

# Daniel R. Carmody

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CONTACT INFORMATION	Senseable City Laboratory MIT 9-216 77 Massachusetts Ave Cambridge, MA 02139 USA	<i>Github:</i> <a href="https://github.com/dcarmod2">https://github.com/dcarmod2</a> <i>E-mail:</i> <a href="mailto:dcarmody@mit.edu">dcarmody@mit.edu</a>
ACADEMIC POSITIONS	<b>MIT Senseable City Lab</b> , Cambridge, MA ..... 2021 - Present Postdoctoral Researcher in Complexity Science	
EDUCATION	<b>University of Illinois</b> , Urbana-Champaign, Illinois USA ..... 2014 - 2020 Ph.D., Mathematics Advisor: Jeremiah Heller Thesis title: Cdh Descent for Homotopy Hermitian $K$ -Theory of Rings with Involution  <b>Indiana University</b> , Bloomington, Indiana USA ..... 2010 - 2014 B.S., Mathematics 2014 Minors: Computer Science, Chemistry	
TECHNICAL SKILLS	Python (pandas, numpy, sklearn, JAX, networkx, ...), $\LaTeX$ , C, SQL, Github, Mapbox, topological data analysis, homotopy theory	
APPLIED PROJECTS	<b>Susan C. Morisato IGL Scholar</b>   University of Illinois, Urbana-Champaign ..... Summer 2020 <ul style="list-style-type: none"><li><input type="checkbox"/> Improved classification accuracy of patients with tinnitus by 20% using techniques from Riemannian geometry on fMRI time series.</li><li><input type="checkbox"/> Investigated discriminative connections in the functional neural connectome to help identify pathways responsible for tinnitus.</li></ul> <b>Research Assistant</b>   University of Illinois, Urbana-Champaign ..... Spring 2020 <ul style="list-style-type: none"><li><input type="checkbox"/> Visualized emergent traffic beltways in Manhattan using techniques from topological data analysis.</li><li><input type="checkbox"/> Coded a persistent homology engine and visualization tool from scratch in python.</li></ul> <b>MARTIANS Intern</b>   Sandia National Labs ..... Summer 2019 <ul style="list-style-type: none"><li><input type="checkbox"/> Laid entire pipeline from data preprocessing to binary classification with an RNN for RNA-seq data.</li><li><input type="checkbox"/> Predicted 2 major conflicts weeks in advance in a video game data set using techniques from topological data analysis.</li></ul> <b>NSF PI4 Program Intern</b>   University of Illinois, Urbana-Champaign ..... Summer 2018 <ul style="list-style-type: none"><li><input type="checkbox"/> Developed city-wide measures of traffic risk using publicly available data from millions of yellow taxi trips.</li><li><input type="checkbox"/> Parallelized computations of cheapest paths for different cost functions on a computing cluster using the multiprocessing, osmnx, and networkx python packages.</li><li><input type="checkbox"/> Visualized accident and travel time data on a map of Manhattan using heat maps made with folium.</li><li><input type="checkbox"/> Created comparative plots designed to inform routing policy for public transit vehicles in Manhattan.</li></ul>	

## PUBLICATIONS

### Published

Carmody D, Sowers R. "Tradeoffs between Safety and Time: A Scale-Free Routing View," *Transport. Res. Part C: Emerg. Technol.*, 108:357-377, 2019.

Carmody D, Sowers R. "A Topological Analysis of Manhattan Traffic Congestion via Persistent Homology". 2020 *J. Phys. Complex*. <https://doi.org/10.1088/2632-072X/abc96a>

Carmody D. "Cdh Descent for Homotopy Hermitian  $K$ -Theory of Rings with Involution." *Doc. Math.* 26, 1275-1327 (2021). <https://elibm.org/ft/10012124000>

### Submitted

Carmody D, Mazzarello M, Santi P, Harris T, Lehmann S, Abbasov T, Dunbar R, Ratti C. "The effect of co-location on human communication networks." (Under revision at *Nat. Comp. Sci.*). <https://arxiv.org/abs/2201.02230>

## PRESENTATIONS

### Posters

An B, Carmody D, Durairaj K, Jing A, Lee H, Li J, Liu C, Lyu F, Mousley-Mackay S, Ray D, Ren J, Sowers R, Zhang Y. Geometry of Traffic. Illinois Geometry Lab Open House. Dec 13, 2018.

Carmody D, Guo L, Sowers R, Liu Z. Tradeoffs Between Safety and Time: A Routing View. NCSA Data Science Day. Sept 27, 2018.

Ang R, Arias F, Cheng P, Liu W, Seung D, Shen E, Begovich K, Carmody D, Sowers R. Video as a Sensor. Illinois Geometry Lab Open House. May 3, 2018

Carmody D, Field E, Rapiti Z. A Model for Tetrapod Limb Bud Development. PI4 Poster Session. September 9, 2014.

### Exhibitions

Video as a Sensor Exhibit. University of Illinois Engineering Open House. March 9, 2018.

### Invited Talks

The effect of co-location on human communication networks. Computational Social Science Seminar. MIT Media Lab. February 2022.

Transport Mode Imbalance. Senseable Stockholm Day. Stockholm, Sweden. October 2021.

Fat points on schemes. AMS Contributed Session on Undergraduate Research, Joint Mathematics Meetings. January 16, 2014

Descent and  $cd$ -structures. Vitamin  $K_1$  workshop on the proof of Weibel's conjecture. May 30, 2018.

## WORKSHOPS

Homotopy Theory Summer. Freie Universität Berlin. June 18 - June 29, 2018.

Vitamin  $K_1$  workshop on the proof of Weibel's conjecture. University of Illinois Chicago. May 30 - June 1, 2018.

Algebro-Geometric and Homotopical Methods. Institut Mittag-Leffler. February 26 - March 11, 2017.

USC  $K$ -Theory Summer School. University of Southern California. May 24 - May 27, 2016.

MENTORING

**Postdoc Mentor** | MIT UROP Program ..... Spring 2022

- Mentored an undergraduate researcher preparing a web-based isochrone tool for city planners in the Stockholm city planning office.

**Graduate Mentor** | Illinois Geometry Lab ..... Fall 2019

- Mentored an undergraduate team working on understanding concepts from statistics and topology by creating interactive online visualizations in Javascript/HTML5.
- Set up and managed Gitlab repositories where the students could store their work and remotely update mentors on current progress.

**Graduate Mentor** | Illinois Geometry Lab ..... Fall 2018

- Led an undergraduate team using non-negative matrix factorization to look for patterns in San Francisco parking data.
- Co-wrote a novel non-negative matrix factorization algorithm in python which exploited periodicity in daily parking activity.

**Graduate Mentor** | Illinois Geometry Lab ..... Spring 2018

- Led a team of undergraduates using a neural network for object classification and detection for video streams in urban environments.
- Wrote C code to make the neural network utilize previous frames in a video to influence detections on the current frame.
- Implemented a support vector machine with sklearn to turn detections into an assessment of risk.
- Collaborated with a sysadmin to set up a server cluster with the requisite software for the team.
- Presented a live demo using the neural network for compound object detection at the University of Illinois Engineering Open House.

SERVICE

**Peer Reviewer**

- IEEE Transactions on Intelligent Transportation Systems
- Nature Scientific Reports

**Graduate Seminar Organizer**

- Spectral Sequences Learning Seminar ..... Summer 2018
- Étale Cohomology Reading Group ..... Spring 2017
- Graduate Homotopy Theory Seminar ..... Spring 2017
- K-Theory Reading Group ..... Fall 2016
- Graduate Geometry/Topology Seminar ..... Fall 2016 - Spring 2017

**Awards Committee Reviewer**

- Math TA Teaching Awards Committee ..... Fall 2019

TEACHING  
EXPERIENCE

**Co-instructor** | MIT ..... 2022

Senseable City Lab Class ..... Spring 2020

**Teaching Assistant** | University of Illinois ..... 2014 - 2020

Rated "Excellent Instructor" for 10 semesters by Center for Teaching Excellence.  
Rated "*Outstanding*" for 6 semesters by Center for Teaching Excellence (italicized).

- Multivariable Calculus ..... Spring 2020
- Multivariable Calculus* ..... Fall 2018
- Linear Algebra* ..... Spring 2018
- Multivariable Calculus ..... Fall 2017
- Multivariable Calculus* ..... Spring 2017
- Calculus I* ..... Fall 2016

- ❑ *Calculus II* ..... Spring 2016
- ❑ Calculus I ..... Fall 2015
- ❑ *Calculus II* ..... Spring 2015
- ❑ Calculus I ..... Fall 2014