

Katherine B. Morrison

University of Nebraska – Lincoln • 203 Avery Hall • Lincoln • NE • 68588-0130 • 301-332-0429 • s-kmorri11@math.unl.edu

EDUCATION

University of Nebraska – Lincoln, Lincoln, NE.

MS in Mathematics. August 2008.

PhD in Mathematics, minor in Electrical Engineering. May 2012 (expected).

Thesis: *Equivalence and Duality for Network Coding*

Advisor: Judy Walker

Research Interests: Algebraic Coding Theory, Mathematical Education of Teachers, Neural Coding

Budapest Semesters in Mathematics, Budapest, Hungary. Fall 2005.

Swarthmore College, Swarthmore, PA. May 2005. BA in Mathematics and Psychology.

PROFESSIONAL EXPERIENCE

University of Nebraska – Lincoln, Department of Mathematics,

Graduate Teaching Assistant/GAANN Trainee/MCTP Fellow: August 2006 to Present.

Taught various courses for pre- and in-service teachers as well as college algebra and calculus recitations.

National Institute for Standards and Technology (NIST), *Research Intern:* Summer 2009.

Analyzed ways to efficiently model a large-scale grid computing system and developed mathematical techniques to simplify analysis of the model.

BELL – Building Educated Leaders for Life, *Tutor:* January to March 2006.

Tutored classes of 6 to 10 students in math and reading skills. Responsible for teaching math concepts and building literacy skills for students currently below grade level in their performance.

Math Forum, *Intern:* Winter 2005.

Responsible for finding and cataloguing on the Math Forum website any didactic tools that would aid users in understanding concepts in Multivariable Calculus.

Center for Summer Learning, Johns Hopkins University, *Program Evaluation Intern:* Summer 2004.

Surveyed and interviewed participants and staff in reading program at a Boys' and Girls' Club summer camp. Analyzed data to determine effectiveness of intervention program to encourage children's enjoyment of reading.

AWARDS

Outstanding Graduate Teaching Award: 2009-2010.

Sole recipient of this annual UNL Department of Mathematics teaching award, awarded in December 2010 for the 2009-2010 academic year.

Bill Leavitt Award: 2008.

One of four awards given annually by the UNL Department of Mathematics in honor of emeritus faculty, awarded December 2008 for the 2007-2008 academic year.

Outstanding First Year Student Award: 2007.

Sole recipient of this annual award that recognizes the UNL Department of Mathematics' outstanding first-year graduate student, awarded in December 2007 for the 2006-2007 academic year.

FELLOWSHIPS AND GRANT SUPPORT**AWM Workshop Travel Grant:** 2012.

One of 20 graduate students selected nationwide to present a poster in the *Association for Women in Mathematics Workshop* at the 2012 *Joint Math Meetings* in Boston, MA. Fully funded to attend this event.

AMS Graduate Student Travel Grant: 2012.

Travel grant to attend the 2012 *Joint Math Meetings*, and cover expenses beyond those for *AWM Workshop*.

NSF Learning Network Conference: 2011-2012.

Partially funded for the academic year to help with the planning and execution of NSF's annual Math Science Partnerships *Learning Network Conference* in Washington, D.C., January 23-25, 2011.

NSF Mentoring Through Critical Transition Points Traineeship: 2011.

One of two fellowships given annually by the University of Nebraska -- Lincoln (UNL) Department of Mathematics, with funding from their *NSF Mentoring Through Critical Transition Points* grant.

Great Plains National Security Education Consortium Funding: 2011.

With funding from GP NSEC, worked with two other grad students to create and present an introduction to cryptology for a group of 20 undergraduate students interested in working in the intelligence communities.

MSRI Travel Grant: 2011.

Travel grant to attend the *Critical Issues in the Mathematical Education of Teachers* conference at MSRI.

NSF NebraskaMATH Grant Support: 2009-2011.

Received partial support from the NSF Math Science Partnership grant NebraskaMATH during two semesters and two summers for teaching various graduate level courses for in-service teachers.

GAANN Traineeship: 2009.

One of four fellowships given annually by the UNL Department of Mathematics, with funding from their *USDoE Graduate Assistance in Areas of National Need* grant.

PUBLICATIONS

F. Hunt, K. Morrison, C. Dabrowski. *Spectral Based Methods that Streamline the Search for Failure Scenarios in Large-Scale Distributed Systems*. **Proceedings of the IASTED International Conference on Applied Simulation and Modeling**, June 22-24th, 2011.

C. Dabrowski, F. Hunt, K. Morrison. *Improving Efficiency of Markov Chain Analysis of Complex Distributed Systems*. **NIST Interagency Report 7744**, January, 2011.

Available online at <http://www.math.unl.edu/~s-kmorri11/#research>

N. Axvig, K. Morrison, E. Psota, D. Dreher, L. C. Pérez, J. L. Walker. *Analysis of connections between pseudocodewords*. **IEEE Transactions on Information Theory**. Vol 55, Issue 9, pp. 4099-4107, 2009.

N. Axvig, K. Morrison, E. Psota, D. Dreher, L. C. Pérez, J. L. Walker. *Towards universal cover decoding*. In **Proceedings of International Symposium on Information Theory and Its Applications**. December 2008.

N. Axvig, K. Morrison, E. Psota, D. Dreher, L. C. Pérez, J. L. Walker. *Average min-sum decoding of LDPC codes*. In **Proceedings of Internat'l Symposium on Turbo Codes and Related Topics**. September 2008.

N. Axvig, K. Morrison, E. Psota, D. Dreher, L. C. Pérez, J. L. Walker. *A Universal Theory of Decoding and Pseudocodewords*. **SGER Technical Report 0801**, University of Nebraska–Lincoln, March 2008.

Available online at <http://www.math.unl.edu/~s-kmorri11/#research>

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C. Curto, V. Itskov, K. Morrison, Z. Roth, J. L. Walker. *Combinatorial neural codes from a mathematical coding theory perspective*. In preparation.

TALKS AND PRESENTATIONS

Equivalence and Duality for Rank-Metric Codes

20 minute presentation, based on my dissertation research, given at the Seminar in Coding Theory in Dagstuhl, Germany in November 2011.

Equivalence and Duality for Rank-Metric and Matrix Codes

20 minute presentation, based on my dissertation research, given at the Coding Theory special session of the AMS Fall Central Sectional Meeting in October 2011.

Introduction to Cryptology

75 minute presentation with two other graduate students to introduce past and present methods in cryptology to 20 undergraduate students interested in the intelligence communities. We also designed and implemented a code-breaking activity for these students as part of a week-long simulation of work in the intelligence communities put on by the Great Plains National Security Education Consortium in July 2011.

Properties of Rank-metric and Matrix Codes with Applications to Network Coding

15 minute presentation on my research with an emphasis on the role of algebraic techniques in network coding, given at the Algebraic Structure in Network Information Theory conference in August 2011.

Reflection on A Matrix Algebra Course for Secondary Teachers

20 minute presentation, based on the experience of co-teaching a hybrid-distance learning Matrix Algebra course for teachers, given at the MAA Nebraska/SE South Dakota Spring Sectional Meeting in April 2011.

The Journey to Solve Fermat's Last Theorem: From the 6th century BC to the 20th century AD

50 minute presentation on the history of Fermat's Last Theorem, based on the book *Fermat's Enigma* by Simon Singh, given to the undergraduate math club at Nebraska Wesleyan University in April 2011.

Towards a Duality Theory of Subspace Codes for Network Coding

20 minute presentation, based on joint work with Dr. Judy Walker, given in the Coding Theory special session of the AMS Spring Southeastern Sectional Meeting in March 2010.

An Analysis of Relationships Between Pseudocodewords

Poster presentation, based on joint work in coding theory between the departments of Mathematics and Electrical Engineering, given at the IMA workshop on Career Options for Women in the Mathematical Sciences in April 2009.

On Relationships Between Pseudocodewords

20 minute presentation, based on joint work in coding theory between the Departments of Mathematics and Electrical Engineering, given at the Canadian Summer School on Communications and Information Theory in August 2008.

On the Optimality of Huffman Coding in Data Compression

15 minute presentation, based on senior research project on data compression, given at the Nebraska Conference for Undergraduate Women in Mathematics in March 2005.

SEMINARS AND RESEARCH GROUPS

University of Nebraska Neural Coding Research Group: 2009 – Present

This research group is a collaboration between coding theorists and mathematical neuroscientists in the UNL Department of Mathematics. The goal is to apply coding theory principles to better understand how the brain interprets/decodes what stimulus was presented.

University of Nebraska Mathematical Neuroscience Seminar: 2009 – Present

Weekly seminar focused on reading and discussing new research articles in mathematical neuroscience. I have given multiple 50 minute presentations in this seminar between 2010 and 2011.

University of Nebraska Issues in Mathematics and Science Education Seminar: 2008 – Present

Weekly seminar focused on issues in the teaching and learning of math and science in the K-12 setting as well as the undergraduate setting.

University of Nebraska Discrete Mathematics Seminar: 2007 – Present

Weekly seminar focused on presenting research in various areas of discrete mathematics such as graph theory, combinatorics, and coding theory.

I have given multiple 50 minute presentations in this seminar between 2008 and 2011.

University of Nebraska Coding Theory Research Group: 2007 – 2009

This research group was an interdisciplinary collaboration with the Department of Electrical Engineering at UNL. The primary goal was to analyze the error patterns that arise in decoding LDPC codes with efficient message-passing decoding algorithms.

INVITATION-ONLY WORKSHOPS**Seminar in Coding Theory:** LZI Schloss, Dagstuhl, Germany. November 2011.

Week-long workshop for ~40 invited researchers from both academia and industry intended to promote collaboration on emerging problems in algebraic coding theory, codes on graphs, and network coding.

Algebraic Structure in Network Information Theory Workshop: BIRS, Banff, Canada. August 2011.

Week-long workshop for ~45 invited participants aimed at uniting mathematicians, computer scientists, and engineers to exchange ideas on the role of algebraic structure in problems in network information theory.

SUMMER SCHOOLS**Computational Neuroscience Summer School at University of Ottawa:** Ottawa, Canada. June 2010.

Two-week long summer course on computational neuroscience aimed at building collaboration between mathematicians and lab scientists to promote further interdisciplinary research in neuroscience.

Canadian Summer School on Communications and Information Theory: Banff, Canada. August 2008

Week-long summer school with morning lectures given by professors in the field followed by afternoon talks by graduate students about their current research.

Summer School in Coding Theory: Nordfjordeid, Norway. June 2007.

Week-long summer school consisting of lecture series and extensive problem sessions in coding theory and its applications.

CONFERENCES**Enacting Standards for Mathematical Practice Conference:** Lincoln, NE. October 2011.**AMS Fall Central Sectional Meeting:** Lincoln, NE. October 2011.**Critical Issues in the Mathematical Education of Teachers:** MSRI, Berkeley, CA. May 2011.**MAA Spring Nebraska/Southeastern South Dakota Sectional Meeting:** Kearney, NE. April 2011.**Nebraska Conference for Undergraduate Women in Mathematics:** Lincoln, NE. January 2011.

Attended as the invited graduate student representing the UNL Department of Mathematics.

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AMS Spring Southeastern Sectional Meeting: Lexington, KY. April 2010.

Career Options for Women in the Mathematical Sciences IMA Workshop: Minn., MN. April 2009.

Information Theory and Applications Workshop: San Diego, CA. February 2009.

AMS/MAA Joint Mathematics Meetings: Washington D.C. January 2009.

AMS/MAA Joint Mathematics Meetings: New Orleans, LA. January 2007.

Nebraska Conference for Undergraduate Women in Mathematics: Lincoln, NE. January 2005.
Attended as an undergraduate participant while at Swarthmore College.

SERVICE AND PROFESSIONAL ACTIVITIES

Faculty Mentorship through MCTP Fellowship: 2011.

Partnered with Dr. Melissa Erdmann at Nebraska Wesleyan University in Lincoln, NE. Visited her Introduction to Proofs class and taught this course for two class periods. We discussed the planning and preparation of teaching such a course for potential math majors as well as the preparation for presenting to an undergraduate math club.

Math Education Faculty Search Committee Member: 2010-2011.

Sole graduate student member of search committee for a senior-level professor position with a focus in mathematics education.

Graduate Student Advisory Board (GSAB) Member: 2009-2011.

Senior member of GSAB, which is intended to promote dialogue between the graduate students and the UNL Department of Mathematics faculty. Responsible for conveying graduate student concerns on topics such as teaching load inconsistencies, the next department chair, and teaching methodology for college algebra course. Also organized social events to promote graduate student and faculty camaraderie.

Invited Graduate Student for NCUWM: January 2011

Graduate student representative of the UNL Department of Mathematics at the Nebraska Conference for Undergraduate Women in Mathematics.

PANELS

Careers in Mathematics

Panel discussion giving advice about preparation for careers in mathematics for students entering mathematics graduate school in the fall, given at the *Intensive Mathematics: A Mentoring, Education and Research Summer Experience (IMMERSE)* program at University of Nebraska in June 2011.

Random Bits of Advice

Panel discussion giving advice about graduate school and careers in mathematics for undergraduate women in math at Nebraska Conference for Undergraduate Women in Mathematics (NCUWM) in January 2011.

Choosing A Graduate School

Panel discussion about choosing a graduate school in mathematics or related field for undergraduate women in math at NCUWM in January 2011.

Surviving Graduate School

Panel discussion giving advice in the First-Year Orientation to help ease the transition into graduate school for first-year students entering the UNL Department of Mathematics in August 2009.

TEACHING EXPERIENCE**Courses Taught As Instructor Of Record:****Math 300: Mathematics Matters**

Had full responsibility for teaching a content course for pre-service elementary school teachers. The course focused on exploring the depth of numbers and operations as taught in elementary school; specifically, it aimed at getting pre-service teachers comfortable with the conceptual underpinnings of the elementary math curriculum to help negate the view that math consists solely of rote memorization.

Math 300M: Math as a Second Language

Had full responsibility for teaching a course for pre-service teachers receiving a middle-level certification. This course focused on developing a deep understanding of numbers and operations, improving problem-solving skills, careful reasoning, and communication of mathematics.

Math 101: College Algebra

Had full responsibility for teaching a college algebra course.

NebraskaMATH and NMSSI Grant-Funded Courses:**Math 896T: Matrix Algebra for Teachers**

Taught the online component of a new hybrid distance-learning NebraskaMATH-funded matrix algebra course for in-service secondary teachers. Served to support their understanding of assigned readings and prompt them to explore new connections between high school curriculum on matrices and more abstract linear algebra.

Math 806T: Number Theory and Cryptology

Assisted with and partially taught a week-long NMSSI-funded summer course for in-service secondary teachers, designed to introduce the number theoretic topics needed to build up to understanding RSA cryptography. The discovery-based format of the course aimed at exposing teachers to the thought processes and activities typically performed by research mathematicians, and developing their reasoning and proof-writing skills.

Math 802P: Functions, Algebra and Geometry for K-3 Mathematics Specialists

Assisted with and partially taught this two-week long summer course for in-service teachers working toward a K-3 math specialist certificate. This NebraskaMATH-funded course focused on exploring the depth of numbers, operations, and pre-algebra concepts as taught in the primary grades.

Other Teaching Experiences:**Abstract Algebra Course for IMMERSE**

Was the graduate student TA for a 6-week summer course in abstract algebra through the *Intensive Mathematics: A Mentoring, Education, and Research Summer Experience* (IMMERSE) program, which is a bridge program for students beginning grad school in math the following fall. This course was focused around learning the algebra topics needed to understand a selected journal paper to provide experience reading research papers and to provide preparation for first-year graduate school material.

Math 106 Recitation: Calculus I Recitation

Taught a recitation section for a large lecture first-semester calculus course.

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

American Mathematical Society (AMS)

Association for Women in Mathematics (AWM)

Society for Industrial and Applied Mathematics (SIAM)