Curriculum Vitae
Pat Langley

Personal Information

Institute for the Study of Learning and Expertise
2164 Staunton Court, Palo Alto, CA 94306 USA
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PATRICK.W.LANGLEY@GMAIL.COM
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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)

Research Scientist, Center for Design Research, Mechanical Engineering, Stanford University (8/00–7/03)

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

COMPUTATIONAL DISCOVERY OF SCIENTIFIC PROCESS MODELS, AFOSR [$435,000] 9/1/2023 – 8/31/2026

UNIFYING SYMBOLIC REASONING AND CONTINUOUS SPACE CONTROL IN ROBOTICS, ONR   [$269,963]
5/1/2023 – 4/30/2026 (subaward from University of Birmingham, PI M. Sridharan)

AN ARCHITECTURE FOR NORMATIVE, EXPLAINABLE, AND JUSTIFIED AGENCY, AFOSR   [$446,745]
8/1/2020 – 7/31/2023 (co-PIs L. Leifer)

RAPID ACQUISITION OF HIERARCHICAL PROCEDURES FROM INSTRUCTIONAL DOCUMENTS, ONR [$1,340,358]
5/18/2020 – 5/17/2023 (co-PIs H. Shrobe and B. Katz, MIT)

SCALABLE INFERENCE OF AFFORDANCE, ACTIVITY, AND INTENT FROM SPATIO-TEMPORAL INPUT, ONR
[$245,645] 06/01/2017 – 12/31/2020 (subaward from University of Auckland, PI M. Sridharan)

AN ARCHITECTURE FOR RADICALLY AUTONOMOUS SYSTEMS, ONR [$542,252] 07/01/2015 – 12/31/2018

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 from SET Corporation, PI A. Pope)

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. . . through Robust. . . Dialogue and Dynamic Autonomy, ONR [∼$2,500,000] 10/1/2007 – 9/30/2012 (Subaward from Indiana University, PI M. Scheutz)

Computational Approaches to Creativity through Goal-Directed Cross-Domain Analogy, National Science Foundation [$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 from 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, . . . , NASA Ames [$348,500] 7/1/01 – 6/30/04 (Co-PIs A. Pohorille and J. Shrager)

Filtering Information in Complex Temporal Domains, NASA Ames [$776,000] 3/1/01 – 7/31/04

Computational Discovery of Knowledge in Earth Science, NASA Ames [$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, ONR [$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, NSF 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, NSF 9/1/79 – 8/31/81 [$53,715]

Research Interests

Computational scientific discovery	Cognitive architectures for physical agents
Computational models of human cognition	Science informatics and e-science
Machine learning and induction	Recommender systems and personalization
Problem solving and reasoning	Computational biology and ecology
Synthetic characters for virtual environments	Interactive intelligent systems

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)*

Douglas Fisher, Member (1984–1987)	*Jeff Schlimmer*, Member (1985–1987)
Randy Jones, Chair (1985–1989)	*Bernd Nordhausen*, Chair (1985–1989)
Wayne Iba, Chair (1986–1991)	*John Gennari*, Chair (1986–1990)
James Wogulis, Member (1986–1990)	Patrick Young, Chair (1986–1988)
Kevin Thompson, Chair (1986–1992)	*Donald Rose*, Chair (1984–1989)
Klaus Gross, Member (1989–1991)	John Allen, Chair (1988–1992)
Ron Kohavi, Member (1996)	*George John*, Member (1994–1997)
Ofer Maitan, Member (1997)	*Daniel Shapiro*, Co-Chair (1997–2000)
Oren Shiran, Co-Chair (2003–2005)	*Nan Li*, Chair (2006–2009), Member (2012–2013)
Dongkyu Choi, Chair (2003–2010)	*Negin Nejati* Co-Chair (2003–2011)
Nima Asgharbeygi, Co-Chair (2004–2011)	*Chunki Park*, Co-Chair (2005–2013)
Archana Ramesh, Member (2009–2010)	*Mahmoud Dinar*, Member (2014–2015)
Adam Arvay, Chair (2013–2018)	*Christopher MacLellan*, 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*, 2012–2023

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

Program Co-chair, Sixth Annual Conference on Advances in Cognitive Systems, 2018

Co-editor, special issue of *Machine Learning* on learning with probabilistic representations, 1997

Associate, *Behavioral and Brain Sciences*, 1987–1991

Editorial board, *Machine Learning*, 1985–2023

Editorial board, *Knowledge Discovery and Data Mining*, 1996–2018

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, 2018

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

Co-Organizer, 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

Co-Organizer, AAAI Spring Symposium on Computational Approaches to Scientific Discovery, 2023

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] Langley, P., & Katz, E. P. (in press). Spatial representation and reasoning in an architecture for embodied agents. *Spatial Cognition and Computation*.

[2] Langley, P., Shrobe, H. E., & Katz, B. (in press). A cognitive task analysis of rapid procedure acquisition from instructional documents. *Advances in Cognitive Systems*.

[3] Langley, P. (2021). Agents of exploration and discovery. *AI Magazine*, *42*, 72–82.

[4] Langley, P., & Meadows, B. (2019). Heuristic construction of explanations through associative abduction. *Advances in Cognitive Systems*, *8*, 93–112.

[5] Langley, P. (2019). Scientific discovery, causal explanation, and process model induction. *Mind & Society*, *18*, 43–56.

[6] Langley, P., Barley, M., & Meadows, B. (2018). Adaptive search in a hierarchical problem-solving architecture. *Advances in Cognitive Systems*, *6*, 251–270.

[7] Choi, D., & Langley, P. (2018). Evolution of the ICARUS cognitive architecture. *Cognitive Systems Research*, *48*, 25–38.

[8] Arvay, A., & Langley, P. (2016). Heuristic adaptation of quantitative process models. *Advances in Cognitive Systems*, *4*, 207–226.

[9] Dinar, M., Danielescu, 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.

[10] Langley, P., Meadows, B., Gabaldon, A., & Heald, R. (2014). Abductive understanding of dialogues about joint activities. *Interaction Studies*, *15*, 426–454.

[11] Meadows, B., Langley, P., & Emery, M. (2014). An abductive approach to understanding social interactions. *Advances in Cognitive Systems*, *3*, 87–106.

[12] 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.

[13] 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.

[14] 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.

[15] Li, N., Stracuzzi, D. J., & Langley, P. (2012). Improving acquisition of teleoreactive logic programs through representation extension. *Advances in Cognitive Systems*, *1*, 109–126.

[16] Bridewell, W. & Langley, P. (2010). Two kinds of knowledge in scientific discovery. *Topics in Cognitive Science*, *2*, 36–52.

[17] 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.

[18] Langley, P., Choi, D., & Rogers, S. (2009). Acquisition of hierarchical reactive skills in a unified cognitive architecture. *Cognitive Systems Research*, *10*, 316–332.

[19] Langley, P., Laird, J. E., & Rogers, S. (2009). Cognitive architectures: Research issues and challenges. *Cognitive Systems Research*, *10*, 141–160.

[20] Cassimatis, N. L., Bello, P., & Langley, P. (2008). Ability, breadth and parsimony in computational models of higher-order cognition. *Cognitive Science*, *32*, 1304–1322.

[21] Bridewell, W., Langley, P., Todorovski, L., & Džeroski, S. (2008). Inductive process modeling. *Machine Learning*, *71*, 1–32.

[22] 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.

[23] 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.

[24] Langley, P., & Choi, D. (2006). Learning recursive control programs from problem solving. *Journal of Machine Learning Research*, *7*, 493–518.

[25] Langley, P. (2006). Cognitive architectures and general intelligent systems. *AI Magazine*, *27*, 33–44.

[26] Asgharbeygi, N., Bay, S., Langley, P., & Arrigo, K. (2006). Inductive revision of quantitative process models. *Ecological Modelling*, *194*, 70–79.

[27] Jones, R. M., & Langley, P. (2005). A constrained architecture for learning and problem solving. *Computational Intelligence*, *21*, 480–502.

[28] Ichise, R., Shapiro, D., & Langley, P. (2005). Structured program induction from behavioral traces. *Systems and Computers in Japan*, *36*, 49-59.

[29] 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.

[30] Thompson, C. A., Göker, M. H., & Langley, P. (2004). A personalized system for conversational recommendations. *Journal of Artificial Intelligence Research*, *21*, 393–428.

[31] 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.

[32] Lavrac, N., Motoda, H., Fawcett, T., Holte, R., Langley, P., & Adriaans, P. (2004). Lessons learned from data mining applications and collaborative problem solving. *Machine Learning*, *57*, 13–34.

[33] 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.

[34] 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.

[35] Langley, P. (2000). The computational support of scientific discovery. *International Journal of Human-Computer Studies*, *53*, 393–410.

[36] Kocabas, S., & Langley, P. (2000). Computer generation of process explanations in nuclear astrophysics. *International Journal of Human-Computer Studies*, *53*, 377–392.

[37] Blum, A. L., & Langley, P. (1997). Selection of relevant features and examples in machine learning. *Artificial Intelligence*, *97*, 245–271.

[38] Yamauchi, B., & Langley, P. (1997). Place recognition in dynamic environments. *Journal of Robotic Systems*, *14*, 107–120.

[39] Langley, P., Pfleger, K., & Sahami, M. (1997). Lazy acquisition of place knowledge. *Artificial Intelligence Review*, *11*, 315–342.

[40] Langley, P., & Simon, H. A. (1995). Applications of machine learning and rule induction. *Communications of the ACM*, *38*, November, 55–64.

[41] Nordhausen, B., & Langley, P. (1993). An integrated framework for empirical discovery. *Machine Learning*, *12*, 17–47.

[42] Langley, P., & Żytkow, J. M. (1989). Data-driven approaches to empirical discovery. *Artificial Intelligence*, *40*, 283–312.

[43] Gennari, J. H., Langley, P., & Fisher, D. H. (1989). Models of incremental concept formation. *Artificial Intelligence*, *40*, 11–61.

[44] Iba, W., & Langley, P. (1987). A computational theory of motor learning. *Computational Intelligence*, *3*, 338–350.

[45] Żytkow, J. M., Langley, P., & Simon, H. A. (1987). Computer system of discovery STAHL. *Studia Filozoficzne or Zagadnienia Naukoznawstwa*, *23*, 518–536.

[46] Rose, D., & Langley, P. (1986). Chemical discovery as belief revision. *Machine Learning*, *1*, 423–451.

[47] Langley, P. (1985). Learning to search: From weak methods to domain-specific heuristics. *Cognitive Science*, *9*, 217–260.

[48] 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.

[49] Bradshaw, G. L., Langley, P., & Simon, H. A. (1983). Studying scientific discovery by computer simulation. *Science*, *222*, 971–975.

[50] Langley, P. (1983). Representational issues in learning systems. *IEEE Computer*, *16*, 47–51.

[51] Langley, P. (1983). Learning search strategies through discrimination. *International Journal of Man–Machine Studies*, *18*, 513–541.

[52] Langley, P. (1982). Language acquisition through error recovery. *Cognition and Brain Theory*, *5*, 211–255.

[53] Simon, H. A., Langley, P., & Bradshaw, G. L. (1981). Scientific discovery as problem solving. *Synthese*, *47*, 1–27.

[54] Langley, P. (1981). Data-driven discovery of physical laws. *Cognitive Science*, *5*, 31–54.

[55] 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.

[56] Langley, P. (1979). A production system model for the induction of mathematical functions. *Behavioral Science*, *24*, 121–139.

Refereed Conference Papers

[1] Langley, P. (in press). Integrated systems for computational scientific discovery. *Proceedings of the Thirty-Eighth Annual AAAI Conference on Artificial Intelligence*. Vancouver, BC: AAAI Press.

[2] Langley, P. (2023). Learning hierarchical problem networks for knowledge-based planning. *Proceedings of the Thirty-First International Conference on Inductive Logic Programming*. Windsor Great Park, UK.

[3] MacLellan, C. J., Matsakis, P., & Langley, P. (2022). Efficient induction of language models via probabilistic concept formation *Proceedings of the Tenth Annual Conference on Advances in Cognitive Systems*. Arlington, VA.

[4] Langley, P., & Katz, E. P. (2022). Motion planning and continuous control in a unified cognitive architecture. *Proceedings of the Tenth Annual Conference on Advances in Cognitive Systems*. Arlington, VA.

[5] Langley, P. (2022). The computational gauntlet of human-like learning. *Proceedings of the Thirty-Sixth AAAI Conference on Artificial Intelligence* (pp. 12268–12273). Vancouver, BC: AAAI Press.

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Invited Chapters and Papers

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