

Clayton H. Sanford

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EXECUTIVE SUMMARY

Machine learning researcher and theoretical computer scientist with NSF GRFP support and a publication record at top-tier ML venues (NeurIPS, COLT) on the fundamental representational and generalization properties of feed-forward neural networks, recurrent neural networks, and transformers.

Creative and adaptable interdisciplinary researcher with published empirical work on the intersections of machine learning/data science and climate modeling, dynamical systems, and molecular biology.

Skilled data scientist and engineer with successful internships at Microsoft Research and Allen Institute for AI (Outstanding Intern award) and full-time employment at LinkedIn.

Effective communicator and leader in technical research, teaching, academic service, and local government.

CORE COMPETENCIES

Machine Learning & Artificial Intelligence ◇ Python and Java ◇ Deep Learning in Pytorch
Mathematical Modeling ◇ Data Analytics (Hadoop, Spark, SQL) ◇ Dynamical Systems and Climate Modeling
Communication and Leadership ◇ Technical and Academic Writing ◇ Public Speaking

EDUCATION

Columbia University

Ph.D. in Computer Science

September 2019 — May 2024 (expected)

New York, NY

- Advisors: Daniel Hsu and Rocco Servedio.

Brown University

Sc.B. with Honors in Applied Math - Computer Science, Magna Cum Laude

September 2014 — May 2018

Providence, RI

WORK EXPERIENCE

Applied Sciences Intern

Microsoft Research

May 2023 — August 2023

New York, NY

- Trained transformer models with up to 500 million parameters to learn combinatorial search tasks with behavioral cloning and chain-of-thought reasoning.
- Proved theoretical results about the advantages of transformers over graph neural networks (GNNs) for identifying isomorphisms between different combinatorial problems, to support positive empirical results. (Manuscript in progress.)

Research Intern (PhD)

Allen Institute for AI

May 2022 — August 2022

Seattle, WA

- Improved reliability and quality of annual temperature and humidity estimates of ML-corrected coarse-grid climate model with novelty detection.
- Presentations at NeurIPS 2022 climate ML workshop and American Meteorological Society.
- Contributions recognized with Outstanding Intern award.

Software Engineering Intern

Lumi Labs

April 2019 — August 2019

Palo Alto, CA

- Designed and built front-end (Objective C) and back-end (Java and Scala) features as at 15-person startup.
- Implemented clustering algorithms on geographic data in Java.

Associate Data Scientist

LinkedIn

August 2018 — April 2019

San Francisco, CA

- Analyzed usage patterns of LinkedIn Learning, conducted A/B tests, and tracked metrics with Hive and Spark.

PUBLICATIONS

Machine learning theory

- C. Sanford, D. Hsu, M. Telgarsky. “Representational strengths and limitations of transformers.” *Appearing at Neural Information Processing Systems (NeurIPS) 2023*.
- N. Ardeshtir*, D Hsu*, C. Sanford*. “Intrinsic dimensionality and generalization properties of the R-norm inductive bias.” *Conference on Learning Theory (COLT) 2023*.
- A. Bietta*, J. Bruna*, C. Sanford*, M. Song*. “Learning single-index models with shallow neural networks.” *NeurIPS 2022*.
- V. Chatziafratis*, I. Panageas*, C. Sanford*, S. Stavroulakis*. “On scrambling phenomena for randomly initialized recurrent networks.” *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.” *COLT 2022*.
- C. Sanford, V. Chatziafratis. “Expressivity of Neural Networks via Chaotic Itineraries beyond Sharkovsky’s Theorem.” *AISTATS 2022*.
- N. Ardeshtir*, C. Sanford*, D. Hsu. “Support vector machines and linear regression coincide with very high-dimensional features.” *NeurIPS 2021*.
- D. Hsu*, C. Sanford*, R. Servedio*, E.-V. Vlatakis-Gkaragkounis*. “On the Approximation Power of Two-Layer Networks of Random ReLUs.” *COLT 2021*.

Interdisciplinary ML and data science

- 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.” *Appearing in Journal of Advances in Modeling Earth Systems*.
- 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.
- K. Cygan*, C. Sanford*, W. Fairbrother. “Spliceman2 - A Computational Web Server That Predicts Sequence Variations in Pre-mRNA Splicing.” *Bioinformatics* 33 (18), 2017.

AWARDS

NSF GRFP Fellow	March 2021
Outstanding Intern Award, Allen Institute for AI Awarded to four summer interns who went above and beyond as researchers and as colleagues (cash prize).	December 2022
Paul Charles Michelman Memorial Award Given to a PhD student in Computer Science who has performed exemplary service to the department, devoting time and effort beyond the call to further the department’s goals (cash prize).	May 2023
Department Service Award, Columbia Computer Science	May 2020, 2022, 2023
Senior Prize, Brown Computer Science Awarded to the top students in the Computer Science department by faculty selection (cash prize).	May 2018
Outstanding Winner, Interdisciplinary Contest in Modeling Top 5 teams out of over 3000 in 96-hour math modeling competition on water scarcity.	April 2016

TEACHING AND SERVICE

Reviewer: ICLR (2024), ALT (2024), NeurIPS (2023), JMLR (2023), SODA (2022), STOC (2022).	
Teaching Assistant, Brown and Columbia Universities Designed assignments, taught lab sections, held office hours, and hired undergraduates TAs, and managed course logistics as a TA for 8 different computer science and applied math classes.	September 2015 — present
PhD Representative, Columbia Computer Science Serves as liaison between computer science students, faculty, and administrators and attends faculty meetings.	September 2022 — present
Community Board Member, Manhattan Community Board 9 Appointed by the borough president to represent community needs of a district on the west side of Manhattan between 110th and 155th St. Serves on Economic Development and LGBTQ Committees.	May 2023 — present
President, qSTEM Led a team of student organizers in planning events for LGBTQ+ students at the Columbia School of Engineering.	September 2022 — September 2023