Clayton H. Sanford

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EDUCATION

Columbia University September 2019 - present
Ph.D. in Computer Science *GPA: 4.24/4.33*

- Proposed Thesis: "Neural Network Generalization and Approximation with Intrinsically Low-dimensional Data."
- Advisors: Daniel Hsu and Rocco Servedio.
- Coursework: Randomized Algorithms; Optimization Methods; ML Theory; Economics, AI, and Optimization; Computation and the Brain.

Brown University September 2014 - May 2018
Sc.B. with Honors in Applied Math - Computer Science, Magna Cum Laude *GPA: 3.90/4.0*

- Thesis: "Applying Rademacher-Like Bounds to Combinatorial Samples and Function Selection."
- Coursework: ML; Combinatorial Optimization; Cryptography; Computational Linear Algebra; Algorithms; Information Theory; Software Engineering.

WORK EXPERIENCE

Applied Sciences Intern May 2023 - August 2023
Microsoft Research *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) May 2022 - August 2022
Allen Institute for AI *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 April 2019 - August 2019
Lumi Labs *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 August 2018 - April 2019
LinkedIn *San Francisco, CA*

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

PUBLICATIONS

C. Sanford, D. Hsu, M. Telgarsky. "Representational strengths and limitations of transformers." *Submitted for publication,* 2023.

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,* 2023.

N. Ardeshir*, 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." *Neural Informational Processing Systems (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.*

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." *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.*

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 December 2022
Awarded to four summer interns who went above and beyond as researchers and as colleagues (cash prize).

Paul Charles Michelman Memorial Award May 2023
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).

Department Service Award, Columbia Computer Science May 2020, 2022, 2023

Senior Prize, Brown Computer Science May 2018
Awarded to the top students in the Computer Science department by faculty selection (cash prize).

Outstanding Winner, Interdisciplinary Contest in Modeling April 2016
Top 5 teams out of over 3000 in 96-hour math modeling competition on water scarcity.

TEACHING AND SERVICE

Reviewer: NeurIPS (2023), JMLR (2023), ICLR climate workshop (2023), SODA (2022), STOC (2022).

Teaching Assistant, Brown and Columbia Universities September 2015 - present
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.

PhD Representative, Columbia Computer Science September 2022 - present
Serves as liaison between computer science students, faculty, and administrators and attends faculty meetings.

Community Board Member, Manhattan Community Board 9 May 2023 - present
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.

President, qSTEM September 2022 - September 2023
Led a team of student organizers in planning events for LGBTQ+ students at the Columbia School of Engineering.

TECHNICAL SKILLS

Programming Languages	Python, Java, Matlab, SQL, Scala, Javascript, PHP, Perl, SQL
Technologies	Pytorch, Tensorflow Docker, Kubernetes, Hadoop, Spark, Git, LaTeX