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Dynamical & Evolutionary Machine Organization
(DEMO)

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Full Curriculum Vita

Highlights of my career at Brandeis:

- Founded an internationally known Lab in AI/ALife (DEMO laboratory);
- \$3M in new Grants, including a DARPA ITE Grant;
- 16 refereed journal articles including one in Nature, which made headline news;
- 56 refereed conference papers;
- 8 new Ph.D's, all gainfully employed
- Covered by NY Times, Scientific American Frontiers, Wired, Slashdot, etc.
- Named one of MIT Technology Review's "TR 10" in 2001.

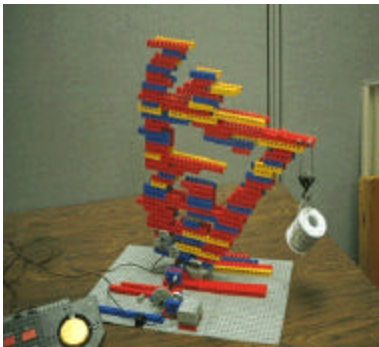


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BASIC DATA

Personal

Born: 19 July 1957
Citizenship: United States
Married, Two Children

Education

1987	Ph.D	Computer Science University of Illinois Urbana-Champaign “On Connectionist Models of Natural Language Processing”
1978	B.S.	Mathematics State University of New York Binghamton “On Tiling Rectangles with Dominos”

Honors

1984-1986	IBM Graduate Fellowship
2001	MIT Technology Review “TR 10”

Employment History

Oct 2004-	Full Professor Computer Science & Complex Systems Brandeis University
Oct 1994 -Sep2004	Associate Professor Computer Science & Complex Systems Brandeis University
Jul 1988 - Sep 1994	Assistant Professor Computer & Information Science The Ohio State University
Jun 1986 - Jun 1988	Research Scientist Computing Research Laboratory New Mexico State University
Jun 1984 - Aug 1984	AI Consultant Hewlett Packard Laboratories Palo Alto, California
Jan 1978 - Jul 1980	Associate Programmer IBM Federal Systems Division Owego, New York

Research and Teaching Areas

- Computer Programming
- Artificial Intelligence
- Machine Learning
- Neural and Evolutionary computation
- Artificial Life
- Dynamical Systems
- Intellectual Property
- Educational Technology
- Internet and Society

NARRATIVE STATEMENTS

Summary of Research Accomplishments

After tenure, I became convinced that even when based on brain-like systems rather than computer programs, a cognitive model would be incomplete without an evolutionarily plausible explanation for its origin. This means that the components, representations, and mechanisms proposed as part of a model must be evolvable, and simulated evolutionary models could provide evidence towards the reality of our cognitive theories. But there were no evolutionary models producing the kind of open-ended complexity of brain-like structures necessary to compete with human software engineering. Thus the central question of my research of the last decade became the quest to organize an artificial process which could mimic, electronically, the fundamental evolutionary processes of life itself, resulting in automatically designed systems that are complex enough to be competitive with human designed systems.

The most primitive definition of life is a chemical reaction that dissipates energy and creates a local reversal of entropy. So a definition of “Artificial Life” is a process that dissipates computational energy, and gets more organized, and smarter over time. If we really can get it right, and have enough computer time to spare (which Moore’s law predicts we shall), then the resulting self-organized systems could provide a source for evolutionarily plausible models for cognition, as well as be competitive with programmed AI models, which have many beneficent applications.

Through my tenure at Brandeis, my students and I have published a series of papers around a core theme, called “Co-evolutionary Learning” in the scholarly conferences and journals of Artificial Life and sister fields like machine learning, evolution, and theoretical biology. While developing better theories for open-ended self-learning systems, we solved specific optimization and design problems, in game playing, automata, and processes like sorting and classification. Most famously, we developed our co-evolutionary insights into three generations of automatically designed robots, where the body and brain are co-adapted simultaneously. By combining our evolutionary designs with computer-aided-manufacturing, we demonstrated the first robotic system that designed and manufactured another robot. We have made 3 generations of these systems, proving that the evolution of robots is not pure science fiction.

Ongoing Research

My research work going forward is very exciting. Work on evolutionary robots continues, focused on modular and reusable forms using generative representations and modular mechanical components for assembly. The central question for scaling up the complexity of these efforts revolves around recognizing that designs are not static blueprints, but active process specifications which can overcome the buildup of errors in manufacturing.

Also, we have discovered that evolutionary learning systems organized

according to the “competition” principle cannot make consistent or open-ended progress. Competitively organized systems have dynamics that lead to phenomena like boom and bust cycles, memory loss, and the emergence of equilibria where several mediocre species collude to support each other and exclude innovation. Winner-take-all dynamics lead to a loss of the information gradient necessary for further learning. We have discovered a new “equation” for learning that replaces zero-sum competition and have demonstrated that this equation can lead to populations of self-interested agents who continually assess and challenge each other, maintaining motivation towards open-ended learning. This principle is being captured in a new educational technology we have released as websites, such as www.spellbee.org.

Teaching Statement

Besides the standard undergraduate curriculum in computer science I also teach graduate electives across Machine Learning and Artificial Life. I have also turned my interest in intellectual property into a seminar which is open to freshman.

I also contribute teaching through web based activities, such as the online Backgammon, Tron, and SpellBee.org from my Lab, as well as free Pokemon® literacy games which thousands of children have downloaded. My feeling is that the best educational software systems will not be general purpose AI based teachers, but will be environments where children spend millions of collective hours learning, and it is important to provide alternatives to the shoot-em-up fare of video consoles. A million hours is all that an entire town’s school system can deliver with a \$10M budget. Could one webserver also deliver a million hours?

Service

I have served my department in roles such as seminar chair, computer facilities chair, Graduate Admissions, and representative to the Volen Center. I have been on the university IP committee as well as the founding committee for the Rabb school of Continuing studies. I took a lead role in envisioning a more significant future for information technology research at Brandeis, which was presented to President Reinharz. In 2002 I participated in the University’s interdisciplinary seminar on Concilience. When asked, I routinely speak at Alumni, Trustee, development, BNWC and Bali events for the University. I also engage in service to my scientific communities, most notably on editorial boards and organizing major conferences.

Industrial Activities

I have made many contacts within the Boston Area “High Technology” communities, mainly in Software and Telecommunications. I served as “Chief Scientist” to **Abuzz** Technology, which was an enterprise/internet startup during my last sabbatical in 97-98. I am asked to be on various advisory boards, which I evaluate individually; Currently I serve on the advisory board of **Affinnova**. In 1999, I patented an idea (which was released by Brandeis) and started my own company **Thinmail**. Recently, the university released another invention, **Nannon**, which I am seeking to license.

PUBLICATIONS

Refereed Articles

- J30: Ficici, S & J. B. Pollack (Submitted) A Game-Theoretic and Dynamical-Systems Analysis of Selection Methods in Coevolution, IEEE Trans on Evolutionary Computation.
- J29: DeJong, E. D. & J. B. Pollack (2003). Multi-objective methods for Tree Size Control. Genetic Programming and Evolvable Machines, 4,211-233
- J28: De Jong, E.D. and J.B. Pollack (in press). Principled Evaluation in Coevolution, Evolutionary Computation.
- J27: Pollack, J.B, Hornby, G. S, and Lipson H. (2003) "Computer Creativity in the Automatic Design of Robots, LEONARDO Vol. 36, No. 2, 115-121
- J26: Hornby, G. S. and Pollack, J. B. (2002) Creating High-level Components with Generative Representation for Body-Brain Evolution. Artificial Life 8,3. 223-246
- J25: Hornby G. S., Lipson H., Jordan B. Pollack J. B., (2003) "Generative Encoding for Automated Design of Modular Physical Robots" IEEE Transactions on Robotics and Automation, 19, 4, 1-19.
- J24: Melnik, O, and Pollack, J. B. (2002) Theory and Scope of Exact Representation Extraction from Feed-Forward Networks, Journal of Cognitive Systems Research.3, 2, 203-226.
- J23 Lipson, H., Pollack J. B., Suh N. P., (2002) "On the evolution of modularity", Evolution, 56/ 8, pp. 1549-1556
- J22: Watson, Richard A., Ficici, Sevan G. and Pollack, Jordan B. (2002). "Embodied Evolution: Distributing an Evolutionary Algorithm in a Population of Robots", Journal of Robotics and Autonomous Systems, 39, 1-18.
- J21: Watson RA & Pollack JB, (2002) "The Major Evolutionary Transitions, Symbiotic Composition, and Implications for Evolvability", Biosystems, Volume 69, Issues 2-3, Pages 187-209.
- J20: Pollack J. B., Lipson H., Funes P., Hornby G., 2001, "Three Generations of Coevolutionary Robotics", Artificial Life 7,3.
- J19: Lipson H., Pollack J. B., 2000, "Automatic design and Manufacture of Robotic Lifeforms", Nature 406, pp. 974-978
- J18: Elizabeth Sklar and Jordan B. Pollack (2000). A Framework for Enabling an Internet Learning Community. Journal of Educational Technology & Society 3, 3, pages 393-408

- J17: Hugues Juille and Jordan B. Pollack, (2000) "Coevolutionary Learning and the Design of Complex Systems" in *Advances in Complex Systems*, pp.371-393.
- J16: Pollack, J. B. & Blair A. (1998). Co-Evolution in the Successful Learning of Backgammon Strategy. *Machine Learning*, 32, 225-240.
- J15: Funes, P & Pollack, J. B (1998). Evolution of modular structures: Steps towards adaptive robot bodies. *Artificial Life*, 4, 336-357.
- J14: Pollack J. B. & A Blair. (1997) What makes a good co-evolutionary learning environment? *Australian Journal of Intelligent Information Processing Systems*. 4, 3, 166-175.
- J13: Blair A. & Pollack, J. B. (1997) "Precise Analysis of Dynamical Recognizers", *Neural Computation*, 9, 1127-1142.
- J12: Kolen, J. F. & Pollack, J. B. (1995) The Observer's Paradox: Apparent computational complexity in physical systems *J Experimental and Theoretical AI*, 7, 253-277.
- J11: Large, E. W., C. Palmer, & J.B. Pollack (1995) "Reduced Memory Representations for Music, *Cognitive Science*, 19,1,53-96..
- J10: P. Angeline, G. Saunders, & J. Pollack (1994) An evolutionary algorithm that constructs recurrent networks, *IEEE Trans. on Neural Networks*, 5, 54-65.
- J9: Pollack, J. B. (1992) On Wings of Knowledge: A review of Newell's *Unified Theories of Cognition*, *Artificial Intelligence*. 59, 355-369 .
- J8: Pollack, J.B. (1991) The Induction of Dynamical Recognizers. *Machine Learning*, 7, 227-252.
- J7: Pollack, J. B. (1990). Recursive Distributed Representations. *Artificial Intelligence* 46, 1, 77-105.
- J6: Kolen J. F. & Pollack, J. B. (1990) Back-Propagation is Sensitive to Initial Conditions *Complex Systems*, 4,3, 269-280.
- J5: Pollack, J. B. (1989). No Harm Intended: A Review of the *Perceptrons expanded edition*. *Journal of Mathematical Psychology*, **33, 3, 358-365**.
- J4: Pollack, J. B. (1989). Connectionism: Past, Present, and Future. *Artificial Intelligence Review*, **3, 3-20**.
- J3: Pollack, J. B. (1988). High-Level Connectionist Models. *Artificial Intelligence Magazine*, **9, 4, 65-69**.
- J2: Waltz, D. L. & Pollack, J. B. (1985). Massively Parallel Parsing: A Strongly Interactive Model of Natural Language Interpretation. *Cognitive Science*, **5, 51-74**.

J1: Klarner, D. A. & Pollack, J. B. (1980). Domino Tilings of Rectangles with Fixed Width. *Discrete Mathematics*, **32**, 45-52.

Books

B1: Barnden, J. A. & Pollack, J. B. (Eds.) (1991) HIGH-LEVEL CONNECTIONIST MODELS: Advances in Connectionist and Neural Computational Theory. Norwood, NJ: Ablex

B2: Maes, Mataric, Meyer, Pollack, & Wilson (Eds) (1996) From Animals to Animats 4: Proceedings of the international conference on simulation of adaptive behavior. Cambridge: MIT Press.

B3: Pollack, Bedau, Husbands, Ikegami, Watson (Eds) (2004) Artificial Life: Proceedings 9th International Conference. MIT Press

Refereed Conference Proceedings

C86: Pollack, J. B (Submitted) "A Nano backgammon game for Machine Learning Research" Proceedings 2005 Int'l Conference Computational Intelligence in Games

C85: Viswanathan, S. and Pollack, J.B. (2004) Analysis of substrates for contingent development. Proceedings 9th International Conference on Artificial Life, MIT Press.

C84: Bader-Nadal, A., & Pollack, J.B. A population differential method of monitoring success and failure in Coevolution. (2004) Proceedings of the 2004 Genetic and Evolutionary Computation Conference, Springer Verlag.

C83: Bucci, A., Pollack, J.B. and De Jong, E.D. (2004). Automated Extraction of Problem Structure. Proceedings of the 2004 Genetic and Evolutionary Computation Conference, Springer Verlag.

C82: Rieffel, J., & Pollack, J. B (2004) The emergence of ontogenetic scaffolding in a stochastic development environment. Proceedings 2004 Genetic and Evolutionary Computation Conference, Springer-Verlag.

C81: Ficici, S, & Pollack, J. B. (2003) A Game-Theoretic Memory Mechanism for Coevolution. Proceedings of the 2003 Genetic and Evolutionary Computation Conference, Springer Verlag, 2003

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C79: Bucci, A. and Pollack, J.B. (2003). Focusing versus Intransitivity: Geometrical Aspects of Co-evolution. Proceedings of the 2003 Genetic and Evolutionary Computation Conference, Springer Verlag, 2003.

C78: Dejong, E. and Pollack J.B (2003) Learning the Ideal Evaluation Function,

Proceedings of the 2003 Genetic and Evolutionary Computation Conference, Springer Verlag, 2003.

- C77: Levy, Simon D. and Pollack, Jordan B. (2003). Escape the Building-Block / Rule Dichotomy: A Case Study. AAI Spring Symposium on Computational Synthesis.
- C76: Bucci, A. and Pollack, J.B. (2002). A Mathematical Framework for the Study of Coevolution. Foundations of Genetic Algorithms 7. Proceedings of FOGA VII, Torremolinos Spain..
- C75: Bucci, A. and Pollack, J.B. (2002). Order-theoretic Analysis of Coevolution Problems: Coevolutionary Statics. 2002 Genetic and Evolutionary Computation Conference Workshop: Understanding Coevolution.
- C74: Hornby G. S & Pollack, J. B (2001) Body-Brain Coevolution using L-systems as an generative Encoding. In GECCO-2001: Proceedings of the Genetic and Evolutionary Computation Conference. Spector, L, et al, editors. Morgan Kaufmann, 2001.
- C73: Hornby G. S & Pollack, J. B (2001) Evolving L-Systems to generate virtual creatures. (2001) Computers & Graphics 25,1041-1048 (SIGGRAPH)
- C72: Hornby G. S. & Pollack, J. B. (2001). The advantages of Generative Grammatical Encoding for Physical Design. Congress on Evolutionary Computation, 600-607
- C71: Hornby G. S, Lipson, H, and Pollack J. B. (2001). Evolution of generative design systems for modular physical robots. IEEE conf on robotics and automation, 3040-3045.
- C70: Watson RA & Pollack JB, 2001, "Symbiotic Composition and Evolvability", in Proceedings of European Conference on Artificial Life (ECAL 2001). Jozef Kelemen (ed.), Springer, 2001. *best student paper*
- C69: Watson RA & Pollack JB, 2001, "Coevolutionary Dynamics in a Minimal Substrate", in GECCO-2001: Proceedings of the Genetic and Evolutionary Computation Conference. Spector, L, et al, editors. Morgan Kaufmann, 2001.
- C68: De Jong, E.D. and Pollack, J.B. (2001). Utilizing Bias to Evolve Recurrent Neural Networks. Proceedings of the International Joint Conference on Neural Networks 2001, vol.4, pp. 2667-2672.
- C67: De Jong, E.D., Watson, R.A., and Pollack, J.B. (2001). Reducing Bloat and Promoting Diversity using Multi-Objective Methods. Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2001, pp. 11-18.
- C66: Pollack J. B., Lipson H., Funes P., Hornby G., 2001, "Three Generations of Coevolutionary Robotics", in Gomi (ed) Evolutionary Robotics From Intelligent Robots to Artificial Life. Tokyo: Springer.
- C65: Lipson, H., Pollack J. B., Suh N. P., 2001, "Promoting Modularity In Evolutionary Design", Proceedings of DETC'01 2001 ASME Design Engineering Technical Conferences, September 9-12, 2001, Pittsburgh, Pennsylvania, USA.

- C64: Levy, S. and Pollack, J. (2001). Infinite RAAM: A Principled Connectionist Substrate for Cognitive Modeling. ICCM2001, Lawrence Erlbaum Associates.
- C63: Levy, S. and Pollack, J.B. (2001). Logical Computation on a Fractal Neural Substrate. IJCNN 2001, IEEE press
- C62: Watson, R.A. and Pollack, J.B. (2000). "Recombination Without Respect: Schema Combination and Disruption in Genetic Algorithm Crossover", Proceedings of the 2000 Genetic and Evolutionary Computation Conference, Whitley, D., et al (eds.), Morgan Kaufmann, 2000.
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- C60: Watson, R.A. and Pollack, J.B. (2000). "Symbiotic Combination as an Alternative to Sexual Recombination in Genetic Algorithms", Proceedings of Parallel Problem Solving from Nature (PPSNVI), Marc Schoenauer, Kalyanmoy Deb, Guenter Rudolph, Xin Yao, Evelyne Lutton, Juan Julian Merelo, Hans-Paul Schwefel (Eds.), 2000. Springer Verlag.
- C59: Levy, S., Melnik, O. and Pollack, J.B. (2000). Infinite RAAM: A Principled Connectionist Basis for Grammatical Competence. COGSCII 2000, IEEE press .
- C58: Melnik, O. and Pollack, J.B. (2000). Using Graphs to Analyze High-Dimensional Classifiers . IJCNN 2000, IEEE press, Presented at Montreal Workshop on Selecting and Combining Models with Machine Learning Algorithms .
- C57: Melnik, O. and Pollack, J.B. (2000). Exact Representations from Feed-Forward Networks . IJCNN 2000, IEEE press
- C56: Melnik, O., Levy, S. and Pollack, J.B. (2000). RAAM for Infinite Context-Free Languages. IJCNN 2000, IEEE press .
- C55: Lipson, H. and Pollack J. B., 2000, "Towards Continuously Reconfigurable Self-Designing Robotics", IEEE conference on Robotics and Automation (ICRA2000)
- C54: Lipson, H. and Pollack J. B., 2000, "Evolving Physical Creatures", in Proceedings of Artificial Life VII (ALIFE7), (Eds.) M. A. Bedau, J. S. McCaskill, N. H. Packard, S. Rasmussen, Portland, OR, pp. 282-287
- C53: Lipson, H. and Pollack J. B., 2000, "Evolution of physical machines", Proceedings of 6th International Conference on Artificial Intelligence in Design, AID'00, pp. 269-285, 26-29 June 2000, Worcester Polytechnic Institute, Worcester, Massachusetts, USA
- C52: Lipson, H. and Pollack J. B., 2000, "Towards fully automated design and manufacturing", Proceedings of International CIRP Design Seminar (DN2000), Haifa, Israel
- C51: Hornby, G. S, Takamura, S. Hanagat, O, Fujita, M. and Pollack, J. (2000) Evolution of controllers from a high level simulaotr to a high DOF robot. Third Intl

- conference on evolvable systems, 80-89.
- C50: Pollack J. B., Lipson H., 2000, "The GOLEM Project: Evolving Hardware Bodies and Brains", The Second NASA/DoD Workshop on Evolvable Hardware, July 13-15, 2000, Palo Alto, California, USA
- C49: Ficici, Sevan G., Melnik, Ofer and Pollack, Jordan B. (2000). A Game-Theoretic Investigation of Selection Methods Used in Evolutionary Algorithms. Proceedings of the 2000 Congress on Evolutionary Computation, A. Zalzal, et al, (eds.), IEEE Press,
- C48: Jordan B. Pollack, Hod Lipson, Sevan Ficici, Pablo Funes, Greg Hornby, Richard A. Watson, 2000, "Evolutionary Techniques in Physical Robotics", Third International Conference on Evolvable Systems: From Biology to Hardware (ICES2000)
- C47: Watson, R.A. and Pollack, J.B. (1999). "Incremental Commitment in Genetic Algorithms", Proceedings of 1999 Genetic and Evolutionary Computation Conference (GECCO 99). Banzhaf, Daida, Eiben, Garzon, Honavar, Jakiela, Smith, eds., Morgan Kaufmann, pp.710-717.
- C46: Watson, R.A. and Pollack, J.B. (1999). "How Symbiosis Can Guide Evolution", Fifth European Conference on Artificial Life, Dario Floreano, Jean-Daniel Nicoud, Francesco Mondada, eds. Springer, 1999.
- C45: Watson, R.A. and Pollack, J.B. (1999). "Hierarchically-Consistent Test Problems for Genetic Algorithms", Proceedings of 1999 Congress on Evolutionary Computation (CEC 99). Angeline, Michalewicz, Schoenauer, Yao, Zalzal, eds. IEEE Press, pp.1406-1413.
- C44: Watson, Richard A., Ficici, Sevan G. and Pollack, Jordan B. (1999). "Embodied Evolution: Embodying an Evolutionary Algorithm in a Population of Robots", 1999 Congress on Evolutionary Computation, Angeline, Michalewicz, Schoenauer, Yao, Zalzal, eds. IEEE Press, 335-342.
- C43: Ficici, Sevan G., Watson, Richard A. and Pollack, Jordan B. (1999). "Embodied Evolution: A Response to Challenges in Evolutionary Robotics". Eighth European Workshop on Learning Robots. Jeremy L. Wyatt, John Demiris, eds., 14-22.
- C42: Watson, Richard A. , Hornby, G. S. and Pollack, J. B. (1998). "Modeling Building-Block Interdependency", Parallel Problem Solving from Nature, proceedings of Fifth International Conference /PPSN V, Springer 1998, pp.97-106.
- C41: Pollack, Jordan B., Lipson, Hod, Funes, Pablo, Ficici, Sevan G. and Hornby, Greg (1999). "Coevolutionary Robotics", The First NASA/DoD Workshop on Evolvable Hardware (EH'99). John R. Koza, Adrian Stoica, Didier Keymeulen, Jason Lohn, eds., IEEE Press
- C40: Paul J. Darwen and Jordan B. Pollack, "Co-Evolutionary learning on noisy tasks" Congress on Evolutionary Computation (CEC-99), pages 1724-1731, July 1999, IEEE Press..
- C39: Juille, H. Pollack J.B. , (1998) A Sampling-Based Heuristic for Tree Search Applied

- to Grammar Induction. Proceedings of the Fifteenth National Conference on Artificial Intelligence (AAAI-98), Madison, Wisconsin, USA, July 26-30, 1998.
- C38: Juille, H. and Pollack, J. B. (1998) Coevolving the "Ideal" Trainer: Application to the Discovery of Cellular Automata Rules. Proceedings of the Third Annual Genetic Programming Conference (GP-98), Madison, Wisconsin, USA, July 22-25, 1998.
- C37: Funes, P., Sklar, E, Juille, H and Pollack, J (1998) Animal-Animat Coevolution: Using the Animal Population as Fitness Function. From Animals to Animats 5: Proceedings of the Fifth International Conference on Simulation of Adaptive Behavior. Pfeifer, Blumberg, Kobayashi, eds MIT Press
- C36: Juille H., & Pollack, J. B. (1998) "Coevolutionary Learning: a Case Study" Int'l conference on Machine Learning.
- C35: Ficici, S. & Pollack, J. (1998) "Challenges in Coevolutionary Learning: Arms-Race Dynamics, Open-Endedness, and Mediocre Stable States." Proceedings of the Sixth International Conference on Artificial Life. Adami, Belew, Kitano, Talor, eds. Cambridge: MIT Press
- C34: Ficici S., & Pollack, J. (1998) "Coevolving Communicative Behavior in a Linear Pursuer-Evader Game." Proceedings of the Fifth International Conference of the Society for Adaptive Behavior. Pfeifer, Blumberg, Kobayashi, eds. Cambridge: MIT Press
- C33: Juille, H. & Pollack, J. (1998) A stochastic search approach to grammar induction. 1998 International Conference on Grammatical Induction. Springer Verlag.
- C32 Sklar, E, Pollack J, and Blair A (1998) Co-evolutionary learning: machines and humans schooling together. in: G. Ayala, ed., Proceedings of Workshop on Current Trends and Applications of Artificial Intelligence in Education, ITESM, Mexico, 98-105.
- C31: Melnik, O. and Pollack J. B., A Gradient Descent Method for a Neural Fractal Memory. IJCNN 1998, IEEE and INNS.
- C30: Blair A, & Pollack, J. B (1997) Quasi-orthogonal maps for dynamic language recognition Proceedings of the Fourth International Conference on Neural Information Processing, Springer, 1065-1067.
- C29: Funes P. & Pollack J (1997) Evolution of Buildable Structures. Proceedings European Conference on Artificial Life 1997,
- C28: Pollack, J, & Blair A, Why did TD-Gammon Work (In Press), 1996 Conference on Neural Information Processing Systems
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- C26: Saunders, G. M. & Pollack, J. B. (1996) The Evolution of communication schemes of continuous channels. Proceedings 4th International conference on Simulation of

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- C25: Juille, H. & Pollack, J. (1996), Coevolving Intertwined Spirals, Proceedings Evolutionary Programming Conference, MIT Press
- C24: Pollack, J., Blair A., & Land, M, Coevolution of A Backgammon Player (1996) Proceedings Artificial Life V, C. Langton, (Ed), MIT Press
- C23: Kolen, J. F. & Pollack, J. B (1994) Back Propagation without weight transport. Proceedings World Conference on Computational Intelligence.
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- C21: Angeline, P. J., Saunders G. M., and Pollack J. B. (1994) Complete Induction of Recurrent Neural Networks, Proceedings of the Third International Conference on Evolutionary Programming.
- C20: Saunders, G. Angeline P. & Pollack, J. (1994) Structural and Behavioral Evolution of Recurrent Networks. Neural Information Processing Systems Conference 6.
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- C17: Angeline, P. J. & Pollack, J. B. (1993) Competitive environments evolve better solutions to complex problems. Fifth International Conference on Genetic Algorithms. 264-270.
- C16: Angeline, P. J. & Pollack, J. B. (1993) Evolutionary Module Acquisition, Second Evolutionary Programming Meeting, 154-163.
- C15: Stucki, D. S. & J. B. Pollack (1992) Fractal (Reconstructive Analogue) Memory, 14th Annual Cognitive Science Conference, 118-123
- C14: Angeline, P. J., and J. B. Pollack (1992) Evolutionary Induction of subroutines. *14th Annual Cognitive Science Conference, 236-241*
- C13: Saunders, G., Kolen, J, Angeline, P, and Pollack, J. (1992) Additive Modular learning in Preemptrons. 14th Annual Cognitive Science Conference, 1098-1103.
- C12: Kolen J. F., J. B. Pollack (1991) Multi-Associative Memory. 13th Annual Cognitive Science Conference, Chicago, 785-789.
- C11: Large, E., Palmer C, & Pollack, J. (1991) Connectionist Representation of Intermediate Music Structure. Proceedings of the 13th Annual Conference of the Cognitive Science Society. Chicago, 412-417.
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- C09: Kolen J. F. & Pollack, J. B. (1991). Back-Propagation is Sensitive to Initial

- Conditions. *Advances in Neural Information Processing Systems III*. San Mateo: Morgan Kaufmann, 860-867.
- C08: Pollack, J.B. (1990) Language Acquisition via Strange Automata. *Proceedings of the 12th Annual Conference of the Cognitive Science Society*, Cambridge, MA, 678-685.
- C07: Kolen J. F. & Pollack, J. B. (1990). Back-Propagation is Sensitive to Initial Conditions. *Proceedings of the 12th Annual Conference of the Cognitive Science Society*, Cambridge, MA, 868-875.
- C06: Pollack, J. B. (1989) Implications of Recursive Distributed Representations. In *Advances in Neural Information Processing Systems I*, San Mateo: Morgan Kaufmann, 527-536.
- C05: Pollack J. B. (1988) Recursive Auto-Associative Memory: Devising Compositional Distributed Representations. In *Proceedings of the Tenth Annual Conference of the Cognitive Science Society*. Montreal, 33-39.
- C04: Pollack J. B. (1987). Cascaded Back-Propagation on Dynamic Connectionist Networks. In *Proceedings of the Ninth Annual Conference of the Cognitive Science Society*. Seattle, 391-404.
- C03: Pollack J. B. & Waltz, D. L. (1984). Parallel Interpretation of Natural Language. *Proceedings of the International Conference on Fifth Generation Computer Systems*. Tokyo, Japan, November 1984, pp. 686-691.
- C02: Waltz, D. L. & Pollack, J. B. (1984). Phenomenologically Plausible Parsing. *Proceedings of the National Conference on Artificial Intelligence*. Austin, TX, pp. 335-339.
- C01: Pollack, J. B. & Waltz, D. L. (1982). Natural Language Processing Using Spreading Activation and Lateral Inhibition. *Proceedings of the Fourth Annual Conference of the Cognitive Science Society*. Ann Arbor, 50-53.

Patents

- P12: Pollack, J. B. (2004 submitted): Nano version of Backgammon game and method.
- P11: Hornby, G & Pollack, J. B. (2002 Submitted/Withdrawn) "Generative Representations"
- P10: Pollack, J.B. (2000 Submitted) "Email based remote control manipulation of stored files", Submitted
- P9: Pollack, J. B, Sklar, E, & Funes, P (1999) "Communities of evolving learners", Submitted/Withdrawn
- P8: Pollack, J. B, "Networked Attached Email Storage System and Method", 6,505,236
- P7: Funes, P, and Pollack, J. B , Computer apparatus and method for analyzing

structural stability 6,434,492

P6: Pollack, J. B et al “Distributing information to users” 6,578,025

P5: Pollack, J. B J. Stevenson “Adaptive Relevancy System”, 6,546,390

P4: Pollack, J.B., J. Stevenson, A. Rodriguez “Regulating flow of information to users”, 6,571,238

P3: Pollack, J. B, A. Sack (2003) “Dual use email system”, 6,539,385:

P2: Pollack, J. B (1995) Data Input Device & Method, 5,473,346

P1: Pollack, J. B (1994) Data Input Device & Method, 5,361,083.

Other Publications (Essays, Chapters)

O16: Pollack, Jordan (2005, in press) “7 Laws of Robot Ethics,” Wired

O15: Pollack, Jordan (2003) “For \$100B there can be peace” Haaretz, Jan 29th

O14: Pollack, Jordan (2001) “Bomb Computing” Wall Street Journal, Jul 9, 2001

O13: Pollack Jordan (1999) In search of the Perfect License. Legal Times April 1999, p49-51

O12: Pollack, Jordan: A Purl of fluctuating value: IP Magazine, July 1999, p27-29.

O11: Pollack, Jordan B., Lipson, Hod, Ficici, Sevan G., Funes, Pablo, Hornby, Greg and Watson, Richard A. (2001). "Evolutionary Techniques in Physical Robots," in Creative Evolutionary Systems, Peter J. Bentley and David W. Corne (eds). Morgan-Kaufmann, 2001.

O10: Funes, P.J. and Pollack, J.B. (1999) Computer Evolution of Buildable Objects. In Evolutionary Design by Computers. P. Bentley (editor). Academic Press. To appear.

O9: Juille & Pollack, Massively Parallel Genetic Programming, (1996, Advances in GP II, Kinnear & Angeline, Ed. MIT Press

O8: Pollack, J. B. (1995) Induction of Dynamical Recognizers, in R. Port & T. VanGelder (Eds.) *Mind as Motion*, Cambridge:MIT Press

O7: Saunders, G. M. & Pollack, J. B. (1994) The Evolution of communication schemes of continuous channels. Columbus: Ohio State University LAIR Tech report 94-GS-

EVCOMM.

- 06: Pollack, J. B. (1991). Recursive Distributed Representations. in G. Hinton (Ed.) *Connectionist Symbol Processing*. Cambridge: MIT Press. (Reprint)
- 05: Waltz, D. L. & Pollack, J. B. (1989). Massively Parallel Parsing: A Strongly Interactive Model of Natural Language Interpretation. In Waltz D. & Feldman, J (Eds.) *Connectionism: A Cognitive Science Perspective*. Hillsdale: Lawrence Erlbaum. (Reprint)
- 04: Pollack, J. B. & Waltz, D. L. (1986). Interpretation of Natural Language. *BYTE*, **11, 2**, **189-198**.
- 03: Pollack, J. B. (1989). Structured Symbolic Representations in Neural State Vectors. *Fifth Annual Aerospace Applications of Artificial Intelligence Conference, Dayton, OH*.
- 02: Pollack, J. B. (1986) Compositional Ambiguity: A problem for Connectionist Natural Language Processing. First Connectionist Summer School, 242-249
- 01: Pollack, J. B. (1986). Universal Neural Networks. Proceedings of the Second New Mexico Computer Science Conference. Las Cruces, NM, pp. 37-45.

PROFESSIONAL ACTIVITIES

Manager	NEUROPROSE Electronic Technical Report Service
Assoc. Editor	Artificial Intelligence Review, 1987-1989
Assoc. Editor	J. Experimental and Theoretical AI
Editorial Board	Artificial Intelligence Review
Editorial Board	Connection Science
Editorial Board	Artificial Life
Secy/Director	International Society for Adaptive Behavior
Corporate Affiliations	Abuzz technologies Advisor (Sold to NY Times)
	Affinnova (Advisor)
	Flagship Ventures (Advisor)
	Thinmail (Founder)
Organizer	Workshop on High-Level Connectionism, NMSU, Apr. 1988
	Midwest Connectfest II, OSU, Oct. 1991
	NIPS Workshop on Modularity in Connectionism Dec 1991

	Int'l Conference on Simulation of Adaptive Behavior Sep 1996
	Int'l Conference on Artificial Life Sep 2004
Program Committees	Int'l conference on Artificial Neural Networks, 1998 Artificial Life 6, 1998 European Conference on Artificial Life, 1997 Genetic Programming, 1996 AAAI Symposium on Connectionist NLP, March 1991 Machine Learning 1991 Workshop on Human Learning AAAI Annual Conference, August 1992, (Area Chair)
Ad Hoc Reviewer	<i>Cognitive Science, Artificial Intelligence, Machine Learning, Journal of the ACM, Neural Computation, IEEE Trans. On Neural Networks</i> Conferences: AAI, IJCAI, Cognitive Science, NIPS.

INVITED TALKS

International Programs

2003	Germany	European Conference on Artificial Life (Keynote)
2002	Hawaii	International Conference on Evolutionary Computation (Keynote)
2001	Tokyo	International Conference on Evolutionary Robotics (Keynote)
2001	Montreal	International conference on Multi agent Systems (Keynote)
1998	Suffolk	British Telephone Conference on Intelligent Robotics
1997	Tsukuba	IMSA Conference on Biologically Inspired Computation
1996	Montreal	Spring School on Neural Networks and Learning
1992	Skovde	First Swedish Nat'l Conference on Connectionism
	Montreal	Society for Philosophy and Psychology
1991	Paris	International Conference on Compositionality in Neural Systems
	Denver	IEEE NIPS workshop on recurrent networks
1990	Columbus	International CODATA Conference

National Programs

2003	New Jersey	DARPA workshop on Competitive Robot vehicle testing
2003	Portland	Annual Maine Law Conference

2003 Scottsdale DEMO 2003
 2002 Camden, ME POPTech
 2001 Woodstock Future Forward
 2002 Palo Alto NSF Educational Technology conference
 2001 DC NSF Nano-Bio-Info Conference
 2001 DC Defense Science Board Review
 2001 Scottsdale PC Forum Presentation on Robotics
 1997 Washington Highlands Forum on Mind, Brain, Computing
 Providence AAI Symposium on Multi-Agent Learning
 Nashville Machine Learning Wkshop on Grammatical Inference
 1996 Wilmington ONR Workshop on Genetic Control Networks
 1993 Boulder Connectionist Summer School (Faculty)
 Indiana Dunes Midwest AI & Cognitive Science (Keynote)
 1992 Boca Raton ONR Workshop on Nonlinear Dynamics of Brain
 Woods Hole ONR Workshop on Hybrid Machine Learning
 1991 Palo Alto AAI Symposium-Machine Learning of Language
 Bloomington Indiana Conference on Dynamical Representation (Keynote)

Departmental Colloquia

2004 Austin Univ. Texas CS Dept AI Lecture Series
 2004 New Haven Yale University CS Dept
 2004 New Haven Yale University Interdisciplinary Bioethics Program
 2004 Amsterdam Shell Oil Future Scenarios Group
 2003 Brighton UK University of Sussex COGS Department
 2003 Atlanta Georgia Tech CS Dept Distinguished AI Series
 2003 Lowell Computer Science Dept
 2001 Boston Fidelity Innovation Conference
 2001 DC NIST Distinguished Lecture series
 2001 Woodstock New England Innovation Meeting
 2001 NJ Att Labs Lecture Series
 Boston Boston University CNS Colloquium
 2001 Storrs University of Ct. Psychology Department
 2000 Columbus Ohio State Cognitive Science Festival (Keynote)
 1998 Cambridge MIT Brain Cognitive Sciences
 1997 Worcester WPI Computer Science Dept
 1996 Boston Boston University (CNS)

1995 Providence Brown University (Cognitive Science)
 1994 Princeton NEC Research Institute
 Waltham Brandeis University (CS)
 1993 Bloomington IU Cognitive Science Program (Distinguished Lecture Series)
 1992 Washington Naval Research Laboratory/AFOSR (Distinguished Lecture Series)
 Waltham Brandeis Center for Complex Systems (Keynote)
 Santa Fe Santa Fe Institute (External Faculty)
 1991 Las Cruces New Mexico State University (CRL)
 Ann Arbor University of Michigan (CSE)
 Exeter University of Exeter (CS)
 Oxford Oxford AI Society

GRANTS & CONTRACTS RECEIVED

G19: 15,000 “Support for Artificial Life Conference,” International Society for Artificial Life, and Icosystems, Inc.
 G18: \$150,000 “Peer to Peer Education Technology”, Hewlett Foundation, July 2003-July 2005
 G17: \$330,000 “ITR: One to one learning across the Internet”, NSF, Sept 2001-Aug 2004
 G16: \$526,000 “Research in Intelligent Machines” DOE, Sept 2001-Aug 2004
 G15: \$927,000 “Fully automated Design of Throwaway Robots” DARPA, July 1999-June 2003
 G14: \$98,000 “SGER: Communities of Evolving Learners” NSF, Sept 2000-Dec 2001.
 G13: \$361,000, “Dynamic Architecture, Dynamic Training”, Office of Naval Research, Jan 1996-Dec 1998.
 G12: \$75,000 “Dynamic training of humans and tutoring agents,” Office of Naval Research, Apr 1998-Mar 2001
 G11: \$232,782, “High Capacity Neural Coding,” National Science Found, May 1996-Apr 1999
 G10: \$18,000, “Support for SAB96 Conference”, combination ONR, M. R. Bauer Foundation, Int’l Society for Adaptive Behavior, Jan-Dec 1996.
 G9: \$195,671, “Acquisition of research infrastructure for autonomous robotics,” (co-PI with M. Mataric), NSF, Sep 1995-Aug 1998.

- G8: \$50,000, "Support for Postdoctoral Fellow," Krasnow Foundation, Oct 1994-Sep 1996.
- G7: \$5000, "Interdisciplinary Seminar in Neural Computation," (Co-PI with D. Wang), Office of Research, Ohio State University, 1 Year, Oct 1994.
- G6: \$330,000, "Dynamical Cognitive Systems", Office of Naval Research, 3.5 years, Jan. 1992-May 1995.
- G5: \$25,000, "High-Level Connectionist Models, continuation", Office of Naval Research, 1 year, Oct. 1992-Sep. 1993.
- G4: \$298,040, "High-Level Connectionist Models", Office of Naval Research, 3.5 years, Jan. 1989-Jun. 1992.
- G3: \$6000, "Robot Helicopter," Air Force Office of Scientific Research, April 1992, (HW Gift)
- G2: \$5,400, "High Bandwidth Submotor Event Recognition" OSU Center for Cognitive Science, July 1990. (With M. Torello).
- G1: \$10,000, "Workshop on Connectionism," American Association for Artificial Intelligence and Office of Naval Research, April 1988 (Co-PI With J. Barnden).

GRADUATE EDUCATION

Postdoctoral Trainees

Alan Blair	University of New South Wales
Paul Darwen	Protagonist Design
Miguel Schneider Fontan	Unknown
Hod Lipson	Cornell University
Edwin DeJong	University of Utrecht

Completed Ph.D's

Peter Angeline OSU, 1993	Nutech Solutions Evolutionary Algorithms and Emergent Intelligence
Barbara Becker OSU, 1994	Unknown Location Pragmatic Modeling in Natural Language Processing

Sevan Ficici Brandeis, 2004	Affinnova, Inc Solution concepts in Co-evolution
Pablo Funes Brandeis, 2000	Icosystems Evolutionary interaction with Real World
Gregory Hornby Brandeis 2002	NASA Ames Evolution with Generative Representations
Hugues Juille Brandeis 1998	Eurobios Evolutionary Optimization
John Kolen OSU, 1994	University of West Florida Computation in Dynamical Systems
Ed Large OSU, 1994	Florida Atlantic University Dynamic representation of Music Structure
Simon Levy Brandeis, 2002	Washington and Lee University Recursive Distributed Representations
Ofer Melnik Brandeis 2001	Rutgers DIMACS Understanding Neural Representations
Greg Saunders OSU, 1994	Carnegie Mellon University Evolution of Communication in Adaptive Agents
Elizabeth Sklar Brandeis 2000	Columbia University Communities of Evolving Learners
Richard Watson Brandeis 2002	Harvard University Symbiotic Evolutionary Algorithms

Masters Degrees Supervised

Doug Moreland	M.S. (OSU, 1989)
Vietanh Nguyen	M.S. (OSU, 1990)
Tony Plate	M.S. (NMSU, 1988)

M. Soundararajan
David Stucki
Tillman Wendel

M.S. (OSU, 1991)
M.S. (OSU, 1989)
M.S. (OSU, 1992, Fullbright Fellow)

Current Ph.D Students

Ari Bader-Nadal
Anthony Bucci
Keki Burojee
Kristian Kime
John Reiffel
Shiva Viswanathan

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