

SAWYER JACK ROBERTSON

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BIO

I am currently a third-year applied mathematics Ph.D. student at UC San Diego. My interests are primarily in applications of spectral graph theory to problems and techniques in machine learning. I am currently looking for a research internship starting Summer 2023, and in my free time I enjoy baking, digital design in various media, and backcountry backpacking.

EDUCATION

Ph.D. in Mathematics University of California, San Diego 2020 - 2025 (Estimated)
Advisors: Alex Cloninger, Fan Chung Graham
M.A. in Applied Mathematics University of California, San Diego 2020 - 2022
B.S. in Mathematics, *summa cum laude* University of Oklahoma 2016 - 2020
Advisor: Javier Alejandro Chávez-Domínguez
Honors thesis: *Analysis on Magnetic Graphs*

EXPERIENCE

Graduate Student Researcher Jun 2021 - Present
Halıcıoğlu Data Science Institute, UC San Diego

Teaching Assistant Oct 2020 - Present
Math Department, UC San Diego

- Courses taught: mathematical statistics, graph theory & algorithms, multivariable calculus

Undergraduate Academic Assistant Aug 2016 - May 2020
Math Department, University of Oklahoma

- Tutored multivariable calculus and graded for math courses

AWARDS & RECOGNITION

- Selected for the lead TA team for the UC San Diego Math Department Sept 2022
- Halıcıoğlu Data Science Institute Graduate Prize Fellowship Oct 2020
- Samuel Watson Reaves Award for Outstanding Senior Math Major, University of Oklahoma May 2020
- Undergraduate Research Award, University of Oklahoma Libraries May 2019

RESEARCH INTERESTS & CURRENT PROJECTS

Machine Learning on Graphs

- Theoretical capabilities of graph neural networks to approximate functions on graphs and graph-like data; with particular emphasis on spectral graph convolutional neural networks
- Graph transfer learning & transferability. Error estimates for transfer of trained model parameters to different data registered on random graphs from the same model (*Current work*)
- Generative models for synthetic feature data on geometric graphs (*Current work*)

Connection Graphs

- Using and studying connection graphs as discrete models for manifolds and high-dimensional datasets; and bootstrapping the spectral theory and techniques for classical graphs to find new insights
- Optimal transport & Wasserstein distance formulations for vector densities on connection graphs (*Current work*)

- Effective resistance, PageRank, and Cheeger theory for connection graphs (*Current work*)

Other Interests & Directions

- Linearized optimal transport techniques and applications to unsupervised learning problems
- State graphs, random walk processes, and applications to voter models
- All things graph signal processing
- Spectral theory of directed graphs and connections to other graph models

SKILLS

Computer Programming Languages MATLAB, Python, Java, R, Mathematica, HTML

SELECTED MANUSCRIPTS

Harnack Inequality for Magnetic Graphs. arXiv:1910.04019

A Survey of Random Walks on Networks.

Spectral Proof of Szemerédi Regularity for Graphs with Edge Coloring.

Additional written research viewable on Google Scholar

SELECTED TALKS

Joint Math Meetings AMS Special Session on Combinatorics and Graph Theory III Denver, CO Jan 2020

Joint Math Meetings AMS Session on Optics and Electromagnetism Baltimore, MD Jan 2019

Presented poster Undergraduate Math Symposium at UIC Chicago, IL Nov 2018

MAA MathFest Denver, CO Aug 2018

CeSMUR Conference Lincoln, NE Apr 2018

EXTRA-CURRICULAR ACTIVITIES & LEADERSHIP

- Led the communications for the Mathematics Graduate Student Council at UC San Diego (*Oct 2021 - July 2022*)
- Co-own, operate, and maintain a Minecraft server for a group of friends focused on elaborate and immersive digital designs
- Demographics, elections and population data visualization as a hobby