Heng Guo

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Academic Positions

- Lecturer in algorithms and complexity, University of Edinburgh 2017/09 – present
- Visiting Professor, Institute for Theoretical Computer Science, Shanghai University of Finance and Economics 2018/05 – present
- Google research fellow, Simons Institute for the Theory of Computing, University of California, Berkeley 2016/01 – 2016/05
- Postdoctoral researcher, Queen Mary, University of London 2015/10 – 2017/08

Education

- Ph.D. in *Computer Science* University of Wisconsin-Madison, 2015
  Advisor: Jin-Yi Cai
  Thesis: Complexity Classification of Exact and Approximate Counting Problems
- M.A. in *Mathematics* University of Wisconsin-Madison, 2013
- M.S. in *Computer Science* Peking University, 2010
- B.S. in *Mathematics* Peking University, 2007

Research Interests

- Theoretical computer science, with an emphasis on computational counting and sampling.

Honours and Awards

- Best paper award of ICALP 2018 track A, for the paper "A polynomial-time approximation algorithm for all-terminal network reliability" (joint work with Mark Jerrum).
- EATCS distinguished dissertation award. European Association for TCS, 2016.
- Google research fellow. Simons Institute of Computing, UC-Berkeley, 2016 Spring.
- Simons award for graduate students in TCS. The Simons foundation, 2013-2015.
- Kang Zheng fellowship. Peking University, 2008-2009.

Research Articles

- Perfect simulation of the hard disks model by partial rejection sampling
  Heng Guo and Mark Jerrum
  ICALP'18, to appear
  arXiv: 1801.07342
- A polynomial-time approximation algorithm for all-terminal network reliability
  Heng Guo and Mark Jerrum
  ICALP'18, to appear (Best paper award for track A)
  arXiv: 1709.08561

- Counting hypergraph colorings in the local lemma regime
  Heng Guo, Chao Liao, Pinyan, Lu, and Chihao Zhang
  STOC'18, to appear
  arXiv: 1711.03396
- Holographic algorithms beyond matchgates
  Jin-Yi Cai, Heng Guo, and Tyson Williams
  Inf. Comput., 259(1), 102-129, 2018
  Preliminary version: **ICALP'14**, pp. 271-282
- Layerwise systematic scan: deep Boltzmann machines and beyond
  Heng Guo, Kaan Kara, and Ce Zhang
  AISTATS'18, PMLR 84, 178-187
- The complexity of approximating complex-valued Ising and Tutte partition functions
  Leslie Ann Goldberg and Heng Guo
  Comput. Complex., 26(4), 765-833, 2017
- Random cluster dynamics for the Ising model is rapidly mixing
  Heng Guo and Mark Jerrum
  Ann. Appl. Probab., 28(2), 1292-1313, 2018
  Preliminary version: **SODA'17**, pp. 1818-1827
- Uniform sampling through the Lovász local lemma
  Heng Guo, Mark Jerrum, and Jingcheng Liu
  STOC'17, pp. 342-355
- Uniqueness, spatial mixing, and approximation in ferromagnetic 2-spin systems
  Heng Guo and Pinyan Lu
  RANDOM'16, 31:1-26
- Approximation via correlation decay when strong spatial mixing fails
  Ivona Bezáková, Andreas Galanis, Leslie Ann Goldberg, Heng Guo, and Daniel Štefankovič
  ICALP'16, 45:1-13
- A complete dichotomy rises from the capture of vanishing signatures
  Jin-Yi Cai, Heng Guo, and Tyson Williams
  SIAM J. Comput., 45(5), 1671-1728, 2016
  Preliminary version: **STOC'13**, pp. 635-644
- The complexity of counting edge colorings and a dichotomy for some higher domain Holant problems
  Jin-Yi Cai, Heng Guo, and Tyson Williams
  Res. Math. Sci., 3:18, 2016
  Preliminary version: **FOCS'14,** pp. 601-610
- #BIS-hardness for 2-spin systems on bipartite bounded degree graphs in the tree nonuniqueness region
  Jin-Yi Cai, Andreas Galanis, Leslie Ann Goldberg, Heng Guo, Mark Jerrum, Daniel Štefankovič, and Eric Vigoda
  J. Comput. Syst. Sci., 82(5), 690-711, 2016
  Preliminary version: **RANDOM'14**, pp. 582-595

- A Holant dichotomy: Is the FKT algorithm universal?
  Jin-Yi Cai, Zhiguo Fu, Heng Guo, and Tyson Williams
  FOCS'15, pp. 1259-1276
- The complexity of symmetric Boolean parity Holant problems
  Heng Guo, Pinyan Lu, and Leslie G. Valiant
  SIAM J. Comput., 42(1), 324-356, 2013
  Preliminary version: **ICALP'11**, pp. 712-723
- The complexity of planar Boolean #CSP with complex weights
  Heng Guo and Tyson Williams
  ICALP'13, pp. 516-527
- Inapproximability after uniqueness phase transition in two-spin systems
  Jin-Yi Cai, Xi Chen, Heng Guo, and Pinyan Lu
  COCOA'12, pp. 336-347
- The complexity of weighted Boolean #CSP modulo k
  Heng Guo, Sangxia Huang, Pinyan Lu, and Mingji Xia
  STACS'11, pp. 249-260
- On model checking Boolean BI
  Heng Guo, Hanpin Wang, Zhongyuan Xu and Yongzhi Cao
  CSL'09, pp. 302-316

Preprints

- Clifford gates in the Holant framework
  Jin-Yi Cai, Heng Guo, and Tyson Williams
  Submitted. arXiv: `1705.00942`

Book Chapters, Surveys, Other Writings

- On the complexity of Holant problems
  Heng Guo and Pinyan Lu
  The Constraint Satisfaction Problem, **Dagstuhl Follow-Ups 7**, 159-177, 2017
- Mapping the complexity of counting problems
  Heng Guo
  Bulletin of EATCS, No 120: October 2016
- Holant problems
  Jin-Yi Cai, Heng Guo, and Tyson Williams
  Encyclopedia of Algorithms 2016: 918-921

Talks

- A polynomial-time approximation algorithm for all-terminal network reliability
  - 2018 May, FATA seminar, University of Glasgow, UK
  - 2018 May, TADS seminar, Alan Turing Institute, London, UK
  - 2018 Apr, Scottish Combinatorics Meeting, Edinburgh, UK
- A simple FPRAS for bi-directed reachability
  - 2017 Dec, TCS seminar, Peking University, China

- Counting hypergraph colorings in the local lemma regime
  - 2017 Dec, China Academy of Science, China
- Uniform sampling through the Lovász Local Lemma
  - 2017 Nov, Heriot-Watt University, UK
  - 2017 Nov, University of Durham, UK
  - 2017 Aug, Dagstuhl Seminar 17341: Computational Counting, Germany
  - 2017 Jun, STOC, Montreal, Canada
  - 2017 Jun, Reunion workshop, Simons Institute, UC-Berkeley, CA
  - 2017 May, Nanjing Theory Day 2017, Nanjing, China
  - 2016 Dec, Nanjing University, China
  - 2016 Dec, ITCS Workshop I, Shanghai University of Finance and Economics, China
- Random cluster dynamics for the Ising model is rapidly mixing
  - 2017 Dec, Probability seminar, Peking University, China
  - 2017 Jul, LMS - EPSRC Durham Symposium, Durham, UK
  - 2017 Jan, SODA, Barcelona, Spain
  - 2016 Nov, Oxford University, UK
  - 2016 Oct, Queen Mary, University of London, UK
  - 2016 Jun, Shanghai University of Finance and Economics, China
  - 2016 May, Harvard University, MA
  - 2016 Apr, Simons Institute, UC-Berkeley, CA
- Computational counting and sampling
  - 2017 Mar, University of Edinburgh, UK
  - 2017 Mar, CS Colloquium, University of Chicago, IL
- Uniqueness, spatial mixing, and approximate counting
  - 2016 Sep, RANDOM, Paris, France
  - 2016 Mar, Classification workshop, Simons Institute, UC-Berkeley, CA
  - 2015 Oct, Columbia University, NY
- Approximation via correlation decay when strong spatial mixing Fails
  - 2016 Jul, ICALP, Rome, Italy
- Planar dichotomy theorems
  - 2016 Jan, Counting program bootcamp, Simons Institute, UC-Berkeley, CA
  - 2015 Oct, FOCS, Berkeley, CA
- The complexity of Ising models with complex weights
  - 2014 Dec, Midwest Theory Day, University of Michigan, MI

- Dichotomy theorems in computational complexity
  - 2014 Sep, Nanjing University, China
  - 2014 Feb, Durham University, UK
- Edge coloring, Siegel's theorem, and a Holant dichotomy
  - 2014 Sep, China Theory Week, Tsinghua University, China
- #BIS-hardness for 2-spin systems on bipartite bounded degree graphs in the tree nonuniqueness region
  - 2014 Sep, RANDOM, Barcelona, Spain
- Holographic algorithms beyond matchgates
  - 2014 Jul, ICALP, Copenhagen, Denmark
- Phase transition and computational transition
  - 2014 May, Oxford University, UK
- The complexity of planar Boolean #CSP with complex weights
  - 2013 Jul, ICALP, Riga, Latvia
- A complete dichotomy rises from the capture of vanishing signatures
  - 2013 Jun, STOC, Palo Alto, CA
  - 2013 Jan, Dagstuhl Seminar 13031: Computational Counting, Germany

Teaching

- 2018 Spring Computational Complexity (INFR11102), University of Edinburgh
- 2016 Fall Advanced Combinatorics (MTH742P), Queen Mary, University of London

Services

- Program committee: FAW 2018, NCTCS 2018.
- LFCS (Edinburgh) seminar organizer from 2018.
- Seminar organizer of the 2016 spring program "Counting Complexity and Phase Transitions" in the Simons institute of UC-Berkeley.
- Journal Reviews: SIAM Journal on Computing,
  Journal of Computer and System Sciences,
  Computational Complexity,
  Information and Computation,
  Random Structures and Algorithms,
  Theoretical Computer Science,
  Theory of Computing,
  ACM Transactions on Computation Theory,
  Theory of Computing Systems,
  Journal of Discrete Algorithms.
- Conference Reviews: COLT, ESA, FAW, FOCS, ICALP, ISAAC, MFCS, QIP, RANDOM, SODA, STACS, TAMC.
- Other Reviews: MathSciNet, Handbook of the Tutte Polynomial.