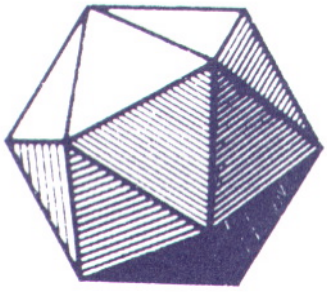
North Central Section

Mathematical Association of America



Spring Meeting • March 26-27, 2021
Virtual Meeting

Friday, March 26, 2021

Contributed Session I – Presiding: Megan Breit-Goodwin

7:00 – 7:20 **Travis Peters, College of Saint Benedict & Saint John's University, Ryan Munter, Saint John's University**
Lights Out on Graph Products over the Ring of Integers Modulo *k*

7:20 – 7:40 **John Starway, NCMA, ADRIM Canada and ARA of Arts and Sciences**
The Crossmultiplication in Studying History and Potential Crimes

7:40 – 8:00 **James Sellers, University of Minnesota Duluth**
Relating the Crank of a Partition and Smallest Missing Parts

Invited Lecture I – Presiding: John Zobitz; Moderator: Megan Breit-Goodwin

8:05 – 8:10 **Welcome**: John Zobitz

8:10 – 9:00 **Dominic Klyve, Central Washington University**
Mathematical Fights! The Seedy Underbelly of Mathematical History

Saturday, March 27, 2021

Invited Lecture II – Presiding: Aaron Wangberg; Moderator: John Zobitz

9:00 – 9:50 **Jesse Berwald, Quantum Computing, Inc.**
Quantum Computing: A Brief Tour with Mathematical Highlights

Contributed Session IIa – Presiding: Aaron Wangberg

10:00 – 10:20 **Xinli Wang, University of Manitoba**
Inclusive Course Design of an Online Second Year Math Course

10:20 – 10:40 **Thomas Q. Sibley, College of Saint Benedict & Saint John's University**
The Probability of Generating a Group

10:40 – 11:00 **Dale Buske, St. Cloud State University**
Opening Doors Via MyOpenMath

Contributed Session IIb – Presiding: Jonathan Rogness

10:00 – 10:20 **Delanna Do, University of Minnesota Twin Cities** (undergraduate)
Generating SpotIt! Decks from Mutually Orthogonal Latin Squares

10:20 – 10:40 **Patrick Gallagher, University of Minnesota Twin Cities** (undergraduate),
Sasha Hydrie, University of Minnesota Twin Cities (undergraduate),
Jason Wang, University of Minnesota Twin Cities (undergraduate),
Alexis Johnson, University of Minnesota Twin Cities
Using Voter Precinct Data to Create a Partisan Gerrymandering Detection Metric

Contributed Session III – Presiding: Jeremiah Bartz

11:00 – 11:20 **Jeremiah Bartz, University of North Dakota**
Good Things Come in Threes

11:20 – 11:40 **Sunil Chetty, College of Saint Benedict & Saint John's University**
Primitive Pythagorean Triples of Special Form

11:40 – 12:00 **Daniel Perry, Augustana University**
Lipschitz Homotopy Groups of Contact 3-Manifolds

12:00 – 12:50 **Business Meeting** – Presiding: John Zobitz, Section President

Invited Lecture III – Presiding: John Zobitz; Moderator: Donna Flint

1:00 – 1:50 **Tim Chartier, Davidson College**
Mathematical Celebrity Look-Alikes

Abstracts

Invited Addresses

Jesse Berwald, Quantum Computing, Inc.

Quantum Computing: A Brief Tour with Mathematical Highlights

The race is on to build a quantum computer that provides a clear advantage over classical computers. A quantum computer is a specialized device that leverages the properties of quantum mechanics for computational purposes. Much of the noise surrounding quantum computing can seem like hype, but the achievements are solidly real and the devices steadily improve. Amidst the physical hardware challenges there are many deep and exciting mathematical avenues to explore. This tour will give a high-level overview of the field from a mathematical perspective.

Tim Chartier, Davidson College

Mathematical Celebrity Look-Alikes

Have you ever wondered what celebrities you look like? This talk develops a mathematical answer to this question from a group of celebrity photos. Vector norms enable us to discern what celebrity looks most like a selected individual. Then, we broaden the question to explore what linear combination of celebrity photos best approximates a selected photo. Would you describe yourself as a cross between Dwayne Johnson and Ryan Reynolds? maybe Halle Berry and Lucy Liu? or possibly Jennifer Lopez and Nicole Kidman? In this talk, we learn how to answer this question using mathematical methods from undergraduate linear algebra classes.

Dominic Klyve, Central Washington University

Mathematical Fights! The Seedy Underbelly of Mathematical History

Although students are often led to believe that mathematics is a purely rational, unemotional, and orderly field of study, history shows that this is often not the case. This talk will discuss some of the greatest fights in the history of mathematics. We will hear stories of friendships destroyed and national rivalries heightened because of disagreements about underlying mathematics. We will consider what these fights teach us about the nature of mathematics, and we will learn some interesting math on the way.

Contributed Talks

Jeremiah Bartz, University of North Dakota

Good Things Come in Threes

A common saying is that good things come in threes. In 1934, B. Berggren may have agreed when unearthing the three matrices which generate a ternary tree of all primitive Pythagorean triples from the initial triple $(3,4,5)$. We show that a similar structure exists when replacing primitive Pythagorean triples with triangular triples. The construction of both ternary trees are intertwined, involving Berggren's three matrices and a third ternary tree. Perhaps good things really do come in threes!

Dale Buske, St. Cloud State University

Opening Doors Via MyOpenMath

After spending several years in an administrative role, the speaker returned as a remarkably different person to a remarkably different classroom on March 30, 2020. One significant change made was the adoption of Open Educational Resources (OER's). One particular resource, the electronic homework system MyOpenMath, proved to be of great value over the last year. This talk will present an overview of two semesters of experience with the platform and the new learning and assessment opportunities it affords for those that may be interested in this path.

Sunil Chetty, College of Saint Benedict & Saint John's University

Primitive Pythagorean Triples of Special Form

We explore primitive Pythagorean triples of special forms $(a, b, b + g)$ and $(a, a + f, c)$, with g and f positive integers. For each g and f, we will describe how to generate an infinitely family of the relevant form. We will also describe the asymptotic density of primitive $(a, b, b + g)$ triples within all primitive triples.

Delanna Do, University of Minnesota Twin Cities

Generating SpotIt! Decks from Mutually Orthogonal Latin Squares

SpotIt! decks consist of cards with the same number of pictures. For any two cards in the deck, there is exactly one picture on both cards. Sets of mutually orthogonal Latin squares (MOLS) are sets of square matrices satisfying a certain set of properties. There exist well-known bijections between (MOLS and finite projective planes (FPP)) and (FPP to *SpotIt!* decks). In this presentation, we will explore a direct bijection between MOLS and *SpotIt!* decks.

Patrick Gallagher, University of Minnesota Twin Cities,
Sasha Hydrie, University of Minnesota Twin Cities,
Jason Wang, University of Minnesota Twin Cities
Alexis Johnson, University of Minnesota Twin Cities

Using Voter Precinct Data to Create a Partisan Gerrymandering Detection Metric

Gerrymandering is the intentional drawing of election districts to provide particular voter groups an unfair advantage. Most existing metrics that attempt to quantify gerrymandering use either map metrics or election outcome data, both of which have inherent shortcomings on their own. We developed two gerrymandering metrics that use both the geometry and election outcome data from precincts within and surrounding a given district. We apply our metric to results from the 2018 U.S. midterms in Minnesota and compare them to results obtained using other metrics. We present examples that show how our metric resolves some of the issues that linger in other gerrymandering metrics and address potential flaws with our metric.

Daniel Perry, Augustana University

Lipschitz Homotopy Groups of Contact 3-Manifolds

Contact 3-manifolds are introduced and studied using the techniques of sub-Riemannian geometry and geometric measure theory, in particular establishing properties of their Lipschitz homotopy groups. Of note with this metric space approach is a biLipschitz version of the Theorem of Darboux: a contact $(2n+1)$-manifold endowed with a sub-Riemannian structure is locally biLipschitz equivalent to the Heisenberg group H^n with its Carnot-Carathéodory metric. It follows that any contact 3-manifold endowed with this metric is purely 2-unrectifiable. This metric quality is used to show that the first Lipschitz homotopy group of a contact 3-manifold is uncountably generated while all higher Lipschitz homotopy groups are trivial.

Travis Peters, College of Saint Benedict & Saint John's University,
Ryan Munter, College of Saint Benedict & Saint John's University

Lights Out on Graph Products Over the Ring of Integers Modulo k

Lights Out is a game played on a finite, simple graph. The vertices of the graph are the lights, which may be on or off, and the edges of the graph determine how neighboring vertices turn on or off when a vertex is pressed. Given an initial configuration of vertices that are on, the object of the game is to turn all the lights out. The traditional game is played over Z_2, where the vertices are either lit or unlit, but the game can be generalized to Z_k where the lights have different colors. Previously, the game was investigated on Cartesian product graphs over Z_2. We extend this work to Z_k and investigate two other fundamental graph products, the direct (or tensor) product and the strong product. We provide conditions for which the direct product graph and the strong product graph are solvable based on the factor graphs, and we do so using both open and closed neighborhood switching over Z_k.

James Sellers, University of Minnesota Duluth

Relating the Crank of a Partition and Smallest Missing Parts

The primary goal of this talk is to demonstrate a natural connection between the smallest missing part of an integer partition and the concept of the crank of a partition. After providing a brief history of the crank of a partition a la Dyson as well as Andrews and Garvan, we will utilize straightforward generating function manipulations to make this connection. We close by strengthening a result of Yuefei Shen comparing the number of partitions with smallest missing part odd and those with smallest missing part even. This is joint work with Brian Hopkins.

Thomas Q. Sibley, College of Saint Benedict & Saint John's University

The Probability of Generating a Group

Six of my students have investigated the probability that two random elements of a group generate it for various groups. This builds on Euler's phi function, which leads to the probability that a random element of a finite cyclic group generates the group. I will describe my students work and results. I hope to inspire others to continue this accessible area of undergraduate research.

John Starway, NCMA, ADRIM Canada and ARA of Arts and Sciences

The Cross Multiplication in Studying History and Potential Crimes

The paper presents a modification of cross multiplication rule for the purpose of studying the history and criminal actions that occurred in past.

Xinli Wang, University of Manitoba

Inclusive Course Design for an Online Second Year Math Course

My teaching focus has shifted to building a learning community since the pandemic started in 2020 March. I believe being able to connect with students and offering them the space and opportunity to work with each other is more important than the actual content covered for a course. In this talk, I will share inclusive course design ideas that focus on community building in an online 2nd year multivariable calculus course. These ideas stem from principles of universal design for learning, which not only helped making the course more accessible, but they also make it possible for students to build a caring learning community which they all benefit from.