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Miklós Z. Rácz

Research interests

Solving statistical inference problems in complex systems.
In particular, I am interested in statistical inference problems on random graphs and in genomics. I am also interested more broadly in applied probability, combinatorial statistics, information theory, control theory, interacting particle systems, and voting.

Employment

July 2017 - present **Princeton University**, Princeton, NJ, USA.
Assistant Professor in the ORFE Department

2015 - 2017 **Microsoft Research**, Redmond, WA, USA.
Postdoctoral researcher in the Theory Group

Education

2010 — 2015 **PhD**, Statistics, **University of California, Berkeley**.

MS, Computer Science, **University of California, Berkeley**.
Dissertation (PhD): *Influences in Voting and Growing Networks*
Thesis (MS): *A quantitative Gibbard-Satterthwaite theorem without neutrality*
Advisor: Elchanan Mossel

2005 — 2010 **MS**, Mathematics, **Budapest University of Technology and Economics (BUTE)**.
Thesis: *Competing Prices: Analyzing a Stochastic Interacting Particle System*
Advisors: Márton Balázs and Bálint Tóth

1999 — 2005 **Fazekas Mihály High School**, Budapest, Hungary.
Special mathematics class, graduated with honors

Experience

Nov 2015 - present **Microsoft Research**, Redmond, WA & **University of Washington**, Seattle, WA.
Mentor: Sergey Yekhanin
I am working on statistical error correction algorithms for DNA sequencing.
My work is part of a larger MSR-UW group effort to make DNA Storage a reality. DNA Storage aims to use synthetic DNA as a high-density, durable, and easy-to-manipulate storage medium of digital data.

Summer 2014 **Microsoft Research**, Redmond, WA.
Mentor: Sébastien Bubeck
I was a research intern in the Theory Group, working on statistical inference problems on random graphs.

Summer 2009 **University of Oxford**, Oxford, UK.
Mentors: Jotun Hein, Rune Lyngsø, and István Miklós
I was a summer research student in the Department of Statistics, working on the infinite sites model in population genetics.

Summer 2008 **University of California, Los Angeles**, CA.

Mentors: Susana Serna and Gilles Gnacadja

I was a summer research student in the Research in Industrial Projects for Students (RIPS) program at the Institute for Pure and Applied Mathematics (IPAM). I worked on a team of four students, modeling and measuring unstable behavior in hematopoiesis.

Awards and Honors

- Outstanding Graduate Student Instructor Award, UC Berkeley, 2014 - 2015
- UC Berkeley Graduate Fellowship, 2010 - 2012
- Scholarship of the Hungarian Republic, 2009 - 2010
- SIAM Award for Outstanding Talk in Applied Mathematics, MAA MathFest 2009
- Outstanding Student of the Faculty of Natural Sciences, BUTE, 2008 - 2009
- Second Prize, National Scientific Student Conference, Hungary, April 2009
- Scholarship of the Faculty of Natural Sciences, BUTE, Fall 2008, Spring 2009

Publications

Combinatorial Statistics / Statistical Network Analysis / Random Graphs

- **Optimal control for diffusions on graphs**
  Laura Florescu, Yuval Peres, and Miklos Z. Racz
  Submitted, April 2017.
- **A smooth transition from Wishart to GOE**
  Miklos Z. Racz and Jacob Richey
  Submitted, November 2016.
- **Basic models and questions in statistical network analysis**
  Miklos Z. Racz and Sébastien Bubeck
  Statistics Surveys, 11:1–47, 2017.
- **Beta-gamma tail asymptotics**
  Jim Pitman and Miklos Z. Racz
  Electronic Communications in Probability, 20(84):1–7, 2015.
- **Braess's paradox for the spectral gap in random graphs and delocalization of eigenvectors**
  Ronen Eldan, Miklos Z. Racz, and Tselil Schramm
  Random Structures & Algorithms, 50(4):584–611, 2017.
- **Testing for high-dimensional geometry in random graphs**
  Sébastien Bubeck, Jian Ding, Ronen Eldan, and Miklos Z. Racz
  Random Structures & Algorithms, 49(3):503–532, 2016.
- **From trees to seeds: on the inference of the seed from large trees in the uniform attachment model**
  Sébastien Bubeck, Ronen Eldan, Elchanan Mossel, and Miklos Z. Racz
  Bernoulli, 23(4A):2887–2916, 2017.
- **On the influence of the seed graph in the preferential attachment model**
  Sébastien Bubeck, Elchanan Mossel, and Miklos Z. Racz
  IEEE Transactions on Network Science and Engineering, 2(1):30–39, 2015.
- **Coexistence in preferential attachment networks**
  Tonći Antunović, Elchanan Mossel, and Miklos Z. Racz
  Combinatorics, Probability and Computing, 25(6):797–822, 2016.

Mathematics & Statistics in Biology

- **Scaling up DNA data storage and random access retrieval**
  Lee Organick, Siena Dumas Ang, Yuan-Jyue Chen, Randolph Lopez, Sergey Yekhanin, Konstantin Makarychev, Miklos Z. Racz, Govinda Kamath, Parikshit Gopalan, Bichlien Nguyen, Christopher Takahashi, Sharon Newman, Hsing-Yeh Parker, Cyrus Rashtchian, Kendall Stewart, Gagan Gupta, Robert Carlson, John Mulligan, Douglas Carmean, Georg Seelig, Luis Ceze, and Karin Strauss
  Submitted, March 2017.
- **Trace reconstruction from noisy polynucleotide sequencer reads**
  Parikshit Gopalan, Karin Strauss, Siena Dumas Ang, Miklos Racz, Luis Ceze, Sergey Yekhanin, and Nebojsa Jojic
  Patent filed, May 2016.
- **Sequence assembly from corrupted shotgun reads**
  Shirshendu Ganguly, Elchanan Mossel, and Miklos Z. Racz
  IEEE International Symposium on Information Theory (ISIT), 2016.
- **Can one hear the shape of a population history?**
  Junhyong Kim, Elchanan Mossel, Miklos Z. Racz, and Nathan Ross
  Theoretical Population Biology, 100:26–38, 2015.
- **Analysis of unstable behavior in a mathematical model for erythropoiesis**
  Susana Serna, Jasmine A. Nirody, and Miklos Z. Racz
  Journal of Mathematical Biology, 66(3):595–625, 2013.

Information and Control Theory

- **Rate-limited control of systems with unknown gain**
  Victoria Kostina, Yuval Peres, Miklos Z. Racz, and Gireeja Ranade
  IEEE Allerton Conference on Communication, Control, and Computing, 2016.

Interacting Particle Systems

- **Multidimensional sticky Brownian motions as limits of exclusion processes**
  Miklos Z. Racz and Mykhaylo Shkolnikov
  Annals of Applied Probability, 25(3):1155–1188, 2015.
- **Modeling Flocks and Prices: Jumping Particles with an Attractive Interaction**
  Márton Balázs, Miklos Z. Racz, and Bálint Tóth
  Annales de l'Institut Henri Poincaré – Probabilités et Statistiques, 50(2):425–454, 2014.

Voting

- **A Smooth Transition from Powerlessness to Absolute Power**
  Elchanan Mossel, Ariel D. Procaccia, and Miklos Z. Racz
  Journal of Artificial Intelligence Research, 48:923–951, 2013.
- **Election Manipulation: The Average Case**
  Elchanan Mossel and Miklos Z. Racz
  ACM SIGecom Exchanges, 11(2):22–24, 2012.
- **A quantitative Gibbard-Satterthwaite theorem without neutrality**
  Elchanan Mossel and Miklos Z. Racz
  Combinatorica, 35(3):317–387, 2015.
  An extended abstract appeared at the *Symposium on Theory of Computing (STOC)*, 2012.

Pricing Mechanisms

- **Dynamic Budget-Constrained Pricing in the Cloud**
  Eric Friedman, Miklos Z. Racz, and Scott Shenker
  Canadian Conference on Artificial Intelligence, 2015.

Teaching

Fall 2017 **ORF 526: Probability Theory**, Princeton University.
I am the Instructor for this graduate introduction to probability theory with a focus on stochastic processes.

Summer 2016 **Basic models and questions in statistical network analysis**.
I co-designed (together with Sébastien Bubeck) this graduate minicourse, consisting of five one-hour lectures, which aim to explain in an elementary way some of the key ideas involved in cutting-edge statistical network analysis research. I also wrote lecture notes which are available online (38 pages, 10 figures). I taught this minicourse twice:

- **June 6 – 10, 2016: University of Washington**
  Approx. 30 graduate students attended from a variety of departments (math, stat, CS, EE).
- **July 4 – 8, 2016: XX Brazilian School of Probability**
  Approx. 100 participants attended, ranging from masters students to professors.

2011 — 2015 **Berkeley Math Circle**, Berkeley, CA.
I volunteered as a mathematics teacher and held problem-solving sessions for talented youth at the elementary, middle, and high school level. I designed several problem sets, with topics including probability games and graph theory.

Spring 2014 **Stanford Math Circle**, Stanford, CA.
I volunteered as a mathematics teacher and held problem-solving sessions for talented middle school students. The sessions were on probability games, based on problem sets that I designed.

Spring 2014 **Stat 150: Stochastic Processes**, UC Berkeley.
I was a Graduate Student Instructor (GSI) for this upper-division course of approx. 60 students, taught by Ani Adhikari. I designed and held weekly discussion sections and held office hours.

Summer 2013 **Probability Models of Information Exchange on Networks**, Cornell University.
I designed and held a tutorial session for Elchanan Mossel's short course at the Cornell Probability Summer School.

Spring 2013 **Stat 155: Game Theory**, UC Berkeley.
I was a Graduate Student Instructor (GSI) for this upper-division course of approx. 60 students, taught by Elchanan Mossel. I designed and held weekly discussion sections, held office hours, and graded homework, quizzes, and exams.

Summer 2011 **Stat W21: Introductory Statistics**, UC Berkeley.
I was a Graduate Student Instructor (GSI) for this lower-division course of approx. 250 students, taught by Philip Stark. This was an online course and I held in-person and online office hours.

2008 — 2009 **Calculus for civil engineer students**, Budapest University of Technology and Economics.
I was a Teaching Assistant for three semesters. I held discussion sections and graded exams.

2007 — 2010 **Mathematics Institute**, Budapest University of Technology and Economics.
I graded homework for various courses in calculus, linear algebra, algebra, and probability theory. I also served as a tutor at the walk-in tutoring center.

Mentoring

Jun 2016 - present **Jacob Richey**, University of Washington PhD student.
Working on random matrices and diffusions on networks.

Summer 2016 **Govinda Kamath**, Stanford EE PhD student.
Together with Sergey Yekhanin, I co-mentored Govinda's 12-week internship at Microsoft Research on a project involving statistical inference and coding theory problems in genomics, motivated by applications in DNA Storage. His work also included the analysis of a large DNA synthesis-sequencing dataset.

Invited Talks

Statistical Inference in Networks and Genomics

- ORFE Colloquium, Princeton University — February 6, 2017
- Mathematics Colloquium, University of British Columbia — January 13, 2017
- Mathematics Colloquium, University of Wisconsin, Madison — January 9, 2017
- Mathematics Colloquium, McGill University — December 7, 2016
- Mathematics Colloquium, Carnegie Mellon University — December 5, 2016

Finding and hiding the seed

- Dynamic Networks Workshop, Isaac Newton Institute, Cambridge, UK — December 16, 2016
- Probability Seminar, Princeton University — November 30, 2016

Controlled diffusion on graphs

- Probability Seminar, University of Washington — November 21, 2016

Sequence assembly from corrupted shotgun reads

- MSR Theory Day, Microsoft Research, Redmond — March 10, 2016

Braess's paradox for the spectral gap in random graphs and delocalization of eigenvectors

- Probability Seminar, University of Minnesota — February 12, 2016
- Theory Lunch, UC Berkeley — January 27, 2016
- Random Matrix Seminar, Princeton University — November 23, 2015
- Theory Lunch, Microsoft Research, Redmond — July 29, 2015

From trees to seeds: on the inference of the seed from large random trees

- Probability Seminar, Duke University — October 13, 2016
- BIRS Retreat for Young Researchers in Stochastics, Banff — September 25, 2016
- Theory Seminar, University of Washington — October 13, 2015
- Probability Seminar, University of Bristol — March 27, 2015
- Probability Seminar, UC San Diego — January 22, 2015
- SILO Seminar, University of Wisconsin, Madison — January 14, 2015
- Probability Seminar, Stanford University — January 12, 2015
- Probability Seminar, BUTE, Budapest — January 6, 2015
- Probability Seminar, UC Berkeley — October 22, 2014

High-dimensional random geometric graphs

- Probability Seminar, University of British Columbia — January 12, 2017
- Probability Seminar, University of Wisconsin, Madison — January 15, 2015
- Theory Lunch, Microsoft Research, Redmond — August 27, 2014

Multidimensional sticky Brownian motions as limits of exclusion processes

- Monash Workshop on Self-interacting Processes — September 7, 2016

- Probability Seminar, University of Wisconsin, Madison — November 14, 2013

Coexistence in preferential attachment networks

- Risk Management Seminar, UC Berkeley — April 15, 2014
- Theory Lunch, Microsoft Research, Redmond — June 5, 2013
- Probability Seminar, UCLA — May 15, 2013
- Probability Seminar, UC Berkeley — March 13, 2013

Election manipulation: the average-case

- EconCS Seminar, UC Berkeley — April 9, 2013
- Probability Seminar, BUTE, Budapest — January 4, 2012
- Combinatorial Stochastic Processes Seminar, UC Berkeley — October 14, 2011

Modeling Flocks and Prices: Jumping Particles with an Attractive Interaction

- Mathematical Physics & Probability Seminar, UC Davis — November 14, 2012
- Statistical Physics Seminar, Eötvös University (ELTE) — Budapest, April 15, 2009

Leadership and Service

March 2016 **Berkeley Statistics Annual Research Symposium (BSTARS)**, UC Berkeley.
I represented Microsoft Research at the annual Industry Alliance event of the Berkeley Statistics Department, where I also gave a short talk illustrating research efforts at Microsoft.

2014 — 2015 **Head of Student Hospitality Committee**, Department of Statistics, UC Berkeley.
I coordinated the lunches between the departmental seminar speaker and graduate students.

2013 — 2014 **Graduate Admissions Committee**, Department of Statistics, UC Berkeley.
I reviewed 100+ applications to the Statistics PhD program.

2012 — 2013 **Co-President, Statistics Graduate Student Association (SGSA)**, UC Berkeley.
I co-led a team of a dozen student officers who worked on improving graduate student life in the department. We designed and conducted a survey to assess student opinions. We worked closely with faculty who founded the Industry Alliance Program, which in turn greatly benefited graduate students. For instance, based on our suggestions, from the following year onwards, Graduate Student Instructors received an increased stipend, equal to that of Graduate Student Researchers. We also revamped communications between students and the department, e.g., by resurrecting the student newsletter.

2010 — 2014 **Student Seminar Committee**, Department of Statistics, UC Berkeley.
I was involved with organizing the bi-weekly statistics student seminars.

Referee for the following journals:

- Annals of Applied Probability
- Bernoulli Journal
- Electronic Communications in Probability
- Electronic Journal of Probability
- Journal of Machine Learning Research
- Random Structures & Algorithms
- Theory of Computing
- Transactions on Economics and Computation

Referee for the following conferences:

- COLT 2016; ISIT 2017; NIPS 2016, 2017; RANDOM 2017; SODA 2017, 2018; STOC 2016

Other

Computer skills C/C++, Maple, Mathematica, Matlab, Python, LaTeX

Language skills	Hungarian (native), English (fluent), French (advanced), Spanish, Konkani (basic)
Hobbies	Football, running, swimming, debate, reading, traveling