

# Curriculum Vitae

## Pat Langley

### Personal Information

#### *ASU Address:*

School of Computing and Informatics  
Arizona State University, Tempe, AZ 85287  
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Age: 55                      Citizenship: U.S.A.

#### *ISLE Address:*

Institute for the Study of Learning and Expertise  
2164 Staunton Court, Palo Alto, CA 94306  
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### Education

Carnegie Mellon University, M.S., 1976, Ph.D., 1980, Cognitive Psychology

Texas Christian University, B.A., 1975, Mathematics and Psychology

### Employment/Administrative History

Professor of Computing and Informatics / Psychology, Arizona State University, Tempe, Arizona  
(8/06–present)

Director and President, Institute for the Study of Learning and Expertise, Palo Alto, CA (9/88–present)

Consulting Professor of Symbolic Systems, Stanford University, and Head, Computational Learning  
Laboratory, Center for the Study of Language and Information (1/1/97–present)

Head, Adaptive Systems Group, DaimlerChrysler Research & Technology Center (9/1/96–10/31/00)

Senior Research Associate, Robotics Laboratory, Stanford University (1/94–9/96)

Senior Scientist, Learning Systems Department, Siemens Corporate Research (12/92–12/93)

Senior Scientist, AI Research Branch, NASA Ames Research Center (9/89–9/92)

Associate Professor, Department of Computer Science, University of California, Irvine, CA (7/84–6/91)

Research Scientist, The Robotics Institute, Carnegie Mellon University, Pittsburgh, PA (9/81–6/84)

Research Associate, Department of Psychology, Carnegie Mellon University, Pittsburgh, PA (9/79–8/81)

### Grants and Contracts

AN INTRODUCTORY COURSE IN SCIENCE INFORMATICS, Microsoft Research [\$50,000] 5/1/08 – 4/30/10  
SYMPOSIUM ON COMPUTATIONAL APPROACHES TO CREATIVITY IN SCIENCE, NSF [\$18,000] 2/1/08  
– 1/31/09 (Co-PI W. Bridewell)

COMPUTATIONAL APPROACHES TO CREATIVITY THROUGH GOAL-DIRECTED CROSS-DOMAIN ANAL-  
OGY, NSF [\$199,828] 8/16/07 – 8/15/09 (Co-PI S. Kambhampati)

LEARNING HIERARCHICAL TASK MODELS FROM BEHAVIORAL TRACES, Defense Advanced Research  
Projects Agency [\$1,045,367] 4/1/06 – 3/31/10 (Subcontract through BBN, PI M. Burstein)

TRANSFER LEARNING IN INTEGRATED COGNITIVE SYSTEMS, Defense Advanced Research Projects  
Agency [\$12,242,291] 10/1/05 – 9/30/08 (Co-PIs P. Domingos, L. Holder, and others)

LEARNING HIERARCHICAL RELATIONAL SKILLS FROM KNOWLEDGE AND EXPERIENCE, Defense Ad-  
vanced Research Projects Agency [\$1,571,070] 11/1/03 – 10/31/06

COMPUTATIONAL INDUCTION OF SCIENTIFIC PROCESS MODELS, NSF [\$2,650,000] 9/15/03 – 9/14/09  
(Co-PIs K. Arrigo and B. Widrow)

NEW RESEARCH DIRECTIONS IN INTEGRATED COGNITIVE ARCHITECTURES, NSF [\$99,271] 9/1/03 –  
6/30/05

COMBINING SHALLOW SEMANTICS AND DOMAIN KNOWLEDGE, Scottish Enterprise through Edinburgh  
University and Stanford University [\$351,000] 4/1/2004 – 3/31/2007 (Co-PI C. Manning)

- SYMPOSIUM ON REASONING AND LEARNING IN COGNITIVE SYSTEMS, ONR [\$5,100], NSF [\$4,500] 3/1/04 – 2/28/05 (Co-PI S. Rogers)
- SYMPOSIUM ON MACHINE LEARNING FOR ANOMALY DETECTION, NSF [\$5,600] 5/1/04 – 11/1/04 (Co-PI S. Bay)
- SYMPOSIUM ON ADVANCES IN COGNITIVE ARCHITECTURES, DARPA [\$10,000], NSF [\$7,510] 3/1/03 – 2/28/04 (Co-PI D. Shapiro)
- INTERACTIVE COMPUTATIONAL ASSISTANT FOR VIDEO SEGMENTATION AND CLASSIFICATION, Media X, Stanford University [\$22,129] 4/1/2003 – 8/31/2003 (Co-PIs C. Manning and M. Gervasio)
- COMPUTATIONAL DISCOVERY OF COMMUNICABLE KNOWLEDGE, Nippon Telegraph and Telephone Company [\$623,657] 10/16/00 – 10/15/05
- COMPUTATIONAL TECHNIQUES FOR RECONSTRUCTION AND DISCOVERY OF METABOLIC, SIGNAL TRANSDUCTION, AND EVOLUTIONARY PATHWAYS, NASA Ames Research Center [\$348,500] 7/1/01 – 6/30/04 (Co-PIs A. Pohorille and J. Shrager)
- FILTERING INFORMATION IN COMPLEX TEMPORAL DOMAINS, NASA Ames Research Center [\$776,000] 3/1/01 – 7/31/04
- COMPUTATIONAL DISCOVERY OF KNOWLEDGE IN EARTH SCIENCE, NASA Ames Research Center [\$175,000] 7/1/99 – 3/31/01
- ADAPTIVE USER INTERFACES FOR CRISIS RESPONSE TASKS, Office of Naval Research [\$580,000] 8/1/99 – 7/31/01
- ADAPTIVE CRISIS RESPONSE: INTELLIGENT ASSISTANTS FOR JOINT-FORCE CRISIS RESPONSE, Office of Naval Research [\$3,000,000] 9/1/96 – 8/31/99 (co-PI M. Fehling)
- LEARNING OBJECT MODELS FROM VISUAL OBSERVATION AND BACKGROUND KNOWLEDGE, Office of Naval Research and ARPA [\$615,832] 6/1/94 – 3/31/00 (co-PI T. Binford)
- MACHINE LEARNING FOR ROBOTIC LOCALIZATION AND NAVIGATION, Office of Naval Research [\$281,658] 3/1/94 – 2/28/97
- COMPUTATIONAL MODELS OF HUMAN LEARNING WITH INSTRUCTIONAL RELEVANCE, Air Force Office of Scientific Research [\$308,167] 1/1/94 – 12/31/97 (co-PI N. Nilsson)
- WORKSHOP ON FIELDIED APPLICATIONS OF MACHINE LEARNING, Office of Naval Research [\$4,800] 6/1/93 – 12/31/93 (Co-PI Y. Kodratoff)
- SYMPOSIUM ON LEARNING METHODS FOR PLANNING AND SCHEDULING, DARPA [\$5,200], ONR [\$5,100], AAAI [\$5,000] 1/1/91 – 12/31/91 (Co-PI S. Minton)
- SYMPOSIUM ON COMPUTATIONAL APPROACHES TO CONCEPT FORMATION, NSF [\$5,000], ONR [\$5,000], AAAI [\$5,000] 1/1/90 – 12/31/90 (Co-PI D. Fisher)
- SYMPOSIUM ON COMPUTATIONAL MODELS OF SCIENTIFIC DISCOVERY, National Science Foundation [\$7,300], Office of Naval Research [\$5,000], American Association for Artificial Intelligence [\$5,000] 1/1/89 – 12/31/89 (Co-PI J. Shrager)
- FOURTH INTERNATIONAL WORKSHOP ON MACHINE LEARNING, NSF [\$7,001], ONR [\$5,000], DARPA [\$5,000], AAAI [\$10,000] 1/1/87 – 12/31/87
- A LABORATORY FOR SOFTWARE RESEARCH, National Science Foundation Coordinated Experimental Research Grant, 7/1/86 – 6/30/91 [\$3,131,000] (Co-PI's P. Freeman, N. Leveson, R. Razouk, R. Selby, T. Standish, R. Taylor)
- LEARNING IN A REACTIVE ENVIRONMENT, DARPA, 7/1/85 – 8/30/86 [\$250,127], Army Research Institute [\$1,381,907] 9/1/85 – 8/31/90 (Co-PI's D. Kibler and R. Granger)
- MACHINE LEARNING RESEARCH, Hughes Aircraft, [\$60,000] 7/1/85 – 6/30/87 (Co-PI D. Kibler)
- FOCUSED RESEARCH PROGRAM IN COMPUTATION AND LEARNING, University of California, Irvine [\$100,000] 7/1/85 – 6/30/88 (Co-PI K. Wexler)
- THE EFFECT OF MULTIPLE KNOWLEDGE SOURCES ON LEARNING AND TEACHING, Office of Naval Research [\$324,926] 7/1/85 – 6/30/88 (Co-PI D. Kibler)

RESEARCH IN MACHINE LEARNING, ONR [\$375,000] 1/1/84 – 12/31/86 (Co-PI J. G. Carbonell)  
 MODELING THE STRATEGIES OF MATHEMATICS STUDENTS, ONR [\$203,425] 12/1/82 – 11/30/84  
 DATA-DRIVEN DISCOVERY OF EMPIRICAL LAWS, Office of Naval Research [\$205,674] 2/15/82 – 12/31/83  
 (Co-PI H. A. Simon)

## Research Interests

Computational scientific discovery	Cognitive architectures for intelligent agents
Computational biology and ecology	Computational models of human learning
Learning and problem solving	Concept formation and retrieval
Adaptive interfaces and personalization	Applications of machine learning
Experimental study of learning algorithms	Average-case analysis of learning algorithms

## Professional Memberships

American Association for Artificial Intelligence (Fellow)  
 Cognitive Science Society (Fellow)  
 Association for Computing Machinery (SIG for Knowledge Discovery and Data Mining)

## Courses Taught *(at UCI, Stanford University, and Arizona State University)*

Cognitive Systems and Intelligent Agents – Spring, 2007, 2008, 2009  
 Introduction to Artificial Intelligence – Winter, 1985; Fall, 1986, 1987  
 AI Projects/Programming Techniques – Winter, 1986; Spring, 1986, 1988  
 Introduction to Machine Learning – Spring, 1985, 1986, 1987, 1991; Winter, 1995; Spring, 1996  
 Production System Models of Learning and Development – Winter, 1987  
 Projects in Artificial Intelligence – Spring, 1986  
 Readings/Projects in Artificial Intelligence – Fall, 1985, 1986; Spring, 1986  
 Experimental Methodologies for Machine Learning – Winter, 1988  
 Computational Models of Learning and Development – Spring, 1995  
 Adaptive Interfaces and User Modeling – Spring, 1999, 2000  
 Causal Models in Biomedical Informatics – Winter, 2003  
 Reasoning and Learning in Cognitive Systems – Winter, 2004, 2005, 2006  
 Computational Approaches to Scientific Reasoning and Discovery – Spring, 2004, 2005

## Postdoctoral Mentorships

Brian Yamauchi (1995–1996)	Marcus Maloof (1996–1998)
Simon Handley (1997–1998)	Cindi Thompson (1998–2000)
Will Bridewell (2004–2008)	Ljupčo Todorovski (2004–2005)
Stuart Borrett (2005–2007)	Tolga Könik (2005–2008)
David Stracuzzi (2005–2007)	Stephen Racunas (2005–2007)

## Doctoral Committees *(completed dissertations in italics)*

<i>Douglas Fisher</i> , Member (1984–1987)	<i>Jeff Schlimmer</i> , Member (1985–1987)
<i>Randy Jones</i> , Chair (1985–1989)	<i>Bernd Nordhausen</i> , Chair (1985–1989)
<i>Wayne Iba</i> , Chair (1986–1991)	<i>John Gennari</i> , Chair (1986–1990)
<i>James Wogulis</i> , Member (1986–1990)	Patrick Young, Chair (1986–1988)
Kevin Thompson, Chair (1986–1992)	<i>Donald Rose</i> , Chair (1984–1989)
<i>Klaus Gross</i> , Member (1989–1991)	John Allen, Chair (1988–1992)
<i>Ron Kohavi</i> , Member (1996)	<i>George John</i> , Member (1994–1997)
<i>Ofer Maitan</i> , Member (1997)	<i>Daniel Shapiro</i> , Co-Chair (1997–2000)
Dongkyu Choi, Chair (2003–2009)	Nima Asgharbeygi, Co-Chair (2004–2009)
Oren Shiran, Co-Chair (2003–2005)	Negin Nejati, Co-Chair (2003–2009)
Nan Li, Chair (2006–2009)	Chunki Park, Co-Chair (2005–2009)

## Professional Service

Reviewer, National Science Foundation, 1986–1988, 1991, 1994, 1998, 2002, 2004, 2005  
Reviewer, International Joint Conference on Artificial Intelligence, 1983, 1985, 1987, 1989, 1995, 2001  
Program committee, International Joint Conference on Artificial Intelligence, 1989  
Program committee, National Conference on Artificial Intelligence, 1987–1988, 1991, 1996–1997, 2005, 2007  
Program chair, International Workshop/Conference on Machine Learning, 1987, 2000  
Program committee, International Conference on Machine Learning, 1988/89, 1991/93/97, 2000/02/03/04/05  
Reviewer, Annual Conference of the Cognitive Science Society, 1985, 1993, 1994, 2004  
Reviewer, *Cognitive Science*, 1986, 1987, 1994, 2001–2008  
Editorial board, *Cognitive Science*, 2003–2005  
Reviewer, *Artificial Intelligence*, 1986, 1988, 1993, 1994  
Associate, *Behavioral and Brain Sciences*, 1987–1991  
Executive Editor, *Machine Learning*, 1985–1988  
Editor, *Machine Learning*, 1989–1990, 1996–1998  
Editorial board, *Machine Learning*, 1985–2009  
Editorial board, *Journal of Artificial Intelligence Research*, 1993–1996  
Reviewer, *Journal of Artificial Intelligence Research*, 1993–1996, 2003, 2005  
Editorial board, *Knowledge Discovery and Data Mining*, 1996–2009  
Editor, Morgan Kaufmann Series in Machine Learning, 1990–1999  
Co-organizer, Symposium on Computational Models of Scientific Discovery, 1989  
Co-organizer, Symposium on Computational Approaches to Concept Formation, 1990  
Co-organizer, Symposium on Learning Methods for Planning and Scheduling, 1991  
Co-organizer, Workshop on Fielded Applications of Machine Learning, 1993  
Organizing committee, AAAI Spring Symposium on Integrated Intelligent Architectures, 1991  
Program committee, International Conference on AI Planning Systems, 1992, 1994, 1996, 2004  
Co-presenter – AAAI/IJCAI Tutorial on Machine Learning – 1985, 1986, 1988, 1992  
Organizer and co-presenter – CSLI Tutorial on Applications of Machine Learning – 1994–1996, 1998  
Organizing committee, AAAI Workshop on Computational Models of Human Learning, 1996  
Co-editor, special issue of *Machine Learning* on learning with probabilistic representations, 1997  
Program co-chair, Nineteenth Annual Conference of the Cognitive Science Society, 1997  
Co-organizer, Symposium on Applications of Reinforcement Learning, 1998  
Organizer, Symposium on Computational Discovery of Communicable Knowledge, 2001  
Co-organizer, Symposium on Advances in Cognitive Architectures, 2003  
Co-organizer, Symposium on Reasoning and Learning in Cognitive Systems, 2004  
Co-organizer, Symposium on Machine Learning for Anomaly Detection, 2004

## University Service

Industrial Affiliates Committee (Chair), ICS Department, UCI, 1984–1985  
Faculty Chair, ICS Department, UCI, 1984–1985  
Computing Resources Committee, ICS Department, UCI, 1985–1986  
Executive Committee, ICS Department, UCI, 1985–1986  
Organizer, Seminar on Computational Learning and Adaptation, Stanford University, 1994–2006  
Consulting Professor, Symbolic Systems Program, Stanford University – 1996–2005  
Symbolic Systems Program Masters Committee, Stanford University, 1997–1998  
CSLI Distinguished Lecture Series Committee, Stanford University, 1999–2001  
CSLI Advisory Committee, Stanford University, 2003–2007  
Executive Committee, Department of Computer Science, Arizona State University, 2008–2009

## Books

- [1] Langley, P. (Ed.) (2000). *Proceedings of the Seventeenth International Conference on Machine Learning*. Stanford, CA: Morgan Kaufmann.
- [2] Shafto, M. G., & Langley, P. (Eds.) (1997). *Proceedings of the Nineteenth Annual Conference of the Cognitive Science Society*. Mahwah, NJ: Lawrence Erlbaum.
- [3] Langley, P. (1995). *Elements of Machine Learning*. San Francisco: Morgan Kaufmann.
- [4] Fisher, D. H., Pazzani, M. J., & Langley, P. (Eds.) (1991). *Concept Formation: Knowledge and Experience in Unsupervised Learning*. San Francisco: Morgan Kaufmann.
- [5] Shrager, J., & Langley, P. (Eds.) (1990). *Computational Models of Scientific Discovery and Theory Formation*. San Francisco: Morgan Kaufmann.
- [6] Langley, P. (Ed.) (1987). *Proceedings of the Fourth International Workshop on Machine Learning*. San Francisco: Morgan Kaufmann.
- [7] Langley, P., Simon, H. A., Bradshaw, G. L., & Żytkow, J. M. (1987). *Scientific Discovery: Computational Explorations of the Creative Processes*. Cambridge, MA: MIT Press.
- [8] Klahr, D., Langley, P., & Neches, R. (Eds.) (1987). *Production System Models of Learning and Development*. Cambridge, MA: MIT Press.

## Refereed Journal Articles

- [1] Könik, T., O’Rorke, P., Shapiro, D., Choi, D., Nejati, N., & Langley, P. (in press). Skill transfer through goal-driven representation mapping. *Cognitive Systems Research*.
- [2] Langley, P., Choi, D., & Rogers, S. (in press). Acquisition of hierarchical reactive skills in a unified cognitive architecture. *Cognitive Systems Research*.
- [3] Langley, P., Laird, J. E., & Rogers, S. (2009). Cognitive architectures: Research issues and challenges. *Cognitive Systems Research*, 10, 141–160.
- [4] Cassimatis, N. L., Bello, P., & Langley, P. (2008). Ability, breadth and parsimony in computational models of higher-order cognition. *Cognitive Science*, 32, 1304–1322.
- [5] Bridewell, W., Langley, P., Todorovski, L., & Džeroski, S. (2008). Inductive process modeling. *Machine Learning*, it 71, 1–32.
- [6] Bridewell, W., Billman, D., Sánchez, J. N., & Langley, P. (2006). An interactive environment for the modeling and discovery of scientific knowledge. *International Journal of Human-Computer Studies*, 64, 1099–1114.
- [7] Langley, P., Shiran, O., Shrager, J., Todorovski, L., & Pohorille, A. (2006). Constructing explanatory process models from biological data and knowledge. *Artificial Intelligence in Medicine*, 37, 191–201.
- [8] Langley, P., & Choi, D. (2006). Learning recursive control programs from problem solving. *Journal of Machine Learning Research*, 7, 493–518.
- [9] Asgharbeygi, N., Bay, S., Langley, P., & Arrigo, K. (2006). Inductive revision of quantitative process models. *Ecological Modelling*, 194, 70–79.
- [10] Jones, R. M., & Langley, P. (2005). A constrained architecture for learning and problem solving. *Computational Intelligence*, 21, 480–502.
- [11] Schroedl, S., Wagstaff, K., Rogers, S., Langley, P., & Wilson, C. (2004). Mining GPS traces for map refinement. *Knowledge Discovery and Data Mining*, 9, 59–87.
- [12] Thompson, C. A., Göker, M. H., & Langley, P. (2004). A personalized system for conversational recommendations. *Journal of Artificial Intelligence Research*, 21, 393–428.
- [13] Ichise, R., Shapiro, D., & Langley, P. (2004). Structured program induction from behavioral traces. *IEICE Transactions on Information and Systems*, J87-D-1, 730–740 (in Japanese).
- [14] Todorovski, L., Džeroski, S., Langley, P., & Potter, C. (2003). Using equation discovery to revise an Earth ecosystem model of carbon net production. *Ecological Modelling*, 170, 141–154.

- [15] Bay, S. D., Shragar, J., Pohorille, A., & Langley, P. (2003). Revising regulatory networks: From expression data to linear causal models. *Journal of Biomedical Informatics*, *35*, 289–297.
- [16] Maloof, M. A., Langley, P., Binford, T. O., Nevatia, R., & Sage, S. (2003). Improved rooftop detection in aerial images with machine learning. *Machine Learning*, *53*, 157–191.
- [17] Langley, P. (2000). The computational support of scientific discovery. *International Journal of Human-Computer Studies*, *53*, 393–410.
- [18] Kocabas, S., & Langley, P. (2000). Computer generation of process explanations in nuclear astrophysics. *International Journal of Human-Computer Studies*, *53*, 377–392.
- [19] Blum, A. L., & Langley, P. (1997). Selection of relevant features and examples in machine learning. *Artificial Intelligence*, *97*, 245–271.
- [20] Yamauchi, B., & Langley, P. (1997). Place recognition in dynamic environments. *Journal of Robotic Systems*, *14*, 107–120.
- [21] Langley, P., Pflieger, K., & Sahami, M. (1997). Lazy acquisition of place knowledge. *Artificial Intelligence Review*, *11*, 315–342.
- [22] Langley, P., & Simon, H. A. (1995). Applications of machine learning and rule induction. *Communications of the ACM*, *38*, November, 55–64.
- [23] Nordhausen, B., & Langley, P. (1993). An integrated framework for empirical discovery. *Machine Learning*, *12*, 17–47.
- [24] Langley, P., & Żytkow, J. M. (1989). Data-driven approaches to empirical discovery. *Artificial Intelligence*, *40*, 283–312.
- [25] Gennari, J. H., Langley, P., & Fisher, D. H. (1989). Models of incremental concept formation. *Artificial Intelligence*, *40*, 11–61.
- [26] Iba, W., & Langley, P. (1987). A computational theory of motor learning. *Computational Intelligence*, *3*, 338–350.
- [27] Żytkow, J. M., Langley, P., & Simon, H. A. (1987). Computer system of discovery STAHL. *Studia Filozoficzne or Zagadnienia Naukoznawstwa*, *23*, 518–536.
- [28] Rose, D., & Langley, P. (1986). Chemical discovery as belief revision. *Machine Learning*, *1*, 423–451.
- [29] Langley, P. (1985). Learning to search: From weak methods to domain-specific heuristics. *Cognitive Science*, *9*, 217–260.
- [30] Langley, P., Larson, P., Silas, S., & Wertz, S. (1983). A proof of CNQNP from CPQ by the rule of detachment in Jeffrey’s system 5.6. *International Logic Review*, *14*, 37–40.
- [31] Bradshaw, G. L., Langley, P., & Simon, H. A. (1983). Studying scientific discovery by computer simulation. *Science*, *222*, 971–975.
- [32] Langley, P. (1983). Representational issues in learning systems. *IEEE Computer*, *16*, 47–51.
- [33] Langley, P. (1983). Learning search strategies through discrimination. *International Journal of Man-Machine Studies*, *18*, 513–541.
- [34] Langley, P. (1982). Language acquisition through error recovery. *Cognition and Brain Theory*, *5*, 211–255.
- [35] Simon, H. A., Langley, P., & Bradshaw, G. L. (1981). Scientific discovery as problem solving. *Synthese*, *47*, 1–27.
- [36] Langley, P. (1981). Data-driven discovery of physical laws. *Cognitive Science*, *5*, 31–54.
- [37] Langley, P., Neches, R., Neves, D., & Anzai, Y. (1980). A domain-independent framework for learning procedures. *International Journal of Policy Analysis and Information Systems*, *4*, 163–197.
- [38] Langley, P. (1979). A production system model for the induction of mathematical functions. *Behavioral Science*, *24*, 121–139.

## Refereed Conference Papers

- [1] Li, N., Stracuzzi, D., & Langley, P. (2008). Learning conceptual predicates for teleoreactive logic programs. *Proceedings of the Eighteenth International Conference on Inductive Logic Programming: Late-Breaking Papers*. Prague: Springer.
- [2] Li, N., Choi, D., & Langley, P. (2007). Adding goal priorities to teleoreactive logic programs. *Proceedings of the First International Symposium on Skill Science*. Tokyo, Japan.
- [3] Könik, T., Choi, D., Shapiro, D., Park, C., Nejati, N., Langley, P., & Stracuzzi, D. (2007). Structural transfer of cognitive skills. *Proceedings of the Eighth International Conference on Cognitive Modeling*. Ann Arbor, MI.
- [4] Choi, D., Könik, T., Nejati, N., Park, C., & Langley, P. (2007). A believable agent for first-person shooter games. *Proceedings of the Third Annual Artificial Intelligence and Interactive Digital Entertainment Conference* (pp. 71–73). Stanford, CA: AAAI Press.
- [5] Bridewell, W., Langley, P., Racunas, S., & Borrett, S. R. (2006). Learning process models with missing data. *Proceedings of the Seventeenth European Conference on Machine Learning* (pp. 557–565). Berlin: Springer.
- [6] Langley, P., & Choi, D. (2006). A unified cognitive architecture for physical agents. *Proceedings of the Twenty-First National Conference on Artificial Intelligence*. Boston: AAAI Press.
- [7] Nejati, N., Langley, P., & Könik, T. (2006). Learning hierarchical task networks by observation. *Proceedings of the Twenty-Third International Conference on Machine Learning* (pp. 665–672). Pittsburgh, PA.
- [8] Asgharbeygi, N., Langley, P., & Stracuzzi, D. (2006). Relational temporal difference learning. *Proceedings of the Twenty-Third International Conference on Machine Learning* (pp. 49–56). Pittsburgh, PA.
- [9] Choi, D., & Langley, P. (2005). Learning teleoreactive logic programs from problem solving. *Proceedings of the Fifteenth International Conference on Inductive Logic Programming* (pp. 51–68). Bonn, Germany: Springer.
- [10] Bridewell, W., Bani Asadi, N., Langley, P., & Todorovski, L. (2005). Reducing overfitting in process model induction. *Proceedings of the Twenty-Second International Conference on Machine Learning* (pp. 81–88). Bonn, Germany.
- [11] Asgharbeygi, N., Nejati, N., Langley, P., & Arai, S. (2005). Guiding inference through relational reinforcement learning. *Proceedings of the Fifteenth International Conference on Inductive Logic Programming* (pp. 20–37). Bonn, Germany: Springer.
- [12] Todorovski, L., Shiran, O., Bridewell, W., & Langley, P. (2005). Inducing hierarchical process models in dynamic domains. *Proceedings of the Twentieth National Conference on Artificial Intelligence* (pp. 892–897). Pittsburgh, PA: AAAI Press.
- [13] Langley, P., & Rogers, S. (2005). An extended theory of human problem solving. *Proceedings of the Twenty-seventh Annual Meeting of the Cognitive Science Society*. Stresa, Italy.
- [14] Langley, P., & Rogers, S. (2004). Cumulative learning of hierarchical skills. *Proceedings of the Third International Conference on Development and Learning*. San Diego, CA.
- [15] Langley, P., & Cummings, K. (2004). Hierarchical skills and cognitive architectures. *Proceedings of the Twenty-Sixth Annual Conference of the Cognitive Science Society* (pp. 779–784). Chicago, IL.
- [16] Choi, D., Kaufman, M., Langley, P., Nejati, N., & Shapiro, D. (2004). An architecture for persistent reactive behavior. *Proceedings of the Third International Joint Conference on Autonomous Agents and Multi Agent Systems* (pp. 988–995). New York: ACM Press.
- [17] Langley, P., Shrager, J., Asgharbeygi, N., Bay, S., & Pohorille, A. (2004). Inducing explanatory process models from biological time series. *Proceedings of the Ninth Workshop on Intelligent Data Analysis and Data Mining* (pp. 85–90). Stanford, CA.

- [18] Sanchez, J. N., & Langley, P. (2003). An interactive environment for scientific model construction. *Proceedings of the Second International Conference on Knowledge Capture* (pp. 138–145). Sanibel Island, FL: ACM Press.
- [19] George, D., Saito, K., Langley, P., Bay, S., & Arrigo, K. (2003). Discovering ecosystem models from time-series data. *Proceedings of the Sixth International Conference on Discovery Science* (pp. 141–152). Saporro, Japan: Springer.
- [20] Langley, P., George, D., Bay, S., & Saito, K. (2003). Robust induction of process models from time-series data. *Proceedings of the Twentieth International Conference on Machine Learning* (pp. 432–439). Washington, D.C.: AAAI Press.
- [21] Yoo, J., Gervasio, M., & Langley, P. (2003). An adaptive stock tracker for personalized trading recommendations. *Proceedings of the International Conference on Intelligent User Interfaces* (pp. 197–203). Miami, Florida.
- [22] Chrisman, L., Langley, P., Bay, S., & A. Pohorille (2003). Incorporating biological knowledge into evaluation of causal regulatory hypotheses. *Proceedings of the Pacific Symposium on Biocomputing* (pp. 128–139). Lihue, Hawaii.
- [23] Saito, K., Bay, S., & Langley, P. (2002). Revising qualitative models of gene regulation. *Proceedings of the Fifth International Conference on Discovery Science* (pp. 59–70). Lubeck, Germany: Springer.
- [24] Ichise, R., Shapiro, D. G., & Langley, P. (2002). Learning hierarchical skills from observation. *Proceedings of the Fifth International Conference on Discovery Science* (pp. 247–258). Lubeck, Germany: Springer.
- [25] Bay, S. D., Shapiro, D. G., & Langley, P. (2002). Revising engineering models: Combining computational discovery with knowledge. *Proceedings of the Thirteenth European Conference on Machine Learning* (pp. 10–22). Helsinki, Finland.
- [26] Langley, P., Sanchez, J., Todorovski, L., & Džeroski, S. (2002). Inducing process models from continuous data. *Proceedings of the Nineteenth International Conference on Machine Learning* (pp. 347–354). Sydney: Morgan Kaufmann.
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### Invited Chapters and Papers

- [1] Bridewell, W., Borrett, S. R., & Langley, P. (in press). Supporting the construction of dynamic scientific models. In A. Markman (Ed.), *Tools for innovation*. New York: Oxford University Press.
- [2] Langley, P., & Bridewell, W. (2008). An interdisciplinary curriculum in science informatics. In Y. Xu (Ed.), *Transform science - Computational education for scientists (Vol. 2): What to Teach?*. Redmond, WA: Microsoft Research.
- [3] Choi, D., Morgan, M., Park, C., & Langley, P. (2007). A testbed for evaluation of architectures for physical agents. *Proceedings of the AAAI-2007 Workshop on Evaluating Architectures for Intelligence*. Vancouver, BC: AAAI Press.
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- [5] Langley, P. (in press). Intelligent behavior in humans and machines. In J. Moor (Ed.), *AI at 50*. Publisher to be determined.
- [6] Langley, P. (in press). Artificial intelligence and cognitive systems. In P. Cohen (Ed.), *AI: The first hundred years*. Menlo Park, CA: AAAI Press.
- [7] Dietterich, T. G., & Langley, P. (2007). Machine learning for cognitive networks: Technology assessment and research challenges. In Q. Mahmoud (Ed.), *Cognitive networks: Towards self-aware networks*. New York: John Wiley.
- [8] Saito, K., & Langley, P. (2007). Quantitative revision of scientific models. In S. Džeroski & L. Todorovski (Eds.), *Computational discovery of communicable scientific knowledge*. Berlin: Springer.
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- [10] Džeroski, S., Langley, P., & Todorovski, L. (2007). Computational discovery of scientific knowledge. In S. Džeroski & L. Todorovski (Eds.), *Computational discovery of communicable scientific knowledge*. Berlin: Springer.
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- [12] Langley, P. (2005). An adaptive architecture for physical agents. *Proceedings of the 2005 IEEE/WIC/ACM International Conference on Intelligent Agent Technology* (pp. 18–25). Compiegne, France: IEEE Computer Society Press.
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- [29] Langley, P. (1992). Areas of application for machine learning. *Proceedings of the Fifth International Symposium on Knowledge Engineering*. Seville, Spain.
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### Non-Refereed Workshop and Symposium Papers

- [1] Langley, P., & Bridewell, W. (2008). Processes and constraints in explanatory scientific discovery. *Proceedings of the Thirtieth Annual Meeting of the Cognitive Science Society*. Washington, D.C.
- [2] Langley, P. (2007). Varieties of problem solving in a unified cognitive architecture. *Proceedings of the Twenty-Ninth Annual Meeting of the Cognitive Science Society*. Nashville, TN.
- [3] Asgharbaygi, N., Bay, S., Langley, P., & Arrigo, K. (2004). Computational revision of ecological process models. *Proceedings of the Fourth International Workshop on Environmental Applications of Machine Learning* (pp. 13–14). Bled, Slovenia.
- [4] Langley, P., & Messina, E. (2004). Experimental studies of integrated cognitive systems. *Proceedings of the Performance Metrics for Intelligent Systems Workshop*. Gaithersburg, MD.
- [5] Langley, P., Arai, S., & Shapiro, D. (2004). Model-based learning with hierarchical relational skills. *Proceedings of the ICML-2004 Workshop on Relational Reinforcement Learning*. Banff, Alberta.

- [6] Langley, P., Shapiro, D., Aycinena, M., & Siliski, M. (2003). A value-driven architecture for intelligent behavior. *Proceedings of the IJCAI-2003 Workshop on Cognitive Modeling of Agents and Multi-Agent Interactions* (pp. 10–18). Acapulco, Mexico.
- [7] Džeroski, S., & Langley, P. (2001). Computational discovery of communicable knowledge: Symposium report. *Proceedings of the Fourth International Conference on Discovery Science* (pp. 45–49). Washington, D.C.: Springer.
- [8] Rogers, S., Fiechter, C., & Langley, P. (1999). A route advice agent that models driver preferences. *Proceedings of the AAAI Spring Symposium on Agents with Adjustable Autonomy*. Stanford, CA: AAAI Press.
- [9] Ali, K. M., Langley, P., Maloof, M. A., Binford, T. O., & Sage, S. (1998). Improving rooftop detection with interactive visual learning. *Proceedings of the Image Understanding Workshop* (pp. 479–492). Monterrey, CA: Morgan Kaufmann.
- [10] Maloof, M. A., Langley, P., Binford, T. O., & Nevatia, R. (1998). Generalizing over aspect and location for rooftop detection. *Proceedings of the Fourth IEEE Workshop on Applications of Computer Vision* (pp. 194–199). Princeton, NJ: IEEE Press.
- [11] Kocabas, S., & Langley, P. (1998). Generating process explanations in nuclear astrophysics. *Proceedings of the ECAI-98 Workshop on Machine Discovery* (pp. 4–9). Brighton, UK.
- [12] Gervasio, M., Iba, W., & Langley, P. (1998). Case-based seeding for an interactive crisis response assistant. *Proceedings of the AAAI-98 Workshop on Case-Based Reasoning Integrations*. Madison, WI.
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