

# Heng Guo

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- Academic Positions**
- Lecturer in algorithms and complexity, University of Edinburgh 2017/09 – present
  - Google research fellow, Simons Institute, UC-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
  - 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**
- 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.
  - Summer graduate research fellowship. University of Wisconsin-Madison, 2011.
  - Kang Zheng fellowship. Peking University, 2008-2009.
- Research Articles**
- The Complexity of Approximating Complex-Valued Ising and Tutte Partition Functions  
Leslie Ann Goldberg and Heng Guo  
**Comput. Complex.**  
DOI: 10.1007/s00037-017-0162-2
  - Random Cluster Dynamics for the Ising Model is Rapidly Mixing  
Heng Guo and Mark Jerrum  
**Ann. Appl. Probab.**, to appear  
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
- Holographic Algorithms Beyond Matchgates  
Jin-Yi Cai, Heng Guo, and Tyson Williams  
**ICALP'14**, pp. 271-282
- 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

- Layerwise Systematic Scan: Deep Boltzmann Machines and Beyond  
Heng Guo, Kaan Kara, and Ce Zhang  
*Submitted*. Available at <http://arxiv.org/abs/1705.05154>
- Clifford Gates in the Holant Framework  
Jin-Yi Cai, Heng Guo, and Tyson Williams  
*Submitted*. Available at <http://arxiv.org/abs/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

- |      |     |   |
|------|-----|---|
| 2017 | Aug | Uniform sampling through the Lovász Local Lemma<br>Dagstuhl Seminar 17341: Computational Counting, Germany              |
|      | Jul | Random cluster dynamics for the Ising model is rapidly mixing<br>LMS - EPSRC Durham Symposium, Durham, UK               |
|      | Jun | Uniform sampling through the Lovász Local Lemma<br>STOC 2017, Montreal, Canada  |
|      | Jun | Uniform sampling through the Lovász Local Lemma<br>Reunion workshop, Simons Institute, UC-Berkeley, CA                  |
|      | May | Uniform sampling through the Lovász Local Lemma<br>Nanjing Theory Day 2017, Nanjing, China                              |
|      | Mar | Computational counting and sampling<br>University of Edinburgh, UK  |
|      | Mar | Computational counting and sampling<br>CS Colloquium, University of Chicago, IL   |
|      | Jan | Random cluster dynamics for the Ising model is rapidly mixing<br>SODA 2017, Barcelona, Spain                            |
| 2016 | Dec | Uniform sampling through the Lovász Local Lemma<br>Nanjing University, China  |
|      | Dec | Uniform sampling through the Lovász Local Lemma<br>ITCS Workshop I, Shanghai University of Finance and Economics, China |
|      | Nov | Random cluster dynamics for the Ising model is rapidly mixing<br>Oxford University, UK                                  |
|      | Oct | Random cluster dynamics for the Ising model is rapidly mixing<br>Queen Mary, University of London, UK                   |

- Sep Uniqueness, spatial mixing, and approximation in ferromagnetic 2-Spin Systems  
RANDOM 2016, Paris, France
- Jul Approximation via correlation decay when strong spatial mixing Fails  
ICALP 2016, Rome, Italy
- Jun Random cluster dynamics for the Ising model is rapidly mixing  
Shanghai University of Finance and Economics, China
- May Random cluster dynamics for the Ising model is rapidly mixing  
Harvard University, MA
- Apr Random cluster dynamics at  $q = 2$  is rapidly mixing  
Counting program seminar, Simons Institute, UC-Berkeley, CA
- Mar Approximating 2-state spin systems  
Classification workshop, Simons Institute, UC-Berkeley, CA
- Jan Planar dichotomy theorems  
Counting program bootcamp, Simons Institute, UC-Berkeley, CA
- 2015 Oct Uniqueness, spatial mixing, and approximate counting  
Columbia University, NY
- Oct A Holant dichotomy: is the FKT algorithm universal?  
FOCS 2015, Berkeley, CA
- 2014 Dec The complexity of Ising models with complex weights  
Midwest Theory Day, University of Michigan, MI
- Sep Dichotomy theorems in computational complexity  
Nanjing University, China
- Sep Edge coloring, Siegel's theorem, and a Holant dichotomy  
China Theory Week, Tsinghua University, China
- Sep #BIS-hardness for 2-spin systems on bipartite bounded degree graphs in the tree nonuniqueness region  
RANDOM 2014, Barcelona, Spain
- Jul Holographic algorithms beyond matchgates  
ICALP 2014, Copenhagen, Denmark
- May Phase transition and computational transition  
Oxford University, UK
- Feb Complexity dichotomies for counting problems  
Durham University, UK
- 2013 Jul The complexity of planar Boolean #CSP with complex weights  
ICALP 2013, Riga, Latvia
- Jun A complete dichotomy rises from the capture of vanishing signatures  
STOC 2013, Palo Alto, CA
- Jan A complete dichotomy rises from the capture of vanishing signatures  
Dagstuhl Seminar 13031: Computational Counting, Germany

## Teaching Experiences

- Lecturer in Queen Mary, University of London:
  - 2016 Fall MTH742P (Advanced Combinatorics)
- Teaching Assistant in the University of Wisconsin Madison:
  - 2013 Fall CS520 (Introduction to Theoretical Computer Science)
  - 2011 Fall CS577 (Introduction to Algorithms)
  - 2011 Spring CS302 (Introduction to Computation)
  - 2010 Fall CS202 (Introduction to Programming)
- Teaching Assistant in Peking University:
  - 2009 Spring Mathematical Logic
  - 2008 Fall Concurrency Theory
  - 2008 Fall Number Theory
  - 2008 Spring Mathematical Logic
  - 2007 Fall Probability and Statistics

## Services

- 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, Theoretical Computer Science, Theory of Computing, ACM Transactions on Computation Theory, Theory of Computing Systems, Journal of Discrete Algorithms.
- Conference Reviews: ESA, FAW, FOCS, ICALP, ISAAC, MFCS, SODA, STACS, TAMC.
- Other Reviews: MathSciNet, Handbook of the Tutte Polynomial.