

## Tom M. Mitchell

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### Research Interests:

Computer science, machine learning, artificial intelligence, and cognitive neuroscience. My research focuses on basic and applied problems in machine learning, understanding how the human brain represents information in terms of neural activity, and statistical learning algorithms for natural language processing.

### Positions Held:

University Professor, Carnegie Mellon University, (2009-present)

Department Head, Machine Learning Department, Carnegie Mellon University, (2006-present).

E. Fredkin Professor, School of Computer Science, Carnegie Mellon University. (1999-present)

Chief Scientist and Vice President, WhizBang! Labs, (2000-2001).

Professor, Computer Science, Robotics, and Language Technologies, Carnegie Mellon, (1986-present)

Assistant/Associate Professor, Department of Computer Science, Rutgers University, NJ. (1978-86)

### Education:

Ph.D. Stanford University. Electrical Engineering, Computer Science minor. April, 1979.

S.B. Massachusetts Institute of Technology. Electrical Engineering. June, 1973.

### Honors and Awards:

2010 Elected to National Academy of Engineering

2008 Elected Fellow of American Association for the Advancement of Science (AAAS)

2008 10-Year Best Paper Award at ICML/COLT.

2007 Distinguished Service Award, Association for Advancement of Artificial Intelligence (AAAI)

2003 Best Foundational Paper Award, American Medical Informatics Association (AMIA)

2002 Peter Debye Prize, Edmund Hustinx Foundation, University of Maastricht

1990 Elected Fellow of the Association for the Advancement of Artificial Intelligence (AAAI)

1984 NSF Presidential Young Investigator Award.

1984 Best Paper Award, 21st IEEE Design Automation Conference.

1983 IJCAI Computers and Thought Award.

**Professional Activities:**

Member, US Department of Justice OJP Science Advisory Board Subcommittee on National Institute of Justice. April 2011 to present.

Testimony to United States House of Representatives Committee on Veterans' Affairs: use of artificial intelligence to improve benefits claims processing at the VA. January 2008.

Chair, American Association for the Advancement of Science, Section on Information, Computing, and Communication (2006-2007).

President, Association for the Advancement of Artificial Intelligence (AAAI) (2001-2003).

Member of National Research Council, Computer Science and Telecommunications Board (1997-2006).

Chair, National Academy of Sciences Workshop on Information Fusion for Counter Terrorism, (June 2002).

Member of Editorial Board of *Journal of Machine Learning Research* (2001-present).

Member of Editorial Board of *Cognitive Science* journal (2005-present).

Member of Editorial Board of *Journal of Artificial Intelligence Research* (1997-present).

Member of Editorial Board of *Artificial Intelligence* (1983-2008).

Member of Editorial Board of *Information Retrieval* (1998-present).

Member of Advisory Board of *Springer-Verlag Series on Cognitive Science and Artificial Intelligence* (2002-present).

Co-founder and Associate Editor, *Machine Learning Journal*, Kluwer Academic Press, (1985-1989).  
Member of Editorial Board (1985-2001).

Co-founder of the International Conference on Machine Learning, and co-organizer of the first five annual conferences.

**Books:**

*Machine Learning*, T.M. Mitchell, McGraw Hill, 1997.

*Mind Matters: A Tribute to Allen Newell*, D. Steier and T. Mitchell (eds.), Erlbaum, 1996.

*Recent Advances in Robot Learning*, J. Franklin, T. Mitchell, and S. Thrun (eds.), Kluwer Academic Publishers, 1996.

*Machine Learning: A Guide to Current Research*, Mitchell, Carbonell, and Michalski, eds., Kluwer Academic Publishers, 1986.

*Machine Learning: An Artificial Intelligence Approach. Volume 2* Michalski, Carbonell, and Mitchell, eds., Morgan-Kaufman, 1986.

*Machine Learning: An Artificial Intelligence Approach*, Michalski, Carbonell, and Mitchell, eds., Tioga Press, 1983.

#### **Selected Publications:**

1. "Coupled Semi-Supervised Learning for Information Extraction," Andrew Carlson, Justin Betteridge, Richard C. Wang, Estevam R. Hruschka Jr. and Tom M. Mitchell. *Proceedings of the Third ACM International Conference on Web Search and Data Mining (WSDM)*, Feb. 2010.
2. "A Neurosemantic Theory of Concrete Noun Representation Based on the Underlying Brain Codes," Marcel A. Just, Vladimir L. Cherkassky, Sandesh Aryal, Tom M. Mitchell, *PLoS ONE* 5(1): e8622 DOI: 10.1371/journal.pone.0008622, January 13, 2010.
3. "Mining Our Reality," Tom M. Mitchell, *Perspective in Science*, 326, DOI:10.1126/science.1174459, December 2009.
4. "Zero-Shot Learning with Semantic Output Codes", M. Palatucci, D. Pomerleau, G. Hinton, T. Mitchell, *Neural Information Processing Systems (NIPS)*, 2009.
5. "Modeling fMRI Data Generated by Overlapping Cognitive Processes with Unknown Onsets Using Hidden Process Models," R.A. Hutchinson, R.S. Niculescu, T.A. Keller, I. Rustandi, T.M. Mitchell, *NeuroImage* (2009), doi: 10.1016/j.neuroimage.2009.01.025
6. "Populating the Semantic Web by Macro-Reading Internet Text", Tom M. Mitchell, Justin Betteridge, Andrew Carlson, Estevam Hruschka, and Richard Wang, Invited paper, *Proceedings of the 8th International Semantic Web Conference (ISWC 2009)*, October 2009.
7. "Integrating Multiple-Study Multiple-Subject fMRI Datasets Using Canonical Correlation Analysis", I. Rustandi, M.A. Just, T.M. Mitchell. *Proceedings of the MICCAI 2009 Workshop: Statistical modeling and detection issues in intra- and inter-subject functional MRI data analysis*, September 2009.
8. "Coupling Semi-Supervised Learning of Categories and Relations," A. Carlson, J. Betteridge, E. R. Hruschka Jr. and T. M. Mitchell. *NAACL HLT 2009 Workshop on Semi-supervised Learning for Natural Language Processing*, June 2009.
9. "Machine learning classifiers and fMRI: a tutorial overview," Pereira F., Mitchell T., Botvinick M., *NeuroImage*, Volume 45, Issue 1, Pages S199-S209, March 2009.
10. "Computational Models of Neural Representations in the Human Brain," (extended abstract) T.M. Mitchell, DS 2008, Lecture Notes in Artificial Intelligence 5255, J.-F. Boulicaut, M.R. Berthold, and T. Horvarth (Eds.), Springer-Verlag Berlin Heidelberg, pp. 26–27, 2008.
11. "Discovering a Semantic Basis of Neural Activity Using Simultaneous Sparse Approximation," M. Palatucci, T.M. Mitchell, and H. Liu *International Conference on Machine Learning (ICML - Sparse Optimization and Variable Selection Workshop)*, July, 2008.
12. Exploring Hierarchical User Feedback in Email Clustering, Yifen Huang and Tom Mitchell. *Enhanced Messaging Workshop, AAAI 2008, Chicago, IL, July 2008*
13. "Predicting Human Brain Activity Associated with the Meanings of Nouns," T. M. Mitchell, S. V. Shinkareva, A. Carlson, K. Chang, V. L. Malave, R. A. Mason, M. A. Just, *Science*, vol. 320, May 30, 2008.
14. "Using fMRI Brain Activation to Identify Cognitive States Associated with Perception of Tools and Dwellings," S.V. Shinkareva, R.A. Mason, V.L. Malave, W. Wang, T. M. Mitchell, and M. A. Just, *PLoS ONE* 3(1): e1394. doi:10.1371/journal.pone.0001394, January 2, 2008.
15. "A Combined Expression-Interaction Model for Inferring the Temporal Activity of Transcription Factors," Y. Shi, I. Simon, T. Mitchell and Z. Bar-Joseph, *Proceedings of The 12th Annual International Conference on Research in Computational Molecular Biology (RECOMB)*, 2008.

16. "Inferring Gene Regulatory Relationships from Multiple Time Series Datasets" Y. Shi, T. Mitchell and Z. Bar-Joseph , *Bioinformatics*, 23(6), pp. 755-763, 2007.
17. "Continuous hidden process model for time series expression experiments," Y. Shi, M. Klustein, I. Simon, T. Mitchell, and Z. Bar-Joseph, *Bioinformatics (Proceedings of ISMB 2007)*, 23(13), pp i459-i467, 2007.
18. "Feature Selection for Grasp Recognition from Optical Markers," L.Y. Chang, N. Pollard, T. Mitchell, and E.P. Xing, Proceedings of the 2007 IEEE/RSJ Intl. Conference on Intelligent Robots and Systems (IROS 2007), pp. 2944-2950, October, 2007.
19. "Classification in Very High Dimensional Problems with Handfuls of Examples," M. Palatucci and T. Mitchell, Principles and Practice of Knowledge Discovery in Databases (ECML/PKDD), Springer-Verlag, September, 2007
20. "Text Clustering with Extended User Feedback," Y. Huang and T. Mitchell, *Proceedings of SIGIR 2006*, August, 2006.
21. "Extracting Knowledge about Users' Activities from Raw Workstation Contents," T. Mitchell, S. Wang, Y. Huang, and A. Cheyer, in *Proceedings of the AAAI Conference*, July 2006.
22. "Hidden Process Models," R. Hutchinson, T. Mitchell, I. Rustandi, in *Proceedings of the International Conference on Machine Learning*, Pittsburgh, PA, June 2006.
23. "Classifying cognitive states associated with reading single words and two-word sentences," Svetlana V. Shinkareva, Robert A. Mason, Vicente L. Malave, Tom M. Mitchell, Marcel A. Just. 12th Conference on Human Brain Mapping, June, 2006.
24. "Decoding of Semantic Category Information from Single Trial fMRI Activation in Response to Word Stimuli", Using Searchlight Voxel Selection ," F. Pereira, R. Mason, M. Just, T. Mitchell, N. Kriegeskorte, *12th Conference on Human Brain Mapping*, June, 2006.
25. "Bayesian Network Learning with Parameter Constraints," R.S. Niculescu, T.M. Mitchell, R.B. Rao, *Journal of Machine Learning Research*, 7, pp. 1357-1383, July 2006.
26. "Exploring predictive and reproducible modeling with the single-subject FIAC data set," X. Chen, F. Pereira, W. Lee, S. Strother, T. Mitchell, *Human Brain Mapping*, 2006.
27. "Semi-Supervised Text Classification Using EM," K. Nigam, A. McCallum, and T. Mitchell, in *Semi-Supervised Learning*, Olivier Chapelle, Bernhard Schölkopf, and Alexander Zien (eds.), MIT Press, 2006.
28. "Learning Topic-Based Mixture Models for Factored Classification," Q. Chen and T. M. Mitchell, *Proceedings of the International Conference on Intelligent Agents, Web Technologies and Internet Commerce - IAWTIC'2005*, IEEE Computer Society, M. Mohammadian (ed.), Vienna, Austria, November 2005, pp. 1114--1120.
29. "Learning to Identify Overlapping and Hidden Cognitive Processes from fMRI Data," R. Hutchinson, T.M. Mitchell, I. Rustandi, *11th Conference on Human Brain Mapping*, June, 2005.
30. "Predicting Dire Outcomes of Patients with Community Acquired Pneumonia," G.F.Cooper, V. Abraham, C. F. Aliferis, J M. Aronis, B. G. Buchanan, R. Caruana, M. J. Fine, J. E. Janosky, G. Livingston, T. Mitchell, S. Montik, and P. Spirtes, *Journal of Biomedical Informatics*, 38, 2005, pp. 347-366.
31. "Detecting Significant Multidimensional Spatial Clusters," D.Neill, A. Moore, F. Pereira, T.M. Mitchell, *Neural Information Processing Systems*, December, 2004.
32. "Learning to Decode Cognitive States from Brain Images," T.M. Mitchell, R. Hutchinson, R.S. Niculescu, F.Pereira, X. Wang, M. Just, and S. Newman, *Machine Learning*, Vol. 57, Issue 1-2, pp. 145-175, October, 2004.
33. "Inferring Ongoing Activities of Workstation Users by Clustering Email," Y. Huang, D. Govindaraju, T. M. Mitchell, *First Conference on Email and Anti-Spam, CEAS2004*, Mountain View, CA, July 2004.

34. "Learning to Classify Email into Speech Acts," W. Cohen, Vi. R. Carvalho, and T. M. Mitchell, *Proceedings of the Conference on Empirical Methods in Natural Language Processing*, Barcelona, July 2004.
35. "Training fMRI Classifiers to Detect Cognitive States across Multiple Human Subjects ," X. Wang, R. Hutchinson, and T. M. Mitchell, *Neural Information Processing Systems*, Vancouver, December 2003.
36. "Classifying Instantaneous Cognitive States from fMRI Data," T. Mitchell, R. Hutchinson, M. Just, R.S. Niculescu, F. Pereira, X. Wang, *American Medical Informatics Association Annual Symposium*, Washington D.C., November 2003. *received 'Best Foundational Paper' award.*
37. "Distinguishing Natural Language Processes on the Basis of fMRI-measured Brain Activation," F. Pereira, M. Just, T. Mitchell, *PKDD 2001*, Freiburg, Germany, 2001.
38. "Discovering test set regularities in relational domains," S. Slattery and T.M. Mitchell. *Proceedings of the 17th International Conference on Machine Learning (ICML-00)*, pp. 895-902, Morgan Kaufmann, 2000.
39. "Predicting Caesarean Section with Decision Trees," C. Simms, R. Caruana, M.J. Krohn, L. Meyn, T.M. Mitchell, R.B. Rao, and I. Schmeuking, *Annual Meeting of the Society of Fetal and Maternal Medicine*, February 2000
40. "Machine Learning and Data Mining," T. Mitchell, *Communications of the ACM*, Vol. 42, No. 11, November 1999.
41. "Learning to Construct Knowledge Bases from the World Wide Web," M. Craven, D. DiPasquo, D. Freitag, A. McCallum, T. Mitchell, K. Nigam, and S. Slattery, *Artificial Intelligence*, Elsevier, 1999.
42. "Text Classification from Labeled and Unlabeled Documents using EM," K. Nigam, Andrew McCallum, Sebastian Thrun and Tom Mitchell. *Machine Learning*, Kluwer Academic Press, 1999.
43. "The Role of Unlabeled Data in Supervised Learning," T. Mitchell, *Proceedings of the Sixth International Colloquium on Cognitive Science*, San Sebastian, Spain, 1999 (invited paper). Also appears in *Language, Knowledge, and Representation*, J.M. Larrazabel and L.A. Perez Miranda (eds.), Kluwer Academic Publishers, pp. 97-104, (2002).
44. "Combining Labeled and Unlabeled Data with Co-Training," A. Blum and T. Mitchell, *Proceedings of the 1998 Conference on Computational Learning Theory*, July 1998. *Received 10-Year Best Paper Award at ICML/COLT in 2008.*
45. "Improving Text Classification by Shrinkage in a Hierarchy of Classes," A. McCallum, R. Rosenfeld, T. Mitchell and A. Ng. *Proceedings of the 1998 International Conference on Machine Learning*. July 1998.
46. "Learning to Extract Symbolic Knowledge from the World Wide Web," M. Craven, D. DiPasquo, D. Freitag, A. McCallum, T. Mitchell, K. Nigam, and S. Slattery, *Proceedings of the 1998 National Conference on Artificial Intelligence*, July 1998.
47. "Learning to Classify Text from Labeled and Unlabeled Documents," A. McCallum, K. Nigam, S. Thrun, and T. Mitchell, *Proceedings of the 1998 National Conference on Artificial Intelligence*, July 1998.
48. "Data Mining at CALD-CMU: Tools, Experiences and Research Directions" C. Faloutsos, G. Gibson, T. Mitchell, A. Moore, S. Thrun, *First Federal Data Mining Symposium*, Washington, D.C., December 1997.
49. "Does Machine Learning Really Work?," T. Mitchell, Invited paper, *AI Magazine*, Vol. 18, Number 3, AAAI Press, Fall 1997, p.11-20.
50. "WebWatcher: A Tour Guide for the World Wide Web," T. Joachims, D. Freitag, and T. Mitchell, *Proceedings of the 1997 IJCAI*, August 1997.
51. "Learning to Extract Symbolic Knowledge from the World Wide Web," M. Craven, D. Freitag, A. McCallum, T. Mitchell, K. Nigam, C.Y. Quek, Internal Report, January 1997.

52. "Improving Learning Accuracy in Information Filtering," H.C.M. de Kroon, T.M. Mitchell, and E.J.H. Kerckhoffs, Workshop on ML and HCI affiliated with the 1996 International Conference on Machine Learning, Bari, Italy, July 1996.
53. "The Prospective Student's Introduction to the Robot Learning Problem," U. Nehmzow, and T.M. Mitchell, Technical Report UMCS-95-12-6, Computer Science Dept., Univ. of Manchester, December 1995.
54. "An Evaluation of Machine-Learning Methods for Predicting Pneumonia Mortality," G. Cooper, C. Aliferis, R. Ambrosino, J. Aronic, B. Buchanan, R. Caruana, M. Fine, C. Glymour, G. Gordon, B. Hanusa, J. Janosky, C. Meek, T. Mitchell, R. Richardson, and P. Spirtes, *Artificial Intelligence in Medicine*, 1997.
55. "Lifelong Robot Learning," S. Thrun and T.M. Mitchell, in *Robotics and Autonomous Systems*, 15, pp. 24-46, 1995.
56. "Using the Future to Sort Out the Present: Rankprop and Multitask Learning for Medical Risk Analysis," R. Caruana, S. Baluja, and T. Mitchell, *Neural Information Processing* 7, December 1995.
57. "WebWatcher: Machine Learning and Hypertext," T. Joachims, R. Armstrong, D. Freitag, and T. Mitchell, German Workshop on Machine Learning, May 1995.
58. "Explanation Based Learning for Mobile Robot Perception", J. O'Sullivan, T. Mitchell, and S. Thrun, in *Symbolic Visual Learning*, Ikeuchi and Veloso (eds.), 1996.
59. "WebWatcher: A Learning Apprentice for the World Wide Web", R. Armstrong, D. Freitag, T. Joachims, and T. Mitchell, in 1995 AAAI Spring Symposium on Information Gathering from Heterogeneous, Distributed Environments, March 1995.
60. "Learning One More Thing", S. Thrun and T.M. Mitchell, *Proceedings of IJCAI 1995*, Montreal, August, 1995. A longer version is available as Carnegie Mellon School of Computer Science Technical Report CMU-CS-94-184, September, 1994.
61. "Learning Analytically and Inductively", T. Mitchell and S. Thrun, in *Mind Matters: A Tribute to Allen Newell*, Steier and Mitchell (eds.), Erlbaum, 1995.
62. "Explanation-Based Learning for Mobile Robot Perception", T.M. Mitchell, J. O'Sullivan, and S. Thrun, *Proceedings of the Workshop on Learning Robots*, S. Mahadevan (ed.), July, 1994.
63. "Experience With a Learning Personal Assistant", T.M. Mitchell, R. Caruana, D. Freitag, J. McDermott, and D. Zabowski, *Communications of the ACM*, Vol. 37, No. 7, pp. 81-91, July 1994.
64. "Machine Learning and Human Interface for the CMU Navlab" Chuck Thorpe, Haralabos Athanassiou, Jennifer Kay, Tom Mitchell, and Dean Pomerleau, in Proc. 6th Int. Symposium on Robotics Research, T. Kanade and R. Paul, eds., 1993.
65. "Explanation-Based Learning: A Comparison of Symbolic and Neural Network Approaches", T.M. Mitchell and S.B. Thrun, *Tenth International Conference on Machine Learning*, Amherst, MA, June 27-29, 1993.
66. "Office Automation Systems that are Programmed by their Users", S. Bocionek and T.M. Mitchell. *23rd Annual Conference of the German Association of Computer Science* (Gesellschaft fur Informatik, GI), Dresden, Germany, September, 1993.
67. "Explanation-Based Neural Network Learning for Robot Control", T.M. Mitchell and S.B. Thrun, *Advances in Neural Information Processing Systems 5*, Hanson, Cowan, and Giles (eds.), Morgan-Kaufmann Press, 1993, pp. 287-294.
68. "The Engineering Design Research Center of Carnegie Mellon University", G.H. Demes, S.J. Fenves, I.E. Grossmann, C.T. Hendrickson, T.M. Mitchell, F.B. Prinz, D.P. Siewiorek, E. Subramanian, S. Talukdar, A. Westerberg, *Proceedings of the IEEE*, Special Issue on Engineering Research Centers, Invited paper, Vol. 81, No. 1, pp. 10-24, January, 1993.
69. "Integrating Inductive Neural Network Learning and Explanation-Based Learning", Thrun, S., and Mitchell, T.M., *Proceedings of the 1993 International Joint Conference on Artificial Intelligence*, August 1993.

70. "A Personal Learning Apprentice", Dent, L., Boticario, J., McDermott, J., Mitchell, T., and Zabowski, D., *1992 National Conference on AI*, July, 1992.
71. "Memory Approaches to Reinforcement Learning in Non-Markovian Domains", L.J. Lin and T.M. Mitchell, Carnegie Mellon School of Computer Science Technical Report CMU-CS-92-138, May 1992.
72. Using EBG to Simulate Human Learning from Examples and Learning by Doing, Qin, Y., Mitchell, T., and H. Simon, *Proceedings of the Florida AI Research Symposium*, April 1992, pp. 235-239.
73. "The MONK's Problems: A Performance Comparison of Different Learning Algorithms", S. Thrun, et al., Carnegie Mellon School of Computer Science Technical Report CMU-CS-91-197, December 1991.
74. "An Apprentice-Based Approach to Knowledge Acquisition", Mahadevan, S., Mitchell, T., Mostow, D.J., Steinberg, L., Tadepalli, P., *Artificial Intelligence* Vol 64, No. 1, (November 1993), pages 1-52. Also Rutgers University Computer Science Technical Report, August, 1991.
75. "Interfaces that Learn: A Learning Apprentice for Calendar Management", Jourdan, J., Dent, L., McDermott, J., Mitchell, T., and D. Zabowski, in *Machine Learning Methods for Planning and Scheduling*, S. Minton (ed.), Morgan-Kaufmann Press, 1992. A preliminary version of this paper appears as Carnegie Mellon School of Computer Science Technical Report CMU-CS-91-135, May 1991.
76. "Plan-Then-Compile Architectures", T.M. Mitchell, *Proceedings of the AAAI Spring Symposium on Integrated Intelligent Architectures*, Stanford University, March 1991.
77. "Learning Robots", T.M. Mitchell, *Proceedings of the 1990 Australian National Conference on Artificial Intelligence*, November, 1990.
78. "Becoming Increasingly Reactive", T.M. Mitchell, *1990 National Conference on AI*, Cambridge, MA, August, 1990.
79. "Learning Reliable Manipulation Strategies without Initial Physical Models", A. Christiansen, M. Mason, and T.M. Mitchell, *Robotics and Autonomous Systems*, vol. 8, pp. 7-18, 1991. (Reprinted from *Proceedings of the IEEE International Conference on Robotics and Automation*, May, 1990).
80. "Embedding Learning in a General Frame-Based Architecture", T. Tanaka and T.M. Mitchell, *International Journal of Pattern Recognition and Artificial Intelligence*, Vol. 4, No. 2, pp. 125-145, June 1990. An earlier version of this paper appeared in *Proceedings of the IEEE International Workshop on Tools for Artificial Intelligence '89*, IEEE Computer Society Press, George Mason University, October 1989, pp. 77-84.
81. "Machine Learning", T. Mitchell, B. Buchanan, G. DeJong, T. Dietterich, P. Rosenbloom, A. Waibel, *Annual Review of Computer Science*, vol. 4, 1990, pp. 417-433.
82. "Justification-Based Refinement of Expert Knowledge", J.C. Schlimmer, T.M. Mitchell, and J. McDermott, in G. Piatetsky-Shapiro and W. Frawley (Eds.), *Knowledge Discovery in Databases*, AAAI Press, pp. 397-410, 1991. (an earlier version appears in *Proceedings of the Workshop on Knowledge Discovery in Databases*, workshop held in conjunction with IJCAI-89, Detroit, MI, August 1989.)
83. "On Becoming Reactive", J. Blythe and T.M. Mitchell, *Proceedings of the 6th International Workshop on Machine Learning*, Cornell University, June, 1989.
84. "Experiments in Robot Learning", M.T. Mason, A.D. Christiansen, and T.M. Mitchell, *Proceedings of the 6th International Workshop on Machine Learning*, Cornell University, June, 1989, pp. 141-145.
85. "A Task Control Architecture for Mobile Robots", R. Simmons and T. Mitchell, in *Proceedings of the 1989 AAAI Spring Symposium on Robot Navigation*, Palo Alto, March, 1989.
86. "A Comparative Analysis of Chunking and Decision-Analytic Control", O. Etzioni and T. Mitchell, in *Proceedings of the 1989 AAAI Spring Symposium on Limited Rationality and Artificial Intelligence*, Palo Alto, March, 1989.

87. "A Case Study in Robot Exploration", L. Lin, A. Philips, T.M. Mitchell, R. Simmons, Robotics Institute Technical Report CMU-RI-89-001, CMU, January 1989.
88. "An Autonomous Rover for Exploring Mars", J. Bares, M. Hebert, T. Kanade, E. Krotkov, T. Mitchell, R. Simmons, W. Whittaker, *IEEE Computer*, Special Issue on Autonomous Intelligent Machines, June, 1989 pp18-26.
89. "Theo: A Framework for Self-Improving Systems", Tom M. Mitchell, John Allen, Prasad Chalasani, John Cheng, Oren Etzioni, Marc N. Ringuette, Jeffrey C. Schlimmer, in "Architectures for Intelligence", K. Vanlehn (ed.), Lawrence Erlbaum Associates, New Jersey, 1991, pp. 323-356.
90. "Toward a Learning Robot", T.M. Mitchell, M.T. Mason, and A.D. Christiansen, "Proceedings of the Workshop on Representation and Learning in an Autonomous Agent", Portugal, November 1988. (written January 1988). (also CMU Computer Science Technical Report CMU-CS-89-106 January, 1989).
91. "Machine Learning and Planning in Reactive Environments", J. G. Carbonell, M. T. Mason, and T. M. Mitchell, "Proceedings of The Second Annual NASA Artificial Intelligence Research Forum", NASA Ames Research Center, CA, pp. 254-262. November, 1987.
92. "Artificial Intelligence Systems in the Space Station", T. M. Mitchell, Proceedings of the Symposium on Human Factor Needs in Space Station Design, National Academy of Sciences, Washington D.C., January 29-30, 1987.
93. "Progress Toward a Knowledge-Based Aid for Mechanical Design", N.A. Langrana and T.M. Mitchell, ASME Symposium on Integrated Intelligent Manufacturing: Analysis and Synthesis, December 1986.
94. "Explanation-Based Generalization: A Unifying View", T. Mitchell, R. Keller, and S. Kedar-Cabelli, *Machine Learning*, vol. 1, issue 1, January, 1986.
95. "LEAP: A Learning Apprentice for VLSI Design", T. Mitchell, S. Mahadevan, and L. Steinberg, *Ninth International Joint Conference on Artificial Intelligence*, August 1985. Also a chapter in *Machine Learning: An Artificial Intelligence Approach, Vol. III*, Kodratoff and Michalski (eds.), Morgan Kaufmann Press, 1990.
96. "Representation and Use of Explicit Justifications for Knowledge Base Refinement", R.G. Smith, H.A. Winston, T. Mitchell, and B. Buchanan, *Ninth International Joint Conference on Artificial Intelligence*, August 1985.
97. "Learning in Knowledge Base Management Systems", T. M. Mitchell, *On Knowledge Base Management Systems: Integrating Artificial Intelligence and Database Technologies*, J. Mylopoulos and M. Brodie (eds.), Springer-Verlag, 1986.
98. "Learning Improved Integrity Constraints and Schemas from Exceptions in Data and Knowledge Bases", A. Borgida, T.M. Mitchell, and K.E. Williamson. *On Knowledge Base Management Systems: Integrating Artificial Intelligence and Database Technologies*, J. Mylopoulos and M. Brodie (eds.), Springer-Verlag, 1986.
99. "A Knowledge-Based Approach to Design", T. Mitchell, L. Steinberg, and J. Shulman, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, September, 1985. An earlier version of this paper appeared in *Proceedings of the IEEE Workshop on Principles of Knowledge-Based Systems*, Denver, Colorado, December 1984.
100. "A Knowledge-Based Approach to VLSI CAD", L. Steinberg and T. Mitchell, in *Proceedings of the 21st Design Automation Conference*, IEEE and ACM, Albuquerque, New Mexico, June 1984 (received Best Paper Award). A slightly modified version of this paper appeared subsequently in *IEEE Design and Test*, February, 1985.
101. "Learning and Problem-Solving", T. Mitchell, in *Proceedings of the Eighth International Joint Conference on Artificial Intelligence*, Karlsruhe, Germany, August 1983 (Computers and Thought Award Paper).
102. "Goal-Directed Learning", T. Mitchell and R. Keller, in *Proceedings of the Second International Workshop on Machine Learning*, Allerton, Illinois, June 1983.

103. "An Intelligent Aid for Circuit Redesign", T. Mitchell, L. Steinberg, Smadar Kedar-Cabelli, Van E. Kelly, Jeffrey Shulman, and Timothy Weinrich, in *Proceedings of the Third National Conference on Artificial Intelligence*, Washington D.C., August 1983.
104. "An Overview of Machine Learning", J. Carbonell, R. Michalski, and T. Mitchell, in *Machine Learning*, Michalski, Carbonell, and Mitchell (eds.), Tioga Press, 1983.
105. "Learning by Experimentation: Acquiring and Modifying Problem-Solving Heuristics", T. Mitchell, P. Utgoff, and R. Banerji, in *Machine Learning*, Michalski, Carbonell, and Mitchell (eds.), Tioga Press, 1983, pp.163-190. Also Rutgers Computer Science Department Technical Report LCSR-TR-31.
106. "Constructing an Expert System," B. G. Buchanan, R. Bechtal, J. Bennett, W. Clancey, C. Kulikowski, T. Mitchell, and D. Waterman, in *Building Expert Systems*, F. Hayes-Roth, D. Lenat, and D. Waterman (eds.), Prentice-Hall, 1983.
107. "Learning from Solution Paths: An Approach to the Credit Assignment Problem", D. Sleeman, P. Langley, and T. Mitchell, *AI Magazine*, vol. 3, no. 2, 1982. Also Carnegie Mellon University Department of Psychology CIP Working Paper No. 443.
108. "Data Base Management Systems and Expert Systems for Computer Aided Design", G. Lafue and T. Mitchell, in *Proceedings of the IFIP Working Conference on CAD System Frameworks*, Roros, Norway, June, 1982.
109. "Acquisition of Appropriate Bias for Inductive Concept Learning", P. Utgoff and T. Mitchell, *Proceedings of the Second National Conference on Artificial Intelligence*, Pittsburgh, August, 1982, pp. 414-417.
110. "Toward Combining Empirical and Analytical Methods for Inferring Heuristics," Tom M. Mitchell, in *Artificial and Human Intelligence*, Elithorn and Banerji (eds.), North-Holland, 1984. Also Rutgers Computer Science Department Technical Report LCSR-TR-27, 1981.
111. "Generalization as Search", T.M. Mitchell, *Artificial Intelligence*, Volume 18, No. 2, 1982. Also appears in *Readings in Artificial Intelligence*, Webber and Nilsson (eds.), Tioga Press, 1981, pp. 517-542.
112. "Representations for Reasoning about Digital Circuits", T.M. Mitchell, L. Steinberg, R.G.Smith, P. Schooley, V. Kelly. *Proceedings of the 7th International Joint Conference on Artificial Intelligence*, Aug., 1981, pp. 343-344. Also Rutgers Computer Science Department Technical Report LCSR-TR-11.
113. "Learning Problem-Solving Heuristics by Practice", T.M. Mitchell, P. Utgoff, B. Nudel, R. Banerji, *Proceedings of the 7th International Joint Conference on Artificial Intelligence*, Aug., 1981, pp. 127-134.
114. "Description Languages and Learning Algorithms: A Paradigm for Comparison", R.B. Banerji and T.M. Mitchell, *International Journal of Policy Analysis and Information Systems*, special issue on Knowledge Acquisition and Induction, vol. 4, p. 197, 1980. Also Rutgers Computer Science Department Technical Report CBM-TR-107.
115. "The Need for Biases in Learning Generalizations", T.M. Mitchell, Rutgers Computer Science Department Technical Report CBM-TR-117, May, 1980. Reprinted in *Readings in Machine Learning*, J. Shavlik and T. Dietterich, eds., Morgan Kaufmann, 1990.
116. "Considerations for Microprocessor-Based Terminal Designs" R.G. Smith and T.M. Mitchell, Invited paper, *Proceedings of the Twelfth Annual Asilomar Conference on Circuits, Systems, and Computers*, Pacific Grove, CA, November, 1978. Also Stanford Computer Science Department Technical Report HP-78-22.
117. "Version Spaces: An Approach to Concept Learning", T.M. Mitchell, Ph.D. dissertation, Electrical Engineering Department, Stanford University, December, 1978. Also Stanford Computer Science Department Technical Report STAN-CS-78-711. 204 pages.
118. "Models of Learning Systems", B.G. Buchanan, T.M. Mitchell, R.G. Smith, and C.R. Johnson, in *Encyclopedia of Computer Science and Technology*, Marcel Dekker, Inc., New York, vol. 11, 1978, pp.24-50.

119. "Applications of Artificial Intelligence for Chemical Inference XXV. A Computer Program for Automated Empirical <sup>13</sup>C-NMR Rule Formation", T.M. Mitchell and G.M. Schwenzer, *Organic Magnetic Resonance*, vol. 11, no. 8, 1978, pp. 378-384.
120. "Model-Directed Learning of Production Rules", B.G. Buchanan and T.M. Mitchell, in *Pattern Directed Inference Systems*, D.A. Waterman and F. Hayes-Roth eds., Academic Press, New York, 1978, pp. 297-312. Also Stanford Heuristic Programming Project Memo HPP-77-6, and Stanford Computer Science Department Report No. STAN-CS-77-597.
121. "Version Spaces: A Candidate Elimination Approach to Rule Learning", T.M. Mitchell, *Proceedings of the 5th International Joint Conference on Artificial Intelligence*, Cambridge MA, August 1977, pp. 305-310.
122. "Computer Assisted Structure Elucidation Using Automatically Acquired <sup>13</sup>C-NMR Rules", G.M. Schwenzer and T.M. Mitchell, in *Computer Assisted Structure Elucidation*, American Chemical Society Symposium Series, Volume 54, D. H. Smith editor, Washington D.C., 1977, pp. 58-76.