

# EMILY MCMILLON

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## RESEARCH INTERESTS

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I am interested in coding theory and applied discrete math: specifically graph-based codes and iterative decoding analysis. Further, I am broadly interested in mathematics education.

## EDUCATION

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**Doctor of Philosophy**, Mathematics May 2022  
*University of Nebraska, Lincoln, NE*  
 Minor: Electrical Engineering<sup>†</sup>  
 Advisor: Dr. Christine A. Kelley  
 Dissertation: *Theory and Design of Graph-Based Codes for Improved Iterative and Windowed Decoding*

**Master of Science**, Mathematics May 2018  
*University of Nebraska, Lincoln, NE*

**Bachelor of Science**, Mathematics May 2016  
*Lamar University, Beaumont, TX*  
 Minor: Space Science

**Bachelor of Science**, Chemical Engineering May 2016  
*Lamar University, Beaumont, TX*

## ACADEMIC POSITIONS HELD

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**NSF Postdoctoral Fellow** July 2023 - Present  
*Mathematics Department, Virginia Tech, Blacksburg, VA*

**RTG Lovett Instructor** (Postdoc) July 2022 - June 2023  
*Mathematics Department, Rice University, Houston, TX*

**Graduate Teaching Assistant** Aug. 2016 - May 2022  
*Mathematics Department, University of Nebraska, Lincoln, NE*

**Graduate Research Assistant** Aug. 2020 - May 2022  
*Center for Science, Mathematics, & Computer Education, University of Nebraska, Lincoln, NE*  
 Project: Teacher Leadership (T-Lead): Investigating the Persistence and Trajectories of Noyce Master Teaching Fellows. Project Supervisor & Co-PI: Dr. Wendy Smith. NSF Award #1758462.

## NON-ACADEMIC POSITIONS HELD

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**Software Engineering Intern** Summer 2015  
*IGN Entertainment, San Francisco, CA*

**NASA Ames Academy Fellow** Summer 2014  
*Ames Research Center, Mountain View, CA*

**Undergraduate Student Research Project (USRP) Intern** Spring 2013  
*Materials Science Research Department, Glenn Research Center, Cleveland, OH*

**Process Engineering Intern** Summer 2012  
*Motiva Enterprises, Port Arthur, TX*

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<sup>†</sup>Five courses at the graduate level.

## AWARDS, GRANTS, & FELLOWSHIPS

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- **Mathematical Sciences Postdoctoral Research Fellowship** Jan. 2023  
*National Science Foundation*
- **Virginia Tech Presidential Postdoctoral Fellowship** Dec. 2022  
*Virginia Tech Office of Research and Innovation*
- **ISIT 2022 Travel Grant** June 2022  
*IEEE International Symposium on Information Theory Travel Awards*
- **Don Miller Outstanding GTA Award** Nov. 2021  
*University of Nebraska–Lincoln Mathematics Department*  
– Awarded annually to one experienced graduate student for outstanding teaching.
- **Linda Bors Fellowship** Oct. 2020  
*University of Nebraska–Lincoln Mathematics Department*  
– Awarded annually to three graduate students for outstanding scholarship.
- **NASA Nebraska Space Grant Fellowship** Aug. 2020  
*Nebraska Space Grant Consortium*
- **Parents’ Recognition Award** Feb. 2019  
*UNL Parents Association, University of Nebraska–Lincoln*  
– Annual recognition given to faculty and nominated by students for making a significant difference in an undergraduate student’s life.
- **Outstanding Senior Award** May 2016  
*Lamar University Mathematics Department*
- **Otho Plummer Award** May 2016  
*Lamar University President’s Office*

## PUBLICATIONS

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9. Emily McMillon, “LDPC Codes from Steiner 2-Designs,” *In preparation*.
8. Christine A. Kelley, Emily McMillon, and Tefjol Pllaha, “Spatially Coupled LDPC Codes from Finite Geometries,” *In preparation*.
7. Emily McMillon and Christine A. Kelley, “Window Code Parameters of Spatially-Coupled LDPC Codes,” accepted to appear in the *Journal of Algebra and Applications*.
6. Wendy M. Smith, Rachel Funk, Kelsey Quaisley, and Emily McMillon, “Building a Community to Support and Strengthen Mathematics Teacher Leaders,” *Submitted*.
5. Emily McMillon and Christine A. Kelley, “Cycle-free Windows of SC-LDPC Codes,” *Proceedings of the IEEE International Symposium on Information Theory*, pp. 390-395, June 2022.
4. Emily McMillon and George Nasr, “Mastery Grading for Future Elementary School Teachers,” *AMS Blog on Teaching and Learning Mathematics*, Feb. 2021.
3. Emily McMillon, Allison Beemer, and Christine A. Kelley, “Extremal Absorbing Sets In Low-Density Parity-Check Codes.” *Advances in Mathematics of Communications*, 19 pages, Jan. 2021.

2. Emily McMillon, Allison Beemer, and Christine A. Kelley, "Analysis of Absorbing Sets Using Cosets and Syndromes." *Proceedings of the IEEE International Symposium on Information Theory*, pp. 367-372, June 2020.
1. Mary Ann B. Meador, Emily McMillon, Anna Sandberg, Elizabeth Barrios, Nathan G. Wilmoth, Carl H. Mueller, and Felix A. Miranda, "Dielectric and Other Properties of Polyimide Aerogels Containing Fluorinated Blocks." *ACS Applied Materials & Interfaces*, pp. 6062-6068, Jan. 2014.

## CONFERENCE TALKS & POSTER PRESENTATIONS

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16. **Spatially Coupled LDPC Codes from Finite Geometries** (Invited; 25 min.) July 2023  
*SIAM Conference on Applied Algebraic Geometry, Eindhoven, The Netherlands*  
Minisymposium on Coding Theory
15. **Absorbing Sets and Cosets of Linear Codes** (20 min.) May 2023  
*Spectra Survey of Mathematics Conference, Lexington, KY*
14. **LDPC Codes from Steiner 2-Designs** (Invited; 20 min.) Jan. 2023  
*Joint Math Meetings, Boston, MA*  
Special Session on Coding Theory for Modern Applications
13. **Algebraic Connections Between Absorbing Sets and Cosets** (20 min.) July 2022  
*Coding Theory and Cryptography: A Conference in Honor of Joachim Rosenthal's 60th Birthday, Zurich, Switzerland*
12. **Cycle-free Windows of SC-LDPC Codes** (20 min.) June 2022  
*International Symposium on Information Theory, Espoo, Finland*
11. **Building a Co-Requisite Mathematics Course** (45 min.) May 2022  
*Change DIAL Conference, Lincoln, NE*
10. **Spatially Coupled LDPC Codes with Cycle-Free Windows** (Invited; 20 min.) Apr. 2022  
*Joint Math Meetings, Virtual*  
Special Session on Advances in Coding Theory
9. **Online Versus In-Person Delivery: Exploring the Effects of Mastery Grading in a Geometry Course for Pre-Service Elementary Teachers** (15 min.) Aug. 2021  
*MAA Mathfest, Virtual*  
Contributed Session on Alternative Assessments: Lessons from the Pandemic
8. **Designing Graph-Based Codes for Window Decoding** (Invited; 25 min.) July 2021  
*SIAM Conference on Discrete Mathematics, Virtual*  
Minisymposium on Graphs and Geometries
7. **Characterizing Absorbing Sets Using Syndromes and Cosets** (Poster) July 2021  
*SIAM Annual Meeting, Virtual*  
AWM Workshop: Poster Session
6. **SC-LDPC Codes with Good Window Distance Properties** (Invited; 20 min.) Apr. 2021  
*AMS Spring Central Sectional Meeting, Virtual*  
Special Session on Graph Theory and Applications
5. **Mastery Grading for Future K-6 Teachers** (Poster) June 2020  
*Mastery Grading Conference, Virtual*
4. **Analysis of Absorbing Sets Using Cosets and Syndromes** (20 min.) June 2020  
*International Symposium on Information Theory, Virtual*

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| 3. <b>Characterization of Absorbing Sets Using Graph Structure and Syndrome Weights</b> (Invited; 20 min.)<br><i>Joint Math Meetings, Denver, CO</i><br>Special Session on Coding Theory and Applications | Jan. 2020 |
| 2. <b>Get Out of My Seat! Probability Problems While Entering a Theater</b> (20 min.)<br><i>Lamar University Undergraduate Research Exposition</i>  | Apr. 2016 |
| 1. <b>Fluorinated Polyimide Aerogels for Aeronautical Antennae Applications</b> (Poster)<br><i>NASA Glenn Research Center USRP Showcase, Cleveland, OH</i>  | Apr. 2013 |

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#### OTHER CONFERENCES ATTENDED

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| • <b>SIAM Southeastern Atlantic Section Annual Meeting</b><br><i>Virginia Tech, Blacksburg, VA</i>                    | Mar. 2023 |
| • <b>Conference on Research on Undergraduate Mathematics Education</b><br><i>Boston, MA and Virtual</i>               | Feb. 2022 |
| • <b>AMS Fall Central Sectional Meeting</b><br><i>Virtual</i>   | Oct. 2021 |
| • <b>International Symposium on Information Theory</b><br><i>Virtual</i>  | July 2021 |
| • <b>AMS/MAA Joint Math Meetings</b><br><i>Virtual</i>  | Jan. 2021 |
| • <b>AMS Fall Southeastern Sectional Meeting</b><br><i>Virtual</i>  | Oct. 2020 |
| • <b>IEEE Conference on Communications and Network Security</b><br><i>Virtual</i>                                     | June 2020 |
| • <b>Eleventh Annual Texas Undergraduate Mathematics Conference</b><br><i>University of Texas at Tyler, Tyler, TX</i> | Oct. 2015 |

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#### RESEARCH WORKSHOPS ATTENDED

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| • <b>Coding &amp; Cryptography Workshop</b><br><i>Virginia Tech Steger Center, Riva San Vitale, Switzerland</i>        | July 2023 |
| • <b>Topological Methods for the Discrete Mathematician</b><br><i>MSRI, St. Mary's College, Moraga, CA</i>             | July 2022 |
| • <b>Algebraic Coding Theory Summer School 2022</b><br><i>University of Zurich, Switzerland</i>                        | July 2022 |
| • <b>Algebraic Coding Theory Summer School 2021</b><br><i>Virtual; hosted by the University of Zurich, Switzerland</i> | June 2021 |
| • <b>North American School of Information Theory (NASIT)</b><br><i>Boston University, Boston, MA</i>                   | July 2019 |

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#### EXTERNAL (INVITED) SEMINAR TALKS

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| 5. <b>Cycles in Spatially-Coupled LDPC Codes</b><br><i>Virginia Tech, ACTiV(T)</i> | Nov. 2022 |
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4. **LDPC Codes, Absorbing Sets, and Windowed Decoding** Sept. 2022  
*Virginia Tech, Applied Algebra Research Group Seminar*
3. **Designing Spatially Coupled LDPC Codes by Optimizing Window Codes** July 2021  
*Postgraduate International Coding Theory Seminar*  
Organized by Eindhoven University of Technology & University College Dublin
2. **An Introduction to Coding Theory and Its Applications** Mar. 2021  
*Benedictine College, Mathematics and Computer Science Colloquium*
1. **Reliable Communication in Outer Space** Oct. 2020  
*Metropolitan State University–Denver, Mathematics Colloquium*

## INTERNAL SEMINAR TALKS

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10. **Reliable Communication in Outer Space** Apr. 2023  
*Rice University, Undergraduate Mathematics Colloquium*
9. **Algebraic Connections between Cosets, Syndromes, and Absorbing Sets** Aug. 2022  
*Rice University, Algebraic Geometry and Number Theory Seminar*
8. **Effective Practices in Graduate STEM Education** Apr. 2022  
*University of Nebraska–Lincoln, Mathematics Education Doctoral Seminar*
7. **Mathematics Doctoral Student Persistence** Apr. 2021  
*University of Nebraska–Lincoln, Mathematics Education Doctoral Seminar*
6. **MDS Codes for Windowed Decoding** Feb. 2021  
*University of Nebraska–Lincoln, Discrete Math Seminar*
5. **Mastery Grading for Future K-6 Teachers** Nov. 2020  
*University of Nebraska–Lincoln, Mathematics Education Doctoral Seminar*
4. **Piloting and Implementing Mathematics Co-Requisite Courses** Oct. 2020  
*University of Nebraska–Lincoln, Mathematics Education Doctoral Seminar*
3. **Coding Theory for Deep Space Communications** Sept. 2020  
*University of Nebraska–Lincoln, Graduate Student Seminar*
2. **Absorbing Set Classification** Jan. 2020  
*University of Nebraska–Lincoln, Discrete Math Seminar*
1. **Codes with Cycle-Free Tanner Graphs** Mar. 2019  
*University of Nebraska–Lincoln, Discrete Math Seminar*

## TEACHING EXPERIENCE

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All courses taught have made use of an active learning environment, meaning students spend a significant portion of class time working on problems in groups. All courses listed are 3 credits, unless otherwise noted.

### INSTRUCTOR OF RECORD (RICE)

- Math 101: *Single Variable Calculus I* Spring 2023
- Math 368: *Topics in Combinatorics* Fall 2022

### INSTRUCTOR OF RECORD (UNL)

- Math 101C: *College & Intermediate Algebra Co-Requisite* (5 credits) Fall 2021
- Math 301: *Geometry Matters* Fall 2019, Spring 2020
  - Course for pre-service elementary education teachers.

- Math 100A: *Intermediate Algebra* Spring 2018, Fall 2018, Spring 2019
- Math 101: *College Algebra* Fall 2017

#### ASSOCIATE COURSE CONVENER (UNL)

- Math 100A: *Intermediate Algebra* Fall 2018, Spring 2019
  - Associate Course Convener duties for *Intermediate Algebra* include coordinating materials for all sections of the course and mentoring junior graduate students teaching their own courses for the first time. I coordinated 12 sections in Fall 2018 and 2 sections in Spring 2019.

#### COURSE DEVELOPMENT (UNL)

- MATH 101C: *College & Intermediate Algebra Co-Requisite* Summer 2021
  - Combined pre-existing College Algebra and Intermediate Algebra course materials to create a co-requisite course.
- MATH 801P: *Geom., Meas., & Algebraic Thinking for K-3 Math Specialists* Summer 2020
  - Assisted in moving the course to an online format by creating videos and other supplementary online course materials.
- MATH 800P: *Number and Operations for K-3 Math Specialists* Summer 2020
  - Same as preceding item description.
- Math 100A: *Intermediate Algebra* Summer 2018
  - Assisted in proofreading and editing the Intermediate Algebra section of a new open educational resource textbook for the precalculus courses at UNL. Additionally, I reformatted the course workbook to reflect a change in textbook as well as to better serve the course objectives.

#### TEACHING ASSISTANT (UNL)

Each of these is a master's-level course for in-service teachers.

- Math 801P: *Geom., Meas., & Algebraic Thinking for K-3 Math Specialists* Summer 2020
- Math 800P: *Number and Operations for K-3 Math Specialists* Summer 2020
- Math 806T: *Number Theory & Cryptology for Teachers* Summer 2018
- Math 812T: *Geometry for Geometry Teachers* Summer 2017

#### RECITATION INSTRUCTOR (UNL)

- Math 107: *Calculus II Recitation* (2 credits) Spring 2017 (2 sections)
- Math 106: *Calculus I Recitation* (2 credits) Fall 2016 (2 sections)

#### PROFESSIONAL DEVELOPMENT

- **Inclusive STEM Teaching Project** Spring 2022  
*Virtual; offered by Boston University through edX.org*
  - Participated in a six-week online course designed to improve participants' awareness, self-efficacy, and ability to create inclusive STEM learning environments for their students.
- **NextProf Science 2021** May 2021  
*Virtual; hosted by the University of Michigan, Ann Arbor*
  - Was selected to participate in this workshop, aimed to bring together graduate students with a demonstrated commitment to diversity and prepare them for successful academic careers.
- **Preparing Future Faculty** May 2020  
*University of Nebraska–Lincoln*
- **Combining Mathematical and Computational Thinking in a General Education Math Course** Jan. 2020  
*MAA Minicourse at the 2020 Joint Math Meetings, Denver, CO*

- **Mathematical Education of Teachers as an Application of Undergraduate Mathematics** Jan. 2020  
*MAA META Math Workshop at the 2020 Joint Math Meetings, Denver, CO*
- **Generating Ideas of Undergraduate Research Projects** Jan. 2020  
*MAA Workshop at the 2020 Joint Math Meetings, Denver, CO*
- **Teaching & Learning Mathematics at the Post-Secondary Level** Aug. 2017 - May 2018  
*University of Nebraska–Lincoln*
  - This three-credit sequence of courses is offered to UNL mathematics graduate teaching assistants and seeks to train graduate students to be effective teachers, classroom managers, and to build the pedagogical foundations necessary to understand educational research.
- **Math to Industry Boot Camp** Summer 2017  
*Institute for Applied Mathematics, University of Minnesota, Minneapolis, MN*

## PROFESSIONAL SERVICE

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- **Staff Member of Teacher Leadership Program** Summer 2023  
*Park City Mathematics Institute*
- **Reviewer for IEEE Transactions on Information Theory** Aug. 2022 - Present

## DEPARTMENTAL SERVICE

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### AT VIRGINIA TECH:

- **Coding & Cryptography Undergraduate Research Program Mentor** Fall 2023
  - Mentored a group of five undergraduate students in a research project on graph-based codes.

### AT RICE UNIVERSITY:

- **Directed Reading Program Group Leader** Spring 2023
  - Mentored a group of four undergraduate students through topological graph theory, which is not typically covered in the Rice undergraduate curriculum.
- **Teaching Seminar Committee Member and Co-Facilitator** Aug. 2022 - May 2023
  - Helped run the departmental teaching seminar, which provides professional development to first and second-year Rice mathematics graduate students to help them learn to teach.

### AT THE UNIVERSITY OF NEBRASKA–LINCOLN:

- **Nebraska Conference for Undergraduate Women in Mathematics (NCUWM) Organizing Committee Member** Aug. 2020 - Feb. 2022
  - This is an annual conference to encourage undergraduate women in mathematics. Around 260 undergraduates from around the country attend each year.
- **Graduate Student Peer Mentor** Aug. 2018 - May 2020, Aug. 2021 - May 2022
  - Mentored three first year graduate students to support their transition to graduate school.
- **Graduate Student Peer Mentoring Program Coordinator** Aug. 2020 - May 2021
- **Mathematics Department Recognition Reception Organizing Committee Member** Spring 2019
- **Nebraska Conference for Undergraduate Women in Mathematics (NCUWM) Volunteer** Annually 2017 - 2020

## COMMUNITY SERVICE AND OUTREACH

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- **Humane Society Volunteer** Aug. 2023 - Present  
*Montgomery County Animal Care and Adoption Center, Christiansburg, Virginia*
- **High School Math Club Speaker** Mar. 2023  
*St. John's High School*
  - Designed and led interactive session on graph and coding theory to high school math club.
- **Math Circle Activity Leader** Nov. 2022 - Apr. 2023  
*Rice University*
  - Led monthly math circle activities for middle school students.
- **Humane Society Volunteer** Aug. 2019 - May 2022  
*Capital Humane Society of Lincoln, Nebraska*
- **Math Circle Activity Leader** Mar. 2022  
*University of Nebraska–Lincoln*
  - Designed and led an activity on math and origami for high school students.
- **Girls Inc. Eureka! Mathematics Instructor** July 2021  
*Girls Inc. of Lincoln, Nebraska*
  - Prepared materials for and facilitated two weeks of interactive mathematics lessons for low income middle and high school girls.
  - Encouraged girls to pursue undergraduate and graduate education.
- **Math Day Volunteer** Annually 2016 - 2021  
*University of Nebraska–Lincoln*

## SKILLS

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### **C++, Java, MATLAB, SageMath, HTML, CSS, PHP, Javascript, L<sup>A</sup>T<sub>E</sub>X**

- Used C++, Java, and MATLAB as a student in programming-focused computer science and engineering courses.
- Informal training with MATLAB and SageMath for use in research projects.
- Used HTML, CSS, PHP, and Javascript in software engineering internship.
- Proficient in L<sup>A</sup>T<sub>E</sub>X.