

Curriculum Vitae

Pat Langley

Personal Information

California Address:

Institute for the Study of Learning and Expertise
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Computer Science Dept., University of Auckland
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Citizenship: USA

Education

Carnegie Mellon University, M.S., 1976, Ph.D., 1979, Cognitive Psychology
Texas Christian University, B.A., 1975, Mathematics and Psychology

Employment/Administrative History

Director and President, Institute for the Study of Learning and Expertise, Palo Alto, CA (9/88–present)
Professor of Computer Science, University of Auckland, Auckland, NZ (6/12–12/15, Honorary from 1/16)
Distinguished Scientist, Carnegie Mellon University, Moffett Field, CA (8/12–5/15)
Professor of Computing and Informatics / Psychology, Arizona State University, Tempe, AZ (8/06–8/12)
Consulting Professor of Symbolic Systems, Stanford University, and Head, Computational Learning Laboratory, Center for the Study of Language and Information (1/1/97–9/09)
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, Contracts, and Gifts

SCALABLE INFERENCE OF AFFORDANCE, ACTIVITY, AND INTENT FROM SPATIO-TEMPORAL INPUT, ONR [\$245,645] 06/01/2017 – 5/31/2020 (subaward from University of Auckland, PI M. Sridharan)
AN ARCHITECTURE FOR RADICALLY AUTONOMOUS SYSTEMS, ONR [\$542,252] 07/01/2015 – 6/30/2018
INTERACTIVE CONSTRUCTION OF CASCADED CAUSAL MODELS, GE [\$50,000] 05/01/2016 – 12/31/2016
ACTIVE TRANSFER OF KNOWLEDGE FOR PROCESS MODELING, ONR [\$861,253] 10/1/2010 – 9/30/2016
AUTONOMOUS DISCOVERY OF OBJECT PROPERTIES: ROBOTS THAT CREATE SIMPLE MACHINES, ONR [\$211,797] 1/1/2012 – 7/31/2015 (subaward from Georgia Tech, PI M. Stilman)
MENTAL SIMULATION AND LEARNING IN THE ICARUS ARCHITECTURE, ONR [\$538,952] 2/1/2012 – 6/30/2015
UNDERSTANDING AND AIDING PROBLEM FORMULATION IN CREATIVE CONCEPTUAL DESIGN, NSF [\$741,000] 8/1/10 – 7/31/15 (Co-PIs J. Shah and E. Campana)
A UNIFIED COMPUTATIONAL THEORY OF LANGUAGE AND COGNITION, Office of Naval Research (MURI program) [~\$4,400,000] 6/1/09 – 5/31/12 (co-PI's N. Cassimatis, J. Hobbs, S. Nirenburg)
SOFTWARE INTEGRATION FOR COMPUTATIONAL COGNITIVE MODELS IN VIRTUAL ENVIRONMENTS, AFOSR [\$228,702] 7/1/09 – 9/14/11 (Subcontract through SET Corporation, PI A. Pope)
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)
- EFFECTIVE HUMAN-ROBOT INTERACTION UNDER TIME PRESSURE THROUGH ROBUST NATURAL LANGUAGE DIALOGUE AND DYNAMIC AUTONOMY, ONR [~\$2,500,000] 10/1/2007 – 9/30/2012 (Subaward through Indiana University, PI M. Scheutz)
- COMPUTATIONAL APPROACHES TO CREATIVITY THROUGH GOAL-DIRECTED CROSS-DOMAIN ANALOGY, NSF [\$199,828] 8/16/07 – 2/28/10 (Co-PI S. Kambhampati)
- LEARNING HIERARCHICAL TASK MODELS FROM BEHAVIORAL TRACES, Defense Advanced Research Projects Agency [\$1,045,367] 4/1/06 – 3/31/09 (Subcontract through BBN, PI M. Burstein)
- TRANSFER LEARNING IN INTEGRATED COGNITIVE SYSTEMS, Defense Advanced Research Projects Agency [\$12,242,291] 10/1/05 – 4/30/10 (Co-PIs P. Domingos, L. Holder, and others)
- LEARNING HIERARCHICAL RELATIONAL SKILLS FROM KNOWLEDGE AND EXPERIENCE, Defense Advanced 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 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 FIELDED APPLICATIONS OF MACHINE LEARNING, ONR [\$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, NSF [\$7,300], ONR [\$5,000], AAAI [\$5,000] 1/1/89 – 12/31/89 (Co-PI J. Shrager)

FOURTH INTERNATIONAL WORKSHOP ON MACHINE LEARNING, National Science Foundation [\$7,001], Office of Naval Research [\$5,000], Defense Advanced Research Projects Agency [\$5,000], American Association for Artificial Intelligence [\$10,000], 1/1/87 – 12/31/87

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 R. Taylor, R. Selby, et al.)

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)

AN INFORMATION PROCESSING THEORY OF PROCEDURAL LEARNING, National Science Foundation, Division of Information Science and Technology, 9/1/79 – 8/31/81 [\$53,715]

Research Interests

Unified cognitive architectures	Computational scientific discovery
Computational models of human cognition	Science informatics and e-science
Problem solving and reasoning	Computational biology and ecology
Synthetic characters for virtual environments	Human-robot interaction
Machine learning and induction	Adaptive interfaces and personalization

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, Arizona State University, and University of Auckland)

Introduction to Artificial Intelligence – Winter, 1985; Fall, 1986, 1987, 2013, 2014
 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
 Cognitive Systems and Intelligent Agents – Spring, 2007, 2008, 2009, Fall, 2009, 2011, Spring, 2014
 Introduction to Science Informatics – Spring, 2009; Decision Making and Modeling – Spring, 2012
 Machine Learning and Data Mining – Fall, 2012; Introduction to Cyberspace – Fall, 2013, 2014
 Interactive Cognitive Systems – Spring, 2014, 2015

Postdoctoral Mentorships

Brian Yamauchi (1995–1996)	Marcus Maloof (1996–1998)
David Moriarty (1996–1997)	Simon Handley (1997–1998)
Cindi Thompson (1998–2000)	Melinda Gervasio (1997–2000)
Stephen Bay (2001–2004)	Will Bridewell (2004–2009)
Ljupčo Todorovski (2004–2005)	Stuart Borrett (2005–2007)
Tolga Könik (2005–2010)	Stephen Racunas (2005–2007)
David Stracuzzi (2005–2007)	Alfredo Gabaldon (2012–2014)

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)
Oren Shiran, Co-Chair (2003–2005)	<i>Nan Li</i> , Chair (2006–2009), Member (2012–2013)
<i>Dongkyu Choi</i> , Chair (2003–2010)	<i>Negin Nejati</i> Co-Chair (2003–2011)
Nima Asgharbeygi, Co-Chair (2004–2011)	<i>Chunki Park</i> , Co-Chair (2005–2013)
<i>Archana Ramesh</i> , Member (2009–2010)	<i>Mahmoud Dinar</i> , Member (2014–2015)
Adam Arvay, Chair (2013–2017)	<i>Christopher MacLellan</i> , Member (2012–2017)

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

Professional Service

Founding Executive Editor, *Machine Learning*, 1985–1988
Editor, *Machine Learning*, 1989–1990, 1996–1998
Editor, Morgan Kaufmann Series in Machine Learning, 1990–1999
Founding Editor, *Advances in Cognitive Systems*, 2012–2017
Program co-chair, Nineteenth Annual Conference of the Cognitive Science Society, 1997
Program chair, AAAI Fall Symposium on Advances in Cognitive Systems, 2011
Program chair, First Annual Conference on Advances in Cognitive Systems, 2012
Co-editor, special issue of *Machine Learning* on learning with probabilistic representations, 1997
Associate, *Behavioral and Brain Sciences*, 1987–1991
Editorial board, *Machine Learning*, 1985–2017
Editorial board, *Knowledge Discovery and Data Mining*, 1996–2017
Editorial board, *Cognitive Science*, 2003–2005
Editorial board, *Journal of Artificial Intelligence Research*, 1993–1996
Reviewer, National Science Foundation, 1986–1988, 1991, 1994, 1998, 2002, 2004, 2005
Reviewer, *Artificial Intelligence*, 1986, 1988, 1993, 1994
Reviewer, International Joint Conference on Artificial Intelligence, 1983, 1985, 1987, 1989, 1995, 2001
Program committee, International Joint Conference on Artificial Intelligence, 1989, 2017
Program committee, International Conference on AI Planning Systems, 1992, 1994, 1996, 2004
Program committee, AAAI Conference on Artificial Intelligence, 1987–1988, 1991, 1996–1997, 2005
Program co-chair, AAAI Integrated Intelligence track, 2007, 2008, 2010
Program chair, International Workshop/Conference on Machine Learning, 1987, 2000
Program committee, International Conference on Machine Learning, 1988/89, 1991/3/7, 2000/2/3/4/5
Reviewer, Annual Meeting of the Cognitive Science Society, 1985, 1993, 1994, 2004, 2010
Program committee, International Conference on the Foundations of Digital Games, 2009
Reviewer, *Cognitive Science*, 1986, 1987, 1994, 2001–2008
Reviewer, *Journal of Artificial Intelligence Research*, 1993–1996, 2003, 2005
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
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-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
Co-organizer, Symposium on Computational Approaches to Creativity in Science, 2008
Co-organizer, Symposium on Systems Biology of Aging, 2008

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. (1996). *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] Choi, D., & Langley, P. (2018). Evolution of the ICARUS architecture. *Cognitive Systems Research*, 48, 25–38.
- [2] Arvay, A., & Langley, P. (2016). Heuristic adaptation of quantitative process models. *Advances in Cognitive Systems*, 4, 207–226.
- [3] Dinar, M., Danieleescu, A., MacLellan, C., Shah, J. J., & Langley, P. (2015). Problem Map: An ontological framework for a computational study of problem formulation in engineering design. *Journal of Computing and Information Science in Engineering*, 15, 031007/1–10.
- [4] Langley, P., Meadows, B., Gabaldon, A., & Heald, R. (2014). Abductive understanding of dialogues about joint activities. *Interaction Studies*, 15, 426–454.
- [5] Meadows, B., Langley, P., & Emery, M. (2014). An abductive approach to understanding social interactions. *Advances in Cognitive Systems*, 3, 87–106.
- [6] Gabaldon, A., Langley, P., & Meadows, B. (2014). Integrating meta-level and domain-level knowledge for task-oriented dialogue. *Advances in Cognitive Systems*, 3, 201–219.
- [7] Langley, P., Pearce, C., Barley, M., & Emery, M. (2014). Bounded rationality in problem solving: Guiding search with domain-independent heuristics. *Mind and Society*, 13, 83–95.
- [8] MacLellan, C. J., Langley, P., Shah, J., Dinar, M. (2013). A computational aid for problem formulation in early conceptual design. *Journal of Computing and Information Science in Engineering*, 13, 031005/1–10.
- [9] Li, N., Stracuzzi, D. J., & Langley, P. (2012). Improving acquisition of teleoreactive logic programs through representation extension. *Advances in Cognitive Systems*, 1, 109–126.
- [10] Bridewell, W. & Langley, P. (2010). Two kinds of knowledge in scientific discovery. *Topics in Cognitive Science*, 2, 36–52.
- [11] Könik, T., O’Rorke, P., Shapiro, D., Choi, D., Nejati, N., & Langley, P. (2009). Skill transfer through goal-driven representation mapping. *Cognitive Systems Research*, 10, 270–285.
- [12] Langley, P., Choi, D., & Rogers, S. (2009). Acquisition of hierarchical reactive skills in a unified cognitive architecture. *Cognitive Systems Research*, 10, 316–332.

- [13] Langley, P., Laird, J. E., & Rogers, S. (2009). Cognitive architectures: Research issues and challenges. *Cognitive Systems Research*, 10, 141–160.
- [14] Cassimatis, N. L., Bello, P., & Langley, P. (2008). Ability, breadth and parsimony in computational models of higher-order cognition. *Cognitive Science*, 32, 1304–1322.
- [15] Bridewell, W., Langley, P., Todorovski, L., & Džeroski, S. (2008). Inductive process modeling. *Machine Learning*, 71, 1–32.
- [16] 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.
- [17] 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.
- [18] Langley, P., & Choi, D. (2006). Learning recursive control programs from problem solving. *Journal of Machine Learning Research*, 7, 493–518.
- [19] Asgharbeygi, N., Bay, S., Langley, P., & Arrigo, K. (2006). Inductive revision of quantitative process models. *Ecological Modelling*, 194, 70–79.
- [20] Jones, R. M., & Langley, P. (2005). A constrained architecture for learning and problem solving. *Computational Intelligence*, 21, 480–502.
- [21] Ichise, R., Shapiro, D., & Langley, P. (2005). Structured program induction from behavioral traces. *Systems and Computers in Japan*, 36, 49–59.
- [22] 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.
- [23] Thompson, C. A., Göker, M. H., & Langley, P. (2004). A personalized system for conversational recommendations. *Journal of Artificial Intelligence Research*, 21, 393–428.
- [24] 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.
- [25] Bay, S. D., Shrager, J., Pohorille, A., & Langley, P. (2003). Revising regulatory networks: From expression data to linear causal models. *Journal of Biomedical Informatics*, 35, 289–297.
- [26] 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.
- [27] Langley, P. (2000). The computational support of scientific discovery. *International Journal of Human-Computer Studies*, 53, 393–410.
- [28] Kocabas, S., & Langley, P. (2000). Computer generation of process explanations in nuclear astrophysics. *International Journal of Human-Computer Studies*, 53, 377–392.
- [29] Blum, A. L., & Langley, P. (1997). Selection of relevant features and examples in machine learning. *Artificial Intelligence*, 97, 245–271.
- [30] Yamauchi, B., & Langley, P. (1997). Place recognition in dynamic environments. *Journal of Robotic Systems*, 14, 107–120.
- [31] Langley, P., Pfeleger, K., & Sahami, M. (1997). Lazy acquisition of place knowledge. *Artificial Intelligence Review*, 11, 315–342.
- [32] Langley, P., & Simon, H. A. (1995). Applications of machine learning and rule induction. *Communications of the ACM*, 38, November, 55–64.
- [33] Nordhausen, B., & Langley, P. (1993). An integrated framework for empirical discovery. *Machine Learning*, 12, 17–47.

- [34] Langley, P., & Żytkow, J. M. (1989). Data-driven approaches to empirical discovery. *Artificial Intelligence*, 40, 283–312.
- [35] Gennari, J. H., Langley, P., & Fisher, D. H. (1989). Models of incremental concept formation. *Artificial Intelligence*, 40, 11–61.
- [36] Iba, W., & Langley, P. (1987). A computational theory of motor learning. *Computational Intelligence*, 3, 338–350.
- [37] Żytkow, J. M., Langley, P., & Simon, H. A. (1987). Computer system of discovery STAHL. *Studia Filozoficzne or Zagadnienia Naukoznawstwa*, 23, 518–536.
- [38] Rose, D., & Langley, P. (1986). Chemical discovery as belief revision. *Machine Learning*, 1, 423–451.
- [39] Langley, P. (1985). Learning to search: From weak methods to domain-specific heuristics. *Cognitive Science*, 9, 217–260.
- [40] 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.
- [41] Bradshaw, G. L., Langley, P., & Simon, H. A. (1983). Studying scientific discovery by computer simulation. *Science*, 222, 971–975.
- [42] Langley, P. (1983). Representational issues in learning systems. *IEEE Computer*, 16, 47–51.
- [43] Langley, P. (1983). Learning search strategies through discrimination. *International Journal of Man–Machine Studies*, 18, 513–541.
- [44] Langley, P. (1982). Language acquisition through error recovery. *Cognition and Brain Theory*, 5, 211–255.
- [45] Simon, H. A., Langley, P., & Bradshaw, G. L. (1981). Scientific discovery as problem solving. *Synthese*, 47, 1–27.
- [46] Langley, P. (1981). Data-driven discovery of physical laws. *Cognitive Science*, 5, 31–54.
- [47] 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.
- [48] Langley, P. (1979). A production system model for the induction of mathematical functions. *Behavioral Science*, 24, 121–139.

Refereed Conference Papers

- [1] Langley, P., Choi, D., Barley, M., Meadows, B., & Katz, E. P. (2017). Generating, executing, and monitoring plans with goal-based utilities in continuous domains. *Proceedings of the Fifth Annual Conference on Cognitive Systems*. Troy, NY.
- [2] Langley, P., & Cooper, R. P. (2017). Symposium on problem solving and goal-directed sequential activity. *Proceedings of the Thirty-Ninth Annual Meeting of the Cognitive Science Society*. London.
- [3] Langley, P. (2017). A cognitive systems analysis of personality and conversational style. *Proceedings of the Fifth Annual Conference on Cognitive Systems*. Troy, NY.
- [4] Langley, P., & Arvay, A. (2017). Flexible model induction through heuristic process discovery. *Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence* (pp. 4415–4421). San Francisco: AAAI Press.
- [5] Langley, P. (2017). Progress and challenges in research on cognitive architectures. *Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence* (pp. 4870–4876). San Francisco: AAAI Press.
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Invited Chapters and Papers

- [1] Langley, P. (in press). Interactive cognitive systems and social intelligence. *IEEE Expert*.
- [2] Gabaldon, A., Meadows, B., & Langley, P. (2015). Knowledge-guided interpretation and generation of task-oriented dialogue. In A. Raux, W. Minker, & I. Lane (Eds.), *Situated dialog in speech-based human-computer interaction*. Berlin: Springer.
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