

# Clayton H. Sanford

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## EDUCATION

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### Columbia University

*Ph.D. in Computer Science*

September 2019 - present  
New York, NY

- 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

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

September 2014 - May 2018  
Providence, RI

- 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

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### 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

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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 Information 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

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**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

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**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

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**Programming Languages** Python, Java, Scala, SQL  
**Technologies** Pytorch, Tensorflow, Docker, Hadoop, Spark, Git