Lee Spector

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Northampton, MA 01060
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CITIZENSHIP
U.S.A.

EDUCATION
Ph.D., University of Maryland, Department of Computer Science, May 1992
Dissertation: Supervenience in Dynamic-World Planning
Advisor: James Hendler
Principal area: Artificial Intelligence
Other areas: Programming Languages, Theory of Computation
Additional graduate study at George Washington University, Washington D.C.

B.A., Oberlin College, Department of Philosophy, May 1984
Other areas: Computer Music, Aesthetics, Conceptual Art, Visual Arts
Active in the Technology in Music and Related Arts (TIMARA) program

RESEARCH INTERESTS
Genetic and Evolutionary Computation, Quantum Computation, Planning and Action Systems, Intelligent Agents, Artificial Intelligence and Cognitive Neuroscience, Human and Machine Learning, Computational Models of Creative Processes, Computer Science Education

EMPLOYMENT
Professor of Computer Science
School of Cognitive Science — July, 1992 – present
Hampshire College
Full professor rank since July, 2004
Dean, Cognitive Science, July 2002 – June 2005
MacArthur Chair, July 1997 – June 2000
Faculty Trustee, July 1998 – June 2000

Adjunct Professor and Associated Five-College Graduate Faculty member
Department of Computer Science — September, 2007 – present
University of Massachusetts, Amherst

Research Associate and Visiting Assistant Professor of Computer Science
Department of Computer Science — August 1995 – July 1996
University of Maryland at College Park

Faculty Research Assistant
Department of Computer Science — March 1992 – June 1992
University of Maryland at College Park

Graduate Research Assistant
Systems Research Center — August 1988 – March 1992
University of Maryland at College Park

Graduate Research Assistant
Computer Vision Lab — January 1987 – June 1988
University of Maryland at College Park

Human Interface Programmer
Academic Hospital of Groningen — Summer 1987
Groningen, The Netherlands

Graduate Teaching Assistant
Department of Computer Science — Fall 1986
University of Maryland at College Park

Graduate Research Assistant
Institute for Artificial Intelligence — June 1986 – January 1987
George Washington University, Washington D.C.

Artificial Intelligence Programmer
Intellitek Inc. — Summer 1986
Washington D.C.

Graduate Teaching Assistant
Department of Computer Science — Spring 1986
George Washington University, Washington D.C.

Graduate Research Assistant
Department of Computer Science — August 1985 – June 1986
George Washington University, Washington D.C.

Chief Engineer
WOBC Radio — Spring 1984
Oberlin, Ohio

Current Professional Positions

Associate Editor, *Genetic Programming and Evolvable Machines,* a journal published by Kluwer (Wolfgang Banzhaf, Editor-in-Chief).

Member, Editorial Board, *Evolutionary Computation,* a journal published by MIT Press (Marc Schoenauer, Editor-in-Chief).

Member, Executive Board, *SIGEVO*, a special interest group of the Association for Computing Machinery (formerly the *International Society for Genetic and Evolutionary Computation*).

Publications

Books

Spector, L. 2007 and 2004. *Automatic Quantum Computer Programming: A Genetic Programming Approach.* New York: Springer Science+Business Media, 2007 (paperback). Boston: Kluwer Academic Publishers, 2004 (hardcover).

Deb, K., R. Poli, W. Banzhaf, H-G Beyer, E. Burke, P. Darwen, D. Dasgupta, D. Floreano, J. Foster, M. Harman, O. Holland, P. Lanzi, L. Spector, A. Tettemanzi, D. Thierens and A. Tyrrell, editors. 2004. *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2004.* Lecture Notes in Computer Science, Vol. 3102-3103, Springer-Verlag.

Spector, L., E. Goodman, A. Wu, W.B. Langdon, H.-M. Voigt, M. Gen, S. Sen, M. Dorigo, S. Pezeshk, M. Garzon, and E. Burke, editors. 2001. *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2001.* San Francisco, CA: Morgan Kaufmann Publishers.

Whitley, D., D. Goldberg, E. Cantú-Paz, L. Spector, I. Parmee, and H.-G. Beyer, editors. 2000. *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2000.* San Francisco, CA: Morgan Kaufmann Publishers.

Spector, L., U.-M. O'Reilly, W. Langdon, and P. Angeline, editors. 1999. *Advances in Genetic Programming, Volume 3.* Cambridge, MA: MIT Press.

Book Chapters

Klein, J., and L. Spector. 2009. 3D Multi-Agent Simulations in the breve Simulation Environment. In *Artificial Life Models in Software, 2nd edition*, edited by A. Adamatzky and M. Komosinski. New York: Springer-Verlag. In press.

Klein, J., and L. Spector. 2008. Genetic Programming with Historically Assessed Hardness. In *Genetic Programming Theory and Practice VI*, edited by R. L. Riolo, T. Soule, and B. Worzel. New York: Springer-Verlag. In press.

Spector, L., and J. Klein. 2006. Multidimensional Tags, Cooperative Populations, and Genetic Programming. In *Genetic Programming Theory and Practice IV*, edited by R.L. Riolo, T. Soule, and B. Worzel, pp. 97–112. New York: Springer-Verlag.

Spector, L., and J. Klein. 2005. Trivial Geography in Genetic Programming. In *Genetic Programming Theory and Practice III*, edited by T. Yu, R.L. Riolo, and B. Worzel, pp. 109–124. Boston, MA: Kluwer Academic Publishers.

Grafman, J., L. Spector, and M.J. Rattermann. 2005. Planning and the Brain. In *The Cognitive Psychology of Planning*, edited by R. Morris and G. Ward, pp. 181–198. New York, NY: Psychology Press (Taylor & Francis Group).

Spector, L. 2003. An Essay Concerning Human Understanding of Genetic Programming. In *Genetic Programming: Theory and Practice*, edited by R. Riolo and B. Worzel, pp. 11–24. Boston, MA: Kluwer Academic Publishers.

Spector, L., H. Barnum, and H.J. Bernstein. 1999. Quantum Computing Applications of Genetic Programming. In *Advances in Genetic Programming, Volume 3*, edited by L. Spector, U.-M. O'Reilly, W. Langdon, and P. Angeline, pp. 135–160. Cambridge, MA: MIT Press.

Spector, L. 1996. Simultaneous Evolution of Programs and their Control Structures. In *Advances in Genetic Programming 2,* edited by P. Angeline and K. Kinnear, pp. 137–154. Cambridge, MA: MIT Press.

Spector, L. and J. Grafman. 1994. Planning, Neuropsychology, and Artificial Intelligence: Cross-Fertilization. In *Handbook of Neuropsychology,* Volume 9, edited by F. Boller, and J. Grafman, 377–392. Amsterdam: Elsevier Science Publishers B.V.

Journal Publications

Spector, L. 2008. Introduction to the Special Issue on Genetic Programming for Human-Competitive Designs. In *AI-EDAM: Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, Vol. 22, No. 3, pp. 183–184.

Spector, L., and J. Klein. 2008. Machine Invention of Quantum Computing Circuits by Means of Genetic Programming. In *AI-EDAM: Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, Vol. 22, No. 3, pp. 275–283.

Spector, L. 2006. Evolution of Artificial Intelligence. In *Artificial Intelligence*, Vol. 170, Issue 18, pp. 1251–1253.

Spector, L., and J. Klein. 2006. Genetic Stability and Territorial Structure Facilitate the Evolution of Tag-mediated Altruism. In *Artificial Life*, Vol. 12, No. 4, pp. 553–560.

Spector, L., J. Klein, and K. Harrington. 2005. Selection Songs: Evolutionary Music Computation. In *YLEM Journal*, Vol. 25, No. 6 & 8, pp. 24–26.

Spector, L., J. Klein, C. Perry, and M. Feinstein. 2005. Emergence of Collective Behavior in Evolving Populations of Flying Agents. In *Genetic Programming and Evolvable Machines*, Vol. 6, No. 1, pp. 111–125.

Spector, L. 2002. Book Review: The Quest for the Quantum Computer, by J. Brown. In *Genetic Programming and Evolvable Machines*, Vol. 3, No. 4, pp. 391–393.

Spector, L., and A. Robinson. 2002. Genetic Programming and Autoconstructive Evolution with the Push Programming Language. In *Genetic Programming and Evolvable Machines*, Vol. 3, No. 1, pp. 7–40.

Spector, L. 2002. Hierarchy Helps it Work That Way. In *Philosophical Psychology*, Vol. 15, No. 2 (June, 2002), pp. 109–117.

Rattermann, M.J., L. Spector, J. Grafman, H. Levin, and H. Harward. 2001. Partial and total-order planning: evidence from normal and prefrontally damaged populations. In *Cognitive Science*, Vol. 25, No. 6 (November/December, 2001), pp. 941–975.

Barnum, H., H.J. Bernstein, and L. Spector. 2000. Quantum circuits for OR and AND of ORs. *Journal of Physics A: Mathematical and General*, Vol. 33 No. 45 (17 November, 2000), pp. 8047–8057.

Spector, L. 2000. The Evolution of Arbitrary Computational Processes. In *IEEE Intelligent Systems*, May/June 2000, pp. 80–83.

Spector, L. 1997. Automatic Generation of Intelligent Agent Programs. In *IEEE Expert.* Jan–Feb 1997, pp. 3–4.

Spector, L. 1996. Social Structure in Evolutionary Computation Systems. In *Communication and Cognition–Artificial Intelligence.* Vol. 13, nos 2–3. pp. 141–161.

Spector, L. 1995. Artificial Intelligence as the Liberal Arts of Computer Science. In *SIGART Bulletin: Special Issue on AI Education.* Volume 6, Number 2, pp. 8–10. The Association for Computing Machinery.

Evett, M. P., J. A. Hendler, and L. Spector. 1994. Parallel Knowledge Representation on the Connection Machine. *Journal for Parallel and Distributed Computing.* Volume 22, number 2, pp. 168–184.

Grafman, J., A. Sirigu, L. Spector, and J. Hendler. 1993. Damage to the prefrontal cortex leads to decomposition of structured event complexes. In *The Journal of Head Trauma Rehabilitation,* Volume 8, Number 1, Aspen Publishers, Inc., pp. 73–87.

Spector, L. and J. Hendler. 1992. Planning and Reacting Across Supervenient Levels of Representation. In *International Journal of Intelligent and Cooperative Information Systems,* Volume 1, Numbers 3 & 4, pp. 411–449.

Spector, L. and J. Hendler. 1989. Book Review: Minimal Rationality, by C. Cherniak. In *Artificial Intelligence,* Volume 39, Number 1.

Newspaper Op-Ed

And now, digital evolution. In *The Boston Globe*, August 29, 2005.

Peer Reviewed Conference and Workshop Papers

Spector, L., D. M. Clark, I. Lindsay, B. Barr, and J. Klein. 2008, in press. Genetic Programming for Finite Algebras. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2008).* ACM Press.

Spector, L., J. Klein, and M. Feinstein. 2007. Division blocks and the open-ended evolution of development, form, and behavior. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2007)*, pp. 316–323. ACM Press.

Klein, J., and L. Spector. 2007. Unwitting Distributed Genetic Programming via Asynchronous JavaScript and XML. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2007)*, pp. 1628–1635. ACM Press.

Spector, L., J. Klein, and M. Keijzer. 2005. The Push3 Execution Stack and the Evolution of Control. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2005)*, pp. 1689–1696. Springer-Verlag.

Stout, A., and L. Spector. 2005. Validation of Evolutionary Activity Metrics for Long-Term Evolutionary Dynamics. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2005)*, pp. 137–142. Springer-Verlag.

Spector, L., J. Klein, K. Harrington, and R. Coppinger. 2005. Teaching the Evolution of Behavior with SuperDuperWalker. In *Proceedings of the 12th International Conference on Artificial Intelligence in Education (AIED-2005)*, pp. 923–925. IOS Press.

Spector, L., J. Klein, and C. Perry. 2004. Tags and the Evolution of Cooperation in Complex Environments. In *Proceedings of the AAAI 2004 Symposium on Artificial Multiagent Learning.* Melno Park, CA: AAAI Press.

Spector, L., J. Klein, C. Perry, and M. Feinstein. 2003. Emergence of Collective Behavior in Evolving Populations of Flying Agents. In E. Cantu-Paz, J.A. Foster, K. Deb, L.D. Davis, R. Roy, U.-M. O'Reilly, H.-G. Beyer, R. Standish, G. Kendall, S. Wilson, M. Harman, J. Wegener, D. Dasgupta. M.A. Potter, A.C. Schultz, K.A. Dowsland, N. Jonoska, J. Miller (Eds.), *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2003)*, pp. 61–73. Berlin: Springer-Verlag.

Winner, Best Paper Award, AAAA Track.

Spector, L. 2002. Adaptive populations of endogenously diversifying *Pushpop* organisms are reliably diverse. In R. K. Standish, M. A. Bedau, and H. A. Abbass (eds.), *Proceedings of Artificial Life VIII, the 8th International Conference on the Simulation and Synthesis of Living Systems*, pp. 142–145. Cambridge, MA: The MIT Press.

Spector, L., and J. Klein. 2002. Evolutionary Dynamics Discovered via Visualization in the BREVE Simulation Environment. In Bilotta et al. (eds.), *Workshop Proceedings of the 8th International Conference on the Simulation and Synthesis of Living Systems*, pp. 163–170. Sydney, Australia: University of New South Wales.

Spector, L., and J. Klein. 2002. Complex Adaptive Music Systems in the BREVE Simulation Environment. In Bilotta et al. (eds.), *Workshop Proceedings of the 8th International Conference on the Simulation and Synthesis of Living Systems*, pp. 17–23. Sydney, Australia: University of New South Wales.

Spector, L., and H.J. Bernstein. 2002. Communication Capacities of Some Quantum Gates, Discovered in Part through Genetic Programming. In J.H. Shapiro and O. Hirota, (eds.), *Proceedings of the Sixth International Conference on Quantum Communication, Measurement, and Computing* (QCMC), pp. 500–503. Princeton, NJ: Rinton Press.

Spector, L., and A. Robinson. 2002. Multi-type, Self-adaptive Genetic Programming as an Agent Creation Tool. In *Proceedings of the Workshop on Evolutionary Computation for Multi-Agent Systems, ECOMAS-2002*, International Society for Genetic and Evolutionary Computation.

Crawford-Marks, R., and L. Spector. 2002. Size Control via Size Fair Genetic Operators in the PushGP Genetic Programming System. In W. B. Langdon, E. Cantu-Paz, K. Mathias, R. Roy, D. Davis, R. Poli, K. Balakrishnan, V. Honavar, G. Rudolph, J. Wegener, L. Bull, M. A. Potter, A. C. Schultz, J. F. Miller, E. Burke, and N. Jonoska (eds.), *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2002*, pp. 733–739. San Francisco, CA: Morgan Kaufmann Publishers.

Spector, L. 2001. Autoconstructive Evolution: Push, PushGP, and Pushpop. In Spector, L., E. Goodman, A. Wu, W.B. Langdon, H.-M. Voigt, M. Gen, S. Sen, M. Dorigo, S. Pezeshk, M. Garzon, and E. Burke, editors, *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO-2001,* pp. 137-146. San Francisco, CA: Morgan Kaufmann Publishers.

Weisler, S., R. Bellin, L. Spector, and N. Stillings. 2001. An Inquiry-based Approach to E-learning: The CHAT Digital Learning Environment. In *Proceedings of SSGRR-2001, the International Conference on Advances in Infrastructure for Electronic Business, Science, and Education on the Internet.* Scuola Superiore G. Reiss Romoli, L'Aquila, Italy. Proceedings ISBN: ISBN:88-85280-61-7, URL: http://www.ssgrr.it/en/ssgrr2001/papers.htm.

Spector, L., H. Barnum, and H.J. Bernstein. 1998. Genetic Programming for Quantum Computers. In *Genetic Programming 1998: Proceedings of the Third Annual Conference,* edited by J.R. Koza, W. Banzhaf, K. Chellapilla, K. Deb, M. Dorigo, D.B. Fogel, M.H. Garzon, D.E. Goldberg, H. Iba, and R.L. Riolo. pp. 365–374. San Francisco, CA: Morgan Kaufmann.

Luke, S., and L. Spector. 1998. A Revised Comparison of Crossover and Mutation in Genetic Programming. In *Genetic Programming 1998: Proceedings of the Third Annual Conference,* edited by J.R. Koza, W. Banzhaf, K. Chellapilla, K. Deb, M. Dorigo, D.B. Fogel, M.H. Garzon, D.E. Goldberg, H. Iba, and R.L. Riolo. pp. 208–214. San Francisco, CA: Morgan Kaufmann.

Luke, S. and L. Spector. 1997. A Comparison of Crossover and Mutation in Genetic Programming. In *Genetic Programming 1997: Proceedings of the Second Annual Conference*, 240–248. Cambridge, MA: The MIT Press.

Luke, S., L. Spector, D. Rager, and J. Hendler. 1997. Ontology-based Web Agents. In *Proceedings of the First International Conference on Autonomous Agents*, 59–66. W. L. Johnson, Editor. New York: ACM Press.

Spector, L. 1997. Genetic Programming of Cognitive Models. In M.G. Shafto and P. Langley (editors), *Proceedings of the Nineteenth Annual Conference of the Cognitive Science Society*, p. 1059. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Spector, L., and K. Stoffel. 1996. Automatic Generation of Adaptive Programs. In P. Maes, M. Mataric, J.-A. Meyer, J. Pollack, and S.W. Wilson (editors), *From Animals to Animats 4: Proceedings of the Fourth International Conference on Simulation of Adaptive Behavior*, 476–483. Cambridge, MA: The MIT Press.

Spector, L., and S. Luke. 1996. Culture Enhances the Evolvability of Cognition. In G. Cottrell (editor), *Proceedings of the Eighteenth Annual Conference of the Cognitive Science Society*, 672–677. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Spector, L., and S. Luke. 1996. Cultural Transmission of Information in Genetic Programming. In Koza, John R., Goldberg, David E., Fogel, David B., and Riolo, Rick L. (editors) *Genetic Programming 1996: Proceedings of the First Annual Conference*, 209–214. Cambridge, MA: The MIT Press.

Spector, L., and K. Stoffel. 1996. Ontogenetic Programming. In Koza, John R., Goldberg, David E., Fogel, David B., and Riolo, Rick L. (editors) *Genetic Programming 1996: Proceedings of the First Annual Conference,* 394–399. Cambridge, MA: The MIT Press.

Luke, S., and L. Spector. 1996. Evolving Teamwork and Coordination with Genetic Programming. In Koza, John R., Goldberg, David E., Fogel, David B., and Riolo, Rick L. (editors) *Genetic Programming 1996: Proceedings of the First Annual Conference*, 150–156. Cambridge, MA: The MIT Press.

Stoffel, K., and L. Spector. 1996. High-Performance, Parallel, Stack-Based Genetic Programming. In Koza, John R., Goldberg, David E., Fogel, David B., and Riolo, Rick L. (editors) *Genetic Programming 1996: Proceedings of the First Annual Conference,* 224–229. Cambridge, MA: MIT Press.

Spector, L., and A. Alpern. 1994. Criticism, Culture, and the Automatic Generation of Artworks. In *Proceedings of the Twelfth National Conference on Artificial Intelligence, AAAI-94,* 3–8. Menlo Park, CA and Cambridge, MA: AAAI Press/The MIT Press.

Spector, L. 1994. Genetic Programming and AI Planning Systems. In *Proceedings of the Twelfth National Conference on Artificial Intelligence, AAAI-94,* 1329–1334. Menlo Park, CA and Cambridge, MA: AAAI Press/The MIT Press.

Spector, L., M. J. Rattermann, and K. Prentice. 1994. Ordering Relations in Human and Machine Planning. In *Proceedings of the Twelfth National Conference on Artificial Intelligence, AAAI-94,* 80–85. Menlo Park, CA and Cambridge, MA: AAAI Press/The MIT Press.

Spector, L., and J. Hendler. 1994. The Use of Supervenience in Dynamic-World Planning. In *Proceedings of the Second International Conference on Artificial Intelligence Planning Systems,* edited by Kristian Hammond, 158–163. Menlo Park, CA: AAAI Press.

Spector, L. and J. Hendler. 1990. An Abstraction-Partitioned Model for Reactive Planning. In *Proceedings of the Fifth Rocky Mountain Conference on Artificial Intelligence (RMCAI-90),* New Mexico State University, Las Cruces, New Mexico.

Evett, M., L. Spector, and J. Hendler. 1989. Knowledge Representation on the Connection Machine. In *Proceedings of Supercomputing '89,* (Reno, NV; Nov. 13-17, 1989), ACM, New York, NY.

Additional Publications

Spector, L., C. Perry, J. Klein, and M. Keijzer. 2004. Push 3.0 Programming Language Description. Hampshire College Cognitive Science Technical Report HC-CSTR-2004-02. http://www.hampshire.edu/cms_PDF/HC-CSTR-2004-02.pdf

Spector, L., E. Anderson, J. Miller, L. Sizer, and N. Stillings. 2004. Hampshire College School of Cognitive Science - Self Study Report. Hampshire College Cognitive Science Technical Report HC-CSTR-2004-01.
http://www.hampshire.edu/cms_PDF/HC-CSTR-2004-01.pdf

Crawford-Marks, R., L. Spector, and J. Klein. 2004. Virtual Witches and Warlocks: A Quidditch Simulator and Quidditch-Playing Teams Coevolved via Genetic Programming. In *Late-Breaking Papers of GECCO-2004, the Genetic and Evolutionary Computation Conference.* Published by the International Society for Genetic and Evolutionary Computation.

Spector, L., C. Perry, and J. Klein. 2003. Push 2.0 Programming Language Description. http://hampshire.edu/lspector/push2-description.html

Robinson, A., and L. Spector. 2002. Using Genetic Programming with Multiple Data Types and Automatic Modularization to Evolve Decentralized and Coordinated Navigation in Multi-Agent Systems. In *Late-Breaking Papers of GECCO-2002, the Genetic and Evolutionary Computation Conference.* Published by the International Society for Genetic and Evolutionary Computation.

Spector, L., R. Moore, and A. Robinson. 2001. Virtual Quidditch: A Challenge Problem for Automatically Programmed Software Agents. In E.D. Goodman, editor, *Late-Breaking Papers of GECCO-2001, the Genetic and Evolutionary Computation Conference.* Published by the International Society for Genetic and Evolutionary Computation.

Barnum, H., H. J. Bernstein, and L. Spector. 2000. Quantum circuits for OR and AND of OR's. Technical Report CSTR-00-014, Dept. of Computer Science, University of Bristol, August 2000.

Spector, L, H. Barnum, H.J. Bernstein, and N. Swamy. 1999. Abstract for Invited Presentation: Quantum Computing and AI. In *Proceedings of the Sixteenth National Conference on Artificial Intelligence, AAAI-99*, AAAI Press.

Spector, L., H. Barnum, H.J. Bernstein, and N. Swamy. 1999. Finding a Better-than-Classical Quantum AND/OR Algorithm using Genetic Programming. In *Proceedings of the 1999 Congress on Evolutionary Computation*, pp. 2239–2246. IEEE Press.

Barnum, H., Bernstein, H. J., and Spector, L. 1999. Better-than-classical Circuits for OR and AND/OR Found Using Genetic Programming. Los Alamos Preprint Archive, http://xxx.lanl.gov/abs/quant-ph/9907056

Luke, S., L. Spector, and D. Rager. 1996. Ontology-Based Knowledge Discovery on the World-Wide Web. In *Working Notes of the AAAI-96 Workshop on Internet-based Information Systems.*

Luke, S., and L. Spector. 1996. Evolving Graphs and Networks with Edge Encoding: Preliminary Report. In Koza, John R. (editor), *Late-Breaking Papers at the Genetic Programming 1996 Conference.* Palo Alto, CA: Stanford Bookstore (ISBN 0-18-201-031-7).

Spector, L. 1995. Evolving Control Structures with Automatically Defined Macros. *Working Notes of the AAAI Fall Symposium on Genetic Programming.* The American Association for Artificial Intelligence. pp. 99–105.

Spector, L., and A. Alpern. 1995. Induction and Recapitulation of Deep Musical Structure. In *Working Notes of the IJCAI-95 Workshop on Artificial Intelligence and Music.* pp. 41–48. Spector, L. 1994. Artificial Intelligence as the Liberal Arts of Computer Science. In *Working Notes of the AAAI Fall Symposium on Improving the Instruction of Introductory AI.* The American Association for Artificial Intelligence. pp. 31–33.

Spector, L. 1992. Supervenience in Dynamic-World Planning, Doctoral dissertation. CS-TR-2899, UMIACS-TR-92-55, Department of Computer Science, University of Maryland.

Spector, L., B. Andersen, J. Hendler, B. Kettler, E. Schwartzman, C. Woods, and M. Evett. 1992. Knowledge Representation in PARKA – Part 2: Experiments, Analysis, and Enhancements. CS-TR-2837, UMIACS-TR-92-16, Department of Computer Science, University of Maryland.

Spector, L. and J. Hendler. 1991. The Supervenience Architecture. In *Proceedings of the AAAI Fall Symposium on Sensory Aspects of Robotic Intelligence.* The American Association for Artificial Intelligence.

Spector, L. and J. Hendler. 1991. The Supervenience Architecture. In *The Proceedings of the IJCAI-91 Workshop on Theoretical and Practical Design of Rational Agents,* Sydney, Australia.

Spector, L. and J. Hendler. 1990. Knowledge Strata: Reactive Planning with a Multi-level Architecture. UMIACS-TR-90-140, CS-TR-2564, Department of Computer Science, University of Maryland.

Spector, L., J. Hendler, and M. Evett. 1990. Knowledge Representation in PARKA. UMIACS-TR-90-23, CS-TR-2410, Department of Computer Science, University of Maryland.

Evett, M., J. Hendler, and L. Spector. 1990. PARKA: Parallel Knowledge Representation on the Connection Machine. UMIACS-TR-90-22, CS-TR-2409, Department of Computer Science, University of Maryland.

Spector, L., J. Hendler, J. Canning, and A. Rosenfeld. 1988. Symbolic Model/Image Matching in Expert Vision Systems. CAR-TR-370, CS-TR-2060, University of Maryland Center for Automation Research.

Letters to the Editor

Letter to the editor, *The Daily Hampshire Gazette*, regarding funding for public education, May 19, 2006.

Letter to the editor, *New York Times*, regarding warrantless surveillance, March 10, 2006.

Letter to the editor, *Scientific American*, regarding nanobots, January, 2002.

Letter to the editor, *Circuits* section, *New York Times*, regarding robotic pets, May 11, 2000.

Letter to the editor, *IEEE Intelligent Systems*, regarding quantum computing, September/October,

1999.

Presentations, Tutorials and Posters

(in addition to those for conference, workshop, and symposium papers listed above)

Climate Change and Complex Adaptive Systems. *Focus Hampshire*, a climate change teach-in, Hampshire College, March 7, 2008.

Evolution, the Programmer and Mathematician. School of Cognitive Science, Hampshire College, February 20, 2008.

Advanced Computing in a Complex World. Vermont Advanced Computing Center, University of Vermont, January, 2008.

The Computational Creativity Curriculum. School of Cognitive Science, Hampshire College, October, 2007.

Quantum Computing. Tutorial, *Genetic and Evolutionary Computation Conference (GECCO)*, June, 2007.

Intelligence Evolving. Invited presentation. *Oberlin Club of Western New England*, Northampton, Massachusetts, May 6, 2007.

Evolutionary Computation for Science, Engineering and Art. Invited presentation. *School of Science & Engineering Colloquium Series*, State University of New York at New Paltz, April 26, 2007.

Algorithmic Art. Invited presentation. Hampshire College course on *Topics in Computer Graphic Animation Arts*, taught by Eric Wilson, March 13, 2005.

Strange Bits: Quantum Computing and the Search for New Quantum Algorithms. Invited Presentation. *Sigma Xi* Scientific Research Society, Swarthmore College Chapter, January 30, 2007.

Cooperation and Computational Evolution. *The Grey Thumb Society*, Cambridge, MA, December 4, 2006.

Division Blocks. School of Cognitive Science, Hampshire College, October 12, 2006.

Quantum Computing. Tutorial, *Genetic and Evolutionary Computation Conference (GECCO)*, June, 2006.

Evolution of Irreducible Complexity by Natural Selection. *Evolution, Science, and Intelligent Design - A Panel Discussion*, Hampshire College, February 8, 2006.

Guest presentations on topics in science and math at Bridge Street Elementary School, Northampton MA. Topics included robotics, physics of sound, fractals, logo programming, binary, light and spectroscopy, planetary orbits, the Krypto math game, insects and swarm intelligence, digital microscopy, and the fourth dimension.

Algorithmic Arts. *Art and Technology Retreat*, Hampshire College, January 27, 2006.

The Chomsky Hierarchy. Invited presentation. Hampshire College course on *Human Nature, Language, and Politics: Noam Chomsky and His Critics*, taught by Ernie Alleva and Steve Weisler, December 5, 2005.

Quantum Computing. Tutorial, *Genetic and Evolutionary Computation Conference (GECCO)*,

June, 2005.

The Evolution of Arbitrary Computational Processes. Invited presentation. Department of Computer Science, University of Maryland, College Park, March 7, 2005.

Automated Invention by Means of Genetic Programming. Tutorial, with John Koza, *Nineteenth National Conference on Artificial Intelligence, AAAI-04*, July 25, 2004.

Quantum Computing. Tutorial, *Genetic and Evolutionary Computation Conference (GECCO)*, July 13, 2003.

Quantum Computing for Genetic Programmers. Tutorial, *Genetic and Evolutionary Computation Conference (GECCO)*, July 9, 2002.

Quantum Computing and Artificial Intelligence. Chevron TechNet Advanced Information-Based Modeling seminar series. November 12, 1999.

Quantum Computing and AI. Invited Presentation, *Sixteenth National Conference on Artificial Intelligence, AAAI-99*, 1999.

Quantum Computation. Tutorial, *Genetic and Evolutionary Computation Conference (GECCO)*, July 14, 1999.

Total and Partial-Order Planning: Application of Results from Artificial Intelligence to Children and Lesioned Adults. Poster presentation with Mary Jo Rattermann and Jordan Grafman. 1996 Cognitive Science Society Meeting. 1996.

Genetic Programming of Intelligent Agents and Artists. Invited lecture. Swarthmore College Cognitive Science Colloquium Series. 1996.

Genetic Programming of Cognitive Models. Invited presentation. Cognitive Neuroscience Unit, National Institute of Neurological Disorders and Stroke, National Institutes of Health. 1996.

Automatic Generation of Planning Systems. Georgia Institute of Technology. 1996.

Artificial Intelligence as the Liberal Arts of Computer Science. Cognitive Science Brown Bag Lunch Presentation, Georgia Institute of Technology. 1996.

Evolving Control Structures with Automatically Defined Macros. Poster presentation. Genetic Programming Workshop at the Sixth International Conference on Genetic Algorithms. 1995.

Total and Partial-Order Planning: The Application of Results from Artificial Intelligence to Children's Planning. Presented by Mary Jo Rattermann. Poster presentation. Biennial Meeting of the Society for Research in Child Development. 1995.

Exploring the Internet. Science Education Partnership , Hampshire College. 1994.

What Computers Can't Do. Guest lecture. Smith College. 1993.

Representations and Processes in Human Prefrontal Cortex: Convergence of Cognitive Neuroscience, Cognitive Science, and Artificial Intelligence Research. Panel presentation. Thirteenth Annual Conference of the Cognitive Science Society. 1991.

An Abstraction-Partitioned Model for Reactive Planning. Poster presentation. University of Mary-

land Systems Research Center. 1990.

PARKA: Knowledge Representation on the Connection Machine. Panel presentation. Workshop on Term Subsumption Languages in Knowledge Representation. 1989.

Grants and Awards

National Science Foundation, CreativeIT program. The Computational Creativity Curriculum. Co-Principal Investigators: J. Davila, C. Perry. $49,641. 2008–2009.

Elected *Fellow*, International Society for Genetic and Evolutionary Computation. 2004.

Gold medal, GECCO-2004 Human-Competitive Results contest. $1,500. 2004.

National Science Foundation, Director's Award for Distinguished Teaching Scholars. Open-Ended Evolution in Visually Rich Virtual Worlds: Implementation, Analysis, and Use in Undergraduate Education. $300,000. 2003–2007.

Best Paper Award, Genetic and Evolutionary Computation Conference (GECCO-2003), AAAA Track (A-Life, Adaptive Behavior, Agents, and Ant Colony Optimization).

National Science Foundation, Major Research Instrumentation program and Research in Undergraduate Institutions program. Acquisition of Instrumentation for Research in Genetic Programming, Quantum Computation, and Distributed Systems. $99,751. 2002–2005.

Defense Advanced Research Projects Agency (DARPA) program on Agent Based Computing. Multi-type, Self-adaptive Genetic Programming for Complex Applications. $295,936. 2001–2004.

Hampshire College support for the Institute for Computational Intelligence.

MacArthur Chair at Hampshire College. $45,000. 1997–2000.

National Science Foundation, Learning and Intelligent Systems Program. Inquiry-Based Science Education: Cognitive Measures and Systems Support. Co-Principal Investigators: N. Stillings, L. Spector, S. Weisler, L. Winship, and B. Woolf. $1,100,000. 1997.

Lemelson National Program in Invention, Innovation and Creativity. Applications of Evolved Complex Dynamic Systems. With Mark Feinstein. $3,000. 1997.

Lemelson National Program in Invention, Innovation and Creativity. Enhancing the human/computer interface: video-based movement analysis. With Slavoljub Milekic and Mark Feinstein. $6,200. 1996.

Hewlett-Mellon Faculty Development Grant. Intelligent Real-time Music Processing. $700. 1996.

Hewlett-Mellon Faculty Development Grant. Evolutionary Computation and the Arts. $1,500. 1995.

Lemelson National Program in Invention, Innovation and Creativity. MIDI/Motion Device, Demonstration and Enhancement. $2,500. 1995.

Hewlett-Mellon Faculty Development Grant. The Virtual Student Union. $1,500. 1994.

Lemelson National Program in Invention, Innovation and Creativity. Travel grant for AAAI-94. $1,000. 1994.

Lemelson National Program in Invention, Innovation and Creativity. Grant for the establishment of the Creative Cognition Laboratory. $15,000. 1993.

SERVICE

Professional Conference Program Committees

Genetic and Evolutionary Computation Conference, GECCO-2006
Fourth European Workshop on Evolutionary Music and Art, EvoMUSART-2006
IEEE Computational Intelligence and Games, CIG-2005
Third European Workshop on Evolutionary Music and Art, EvoMUSART-2005
AAAI 2004 Fall Symposium on Artificial Multi-Agent Learning,
Organizing committee
Genetic and Evolutionary Computation Conference, GECCO-2004,
Chair, genetic programming track
Judge, TinyGP competition
European Conference on Artificial Intelligence, ECAI 2004
Genetic and Evolutionary Computation Conference, GECCO-2003
Genetic and Evolutionary Computation Conference, GECCO-2001,
Proceedings Editor-in-Chief
Genetic and Evolutionary Computation Conference, GECCO-2000,
Chair, genetic programming and evolvable hardware tracks
Sixteenth National Conference on Artificial Intelligence, AAAI-99,
Senior program committee
Fifteenth National Conference on Artificial Intelligence, AAAI-98
Third International Conference on Genetic Programming, GP-98
Thirteenth National Conference on Artificial Intelligence, AAAI-96
First International Conference on Genetic Programming, GP-96
Genetic Programming Track, IEEE Intl. Conference on Evolutionary Computation, ICEC-96
Florida Artificial Intelligence Research Society (FLAIRS) conference

Additional Reviewing

Adaptive Behavior (journal)
Advances in Genetic Programming 2 (MIT Press)
Artificial Intelligence (journal)
Artificial Life (journal)
BioSystems (journal)
Computational Intelligence (journal)
Design Automation Conference, 2004, Ph.D. Forum
Evolutionary Computation (journal)
Genetic Programming and Evolvable Machines (journal)
Genetic Programming: Theory and Practice (Kluwer Academic Publishers)
IEEE Transactions on Evolutionary Computation (journal)
Journal of Experimental and Theoretical Artificial Intelligence (journal)
National Science Foundation Distinguished Teaching Scholars Panel
National Science Foundation Instrumentation and Laboratory Improvement Review Panel
Natural Sciences and Engineering Research Council of Canada
Nederlandse Organisatie voor Wetenschappelijk Onderzoek (The Netherlands)
Nature Reviews Genetics (journal)
Physical Review Letters (journal)
Science Foundation Ireland
The Marsden Fund (The Royal Society of New Zealand)

Additional Service

Faculty representative to the Hamphire College Board of Trustees
Making of the College 2.0 Oversight Committee (co-chair)

Educational Policy Council
Campus Committee on Faculty Reappointments and Promotions
Information Technology Steering Committee
Faculty Compensation Committee
Executive Committee of the Faculty
Task force to examine the granting of graduate degrees (chair)
Several additional task forces and faculty/staff search committees
Science Fair judge, Northampton MA Public Schools
Graduate Student Workshop judge, Genetic and Evolutionary Computation Conference
Competitions judge (several occasions), Genetic and Evolutionary Computation Conference

Graduate Student Thesis Committees

Jon Klein (Ph.D. in progress, Chalmers U., Sweden)
Terry Van Belle (Ph.D., U. New Mexico)
Sean Luke (Ph.D., U. Maryland)
Brian Kettler (Ph.D., U. Maryland)
Jason Lohn (Ph.D., U. Maryland)
Oliver Seeliger (M.S., U. Maryland)

Courses Taught

Introduction to Computer Science
Introduction to Cognitive Science
Computing Concepts: Creative Machines?
Cognitive Science Fiction
Creative Programming Workshop
What Computers Can't Do (limits of computing)
When Machines Talk (natural language processing)
Reasoning About Action
Introduction to Artificial Intelligence
Advanced Topics in Artificial Intelligence
Artificial Intelligence in 3D Virtual Worlds
Evolutionary Computation
Quantum Computing with No Prerequisites of Any Kind
Hypertext
Programming Language Paradigms
Computational Models of Biological Systems
Animals and Animats: Natural and Artificial Intelligence and Behavior
Biocomputational Developmental Ecology
Algorithmic Arts
Computer Science Projects
Current Issues in Cognitive Science

Software Development Projects

LGP, HiGP, MidGP, PushGP, Pushpop and other tools for genetic programming research and applications. 1995–present. See http://hampshire.edu/lspector/code.html.

QGAME (Quantum Gate and Measurement Emulator), a system for simulating quantum computer algorithms on ordinary (classical) computer hardware, based on the quantum gate array model of quantum computation. 1999–present. See http://hampshire.edu/lspector/qgame.html.

SwarmEvolve, a framework for experiments on the emergence of collective behavior in populations of flying agents. 2002-2005. See http://hampshire.edu/lspector/gecco2003-collective.html.

PLANET H, a framework for experiments on the cognitive psychology of human planning. With Jordan Grafman at the National Institutes of Health, NINDS. 1996–present.

What about AIDS?, WWW and CD ROM versions of the New York Hall of Science exhibit on AIDS. With Christopher Chase, Richard Muller, and Rebecca S. Neimark. 1994–1998.

CHORES, a framework for experiments on the cognitive psychology of human planning. With Jordan Grafman at the National Institutes of Health, NINDS. 1992–1996.

ErunticLab, an artificial life environment with genetic genetic programming components. 1995. See http://hampshire.edu/lspector/code.html.

Semantic network-based "Stream of Consciousness" interface concept for James Joyce *Ulysses* CD ROM. With StonySoft. 1994.

ARTS PROJECTS

Selection Songs, music produced by evolving agents in a 3D virtual world. *YLEM Journal*, Vol. 25, No. 6 & 8, pp. 24–26, and accompanying CD. With Jon Klein and Kyle Harrington. 2005.

Albers Automaton, 13x13, a digital projection piece based on the self-organization of colored fields. Gallery Tk (Northampton, Massachusetts); November 18 – December 5, 2004.

CA3D, projection artworks based on 3D cellular automata. Venues include Show Gallery's October, 2002 MASQ fundraiser (Northampton, Massachusetts); Pablo (Bongohead) Yglesias's 2002 Bar 19 show (Northampton, Massachusetts); Open Square Arts Party, April, 2004 (Holyoke, Massachusetts).

SwarmEvolveMusic, projection artworks (with audio) based on simulations of evolving, goal-directed swarms. Venues include Show Gallery's October, 2002 MASQ fundraiser (Northampton, Massachusetts) and Bar 19 (Northampton, Massachusetts). 2002.

Autonomous Color Studies, flat panel/projection artworks based on 2D cellular automata. 1999.

Adapta, musical piece for singing audience and evolutionary computation. Invited concert presentation. New Music Mini-Festival, Center for the Arts, Wesleyan University. 1996.

Twitchy, interactive sculpture with video sensing and sound and servo motor motion output. Lemelson-funded E-Team project. Hampshire College. With James Carlson and Garth Zenie. 1995.

Speech activated interactive component of *King Anthracite* installation. With Stashu Kybartas. 1993.

Life & Death, interactive sound installation. 18th Annual Electronic Music Plus Festival. With Benjy Bernhardt and Rebecca S. Neimark. 1991.

MEDIA

Quotes and Mentions

The Daily Hampshire Gazette, news item on a grant from the NSF CreativeIT program. October 19, 2007.

The Poughkeepsie Journal, announcing "Evolutionary Computation for Science, Engineering and Art," a presentation at SUNY New Paltz. April 26, 2007.

The Daily Hampshire Gazette, news item on the receipt of the gold medal in the "Human-Competitive Results" competition at the 2004 Genetic and Evolutionary Computation Conference, by Cheryl B. Wilson. August 23, 2004.

The Chronicle of Higher Education, on receiving the NSF Director's Award for Distinguished Teaching Scholars. "National Science Foundation Honors Teaching Scholars." On-line version: May 9, 2003, http://chronicle.com/prm/daily/2003/05/2003050905n.htm

The Daily Hampshire Gazette, feature story on the NSF Director's Award for Distinguished Teaching Scholars. "Hampshire prof wins national teaching award," by Cheryl B. Wilson. May 12, 2003.

The Daily Hampshire Gazette, on the awarding of an NSF/MRI grant. May 13, 2002.

The Daily Hampshire Gazette, on the politics of software choices. "Hampshire takes lead on software," by Stacey Butterfield. November 24, 2001.

Technology Research News, on the use of digital organisms in the study of evolutionary dynamics. "Virtual beings boost evolutionary theory," by Ted Smalley Bowen. October 10, 2001.

The Chronicle of Higher Education, on open-source software. "Hampshire College Favors Noncommercial Web Software Open to All." Print version: October 26, 2001, page A35.

New Scientist, on the use of genetic programming for applications in quantum computing. January 20, 2001.

The Orlando Sentinel, on robotic pets. "They Bark, They Byte. Robotic Rovers Are The Rage — Woof It Up With Our Computerized-Pets Guide." Friday, December 8, 2000.

Details magazine, on the possibility of computers having senses of humor. "Take My Hard Drive... Please; A computer may have beaten chess champion Garry Kasparov, but will one ever be able to tell a joke?" March, 2000.

The Daily Hampshire Gazette, on the importance of computers in the 20th century. "It was a century for invention." January 1/2, 2000.

Salon.com on-line magazine, on genetic programming applications to quantum computing and jazz composition. "Software that Writes Software." August 10, 1999.
http://www.salon.com/tech/feature/1999/08/10/genetic_programming/index.html

Scientific American, on the use of "cultures" in genetic programming and on ontogenetic programming. "Programming With Primordial Ooze." October, 1996.

Memberships

Association for Computing Machinery
American Association for Artificial Intelligence
ACM SIGEVO (formerly the International Society for Genetic and Evolutionary Computation)