Mathfest 2004
Providence, RI

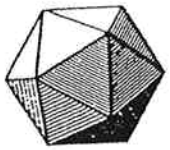
MAA and Pi Mu Epsilon
Student Paper Sessions
August 12–13, 2004

PI MU EPSILON

Pi Mu Epsilon is a national mathematics honor society with over 300 chapters throughout the nation. Established in 1914, Pi Mu Epsilon is a non-secret organization whose purpose is the promotion of scholarly activity in mathematics among students in academic institutions and among staffs of qualified non-academic institutions. It seeks to do this by electing members on an honorary basis according to their proficiency in mathematics and by engaging in activities designed to provide for the mathematical and scholarly development of its members.

Pi Mu Epsilon regularly engages students in scholarly activity through its *Journal* which has published student and faculty articles since 1949. In addition, the society awards monetary prizes for mathematics contests and awards established by chapters.

Since 1952, Pi Mu Epsilon has been holding its annual National Meeting in conjunction with the summer meetings of the Mathematical Association of America (MAA).



MAA Student Chapters

The MAA Student Chapters program was launched in January 1989 to encourage students to continue study in the mathematical sciences, provide opportunities to meet with other students interested in mathematics at national meetings, and provide career information in the mathematical sciences. The primary criterion for membership in an MAA Student Chapter is "interest in the mathematical sciences." Thus, the Student Chapter program supplements, but does not compete with, the chapters of Pi Mu Epsilon. Currently there are approximately 225 active Student Chapters on college and university campuses nationwide. Students are also members of the MAA Sections in their geographic region. Many of the MAA Sections provide special activities for students at their regularly scheduled meetings.

Student Activities
Schedule of Events
All events will be held in the Rhode Island Convention Center (RICC) and the Westin Hotel

Wednesday, August 11

5:30 pm - 6:30 pm	MAA/PME Student Reception	Rotunda, RICC

Thursday, August 12

8:00 am - 11:30 am	PME Council Meeting	Executive Boardroom, Westin
9:00 am - 5:00 pm	Student Hospitality Center	Ballroom A, RICC
1:00 pm - 2:55 pm	MAA Session #1	Bristol Room, Westin
1:00 pm - 2:55 pm	PME Session #1	Newport Room, Westin
1:00 pm - 2:55 pm	MAA Session #2	Kent Room, Westin
1:00 pm - 2:55 pm	PME Session #2	Washington Room,Westin
3:00 pm - 4:55 pm	MAA Session #3	Bristol Room,Westin
3:00 pm - 4:55 pm	PME Session #3	Newport Room, Westin
3:00 pm - 4:55 pm	MAA Session #4	Kent Room, Westin
3:00 pm - 4:55 pm	PME Session #4	Washington Room, Westin
5:00 pm - 5:50 pm	MAA Modeling Contest Winners	Bristol Room, Westin

Friday, August 13

8:00 am - 11:30 am	PME Council Meeting	Executive Boardroom, Westin
9:00 am - 5:00 pm	Student Hospitality Center	Ballroom A, RICC
1:00 pm - 2:55 pm	MAA Session #5	Bristol Room, Westin
1:00 pm - 2:55 pm	PME Session #5	Newport Room, Westin
1:00 pm - 2:55 pm	MAA Session #6	Kent Room, Westin
1:00 pm - 2:55 pm	PME Session #6	Washington Room,Westin
3:00 pm - 5:35 pm	MAA Session #7	Bristol Room,Westin
3:00 pm - 4:55 pm	PME Session #7	Newport Room,Westin
3:00 pm - 5:35 pm	MAA Session #8	Kent Room, Westin
3:00 pm - 4:55 pm	PME Session #8	Washington Room, Westin
6:00 pm - 7:45 pm	PME Banquet	Waterplace Ballroom, Westin
8:00 pm - 9:00 pm	J. Suthlerland Frame Lecture **Joan P. Hutchinson,** Macalester College *When Five Colors Suffice*	Narragansett Ballroom,Westin

Saturday, August 14

9:00 am - 3:00 pm	Student Hospitality Center	Ballroom A, RICC
1:00 pm - 2:50 pm	MAA Student Workshop **Benoit Mandelbrot** *Topics in Fractal Geometry*	RICC 557
3:00 pm - 3:50 pm	MAA Student Lecture **Mario Martelli**, Claremont-McKenna College *The Secret of Brunelleschi's Cupola*	RICC 557
4:00 pm - 4:30 pm	MAA Special Session on *Math Horizons* **Arthur T. Benjamin**, Harvey Mudd College **Jennifer J. Quinn**, Occidental College	RICC 557
4:45 pm - 5:45 pm	Student Problem Solving Competition	RICC 557

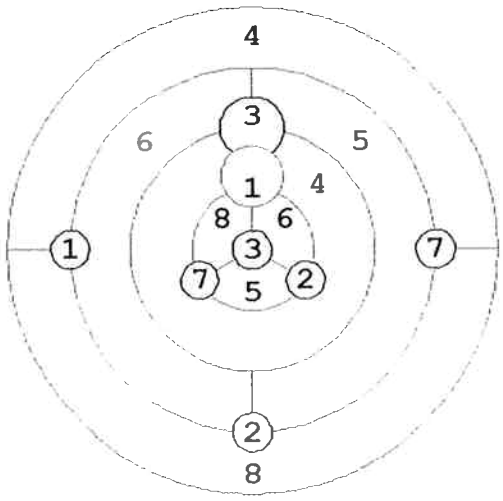
J. Sutherland Frame Lecture

Friday, August 13, 2004
8:00 - 9:00 pm
Narragansett Ballroom, Westin Hotel

When Five Colors Suffice

Joan P. Hutchinson
Macalester College

The challenging four-color conjecture, posed in 1852, asks whether four colors are enough to color the regions of any map so that two regions that share a boundary receive different colors. In 1976 K. Appel and W. Haken proved that "four colors suffice." With some changes to the problem, four colors may no longer be enough. We discuss these variations in which five, not four, colors suffice.



How many colors are needed to color this map? Each country consists of two connected regions, with the two regions numbered the same. Both regions of a country must receive the same color, and adjacent regions must receive different colors.

The J. Sutherland Frame Lecture is named in honor of the ninth President of Pi Mu Epsilon, who served from 1957 to 1966 and passed away on February 27, 1997. In 1952, Sud Frame initiated the student paper sessions at the annual Pi Mu Epsilon meeting, which is held at the Summer Mathfests. He continually offered insight and inspiration to student mathematicians at these summer meetings.

MAA Student Lecture

Saturday, August 14, 2004
3:00 - 3:50 pm
Room 557, Rhode Island Convention Centerl

The Secret of Brunelleschi's Cupola

Mario Martelli
Claremont-McKenna College

How did he do it? In 1420 the architect Filippo Brunelleschi won the competition for building the "octagonal cupola" of Florence's cathedral. His innovative design did not use centering. Brunelleschi built a model to show that his proposal would work, but he categorically refused to reveal his secret. The mystery remains today, but a recent mathematical analysis has been able to lift the veil from parts of Brunelleschi's design. How? Come to the talk to find out.

Pi Mu Epsilon Delegates

Speakers

Name	School	Chapter	PME Session
Serina Alfano	St. Peter's College	NJ Epsilon	6
Melanie Antos	St. Norbert College	WI Delta	7
Holly Attenborough	Miami University	OH Delta	4
Stephanie S.Barille	Mount Union College	OH Omicron	1
Nicholas P. Biller	Occidental College	CA Theta	3
Brian Black	Providence College	RI Gamma	1
Dakota Blair	Texas A&M University	TX Eta	3
Angela Brown	Sam Houston State University	TX Epsilon	5
Nathan Brown	Northwestern University	IL Beta	2
Michael Cortez	Hope College	MI Delta	8
Nicole Cunningham	Youngstown State University	OH Xi	6
Paul Dawkins	Angelo State University	TX Zeta	2
Steve Dinda	Youngstown State University	OH Xi	8
Nathan D. Edington	Hood College	MD Delta	7
John Filkorn	John Carroll University	OH Lambda	4
Henry Gould	Hope College	MI Delta	8
Adam Gray	University of Mississippi	MS Alpha	4
Carly Grey	John Carroll University	OH Lambda	4
Brian Hahn	St. Norbert College	WI Delta	1
Caleb Hallauer	University of Mississippi	MS Alpha	6
Jeremy Hamilton	Youngstown State University	OH Xi	5
Colleen Hughes	Denison University	OH Iota	3
Julie Iammarino	John Carroll University	OH Lambda	5
Adam Kolakowski	St. Peter's College	NJ Epsilon	6
Eric Laber	UCLA	CA Alpha	4
Kristina M. Lund	Grand Valley State University	MI Iota	2
Melissa Marshall	Youngstown State University	OH Xi	5
Ashley Moses	Sam Houston State University	TX Epsilon	1
William Neris	SUNY Fredonia	NY Pi	3
Erin Polsley	Elmhurst College	IL Iota	3
W. Andrew Pruett	Millsaps College	MS Delta	2
Lisa Reeder	New Mexico State University	NM Alpha	7
Jill Schmidt	St. Norbert College	WI Delta	8
Rita Schneider	Fairfield University	CT Gamma	8
Patrick Sigmon	Wake Forest University	NC Lambda	2
Jodi Simons	University of New Hampshire	NH Alpha	6
Theodore T. Stadnik	Youngstown State University	OH Xi	8
Ryan Sternberg	Worcester Polytechnic Institute	MA Alpha	3
Anupama Tippabhotla	University of South Florida	FL Epsilon	1
Sarah Van Asten	St. Norbert College	WI Delta	5
Mark Walters	Miami University	OH Delta	7
Andrew Wells	Hope College	MI Delta	6
Ryan Westbrook	Texas A&M University	TX Eta	7
Alyssa Wood	St. Norbert College	WI Delta	5

Additional Delegates

Aja Johnson	Elon University	NC Nu
Brian Krummel	University of Maryland, Baltimore Cnty.	MD Gamma
Caroline White	St. Louis University.	MO Gamma

MAA Student Speakers

Name	MAA Session	Name	MAA Session
Brandon Batista	5	Meghan Kelley	1
Marisa Belk	1	Robin Koytcheff	8
Elizabeth Bellenot	8	Mark Lane	2
Christina Brakken-Thal	5	David LeRay	5
Kevin Brink	5	Kari Lock	6
Ashley Brown	8	Katherine Magouirk	2
Emily Buessing	6	Alicia Martin	8
Nathanial Burch	3	Nicholas McClure	5
Brian Chen	6	Jacob McMillen	6
Drew Colthorpe	5	Amanda Morris	4
Ivan Corwin	7	Wing L. Mui	8
Adam Cox	6	Ryan Ottman	1
Christy Sue Crouch	6	Shannon Ponek	4
Aubrey da Cunha	8	Caleb Reusser	2
Agata Danielak	3	Andrew Reynolds	2
Matthew Davis	1	Becky Robinson	7
Amy DeCelles	8	Matt Rodrigues	1
Anthony DeLegge	1	Rebecca Russ	4
Christopher Dodd	7	Mary Servatius	1
Shawn Elledge	4	Vojislav Sesum	7
William Espenschied	8	Lauren Shareshian	8
Matthew Fanello	6	Matthew Spencer	3
Rachel Finck	3	Noah Stein	7
Todd Gaylord	1	Colleen Sweeney	8
Matthew Goldfield	8	Dan Tating	1
Richard Gottesman	8	Leya Tesmenitsky	4
André Harmse	4	Abby Van Houten	4
Mohammed Haque	3	Phillip Whitman	4
Stephanie Hurder	7	Kevin Wierzbicki	3
Phakawa Jeasakul	7	Robert Willenbring	8
Anne Jirapattanakul	7	Alice Wilson	8
Pollyanna Jones	2	Jenni Wirth	5
Daniel Kane	7	Zhongtao Wu	3
Matthew Katschke	2	Ya Xu	7

MAA Session #1

Bristol Room (Westin Hotel) **1:00 - 2:57 PM**

1:00-1:15

INTRODUCTION TO KNOTS AND COLORINGS

Marisa Belk
State University of New York - Binghamton

An introduction to the basic principles of knot theory, including: the structure of knots, properties of knots, the importance of invariant operations and colorings. I explore the Kauffman-Harary conjecture by finding the colorability and determinant of a knot using equations, and explaining in what cases the conjecture has been proven.

1:17-1:32

LOOPS AND BANDS

Matthew Davis & Meghan Kelley
West Chester University of Pennsylvania

A popular probability activity involves randomly tying together three strings and recording possible outcomes. We will discuss how to generalize this knot tying activity. To deepen the generalization we modify the experiment by switching from strings to strips of paper and allowing half twists.

1:34-1:49

REGULAR STICK NUMBERS OF $(2,q)$ TORUS KNOTS

Anthony DeLegge
Benedictine University

The $\alpha-$*regular stick number* of a knot K is the minimal number of equal length sticks required to build K in space such that adjacent sticks meet at the angle α. I describe upper and lower bounds in the case that $\alpha = \arccos(-1/3)$ for several $(2,q)$ torus knots.

1:51-2:06

FORMING POLYGONS BY TYING KNOTS WITH RIBBONS

Dan Tating
California State University - Chico

In this presentation, I explore mathematical models for flat knotted ribbons, and make specific conjectures for the least length of ribbon (for a given width) needed to tie $(q+1,q)$ torus knots. My first conjectures give the least length of ribbon to tie $(3,2),(4,3),\ldots,(10,9)$ torus knots. The main conjecture determines a general formula for finding the least length of ribbon to tie a $(q+1,q)$ torus knot, given q and a given width.

2:08-2:23

THE RELATIONSHIP BETWEEN INTRINSIC KNOTTING AND INTRINSIC LINKING

Ryan Ottman & Matt Rodrigues
California State University - Chico

We explore the unsolved question mentioned in Adams' *The Knot Book*: "Will removing a vertex from an intrinsically knotted graph result in an intrinsically linked graph?" We solve the question for several types of graphs, including complete graphs, complete partite graphs and deficient graphs.

2:25-2:40

RELATIONS BETWEEN CROSSCAP NUMBER AND GENUS OF TORUS KNOTS

Todd Gaylord
University of California - Berkeley

B. Clark defined the crosscap number, $c(K)$, of a knot to be the minimum genus of all non-orientable surfaces which span the knot and gave an upper bound for this number as $c(K) \leq 2g(K)+1$ where $g(K)$ is the genus of the knot. The obvious next question is whether an upper bound for the genus exists in terms of the crosscap number. This talk will examine a family of torus knots that show this cannot be the case. I also extend the conjecture to a more general family of knots.

2:42-2:57

MAKING SPIRALS

Mary Servatius
Worcester Polytechnic Institute

A natural geometric element occuring in art and nature is the spiral. In this talk I explore various methods of generating spirals and examine their geometric and artistic features.

THURSDAY AUGUST 12, 2004

PME Session #1

Newport Room (Westin Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15

DRAWING GRAPHS FROM DEGREE SEQUENCES: A COMPUTER BASED APPROACH TO RECURSIVE ALGORITHMS

Brian Black
Providence College – Rhode Island Gamma

We describe a computer based approach to the Havel-Hakimi recursive algorithm based on Euler's handshaking lemma for determining whether a sequence of non-negative integers is graphical. The program determines if a sequence is graphical and draws any resulting graphs. This presentation includes discussion of the problems arising from the computerization of the innate logic humans use to draw graphs.

1:20-1:35

THE IMPACT OF ADDITIONAL DATA VALUES ON STANDARD STATISTICAL ESTIMATORS

Ashley Moses
Sam Houston State University – Texas Epsilon

In this talk we will discuss the impact on statistical estimators resulting from the availability of additional sample data. We will include the impact of single and multiple new values on the sample mean, variance, standard deviation and correlation coefficient, illustrating the results with a specific example.

1:40-1:55

CATCH THE WAVE

Stephanie S. Barille
Mount Union College– Ohio Omicron

What do audio clips, seismographs, electrocardiograms, FBI finger print cards, and El Niño all have in common? Come catch the "wave" and find out!

2:00-2:15

THE MATHEMATICS OF POLARIZED HELIUM

Brian Hahn
St. Norbert College – Wisconsin Delta

The neutron can be a very complicated item to study because it has no charge and is unstable. By using Polarized Helium 3 we are able to study the neutron by appealing to some quantum mechanics and a little bit of math.

2:20-2:35

INTERACTIONS OF KDV SOLITONS, POSITONS AND NEGATONS

Anupama Tippabhotla
University of South Florida – Florida Epsilon

Among integrable equations is the celebrated Korteweg-deVries (KdV) equation which is both nonlinear and dispersive. In this talk I will discuss the various interactions of multisolitons, positons and negatons using Maple. In particular, I will show the interactions of three and four solitons, positons and negatons.

MAA Session #2

Kent Room (Westin Hotel) **1:00 - 2:55 PM**

1:00 - 1:15

THE MATHEMATICS OF FLORENCE NIGHTINGALE

Pollyanna Jones
Sam Houston State University

This talk will trace the life of Florence Nightingale, who was born and raised in Great Britain during the Nineteenth Century. Although women pursuing any type of education were not encouraged, Nightingale not only studied mathematics but flourished and became an important figure who improved health care by inventing the polar-area diagram.

1:20 - 1:35

MATHEMATICAL DEVELOPMENTS IN EARLY CHINESE HISTORY

Mark Lane
Sam Houston State University

This talk will trace the evolution of Chinese mathematics throughout the early dynasties. I will focus on the influence of "The Nine Chapters of Mathematical Art".

1:40 - 1:55

PYTHAGOREAN SOCIETY

Katherine Magouirk
Sam Houston State University

In this talk, I will trace the development of the Pythagorean society. In particular, I will discuss Pythagoras' early life and the beginnings of the society. I will also discuss some of the beliefs and teachings of the Pythagorean society.

2:00 - 2:15

GERGONNE'S SOLUTION TO THE APOLLONIUS PROBLEM

Caleb Reusser
University of Wisconsin - Platteville

A 19th Century solution to a 2000 year old problem is examined. I shall demonstrate how to construct, using compass and straightedge, a circle that is tangent to three other circles in a plane.

2:20 - 2:35

TODAY OR TOMORROW?

Andrew Reynolds
Sam Houston State University

Within the human quest to understand the world we live in, the annual calendar has changed a great deal. I will discuss the mathematical basis for our calendars, the flaws within them, and who designed them.

2:40 - 2:55

SAN GAKU PROBLEMS IN OTHER GEOMETRIES

Matthew Katschke
Ohio Northern University

San Gaku problems are Euclidean problems often involving arrangements of tangent lines and circles, from ancient Japan, that were inscribed on tablets and hung in temples. By exploring the Euclidean proofs of these problems, they can be generalized to spherical and hyperbolic geometry.

THURSDAY AUGUST 12, 2004

PME Session #2

Washington Room (Westin Hotel) **1:00 P.M. – 2:55 P.M.**

The third and fourth speakers in this session are students of Professor Steven Schlicker in the REU program at Grand Valley State University

1:00-1:15

INTUITION VS. FORMALISM IN MATHEMATICS

Paul Dawkins
Angelo State University – Texas Zeta

In a 1986 paper, Chris Freiling used an intuitive argument to prove the Axiom of Choice and the Continuum Hypothesis false. This is impossible formally since they are independent statements. I discuss the conflict between formal and intuitive mathematics in this context and reconcile the conflict Freiling's paper sets up.

1:20-1:35

IDEMPOTENT MATRICES OVER COMMUTATIVE PRINCIPAL IDEAL RINGS

W. Andrew Pruett
Millsaps College – Mississippi Delta

I show that all idempotent matrices over a nowhere reducible commutative principal ideal ring R are diagonalizable with diagonal entries idempotent in R.

1:40-1:55

THE GEOMETRY OF $\mathcal{H}(\mathbb{R}^N)$: PART I

Kristina Lund
Grand Valley State University – Michigan Iota

The collection of all non-empty compact subsets of $\mathbb{R}^n$ forms a complete metric space, $\mathcal{H}(\mathbb{R}^n, h)$ where h is the Hausdorff metric. This space is an important one for several reasons. For example, this is the natural space in which to study fractals. Applications of this metric can be found in image matching, in visual recognition by robots and in computer-aided surgery. In this presentation I will provide essential background information on $\mathcal{H}(\mathbb{R}^n, h)$, and basic results from our efforts to understand the geometry of this space.

2:00-2:15

THE GEOMETRY OF $\mathcal{H}(\mathbb{R}^N)$: PART II

Patrick Sigmon
Wake Forest University – North Carolina Lambda

The collection of all non-empty compact subsets of $\mathbb{R}^n$ forms a complete metric space, $\mathcal{H}(\mathbb{R}^n, h)$ where h is the Hausdorff metric. This space is an important one for several reasons. For example, this is the natural space in which to study fractals. Applications of this metric can be found in image matching, in visual recognition by robots and in computer-aided surgery.
I will share further results from our study of the geometry on $\mathcal{H}(\mathbb{R}^n)$ induced by the Hausdorff metric.

2:20-2:35

INVARIANT METRICS ON LIE GROUPS WITH NON-NEGATIVE CURVATURE

Nathan Brown
Northwestern University – Illinois Beta

So far, all known examples of manifolds with positive curvature rely on the fact that bi-invariant metrics on compact Lie groups have non-negative curvature. At the Williams College SMALL REU, our group has contributed to the search for new examples by finding other invariant metrics on Lie groups with non-negative curvature.

MAA Session #3

Bristol Room (Westin Hotel) **3:00 - 4:57 PM**

3:00 - 3:15

INVARIANT METRICS ON LIE GROUPS I

Rachel Finck
Massachusetts Institute of Technology

We will announce progress towards the classification of left-invariant metrics on Lie groups with nonnegative curvature.[1]

3:17 - 3:32

INVARIANT METRICS ON LIE GROUPS II

Matthew Spencer- *See Abstract Above*
Williams College

3:34 - 3:49

INVARIANT METRICS ON LIE GROUPS III

Zhongtao Wu - *See Abstract Above*
Massachusetts Institute of Technology

3:51 - 4:06

THE METROPOLIS ALGORITHM

Kevin Wierzbicki
Augustana College, Rock Island, Illinois

The Metropolis Algorithm is an example of a Monte Carlo method that uses a Markov chain to generate transitions on a discrete state space subject to certain probability distributions. One example is a variant of the traveling salesman problem, for which I will present a graphical Java program.

4:08 - 4:23

APPLICATIONS OF THE OMEGA TRANSFORM IN ALGEBRAIC GEOMETRY

Mohammed Haque
Columbia College

I will be discussing the Omega Transform and its application to a particular problem in algebraic geometry. In particular, I will introduce this transform, a powerful tool from partition theory, and then show how it can be applied to difficult combinatorial problems that arise from studying covers of algebraic curves.

4:25 - 4:40

HIGHER ORDER LANCZOS' DERIVATIVES

Nathanial Burch
Grand Valley State University

The Lanczos' generalized derivative, developed by Cornelius Lanczos, is a proper extension of the normal derivative. I will show that this derivative satisfies a least squares property and use this result to construct higher order Lanczos' derivatives. Properties of Legendre polynomials and summability kernels play a prominent role in this construction.

4:42 - 4:57

THE MODULI SPACE OF DIHEDRAL COVERS OF THE PROJECTIVE LINE

Agata Danielak
Columbia University

I investigate the moduli space of covers of the projective line with a fixed Galois group and genus. In the case of the dihedral groups, I count the number of components of this moduli space which is equal to the number of restricted partitions whose entries satisfy certain inequalities arising from applying a theorem of Kani and Rosen.

[1] Williams College REU, K. Tapp advisor.

THURSDAY AUGUST 12, 2004

PME Session #3

Newport Room (Westin Hotel) **3:00 P.M. – 4:55 P.M.**

3:00-3:15

CARTESIAN PRODUCTS OF TRIANGLES AS UNIT DISTANCE GRAPHS

Ryan Alexander Sternberg
Worcester Polytechnic Institute– Massachusetts Alpha

The Cartesian product of n triangles is a unit distance graph of diameter n. It is difficult to produce a drawing of such a graph in the plane such that adjacent vertices are unit distance apart. In these graphs, the number of vertices increases exponentially while the diameter increases linearly.

3:20-3:35

COUNTING HUFFMAN TREES

Erin Polsley
Elmhurst College – Illinois Iota

Huffman trees are binary trees used to construct Huffman codes, which are minimal length encodings for messages. All non-isomorphic Huffman trees with n terminal nodes are given for $n = 1, 2, \ldots, 8$. Different properties and patterns are discussed.

3:40-3:55

INTRINSIC LINKING OF K_6

Colleen Hughes
Denison University – Ohio Iota

Any embedding of K_6, the complete graph on six vertices, will have at least one pair of linked triangles, not necessarily constructed of straight lines. In this talk we explore the possibility of constructing straight-line embeddings of K_6 with 1, 3, 5, and 7 pairs of triangles respectively.

4:00-4:15

SOLVING LINEAR RECURRENCE RELATIONS USING GENERATING FUNCTION AND MATRIX APPROACHES

William Neris
State University of New York at Fredonia – New York Pi

In this research, a single linear recurrence relation was solved using both generating function and matrix approaches. The two methods were then extended to solve a system of linear recurrence relations. Comparison of these approaches will be discussed.

4:20-4:35

OSCILLATING PATTERNS IN LANGTON'S ANT

Dakota Blair
Texas A&M University – Texas Eta

It is known through the Cohen-Kung Theorem that using the Langton's Ant algorithm, a single ant cannot oscillate. However certain patterns with multiple ants can oscillate. We present a way to create oscillating patterns with exactly two ants, examples of oscillators, and patterns resembling gliders in Conway's game of Life.

4:40-4:55

SOME VARIATIONS ON THE TENNIS BALL PROBLEM

Nicholas P. Biller
Occidental College – California Theta

We will study variations of the Tennis Ball Problem that generates Catalan, Motzkin and Schröder numbers. We also investigate a recursive formula for counting Motzkin paths with flaws in terms of Motzkin numbers. A combinatorial proof concerning Motzkin paths with two and three flaws will be given.

MAA Session #4

Kent Room (Westin Hotel) **3:00 - 4:55 PM**

3:00-3:15 USING ODE METHODS TO ANALYZE SOLUTIONS OF A NONLINEAR PDE

Phillip Whitman
University of Texas at Austin

I will present some results on solutions of $\Delta u = u^{-\alpha}$. I will define a "tornado sequence" of solutions and outline how to use ODE methods and the maximum principle to rule them out when $0 < \alpha < 1$. This result implies continuity of limits of positive solutions.

3:20-3:35 PATTERNS IN PICK MATRIX PERMUTATIONS

Rebecca Russ & Shannon Ponek
California Polytechnic Institute - San Luis Obispo

Our objective was to find a pattern in the positive semidefiniteness of 3×3 Pick matrices. Specifically, using the research of J. Weinberg we investigated the patterns that existed in the resulting six matrices when the $z_i's$ of a Pick matrix are permuted. We produced three conjectures based on the determinant properties of positive semidefinite matrices. Scrutiny of these conjectures led to counterexamples that prove no relationship exists in regards to the determinants of these permuted matrices. Further investigations into the eigenvalues of the permuted matrices may prove more fruitful.

3:40-3:55 NEW RESULTS ON SHUFFLE GROUPS

André Harmse
California Polytechnic Institute - San Luis Obispo

I will discuss the permutation groups that arise from perfect card shuffles. In particular I will describe one such infinite family and show that they are isomorphic to a more well known family of groups of functions on vector spaces.

4:00-4:15 FROM NUMBER THEORY TO GROUPS VIA GRAPH PEBBLING

Shawn Elledge
Arizona State University

In 1989 Chung used graph pebbling to prove a number theoretic result of Kleitman and Lemke, first conjectured by Erdős and Lemke. Kleitman and Lemke then conjectured group theoretic generalizations of this result. My research aims to use graph pebbling to prove these conjectures for solvable groups.

4:20-4:35 BIFURCATION DIAGRAMS FOR ONE-DIMENSIONAL DYNAMICAL SYSTEMS

Amanda Morris & Abby Van Houten
Haverford College & Muhlenberg College

We will discuss the one-dimensional dynamical systems that we have spent our summer researching, as well as their accompanying bifurcation diagrams. A bifurcation is a change in the number or stability of the periodic points of a family of functions. A bifurcation diagram shows these attracting and repelling periodic points and how they change in terms of the parameter. We will be presenting some interesting examples of bifurcation diagrams we have encountered, as well as proving some of the properties of these diagrams.

4:40-4:55 A GAME BASED ON VERTEX-MAGIC EDGE LABELING

Leya Tesmenitsky
Hobart & William Smith Colleges

Consider a game based on labeling vertices and edges of graphs. For a given graph G, let V be the number of vertices and E be the number of edges. Let the labels available be the numbers in the set $\{1, 2, ..., V + E\}$. Two players take turns labeling vertices and edges in the graph with single non-repeated labels. The first time a vertex and all the edges incident to it are given labels, the sum of those labels becomes the magic constant k. From that moment on, any time a vertex and the edges incident to it are all labeled, the sum of the labels must be k. The goal of the game is to be the last person to make a move on the graph. If a graph has certain properties, a particular player can have a winning strategy. I will present two previously known strategies as well as new strategies I have developed.