

Jacob Cleveland

<https://github.com/jacleveland>

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Education

- Ph.D Mathematics, Colorado State University, Expected Completion May 2027
- M.S. Mathematics, Colorado State University, Expected Completion May 2024
- B.S. Mathematics, University of Nebraska at Omaha, May 2022
- B.S. Computer Engineering, University of Nebraska - Lincoln, May 2022

Notable Courses and Seminars

- Differential Manifolds, Spring 2023, *Differential Forms by Weintraub 2e*
- Euclidean and Non-Euclidean Geometry, Spring 2023
- Category Theory Seminar, Fall 2022 - present
- Topology Seminar, Fall 2022 - present
- Algebraic Geometry Seminar, Spring 2021, *Ideals, Varieties, and Algorithms by Cox, Little, and O'Shea 4e*
- Probability and Statistics I, Fall 2020, *Mathematical Statistics by Miller and Miller 8e*
- Representation Theory Seminar, Fall 2020, *Linear Representations of Finite Groups by Serre*
- Real Analysis I-II, Fall 2019-Spring 2020, *Principles of Mathematical Analysis by Rudin 3e*
- Linear Algebra, Spring 2020, *Linear Algebra Done Right by Axler 3e*
- Algebraic Number Theory Seminar, Fall 2019, *Number Fields by Marcus 2e*
- Abstract Algebra I-II, Fall 2018-Spring 2019, *Contemporary Abstract Algebra by Gallian 8e*
- Lie Algebra Seminar, Spring 2019, *Introduction to Lie Algebras by Erdmann and Wildon*
- Iterated Function Systems, Spring 2019, *Lecture Notes by Andrzej Roslanowski based on Fractals Everywhere by Barnsley*
- Complex Analysis, Fall 2018, *Fundamentals of Complex Analysis by Saff and Snyder 3e*
- Point-set Topology, Fall 2018, *Lecture Notes by Andrzej Roslanowski based on Rudin and Munkres*
- Lie Group Seminar, Fall 2018, *Naive Lie Theory by Stillwell*
- p -adic Analysis Seminar, Summer 2018, *p -adic numbers by Gouvêa 2e*
- Introduction to Analysis, Summer 2018, *Introductory Real Analysis by Dangelo and Seyfried*
- Number Theory, Spring 2018, *Elementary Number Theory by Kenneth Rosen 6e*

Research Experience

- Pathways Intern, NASA GRC. Mentored summer interns, attended conferences, presented work, and performed research on space networking, celestial navigation, contact graph routing, and parametric path optimization. May 2020-present.
- Summer Intern, NASA GRC. Performed research on artificial neural networks. June 2019 - August 2019.

Research Interests

- Delay tolerant networking, graph algorithms, microcontrollers, celestial navigation, artificial neural networks
- Parametric graph optimization, cellular sheaves, tropical geometry, spectral graph theory, stratified spaces, topological data analysis, applied topology, iterated function systems

Selected Publications

1. Cleveland, Jacob; Cooperband, Zoe; Moy, Michael; Short, Robert *On the Current State of Sheaf-Theoretic Networking* Invited Paper for IEEE WiSEEE 2022. To appear in <https://ntrs.nasa.gov/citations/20220015406>
2. Cleveland, Jacob; Conricode, Dominic; Kirkpatrick, Yael; Kortas, Nadia; Moy, Michael; Piekenbrock, Matthew; Short, Robert; Hylton, Alan *Contact Multigraph Routing: Overview and Implementation* IEEE AeroConf 2023. To appear in <https://ntrs.nasa.gov/>
3. Cleveland, Jacob; Short, Robert; Hylton, Alan *Tropical Geometric Route Decision-Making in Simulated Lunar Gateway Communications* IEEE IPCCC 2022. To appear in <https://ntrs.nasa.gov/>
4. Moy, Michael; Cleveland, Jacob; Short, Robert; Hylton, Alan *Multigraph-based Routing in Delay Tolerant Networks: An Alternative to Contact Graph Routing* IEEE IPCCC 2022. To appear in <https://ntrs.nasa.gov/>
5. Cardona, Robert; Cleveland, Jacob; Curry, Justin; Green, Robert; Heller, Brian; Hylton, Alan; Lam, Tung; Mallery, Brendan; Short, Robert *Algebraic and Geometric Models for Space Networking* Journal of Applied and Computational Topology. To appear in <https://www.springer.com/journal/41468>
6. Cleveland, Jacob; Hylton, Alan; Short, Robert; Mallery, Brendan; Green, Robert; Curry, Justin; Dabke, Devavrat; Freides, Olivia *Introducing Tropical Geometric Approaches to Delay Tolerant Networking Optimization* IEEE AeroConf 2022. Available at <https://ntrs.nasa.gov/citations/20220003679>
7. Hylton, Alan; Short, Robert; Cleveland, Jacob; Freides, Olivia; Memon, Zander; Cardona, Robert; Green, Robert; Mallery, Brendan; Curry, Justin; Gopalakrishnan, Sriram; Dabke, Devavrat; Story, Brittany; Moy, Michael *A Survey of Mathematical Structures for Lunar Networks* IEEE AeroConf 2022. Available at <https://ntrs.nasa.gov/citations/20220003566>
8. Short, Robert; Hylton, Alan; Cleveland, Jacob; Moy, Michael; Cardona, Robert; Green, Robert; Mallery, Brendan; Curry, Justin; Bainbridge, Gabriel; Memon, Zander; Freides, Olivia *Sheaf Theoretic Models for Routing in Delay Tolerant Networks*. IEEE AeroConf 2022. Available at <https://ntrs.nasa.gov/citations/20220002277>
9. Hylton, Alan; Raible, Daniel; Short, Robert; Cleveland, Jacob; Nowakowski, John *New Horizons for a Practical and Performance Optimized Solar System Internet*. IEEE AeroConf 2022. Available at <https://ntrs.nasa.gov/citations/20220003634>
10. Green, Robert; Cardona, Robert; Cleveland, Jacob; Ozbolt, Joseph; Hylton, Alan; Short, Robert; Robinson, Michael *Dude Where's My Stars: A Novel Topologically Justified Approach to Star Tracking*. IEEE AeroConf 2021. Available at <https://ntrs.nasa.gov/citations/20205008929>
11. Short, Robert; Hylton, Alan; Cardona, Robert; Green, Robert; Bainbridge, Gabriel; Moy, Michael; Cleveland, Jacob *Towards Sheaf Theoretic Analyses for Delay Tolerant Networking*. IEEE AeroConf 2021. Available at <https://ntrs.nasa.gov/citations/20205008896>

Preprints and Technical Reports

- Cleveland, Jacob; Mallery, Brendan; Hylton, Alan; Short, Robert *Tropical Technical Memorandum*. Available at <https://ntrs.nasa.gov/citations/20210022137>

- Moy, Michael; Cardona, Robert; Green, Robert; Cleveland, Jacob; Hylton, Alan; Short, Robert
Path Optimization Sheaves. Available at <https://arxiv.org/pdf/2012.05974.pdf>

Expository Publications

- Cleveland, Jacob; *Morse Information*. To appear in arxiv.org.

Presentations

- *Monoids and the Grothendieck Group*, Abstract Algebra II, March 2023
- *Morse Information*, Topology Seminar, March 2023
- *Lev Pontryagin*, Diversity in Mathematics Seminar, March 2023
- *Shing-Shen Chern*, Diversity in Mathematics Seminar, February 2023
- *Free and Finitely Generated Modules over Polynomial Rings*, Abstract Algebra II, February 2023
- *X-math Conference*
- *Envelope Detection in Synthesizers*, Applied Mathematics Seminar, December 2022
- *Tropical Geometric Route Decision-Making in Simulated Lunar Gateway Communications*, IEEE IPCCC 2022, November 2022
- *Introduction to Morse Theory*, Topology Seminar, October 2022
- *Tropical Geometry and Space Networking*, Graduate Student Greenslopes Seminar, August 2022
- *Introduction to Category Theory*, Category Theory Seminar, August 2022
- *The Temporal Joswig Algorithm*, NASA Glenn Research Center LCN Branch Meeting, July 2022
- *Iterated Function Systems*, NASA Glenn Research Center Internship, July 2022
- *Tropical Geometry for Parametric Problems*, NASA Glenn Research Center Internship, May 2022
- *Planting a Flag in the Tropics: Tropical Geometry for Space Networking*, Nebraska Academy of Sciences Annual Meeting, April 2022
- *Introducing Tropical Geometric Approaches to Delay Tolerant Networking Optimization*, IEEE AeroConf 2022, Big Sky, Montana, March 2022
- *Tropical Geometry for Parametric Shortest Paths in Space*, NASA Glenn Research Center LCN Branch Meeting, August 2021
- *Graph Path Optimization*, NASA Glenn Research Center Internship, July 2021
- *Topological Subnetting in Space*, SUNY Albany TIMEAUS research group, April 2021
- *Topological Celestial Navigation, Space Networking, and Affine Varieties*, Nebraska Academy of Sciences Annual Meeting, April 2021
- *Overview of Networking*, SUNY Albany TIMEAUS research group, October 2020
- *Topological Celestial Navigation and Path Optimization Sheaves*, NASA Glenn Research Center LCN Branch Meeting, August 2020
- *A Pseudometric on Artificial Neural Networks*, UNO Math Department colloquium, November 2019
- *Comparing Artificial Neural Networks Using Persistent Homology and the Discrete Wasserstein Metric*, ScaN Internship Project Final Presentations, August 2019
- *Introduction to Iterated Function Systems*, NASA Glenn Research Center Internship, June 2019

- *NASA Math Workforce Development*, Nebraska Academy of Sciences Annual Meeting, April 2019

Teaching Experience

- Instructor of record for Math 155 - Calculus for Biological Scientists Fall 2022, Spring 2023 - present using OER https://www.math.colostate.edu/~shriner/meta_frontmatter.html

Technical Skills

- Confident in ANSI 89/99 C, Verilog HDL, LaTeX, AVR/ARM/8051 Assembly, Python, and Java
- Proficient at Printed Circuit Board design in Cadence OrCAD
- Written code in Matlab, Julia, Maple, and Mathematica

Awards

- NASA Nebraska Space Grant Fellowship, Fall 2021 - Spring 2022
- NASA Nebraska Space Grant Fellowship, Fall 2020 - Spring 2021
- James Earl Scholarship, Fall 2020 - Spring 2021
- NASA Nebraska Space Grant Fellowship, Fall 2019 - Spring 2020
- Problem of the Week, 3rd Place, Spring 2019
- NASA Nebraska Space Grant Mini-Grant, Fall 2018 - Spring 2019

Conferences Attended

- IEEE IPCCC 2022, Austin, Texas, November 2022
- Algebraic Topology and Topological Data Analysis: A conference in honor of Gunnar Carlsson, Institute for Mathematics and its Applications, Minneapolis, Minnesota, Aug 2022
- Nebraska Academy of Sciences 2022, Lincoln, Nebraska, April 2022
- IEEE Aerospace Conference 2022, Big Sky, Montana, March 2022
- Nebraska Academy of Sciences 2021, Lincoln, Nebraska, April 2021
- Nebraska Academy of Sciences 2020, Lincoln, Nebraska, April 2020
- Nebraska Academy of Sciences 2019, Lincoln, Nebraska, April 2019