Cameron E. Freer

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Employment (Academia)

Massachusetts Institute of Technology

Research Scientist, Department of Brain and Cognitive Sciences. 2019 – Present
Research scientist in the Probabilistic Computing Project.

Postdoctoral Associate, Department of Brain and Cognitive Sciences. 2013 – 2015
Research postdoc. Postdoctoral mentors: Joshua B. Tenenbaum and Vikash K. Mansinghka

Postdoctoral Fellow, Computer Science and Artificial Intelligence Laboratory. 2011 – 2013
Research postdoc. Postdoctoral mentors: Joshua B. Tenenbaum and Leslie P. Kaelbling

Instructor in Pure Mathematics, Department of Mathematics. 2008 – 2010
Research and teaching postdoc. Postdoctoral mentors: Hartley Rogers, Jr. and Michael Sipser

University of Hawai'i at Mānoa

Junior Researcher, Department of Mathematics. 2010 – 2011
Research and teaching postdoc. Postdoctoral mentor: Bjørn Kjos-Hanssen

Employment (Industry)

Borelian Corporation

Founder and Chief Scientist. 2016 – Present

Remine

Chief Scientist. 2017 – 2018

Gamalon Labs

Research Scientist. 2013 – 2016

Analog Devices

Lyric Labs Visiting Fellow. 2013 – 2014

Hibernia Atlantic

Advisory Board Member. 2011 – 2012

Education

Harvard University

Ph.D. in Mathematics, 2008. Dissertation: *Models with high Scott rank.*
Advisor: Gerald E. Sacks

University of Chicago

S.B. in Mathematics with Honors, 2003.

Last updated: November 2020

RESEARCH INTERESTS

Interactions of randomness and computation, including the foundations of probabilistic computing, efficient samplers and testing methods for probabilistic inference, and the mathematics of random structures.

PUBLICATIONS

N. L. Ackerman, C. E. Freer, and R. Patel, *On computable aspects of algebraic and definable closure,* Journal of Logic and Computation, to appear.

F. A. Saad, C. E. Freer, M. C. Rinard, and V. K. Mansinghka, *The Fast Loaded Dice Roller: A near-optimal exact sampler for discrete probability distributions,* Proceedings of the 23rd International Conference on Artificial Intelligence and Statistics (AISTATS 2020), Proceedings of Machine Learning Research (PMLR) 108, 1036–1046, 2020.

N. L. Ackerman, C. E. Freer, and R. S. Lubarsky, *An introduction to feedback Turing computability,* Journal of Logic and Computation 30, no. 1, 27–60, 2020.

F. A. Saad, C. E. Freer, M. C. Rinard, and V. K. Mansinghka, *Optimal approximate sampling from discrete probability distributions,* Proceedings of the ACM on Programming Languages 4, POPL, 36:1–36:31, 2020.

N. L. Ackerman, C. E. Freer, and R. Patel, *Computability of algebraic and definable closure,* Proceedings of the Symposium on Logical Foundations of Computer Science (LFCS 2020), LNCS Vol. 11972, 1–11, 2020.

N. L. Ackerman, J. Avigad, C. E. Freer, D. M. Roy, and J. M. Rute, *Algorithmic barriers to representing conditional independence,* Proceedings of the 34th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS 2019), 2019.

N. L. Ackerman, C. E. Freer, and D. M. Roy, *On the computability of conditional probability,* Journal of the ACM 66, no. 3, 23:1–23:40, 2019.

N. L. Ackerman, C. E. Freer, and R. S. Lubarsky, *Feedback computability on Cantor space,* Selected Papers of Logic in Computer Science (LICS) 2015 and 2016, Logical Methods in Computer Science, 15, no. 2, 7:1–7:18, 2019.

F. A. Saad, C. E. Freer, N. L. Ackerman, and V. K. Mansinghka, *A family of exact goodness-of-fit tests for high-dimensional discrete distributions,* Proceedings of the 22nd International Conference on Artificial Intelligence and Statistics (AISTATS 2019), Proceedings of Machine Learning Research (PMLR) 89, 1640–1649, 2019.

N. L. Ackerman, C. E. Freer, and R. Patel, *The entropy function of an invariant measure*, Proceedings of the 14th and 15th Asian Logic Conferences, World Scientific, 3–34, 2019.

S. Staton, D. Stein, H. Yang, N. L. Ackerman, C. E. Freer, and D. M. Roy, *The Beta-Bernoulli process and algebraic effects,* Proceedings of the 45th International Colloquium on Automata, Languages, and Programming (ICALP 2018), 141:1-141:15, 2018.

N. L. Ackerman, C. E. Freer, and D. M. Roy, *On computability and disintegration,* Mathematical Structures in Computer Science 27, no. 8, 1287–1314, 2017.

PUBLICATIONS (CONT'D)

N. L. Ackerman and C. E. Freer, *Graph Turing machines,* Logic, Language, Information, and Computation, Proceedings of WoLLIC 2017, LNCS Vol. 10388, Springer, 1–13, 2017.

N. L. Ackerman, C. E. Freer, A. Kwiatkowska, and R. Patel, *A classification of orbits admitting a unique invariant measure,* Annals of Pure and Applied Logic 168, no. 1, 19–36, 2017.

D. Cai, N. L. Ackerman, and C. E. Freer, *Priors on exchangeable directed graphs,* Electronic Journal of Statistics 10, no. 2, 3490–3515, 2016.

N. L. Ackerman, C. E. Freer, and R. Patel, *Invariant measures concentrated on countable structures,* Forum of Mathematics Sigma 4, e17, 59 pp., 2016.

N. L. Ackerman, J. Nešetřil, C. E. Freer, and R. Patel, *Invariant measures via inverse limits of finite structures,* European Journal of Combinatorics 52, 248–289, 2016.

N. L. Ackerman, C. E. Freer, and R. S. Lubarsky, *Feedback Turing computability, and Turing computability as feedback,* Proceedings of the 30th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS 2015), 523–534, 2015.

C. E. Freer, B. Kjos-Hanssen, A. Nies, and F. Stephan, *Algorithmic aspects of Lipschitz functions,* Computability 3, 45–61, 2014.

C. E. Freer, D. M. Roy, J. B. Tenenbaum, *Towards common-sense reasoning via conditional simulation: legacies of Turing in Artificial Intelligence,* in Turing's Legacy: Developments from Turing's Ideas in Logic, ed. Rod Downey, ASL Lecture Notes in Logic, Cambridge University Press, 2014.

C. E. Freer and B. Kjos-Hanssen, *Randomness extraction and asymptotic Hamming distance,* Selected Papers of the 9th International Conference on Computability and Complexity in Analysis (CCA 2012), Logical Methods in Computer Science, 2013.

A. D. Wissner-Gross and C. E. Freer, *Causal entropic forces,* Physical Review Letters 110, 168702, 2013.

N. L. Ackerman and C. E. Freer, *A notion of a computational step for Partial Combinatory Algebras,* Proceedings of the 10th Annual Conference on Theory and Applications of Models of Computation (TAMC 2013), LNCS Vol. 7876, Springer, 133–143, 2013.

C. E. Freer and D. M. Roy, *Computable de Finetti measures,* Annals of Pure and Applied Logic 163, no. 5, 530–546, 2012.

N. L. Ackerman, C. E. Freer, and D. M. Roy, *Noncomputable conditional distributions,* Proceedings of the 26th Annual IEEE Symposium on Logic in Computer Science (LICS 2011), 107–116, 2011.

A. D. Wissner-Gross and C. E. Freer, *Relativistic statistical arbitrage,* Physical Review E 82, 056104, 2010.

C. E. Freer and D. M. Roy, *Posterior distributions are computable from predictive distributions,* Proceedings of the 13th International Conference on Artificial Intelligence and Statistics (AISTATS 2010), Journal of Machine Learning Research W&CP 9, 2010.

PUBLICATIONS (CONT'D)

C. E. Freer and D. M. Roy, *Computable exchangeable sequences have computable de Finetti measures,* in K. Ambos-Spies, B. Löwe, and W. Merkle (eds.): Mathematical Theory and Computational Practice, Proc. of the 5th Conf. on Computability in Europe (CiE 2009), LNCS Vol. 5635, Springer, 218–231, 2009.

DISSERTATION

C. E. Freer, *Models with high Scott rank*, Ph.D. Dissertation, Harvard University, 2008.

PREPRINTS

S. Spanbauer, C. E. Freer, and V. K. Mansinghka, *Deep involutive generative models for neural MCMC,* arXiv:2006.15167.

N. L. Ackerman, J. Avigad, C. E. Freer, D. M. Roy, and J. M. Rute, *On the computability of graphons,* arXiv:1801.10387.

N. L. Ackerman, C. E. Freer, and R. Patel, *Stable regularity for relational structures,* arXiv:1712.09305.

N. L. Ackerman, C. E. Freer, A. Kruckman, and R. Patel, *Properly ergodic structures,* arXiv:1710.09336.

N. L. Ackerman, C. E. Freer, and R. Patel, *Countable infinitary theories admitting an invariant measure,* arXiv:1710.06128.

N. L. Ackerman and C. E. Freer, *On the computability of graph Turing machines,* arXiv:1703.09406.

D. Cai, N. L. Ackerman, and C. E. Freer, *An iterative step-function estimator for graphons,* arXiv:1412.2129.

PATENTS

C. E. Freer and A. D. Wissner-Gross, *System and method for relativistic statistical securities trading,* U.S. Patent 8,635,133 (2014).

INVITED TALKS

- *Representation theorems for exchangeable structures: a computability-theoretic perspective.* Joint Mathematics Meetings, Denver. ASL invited address, January 17, 2020.
- *Computability of algebraic and definable closure.* Logical Foundations of Computer Science (LFCS 2020), Deerfield Beach, FL. Invited to give talk based on refereed conference proceedings, January 6, 2020.
- *Step algebras.* NII Shonan meeting on higher-order complexity and its applications, Shonan Village Center, Japan. Invited workshop talk, October 10, 2019.
- *Computable representations of exchangeable data.* Computability in Europe (CiE 2019), Special Session on Probabilistic Programming and Higher-Order Computation, Durham University, Durham, UK. Invited special session talk, July 15, 2019.
- *Computability of the Aldous–Hoover theorem,* Workshop on higher-order probabilistic computation, Bellairs Research Institute, Barbados. Invited workshop talk, March 18, 2019.
- *Model theory of invariant probabilistic constructions.* Logic Colloquium, UC Berkeley, September 8, 2017.
- *Some remarks on Category, Measure, and Invariance.* All Kinds of Mathematics Remind Me of You: Conference to celebrate the 70th Anniversary of Peter J. Cameron, Faculdade de Ciências da Universidade de Lisboa, Lisbon, Portugal. Invited conference talk, July 24, 2017.
- *Graph Turing machines.* Workshop on Logic, Language, Information and Computation (WoLLIC), London, UK. Invited to give talk based on refereed conference proceedings, July 19, 2017.

INVITED TALKS (CONT'D)

- *On the computability of graph Turing machines.* AMS Central Sectional Meeting, Special Session on Computability and Inductive Definability over Structures, Indiana University, Bloomington, Indiana. Invited special session talk, April 2, 2017.
- *Priors on propositions: towards probabilistic programming for theorem proving,* 2nd Conference on Artificial Intelligence and Theorem Proving (AITP 2017), Obergurgl, Austria. Invited conference talk, March 29, 2017.
- *Unique ergodicity and measures invariant under permutations of* $\mathbb{N}$*,* Workshop: Algorithmic Randomness Interacts with Analysis and Ergodic Theory, Banff International Research Station, Oaxaca, Mexico. Invited workshop talk, December 6, 2016.
- *Three Problems in Computable Probability Theory*, Workshop on Uncertainty in Computation, Simons Institute for the Theory of Computing, Berkeley, CA. Invited workshop talk, October 4, 2016.
- *Invariant measures via finite structures.* Workshop on Model Theory of Finite and Pseudofinite Structures, University of Leeds, Leeds, UK. Invited workshop talk, July 29, 2016.
- *Exchangeable constructions of countable structures.* Workshop on Bayesian Methods for Networks, Isaac Newton Institute, Cambridge, UK. Invited workshop talk, July 25, 2016.
- *Symmetric probabilistic constructions of countable structures.* 5th CSLI Workshop on Logic, Rationality, & Intelligent Interaction, Stanford University, Palo Alto. Invited workshop talk, May 29, 2016.
- *Exchangeable constructions of countable structures.* Workshop on Networks, Random Graphs, and Statistics, Columbia University, New York. Invited workshop talk, May 5, 2016.
- *Feedback Turing Computability, and Turing Computability as Feedback.* AMS Central Sectional Meeting, Special Session on Computability Theory and Applications, Loyola University, Chicago, Illinois. Invited special session talk, October 3, 2015.
- *The Weihrauch degrees of conditional distributions.* Workshop on Measuring the Complexity of Computational Content: Weihrauch Reducibility and Reverse Analysis, Schloss Dagstuhl, Germany. Invited workshop talk, September 25, 2015.
- *Exchangeable constructions via model theory.* Workshop on Logic and Random Graphs, Lorentz Center, Leiden. Invited workshop talk, August 31, 2015.
- *Ergodic Invariant Measures as Probabilistic Structures, Lecture 2: Connections with graphons.* LMS–EPSRC Durham Symposium on Permutation Groups and Transformation Semigroups, Durham, UK. Invited to give 3-lecture series with coauthors, July 23, 2015.
- *The topology of universal graphons.* Conference on Computability and Complexity in Analysis (CCA 2015), Meiji University, Tokyo. Invited to give talk based on conference proceedings, July 13, 2015.
- *Feedback Turing computability, and Turing computability as feedback.* Logic in Computer Science (LICS), Kyoto. Coauthor invited to give talk based on refereed conference proceedings, July 9, 2015.
- *Computability and complexity of conditioning and conditional independence.* Workshop on Logic and Computational Complexity (LCC15), Kyoto. Invited workshop talk, July 4, 2015.
- *Priors on exchangeable directed graphs.* 10th Conference on Bayesian Nonparametrics (BNP10), Raleigh, NC. Coauthor invited to give talk based on refereed conference proceedings, June 25, 2015.
- *Two "Vaught's Conjectures" for measures invariant under the logic action.* Second Workshop on Vaught's Conjecture, Berkeley. Invited workshop talk, June 3, 2015.
- *Computability of conditioning: approximate inference and conditional independence.* Workshop on Challenges and Trends in Probabilistic Programming, Schloss Dagstuhl, Germany. Invited workshop talk, April 29, 2015.

INVITED TALKS (CONT'D)

- *Infinitary model theory in the study of graphons.* AMS–ASL Joint Mathematics Meetings, Special Session on Beyond First-Order Model Theory, San Antonio. Invited special session talk, January 10, 2015.
- *Invariant measures concentrated on the Henson graph.* NII Shonan meeting on Algorithmic Randomness and Complexity, Shonan Village Center, Japan. Invited workshop talk, September 12, 2014.
- *On computability and disintegration.* Conference on Computability and Complexity in Analysis (CCA 2014), Technische Universität Darmstadt, Germany. Invited to give talk based on conference proceedings, July 22, 2014.
- *Computable invariant measures and algorithmically random structures.* Conference on Computability Theory and Foundations of Mathematics, Tokyo Institute of Technology, Japan. Invited conference talk, February 18, 2014
- *Unique invariant measures, with an application to algorithmically random structures.* Miniconference on Analysis, Randomness, and Applications, University of South Africa, Pretoria. Invited conference talk, February 10, 2014.
- *Random symmetric constructions via inverse limits of finite structures.* AMS–ASL Joint Mathematics Meetings, Special Session on Logic and Probability, Baltimore. Invited special session talk, January 15, 2014.
- *A notion of a computational step for Partial Combinatory Algebras.* Conference on Theory and Applications of Models of Computation (TAMC 2013), University of Hong Kong. Invited to give talk based on refereed conference proceedings, May 21, 2013.
- *When is a graph random?* Workshop on Computability, Complexity, and Randomness, Schloss Dagstuhl, Germany. Invited workshop talk, January 9, 2012.
- *Aspects of randomness in analysis, graph theory, and probability theory.* Asian Logic Conference, Special Session on Algorithmic Randomness, Victoria University of Wellington, NZ. Invited special session talk, December 15, 2011.
- *Effective aspects of Lipschitz functions and variation.* Analysis and Randomness, Auckland. Invited workshop talk, December 12–13, 2011.
- *Invariant measures concentrated on countable structures.* AIM Workshop on Graph and Hypergraph limits, American Institute of Mathematics, Palo Alto. Invited workshop talk, August 16, 2011.
- *Invariant measures on countable structures.* KGRC Mini-workshop, Kurt Gödel Research Center, Vienna. Invited workshop talk, July 12, 2011.
- *The unreasonable effectiveness of statistical artificial intelligence.* Foundational Questions in the Mathematical Sciences, International Academy Traunkirchen, Austria. Invited workshop talk, July 9, 2011.
- *#P-complete conditional distributions.* Logic and Computational Complexity, Toronto. Invited workshop talk, June 25, 2011.
- *Noncomputable conditional distributions.* Logic in Computer Science (LICS), Toronto. Coauthor invited to give talk based on refereed conference proceedings, June 21, 2011.
- *Relativistic statistical arbitrage.* North American Financial Information Summit, New York City. Invited talk, May 24, 2011.
- *Invariant measures on countable models.* AMS–ASL Joint Mathematics Meetings, Special Session on Logic and Analysis, New Orleans. Invited special session talk, January 7, 2011.
- *The computability of exchangeable sequences.* Invited talk, MIT, February 10, 2010.
- *Mechanising mathematics.* Interactive Theorem Proving workshop, Cambridge, UK. Invited workshop talk, August 24, 2009.
- *Computable probability theory.* PROMYS 20th Year Celebration, Boston, MA. Invited conference talk, July 26, 2009.

INVITED TALKS (CONT'D)

- *Computable exchangeable sequences have computable de Finetti measures.* Computability in Europe (CiE 2009), Heidelberg, Germany. Invited to give talk based on refereed conference proceedings; joint work presented by D. M. Roy, July 20, 2009.
- *Computable de Finetti measures.* Mid-Atlantic Mathematical Logic Seminar, MAMLS @ Harvard: A meeting on the intersections of logic and mathematics, Cambridge, MA. Invited conference talk, May 9, 2009.
- *Models with high Scott rank.* AMS Eastern Sectional Meeting, Special Session on Computability Theory and Effective Algebra, Wesleyan University, Middletown, CT. Invited special session talk, October 11, 2008.

SEMINAR TALKS

- *Exchangeable constructions of countable structures.* Logic, Games, and Graphs Seminar, Pennsylvania State University, November 6, 2019.
- *Computability of exchangeable sequences, arrays, and graphs.* Logic Seminar, Harvard University, March 11, 2019.
- *Computability of exchangeable sequences, arrays, and graphs.* Logic Workshop, City University of New York, February 22, 2019.
- *Feedback computability.* Logic Seminar, Harvard University, October 17, 2017.
- *Symmetric random constructions in model theory.* Model Theory Seminar, City University of New York, April 4, 2014.
- *Symmetric random constructions in model theory.* Model Theory Seminar, UC Berkeley, October 23, 2013.
- *A model-theoretic approach to characterizing randomness notions.* Buenos Aires Semester in Computability, Complexity, and Randomness, March 13, 2013.
- *Model-theoretic methods in continuum limits of countable structures.* Connecticut Logic Seminar, Wesleyan University, April 30, 2012.
- *Model-theoretic constructions of limit structures.* Algorithms, Combinatorics, and Optimization Seminar, Carnegie Mellon University, March 29, 2012.
- *Invariant measure concentrated on countable structures.* Mathematical Logic Seminar, Carnegie Mellon University, March 27, 2012.
- *Computability and probabilistic symmetries.* Semester on Semantics and Syntax: A Legacy of Alan Turing, Isaac Newton Institute, Cambridge, UK, February 21, 2012.
- *Invariant measures on countable models.* Logic Workshop, Harvard University, October 27, 2010.
- *Invariant measures on countable models.* Logic Workshop, City University of New York, October 22, 2010.
- *Noncomputability of conditional probability.* Probability Seminar, MIT, March 1, 2010.
- *Computable probability theory and de Finetti's theorem.* Logic Seminar, University of Chicago, May 18, 2009.
- *Computable exchangeable sequences have computable de Finetti measures.* Logic and Computation Seminar, University of Pennsylvania, April 13, 2009.
- *Models with high Scott rank.* Logic Seminar, University of Notre Dame, November 29, 2007.

CONTRIBUTED TALKS

- *On the computability of graphons.* Association for Symbolic Logic, North American Annual Meeting, New York. May 21, 2019.
- *A classification of structures admitting a unique invariant measure.* Workshop on Homomorphisms and Graph Limits III, Hraničnı Zámeček, Hlohovec, Czech Republic. March 25, 2015.
- *Computable invariant measures and algorithmically random structures.* International Congress of Mathematicians, Seoul, August 14, 2014.
- *Computable invariant measures and algorithmically random structures.* Association for Symbolic Logic, North American Annual Meeting, Boulder. May 21, 2014.

CONTRIBUTED TALKS (CONT'D)

- *Topological aspects of dense graph limits.* Arbeitsgemeinschaft: Limits of Structures, Mathematisches Forschungsinstitut Oberwolfach, Germany, April 4, 2013.
- *Computability and Conditional Probability.* Conference on Computability Theory and Foundations of Mathematics, Tokyo Institute of Technology, Japan, February 20, 2013.
- *Model-theoretic constructions of limit structures.* Workshop on Graph Homomorphisms, Limits, and Structures II, Hraničnı Zámeček, Hlohovec, Czech Republic. January 24, 2012.
- *Invariant measures concentrated on countable structures.* Workshop on Homogeneous Structures, Leeds. July 21, 2011.
- *Effective aspects of Lipschitz functions.* Association for Symbolic Logic, North American Annual Meeting, Berkeley. March 24, 2011.
- *The computability of conditional probability distributions.* AMS–ASL Joint Mathematics Meetings, San Francisco. January 15, 2010.
- *The complexity of computable conditional probability.* Computability in Europe (CiE 2009), Heidelberg, Germany. July 20, 2009.
- *Computable exchangeable sequences have computable de Finetti measures.* Association for Symbolic Logic, North American Annual Meeting, Notre Dame. May 20, 2009.

WORKSHOPS

Computability and Complexity

- *Algorithmic Randomness,* American Institute of Mathematics. Invited workshop participant, August 10–14, 2020, online.
- *Higher-order complexity and its applications,* NII Shonan Meeting. Invited speaker, October 7–10, 2019, Shonan Village Center, Japan.
- *Algorithmic Randomness Interacts with Analysis and Ergodic Theory,* Banff International Research Station for Mathematical Innovation and Discovery. Invited workshop participant, December 4–9, 2016, Oaxaca, Mexico.
- *Measuring the Complexity of Computational Content: Weihrauch Reducibility and Reverse Analysis,* Schloss Dagstuhl. Invited workshop participant, September 20–25, 2015, Dagstuhl, Germany.
- *Logic and Computational Complexity (LCC15)*. Invited speaker, July 4–5, 2015, Kyoto.
- *Algorithmic Randomness and Complexity,* NII Shonan Meeting. Invited speaker, September 8–12, 2014, Shonan Village Center, Japan.
- *Logic, Probability, and Reflection IV,* MIRI. Workshop participant, September 7–13, 2013, Berkeley.
- *Computable Stability Theory,* American Institute of Mathematics. Workshop participant, August 12–19, 2013, Palo Alto.
- *Towards Efficient Homomorphic Encryption,* IdeaLab 2013, Institute for Computational and Experimental Research in Mathematics (ICERM). Workshop participant, July 15–19, 2013, Providence, RI.
- *Computability, Complexity, and Randomness,* Universidad de Buenos Aires. Invited special semester participant, March 12–18, 2013, Buenos Aires, Argentina.
- *Semantics and Syntax: A Legacy of Alan Turing,* Isaac Newton Institute. Special semester participant, February 5–26, 2012, Cambridge, UK.
- *Computability, Complexity, and Randomness,* Schloss Dagstuhl. Invited speaker and workshop participant, January 8–13, 2012, Dagstuhl, Germany.
- *Analysis and Randomness,* University of Auckland. Invited speaker, December 12–13, 2011, Auckland.
- *Reverse Mathematics Workshop,* University of Chicago. Workshop participant, September 16–18, 2011, Chicago.
- *Foundational Questions in the Mathematical Sciences,* International Academy Traunkirchen. Invited speaker, July 9-11, 2011, Traunkirchen, Austria.

WORKSHOPS (CONT'D)

Computability and Complexity (cont'd)

· *Logic and Computational Complexity (LCC 2011)* at Logic in Computer Science (LICS 2011). Invited speaker, June 25, 2011, Toronto.

Bayesian Statistics, Machine Learning, and Probabilistic Programming

· *Higher-order probabilistic computation*, Bellairs Research Institute. Invited workshop participant, March 17–21, 2019, Barbados.

· *All of Bayesian Nonparametrics (BNP@NeurIPS)* at NeurIPS 2018. *Goodness-of-fit tests for high-dimensional discrete distributions with application to convergence diagnostics in Bayesian nonparametric inference,* poster, presented by coauthor F. A. Saad, December 7, 2018, Montreal, Canada.

· *Symposium on Advances in Approximate Bayesian Inference (AABI)* colocated with NeurIPS 2018. *Goodness-of-fit tests for high-dimensional discrete distributions with application to convergence diagnostics in approximate Bayesian inference,* poster, December 2, 2018, Montreal, Canada.

· *Probabilistic Programming Semantics* at Principles of Programming Languages (POPL 2017). Co-chair and workshop participant. *On computable representations of exchangeable data*, poster, and *Exchangeable Random Processes and Data Abstraction,* workshop paper, presented by coauthor S. Staton, January 17, 2017, Paris, France.

· *Uncertainty in Computation*, Simons Institute for the Theory of Computing. Invited workshop participant, October 4–7, 2016, Berkeley, CA.

· *Bayesian Methods for Networks,* Isaac Newton Institute. Invited speaker and workshop participant, July 25–27, 2016, Cambridge, UK.

· *Networks, Random Graphs, and Statistics,* Columbia University. Invited speaker and workshop participant, May 4–6, 2016, New York.

· *Probabilistic Programming Semantics* at Principles of Programming Languages (POPL 2016). Program Committee member and workshop participant. *Exchangeable random primitives,* workshop paper, presented by coauthor D. M. Roy, January 23, 2016, St. Petersburg, FL.

· *Bayesian Nonparametrics: The Next Generation* at Neural Information Processing Systems (NIPS 2015), *Priors on exchangeable directed graphs,* workshop paper, presented by coauthor D. Cai, December 12, 2015, Montreal, Canada.

· *Challenges and Trends in Probabilistic Programming,* Schloss Dagstuhl. Invited workshop participant, April 26–30, 2015, Dagstuhl, Germany.

· *Information and Entropy,* NIMBioS. Invited workshop participant, April 8–10, 2015, Knoxville, TN.

· *Probabilistic Programming* at Neural Information Processing Systems (NIPS 2013), *A tour through the theoretical foundations of probabilistic programming,* presented by coauthor D. M. Roy, December 7, 2012, South Lake Tahoe, NV.

· *Monte Carlo Methods for Modern Applications* at Neural Information Processing Systems (NIPS 2010), *When are probabilistic programs probably computationally tractable?*, presented by coauthor V. K. Mansinghka, December 10, 2010, Whistler, Canada.

· *Nonparametric Bayes Workshop* at Neural Information Processing Systems (NIPS 2009), *Predictive computable iff posterior computable*, workshop paper, presented by coauthor D. M. Roy, December 12, 2009, Whistler, Canada.

· *Learning Workshop,* Computational and Biological Learning Society. *Probabilistic programs, computability, and de Finetti measures,* workshop paper, presented by coauthor D. M. Roy, April 13–16, 2009, Clearwater, FL.

WORKSHOPS (CONT'D)

Combinatorics and Model Theory

- *Structure and Dynamics of Polish Groups,* École Polytechnique Fédérale de Lausanne (EPFL). *Entropy of Invariant Measures,* presented by coauthor N. L. Ackerman, March 19, 2018, Lausanne, Switzerland.
- *Model Theory and Combinatorics,* Institut Henri Poincaré. Invited workshop participant, January 29–February 2, 2018, Paris, France.
- *Model Theory of Finite and Pseudofinite Structures,* University of Leeds. Invited speaker and workshop participant, July 27–29, 2016, Leeds, UK.
- *Logic, Rationality, & Intelligent Interaction,* Center for the Study of Language and Information, Stanford University. Invited speaker and workshop participant, May 28–29, 2016, Palo Alto, CA.
- *Homogeneous Structures,* Banff International Research Station for Mathematical Innovation and Discovery. Invited workshop participant, November 8–13, 2015, Banff, Canada.
- *Logic and Random Graphs,* Lorentz Center. Invited speaker and workshop participant, August 31 – September 4, 2015, Leiden, The Netherlands.
- *LMS–EPSRC Durham Symposium on Permutation Groups and Transformation Semigroups,* Durham University. Invited speaker and workshop participant, July 20 – 30, 2015. Durham, UK.
- *Second Workshop on Vaught's Conjecture,* UC Berkeley. Invited workshop participant, June 1–5, 2015. Berkeley, CA.
- *Homomorphisms and Graph Limits III,* Hraničnı Zámeček. Invited workshop participant, March 22–27, 2015. Hlohovec, Czech Republic.
- *Workshop on Homogeneous Structures,* Trimester Program on Universality and Homogeneity, Hausdorff Research Institute for Mathematics, University of Bonn. Invited workshop and trimester program participant, October 27 – November 2, 2013, Bonn, Germany.
- *Arbeitsgemeinschaft: Limits of Structures,* Mathematisches Forschungsinstitut Oberwolfach. Workshop participant, March 31 – April 5, 2013, Oberwolfach, Germany.
- *Graph Homomorphisms, Limits, and Structures II,* Hraničnı Zámeček. Invited workshop participant, January 23–27, 2012. Hlohovec, Czech Republic.
- *Graph and Hypergraph limits,* American Institute of Mathematics. Invited workshop participant, August 15–19, 2011, Palo Alto.
- *Workshop on Homogeneous Structures,* University of Leeds. Workshop participant, July 19–22, 2011, Leeds, UK.
- *KGRC Mini-workshop,* Kurt Gödel Research Center. Invited speaker, July 12–13, 2011, Vienna.
- *Model Theory of Fields,* Mathematics Research Community, American Mathematics Society. Invited workshop participant, June 19–25, 2010, Snowbird, UT.

Interactive Theorem Proving and Formalized Mathematics

- *Artificial Intelligence in Theorem Proving,* CNRS Centre Paul-Langevin. Program Committee member and workshop participant, March 25–30, 2018, Aussois, France.
- *Computer-aided mathematical proof,* Isaac Newton Institute. Invited workshop participant, July 10–14, 2017, Cambridge, UK
- *Artificial Intelligence in Theorem Proving,* University of Innsbruck. Invited speaker, March 26–30, 2017, Obergurgl, Austria.
- *Artificial Intelligence in Theorem Proving,* University of Innsbruck. Workshop participant, April 3–7, 2016, Obergurgl, Austria.
- *Interactive Theorem Proving Workshop,* Computer Laboratory, University of Cambridge. Invited speaker, August 24–25, 2009, Cambridge, UK.
- *Isabelle Theorem Prover Developer's Workshop,* Technische Universität München (TUM). Invited workshop participant, August 13–15, 2009, Munich.

TEACHING

University of Hawai‘i at Mānoa

· *Math 243: Calculus III* (undergraduate course). Instructor, Spring 2011.
· *Math 649B: Logic* (graduate reading course on computational complexity). Co-instructor, Fall 2010.
· *Math 307: Linear Algebra and Differential Equations* (undergraduate course). Instructor, Fall 2010.

Massachusetts Institute of Technology

· *6.885: Probabilistic Programming and Artificial Intelligence* (graduate course). Helped define problem sets and student projects; designed and delivered guest lectures, Spring 2020.
· *6.885: Probabilistic Programming and Artificial Intelligence* (graduate course). Helped define problem sets and student projects; designed and delivered guest lectures, Spring 2019.
· *18.515: Mathematical Logic* (graduate course). Instructor, Spring 2010.
· *18.03: Differential Equations* (undergraduate course). Recitation Instructor and Course Administrator, Fall 2009.
· *18.575: Model Theory* (graduate course). Instructor, Spring 2009.
· *18.03: Differential Equations* (undergraduate course). Recitation Instructor, Fall 2008.

Harvard University

· *QR 28: The Magic of Numbers* (undergraduate course). Head Teaching Fellow, Fall 2007.
· *Math 144: Model Theory and Algebra* (undergraduate course). Teaching Fellow, Spring 2007.
· *QR 28: The Magic of Numbers* (undergraduate course). Teaching Fellow, Fall 2006.
· *Math 141: Intro. to Mathematical Logic* (undergraduate course). Teaching Fellow, Fall 2006.
· *Math 143: Set Theory* (undergraduate course). Teaching Fellow, Spring 2006.
· *Math 141: Intro. to Mathematical Logic* (undergraduate course). Teaching Fellow, Fall 2005.
· *Math 137: Algebraic Geometry* (undergraduate course). Teaching Fellow, Spring 2005.
· *Math 144: Model Theory and Algebra* (undergraduate course). Teaching Fellow, Spring 2005.
· *Math 141: Intro. to Mathematical Logic* (undergraduate course). Teaching Fellow, Fall 2003.

Program in Mathematics for Young Scientists (PROMYS)

· *Undecidability and Hilbert's 10th Problem* (advanced seminar for high school students). Co-instructor, Summer 2020.

MENTORING

Doctoral

Boston University
· *Improved necessary and sufficient conditions for the existence of a subtle cardinal*, Peter Barendse, Ph.D. in Mathematics. Dissertation committee member, 2010.

Master's

African Institute for Mathematical Sciences (AIMS) Senegal
· *Logical methods in combinatorics*, Jean-Marc Mavugo, Master in Mathematical Sciences. External examiner, 2020.

Undergraduate

University of Hawai‘i at Mānoa
· *Computability and the Lovász Local Lemma,* Travis Hee Wai. NSF-funded undergraduate research mentor, Fall 2010. Hee Wai was selected as the Hawai‘i Council of Engineering Societies' 2011 Student Engineer of the Year.

MENTORING (CONT'D)

Undergraduate (cont'd)

Undergraduate Research Opportunities Program (UROP), Massachusetts Institute of Technology

· *Combinatorial games and random structures,* Tamvana Makuluni. Undergraduate research mentor, Summer 2009.

· *Combinatorial games, linear orders, and logic,* Manuel Rivera. Undergraduate research mentor, Fall 2008 and IAP 2009.

Summer Program in Undergraduate Research (SPUR), Massachusetts Institute of Technology

· *A q-analogue of the Narayana numbers and a combinatorial interpretation,* Guilherme Issao Fujiwara. Research Experience for Undergraduates (REU) project mentor, 2005.

· *Some combinatorial results on subset sums of $\mathbb{Z}/n\mathbb{Z}$,* Kyungmin Kim. Research Experience for Undergraduates (REU) project mentor, 2005.

Freshman advising, Massachusetts Institute of Technology

· Advised 4 undergraduate math majors, Fall 2009.

High School

Research Science Institute (RSI)

· *Descriptive complexity of random bit strings,* Benjamin Dozier. High school mathematics research project mentor, 2007. Project led to Dozier being selected as a Finalist (top 40 nationwide) in the Intel Science Talent Search.

· *Cake-cutting with locally negative preference functions,* Winston Luo. High school mathematics research project mentor, 2007.

Program in Mathematics for Young Scientists (PROMYS)

· Co-instructor, *Undecidability and Hilbert's 10th Problem*, Advanced seminar for high school students, 2020.

· High school research project designer, 2008, 2011, and 2020.

· High school mathematics research project mentor, 2004–2007.

· Counselor, 2000–2003.

PROFESSIONAL ACTIVITIES

Board of Trustees

· Trustee, *PROMYS Foundation,* a 501(c)(3) organization with the goal of supporting the PROMYS Program at Boston University, 2011 – Present. (Secretary, 2011–2019.)

Steering Committee

· Steering Committee member, *Workshop on Languages for Inference (LAFI)*, formerly known as the Workshop on Probabilistic Programming Semantics (PPS), 2018–Present.

Program Committee Chair

· Program Committee co-chair, *Workshop on Probabilistic Programming Semantics (PPS 2018),* colocated with POPL, Los Angeles, January 9, 2018.

· Program Committee co-chair, *Workshop on Probabilistic Programming Semantics (PPS 2017),* colocated with POPL, Paris, France, January 17, 2017.

Senior Program Committee / Area Chair

· Area Chair, *Artificial Intelligence and Statistics (AISTATS 2021),* online, April 13–15, 2021.

· Area Chair, *Artificial Intelligence and Statistics (AISTATS 2020),* online, August 26–28, 2020.

· Senior Program Committee member, *Uncertainty in Artificial Intelligence (UAI 2019),* Tel Aviv, Israel, July 22–25, 2019.

PROFESSIONAL ACTIVITIES (CONT'D)

Program Committee

- Program Committee member, *Conference on Artificial Intelligence and Theorem Proving (AITP 2018),* Aussois, France, March 25–30, 2018.
- Program Committee member, *AAAI Conference on Artificial Intelligence (AAAI-17),* San Francisco, CA, February 4–9, 2017.
- Program Committee member, *Workshop on Practical Bayesian Nonparametrics (BNP @ NIPS),* Barcelona, Spain, December 9, 2016.
- Program Committee member, *Mathematical Foundations of Programming Semantics XXXII (MFPS 2016),* Pittsburgh, PA, May 23–26, 2016.
- Program Committee member, *Workshop on Probabilistic Programming Semantics (PPS 2016),* colocated with POPL, St. Petersburg, FL., January 23, 2016.
- Program Committee member, *Conference on Computability and Complexity in Analysis (CCA 2013)*, Nancy, France, July 8–10, 2013.

Organizer

- Co-organizer, *Special Session on Logic and Graph Limits*, Association for Symbolic Logic, North American Annual Meeting, University of California, Irvine, March 27, 2020 (cancelled).
- Co-organizer, Harvard–MIT Logic Seminar, 2012–2013.
- Co-organizer, *Special Session on Computability and Complexity*, American Mathematical Society Sectional Meeting, University of Hawai'i at Mānoa, March 3–4, 2012.
- Co-organizer, MIT Logic Seminar, 2008–2010.
- Local Committee, *MAMLS @ Harvard: A meeting on the intersections of logic and mathematics*, May 9–10, 2009.