control for Automatic Plan Generation,” Air Force Office of Scientific Research Contract F49620-96-1-0403, \$76,992, 1996-1997.

Principal Investigator , “Cooperation and Coordination among Tactical Picture Agents,” Office of Naval Research Contract N00014-95-1-1161, \$78,835, 1995-1996.

Principal Investigator (with T. Znati), Distributed, Interactive Development and Monitoring of Transportation Plans in Dynamic Environments, DARPA Contract F30602-93-C-0038, \$521,160, 1993-1996.

Principal Investigator, Strategies for the Control of Reasoning in Dynamic Environments, Air Force Office of Scientific Research Contract F49620-92-J-0422, \$238,372, 1992-1995.

Principal Investigator, Investigations of Resource-Limited Reasoning, National Science Foundation Young

Investigator's Award, IRI-9258392, 1992-1997, \$125,000.

Principal Investigator, Intelligent Real-Time Problem Solving, AFOSR/RADC/WRDC Contract F49620-91-C-0005, \$84,938, 1991-1992.

Co-Investigator (D. Appelt and K. Konolige, Principal Investigators), Planning Helpful Behavior, Nippon Telegraph and Telephone Grant, \$750,000, 1989-1992.

Co-Investigator (K. Konolige, Principal Investigator), Distributed Reasoning and Planning, ONR Contract N00014-89-C-0095, \$750,000, 1989-1993, and Contract N00014-85-C-0251, \$1,000,000, 1985-1989.

Co-Investigator (F. C. N. Pereira, Principal Investigator), Candide, An Interactive System for the Acquisition of Domain-Specific Knowledge, DARPA Contract N000-39-84-C-0524 \$1,150,000, 1984-1988.

Investigator, Rational Agency Project and Discourse, Intention, and Action Project, Center for the Study of Language and Information, Stanford University, Gift from the System Development Foundation, 1985-1990.

### **Teaching Experience**

Courses Taught at the University of Michigan:

UC 270	The Challenge of College Affordability: Financing the University (with Phil Hanlon)
SI 730	Towards an Index of Leading Online Sociability Indicators (Seminar)
EECS 203	Discrete Mathematics
EECS 281	Introduction to Data Structures and Algorithms (was EECS 380)
EECS 492	Introduction to Artificial Intelligence
EECS 543	Knowledge-Based Systems
EECS 692	Current Topics in Artificial Intelligence (Plan Management)

Courses Taught at the University of Pittsburgh:

CS 401	Introduction to Computer Science using C++
CS 441	Discrete Structures for Computer Science
CS 1571	Introduction to Artificial Intelligence
CS 1699	Intermediate Programming and System Design Using a Mobile Robot
CS 2710	Foundations of Artificial Intelligence (cross-listed as ISSP2160)
CS 2730	Planning, Problem Solving and Search (cross-listed as ISSP2170)
CS 3710	Advanced Topics in Artificial Intelligence

Courses Taught Elsewhere:

Temporal and Resource Reasoning for Planning, Scheduling, and Execution (with N. Muscettola),  
All-Day Tutorial at AAAI 2006 and at ICAPS 2005

Planning and Execution

PLANET European Summer School on Artificial Intelligence Planning, 2002

Computational Models of Discourse,

LSA Summer Institute, Santa Cruz, CA and Summer School of Computational Linguistics, Prague, 1991

Seminar on Rational Agency (with M. Bratman and S. Rosenschein),

Philosophy Dept. and Center for the Study of Language and Information, Stanford University, 1989

Computational Models of Discourse (with D. Appelt and J. Hobbs),

Computer Science Dept., Stanford University, 1987

### **Graduate Student Supervision**

*Postdoctoral Student Supervisor*

Eithan Ephrati, University of Pittsburgh, 1993-1996

Doctoral Student Supervisor

- Julie Weber (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Dec. 2010)  
Thesis Title: "Pssst. . . or Boo! Assessing the Predictability of Notification Delivery Preferences"
- Mark Hodges (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Aug. 2010)  
Thesis Title: "Sensor-Based Analysis of Object-Use Patterns for Automatic Assessment of Cognitive Status"
- Peter Schwartz (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Aug. 2007)  
Thesis Title: "Managing Complex Scheduling Problems with Dynamic and Hybrid Constraints"
- Michael Moffitt (Computer Science and Engineering, University of Michigan, Ph.D. Awarded April 2007)  
Thesis Title: "Efficient and Expressive Extensions of Constraint-Based Temporal Reasoning"
- Bart Peintner (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Aug. 2005)  
Thesis Title: "Algorithms for Constraint-Based Temporal Reasoning with Preferences"
- Colleen McCarthy (Computer Science, University of Pittsburgh, Ph.D. Awarded Dec. 2002)  
Thesis Title: "A Plan-Based Cognitive Orthotic for Reminding"
- Ioannis Tsamardinos (Intelligent Systems, University of Pittsburgh, Ph.D. Awarded Aug. 2001)  
Thesis Title: "Constraint-Based Temporal Reasoning Algorithms, with Applications to Planning"
- Atif Memon (Computer Science, University of Pittsburgh, Ph.D. Awarded, Aug. 2001; co-supervisor Mary Lou Soffa)  
Thesis Title: "A Comprehensive Framework for Testing Graphical User Interfaces"
- Nilufer Onder (Computer Science, University of Pittsburgh. Ph.D. Awarded Aug. 1999)  
Thesis Title: "Contingency Selection in Plan Generation"
- R. Michael Young (Intelligent Systems, University of Pittsburgh. Jointly supervised by Prof. Johanna Moore, Ph.D. Awarded Dec. 1997)  
Thesis Title: "Generating Descriptions of Complex Activities"
- David Joslin (Intelligent Systems, University of Pittsburgh. Ph.D. Awarded Apr. 1996)  
Thesis Title: "Passive and Active Decision Postponement in Plan Generation"

Master's or Pre-Candidate Student Supervisor

- Brett Clippingdale (CSE, University of Michigan)
- Erin Rhode (CSE, University of Michigan, M.S. Awarded May 2007)
- Mark Schaller (CSE, University of Michigan, M.S. Awarded December 2005)
- Martina Gierke (CS, University of Rostock, Germany, jointly supervised by Adeline Uhrmacher, M.S. Awarded January 2005) "Coupling Autominder and James"
- Jacob Balazer (CSE, University of Michigan, M.S. Awarded December 2003)
- Laura Brown (CSE, University of Michigan, M.S. Awarded August 2002)
- Steven Carrion (CSE, University of Michigan, M.S. Awarded December 2001)
- Dirk Colbry (CSE, University of Michigan, M.S. Awarded December 2001)
- Philip Ganchev (Intelligent Systems Program, University of Pittsburgh, M.S. Awarded August 2001) "Flexibility Measures for Sets of Plans"
- Sailesh Ramakrishnan (Intelligent Systems Program, University of Pittsburgh. M.S. Awarded August 2000)  
"Simulation-Based Intelligent Reminding"
- Jun Hu (Intelligent Systems Program, University of Pittsburgh. M.S. Awarded May 2000) "Solving Multi-Agent Plan Refinement Problems using Local Search"
- Colleen McCarthy (Computer Science, University of Pittsburgh. M.S. Awarded December 1999) "Rationale-Based Monitoring: Application to Causal-Link Planning and Implementation in the Robotics Field"
- Ioannis Tsamardinos (Intelligent Systems Program, University of Pittsburgh. M.S. Awarded August 1998)

- “Reformulating Temporal Plans for Efficient Execution”  
 Massimo Paolucci (Intelligent Systems Program, University of Pittsburgh . M.S. Awarded August 1998)  
 “Flaw-Selection Strategies for Partial-Order Causal Link Planning”  
 Marina Milshtein (Computer Science, University of Pittsburgh . M.S. Awarded April 1996) “A Cost-Directed  
 Heuristic Planner”  
 Yagil Ronen (Intelligent Systems Program, University of Pittsburgh. M.S. Awarded August 1995) “Meta-Level  
 Deliberation as Scheduling: The Use of Operating Systems and Operations Research Techniques in Meta-  
 Level Control”  
 Rob Conticello (Computer Science, University of Pittsburgh. M.S. Awarded April 1995) “Implementation of a User  
 Interface for the DIPART System”  
 Arthur Nunes (Computer Science, University of Pittsburgh. M.S. Awarded August 1994) “Towards a Machine IQ:  
 Some Perspectives on Evaluation Metrics for Embedded Agents with an Application to Agents Designed for  
 the Pacifica Evaluation Scenario”

Doctoral Committee Member

- Hadi Katebi (Computer Science and Engineering, University of Michigan, Ph.D. in progress)  
 James Boerkoel (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Dec. 2012)  
 Matt Rudary (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Dec. 2008)  
 Andrew Nuxoll (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Aug. 2007)  
 Sarah Root (Industrial and Operations Engineering, University of Michigan, Ph.D. Awarded April 2007)  
 Tolga Konik (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Dec. 2006)  
 Lin Liao (Computer Science and Engineering, University of Washington, Ph.D. Awarded Aug. 2006)  
 Bill Rand (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Dec. 2005)  
 Jeffrey Cox (Computer Science and Engineering, University of Michigan, Ph. D. Awarded Aug. 2005)  
 Katie Luchini (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Apr. 2005)  
 Haksun Li (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Apr. 2004)  
 Scott Wallace (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Aug. 2003)  
 Tae-Sic Yoo (Electrical Engineering, University of Michigan, Ph.D. Awarded Apr. 2002)  
 Randy Ho (Computer Science and Engineering, University of Michigan, Ph.D. Awarded Apr. 2002)  
 Brad Clement (Computer Science and Engineering, University of Michigan, Ph.D. Awarded, Dec. 2001)  
 Susan Lauzac (Computer Science, University of Pittsburgh, Ph.D. Awarded August 2001)  
 William Walsh (Electrical Engineering and Computer Science, University of Michigan, Ph.D. Awarded, May 2001)  
 Gary Livingston (Computer Science, University of Pittsburgh, Ph.D. Awarded December 2000)  
 Chrisoula Andreou (Philosophy, University of Pittsburgh, Ph.D. Awarded December 2000)  
 Jae Oh (Computer Science, University of Pittsburgh. Ph.D. Awarded August 2000)  
 Pamela Jordan (Intelligent Systems, University of Pittsburgh. Ph.D. Awarded April 2000)  
 Bruce McLaren (Intelligent Systems, University of Pittsburgh. Ph.D. Awarded December 1999)  
 Zvi Cohen (Philosophy, University of Pittsburgh. Ph.D. Awarded September 1999)  
 Donald Bruckner (Philosophy, University of Pittsburgh. Ph.D. Awarded September 1999)  
 Stefano Monti (Intelligent Systems, University of Pittsburgh. Ph.D. Awarded August 1999)  
 Stephen Glaister (Philosophy, University of Pittsburgh. Ph.D. Awarded April 1999)  
 Reiko Tsuneto (Computer Science, University of Maryland, Ph.D. Awarded December 1998)  
 Constantin Aliferis (Intelligent Systems, University of Pittsburgh. Ph.D. Awarded April 1998)  
 Claude-Nicolas Fiechter (Computer Science, University of Pittsburgh. Ph.D. Awarded August 1997)  
 Mark McCullaugh (Philosophy, University of Pittsburgh. Ph.D. Awarded May 1997)  
 Alicia Perez (Computer Science, Carnegie Mellon. Ph.D. Awarded August 1995)  
 Yongwon Lee (Computer Science, University of Pittsburgh. Ph.D. Awarded August 1995)  
 Christopher Geib (Computer and Information Science, Univ. of Pennsylvania, Ph.D. Awarded, May 1995)  
 Rahul De (Business, University of Pittsburgh. Ph.D. Awarded December 1993)  
 S. Rebecca Thomas (Computer Science, Stanford, Ph.D. Awarded August 1993)  
 John Aronis (Intelligent Systems, University of Pittsburgh. Ph.D. Awarded May 1993)  
 Eunok Paek (Computer Science, Stanford, Ph.D. Awarded June 1991)

Master's Committee Member

- Amy Soller (Intelligent Systems Program, University of Pittsburgh. M.S. Awarded December 1999)

Sylvain Lauzac (Computer Science, University of Pittsburgh. M.S. Awarded January 1995)  
Jonathan Rubin (Intelligent Systems Program, University of Pittsburgh. M.S. Awarded April 1994)

Undergraduate Student Supervision

Vikas Reddy, UROP Program, University of Michigan, 2003-2005  
James Shearer, Undergraduate Research Assistant, RDF funding, University of Pittsburgh, 2000.  
Mac Marchandani, Undergraduate Research Assistant on NSF funded project, University of Pittsburgh, 1999.  
Greg Hajcak, Supervisor for Brackenridge Summer Research Fellowship, University of Pittsburgh, 1998.  
Tonya Yount, Supervisor for Chancellor's Undergraduate Research Fellowship, University of Pittsburgh, 1993.