

# Nathan C. Carter

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Director, Center for Analytics and Data Science  
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## Positions

2019–present	Professor, Mathematical Sciences Director, Center for Analytics and Data Science, 2022–present Wilder Teaching Professorship, 2020–2025	Bentley University
2018–2019	Research Associate mathematical software development, GAP team	University of St Andrews (during sabbatical)
2010–2019	Associate Professor, Mathematical Sciences Department Chair during 2014–2018	Bentley University
2009–2010	Game development consultant clients included Spiral Galaxy and Mattel, Inc.	self-employed (during sabbatical)
2004–2010	Assistant Professor, Mathematical Sciences	Bentley University

## Education

### *Indiana University, Bloomington, Indiana*

- Ph.D. Mathematics, July 2004, Advisor: Prof. David Charles McCarty  
Thesis: *Reflexive Logics—Intermediate logics that can prove their own completeness*  
M.S. Computer Science, May 2004, Advisor: Prof. Douglas R. Hofstadter  
Masters Software Project: *Group Explorer* (group theory visualization software)  
M.S. Mathematics, April 2001

### *University of Scranton, Scranton, Pennsylvania*

- B.S. Mathematics and Computer Science, *magna cum laude* with Mathematics Award, May, 1999

## Awards

### *National*

- Distinguished Lecture Series, Mathematical Association of America, March 2022  
Beckenbach Book Prize, Mathematical Association of America, January 2021  
Trevor Evans Award, Mathematical Association of America, August 2012  
Beckenbach Book Prize, Mathematical Association of America, January 2012  
Henry L. Alder Award for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member, Mathematical Association of America, 2010  
National Science Foundation Division of Undergraduate Education: Course, Curriculum, and Laboratory Improvement Grant #0736644, Phase I (\$130,552), PI (with Dr. Kenneth Monks, Co-PI), 2008–2011

### *Institutional*

- Outstanding Scholarly Contribution, Bentley University, September 2012  
Three Innovation in Teaching Awards, Bentley University, 2007, 2014, 2016

## Books

*Data Science for Mathematicians* (editor). Taylor and Francis, September 2020, ISBN 978-0-36702-705-6 (hardback), 978-0-42939-829-2 (ebook).

*Introduction to the Mathematics of Computer Graphics*. Mathematical Association of America Press, September 2016, ISBN 978-1-61444-122-9. Website and resources at <http://nathancarter.github.io/mocg>.

*forallχ in Lurch*. Based on work by P.D. Magnus, August 2012. An Open Educational Resource, a logic textbook integrating the software system *Lurch* throughout. On the web at <https://nathancarter.github.io/faxil/>.

*Visual Group Theory*. Mathematical Association of America Press, May 2009, ISBN 987-0-88385-757-1. My website for this book is at <http://web.bentley.edu/empl/c/nmorgan/vgt>.

Chinese translation, 群论彩图版, from China Machine Press, October 2019, ISBN 978-7-111-62485-1.

## Refereed Publications

N. Carter, A. Iyengar, M. Lanham, S. Nestler, D. Schrader, A. Zadeh. "Clustering algorithms to increase fairness in collegiate wrestling," *Journal of Quantitative Analysis in Sports*, Volume 18, Issue 2, 2022.

M. Agarwal, N. Carter, D. Oury. "Machine Learning," chapter in *Data Science for Mathematicians*, September 2020.

N. Carter. "Circuits in RGB Express," *Mathematics Magazine*, Vol. 92 (2019), pp. 323–388.  
<https://doi.org/10.1080/0025570X.2019.1614418>

N. Carter, D. Oury. "Classroom Management with RStudio Server Professional," *Technology Innovations in Statistics Education*, Volume 11, Issue 1, 2018.

N. Carter, K. G. Monks. "A Web-Based Toolkit for Mathematical Word Processing Applications with Semantics," *Proceedings of CICM 2017*, eds. Herman Geuvers and Jacques Fleuriot (2017).

N. Carter, K. G. Monks. "From Formal to Expository: Using the Proof-Checking Word Processor *Lurch* to Teach Proof Writing," chapter in "Beyond Lecture: Techniques to Improve Student Proof-Writing Across the Curriculum," eds. Schwell, Steurer, and Vasquez, MAA Notes (2016).

N. Carter, K. G. Monks. "*Lurch*: A word processor that can grade students' proofs," *Workshops and Work in Progress at CICM*, Christoph Lange et al., editors. CEUR Workshop Proceedings Vol-1010, Aachen, Germany (2013). Online at <http://ceur-ws.org/Vol-1010/>.

N. Carter, K. G. Monks, "*Lurch*: A word processor built on OpenMath that can check mathematical reasoning," *Workshops and Work in Progress at CICM*, Christoph Lange et al., editors. CEUR Workshop Proceedings Vol-1010, Aachen, Germany (2013). Online at <http://ceur-ws.org/Vol-1010/>.

N. Carter, M. Predescu. "A Study of the Effect of Density Dependence in a Matrix Population Model," *The Australian Journal of Mathematical Analysis and Applications*, Vol. 7, Issue 1 (2010).

N. Carter, C. Hadlock, D. Haughton. "Generating Random Networks from a Given Distribution," *Computational Statistics and Data Analysis*, Vol. 52, No. 8 (April 2008), pp. 3928–3938.

N. Carter. "Reflexive Intermediate First-Order Logics," *Notre Dame J. Formal Logic*, Vol. 49, No. 1 (2008), pp. 75–95.

S. Adams, N. Carter, C. Hadlock, D. Haughton, G. Sirbu. "Change in Connectivity in a Social Network over Time: A Bayesian Perspective," *Connections*, Vol. 28, Issue 2 (2008).

- S. Adams, N. Carter, C. Hadlock, D. Haughton, G. Sirbu. "Proactive Encouragement of Interdisciplinary Research Teams in a Business School Environment: Strategy and Results," *Journal of Higher Education Policy and Management*, Vol. 30, No. 2 (2008).
- N. Carter. "Reflexive Intermediate Propositional Logics," *Notre Dame J. Formal Logic*, Vol. 47, No. 1 (2006), pp. 39–62
- N. Carter, B. Emmons. "Group Theory Visualization with Group Explorer," *J. Online Mathematics and its Applications*, online at <http://www.joma.org>, published Dec. 2005
- N. Carter, R. Eagles, S. Grimes, A. Hahn, C. Reiter. "Chaotic Attractors with Discrete Planar Symmetries," *Chaos, Solitons & Fractals*, Vol. 9, No. 12 (1998), pp. 2031–3054
- N. Carter, S. Grimes, C. Reiter. "Frieze and Wallpaper Chaotic Attractors with a Polar Spin," *Computers and Graphics*, Vol. 22, No. 6 (1998), pp. 765–779

## Publications in Progress

- N. Carter. "How to Data: A free resource for data science students," resubmitted to *Scatterplot* in Spring 2025.
- N. Carter, G. Friedman, O. Tavakoli. "Can AI Grade Mathematical Proofs?" Under review, submitted to *International Journal of Artificial Intelligence in Education* in Fall 2025.

## Expository Publications

- N. Carter. Review of *How to Prove it with Lean*, Daniel J. Velleman. *American Mathematical Monthly*, August, 2025, online at <https://doi.org/10.1080/00029890.2025.2532295>.
- N. Carter. "ChatGPT Gets All the Attention," *Math Horizons*, November 2024.
- N. Carter. "AfterMath: Don't Skip the Code," *Math Horizons*, April 2017, p.34.
- N. Carter, D. Kalman. "It's a Wonderful Log," *Math Horizons*, November 2014, p.18.
- N. Carter, D. Kalman. "Haunted by Pythagoras," *Math Horizons*, November 2012, p.20.
- N. Carter, E. Farrington. "A Quick Tour of Manjul Bhargava's 2011 Hedrick Lectures on Elliptic Curves," *Math Horizons*, November 2011, p.6.
- N. Carter, D. Kalman. "Harvey Plotter and the Circle of Irrationality," *Math Horizons*, November 2011, p.10.
- N. Carter. "AfterMath: Thinking Inside the Box," *Math Horizons*, February 2010, p.34.
- N. Carter. Review of *Five Minute Mathematics*, Erhard Behrends. *Math Horizons*, February 2009, p. 26.
- S. Adams, N. Carter, C. Hadlock, D. Haughton, G. Sirbu. "A Recipe for Collaborative Research," *BizEd*, Sept/Oct (2006), pp. 30–34

## Teaching Experience at Bentley University

### Electives

Data Science (MA346, undergraduate, 6 sections, and MA705, graduate, 5 sections)  
 Discrete Mathematics (8 sections)  
 Mathematical Logic for Honors Students (MA305H, 6 sections)  
 Mathematics of Computer Graphics, MA 307 (10 sections) Mathematical Modeling with VBA in Excel (MA315, 3 sections in partnership with actuaries from Liberty Mutual Insurance, 3 sections independently)

### Directed Study

Honors Capstone projects (5 semesters)  
 iPhone Application Development (2 semesters)  
 Mathematical Software Development (1 semester)  
 Discrete Mathematics (1 semester)  
 Set Theory (1 semester)

### Service Courses

Calculus I, II, and III (MA 126, 131, 139, 233) (several sections in different semesters)  
 Calculus review for graduate students (GR 526) (3 semesters)

## Software

See my full list of software publications, including desktop and web applications, GAP packages, and teaching aids, on my GitHub profile, <http://github.com/nathancarter>.

## Other Professional Experience

*Center for Analytics and Data Science (CADS), Bentley University:* Director, 2022–2025  
*Bentley Team Lead in the AAC&U's Institute for AI, Pedagogy and the Curriculum program* 2025  
*Strategical Plan Implementation Team, Bentley University:* 2022–2025  
*Wilder Teaching Professor, Bentley University,* endowed position, 2020–present  
*Core Curriculum Revision Task Forces, Bentley University:* 2019–2021  
*School of Computer Science, University of St Andrews:* Principal Research Fellow, sabbatical 2018–2019  
*Department of Mathematical Sciences, Bentley University:* Chair, 2014–2018  
*Shared Governance Task Force, Bentley University:* 2016–2018  
*Chauvenet Prize Committee, Mathematical Association of America:* 2014–2017  
*Honors Program, Bentley University:* Associate Director, 2012–2014  
*Math Horizons:* Editorial board member, 2009–2019  
*National Science Foundation:* Proposal Reviewer, as needed, beginning 2008

## Talks

*Functions are All You Need*

Applied Math in Statistics and Data Science Education, ICERM, Providence, RI, May 20, 2025  
[https://icerm.brown.edu/video\\_archive/4151](https://icerm.brown.edu/video_archive/4151)

*Using AI in Python through HuggingFace Transformers (workshop)*  
Analytics Without Borders Conference, Bentley University, April 4, 2025  
[https://videos.bentley.edu/media/t/1\\_mfzy88lh](https://videos.bentley.edu/media/t/1_mfzy88lh)

*Workshop on Lurch (proof checking software)*  
Conference on Intelligent Computer Mathematics, Montreal, QC, August 5, 2024, with K. G. Monks

*Introduction to Lurch (proof checking software)*  
American Institute of Mathematics, Pasadena, CA, December 5, 2023, with K. G. Monks

*Large Language Models: Construction, Use, and New Discoveries*  
New England Statistical Society Data Science Day, University of Connecticut, October 21, 2023.  
<https://www.youtube.com/watch?v=RNJrHWY90nc>

*Mathematics in Data Science*  
Mathematical Association of America Distinguished Lecture Series, online, March 23, 2022.  
<https://www.youtube.com/watch?v=1K5LcwmMn9Y>

*The Surprising Pedagogical Value and Versatility of Cayley Graphs*  
Illustrating Number Theory and Algebra Workshop, ICERM, Brown University, October 21, 2019.

*Cayley Graphs for Building Intuition in Group Theory*  
American Mathematical Society Fall Southeastern Section Meeting, Gainesville, FL, November 3, 2019.

*Lurch: software for immediate feedback for students in a first proof course*  
School of Computer Science seminar, University of St Andrews, Scotland, September 25, 2018

*Clustering with Genetic Algorithms in Division III Collegiate Wrestling*  
Analytics Without Borders Conference, Bentley University, Waltham, MA, March 23, 2018

*A Web-Based Toolkit for Mathematical Word Processing Applications with Semantics*  
Conference on Intelligent Computer Mathematics, Edinburgh, UK, July 2017

*Teaching an Introduction to the Mathematics of Computer Graphics*  
MAA Minicourse, Joint Mathematics Meetings, Atlanta, GA, January 5 and 7, 2017

*Teaching an Introduction to the Mathematics of Computer Graphics*  
MAA Workshop, MathFest, Columbus, OH, August 4, 2016

*Panel on Assessment Facilitated by Technology, Invited Panelist*  
Digital Open Mathematics Education Conference, University of Toronto, June 19, 2016

*Lurch: A Word Processor that can Grade Students' Proofs*  
MathFest, Portland, OR, August 8, 2014

*The Value of Visualization in Group Theory*  
Evening lecture, Indiana University, Bloomington, IN, April 9, 2014

*Lurch: A Word Processor that can Grade Students' Proofs*  
Logic Seminar, Indiana University, Bloomington, IN, April 9, 2014

*What does Rubik's Cube have to do with Quintic Polynomials?*  
Keynote address at the 63rd Annual Western Illinois University Mathematics Teachers Conference,  
Macomb, IL, March 21, 2014

*Introduction to the Mathematics of Computer Graphics*  
Mathematics Department Colloquium, Western Illinois University, Macomb, IL, March 20, 2014

*Using Lurch in an Introduction to Proofs Course*  
MathFest, national meeting of the Mathematical Association of America, Hartford, CT, August 3, 2013

Three talks on various aspects of the software system *Lurch*  
Conference on Intelligent Computer Mathematics, Bath, UK, July 2013

*Lurch: A word processor that checks students' mathematical reasoning*  
Joint Meetings of the AMS and MAA, San Diego, CA, January 9, 2013

*Introduction to the Mathematics of Computer Graphics,*  
Bentley University Mathematics Department Seminar, Waltham, MA, October 31, 2012

*The Lurch Project: A word processor that checks your math*  
Joint Meetings of the AMS and MAA, Boston, MA, January 4, 2012

*The Lurch Project: A word processor that checks your math*  
Joint Meetings of the AMS and MAA, New Orleans, LA, January 6, 2011

*Visualizing Group Theory: From Zero to Galois Theory in 50 Minutes*  
Gordon College, November 11, 2010

*The Lurch Project: A word processor that checks your math*  
MathFest, national meeting of the Mathematical Association of America, in a session for recipients of the Henry L. Alder Award, Pittsburgh, PA, August 6, 2010

*Using Lurch in the Classroom*  
Maryland/D.C./Virginia Section Meeting of the Mathematical Association of America, Virginia State University, Petersburg, MD, April 16, 2010

*Visualization Lessons from Visual Group Theory*  
Joint Meetings of the AMS and MAA, San Francisco, California, January 16, 2010

*Lurch: Software for Teaching Mathematical Proofs*  
Sage Education Day 1, Clay Math Institute, Cambridge, MA, December 6, 2009

*Visual Group Theory*  
MathFest, national meeting of the Mathematical Association of America, Portland, OR, August 6, 2009

*Lurch: Software for Teaching and Writing Mathematical Proofs*  
MathFest, national meeting of the Mathematical Association of America, in a session on Getting Students Involved in Writing Proofs, Portland, OR, August 7, 2009

*Workshop on Lurch: Software for Teaching Mathematical Proofs*  
Northeast Section of the MAA Fall 2008 meeting, November 21, 2008, Bentley University

*A Talk Without Words: Visualizing Group Theory*  
Joint Meetings of the AMS and MAA, San Diego, California, January 7, 2008

*Metal and Money: A Logical Video Game*  
Bentley University Wilder Workshop for Innovation in Teaching Award Winners, April 23, 2008

*Visualizing Group Theory with Group Explorer*  
Joint Meetings of the AMS and MAA, New Orleans, Louisiana, January 5, 2007, MAA Session on Use of Technology in Abstract Algebra and Number Theory

*Visualizing Group Theory: From Zero to Galois Theory in 50 Minutes*  
Marywood University, November 17, 2006

*Visualizing Group Theory: From Zero to Galois Theory in 50 Minutes*  
Wellesley College Mathematics Department Colloquium, September 26, 2006

*Using Software to Explore Upper-Division Mathematics Classes, with a Focus on Abstract Algebra*  
Council on Undergraduate Research National Conference, DePauw University, June 24, 2006, with Allen Hibbard and Ellen Maycock

*Reflexive Intermediate Propositional Logics*  
Association for Symbolic Logic Winter meeting, January 15, 2006

*Reflexive Intermediate Logics*  
Massachusetts Institute of Technology logic seminar, September 28, 2005

*Group Explorer—Visualization Software in the Abstract Algebra Classroom*  
Northeast Section meeting of the MAA, Worcester, Massachusetts, November 20, 2004

*Group Explorer—Visualization Software in the Abstract Algebra Classroom*  
Joint Meetings of the AMS and MAA, Phoenix, Arizona, January 8, 2004, with Brad Emmons MAA  
Contributed Papers Session on Mathlets for Teaching and Learning Mathematics

*Reflexive Intermediate Logics*  
Graduate Student Seminar, Indiana University, December 2003

*Group Explorer—Visualization Software in the Abstract Algebra Classroom*  
Indiana University, in two abstract algebra courses, Sept. and Oct. 2003

*Chaotic Attractors with Discrete Planar Symmetries*  
MAA Eastern Pennsylvania and Delaware section meeting, Shippensburg University, Shippensburg,  
Pennsylvania, April 1998

*Chaotic Attractors with Discrete Planar Symmetries*  
Joint Meetings of the AMS and MAA, Baltimore, Maryland, January 1998, with Richard Eagles and  
Steven Grimes

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