Daniel Kunin

daniel-kunin.com • kunin@stanford.edu

Education

Stanford University	**Stanford, CA**
M.S. Computational and Mathematical Engineering	September 2017 - June 2020
Ph.D. Computational and Mathematical Engineering	Expected graduation June 2025
Brown University	**Providence, RI**
Sc.B. Applied Mathematics, A.B. Computational Biology	September 2013 - May 2017

Publications

From Lazy to Rich: Exact Learning Dynamics in Deep Linear Networks   **Preprint 2024**
Clémentine Dominé*, Nicolas Anguita*, Alexandra M. Proca, Lukas Braun,   **(link)**
<u>Daniel Kunin</u>, Pedro A.M. Mediano, Andrew Saxe

Get rich quick: exact solutions reveal how unbalanced initializations   **NeurIPS Spotlight 2024**
promote rapid feature learning   **(link)**
<u>Daniel Kunin</u>*, Allan Raventós*, Clémentine Dominé, Feng Chen, David Klindt, Andrew Saxe, Surya Ganguli

Stochastic Collapse: How Gradient Noise Attracts SGD Dynamics   **NeurIPS 2023**
Towards Simpler Subnetworks   **(link)**
Feng Chen*, <u>Daniel Kunin</u>*, Atsushi Yamamura*, Surya Ganguli

The Asymmetric Maximum Margin Bias   **ICLR Spotlight 2023**
of Quasi-Homogeneous Neural Networks   **(link)**
<u>Daniel Kunin</u>*, Atsushi Yamamura*, Chao Ma, Surya Ganguli

The Limiting Dynamics of SGD: Modified Loss, Phase Space Oscillations,   **NECO 2023**
and Anomalous Diffusion   **(link)**
<u>Daniel Kunin</u>*, Javier Sagastuy-Brena*, Lauren Gillespie, Eshed Margalit,
Hidenori Tanaka, Surya Ganguli, Daniel L.K. Yamins

Beyond the Quadratic Approximation: the Multiscale Structure of   **JMLR 2022**
Neural Network Loss Landscapes   **(link)**
Chao Ma, <u>Daniel Kunin</u>, Lei Wu, Lexing Ying

Noether's Learning Dynamics: The Role of Kinetic Symmetry   **NeurIPS 2021**
Breaking in Deep Learning   **(link)**
Hidenori Tanaka, <u>Daniel Kunin</u>

Neural Mechanics: Symmetry and Broken Conservation Laws   **ICLR 2021**
in Deep Learning Dynamics   **(blog) (link)**
<u>Daniel Kunin</u>*, Javier Sagastuy-Brena, Surya Ganguli, Daniel L.K. Yamins, Hidenori Tanaka*

Pruning neural networks without any data by iteratively conserving synaptic flow   **NeurIPS 2020**
Hidenori Tanaka*, <u>Daniel Kunin</u>*, Daniel L.K. Yamins, Surya Ganguli   **(link)**

Two Routes to Scalable Credit Assignment without Weight Symmetry   **ICML 2020**
<u>Daniel Kunin</u>*, Aran Nayebi*, Javier Sagastuy-Brena*,   **(link)**
Surya Ganguli, Jonathan M. Bloom, Daniel L.K. Yamins

Loss Landscapes of Regularized Linear Autoencoders   **ICML Oral 2019**
<u>Daniel Kunin</u>*, Jonathan M. Bloom*, Aleksandrina Goeva, Cotton Seed   **(blog) (link)**

Workshops/Talks

KITP Deep Learning Program	**Santa Barbara, CA**
- Participated in Deep Learning from the Perspective of Physics and Neuroscience (**link**)	October 2023
IAIFI Summer Workshop	**Boston, MA**
- Presented plenary talk on Stochastic Collapse (**link**)	August 2023
Princeton Machine Learning Theory Summer School	**Princeton, NJ**
- Presented poster on Stochastic Collapse (**link**)	June 2023
International Conference on Learning Representations	**Kigali, RWND**
- Oral presentation of a top 25% paper (**link**)	May 2023
Sparsity in Neural Networks: Advancing Understanding and Practice	**Virtual**
- Presented poster on theory of network pruning (**link**)	July 2021

Physics ∩ ML	**Virtual**
- Gave talk of my work on symmetry in deep learning (**link**)	February 2021
Machine Learning and the Physical Sciences	**Virtual**
- Presented poster on neural mechanics at NeurIPS 2020 workshop (**link**)	December 2020
DeepMath	**Virtual**
- Presented poster on network pruning at conference (**link**)	November 2020
Institute for Advanced Study	**Princeton, NJ**
- Selected to give a "spotlight talk for young researchers" at *Workshop on Theory of Deep Learning: Where next?* (**link**)	October 2019
International Conference on Machine Learning	**Long Beach, CA**
- One of two papers on Representation Learning selected to give a 20 minute talk at the 2019 International Conference on Machine Learning (**link**)	June 2019
Models, Inference and Algorithms	**Cambridge, MA**
- Presented research on regularized linear autoencoders at Broad Institute's weekly seminar on the interface of biology and mathematics (**link**)	February 2019
Organisation for Economic Cooperation and Development	**Paris, Fr**
-Presented a paper on the importance of data literacy to the 6th Informal Working Group of the Future of Education and Skills: Education 2030 Project	October 2017

Work Experience

Research Intern at NTT Research	**Virtual**
-Researched the intersection of deep learning theory and physics	Jun 2021 - Sept 2021
Deep Learning Course Assistant	**Stanford, CA**
-Course assistant for Andrew Ng's deep learning class CS230	Sept 2018 - March 2019
Visiting Graduate Student at The Broad Institute of MIT and Harvard	**Cambridge, MA**
-Developed a deep learning model for matrix factorization	Jun 2018 - Sept 2018
-Researched loss landscapes of linear autoencoders with regularization	
Deep Learning Visualizations Engineer	**Palo Alto, CA**
-Developed educational visualizations of deep learning models for Deeplearning.ai	April 2018 - Sept 2019
-Developed using D3.js and Tensorflow.js	
Undergraduate Researcher for Chip Lawrence Lab	**Providence, RI**
-Helped rewrite a HMM alignment software for paleoclimate data in Matlab	Jan 2017 - June 2017
-Designed and developed a web platform for using the HMM alignment software	
Front-End Web Developer	**Providence, RI**
-Used D3.js to create interactive visualizations of probability and statistics concepts	May 2016 - Dec 2016
-Designed and developed a web platform with over two million page views and users from nearly every country in the world: *seeingtheory.io*	

Awards/Fellowships

CPAL Rising Star Award	**Hong Kong**
- Part of cohort of sixteen exceptional junior researchers at a starting point in their career.	January 2024
- Presented recent work on SGD at Conference on Parsimony and Learning (CPAL).	
Open Philanthropy AI Fellowship	**San Francisco, CA**
- Part of cohort of eleven promising machine learning researchers selected across institutions	September 2022
- Full graduate stipend and tuition is covered for up to three years.	
Stanford Data Science Scholar	**Stanford, CA**
- Part of cohort of graduate students using data science in their research	January 2020
- Half my stipend and tuition is covered for two years.	
Citadel Data Open Championship	**New York City, NY**
- Investigated the effect of education, demographics, and economics on social mobility	November 2017
- Presented report to a panel of experts and placed in the top five teams.	
Citadel Data Open at Berkeley	**Berkeley, CA**
- Analyzed how Airbnb affects the local renting market in San Fransisco	September 2017
- First place winner; $20,000 award prize; One of 20 teams invited to compete in The Data Open Championship for a $100,000 prize.	
Harvey A. Baker Fellowship	**Providence, RI**
- Awarded annually to outstanding members of the graduating class to aid them in undertaking graduate study at the university of their choice	May 2017
Brown University Royce Fellowship	**Providence, RI**
- Designed and developed a web platform for learning probability and statistics	April 2016