NICHOLAS KARRIS

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RESEARCH INTERESTS

My research interests mainly center around data science and machine learning. Most of my recent work has involved using (linearized) optimal transport to solve problems involving measure-valued data, such as particle system simulations, hyperspectral imaging, and diffusion models.

EDUCATION

University of California, San Diego — La Jolla, CA   (*expected*) *June 2026*
Ph.D. in Mathematics

> *Advisor:* Alex Cloninger
>
> *Research Interests:* Geometric Data Analysis, Optimal Transport, Time Series, Diffusion Models

Northwestern University — Evanston, IL   *June 2021*
B.A. in Mathematics | Minor in Computer Science   *Summa Cum Laude*

> *Advisor:* Ezra Getzler
>
> *Honors Thesis:* Poisson-Lie Groups and Lie Bialgebras

PAPERS

H. Vandecasteele, **N. Karris**, A. Cloninger, I. Kevrekidis. *Newton-Krylov Methods for Computing Steady States of Particle Timesteppers via Optimal Transport.* In preparation.

N. Karris, L. Durell, J. Flores, T. Emerson. *Which Way from B to A: The Role of Embedding Geometry in Image Interpolation for Stable Diffusion.* Accepted, TAG–Data Science Conference. Preprint, arXiv:2511.12757 [cs.CV] (2025)

J. Lentz, **N. Karris**, A. Cloninger, J. Murphy. *Unbalanced Optimal Transport Dictionary Learning for Unsupervised Hyperspectral Image Clustering.* Accepted, IEEE Whispers (2025)

N. Karris, S. Lee, I. Kevrekidis, E. Nikitopoulos, A. Cloninger. *Using Linearized Optimal Transport to Predict the Movement of Stochastic Particle Systems.* Revised and Resubmitted, SIAM Journal on Applied Dynamical Systems. Preprint, arXiv:2408.01857 [math.NA] (2025)

J. Linwu, V. Khurana, **N. Karris**, A. Cloninger. *Linearized Optimal Transport pyLOT Library: A Toolkit for Machine Learning on Point Clouds.* Preprint, arXiv:2502.03439 [stat.ML] (2025)

PRESENTATIONS

Spotlight Talk. TAG–Data Science Conference. UC San Diego, La Jolla, CA.	*1 December 2025*
Poster. NSF CompMath Meeting. University of Utah, Salt Lake City, UT.	*9 May 2025*
Poster. Optimal Transport and Statistics Workshop. Columbia University, New York, NY.	*27 March 2025*
Poster. Mathematics of Data, Dynamics, and Life Sciences Conference. UC Irvine, Irvine, CA.	*21 March 2025*
Poster. SIAM Conference on Mathematics of Data Science. Atlanta, GA.	*22 October 2024*

AWARDS

Travel Award for NSF CompMath Meeting	*May 2025*
Travel Award for Optimal Transport and Statistics Workshop	*March 2025*
Travel Award for Mathematics of Data, Dynamics, and Life Sciences Conference	*March 2025*
Travel Award for SIAM Conference on Mathematics of Data Science	*October 2024*
James B. Ax Fellowship	*September 2021*

TEACHING

Graduate Teaching Assistant — UC San Diego   *September 2021 – Present*
Weekly Discussion Sections, Office Hours, Exam Grading, †Lead TA

Math 10A: Differential Calculus — Summer 2023, Spring 2022
Math 11: Probability and Statistics — Winter 2025
Math 18: Linear Algebra — Spring 2024†, Winter 2024†, Fall 2023†, Spring 2023†
Math 20B: Integral Calculus — Winter 2023†, Fall 2022†, Winter 2022, Fall 2021
Math 20C: Multivariable Calculus — Summer 2022
Math 20E: Vector Calculus — Summer 2023
Math 102: Applied Linear Algebra — Winter 2025
Math 168: Random Walks on Graphs — Summer 2024
Math 173A: Optimization for Data Science — Fall 2024, Fall 2025
Math 180A: Introduction to Probability — Spring 2025
Math 216A: Mathematical Methods of Data Science — Fall 2024

Undergraduate Teaching Assistant — Northwestern   *September 2019 – March 2021*
Weekly Discussion Sections, Office Hours, Homework and Exam Grading

Math 228-1: Multivariable Calculus – Fall 2019
Math 220-2: Integral Calculus – Fall 2020, Winter 2020
Math 226-0: Sequences and Series – Spring 2020
Math 220-1: Differential Calculus – Winter 2021

SERVICE

Mathematics Graduate Student Council — UC San Diego   *September 2022 – Present*
Chair (July 2024 – Present), Vice Chair (July 2023 – June 2024),
Mentorship Committee Co-chair (July 2022 – June 2023)

Description: MGSC at UCSD is a student organization dedicated to improving the mathematics graduate students' experience at UCSD. We represent the mathematics graduate students in department affairs meetings, collaborate with department administration to resolve graduate students' concerns, facilitate a mentorship program, plan social events, and more.

Lead TA — UC San Diego   *September 2022 – Spring 2024*

Description: Lead TAs are selected by the department to assist instructors of large "superlecture" courses. This involves writing worksheets and planning discussion section activities, communicating with all TAs for the course, administering midterm and final exams, and managing course policies and exceptions. As a Lead TA, I also helped develop a large problem bank of interesting discussion problems for future instructors and TAs to use in their worksheets.

Northwestern Emerging Scholars Program — Northwestern   *September 2019 – June 2021*
Peer Leader

Description: NESP is a program designed to introduce early undergraduates to the topics of advanced mathematics courses in a low-stakes, collaborative, inclusive environment. Born out of a desire to ease the transition from introductory to advanced courses, NESP strives to give students of all backgrounds a taste of the courses they would encounter as a math major. As a peer leader, I led weekly sessions in which students would work together on worksheets to guide them through an introduction to various mathematical topics.