Mark Sellke

Education

2018- **PhD in Mathematics**, *Stanford University*.
Advised by Andrea Montanari and Sébastien Bubeck

2017-2018 **M.A.St. in Mathematics with Distinction**, *University of Cambridge*.

2014-2017 **B.S. in Mathematics**, *MIT*.

Fellowships and Awards

- Symposium on Discrete Algorithms (SODA): Best Paper Award 2020
- Symposium on Discrete Algorithms (SODA): Best Student Paper Award 2020
- William R. and Sara Hart Kimball endowed Stanford Graduate Fellowship 2018-2023
- NSF Graduate Research Fellowship 2017-2022
- Trinity College Studentship in Mathematics 2017-2018
- Putnam Exam: 1st place 2014
- International Mathematical Olympiad: Gold Medalist 2013, 2014
- MathCounts National Competition: 1st place 2010

Research

26. Iterative Feature Matching: Toward Provable Domain Generalization with Logarithmic Environments. With Yining Chen, Elan Rosenfeld, Tengyu Ma, and Andrej Risteski. arXiv:2106.09913

25. A Universal Law of Robustness via Isoperimetry. With Sébastien Bubeck. arXiv:2105.12806

24. Optimizing Mean-Field Spin Glasses with External Field. arXiv:2105.03506

23. Tensor Quasi-Random Groups. **Proceedings of the American Mathematical Society**, to appear. arXiv:2103.11048

22. Cutoff for the Asymmetric Riffle Shuffle. arXiv:2103.05068

21. Functions that Preserve Manhattan Distances. With Timothy Chu, Gary Miller, and Shyam Narayanan. arXiv:2011.11503

20. Cooperative and Stochastic Multi-Player Multi-Armed Bandit: Optimal Regret With Neither Communication Nor Collisions. With Sébastien Bubeck and Thomas Budzinski. **COLT 2021**. arXiv:2011.03896.

19. Algorithmic Pure States for the Negative Spherical Perceptron. With Ahmed El Alaoui. arXiv:2010.15811.

18. Approximate Ground States of Hypercube Spin Glasses are Near Corners. **Comptes Rendus Mathématiques**, to appear. arXiv:2009.09316

450 Jane Stanford Way – 94305 Stanford – USA
+1 (765) 497 1714 • msellke AT stanford.edu
web.stanford.edu/ msellke/main

17. Biomimetic Six-Axis Robots Replicate Human Cardiac Papillary Muscle Motion: Pioneering the Next Generation of Biomechanical Heart Simulator Technology. With Annabel M. Imbrie-Moore, Matthew H. Park, Michael J. Paulsen, Rohun Kulkami, Hanjay Wang, Yuanjia Zhu, Justin M. Farry, Alexandra T. Bourdillon, Christine Callinan, Haley J. Lucian, Camille E. Hironaka, Daniela Deschamps and Y. Joseph Woo. **J. R. Soc. Interface**, Volume 17, Issue 173 (2020)

16. Metrical Service Systems with Transformations. With Sébastien Bubeck, Niv Buchbinder, and Christian Coester. **ITCS 2021**. arXiv:2009.08266

15. Vertex Sparsification for Edge Connectivity. With Parinya Chalermsook, Syamantak Das, Bundit Laekhanukit, Yunbum Kook, Yang P. Liu, Richard Peng, and Daniel Vaz. **SODA 2021**. arXiv:2007.07862

14. Online Multiserver Convex Chasing and Optimization. With Sébastien Bubeck and Yuval Rabani. **SODA 2021**.

13. Covering $Irrep(S_n)$ With Tensor Products and Powers. arXiv:2004.05283

12. The Price of Incentivizing Exploration: A Characterization via Thompson Sampling and Sample Complexity. With Aleksandrs Slivkins. **EC 2021**. arXiv:2002.00558

11. Optimization of Mean-field Spin Glasses. With Ahmed El Alaoui and Andrea Montanari. **Annals of Probability**, to appear. arXiv:2001.00904

10. Chasing Convex Bodies Optimally. **SODA 2020**. **Best Paper and Best Student Paper**. arXiv:1905.11968

9. Non-Stochastic Multi-Player Multi-Armed Bandits: Optimal Rate With Collision Information, Sublinear Without. With Sébastien Bubeck, Yuanzhi Li, and Yuval Peres. **COLT 2020**. arXiv:1904.12233

8. First-Order Bayesian Regret Analysis of Thompson Sampling. With Sébastien Bubeck. **ALT 2020**. arXiv:1902.00681

7. Competitively Chasing Convex Bodies. With Sébastien Bubeck, Yin Tat Lee, and Yuanzhi Li. **STOC 2019, invited to the special issue**. arXiv:1811.00887

6. Chasing Nested Convex Bodies Nearly Optimally. With Sébastien Bubeck, Bo'az Klartag, Yin Tat Lee, and Yuanzhi Li. **SODA 2020**. arXiv:1811.00999

5. Exact minimum number of bits to stabilize a linear system. With Victoria Kostina, Yuval Peres, and Gireeja Ranade. **IEEE CDC 2018**. arXiv:1807.07686

4. Stabilizing a system with an unbounded random gain using only a finite number of bits. With Victoria Kostina, Yuval Peres, and Gireeja Ranade. **IEEE Transactions on Information Theory**, vol. 67, no. 4, pp. 2554-2561, Apr. 2021. Conference version in IEEE ISIT 2018. arXiv:1805.05535

3. Approximating Continuous Functions by ReLU Nets of Minimal Width. With Boris Hanin. arXiv:1710.11278

2. The Saxl Conjecture for Fourth Powers via the Semigroup Property. With Sammy Luo. **Journal of Algebraic Combinatorics**, 45 (2017), 33-80. arxiv:1511.02387

1. On the Number of 2-protected Nodes in Tries and Suffix Trees. With Mark Daniel Ward, Jeffrey Gaither, and Yushi Homma. **Discrete Mathematics and Theoretical Computer Science**, volume AQ (2012), 381-398. https://dmtcs.episciences.org/3008/

Invited Talks

21. Banff International Research Station: Algorithmic Pure States for the Negative Spherical Perceptron (August 2021)
20. Microsoft Research Redmond: Pareto-Optimal Collision-Free Regret for Multi-Player Multi-Armed Bandit (August 2021)
19. Stanford Statistics Group Meeting: A Universal Law of Robustness via Isoperimetry (August 2021)
18. Microsoft Research Redmond: The Price of Incentivizing Exploration (July 2021)
17. Montréal MLOpt: A Universal Law of Robustness via Isoperimetry (July 2021)
16. Berkeley EECS Group Meeting: The Price of Incentivizing Exploration (June 2021)
15. NSF-Simons Collaboration on the Theoretical Foundations of Deep Learning: Algorithmic Pure States for the Negative Spherical Perceptron (April 2021)
14. Cornell Probability: Algorithmic Pure States for the Negative Spherical Perceptron (November 2020)
13. Berkeley Theory Lunch: Chasing Convex Bodies (November 2020)
12. Online Geometric Analysis Seminar: Chasing Convex Bodies (November 2020)
11. MIT Algorithms and Complexity Seminar: Chasing Convex Bodies (Februrary 2020)
10. Stanford Theory Lunch: Chasing Convex Bodies (October 2019)
9. TCS+ September 2019: Chasing Convex Bodies (September 2019)
8. University of Washington Theory Lunch: Chasing Convex Bodies (August 2019)
7. MSRI Mathematics of Machine Learning Summer School: Chasing Convex Bodies (August 2019).
6. Microsoft Research NYC: Chasing Convex Bodies (July 2019)
5. Microsoft Research Redmond: Chasing Convex Bodies (July 2019)
4. Microsoft Research Redmond: Small Loss Bounds for Thompson Sampling (September 2018)
3. Brown University: How Wide Does a Neural Net Need to be? (May 2018)
2. Microsoft Research Redmond: How Wide Does a Neural Net Need to be? (September 2017)
1. Purdue Analytic Combinatorics Group Meeting: The Saxl Conjecture for Fourth Powers (August 2015)

Other Presentations

12. COLT 2021: Cooperative and Stochastic Multi-Player Multi-Armed Bandit
11. ICML 2021 Workshop *Overparameterization: Pitfalls & Opportunities*: A Universal Law of Robustness via Isoperimetry (oral spotlight presentation)
10. EC 2021 Workshop *Operations of People-Centric Systems*: The Price of Incentivizing Exploration
9. EC 2021: The Price of Incentivizing Exploration
8. Math Olympiad Program 2021: Introduction to Belief Propagation
7. SODA 2021: Online Multiserver Convex Chasing and Optimization
6. ALT 2020: First-Order Bayesian Regret Analysis of Thompson Sampling
5. SODA 2020: Chasing Convex Bodies Optimally
4. SODA 2020: Chasing Nested Convex Bodies Nearly Optimally
3. STOC 2019: Competitively Chasing Convex Bodies
2. Joint Math Meetings 2016: The Saxl Conjecture for Fourth Powers
1. MIT SPUR 2015: The Saxl Conjecture for Fourth Powers

Reviewer Service

2021. STOC, FOCS, COLT, ITCS, IEEE Transactions on Information Theory, American Economic Review Insights, Discrete and Computational Geometry, NeurIPS (expert reviewer)

2020. ICML (top reviewer), COLT, SPAA

2019. Mathematics of Operations Research, NeurIPS (top reviewer)

Other Activities

Summers '18, '19, '21 — **Microsoft Research AI**, *Research Intern*, Redmond, WA.
Theoretical research in machine learning and optimization. Mentor: Sébastien Bubeck.

Summer 2021 — **Ghana International Math Olympiad Program**, Instructor, Remote.
Personally coached a member of the Ghana IMO team and lectured to younger students. The program was organized by the MISE foundation: `https://misemaths.wordpress.com/olympiad/`.

Spring 2021 — **Stanford University**, *Teaching Assistant*.
Office hours, discussion sections, and grading for Math 52 (multivariable calculus)

Summer 2020 — **D.E. Shaw & Co.**, *Quantitative Research Intern*, Remote (pandemic).

Summers '15, '17, '18, '21 — **Math Olympiad Summer Program**, *Instructor*, Pittsburgh, PA.
Coached top American high school students for the International Mathematical Olympiad

Fall 2019 — **Stanford Kiddie Colloquium**, *Organizer*.
Organized weekly math PhD student talks on a variety of topics

2018 **Brazil National Math Olympiad Program**, *Instructor*, Colégio Etapa, Sao Paulo.
Personally coached entire Brazilian IMO team for one week

2016-present **Contest Math Tutoring**, *Founder*.
Online tutoring service providing students with personalized instruction in contest math

January 2015 **Jane Street Capital**, *Trading Intern*.
Analyzed a statistical model for mergers and acquisitions, learned fundamentals of trading

2011-2012 **William Henry High School**, *Course Instructor*, West Layayette, IN.
Gave half of the lectures for a year-long course in multivariable calculus and linear algebra

450 Jane Stanford Way – 94305 Stanford – USA
+1 (765) 497 1714 • *msellke AT stanford.edu*
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