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Abstracts

William Adkins, Emily Arndt, Cameron Curtis and Alex Paoletti GVSU, (Undergraduate Students)

Composition Properties of Polycubes

Polycubes are connected figures in space formed by joining unit cubes face to face. For some polycubes A and B, if B can be made of multiple copies of A, then A is said to divide B. A prime polycube is one that has no divisors except itself and the unit cube. A composite polycube is one that is non-prime. We will investigate properties of prime and composite polycubes and methods of determining primality or finding divisors for composite polycubes.

Saturday, 8:30–8:43 am **Seminar Room F**

William Adkins, Graham Boonstra and Ava Thomson GVSU, (Undergraduate Students)

Classification of the Seven-Dimensional solvable Lie algebras with $A_{4,1} \oplus \mathbb{R}$.

In this talk, we will give an overview of the classification problem of the seven-dimensional solvable Lie algebra. We highlight our contribution to the classification problem where the nilradical is isomorphic to $A_{4,1} \oplus \mathbb{R}$.

Saturday, 8:45–8:58 am **Seminar Room F**

Simran Adnani The Roeper School, (High School Student)

No Odd Perfect Squares Are Perfect Numbers

"Take an odd perfect square A. There will be several factor pairs. By the definition of a perfect number, omit A from the numbers to be added up. However, since A is a perfect square, there will be two $\sqrt{A}$'s in the factor tree. By the definition of a perfect number, omit one of these from the numbers to be added. There will be an even number of odd numbers to add up left, since two from the pairs were omitted, which will sum to an even number. Since A is odd, this number cannot equal A.

Saturday, 9:15–9:28 am **Seminar Room F**

Feryal Alayont Grand Valley State University, (Faculty)

Ethical Reasoning in Differential Equations Modeling Problems

Introductory differential equations courses contain many modeling problems, ranging from simple growth models to sophisticated systems. However, the way we teach these problems often ignores the messy, real-world aspects of the modeling process. We frequently omit the critical steps of evaluating simplifying assumptions, identifying impacted stakeholders, and recognizing sources of error (beyond the typical discussion of numerical methods). In this talk, I will share practical ways to integrate these ethical considerations into a differential equations course. These small additions do not require significant class time but are essential for preparing students to be responsible practitioners who understand the real-world consequences of their mathematical decisions.

Saturday, 9:00 – 9:25 am **Seminar Room E**

David Austin Grand Valley State University, (Invited Speaker)

Creating accessible mathematical documents

Recent federal mandates require that university faculty provide course materials and other documents only in accessible formats. While we have yet to hear much about this in Michigan, other states are taking this seriously, and it's probably only a matter of time before it becomes a requirement here. Which means we have time to prepare and perhaps to see this change as an opportunity. It is often said that attention to accessibility creates a better experience for everyone. This talk will introduce and demonstrate some authoring tools for creating accessible mathematical documents, including diagrams, and we'll learn about some opportunities to improve the experience of all our readers.

Saturday, 10:05-10:40 am **Banquet Room A**

Arundhati Bagchi Misra US Coast Guard Academy, (Retired)

Deep Learning techniques for image denoising with various noise types

This project explores deep learning based denoising models for color images corrupted by multiple noise types. Neural network (NN) architectures have recently demonstrated strong performance in image noise removal. Earlier, we developed two models for grayscale image denoising: an Artificial Neural Network (ANN) and a Convolutional Neural Network (CNN). Both models were extended to handle color images. Unlike grayscale images, which are represented as two-dimensional matrices, color images are three-dimensional, with the third dimension corresponding to the RGB channels. We separated these channels, applied our grayscale denoising techniques independently to each, and then recombined them. Noise-free images were used to generate training and testing datasets by adding random noises. Model performances were evaluated using Peak Signal-to-Noise Ratio (PSNR) and Mean Squared Error (MSE), where higher PSNR and lower MSE indicate superior denoising quality.

Saturday, 4:20–4:45 pm **Seminar Room D**

Jaben Bakker Aquinas College, (Undergraduate Student)

Dynamic Programming in a Classic Game

This presentation analyzes a classic game called Shut the Box and the methodology used to determine the best winning strategy. The primary method used was memoization, a dynamic programming technique that recursively checks each game state and all subsequent game states to calculate the overall winning strategy at each game position. The result of each "sub-game state" is stored during recursion so it can be retrieved from memory next time it is encountered. Two other methods used were experimental sampling and machine learning.

Saturday, 10:00–10:13 am **Seminar Room F**

Steven Butler Iowa State University, (Polya Award Winner)

Every Game I'm Shufflin', Shufflin'

Shuffling is a well-known aspect of gameplay to help make the decks "sufficiently random" to make the game interesting. Shuffling is also a source of mathematical exploration where shuffles are thought of as permutations of the cards. In this talk, we will take some tools of mathematics, modular arithmetic, and binary numbers, and show how we can apply these to shuffling, and in particular, some simple-to-learn mathematically-based card tricks, which will be performed live. Along the way, we will also learn why we should never work with jokers.

Friday, 7:00–8:00 pm **Banquet Room B**

Micah Dykhuis and Sydney Lipton GVSU, (Undergraduate Students)

Hypercups: What if cups had more than three sides?

There is a trick played on naive people: there are three cups that are flipped two at a time until all three cups are upside down. The trick is that this is only possible with certain starting configurations. A paper by Siu and Stewart shows when it is possible to invert n cups m at a time, and how many moves it takes. But what if the cups had arbitrary k sides? We call these hypercups. We investigate how to invert all n of the $k$ypercups with k states by rotating m at a time.

Saturday, 9:45–9:58 am **Seminar Room F**

Stephanie Edwards Hope College, (Faculty)

Generalized Kempner Series and the Harmonic Series

The Kempner series is created by deleting specific terms from the Harmonic series. In particular, $K(9)$ deletes any term with a 9 appearing in it, i.e., $K(9) = 1+1/2+\cdots+1/8+1/10+\cdots+1/18+1/20+\cdots$. While the harmonic series diverges, the Kempner series converge. In fact, if one deletes all instances of a given string - say "23", the series still converges! We explore the proofs of these facts and some more recent and surprising results which have their roots in both the Harmonic and Kempner series.

Saturday, 8:30 – 8:55 am **Seminar Room E**

Joe Fox Aquinas College, (Faculty)

Characters of the Nullcone Related to Vinberg Groups

In the 1970s, E.B. Vinberg and his colleagues initiated the study of graded Lie algebras and associated groups, now known as Vinberg groups. These arise from automorphisms of reductive algebraic groups and their Lie algebras. In this talk, we discuss a character formula for certain representations of Vinberg groups which are related to nilpotent elements in graded Lie algebras. We will apply these results to representations of the special linear group on nilpotent trivectors using the software Sage. These results will be partially extended to groups defined over fields of positive characteristic.

Saturday, 8:30–8:55 am **Seminar Room D**

Hitesh Gakhar Michigan State University, (Faculty)

Teaching Matrix Algebra with Computational Applications

This talk presents the design of a matrix algebra course that integrates computation into a four-part learning cycle combining lecture, after-class assignments, guided in-class collaborative work, and periodic synthesis tasks. Our goal is to help students learn linear algebra both conceptually and computationally by emphasizing conceptual grounding before computation. Each class includes structured lecture and active-learning components that balance handwritten reasoning with computational exploration. We discuss the principles behind this design and reflect on how instructional sequencing supports both rigor and accessibility in linear algebra.

Saturday, 2:15–2:40 pm **Seminar Room D**

Connor Goka and Andrew Moore SVSU, (Undergraduate Students) POSTER

Investigating Students' Attitudes Toward Math in a Developmental Math Course

When the Numerical Literacy course was designed and piloted, pre/post survey data from three semesters of students about their attitudes and perceptions of math were collected using the Mathematical Attitudes and Perceptions Survey (MAPS). For this project, we investigate this data set, alongside student grades in Numerical Literacy, as well as their performance in subsequent (general education) classes.

Saturday, 11:45 am – 12:30 pm **Banquet Room B**

Olivier Heubo-Kwegna Saginaw Valley State University, (**Invited Speaker**)

MV-Algebras: A Ring Theoretic Approach

The availability of ideals, prime (maximal) ideals in MV-algebras prompt us to transport some ring notions into the MV-algebra context. In this talk, we focus on the notion of radically principal ideal which is an ideal for which its radical is the radical of some principal ideal. We provide some characterizations of radically principal MV-algebras as well as some classes of examples. We also discuss Radically principal MV-algebras from the perspective of lattice-ordered groups.

Friday, 4:30–5:00 pm **Seminar Rooms D-E-F**

Zach Hirsch, Andrew Kurmas, Isaac Root and Karam Singh GVSU, (Undergraduate Students)

Division Patterns of One-Sided Polyominoes

Polyominoes are connected plane figures formed by joining unit squares edge to edge. A polyomino P is said to divide a polyomino Q if Q can be assembled from copies of P. One-sided polyominoes are a classification where two polyominoes are only considered identical if one is a rotation of the other. In particular, we disallow reflections. We will investigate how introducing this constraint impacts polyomino divisibility and patterns that emerge.

Saturday, 9:30–9:43 am **Seminar Room F**

Kohl James Saginaw Valley State University, (Faculty)

Preconditioning for Fully-Implicit Runge-Kutta Methods

Preconditioning methods are used to enhance performance of numerical methods for solving systems of linear equations. Implicit Runge-Kutta (IRK) methods are a class of time-stepping methods used to approximate solutions to systems of differential equations. These methods produce very large systems of linear equations that are poorly-suited for most linear algebra solvers. This work adapts existing preconditioners for the linear systems that arise from applying IRK methods to linear steady-state parabolic PDEs to work on linear time-dependent and fully nonlinear parabolic PDEs.

Saturday, 9:30–9:55 am **Seminar Room D**

Yeonhyang Kim Central Michigan University, (Faculty)

Dual Frame Completion

This work addresses the dual frame completion problem in finite-dimensional Hilbert spaces. We investigate a fundamental question: given a fixed frame F and a partial set of vectors H, does there exist a dual frame G for F that completes the set H?. This research provides both theoretical conditions for the existence of such completions and practical methods for their construction, offering a more general framework for signal reconstruction than existing "bridging" methods used in data erasure scenarios.

Saturday, 3:50–4:15 pm **Seminar Room D**

Grace McClurkin Saginaw Valley State University, (Invited Speaker)

So, I tried a new thing in class...

In this talk, I will discuss small changes that I have tried in a variety of classes, from developmental math to upper-level courses, to support student engagement, build confidence, and create deeper opportunities for learning.

Saturday, 10:45 am–11:20 am **Banquet Room A**

Michail Paparizos Michigan State University, (Faculty)

Intentional Technology Integration in Matrix Algebra

As computational tools become increasingly embedded in mathematics education, instructors face a design challenge: how to use technology to deepen understanding without allowing computation to replace mathematical reasoning. In Matrix Algebra with Computational Applications (MTH 314), we approach this challenge through intentional design of computational activities that reinforce conceptual ideas in linear algebra. This talk highlights several examples of structured in-class computational tasks and how these activities, paired with conceptual prompts and reflective assessment design, encourage students to engage actively with the mathematics while developing computational fluency.

Saturday, 2:45–3:10 pm **Seminar Room D**

Isaac Reinhardt SVSU, (Undergraduate Student)

On Algebraic Reflexivity of Matrix Subspaces

Let $\mathcal{S}$ be a subset of the $m \times n$ matrices over a real or complex field $\mathbb{F}$. A local member of $\mathcal{S}$ is a matrix T such that for all $\mathbf{x} \in \mathbb{F}^n$, there exists a matrix $S \in \mathcal{S}$ such that $T\mathbf{x} = S\mathbf{x}$, and $\mathcal{S}$ is said to be algebraically reflexive if every local member of $\mathcal{S}$ belongs to $\mathcal{S}$. In this talk, we characterize the algebraic reflexivity of affine subspaces of the $m \times n$ matrices and show how this result can be applied to locate the low-rank matrices in a subspace. These ideas will be illustrated through simple examples.

Saturday, 9:00–9:13 am **Seminar Room F**

Christopher St Clair Saginaw Valley State University, (Faculty)

Computations of Grid Homology

We explore the algorithm for computing the grid homology of knots and links, detailing how to adapt it into a program that computes the infinity flavor of the invariant. This is in the context of knot theory, where finding and understanding invariants is key. Grid homology serves as a tedious but more computable version of Knot Floer homology which has proven to be a powerful invariant.

Saturday, 9:00–9:25 am **Seminar Room D**

Steven Tuckey Jackson College, (Invited Speaker)

When Shortcuts Become Short-Circuits: Navigating AI in the Math Class

To many students, AI tools like ChatGPT or Symbolab seem like convenient shortcuts through difficult math problems. But when they are used uncritically, these tools can short-circuit the perseverant reasoning and reflection that are necessary for real understanding and growth. In this session, we'll examine how over reliance on AI can mask gaps in understanding, weaken problem-solving resilience, and erode conceptual fluency. Through guided discussion and examples, we'll examine ways to help students recognize when a shortcut becomes a barrier, and how to reframe AI as a support for persistent curiosity, reflection, explanation, and reasoning (rather than a substitute for them).

Friday, 5:00–5:30 pm **Seminar Room D-E-F**

Cynthia Wyels California State University Channel Islands, (Faculty)

Data Science for and by Pure Mathematicians

Consider the skills and habits of mind developed through studying pure mathematics. These – and some basic statistical techniques – are enough to address some questions of interest given a small data set. With a larger investment of time for individual learning, a healthy dose of humility, and perhaps some collaborators, people whose preparation focused on pure mathematics can produce data-based studies of interest to many audiences. Join me for a story involving a years-long transition, a cast of dozens, some alluring marine megafauna and much serendipity as I argue for the value of all types of research for and by all types of researchers.

Saturday, 1:00–1:55 pm **Banquet Room A**