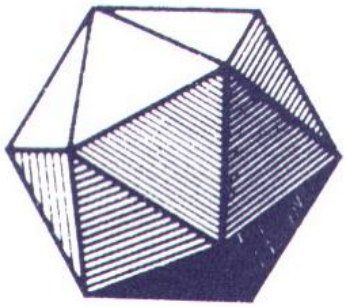
North Central Section (Founded in 1916)

Mathematical Association of America



Fall Meeting • October 23-24, 2015
Bemidji State University
Bemidji, Minnesota

Friday, October 23, 2015

6:30 – 8:30 **Registration** – Sattgast 248
$10 Regular (Students, First time attendees, and Speakers are free)
$5 for MAA-NCS section NExT members.

6:30 – 8:00 **Book Sales**, Sattgast 248

Evening Session – Sattgast 208, Tom Dunn, Presiding

7:00 – 7:15 **James Carr, Normandale Community College**
Restructuring a Developmental Math Program: A Three Stage Process

7:20 – 7:35 **Issac Odegard,** Graduate Student, **University of North Dakota**
The Quadratic Irrationals and Ducci Matrix Sequences

7:40 – 8:00 **Thomas Dunn, Bemidji State University**
Multiplicities and Integral Closure of Monomial Ideals

8:00 – 8:10 **Break**

Invited Lecture

8:10 – 9:00 **François Neville, Bemidji State University**
The Perceptron: Introducing Artificial Intelligence into the Developmental Math Classroom

9:00 – 10:00 **Reception** – David Park House

Saturday, October 24, 2015

8:15 – 11:00 **Registration** – Sattgast 248
8:15 – 11:00, 12:00-1:40 **Book Sales** – Sattgast 248

Morning Session – Sattgast 208, Eric Lund, Presiding

9:00 – 9:05 Welcome
Dr. Martin Tadlock, Provost and Vice President for Academic Affairs

Section NExT Invited Lecture

9:05 – 9:55 **Martha Gregg, Augustana University**
Promoting Success for Native American Students

9:55 – 10:10 **Break**

10:10 – 10:30 **Barry Cipra, Freelance Mathematics Writer**
The Sine LeWitt Puzzle

10:35 – 10:55 **Bill Schwalm,** Physics & Astrophysics, **University of North Dakota**
Electrical Engineering Applied to Organic Chemistry

Invited Lecture – Sattgast 208, Randy Westoff, Presiding

11:00 – 11:50 **Jason Rosenhouse, James Madison University**
The Monty Hall Problem, Reconsidered

12:00 – 1:00 **Luncheon** – Hobson Memorial Union, Crying Wolf Room

1:00 – 1:30 **Business Meeting** – Sattgast 208, Dr. Donna Flint, Section President Presiding

Afternoon Concurrent Session I Sattgast 203, Eric Lund, Presiding

1:35 – 1:55 **Elaheh Gorgin, Minot State University**
An Analysis of Multiplicative Regularization as a Parameter Choice Method

2:00 – 2:20 **Albert Schmitz,** Graduate Student, Department of Physics and Astrophysics, **University of North Dakota**
A Topological Space to Establish the Properties of Length-like Quantities

2:25 – 2:40 **Anne Sinko, College of St. Benedict and St. John's University,**
Miranda Bowie, University of North Alabama,
Louis Sewell, Northrop Grumman, University of Alabama-Huntsville
Set-sized Packing

Afternoon Concurrent Session II – Sattgast 205, Co Livingston, Presiding

1:35 – 1:55 **Jed Yang, University of Minnesota**
Tiling with Simple Tiles Can Be Hard

2:00 – 2:20 **Marshall Hampton, University of Minnesota-Duluth**
A Mystery of Tetrahedra

2:25 – 2:45 **Bret Benesh, College of St. Benedict and St. John's University**
Nim on Cayley Graphs of Dihedral Groups

2:50 – 3:00 **Short Break**

Afternoon Concurrent Session III Sattgast 203, Co Livingston, Presiding

3:00 – 3:20 **Mike Weimerskirch, University of Minnesota-Twin Cities**
Active Learning and Video 'Text'Books in PreCalculus

3:25 – 3:45 **John Hanenburg, Amateur Mathematician & Cost Estimator**
Determining the Optimum Velocity to Travel in the Rain in Order to Stay as Dry as Possible

Afternoon Concurrent Session IV – Sattgast 205, Randy Westoff, Presiding

3:00 – 3:20 **Namyong Lee, Minnesota State University-Mankato**
Big Data Analysis through the TDA Looking Glass

3:25 – 3:45 **Knute Thorsgard, MD, Sanford Health**
Negative *Celeritas*

Local Organizing Committee:
Co Livingston (Chair), Joe Washenberger (student), Randy Westoff, Eric Lund and Tom Dunn

Abstracts

Invited Addresses

- **Martha Gregg,** Augustana University
  Promoting Success for Native American Students

  In this talk, Dr. Gregg will describe a number of projects with which she has been involved which have particularly targeted Native American Students.

Bio: Martha Gregg joined Augustana University in 2008 and is currently Department Chair and Associate Professor. Her graduate studies – in Munich, Tucson, and Lincoln – were interspersed with nine years of teaching both at the secondary level, and as an adjunct instructor at the college level. She earned her PhD at University of Nebraska-Lincoln in 2008 and is a 2009 Project NExT Fellow. Project NExT has been a continual source of support and good ideas, including a contribution to one of the projects to be described in today's talk. Her first teaching position was at Tuba City High School, on the Navajo and Hopi reservations in Northern Arizona. The experience had a strong impact, and has informed her teaching style and philosophy, as well as many other aspects of her life, both personal and professional.

- **François Neville,** Bemidji State University
  The Perceptron: Introducing Artificial Intelligence into the Developmental Math Classroom

  The Perceptron model -- a simple and surprisingly effective technique -- has been used as a project in recent developmental math classes to illustrate the relevance of math in providing intuitive answers to everyday questions. This presentation demonstrates the basic mechanics of the model, its accessibility to developmental math students, and the teaching objectives that it fulfills.

Bio: François Neville received his doctorate in the interdisciplinary field of Spatial Information Science and Engineering at the University of Maine, with a focus on neural network models, and real-time approximation of sensor readings within natural environments. He has taught Computer Science and developmental math students, and the teaching objectives that it fulfills.

- **Jason Rosenhouse,** James Madison University
  The Monty Hall Problem, Reconsidered

  The Monty Hall problem is a classic brainteaser in probability. In its canonical form, it asks you to imagine that you are a game show contestant confronted with three doors. Behind one of the doors is a car, behind the other two are goats. Monty Hall, the host of the show, asks you to choose a door but not open it. After you make your choice, Monty then opens one of the remaining two doors, showing you that it contains a goat. He then gives you the options either of sticking with your original door, or switching to the one remaining option. You then win whatever is behind your final choice. What should you do, assuming you want to maximize your chances of winning the car? This problem routinely causes controversy, since the intuitively obvious answer turns out to be wrong. We shall discuss the mathematics underlying the problem, explain how to think clearly about problems in conditional probability, and discuss a series of increasingly complex variations on the basic scheme. The talk assumes very little mathematics and will be readily accessible to undergraduates.

Bio: Jason Rosenhouse is a professor of mathematics at James Madison University in Harrisonburg, VA. He recieved his PhD in 2000 from Dartmouth College, and his research focuses on algebraic graph theory. He is the author of two books: *The Monty Hall Problem: The Remarkable Story of Math's Most Contentious Brainteaser*, and *Among the Creationists: Dispatches from the Anti-Evolutionist Front Line*. With Laura Taalman he is the author of *Taking Sudoku Seriously: The Math Behind the World's Most Popular Pencil Puzzle*. All three books were published by Oxford University Press. He is also the editor of *Four Lives: A Celebration of Raymond Smullyan*, published by Dover. With Jennifer Beineke, he is the editor of *The Mathematics of Various Entertaining Subjects: Research in Recreational Math*, forthcoming from Princeton University Press. When not doing math he enjoys chess, cooking, and reading locked-room mysteries.

Contributed Talks

- **Bret Benesh,** College of St. Benedict and St. John's University
  Nim on Cayley Graphs of Dihedral Groups

We define a two-player Nim-like game on a directed graph as follows. Put some number of stones on each vertex of the graph and designate a starting vertex. One player removes some positive number of stones from the starting vertex and moves along a directed edge. The game repeats in this manner until a player must try to remove stones from a vertex with zero stones, indicating that that player loses.

I will describe joint work with Marie Meyer on the winning strategies for all games played on planar Cayley graphs of dihedral groups.

- **James Carr,** Normandale Community College
  Restructuring a Developmental Math Program: A Three Stage Process

An account of Normandale Community College's very successful restructuring of our developmental math program. This includes changing to ALEKS as the delivery tool, a novel course structure which addresses all of the problems developmental programs encounter, and some data on the success of the program so far. Normandale has approximately 3000 developmental math students a year and is now enjoying a dramatic improvement in content mastery, retention, and completion times. This could be the new paradigm for developmental math.

- **Barry Cipra,** Freelance Mathematics Writer
  The Sine LeWitt Puzzle

Some years ago the speaker created a mathematical puzzle based on a work of art by Sol LeWitt, the solutions to which have a surprising property. I'll describe this puzzle and present a brand new variant that uses sine waves instead of straight lines. The solutions of the new puzzle may or may not have any surprising properties.

- **Thomas Dunn,** Bemidji State University
  Multiplicities and Integral Closure of Monomial Ideals

We will present an overview of the relationship between Hilbert-Samuel multiplicity, j-multiplicity, and the Achilles-Manaresi multiplicity sequence and their relationship with integral closure in the context of monomial ideals in a polynomial ring. We will present these ideas visually using a staircase diagram and demonstrate how to calculate most of the various multiplicities as an area or volume.

- **Elaheh Gorgin,** Minot State University
  An Analysis of Multiplicative Regularization as a Parameter Choice Method

Tikhonov regularization is one of the most popular methods for solving linear inverse problems. This method needs a regularization parameter and the quality of a good approximated solution depends on how good the regularization parameter is. Multiplicative regularization is a new regularization method, however it turns out that this method can be regarded as defining a parameter choice rule for the Tikhonov regularization method. We demonstrate numerically that this method is guaranteed to define a convenient regularization parameter under some conditions. Computationally, this method is not expensive and is easier to analyze compared to the other parameter choice methods such as the L-curve method.

- **Marshall Hampton,** University of Minnesota-Duluth
  A Mystery of Tetrahedra

How are the angles of a polyhedron related to one another? This general question has been somewhat neglected, and even in the case of tetrahedra the answer is not very simple. An identity will be discussed whose geometric interpretation is still unclear.

- **John Hanenburg,** Amateur Mathematician & Cost Estimator
  Determining the Optimum Velocity to Travel in the Rain in Order to Stay as Dry as Possible

In this presentation, I will present a solution to this problem removing the constraint that the rain is not allowed to stop and restart, the density and velocity of the rain are constant, and the direction and velocity of the wind also constant. When all these variables are constant, then the solution is relatively straight forward, even in three dimensions. Adding these variables makes solution fairly challenging because, in most cases, the equation for the amount of rain water encountered, given your velocity, will not be continuously differentiable.

- **Namyong Lee,** Minnesota State University-Mankato
  Big Data Analysis through the TDA Looking Glass

"Big Data" is everywhere and is rapidly creeping into every part of our life. As "Big Data" is often complex and has too many features, it has many challenges in analysis. We introduce basic idea of TDA (Topological Data Analysis) and its' advantage in visual analysis compare other analysis. A few concrete examples will be given including microarray cancer data analysis.

- **Issac Odegard,** Graduate Student, University of North Dakota
  The Quadratic Irrationals and Ducci Matrix Sequences

The Ducci map is defined by taking a vector $[v_1, \dots, v_n]^T \in \mathbb{R}^n$ to $[|v_1 - v_2|, \dots, |v_n - v_1|]^T$. We establish a connection between the sequences of matrices associated with the action of the Ducci map, continued fraction representations of the real numbers, and the Stern-Brocot tree. A Ducci number system arises with essentially three types of matrix sequences corresponding to the rationals, the quadratic irrationals, and to all other real numbers. This mirrors the situation for continued fraction representations of the reals. It follows that this map on $\mathbb{R}^3$ is closely connected to the Euclidean algorithm and, through its action, locates best rational approximations to irrationals.

- **Albert Schmitz,** Graduate Student, Department of Physics and Astrophysics, University of North Dakota

  A Topological Space to Establish the Properties of Length-like Quantities

In empirical measurement, one assigns a positive, real numbers to quantities such as length, time, or mass. This mapping is given as the ratio of the measured quantity to some standard quantity, though the process of doing so is not rigorously defined. This talk discusses a set of axioms that imply order, density and completeness, which are necessary for measuring uncountable quantities. The sets used to establish these axioms form a topological space. Furthermore, one space induces another satisfying the axioms. This second space is interpreted as the inverse quantity such as inverse length, inverse time, or inverse mass.

- **Anne Sinko,** College of St. Benedict and St. John's University, Miranda Bowie, University of North Alabama, Louis Sewell, Northrop Grumman, University of Alabama-Huntsville

  Set-sized Packing

The packing number of a graph, $\rho(G)$, is defined to be $\max\{|S|: S \subseteq V(G)\ and\ |N[v] \cap S| \leq 1$ for each $v \in V(G)\}$. In other words, for each vertex, there is a restriction on the number of vertices in the packing set that are within that vertex's closed neighborhood. Set-sized packing extends the notion of packing beyond restrictions for individual vertices to collections of vertices. The set-sized packing number $\rho_{X(c_1,c_2,\ldots,c_k,\ldots)}(G)$ is the maximum cardinality of a set $S \subseteq V(G)$ such that, for each set of k vertices, there are no more than c_k vertices of S in the union of their closed neighborhoods. An introduction to set-sized packing will be discussed along with preliminary results.

- **Bill Schwalm,** Physics & Astrophysics, University of North Dakota

  Electrical Engineering Applied to Organic Chemistry

At one time linear analysis was considered central to control theory in engineering. In Laplace transform domain, systems of linear DEs become linear algebra. There is a graphical method of handling these algebraic systems based on the Mason Gain rules (approximately Sach's theorem). The systems become directed graphs and the problems or solutions pertain to walks on the graphs. Meanwhile, in organic chemistry, graph models predict some electronic properties of planar molecules. There the graphs are stick pictures of the molecules. The talk connects these ideas and outlines a proof of the main theorem.

- **Knute Thorsgard, MD,**

  Negative *Celeritas*

A negative squared equals the positive squared. $E = MC^2$ is an excellent description of what will be seen, but $E = MC^2$ is incomplete. $E = MC^2 = M(-C)^2$. Does $-C$ have intrinsic meaning? If $-C$ does not have intrinsic meaning, can it, like longitude, be assigned meaning? $-C$ would require the universe to have a center. In and of itself, does interferometry exclude a center?

- **Mike Weimerskirch,** University of Minnesota-Twin Cities

  Active Learning and Video 'Text'books in PreCalculus

The University of Minnesota has updated its PreCalculus courses, using active learning classrooms, open source videos and textbooks, and a WolframAlpha based homework system. This talk will report on the effect this program has had on student learning, and future spin-offs of the project, including a revised placement system, credit by exam and an expansion to calculus courses. Similar projects at other institutions will be discussed.

- **Jed Yang,** University of Minnesota
  Tiling with Simple Tiles Can Be Hard

Is a region tileable by a collection of tiles? That is, can tiles be placed in a region so that the tiles do not overlap nor leave parts of the region uncovered? Answering this is (computationally) hard in the finite case and undecidable in the infinite case. Moreover, these tileability problems are quite sensitive to the tiles or types of regions being considered. For example, there is an efficient (polynomial time) algorithm for testing tileability by dominoes, whereas testing tileability by trominoes is NP-complete. In this talk, we explore tiling problems that seem very similar but exhibit vastly different behaviours.

NCS MAA Spring 2016 Meeting: April 15-16, 2016 at Macalester College

NCS MAA Fall 2016 Meeting: TBD at University of Minnesota-Minneapolis

Section Website: http://sections.maa.org/northcen/