Rachel Lawrence

Researcher, Theoretical Computer Science

Education

2017 – Present **Ph.D. Computer Science**, *University of California, Berkeley*, Berkeley, CA.
Research interests: Combinatorial optimization; dynamical systems on graphs; fairness, privacy, and security in machine learning.

2012–2016 **Bachelor of Science**, *Yale University*, New Haven, CT.
Applied Mathematics, concentration in Computer Science

Research

2017 – Present **U.C. Berkeley EECS**, *Ph.D. Student, Theoretical Computer Science.*
Advised by Professor Alistair Sinclair.
Quadratic Dynamical Systems. Proved the global attractor conjecture and persistence conjecture in the matroid setting, providing an elementary proof characterizing the steady states of matroid quadratic dynamical systems.
Differentially Private GANs. Designed attacks and defenses against generative adversarial neural networks (GANs); designed and tested GANs with differential privacy guarantees and robustness to adversarial examples.

2020 **Microsoft Research**, *Research Intern, Essex Data Science.*
Performed the first analysis of dynamic graph data from the cortical organoid connectome, a stem-cell model for early brain development. Contributions included theoretical analysis of sampling and community detection on novel random graph models, and empirical study of time-series signalling data.

2016 – 2017 **Reservoir Labs, Inc.**, *Software Engineer.*
Development and medical research applications of ENSIGN, a high-performance tool for unsupervised hypergraph analysis using tensor decompositions. Design, development, and testing of a compiler optimized for a specialized SIMD architecture.

2015 – 2016 **Yale Department of Mathematics**, *SUMRY Fellow.*
Developed algebraic and combinatorial methods to determine incidence of arcs in the projective plane. Proved that the number of 10-arcs in a finite projective plane is not quasipolynomial. See: *Counting Arcs in the Projective Plane via Glynn's Algorithm.* (2016), Journal of Geometry.
Selected talks: MathFest 2015; Ohio State Young Mathematicians' Conference 2015

2016 **Pixar Animation Studios**, *Research and Development Intern.*
Developed an original tool for art-directable cloth simulation for use in Pixar animated feature films as a member of Pixar's computer graphics research group. Work presented at SIGGRAPH 2016.

2013 – 2014 **Yale University**, *Research Intern.*
Department of Mathematics. Designed algorithms using driven iterated function systems for pattern recognition in time-series data.
Center for Statistical Genomics and Proteomics. Designed and implemented algorithms to study pleiotropy in genetic pathways implicated in Bipolar Disorder and Schizophrenia through GWAS data.

Teaching

2018 **UC Berkeley**, *Graduate Student Instructor.*
Taught sections and designed course materials for CS 70: Discrete Mathematics and Probability Theory.

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2018 **Stanford Pre-Collegiate Studies**, *Instructor.*
Artificial Intelligence (Primary Instructor). Designed and taught an original, intensive three-week course. Created supplementary coding and written assignments in addition to 2.5 hours of daily instruction.
Computer Security and Machine Learning (Teaching Assistant). Led discussion section lectures and hands-on labs for pre-college students.

2013 – 2016 **Splash at Yale**, *Executive Director.*
Directed Yale Splash, a 501(c) non-profit educational outreach organization in which members design and teach courses to secondary school students. Organized five annual programs, as well as conferences for leaders of educational outreach programs nationwide. Developed and taught more than 20 courses.

2015 – 2016 **HackYale**, *Board Member and Instructor.*
Coordinated, designed, and taught computer science and graphic design courses for students of all backgrounds. Delivered weekly lectures to classes of 25 undergraduate and graduate students.

2015, 2016 **Yale University**, *Course Grader.*
Course grader for CPSC 365: Design and Analysis of Algorithms.

Languages

Experienced: Python, MATLAB, C++, SageMath

Working knowledge: R, Java, Mathematica, HTML, CSS

Academic Honors

2017 – 2022 **National Physical Sciences Consortium Graduate Fellowship**.
National fellowship supporting graduate study sponsored by the US Department of Defense

2015 **SUMRY Fellowship**.
Awarded for 10-week intensive summer research program at the Yale Department of Mathematics

2014 **Davenport College Richter Fellowship**.
Yale College fellowship awarded for independent study and research

2013, 2014 **Yale College Dean's Research Fellowship**.
Research fellowship awarded for undergraduate work in STEM

Other Projects

2016 – Present **Learning Unlimited**, *Board Member.*
Served as an elected board member of Learning Unlimited, a nonprofit organization dedicated to providing opportunities for accessible, interdisciplinary learning for secondary school students. Advised and coordinated educational outreach programs and conferences at participating universities nationwide.

2015 – 2016 **Counting Hamiltonian Cycles**, *Undergraduate Thesis Research.*
With Professor Asaf Ferber, outlined a new technique for counting and constructing Hamiltonian Cycles in dense and regular directed graphs.

2014 – 2016 **Yale University ITS**, *Media Technology Project Coordinator.*
Provided support for equipment and media software in the Bass Library Media Lab and the Yale School of Art. Directed a new service connecting student organizations with individualized support for media projects and graphic design. Managed approximately 30 student employees per year.

2011 **RHIC Data Analysis**, *Brookhaven National Laboratory.*
Worked with the STAR Detector physics group at Brookhaven's particle accelerator (RHIC) to identify signatures of heavy antimatter particles in particle collider data.