Clayton H. Sanford

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EDUCATION

Columbia University September 2019 - May 2024 (expected)
Ph.D. Student in Computer Science
M.S in Computer Science (Feb. 2021) *GPA: 4.24/4.33*

· Advisors: Rocco Servedio and Daniel Hsu

Brown University September 2014 - May 2018
Sc.B. with Honors in Applied Mathematics - Computer Science *GPA: 3.9/4.0*

· Thesis: "Applying Rademacher-Like Bounds to Combinatorial Samples and Function Selection."
· Thesis Advisor: Eli Upfal; Concentration Advisor: Caroline Klivans
· Magna Cum Laude

PUBLICATIONS

C. Sanford*, N. Ardeshir*, D Hsu. "Intrinsic dimensionality and generalization properties of the R-norm inductive bias." *Submitted for publication*, 2022.

C. Sanford, A. Kwa. O. Watt-Meyer, S. Clark, N. Brenowitz, J. McGibbon, C. Bretherton. "Improving the predictions of ML-corrected climate models with novelty detection." *Submitted for publication*, 2022.

A. Bietta*, J. Bruna*, C. Sanford*, M. Song*. "Learning single-index models with shallow neural networks." *Appearing at Neural Information Processing Systems (NeurIPS)*, 2022.

V. Chatziafratis*, I. Panageas*, C. Sanford*, S. Stavroulakis*. "On scrambling phenomena for randomly initialized recurrent networks." *Appearing at Neural Information Processing Systems (NeurIPS)*, 2022.

D. Hsu*, C. Sanford*, R. Servedio*, E.-V. Vlatakis-Gkaragkounis*. "Near-Optimal Statistical Query Lower Bounds for Agnostically Learning Intersections of Halfspaces with Gaussian Marginals." *Conference on Learning Theory (COLT)*, 2022.

C. Sanford, V. Chatziafratis. "Expressivity of Neural Networks via Chaotic Itineraries beyond Sharkovsky's Theorem." *AISTATS*, 2022.

T. Chin*, J. Ruth*, C. Sanford*, R. Santorella*, P. Carter*, B. Sandstede*. "Enabling equation-free modeling via diffusion maps." *Journal of Dynamics and Differential Equations*, 2022.

N. Ardeshir*, C. Sanford*, D. Hsu. "Support vector machines and linear regression coincide with very high-dimensional features." *Neural Information Processing Systems (NeurIPS)*, 2021.

D. Hsu*, C. Sanford*, R. Servedio*, E.-V. Vlatakis-Gkaragkounis*. "On the Approximation Power of Two-Layer Networks of Random ReLUs." *Conference on Learning Theory (COLT)*, 2021.

K. Cygan*, C. Sanford*, W. Fairbrother. "Spliceman2 - A Computational Web Server That Predicts Sequence Variations in Pre-mRNA Splicing."
Bioinformatics 33 (18), 2017.

J. Gross*, C.Sanford*, G. Kocks*. "Projected Water Needs and Intervention Strategies in India."
Undergraduate Mathematics and its Applications 37 (2), 2016.

* Contributed equally

INDUSTRY EXPERIENCE

Research Intern (PhD) May 2022 - August 2022
Allen Institute for AI

- Improved year-long temperature and humidity predictions of ML-corrected coarse-grid climate models by using novelty detection techniques.
- Upcoming paper submissions to the NeurIPS 2022 climate ML workshop and the *Journal of Advances in Modeling Earth Systems*.

Software Engineering Intern April 2019 - August 2019
Lumi Labs

- Front-end and back-end development with direct ownership of new features core to the product.

Associate Analytics Data Scientist August 2018 - April 2019
LinkedIn

- Used Hive and SQL to create stable and frequently-used datasets that repopulate daily.
- Performed deep-dive analyses on open questions for the LinkedIn Learning product.
- Co-coordinated a bi-weekly machine learning reading group.

Data Analytics Intern June 2017 - August 2017
LinkedIn

- Analyzed subscription patterns with LinkedIn Learning team using Pig, HDFS, SQL, and Python.
- Contextualized findings in the Learning business and presented to stakeholders.

FELLOWSHIPS AND AWARDS

NSF GRFP Fellowship March 2021
National Science Foundation

- Competitive fellowship that provides three years of full funding for graduate research.

Department Service Award May 2020, 2022
Columbia Computer Science

Computer Science Senior Prize May 2018
Brown Computer Science

- Cash prize awarded to the top students in the computer science department based on academic achievement and department service.

Outstanding Winner April 2016
Interdisciplinary Contest in Modeling *Consortium for Mathematics and its Applications*

- Designation given to five out of over 3000 teams for mathematical modeling of water scarcity in the ICM contest.

RELEVANT COURSEWORK

Algorithms and Theory: Models of Computation, Analysis and Design of Algorithms, Advanced Algorithms Seminar, Computational Linear Algebra, Intro to Cryptography, Randomized Algorithms, Computation and the Brain

Artificial Intelligence: Machine Learning, Artificial Intelligence, Foundations of Prescriptive Analytics, Independent Study for ML research, Optimization Methods for ML, ML Theory, Algorithmic Game Theory

Probability and Statistics: Probability and Computation, Information Theory, Recent Applications in Probability and Statistics, Probabilistic Methods in Computer Science

Dynamical Systems: Applied Ordinary Differential Equations, Applied Partial Differential Equations I, Topics in Chaotic Dynamics, Independent Study for Dynamical Systems Research

Pure Mathematics: Linear Algebra, Abstract Algebra, Analysis: Functions of One Variable

Non-Technical: Persuasive Communication, Classrooms in Context: Public Education in Providence

TEACHING EXPERIENCE

Graduate Instructor January 2022 - May 2022
Columbia University Department of Computer Science

- Developed and taught a lab on basics of data science and ML for non-CS students to accompany a then-new class on Natural and Artificial Neural Networks by Christos Papaidimitriou.
- Created a series of Colab notebooks and short lectures to accompany each topic for a lab with fifteen students.

Graduate Teaching Assistant January 2021 - April 2021
Columbia University Department of Computer Science

- Holds office hours, grades assignments, and prepares course materials for Introduction to Computational Learning Theory.

Head Teaching Assistant April 2017 - December 2017
Brown University Department of Computer Science

- Led a staff of 14 UTAs through grading assignments, running review sessions, and holding office hours.
- Hired UTAs after interviewing 35 candidates for the job.
- Managed an Algorithms class with 170 students and coordinated interactive grading sessions and exams.
- Taught an supplemental section on NP-hardness to a group of forty students for 90 minutes.
- Brainstormed, wrote-up, and edited problems for homework assignments and exams.

Undergraduate Teaching Assistant September 2015 - May 2017
Brown University Departments of CS and Applied Math

- Served on the course staffs of four courses: Accelerated Intro to CS, Discrete Structures and Probability, Theory of Computation, Topics in Chaotic Dynamics.
- Created problems for and graded homework assignments and exams.
- Hosted office hours for helping students understand course material and solve homework problems.

Tutor and Volunteer Representative January 2015 - May 2016
Swearer Tutoring Enrichment in Math and Science (STEMS)

- Tutored math and science in class and after school at a nearby public school in Providence.
- Interviewed potential volunteers and planned meetings to help train tutors.

Tutor September 2011 - June 2014
Soquel High School

- Tutored math at homework club after school twice a week for three years.

RESEARCH TALKS

- Kevin Jamieson, Jamie Morgenstern, and Ludwig Schmidt group meeting, University of Washington, July 2022. "Approximation Powers and Limitations of Neural Networks."
- COLT 2022, July 2022. "Near-Optimal Statistical Query Lower Bounds for Agnostically Learning Intersections of Halfspaces with Gaussian Marginals."
- Algorithms and Theory Seminar, Boston University, April 2022. "On the approximation power of two-layer networks of random ReLUs."
- Algorithms and Complexity seminar, MIT, April 2022. "On the approximation power of two-layer networks of random ReLUs."
- Eli Upfal group meeting, Brown University, April 2022. ""Benign overfitting" and the behavior of high-dimensional linear regression and classification models."
- AISTATS, March 2022. "Expressivity of Neural Networks via Chaotic Itineraries beyond Sharkovsky's Theorem."
- Joan Bruna group meeting, NYU, February 2022. "Near-Optimal Statistical Query Lower Bounds for Agnostically Learning Intersections of Halfspaces with Gaussian Marginals."
- Data Science Institute virtual poster session Columbia, February 2022. "On the approximation power of two-layer networks of random ReLUs."
- NeurIPS, December 2021. "Support vector machines and linear regression coincide with very high-dimensional features."
- COLT 2021, August 2021. "On the approximation power of two-layer networks of random ReLUs."
- Demystifying the dissertation, Columbia, December 2020. "Opening the Black Box: Mathematical Approaches to Understanding Deep Learning."
- Demystifying the PhD, Columbia, November 2020.

DEPARTMENT SERVICE

- Organized the CS theory student retreat in fall 2021 and 2022.
- Ran events at and coordinated the Columbia Visit Day for admitted students in Spring 2020.
- Started the Columbia Theory Student seminar, where students share their research on a weekly basis.
- Advised two cohorts of undergraduate theory seminars on ML theory.
- Planned the Columbia TCS student retreat for fall 2021.

LEADERSHIP AND MENTORSHIP EXPERIENCE

PhD Representative May 2022 - present
Department of Computer Science *Columbia University*

- Coordinated a well-attended PhD student welcome event to help new students visit.
- Attends faculty meetings to represent student concerns and communicate faculty decisions to student body.
- Personally assisted students ensure that the department is paying them adequately.

President February 2015 - May 2018
Applied Math Department of Undergraduates (APMA DUG) *Brown University*

- Hosted well-attended advising panels for students interested in Applied Math courses and research.
- Created problems for and managed a casual math competition every semester.
- Coordinated lectures by Applied Math faculty members for undergrads every semester.
- Welcomed prospective students and new concentrators by planning department-sponsored celebrations.

President November 2014 - May 2018
Outing Club *Brown University*

- Led an executive board of forty members that ran trips every weekend of the academic year.
- Managed and apportioned a $27000 annual budget.
- Recruited, interviewed, and trained new trip leaders.

Peer Advisor September 2017 - May 2018
Matched Advising Program for Sophomores (MAPS) *Brown University*

- Advised two sophomore Applied Math students as they declared their concentrations and decided on coursework and internships.

Peer Advisor September 2015 - May 2017
Meiklejohn Peer Advisory Program *Brown University*

- Advised eleven first year students on adjusting to college life, selecting courses, building connections, and finding their academic paths.

MISCELLANEOUS

Programming Languages	Python, Java, Matlab, SQL, Scala, Javascript, PHP, Perl, LaTeX, SQL
Technologies	Tensorflow, Pytorch, Docker, Kubernetes, Hadoop, Spark, Git
Spoken Languages	English (native), Spanish (intermediate proficiency)
Other Interests	Backpacking, Running, Climbing, Cooking, New York, Public Transportation