

## DANIEL LOWD

Department of Computer and Information Science  
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### INTERESTS

Machine learning, data mining, and artificial intelligence.

### EDUCATION

2003–2010: **University of Washington**, Seattle, WA

Ph.D. in Computer Science and Engineering, March 2010

M.S. in Computer Science and Engineering, June 2005

Advisor: Pedro Domingos.

Committee members: Jeff Bilmes, Marina Meila, and Mark S. Handcock.

Dissertation title: *Efficient Algorithms for Learning and Inference in Rich, Statistical Models*.

1999–2003: **Harvey Mudd College**, Claremont, CA.

B.S. in Mathematics/Computer Science with “High Honors.”

### PROFESSIONAL EXPERIENCE

June 2010 – Present: Assistant Professor, Department of Computer and Information Science, University of Oregon

September 2009 – June 2010: Acting Assistant Professor, Department of Computer and Information Science, University of Oregon

September 2003 – August 2009: Research assistant for Pedro Domingos at the University of Washington.

Developed faster machine learning algorithms, more flexible probabilistic models, and methods for learning models with efficient inference.

Summer 2008: Intern at SmartDesktop division of Pi Corporation, Seattle, WA.

Developed and evaluated automatic methods for desktop activity recognition.

Summer 2004: Intern at Microsoft Research with Christopher Meek in Redmond, WA.

Developed simple yet effective attacks against linear spam filters, testing filter robustness and promoting the development of more secure spam filters.

June 2002 – September 2003: Research assistant for Jon Herlocker at Oregon State University.

Conducted a third-party evaluation of prominent collaborative filtering algorithms. Funded by the NSF through the REU program.

Summer 2001: Intern at Green Hills Software in Santa Barbara, CA.

Invented and implemented a binary diff algorithm, reducing code update time by 90-97% for embedded targets. Ported a linker from Solaris to vxWorks and reduced code size by 80% for use on JPL’s Mars Expedition Rover. Ran automated compiler validations for R6K architecture and implemented appropriate fixes in library code.

Summer 2000: Intern at Adobe Systems in San Jose, CA.

Added XML support to Adobe Acrobat's Webcapture plug-in.

Summer 1999: Intern at Spyglass in Los Gatos, CA.

Assisted in the development of a Windows CE application for physical therapists.

## SCHOLARSHIPS, HONORS, AND AWARDS

ICML 2016 Outstanding Reviewer Award (2016)

Army Research Office Young Investigator Award (2015)

Best Paper Award, DEXA Conference (2015)

Google Faculty Research Award (2013)

Microsoft Research Fellow, sponsored by Live Labs (2007–2008)

National Science Foundation Graduate Research Fellowship (2003–2006)

## BOOKS

1. P. Domingos and D. Lowd, *Markov Logic: An Interface Layer for AI*, Morgan & Claypool, 2009.

## BOOK CHAPTERS

2. S. Natarajan, J. Davis, K. Kersting, P. Domingos, D. Lowd and R. Mooney, "Statistical Relational Learning," in *An Introduction to Lifted Probabilistic Inference*, edited by G. Van den Broeck, K. Kersting, S. Natarajan, and D. Poole, MIT Press, 2016. *To appear*.
3. P. Domingos, D. Lowd, S. Kok, H. Poon, M. Richardson and P. Singla, "Markov Logic: A Language and Algorithms for Link Mining," in *Link Mining: Models, Algorithms, and Applications*, edited by P. S. Yu, J. Han, and C. Faloutsos, Springer, 2010.
4. P. Domingos, D. Lowd, S. Kok, H. Poon, M. Richardson and P. Singla, "Just Add Weights: Markov Logic for the Semantic Web," in *Uncertainty Reasoning for the Semantic Web I*, edited by P. Costa, C. d'Amato, N. Fanizzi, K. B. Laskey, K. J. Laskey, T. Lukasiewicz, M. Nickles and M. Pool, Springer, 2008.
5. P. Domingos, S. Kok, D. Lowd, H. Poon, M. Richardson and P. Singla, "Markov Logic," in *Probabilistic Inductive Logic Programming* (pp. 92-117), edited by L. De Raedt, P. Frasconi, K. Kersting and S. Muggleton, Springer, 2008.

## JOURNAL ARTICLES

6. S. Jiang, D. Lowd, S. Kafele, and D. Dou, "Ontology Matching with Knowledge Rules," in *Transactions on Large-Scale Data- and Knowledge-Centered Systems*, 2016. *To appear*.
7. D. Lowd and A. Rooshenas, "The Libra Toolkit for Probabilistic Models," in the *Journal of Machine Learning Research*, vol.16, 2015.
8. D. Lowd and J. Davis, "Improving Markov Network Structure Learning Using Decision Trees," in the *Journal of Machine Learning Research*, vol.15, 2014.

## REFEREED CONFERENCE PUBLICATIONS

9. H. Wang, D. Dou, and D. Lowd, “Ontology-based Deep Restricted Boltzmann Machine,” in *Proceedings of the 27th International Conference on Database and Expert Systems Applications (DEXA 2016)*, Porto, Portugal, 2016. (*To appear.*)
10. A. Rooshenas and D. Lowd, “Discriminative Structure Learning of Arithmetic Circuits,” in *Proceedings of the 19th International Conference on Artificial Intelligence and Statistics (AISTATS)*, Cadiz, Spain, 2016. (Acceptance rate: 31%.)
11. S. Jiang, D. Lowd, and D. Dou, “A Probabilistic Approach to Knowledge Translation,” in *Proceedings of the Thirtieth AAAI Conference on Artificial Intelligence (AAAI-16)*, Phoenix, AZ, USA, 2016. (Acceptance rate: 26%.)
12. S. Jiang, D. Lowd, and D. Dou, “Ontology Matching with Knowledge Rules,” in *Proceedings of the 26th International Conference on Database and Expert Systems Applications (DEXA 2015)*, Valencia, Spain, 2015. **Best Paper Award.**
13. R. Motamedi, R. Rejaie, W. Willinger, D. Lowd, and R. Gonzalez, “Inferring Coarse Views of Connectivity in Very Large Graphs,” in *Proceedings of the ACM Conference on Online Social Networks (COSN)*, Dublin, Ireland, 2014. (Acceptance rate: 16%.)
14. M. Torkamani and D. Lowd, “On Robustness and Regularization of Structural Support Vector Machines,” in *Proceedings of the 31st International Conference on Machine Learning (ICML)*, Beijing, China, 2014. (Acceptance rate: 25%.)
15. A. Rooshenas and D. Lowd, “Learning Sum-Product Networks with Direct and Indirect Interactions,” in *Proceedings of the 31st International Conference on Machine Learning (ICML)*, Beijing, China, 2014. (Acceptance rate: 25%.)
16. A. Bates, R. Leonard, H. Pruse, D. Lowd, and K. Butler, “Leveraging USB to Establish Host Identity Using Commodity Devices,” in *Proceedings of the 21st ISOC Network and Distributed System Security Symposium (NDSS)*, San Diego, CA, USA, 2014. (Acceptance rate: 19%.)
17. D. Lowd and A. Rooshenas, “Learning Markov Networks with Arithmetic Circuits,” in *Sixteenth International Conference on Artificial Intelligence and Statistics (AISTATS)*, Scottsdale, AZ, USA, 2013. (Acceptance rate: 34%.)
18. M. Torkamani and D. Lowd, “Convex Adversarial Collective Classification,” in *Proceedings of the 30th International Conference on Machine Learning (ICML)*, Atlanta, GA, USA, 2013. (Oral. Acceptance rate: 12% for oral presentations.)
19. S. Jiang, D. Lowd, and D. Dou, “Learning to Refine an Automatically Extracted Knowledge Base using Markov Logic,” in *Proceedings of the IEEE International Conference on Data Mining (ICDM)*, Brussels, Belgium, 2012. (Acceptance rate: 20%.)
20. D. Lowd, “Closed-Form Learning of Markov Networks from Dependency Networks,” in *Proceedings of the 28th Conference on Uncertainty in Artificial Intelligence (UAI-12)*, Catalina Island, CA, 2012. (Spotlight. Acceptance rate: 32% overall; 14% with a talk or spotlight.)
21. D. Lowd and A. Shamaei, “Mean Field Inference in Dependency Networks: An Empirical Study,” in *Proceedings of the 25th Conference on Artificial Intelligence (AAAI-11)*, San Francisco, CA, 2011. (Acceptance rate: 25%.)
22. D. Lowd and P. Domingos, “Approximate Inference by Compilation to Arithmetic Circuits,” in *Advances in Neural Information Processing Systems (NIPS) 24*, Vancouver, BC, 2010. (Acceptance rate: 24%.)

23. D. Lowd and J. Davis, “Learning Markov Network Structure with Decision Trees,” in *Proceedings of the 10th IEEE International Conference on Data Mining (ICDM)*, Sydney, Australia, 2010. (Full paper. Acceptance rate: 19% overall; 9% for full papers.)
24. S. Natarajan, T. Khot, D. Lowd, K. Kersting, P. Tadepalli and J. Shavlik, “Exploiting Causal Independence in Markov Logic Networks: Combining Undirected and Directed Models,” in *European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML PKDD)*, Barcelona, Spain, 2010. (Acceptance rate: 16%.)
25. D. Lowd and N. Kushmerick, “Using Saliency to Segment Desktop Activity into Projects,” in *Proceedings of the Thirteenth International Conference on Intelligent User Interfaces*, Sanibel Island, Florida, 2009.
26. D. Lowd and P. Domingos, “Learning Arithmetic Circuits,” in *Proceedings of the Twenty-Fourth Conference on Uncertainty in Artificial Intelligence* (pp. 383-392), Helsinki, Finland, 2008.
27. D. Lowd and P. Domingos, “Efficient Weight Learning for Markov Logic Networks,” in *Proceedings of the Eleventh European Conference on Principles and Practice of Knowledge Discovery in Databases* (pp. 200-211), Warsaw, Poland, 2007.
28. D. Lowd and P. Domingos, “Recursive Random Fields,” in *Proceedings of the Twentieth International Joint Conference on Artificial Intelligence* (pp. 950-955), Hyderabad, India, 2007.
29. D. Lowd and P. Domingos, “Naive Bayes Models for Probability Estimation,” in *Proceedings of the Twenty-Second International Conference on Machine Learning* (pp. 529-536), Bonn, Germany, 2005.
30. D. Lowd and C. Meek, “Good Word Attacks on Statistical Spam Filters,” in *Proceedings of the Second Conference on Email and Anti-Spam*, Palo Alto, CA, 2005.
31. D. Lowd and C. Meek, “Adversarial Learning,” in *Proceedings of the Eleventh ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, Chicago, IL, 2005.

## REFEREED WORKSHOP PUBLICATIONS

32. I. Burago and D. Lowd, “Automated Attacks on Compression-Based Classifiers,” in *Proceedings of the 2015 ACM Workshop on Artificial Intelligence and Security (AISeC)*, Denver, CO, 2015.
33. S. Jiang, D. Lowd, and D. Dou, “A Probabilistic Approach to Knowledge Translation,” in *Fifth International Workshop on Statistical Relational AI (StaR AI 2015)*, 2015.
34. S. Jiang, D. Lowd, and D. Dou, “Ontology Matching with Knowledge Rules,” in *Fifth International Workshop on Statistical Relational AI (StaR AI 2015)*, 2015.
35. M. Torkamani and D. Lowd, “Applying Dropout Regularization to Support Vector Machines,” in *NIPS 2014 Workshop on Perturbation, Optimization, and Statistics*, Montreal, Quebec, Canada, 2014.
36. D. Lowd, B. Lessley, and M. De Raj, “Towards Adversarial Reasoning in Statistical Relational Domains,” in *AAAI-14 Workshop on Statistical Relational AI (StaR AI 2014)*, 2014.
37. M. Torkamani and D. Lowd, “On Robustness and Regularization of Structural Support Vector Machines,” in *NIPS 2013 Workshop on Perturbation, Optimization, and Statistics*, Stateline, NV, USA, 2013.

38. A. Rooshenas and D. Lowd, “Learning Sum-Product Networks with Direct and Indirect Interactions,” in *NIPS 2013 Workshop on Deep Learning*, Stateline, NV, USA, 2013.
39. D. Stevens and D. Lowd, “On the Hardness of Evading Combinations of Linear Classifiers,” in *Proceedings of the 2013 ACM Workshop on Artificial Intelligence and Security (AISec)*, Berlin, Germany, 2013.
40. A. Rooshenas and D. Lowd, “Learning Tractable Graphical Models Using Mixtures of Arithmetic Circuits,” in *Late-Breaking Developments in the Field of Artificial Intelligence: Papers Presented at the Twenty-Seventh AAAI Conference on Artificial Intelligence*, Bellevue, WA, USA, 2013.
41. D. Lowd and A. Rooshenas, “Learning Markov Networks with Arithmetic Circuits,” in *ICML-13 Workshop on Infering*, Atlanta, GA, USA, 2013.
42. M. Torkamani and D. Lowd, “Convex Adversarial Collective Classification,” in *UAI-12 Workshop on Statistical Relational AI*, Catalina Island, CA, 2012.
43. S. Jiang, D. Lowd, and D. Dou, “Using Markov Logic to Refine an Automatically Extracted Knowledge Base,” in *UAI-12 Workshop on Statistical Relational AI*, Catalina Island, CA, 2012.
44. S. Natarajan, T. Khot, D. Lowd, P. Tadepalli, K. Kersting, and J. Shavlik, “Exploiting Causal Independence in Markov Logic Networks: Combining Undirected and Directed Models,” in *AAAI-10 Workshop on Statistical Relational AI*, Atlanta, Georgia, 2010.
45. D. Lowd, C. Meek and P. Domingos, “Foundations of Adversarial Machine Learning,” in *NIPS-2007 Workshop on Machine Learning in Adversarial Environments for Computer Security*, Vancouver, Canada, 2007.
46. D. Lowd and P. Domingos, “Recursive Random Fields,” in *Proceedings of the ICML-2006 Workshop on Open Problems in Statistical Relational Learning*, Pittsburgh, PA, 2006.

## INVITED PAPERS

47. P. Domingos, D. Lowd, S. Kok, A. Nath, H. Poon, and P. Singla, “Unifying Logical and Statistical AI,” in *ACM/IEEE Symposium on Logic in Computer Science*, New York City, NY, 2016.

## SOFTWARE RELEASED

Libra: Machine learning toolkit for Bayesian networks, Markov networks, and arithmetic circuits  
<http://libra.cs.uoregon.edu>

(Published in the Journal of Machine Learning Research Machine Learning Open-Source Software (JMLR MLOSS).)

Alchemy: Algorithms for statistical relational AI

<http://alchemy.cs.washington.edu>

(Along with various other contributors.)

NBE: A Bayesian learner with very fast inference

<http://www.cs.washington.edu/ai/nbe>

CoFE: COLlaborative Filtering Engine

<http://eecs.oregonstate.edu/iis/CoFE/>

(Along with various other contributors. No longer supported.)

## INVITED TALKS

“Adversarial Machine Learning in Relational Domains”

University of Texas Dallas (UTDallas), March, 2016.

“Adversarial Machine Learning in Relational Domains”

University of Utah, March, 2016.

“Adversarial Machine Learning in Relational Domains”

University of Maryland Baltimore County (UMBC), March, 2016.

“Adversarial Machine Learning in Relational Domains”

Tufts University, February, 2016.

“Adversarial Machine Learning in Relational Domains”

Michigan State University, February, 2016.

“Structure Learning for Sum-Product Networks”

Oregon State University, October, 2015.

“Structure Learning for Sum-Product Networks”

University of California Santa Cruz, November, 2014.

“Adversarial Machine Learning in Relational Domains”

LinkedIn, November, 2014.

“Adversarial Machine Learning in Relational Domains”

United Technologies Research Center Berkeley, November, 2014.

“Structure Learning for Sum-Product Networks”

United Technologies Research Center New Haven, November, 2014.

“Adversarial Machine Learning in Relational Domains”

Amazon.com, Inc., October, 2014.

“Machine Learning with Evasive Adversaries”

University of Washington. September, 2014.

“Learning Tractable Probabilistic Models” (with Pedro Domingos)

Tutorial for the 2014 Conference on Uncertainty in Artificial Intelligence (UAI 2014). July, 2014.

“Using Dependency Networks To Learn Markov Networks”

University of Wisconsin-Madison. October, 2013.

“Learning Relational Classifiers for Adversarial Domains”

University of Indiana-Bloomington. October, 2013.

“Learning Relational Classifiers for Adversarial Domains”

SRI International. October, 2013.

“Better Learning and Inference with Dependency Networks”

University of Maryland, College Park. January, 2013.

“Learning Relational Classifiers for Adversarial Domains”

LinkedIn. January, 2013.

“Convex Adversarial Collective Classification”

SRI International. January, 2013.

“Convex Adversarial Collective Classification”  
 Dagstuhl Perspectives Workshop on Machine Learning Methods for Computer Security. October, 2012.

“Convex Adversarial Collective Classification”  
 University of Washington. September, 2012.

“Toward Adversarial Collective Classification”  
 2nd ARO Workshop on Moving Target Defense, George Mason University. October, 2011.

“Better Learning and Inference with Dependency Networks”  
 University of Washington. September, 2011.

“Mean Field Inference in Dependency Networks: An Empirical Study”  
 Oregon State University. July, 2011.

“Inference Complexity As Learning Bias”  
 Oregon State University. January, 2010.

“Adversarial Machine Learning”  
 Portland State University. November, 2009.

“Markov Logic: Representation, Inference and Learning”  
 University of Michigan. March, 2009.

“Markov Logic: Representation, Inference and Learning”  
 University of Oregon. April, 2009.

“Foundations of Adversarial Machine Learning”  
 University of Cagliari. July, 2008.

“Adversarial Learning”  
 Oregon State University. June, 2006.

## GRANTS AND OTHER FUNDING

6/2016 – 6/2020: *AMIA: Automated Media Integrity Assessment*, Defense Advanced Research Projects Agency, Media Forensics (MediFor) Program (DARPA-BAA-15-58), Technical Area TA2, \$807,000 (subcontract from SRI International; total budget: \$9,490,000).

6/2015 – 6/2018: *Inferring Trustworthiness and Deceit with Adversarial Relational Models*, Army Research Office, Young Investigator Program, \$357,573.

9/2014 – 8/2016: *EAGER: Machine Learning to Combat Adversarial Attacks*, National Science Foundation, \$104,997.

9/2013 – 8/2014: *Learning Tractable Graphical Models with Latent Variables*, Google Faculty Research Award, \$56,856.

5/2013 – 2/2016: *Understanding the Mechanism of Social Network Influence in Health Outcomes through Multidimensional and Semantic Data Mining Approaches*, National Institutes of Health, \$1,500,000 (co-PI, with Dejing Dou and 6 others).

7/2011 – 6/2015: *Statistical Knowledge Translation and Knowledge Integration Using Markov Logic*, National Science Foundation, \$495,000 (co-PI, with Dejing Dou).

1/2011 – 6/2014: *A Unified Approach to Abductive Inference*, Multidisciplinary University Research Initiative, Army Research Office, \$232,998 (subcontract from UW).

## COURSES TAUGHT

CIS 211: Computer Science II. Winter 2011, Spring 2011, Winter 2012.

CIS 410/510pm: Probabilistic Methods for AI. Winter 2010, Fall 2010, Spring 2013-2016

CIS 610pm: Probabilistic Methods for AI. Spring 2012.

CIS 413/513: Advanced Data Structures. Spring 2010, Fall 2011.

CIS 313: Intermediate Data Structures. Winter 2014, Fall 2015.

CIS 471/571: Introduction to Artificial Intelligence. Fall 2012.

CIS 472/572: Machine Learning. Winter 2013, Winter 2015, Winter 2016.

## STUDENTS

### Ph.D. advisor (graduated)

Shangpu Jiang (Google) (co-advised with Dejing Dou)

Dissertation title: *Knowledge Base Refinement and Knowledge Translation with Markov Logic Networks*. Fall 2015.

### Ph.D. advisor (current)

Amirmohammad Rooshenas

Mohamad Ali Torkamani

Javid Ebrahimi (co-advised with Dejing Dou)

### M.S. thesis advisor (graduated)

Igor Burago (University of California Irvine)

Thesis title: *Automated Attacks on Compression-Based Classifiers*. Spring 2014.

Arash Shamaei (Oregon State University)

Thesis title: *Fast Inference Algorithms in Dependency Networks*. Summer 2011.

### M.S. thesis advisor (current)

Jonathan Brophy

## PROFESSIONAL SERVICE

### Workshop Program Co-Chair:

AAAI Conference on Artificial Intelligence (AAAI) 2015, 2016

### Proceedings Chair:

Conference on Uncertainty in Artificial Intelligence (UAI) 2014, 2015

### Workshop Co-Chair:

New Perspectives for Relational Learning, held at Banff International Research Station in April 2015

ICML 2014 Workshop on Learning, Security and Privacy

ICML 2014 Workshop on Learning Tractable Probabilistic Models

### Program Committees:

International Joint Conference on Artificial Intelligence (IJCAI) 2011, 2013,



2015-2016 (Senior Program Committee)  
 AAAI Conference on Artificial Intelligence (AAAI) 2006, 2010-2015  
 Uncertainty in Artificial Intelligence (UAI) 2010-2016  
 International Conference on Machine Learning (ICML) 2010-2014,  
 2016 (**Outstanding Reviewer Award**)  
 International Conference on Artificial Intelligence and Statistics (AISTATS) 2012, 2013  
 ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD) 2011,  
 2015-2016  
 ECML-PKDD 2012  
 Asian Conference on Machine Learning (ACML) 2014  
 ACM Workshop on Artificial Intelligence and Security (AISec) 2013-2015  
 AAAI-16 Workshop on Artificial Intelligence for Cyber Security (AICS2016)  
 Workshop on Statistical Relational AI (StaR AI) 2013-2015  
 ICML Workshop on Structured Learning (SLG) 2013  
 ICML Workshop on Statistical Relational Learning 2012  
 AAAI Nectar 2011  
 ECML/PKDD Workshop on Privacy and Security issues in Data Mining and Machine  
 Learning, 2010

**Journal Reviewer:**

Journal of Machine Learning Research (JMLR)  
 IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)  
 Machine Learning Journal (MLJ)  
 Journal of Artificial Intelligence Research (JAIR)  
 Artificial Intelligence Journal (AIJ)  
 Data Mining and Knowledge Discovery (DMKD) journal  
 Transactions on Dependable and Secure Computing (TDSC)  
 IEEE Security & Privacy  
 ACM SIGKDD Explorations  
 Journal of Systems and Software  
 International Journal of Pattern Recognition and Artificial Intelligence

**Conference Reviewer:**

Neural Information Processing Systems (NIPS) conference 2006, 2012-2015  
 International Conference on Machine Learning (ICML) 2008  
 ACM Conference on Electronic Commerce (EC) 2006