SULTAN DANIELS

Curriculum Vitae

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EDUCATION

Ph.D. University of California, Berkeley, Electrical Engineering and Computer Sciences, May 2028

Sc.B. Brown University, Computer Engineering, May 2023

RESEARCH EXPERIENCE

UC Berkeley, Berkeley, CA Aug 2023 to Present
Advisors: Anant Sahai and Gireeja Ranade

- Studying emergent capabilities in transformer-based deep learning models like in-context learning, in-weights memorization, and associative recall.
- Developing pretraining interventions that modulate the learning of emergent capabilities.
- Using linear dynamical systems as a problem domain that allow for quantifiably optimal baselines.
- Studying the fundamental bounds on the energetic costs of floating-point computation.

Flatiron Institute, New York City, NY June 2026 to Aug 2026
Advisor: Dmitri Chklovskii

- Studying E. coli and C. elegans chemotaxis through the lens of optimal control.

IBM Research, Yorktown Heights, NY May 2023 to Aug 2023
Mentor: Luis Lastras

- Worked to build a large language model that performed at the state-of-the-art for question-answering tasks in English, French, Spanish, Portuguese, and German.
- Became comfortable with many Huggingface packages, including transformers and datasets, to finetune pre-trained language models to perform better for machine translation.

California Institute of Technology, Pasadena, CA June 2022 to Aug 2022
Advisors: Victoria Kostina, Oron Sabag
Title: Towards an Optimal Coding Scheme for MIMO Gaussian Channels with Feedback

- Worked to prove the optimality of a coding scheme proposed by Dr. Sabag for MIMO colored Gaussian communication channels with feedback.
- Simulated the coding scheme in MATLAB to study the achievable information rate on each component of the channel output vector.
- Used linear estimation theory to analytically study this scheme's probability of decoding error to find a formula for the maximum achievable information rate on each component.

Brown University, Providence, RI December 2020 to December 2021
Advisor: Christopher Rose
Title: Finding a Bound on the Information Transmitted through Newtonian Gravity

- Studied the mechanics of the two-body Newtonian gravitation problem where the force of gravity was noisy.
- Used concepts from linear systems theory, including Fourier Transforms and convolution, to solve the differential equation for the motion of the bodies.
- Analytically computed the autocorrelation function for the masses' orbital trajectory.
- Numerically solved the differential equation for this noisy two-body system using an iterative method in a C++ program.

RESEARCH INTERESTS

Machine Learning Theory, Deep Learning, Complex Systems, Information Theory, Control Theory, Theoretical Neuroscience

PUBLICATIONS AND PREPRINTS

Workshop Papers

- Daniels, Sultan, Dylan Davis, Gireeja Ranade, and Anant Sahai. "Pretraining with Masked Backstories in a Toy World." In *ICLR 2026 Workshop on Scientific Methods for Understanding Deep Learning*.

- Daniels, Sultan, Dylan Davis, Dhruv Gautam, Wentinn Liao, Gireeja Ranade, and Anant Sahai. "Emergence, pretraining loss and associative recall: a toy model." In *ICML 2025 Workshop on Methods and Opportunities at Small Scale*.
- Daniels, Sultan, Dylan Davis, Dhruv Gautam, Wentinn Liao, Gireeja Ranade, and Anant Sahai. "Different simultaneous mechanisms for in-context recall have distinct learning dynamics." In *3rd ICML Workshop on High-dimensional Learning Dynamics 2025*.

Preprints

- Daniels, Sultan, Samuel H. D'Ambrosia, Michael R. DeWeese, and Anant Sahai. "The Entropy of Floating-Point Numbers." arXiv preprint arXiv:2605.11546 (2026).
- Daniels, Sultan, Dylan Davis, Dhruv Gautam, Wentinn Liao, Gireeja Ranade, and Anant Sahai. "Decomposing Prediction Mechanisms for In-Context Recall." arXiv preprint arXiv:2507.01414 (2025).

HONORS AND AWARDS

- Hearts to Humanity Eternal Research Grant (2024)
- Chancellor's Fellowship, University of California, Berkeley (2023)
- EECS Excellence Award, University of California, Berkeley (2023)
- Sigma Xi Honor Society (2022)
- GEM Fellowship (2022)
- WAVE Fellowship, California Institute of Technology (2022)
- Brown Undergraduate Teaching and Research Award (2021)

TEACHING EXPERIENCE

Deep Neural Networks August 2025 to December 2025
Graduate Student Instructor, UC Berkeley Electrical Engineering and Computer Science

- Taught two discussion sections each week covering course topics including modern optimizers (Adam, Muon), CNNs, SSMs, transformers, and generative models for 20-40 students per section.
- Assisted students with framing and scoping their open-ended research-style course projects.
- Maintained and improved course material including jupyter notebooks, and written problems.

Probability and Random Processes January 2025 to June 2025
Graduate Student Instructor, UC Berkeley Electrical Engineering and Computer Science

- Taught two discussion sections each week covering basic probability, markov chains, information theory, and statistics for 10-15 students.
- Developed course material including homework and exam problems.

POSTERS

Towards an Optimal Coding Scheme for MIMO Gaussian Channels with Feedback, California Institute of Technology Summer Seminar Day, August 2022.
Video Summary: https://www.youtube.com/watch?v=A-7KJYkQTTU&t=9s
Poster: https://drive.google.com/file/d/158MI2dTK0_XvLbPLlZqiZ_rZFguu61JV/view?usp=sharing

Finding a Bound on the Information Transmitted Through Newtonian Gravity, Brown University Summer Research Symposium, August 2021.
Poster: https://drive.google.com/file/d/1tU2vOhkvvNDFfG45x0OK1ujf_2V7tzr/view?usp=sharing

PROFESSIONAL AFFILIATIONS

National Society of Black Engineers, 2021-2023 Secretary & Treasurer of Brown's Chapter.

SKILLS

Programming Languages: Python, Verilog
Applications: Pytorch Lightning, NVIDIA Nsight Systems, SLURM, MATLAB

LANGUAGES

English: Native Language
French: Intermediate (CEFR Level B1/B2)

OTHER

US Citizen

REFERENCES

Prof. Anant Sahai, Professor of Electrical Engineering and Computer Science
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Prof. Gireeja Ranade, Assistant Professor of Electrical Engineering and Computer Science
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