

# Abigail Hickok

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Department of Mathematics

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## Research Interests

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Topological data analysis, geometric data analysis, network science, spatial data, and applications to biology

## Academic Appointments

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**Columbia University**, Department of Mathematics 2023–Present  
*NSF Postdoctoral Research Fellow*

## Education

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**PhD in Mathematics, UCLA** 2018–2023  
Thesis: *Topics in Geometric and Topological Data Analysis*  
Advisor: Mason Porter

**BA in Mathematics, with Honors, Princeton University** 2014–2018  
Senior Thesis: *Khovanov Homology and Genus-2 Mutation*  
Senior Thesis Advisors: Zoltán Szabó and Peter Ozsváth

## Honors & Awards

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AWM Dissertation Prize	2024
Ivo and Renata Babuška Thesis Prize	2024
Pacific Journal of Mathematics Dissertation Prize (UCLA)	2023
NSF Mathematical Sciences Postdoctoral Research Fellowship	2023
UCLA Dissertation Year Fellowship	2022
NSF Graduate Research Fellowship Honorable Mention	2020
UCLA Graduate Dean's Scholar Fellowship	2018
Eugene V. Cota-Robles Fellowship (UCLA)	2018

## Publications & Preprints

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9. Persistent Homology for Resource Coverage: A Case Study of Access to Polling Sites.  
\*A. Hickok, \*B. Jarman, \*M. Johnson, \*J. Luo, M. A. Porter. *SIAM Review*, in press.
8. An Intrinsic Approach to Scalar-Curvature Estimation for Point Clouds.  
A. Hickok and A. J. Blumberg. arXiv:2308.02615, 2023.
7. Computing Persistence Diagram Bundles.  
A. Hickok. arXiv:2210.06424, 2022.
6. Persistence Diagram Bundles: A Multidimensional Generalization of Vineyards.  
A. Hickok. arXiv:2210.05124, 2022.
5. A Family of Density-Scaled Filtered Complexes.  
A. Hickok. arXiv:2112.03334, 2022.
4. Analysis of Spatial and Spatiotemporal Anomalies Using Persistent Homology: Case Studies with COVID-19 Data.  
A. Hickok, D. Needell, M. A. Porter. *SIAM Journal on Mathematics of Data Science*, 4(3):1116-1144, 2022.
3. Topological Data Analysis of Spatial Systems.  
M. Feng, A. Hickok, M. A. Porter. In F. Battiston and G. Petri (eds.) *Higher-Order Systems*, ch. 17, pp. 389–399. Springer, Cham, Switzerland, 2022.
2. A Bounded-Confidence Model of Opinion Dynamics on Hypergraphs.  
A. Hickok, Y. H. Kureh, H. Z. Brooks, M. Feng, M. A. Porter. *SIAM Journal on Applied Dynamical Systems*. 21(1):1–32, 2022.
1. Adaptive Spectral Solution Method for the Landau and Lenard-Balescu Equations.  
C.R. Scullard, \*A. Hickok, \*J. O. Sotiris, \*B. M. Tzolova, \*R. L. Van Heyningen, F. R. Graziani. *Journal of Computational Physics* 402, 109110, 2020.

\*Equal contribution.

## Teaching

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### UCLA (Teaching Assistant)

Math 168: Introduction to Networks	Winter 2020, Spring 2020, Fall 2020
Math 31B: Integration and Infinite Series	Winter 2020, Spring 2020
Math 131AH: Honors Analysis	Fall 2019
Math 1: Precalculus	Fall 2019

### Princeton (Undergraduate Course Assistant)

Math 215: Honors Analysis	Spring 2018
Math 335: Complex Analysis	Fall 2017

# Talks and Poster Presentations

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## Invited Talks

AMS Spring Southeastern Sectional Meeting	Mar. 2024
JMM Special Session on Bridging Applied and Quantitative Topology	Jan. 2024
JMM Special Session on Complex Social Systems	Jan. 2024
SIAM Central States Sectional Meeting	Oct. 2023
ICIAM, minisymposium on Higher-Order Networks for Complex Systems	Aug. 2023
SIAM Conference on Applied Algebraic Geometry	July 2023
AMS Spring Southeastern Sectional Meeting	Mar. 2023
University of Florida, Topological Data Analysis conference	Feb. 2023
SIAM Conference on Applications of Dynamical Systems (virtual)	May 2021
APS March Meeting, Short Course: Introduction to TDA (virtual)	Mar. 2021

## Seminar Talks

Focused Research Group Meeting, K-Theory (virtual)	Mar. 2024
Montana State University, AI Seminar	Feb. 2024
Montana State University, Applied Mathematics Seminar	Feb. 2024
Montana State University, Mathematics Seminar	Feb. 2023
Persistence, Sheaves, and Homotopy Theory Seminar (virtual)	Jan. 2023
Santa Fe Institute	Jan. 2023
Yale, Krishnaswamy Lab group meeting (virtual)	Dec. 2022
AATRN Vietoris–Rips seminar (virtual)	Nov. 2022
SUNY Albany, Applied Topology Seminar (virtual)	Mar. 2022
EPFL, Applied Topology Seminar (virtual)	Feb. 2022
Michigan State University, Topological Data Analysis Seminar (virtual)	Dec. 2021

## Contributed Talks

SIAM New York-New Jersey-Pennsylvania Sectional Meeting	Oct. 2023
Southern California Applied Mathematics Symposium	Apr. 2023
Joint Mathematics Meeting	Jan. 2023
SIAM Conference on Mathematics of Data Science	Sep. 2022
Young Topologist Meeting	July 2022
Joint Mathematics Meeting	Jan. 2017

## General Mathematical Audience Talks

Columbia Michael Zhao Memorial Student Colloquium	Nov. 2023
Columbia Undergraduate Math Society	Nov. 2023

## Posters

9th Mexican Workshop on Applied Geometry and Topology (virtual)	Nov. 2023
Algebraic Topology: Methods, Computation and Science (ATMCS)	June 2022
Applied Algebraic Topology Research Network (virtual)	Jan. 2022
Applied Algebraic Topology Research Network (virtual)	Oct. 2021
Algorithms for Threat Detection (ATD) Workshop (virtual)	Nov. 2020

## Research Visits

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<b>Columbia University</b> Visiting Scientist Host: Andrew Blumberg	Spring 2022
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## Academic Mentorship

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### Independent Research Project Supervision

#### Graduate Projects

- Tristan Luca Saidi Spring 2024-  
Topic: *Graph neural networks for learning curvature in point-cloud and graph data*

#### Undergraduate Projects

- Dasha Strait Spring 2024-  
Topic: *Applications of geometric methods to single-cell RNA sequencing data*
- Zheheng (Tony) Xiao Spring 2024-  
Topic: *Geodesic-distance estimation for high-dimensional data with noise*
- Laura Vinter Spring 2024-  
Topic: *Geometric methods for hierarchical community detection*
- Alena Chan Fall 2023-  
Topic: *The relationship between Ollivier-Ricci curvature and scalar curvature*

### REU Mentorship

- **REU, Irving Institute for Cancer Dynamics, Columbia** Summer 2022  
Co-mentor with Andrew Blumberg.  
Topic: *Scalar curvature estimation for biological data sets.*

- **Research in Industrial Projects for Students (RIPS), IPAM** Summer 2021  
Mentor for a team of four undergraduates that was sponsored by Air Force Research Laboratory.  
Topic: *Deconvolution of Temporally Under-Resolved Image Sequences for Coupled Dynamical Systems.*

## Independent Study Supervision

- **UCLA Directed Reading Program** Fall 2018  
Mentor for an undergraduate in a reading course on Milnor’s books *Topology from the Differentiable Viewpoint* and *Morse Theory*.

## Service & Outreach

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**ENYGMMa (Empowering NY Gender Minority Mathematicians)** Fall 2023-  
Co-organizer

**JMM special session on applied category theory** Jan. 2023  
Co-organizer

**Exploring Your Universe, UCLA** Fall 2019, 2022  
Volunteer

**Women in Math, UCLA** 2020-2022  
Co-Organizer

**Frontiers for Young Minds** 2021  
Coauthor of the outreach article “Connecting the Dots: Discovering the ‘Shape’ of Data,” with M. Feng, Y. H. Kureh, M. A. Porter, and C.M. Topaz.

## Workshop Participation

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ICERM Topology and Geometry in Neuroscience Oct. 2023  
Women in Computational Topology (WinCompTop) July 2023  
Math Research Community (MRC): Applied Category Theory June 2022