College of Science and Mathematics

Department of Mathematics
and Statistics

Third Annual Kennesaw Mountain Undergraduate Mathematics Conference Program and Abstracts [1]

November 8–9, 2013

[1]Funding for the Kennesaw Mountain Undergraduate Mathematics Conference is provided by NSF grant DMS-0846477 through the MAA Regional Undergraduate Mathematics Conferences program (http://www.maa.org/RUMC). Additional support was provided by the Center for Excellence in Teaching and Learning at KSU and the Department of Mathematics and Statistics at KSU.

Welcome

Welcome to the third annual Kennesaw Mountain Undergraduate Mathematics Conference!

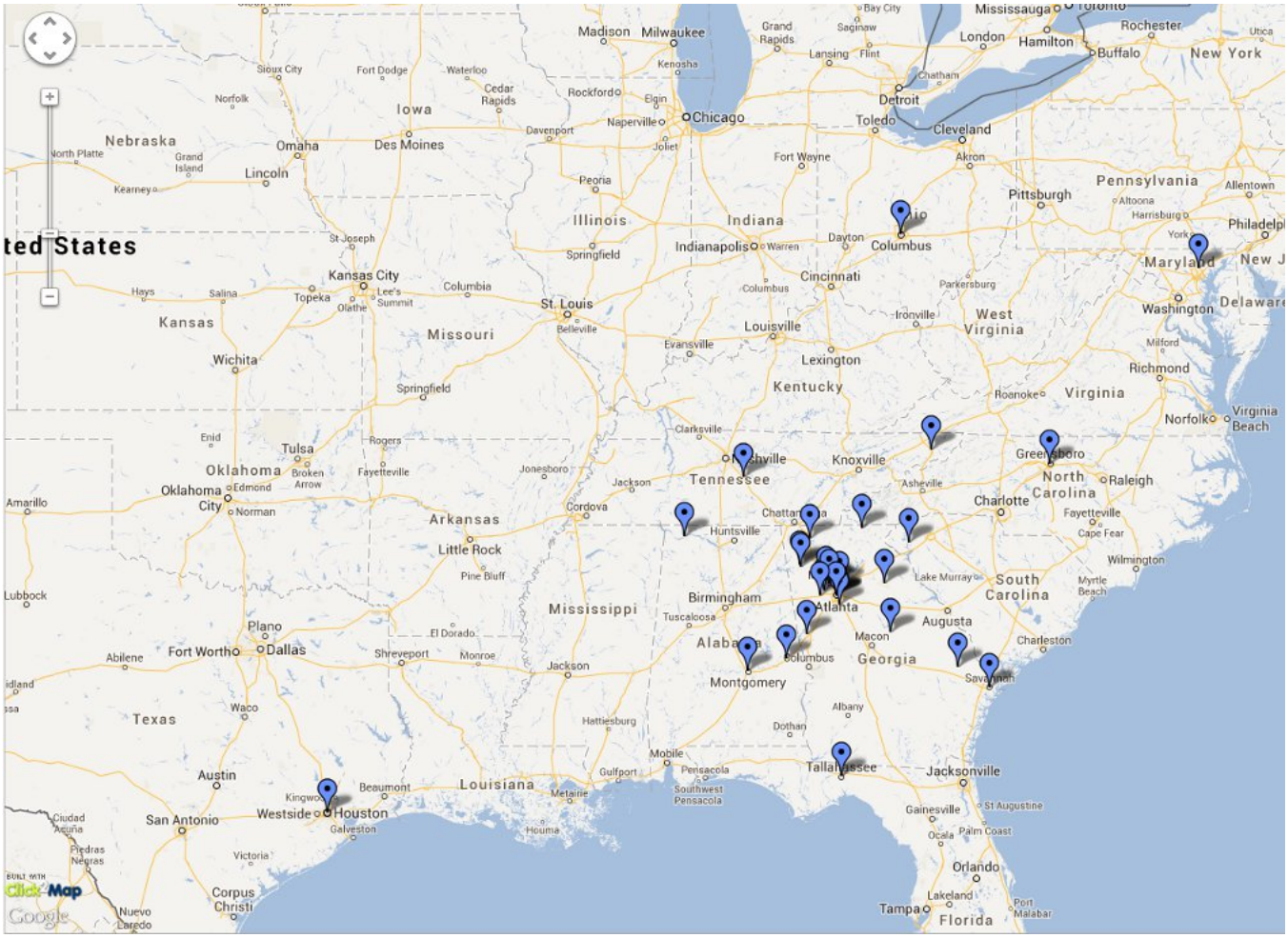
We are thrilled that this year KMUMC attracted over 170 participants from 30 universities in 9 states!

We hope you will enjoy the talks, activities, food, great weather, and the beautiful Kennesaw State University campus and come back next year!

We would also appreciate any feedback and any suggestions you have. Please fill out the feedback form included in your registration materials or send comments to Dr. Yuliya Babenko (ybabenko@kennesaw.edu).

Sincerely,
KMUMC Organizers

KMUMC 2013 Participants Map



Location of Talks

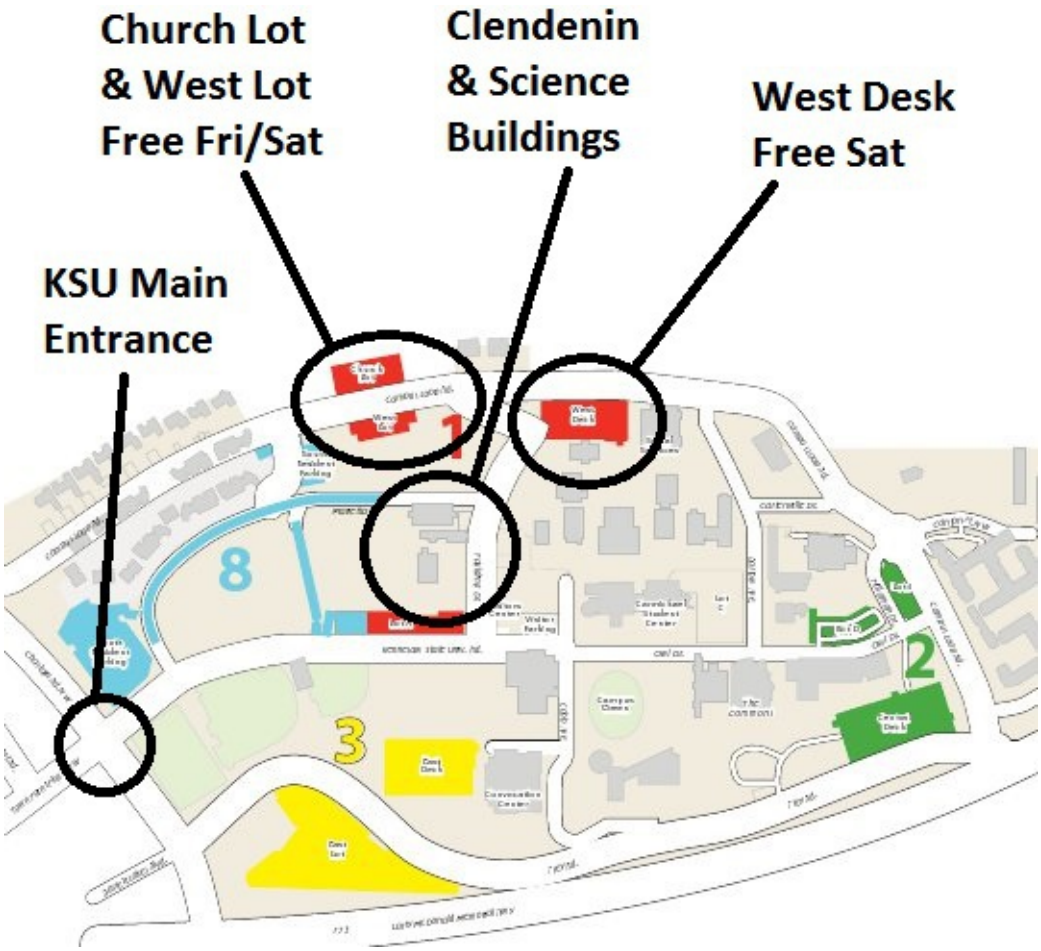
The conference will take place in the Clendenin, Science, and Science Lab Buildings, abbreviated CL, SC, and SL, respectively. See the campus map in your registration packet for directions. Registration and all breaks will be in the Clendenin and Science Lab Building Atriums (CL 1000 and SL 1001).

Accessing KSU WiFi Network

1. Select "`KSUGuest`" from the list of available wireless networks.
2. Enter "`kennesaw`" as security key.
3. Open a web browser.
4. Login with your email address.
5. You are now connected to the WiFi network.

Note: Guests have limited bandwidth, will only be able to access the Network between 6am and midnight, and are restricted to Internet connectivity through a web browser.

Campus Parking Map



On Friday, all visitors can park for free in the Church Lot or West Lot Parking (see map above). **The Visitor Parking Lot is not free on Friday.** Saturday parking is free anywhere. We have been asked to use the West Desk, if possible. All these lots are conveniently close to the Science and Clendenin Buildings. *Please do not park in any spots marked as reserved or you will be ticketed. Handicapped spaces require valid HC tags/plates.*

Friday, November 8, 2013

2:00–6:00 pm	Registration (CL 1000 Atrium)
3:00–4:00 pm	Math Scavenger Hunt
4:00–4:10 pm	Opening Remarks (CL 1010)
4:10–6:00 pm	Plenary Lecture 1: **Robert Beeler** (CL 1010) *Games, Mathematics, and Other Harmless Diversions*
6:00–7:00 pm	Movie: *Julia Robinson and Hilbert's Tenth Problem* (CL 1009) popcorn and soda provided

Saturday, November 9, 2013

8:00–10:30 am	Registration (Breakfast served at 8:00 am) (SL 1001 Atrium)		
	Contributed Talks		
Judges & Moderators:	ALGEBRA/DISCRETE MATH (CL 1010) Beeler & DeMaio	ANALYSIS/APPLIED MATH (CL 1008) Babenko & Ellermeyer	PROBABILITY (CL 1009) Bell & Gadidov
8:30–8:45 am	**M. Force** *Cyclic Domination in Cayley Graphs*	**L. Allen** *Introduction to Splines*	**Z. Carter, N. Song** *Queueing Theory Applied to Traffic Analysis*
8:50–9:05 am	**J. Woltz** *Dominating Sets in* $Cay(\mathbb{Z}_n, \{\pm 1, \ldots, \pm(2k-1)\})$	**L. Allen** *Dimension of Smooth Bivariate Splines on Hexagonal Partitions*	**J. Reinoehl, L. Richards** *Predicting Sales Using Twitter Data*
9:10–9:25 am	**E. Moore** *Decomposition of Partially-Minimal Cayley Graphs*	**J. Hughes** *Application of Akima Method to Cubic Splines*	**M. Thomas** *The Coupon Collector Problem: Analysis of Multiple Collections*
9:30–9:45 am	**N. Smoot** *On the Stability of Ring Structures in Direct Limits*	**R. Mady** *Multiplication of Polynomials in Bernstein-Bézier Form*	**L. Dunn** *Intuitionistic Intensional Type Theory*
9:50–10:05 am	**M. Jackson** *The* $3x+1$ *Problem* mod m	**S. Eccleston** *Growth Rates of Rehabilitated and Wild Eastern Gray Squirrels*	**D. Schmidt** *Edge Colorings Avoiding Some Proper Cycles*
10:10–10:30 am	Coffee Break (SL 1001 Atrium)		

Saturday, November 9, 2013 (cont'd)

	Contributed Talks		
Judges & Moderators:	ALGEBRA/DISCRETE MATH (CL 1010) Castle & Krop	ANALYSIS/APPLIED MATH (CL 1008) Adhikari & Westlund	PEDAGOGICAL (CL 1009) Derado & Watson
10:30–10:45 am	**J. Eubanks** *Multiple Independent Queen Armies*	**E. Couch, B. Graves** *Model Rocket Launch and Simulation as a Pedagogical Tool*	**T. Sorokina** Using MOOCs in Precalculus
10:50–11:05 am	**J. Fisher** *Precedent Based Voting Paradox in the Supreme Court*	**M. Beaver, A. Edwards** *Investigating Cardano's Irreducible Case*	**A. McMunn** *Determining the Effectiveness of Peer-Led Supplemental Instruction from Undergraduate Mathematics Fellows*
11:10–11:25 am	**S. Molitoris Miller** *Single-Target Alliances in Random Order Sequential Quaduels*	**N. Phan** *Finite element solution of blood flow problems in cerebral aneurysms*	**A. Johnson** *Building an Interdisciplinary Undergraduate Research Team at a Predominantly Undergraduate Institution*
11:30–11:45 am	**B. Hoffmann** *Elliptic Curve Cryptography*	**J. Du** *Trinity Matrices, Construction & Applications*	**Garner,Rudchenko,Watson** *The KSU Math Circle Summer Camp*
11:50–12:05 pm	**Middlebrooks, Taylor** *Elliptic Curve Factorization*	**P. Laval** *The Mean Curvature Flow Problem: Applications to Minimal Surfaces and Image Processing*	**C. Sass** *Teaching an Honors Seminar on Fractals for Non-Majors*
12:10–12:25 pm	**P. Anschutz, M. Rafay** *Finding the Precession of Foucault's Pendulum using Differential Geometry*	**N. Dowling** *A Simple Proof of Zorn's Lemma*	**J. Derado** Point Reward System
12:30–1:30 pm	Lunch (SL 1001 Atrium) — check out the orgiami table!		
1:30–2:00 pm	Poster Session (SL 1001 Atrium) Judges: Espinoza & Johnson **V. Awokunle** *Improving Existing Tumor-Growth Models* **K. Cline** *Research Experience for Undergraduates 2013* **J. Dollar** *An Inquiry-Based Approach to Teaching Parameterization* **C. Hanks** *2011 USG Faculty Salary Analysis* **T. Kindred** *Energy Efficiency of Buildings* **A. Madewell** *Research Experience for Undergraduates 2013*		
2:00–2:10 pm	Department Chair's Welcome (SC 109)		
2:10–3:00 pm	Plenary Lecture 2: **Martin Golubitsky** (SC 109) *Patterns and Symmetry*		
3:10–4:00 pm	Panel Session — Careers with Mathematics (SC 109) **Jeffrey Berman** (Lockheed Martin), **Matthew Graham** (Home Depot), **Warren Hearnes** (Cardlytics, Inc.), **Sean Hilden** (Bank of America), **John Jacobson** (Link Analytics), **James Piekut** (Wellpoint)		
4:00–4:30 pm	Coffee Break (SL 1001 Atrium)		
4:30–5:20 pm	Plenary Lecture 3: **Tatyana Sorokina** (SC 109) *In the Barycentric World*		
5:20–5:30 pm	Closing Remarks and Awards Ceremony (SC 109)		

Biographies of Invited Speakers

Robert Beeler: Robert Beeler has been at East Tennessee State University since receiving his doctorate from Clemson University in 2007. He is the author of over twenty papers, more than half of which have student co-authors. His research interests recently have focused on combinatorial games and games on graphs. Currently, he is working on a undergraduate combinatorics textbook which is under contract with Springer.

Martin Golubitsky: Martin Golubitsky is a Distinguished Professor of Mathematics and Physical Sciences at Ohio State University, where he serves as Director of the Mathematical Biosciences Institute. He received his Ph.D. in Mathematics from M.I.T. in 1970 and has been Professor of Mathematics at Arizona State University and Cullen Distinguished Professor of Mathematics at the University of Houston. He is a former president of the Society for Industrial and Applied Mathematics.

Dr. Golubitsky works in the fields of nonlinear dynamics and bifurcation theory, studying the role of symmetry in the formation of patterns in physical systems and the role of network architecture in the dynamics of coupled systems. His recent research focuses on some mathematical aspects of biological applications: animal gaits, the visual cortex, the auditory system, and coupled systems. He has co-authored four graduate texts, one undergraduate text, two nontechnical trade books, and over 100 research papers.

Tatyana Sorokina: Dr. Tatyana Sorokina joined the Department of Mathematics of Towson University in 2007. Dr. Sorokina earned a Diploma in Mathematics from the Kazakh state University (former Soviet Union) in 1991. She earned a M.S. in Environmental Engineering from the University of Alaska Fairbanks in 1999, and a Ph.D. in Mathematics from Vanderbilt University in 2004. Dr. Sorokina was a VIGRE postdoctoral fellow at the University of Georgia until 2006, followed by a visiting position at the University of Utah. The central topic of Dr. Sorokina's research is multivariate splines, their applications, and their connections to algebraic geometry, real analysis and optimal recovery.

Biographies of Career Panelists

Jeffrey Berman: Jeffery Berman attended undergraduate school at Millersville University where he received a B.A. in Mathematics, and graduate school at the University of Delaware where he received an M.A. in Mathematics. His first job was with General Electric in Valley Forge, PA. His current position is Senior Staff Software Engineer at Lockheed-Martin. Jeff's hobbies include teaching Calc 1 and Calc 2 in the evening at KSU, lifting weights, and golf.

Matthew Graham: Matthew Graham received his B.S. and M.S. in Aerospace Engineering from Georgia Institute of Technology. His first job was as an Intern at the NASA Glenn Research Center. His current position is as Director, Inventory Planning and Replenishment, at The Home Depot. Matthew's hobbies included hiking, climbing, and kendo.

Warren Hearnes: Warren Hearnes is a graduate of the United State Military Academy at West Point (BS, Math) and Georgia Institute of Technology (MS, Operations Research). In addition to the Army, he has worked for Lucent Technologies/OFS, UPS, and The Home Depot. Currently, he is the Vice President, Marketing Insights & Analytics, for Cardlytics, Inc. He is a proven analytics leader with 15+ years experience in applying quantitative decision-making to problems in industry that increase revenue or decrease costs.

Sean Hilden: Sean Hilden has a Ph.D. in Mathematical Finance from Carnegie Mellon University. He started working as a Field Engineer for Schlumberger, then became a Vice President for Lehman Brothers, and is currently a Senior Vice President for Bank of America.

John Jacobson: John Jacobson is an Analyst at Link Analytics where he leverages his academic and practical training in statistics, mathematics, and programming as well as the languages SQL, R, SAS, and Python, to help continuously refine Link's approach for Social Network Analysis. In addition, he works with one of their largest Tier 1 mobile carrier clients providing critical analytical and statistical insights that inform some of their highest-value strategic decisions.

Link Analytics is an analytical technology company specializing in developing "Big Data Analytics" Solutions for Fortune 1000 companies. Link works with clients to answer their highest-value questions, transforming complex data into highly-actionable and repeatable solutions.

James Piekut: James Piekut is a graduate of Virginia Tech. His first job was with Towers Perrin and he is currently the Associate Vice President at Wellpoint (formerly Amerigroup). His work as an actuary focuses on pricing and actuarial studies. The pricing work involves producing rate filings, vetting actuarial certifications from the states' actuaries, evaluating new business bids, researching other rate issues and helping their state partners evaluate changes to their programs.

Plenary Talks

1. TITLE: *Games, Mathematics, and Other Harmless Diversions*
SPEAKER: **Robert Beeler**
INSTITUTION: East Tennessee State University
EMAIL: beelerr@etsu.edu
ABSTRACT: Games hold a certain fascination for many mathematicians. In this talk, we present a survey of several types of puzzles and games and their connections to mathematics. Some of the topics of discussion include:

- How one classic puzzle inspired an entire disciple.
- How another puzzle inspired the speaker.
- How mathematics can analyze puzzles and games.
- How games and puzzles can motivate mathematics.
- Do games provide a framework for mathematical research?

There will be several interactive elements to this talk. We will follow with a game session. We will end with a discussion of what was observed during the game session.

---

2. TITLE: *Patterns and Symmetry*
SPEAKER: **Martin Golubitsky**
INSTITUTION: Ohio State University
EMAIL: mg@mbi.osu.edu
ABSTRACT: Regular patterns appear all around us: from vast geological formations to ripples in a vibrating coffee cup, from gaits of horses to the lapping tongues of flames. The mathematical notion of symmetry is a key to understanding how and why these patterns form. This lecture will show some of these fascinating patterns and discuss how mathematical symmetry enters the picture.

---

3. TITLE: *In the Barycentric World*
SPEAKER: **Tatyana Sorokina**
INSTITUTION: Towson University
EMAIL: tsorokina@towson.edu
ABSTRACT: The barycentric coordinate system is a system in which the location of a point is specified relative to the vertices of a fixed simplex. In the bivariate case, a simplex is a triangle, and such coordinates are also known as area coordinates. The system was rigorously introduced in 1827 by August Ferdinand Möbius. However, it was used in geometry much earlier by ancient Greeks. Barycentric coordinates are extremely useful in approximation theory and engineering applications involving partitions of space into simplices. Of utmost importance are the so-called multivariate splines. They are continuous or smooth piecewise polynomials defined over simplicial partitions. Every time you look at the surface of a car or an airplane you see a bivariate spline that was constructed using barycentric coordinates. In this talk, we introduce barycentric coordinates and show how they are used in applications.

Contributed Talks & Posters

1. Title: *Introduction to Splines*
Speaker: **Larry Allen**
Institution: Towson University
Email: lallen13@students.towson.edu
Abstract: We introduce polynomial splines and their role in approximation theory, especially interpolation. Splines are considered from both approximation theory and algebraic geometry points of view. Approximation theory traditionally defines splines as vector spaces, while algebraic geometry defines splines as certain modules.

---

2. Title: *Dimension of Smooth Bivariate Splines on Hexagonal Partitions*
Speaker: **Larry Allen**
Institution: Towson University
Email: lallen13@students.towson.edu
Abstract: Bivariate polynomial splines are considered on a hexagonal tiling of a plane region. Traditional Bernstein-Bézier techniques cannot be applied in this case since the underlying partition is not a triangulation. Using homological algebra methods, we compute the Hilbert polynomial for the space of splines on hexagonal partitions. In turn, the Hilbert polynomial defines the dimension of the splines of any polynomial degree and any smoothness. We use hexagons whose vertices are integers, and begin by investigating the so-called Alfeld split given by three rays emanating from the origin. We obtain a formula for the generators of the spline space on the Alfeld split. By adding lines to this split, we create a partition of the plane that includes non-enclosed hexagons. For this partition, some conjectures are made for the dimension formulae. Our main result deals with the partition consisting of an arbitrary number of enclosed hexagons, where we make some conjectures regarding the dimension of spline spaces and confirm the conjectures computationally by using a code in Macaulay software package.

---

3. Title: *Finding the Precession of Foucault's Pendulum using Differential Geometry*
Speaker: **Philip Anschutz** and **Mohammed Rafay**
Institution: Georgia College & State University
Email: philip.anschutz@bobcats.gcsu.edu, mohammed.rafay@bobcats.gcsu.edu
Abstract: Léon Foucault was a French physicist who is best known for his pendulum. This Pendulum demonstrated that the Earth rotated upon an axis. Given different latitudes, the pendulum would either rotate a full circle in 24 hours, or in some cases oscillate in a single plane. Classical methods of approaching this problem include using physics to represent the position vector of the pendulum and then integrating the second Newton's Law. In this paper we use differential geometry, and techniques from Calculus III to obtain the same equation.

---

4. Title: *Improving Existing Tumor-Growth Models* (poster)
Speaker: **Victoria Awokunle**
Institution: Kennesaw State University
Email: vawokunl@students.kennesaw.edu
Abstract: This poster describes ongoing work started this semester. The goal of the project is to review existing tumor growth models based on logistic growth and study various techniques to improve these models. It has been argued that Gompertz growth is a better fit than logistic growth to describe tumor growth. One approach to improve existing models we are studying is to replace logistic growth by Gompertz growth. Another approach to make the models more realistic is to incorporate into existing models angiogenesis. Angiogenesis is the process by which tumors can grow their own blood vessels.

---

5. Title: *Investigating Cardano's Irreducible Case*
Speaker: **Michael Beaver** and **Alex Edwards**
Institution: University of North Alabama
Email: jbeaver1@una.edu, aedwards1@una.edu
Abstract: Solving cubic equations is a historically rich mathematics problem. Unlike with quadratic equations, cubic equations do not have a "cubic formula." However, over the years many techniques have been presented that successfully find the solutions of cubic equations. Our research investigates one of these techniques, known as Cardano's Method. Cardano's Method provides an algebraic technique for solving the general cubic equation.

Since its initial inception, this technique has suffered a significant drawback. In some instances, the application of Cardano's Method results in what Cardano called the irreducible case. The irreducible case occurs when a complex number is needed in order to complete the process. We are investigating the relationship among the coefficients of the cubic equation and the irreducible case.

---

6. TITLE: *Queueing Theory Applied to Traffic Analysis*
SPEAKER: **Zachary Carter** and **Narae Song**
INSTITUTION: Kennesaw State University
EMAIL: zcarter3@students.kennesaw.edu, nsong@students.kennesaw.edu
ABSTRACT: We apply the mathematical theory of queues to the M/G/1 (Poisson arrivals, general service time, one server) traffic intersection. Computer simulations apply Little's Theorem and model the Poisson arrival distribution, and experimental data are gathered to compare to the simulation. We compute the mean queue length, mean waiting time, and mean total waiting time of the "customers," or cars in the system. We develop a deterministic method to compute the actual queue length at any moment and average sojourn time based on previous arrivals. Finally, the relationship between the ratio of the arrival rate to the service rate and the convergence of the system to steady state is analyzed.

---

7. TITLE: *Research Experience for Undergraduates 2013* (poster)
SPEAKER: **Kayla Cline**
INSTITUTION: LaGrange College
EMAIL: kscline@student.lagrange.edu
ABSTRACT: The klystron, which is a specialized linear-beam tube, is used as the radio frequency energy source for high energy accelerators/medical accelerators in the industry and in research. The design of klystrons for a given application requires defined specifications, such as gain, bandwidth and power output. A typical design process involves iteratively simulating and modifying aspects of the klystron, such as the frequencies of the cavities and the power input, to achieve the desired specifications. Because of the large number of variables, this is often a time consuming and expensive process. This poster describes a computer optimization process for the klystrons. It uses the Java simulation code, AJDISK, and MATLAB optimization routines to produce parameters for a klystron that satisfy some design specifications. Several klystron design cases from the industry are used to test the efficiency and fidelity of the computer optimization process.

---

8. TITLE: *Model Rocket Launch and Simulation as a Pedagogical Tool*
SPEAKER: **Elly Couch, Baillie Graves,** and **Kayla Dailey**
INSTITUTION: University of North Alabama
EMAIL: ecouch@una.edu, bchaddock@una.edu
ABSTRACT: Many Algebra II students struggle with word problems about projectile motion. Our research serves to determine whether or not incorporating a physical model and a software simulation into an Algebra II lesson on simple projectile motion will improve students' understanding of the concept, as compared to students taught through more traditional methods. In our lesson, we taught students about projectile motion by going through the mathematical basics of projectile motion with the help of a simulation of rocket flight. After the lesson the students witnessed a rocket launch to reinforce the lesson concepts. A flight computer was attached to the rocket to record flight data. Lastly, students used the data from the rocket flight to explore the essential mathematical concepts of projectile motion. Early results from regional high school classrooms indicate improvements as measured by pre-test and post-test assessments.

---

9. TITLE: *Point Reward System*
SPEAKER: **Josip Derado**
INSTITUTION: Kennesaw State University
EMAIL: jderado@kennesaw.edu
ABSTRACT: The Point Reward System(PRS) is a novel way of teaching and conducting the classroom. It was created as a response to low retention rates in the classes with high diversity in students' interests and abilities. It implements differentiated teaching and differentiated students' assignments to accommodate individual students pace in learning. The basic elements of the PRS system are; 1) that students are rewarded by points for every fully completed task, 2) students are assigned the difficulty level according to which they choose the tasks. At the end the total number of points collected determines students' grade. This system is significantly different than the standard system used in the most classrooms at USA Universities.

In this talk we will provide more details about the PRS and we will compare it to the standard system.

---

10. TITLE: *An Inquiry-Based Approach to Teaching Parameterization* (poster)
SPEAKER: **Jonathan Dollar**
INSTITUTION: Emory University
EMAIL: j.y.dollar@emory.edu
ABSTRACT: Over the summer, I participated in an REU at the University of Connecticut on a research project in undergraduate mathematical education. My team included Dr. Fabiana Cardetti, Dr. Gabriel Feinberg, and Providence College fourth year Nicole DeMatteo. Since inquiry-based learning (IBL) has shown many positive results with higher level mathematical education regarding student performance and attitudes, the purpose of the study was to create an IBL activity that would assist students' comprehension of parameterization along with a guide for instructors intending to use the activity in their classrooms. Our team consulted with experienced instructors of multivariable calculus, studied popular calculus textbooks, and conducted a focused literature review. In this poster presentation, I will share the results of the study that include the IBL activity, the guide for instructors, and extensions to the problems in the activity.

---

11. TITLE: *A Simple Proof of Zorn's Lemma*
SPEAKER: **Nicole Dowling**
INSTITUTION: Kennesaw State University
EMAIL: ndowlin2@students.kennesaw.edu
ABSTRACT: Zorn's lemma is an efficient way of stating the important mathematical principle known as the axiom of choice which plays a fundamental role in the development of modern algebra, topology, and analysis. For many years, the proofs in the textbooks of the fact that Zorn's lemma and the axiom of choice are logically equivalent to one another appeared to be quite difficult, but an easier approach is available. This presentation will provide a simple proof that the axiom of choice implies Zorn's lemma. The proof presented here is based on a proof given by Jonathan Lewin in the American Mathematical Monthly (98)4, 1991, pp. 353-354.

---

12. TITLE: *Trinity Matrices, Construction & Applications*
SPEAKER: **Joshua Du**
INSTITUTION: Kennesaw State University
EMAIL: jdu@kennesaw.edu
ABSTRACT: A matrix $A = (a_{ij})_{n,n}$ with $a_{i+1,j+1} = a_{i,j}$, $A = A^{-1} = A^T$, $\prod_{i,j=1}^{n} a_{i,j} \neq 0$ is called a *trinity matrix*. The properties and applications will be introduced. The methods of construction of trinity matrices will be discussed.

---

13. TITLE: *Intuitionistic Intensional Type Theory*
SPEAKER: **Lawrence Dunn**
INSTITUTION: Florida State University
EMAIL: lhd10@my.fsu.edu
ABSTRACT: Recent research at Princeton's Institute for Advanced Study has focused on homotopy type theory, a viable candidate for a new foundation of mathematics to replace set theory, desirable for its logical flexibility and its proof-theoretic properties. The logical basis of homotopy type theory is not the usual first-order logic within which set theory is formalized, but rather an entirely different system with different rules — intuitionistic intensional type theory, developed by logician Per Martin-Löf.

The aim of this 15-minute talk to present a condensed summary of this variant of type theory, explaining the motivation for and key differences of the theory: the interpretation of mathematical proofs, the requirement that objects be effectively computable, and the conspicuous absence of the law of the excluded middle. The presentation is ideally suited for anyone with experience in formal logic, but should be accessible to most mathematicians.

---

14. TITLE: *Growth Rates of Rehabilitated and Wild Eastern Gray Squirrels*
SPEAKER: **Sharon Eccleston**

Institution: University of North Alabama
Email: seccleston@una.edu
Abstract: Different kinds of formulas used by rehabilitators can drastically affect the overall health and rate of growth in orphaned squirrels. Many people are misinformed on what formula and how much to feed their infants which can result in stunted growth and numerous health problems. This problem will be investigated by feeding groups of gray squirrels a milk substitute formula and recording their weight, quantity of formula consumed. This data will be used to calculate the growth rate and caloric intake of each squirrel. The results will then be compared to data previously collected from wild infant squirrels to determine the progression of their development, and how their weight compares to the amount of formula consumed. All of the squirrels monitored will be fed the same formula that is believed to be optimal for their growth, and data collected from squirrels previously fed subpar formulas will provide evidence as to why they should not be used. These results will assist rehabilitators in determining whether their orphaned squirrels are developing properly and the caloric intake needed based on body weight of their infants.

---

15. Title: *Multiple Independent Queen Armies*
Speaker: **James Eubanks**
Institution: Kennesaw State University
Email: james.eubanks21@gmail.com
Abstract: The problem of placing 8 non-attacking queens on an 8×8 chessboard is well known. Less known is the problem of placing different colored queens on a chessboard so that no queen attacks one of a different color. In this talk we will give a brief introduction to this problem, from the perspective of both the chessboard and graph theory. We also discuss our approach to computationally search for solutions on small boards using a C++ program we have been developing.

---

16. Title: *Precedent Based Voting Paradox in the Supreme Court*
Speaker: **Jonathan Fisher** and **Mari Castle**
Institution: Kennesaw State University
Email: jonathanrfisher@yahoo.com
Abstract: We denote a (q, n)-rule to be a voting system with n voters and $q > \frac{n}{2}$, where a winning proposition receives at least q votes. An N-alternative "Ranking Wheel Configuration," denoted RWC_N, is a profile of N voter preference rankings which, for a symmetry group of preference rankings, we call a Condorcet N-tuple. Recent results from Donald Saari have subsumed and extended significant results in social choice theory concerning the possibility of undesirable outcomes for (q, n)-rule voting systems using RWC_N. David Cohen has established a model for the Precedent Based Voting Paradox (PBVP) seen in Supreme Court cases. Cohen has shown the existence of the PBVP in 11 unique Supreme Court cases and has suggested that many other cases likely exhibit the conditions required. Here, we apply Saari's aforementioned Unifying Theorem to describe the PBVP, and extend the results to any odd numbered voting body.

---

17. Title: *Cyclic Domination in Cayley Graphs*
Speaker: **Matthew Force**
Institution: Kennesaw State University
Email: mforce1@students.kennesaw.edu
Abstract: A set $S \subseteq V$ is a dominating set of a graph $G = (V, E)$ if each vertex in V is either in S or is adjacent to a vertex in S. The domination number of a graph G, $\gamma(G)$, is the minimum cardinality of a dominating set of G. The Cayley digraph, $Cay(G, C)$, for any group G and $C \subseteq G \setminus \{e\}$ has as its vertex set the group elements of G and the $i \to j$ arc exists if and only if $ji^{-1} \in C$. If C is closed under inverses then $Cay(G, C)$ is a graph rather than a digraph. Assume S is a dominating set in $Cay(G, C)$. We call S **cyclic** if there exists $g, h \in G$ such that $S = \{gh^k \mid k = 1, 2, ..., |h|\}$. The cyclic domination number of a graph G, $\gamma_{cy}(G)$, is the minimum cardinality of a cyclic dominating set of G. In this talk we present properties of cyclic dominating sets.

---

18. Title: *The KSU Math Circle Summer Camp*
Speaker: **Mary Garner, Tatiana Rudchenko,** and **Virginia Watson**
Institution: Kennesaw State University
Email: mgarner@kennesaw.edu, trudche1@kennesaw.edu, vwatson@kennesaw.edu
Abstract: A 2011 KMUMC talk by Dr. Watson on math circles for students and teachers inspired a new

collaboration on the KSU Math Circle for area high school students. The KSU Math Circle Summer Camp is a two week summer program where high school students work with mathematicians on involved projects. Generously supported by two Dolciani Mathematics Enrichment Grants, students listen to presentations by mathematicians, participate in mathematical activities and present their work at the end of the two weeks to an audience of students, parents and mathematicians. We will discuss the last two years of the program and future plans.

---

19. TITLE: *2011 USG Faculty Salary Analysis* (poster)
SPEAKER: **Caroline Hanks**
INSTITUTION: Kennesaw State University
EMAIL: nhanks@students.kennesaw.edu
ABSTRACT: Data from five different higher education institutions with the University System of Georgia are used to perform a complete analysis of faculty salaries within and without these institutions. The data are contained in 5 separate CSV raw data files and will be imported and merged together using R. Each data file consists of one year of information with only five variables and less than 11,000 rows each. We would like to display the salary differences between Georgia Southern, Georgia State University, Kennesaw State University, University of West Georgia, and Valdosta State University. The data was obtained from Dr. Daniel Yanosky at Kennesaw State University. The data contains salary and title information on all employees at the five institutions. The salaries of the faculty that have Instructors, Lecturers, Assistant Professors, Associate Professors, and Professors as listed job titles within the Fiscal year of 2011 are of the sole interest of the study. Therefore, the data will be subset in order to omit the other job titles within the data. The data will be presented though a stratified analysis of salary by title within each institution including n, mean, median, 1st quartile, 3rd quartile, minimum, and maximum with side-by-side boxplots and strip plots. The analysis will be repeated by institution within title. All data will be run through an applied analysis using R.

---

20. TITLE: *Elliptic Curve Cryptography*
SPEAKER: **Benjamin Hoffmann**
INSTITUTION: Kennesaw State University
EMAIL: ignignotcl@gmail.com
ABSTRACT: An elliptic curve is an equation of the form $y^2 = x^3 + ax + b$. These equations have powerful applications to many fields of mathematics, such as number theory and cryptography. In this presentation, we will consider the cryptographic applications of elliptic curves by looking at integer solutions of elliptic equations over the field $\mathbb{Z}/p\mathbb{Z}$ and the cyclic groups they form under a unique operation of 'point addition' for sets of solution pairs to the equations. Specifically, we will look at the Diffie-Hellman method for generating a private key between two parties, as well as the Elliptic Curve Digital Signature Algorithm.

---

21. TITLE: *Application of Akima Method to Cubic Splines*
SPEAKER: **James Hughes**
INSTITUTION: Towson University
EMAIL: jhughe10@students.towson.edu
ABSTRACT: The Akima Method is a useful tool in approximating the derivative at a given point of a curve. We developed a computational module that applies Akima method to a series of points on a curve and collects the necessary information needed to generate a cubic spline. The points and their derivatives are then used to construct a differentiable cubic spline. This module then uses the univariate cubic spline to create a smooth surface of revolution. With the help of the module, we constructed a model of a baseball bat, determined the dimension of the spline space used in the construction, and printed the baseball bat a using 3D-printer.

---

22. TITLE: *The* $3x + 1$ *Problem* $\bmod m$
SPEAKER: **Micah Jackson**
INSTITUTION: Georgia Southern University and Gulfstream Corporation
EMAIL: gj00325@georgiasouthern.edu
ABSTRACT: The Collatz Conjecture, named after Lothar Collatz, is an open problem that is stated as follows: Beginning with any positive integer a_0, the sequence of integers created by iterating the process

$$a_n + 1 = \begin{cases} \frac{a_n}{2}, & \text{if } a_n \text{ is even} \\ 3a_n + 1, & \text{if } a_n \text{ is odd} \end{cases}$$

will eventually reach the cycle $4, 2, 1$. Although the problem, also known as the $3x + 1$ Problem, is simple to state, a proof has eluded mathematicians. In fact Erdős commented, "Mathematics is not yet ready for such problems."

We examine Collatz sequences $\{a_n\} \bmod m$ for various values of the modulus m. For instance, we investigate whether $\{a_n\}$ can reach the cycle $4, 2, 1 \bmod m$ before the non-reduced sequence reaches $4, 2, 1$; we give many examples and categorize this behavior. We also investigate whether or not $\{a_n\}$ can reach a two-element cycle $\bmod m$.

---

23. TITLE: *Weighed Walks and Generating Functions*
SPEAKER: **Nadine Jansen**
INSTITUTION: North Carolina Agricultural and Technical State University
EMAIL: nyjansen@aggies.ncat.edu
ABSTRACT: A walk is a path from the origin of the Cartesian plane to a point in the first quadrant of the Cartesian plane. These walks can be produced by using different arrows of different lengths, directions, and weights. One arrow will always have a weight of one; this is called the primary arrow. A weight is a function that multiplies the way to get from one point to another. Weighed walks have numbers that denote the number of ways to get to that particular point from the origin while staying in the first quadrant. The objective of this research project is twofold: (1) to analyze the numbers that were produced along the positive diagonals, and (2) to find a pattern in walks formed from three arrows. The pattern was discovered by taking the difference of the numbers on a certain diagonal depending on what diagonal it was (this notation was simplified by using a delta operator). [For example, zero difference on the zeoreth diagonal, one difference, Δ, on the first diagonal, two differences, Δ^2 on the second diagonal, etc.]. A conjecture was made: the difference of each diagonal would always equal the same number; this number, which would always be the sum of the two non-primary arrows, raised the power of the diagonal. For example, if the two non-primary arrows had weights of 2 and 3, then the 4th difference of the 4th diagonal between any two points would be 54. The conjecture was proved using mathematical induction for two cases. One is for a $[1, 1, n]$ walk, where n is a natural number representing the weight of the last arrow. The other proof was for a $[1, m, n]$ walk where m and n are natural numbers representing the weights of the two non-primary arrows. Generating functions were sought to represent each diagonal. A construction method that used proceeding terms on the walk to produce the next one was used. The generating functions were rewritten as partial fractions and a pattern was found between the coefficients. A proof was developed to confirm the pattern. This result means that given any walk, of any weights, one can determine the term on any diagonal at any height. Future research includes looking at walks in the x-y-z plane and seeing if what holds in 2-D also holds in 3-D. *[This study was supported in part, by grants from NSF and NSA awarded to the Math SPIRAL program at the University of Maryland.]*

---

24. TITLE: *Building an Interdisciplinary Undergraduate Research Team at a Predominantly Undergraduate Institution*
SPEAKER: **Ashley Johnson, James A. Jerkins, Cynthia L. Stenger,** and **Jessica Stovall**
INSTITUTION: University of North Alabama
EMAIL: ajohnson18@una.edu
ABSTRACT: In this talk we will share our successful approach to building and managing an interdisciplinary undergraduate research team. Over the past two years we have established and grown an interdisciplinary research group of individual students, student teams, and faculty mentors. We will discuss both the academic and social infrastructure of our program as well as tactics for achieving institutional buy-in for undergraduate research. Also, we will share tips and suggestions we have learned while creating, growing, and maintaining our undergraduate research program including program recruiting, promotion, and funding of student research.

---

25. TITLE: *Energy Efficiency of Buildings* (poster)
SPEAKER: **Taylor Kindred**
INSTITUTION: Kennesaw State University
EMAIL: tkindred@students.kennesaw.edu
ABSTRACT: Energy efficiency of just about anything has been a huge factor in both costs and deciding policy. One area where energy efficiency is a concern is with buildings. This concern drives this analysis into what factors of a given building will actually have an effect on energy efficiency. Energy efficiency of a building can, in part, be examined through the energy required to heat and cool a building. Experimentation using buildings, however, have incredibly high costs. Simulations are used to model the physics behind such constructions to

save on these costs. This simulation created a sample of 768 buildings, with varying orientations and shapes, collecting results of each combination of factors. External conditions and building volume was kept constant. This data was retrieved as public access from UCI Machine Learning Repository, donated from University of Oxford, UK. Through this analysis, the aim is to use regression to analyze which factors of the building's shape are correlated with energy efficiency. We wish to examine the effect of relative compactness, wall area, roof area, height, orientation, and glazing area to predict the heating load (or energy required to heat up the building). Presentation of the results will be centered on construction and examination of several fitted regression models. Once a very good fitted model is found, there will be elaboration on that model. The simplest model should allow an accurate prediction of heat load based on various aspects of the building's shape.

---

26. TITLE: *The Mean Curvature Flow Problem: Applications to Minimal Surfaces and Image Processing*
SPEAKER: **Philippe Laval**
INSTITUTION: Kennesaw State University
EMAIL: plaval@kennesaw.edu
ABSTRACT: In this talk, we will first present motion by mean curvature also known as mean curvature flow (MCF). We will then discuss two applications. The first one is related to the Plateau problem and involves finding minimal surfaces. The second one is related to image processing and involves removing noise from images.

---

27. TITLE: *Analyzing Billiard Paths of Obtuse Triangles* (poster)
SPEAKER: **Aaron Madewell**
INSTITUTION: Dalton State College
EMAIL: amadewell@daltonstate.edu
ABSTRACT: Polygonal billiards is the study of elastic collisions of a point mass inside some polygon in the Euclidean plane. Its development began with George Birkhoff. There is a long standing conjecture that every triangle admits a periodic orbit, one that retraces its path after a finite number of collisions. While there are known classes of triangles that admit a periodic orbit, the problem is unsolved in general.

In this poster I present some patterns found regarding aspects of periodic orbits in obtuse triangles. Using the orbit tracer program along with an unfolding method, I find some emerging patterns pertaining to conditions of a particular periodic orbit and some patterns in the data pertaining to extremal properties of periodic orbits.

---

28. TITLE: *Multiplication of Polynomials in Bernstein-Bézier Form*
SPEAKER: **Rachael Mady**
INSTITUTION: Towson University
EMAIL: rmady1@students.towson.edu
ABSTRACT: When dealing with piecewise polynomials, it is useful to write the pieces in the so-called Bernstein-Bézier form. This form uses barycentric coordinates instead of Cartesian coordinates. In order to work with generators for spline spaces, it is necessary to perform multiplication of polynomial pieces in the Bernstein-Bézier form. We developed an algorithm that computes the coefficients of the product in the Bernstein-Bézier form, given the corresponding coefficients of the factors. The algorithm makes use of the so-called "domain points" that are essential in the field of multivariate splines. The algorithm proves that multiplication of polynomials in the Bernstein-Bézier form is local, i.e. only a few coefficients are used. This is in contrast to the multiplication of polynomials with Cartesian coordinates.

---

29. TITLE: *Determining the Effectiveness of Peer-Led Supplemental Instruction from Undergraduate Mathematics Fellows*
SPEAKER: **Autumn McMunn**
INSTITUTION: University of North Alabama
EMAIL: amcmunn@una.edu
ABSTRACT: Many colleges offer individual tutoring for students who struggle with mathematics. Could peer led supplemental instruction from mathematics fellows be an effective alternative? The University of North Alabama has piloted a Fellowship Program, and this paper studies the results of that program. The fellows in the program attend the assigned class and meet with the students once a week to provide supplemental instruction. This study seeks to determine if the Fellowship Program is effective by comparing the first and second test grades between a fellow class and a control class. The results of this study will contribute to peer led learning literature.

---

30. TITLE: *Elliptic Curve Factorization*
SPEAKER: **Danielle Middlebrooks** and **Lynesia Taylor**
INSTITUTION: Spelman College
EMAIL: rmady1@students.towson.edu
ABSTRACT: RSA is a standard system for encrypting messages to keep them secure from eavesdroppers. RSA's security is based on the difficulty of factoring large numbers. Hendrik Lenstra developed a method of factoring large numbers using elliptic curves. Elliptic curves form an abelian group using modular arithmetic. Performing arithmetic on elliptic curves allows us to break cryptosystems by factoring large numbers. In this presentation we discuss the basis of elliptic curves and the elliptic curve factoring method.

---

31. TITLE: *Single-Target Alliances in Random Order Sequential Quaduels*
SPEAKER: **Susanna Molitoris Miller**
INSTITUTION: Kennesaw State University
EMAIL: smolitor@kennesaw.edu
ABSTRACT: A duel is commonly thought of as a conflict between two people, but what if there are more than two people involved? This talk will present some results from an undergraduate research project which explores just that. I extended research done on truels (duels involving three people) to a scenario involving four people, which I refer to as a quaduel. In the study I explored possible alliances to form in a random order sequential quaduel if the marksmanships of all four participants are known. In the talk I will provide and introduction to theory involving truels, unpack exactly what a single target alliance and random order sequential quaduels are, explain the assumptions made to complete my calculations, present my findings and relate them back to results from research on truels to propose a potential theory applicable to a dueling scenario involving any number of participants.

---

32. TITLE: *Decomposition of Partially-Minimal Cayley Graphs*
SPEAKER: **Evan D. Moore**
INSTITUTION: Kennesaw State University
EMAIL: emoore39@students.kennesaw.edu
ABSTRACT: A tree T decomposes a graph G if there exists a partition of the edge set of G into isomorphic copies of T. In 1963, Ringel conjectured that any complete graph on $2k+1$ vertices can be decomposed by any tree with k edges. In 1989, Häggkvist conjectured more generally that every $2k$-regular graph can be decomposed by any tree with k edges. This conjecture remains unresolved in general, despite generating considerable interest and a significant literature. Expanding upon the work of El-Zanati et al. (2000), we present further results on Häggkvist's conjecture by establishing a new family of Cayley graphs that are decomposable by any tree satisfying the divisibility conditions. Some open problems and future directions will also be discussed.

---

33. TITLE: *Finite element solution of blood flow problems in cerebral aneurysms*
SPEAKER: **Ngoc Phan**
INSTITUTION: Emory University
EMAIL: ngoc.phan@emory.edu
ABSTRACT: Partial differential equations for practical applications are in most cases so complicated that finding their solutions in closed form or by purely analytical means such as Laplace or Fourier transform methods, or in the form of power series, et cetera is either impossible or impractical. Thus one has to resort to seeking numerical approximations to the unknown analytical solution. Finite element methods represent a powerful technique for the approximate solution of partial differential equations. The aim of this presentation is to introduce the application of finite element analysis (FEA) to solve viscous incompressible fluid problem which specifies in studying the behavior of blood flow in aneurysm. FEA consists of three steps:

1) Construct of the geometric model to generate the 3D mesh
2) Solve the system of quadratic/linear finite elements
3) Analyze the results and the velocities recapitulated in the simulation

We will present a test case retrieved by the data set of real geometries available at the Aneurisk Web site http://ecm2.mathcs.emory.edu/aneuriskweb.

---

34. TITLE: *Predicting Sales Using Twitter Data*
SPEAKER: **Joshua Reinoehl** and **Lacey Richards**
INSTITUTION: University of North Alabama
EMAIL: josh123a123@gmail.com
ABSTRACT: Many institutions worldwide, are using data mining to gather large volumes of data to conduct research on the impact that social media plays. To study the impact of social media on retail sales, we developed a process for collecting and analyzing Twitter data. The process begins with a Python script that utilizes the Python Twitter library to collect the data of interest. Once the data has been collected it is then formatted and analyzed using linear regression techniques and correlation coefficients in Wolfram Mathematica. Our work gives a detailed guide to social media data collection as well as our findings from applying this process to collecting tweets that contained #iPad or #Surface.

---

35. TITLE: *Teaching an Honors Seminar on Fractals for Non-Majors*
SPEAKER: **Chris Sass**
INSTITUTION: Young Harris College
EMAIL: ctsass@yhc.edu
ABSTRACT: I taught a one credit-hour seminar on fractals for the honors program at a small liberal arts college in spring 2013. We explored fractals in nature, art, music, architecture, and math; we also studied related areas such as chaos and cellular automata. My approach throughout the course was to allow students to actively explore phenomena through computer programs and hands-on activities. In this talk I will outline the course content, share the resources used in the course, describe the class activities, and survey the final projects submitted by the students. I will conclude that this sort of course provides a wonderful opportunity to introduce non-majors to some beautiful mathematical ideas.

---

36. TITLE: *Edge Colorings Avoiding Some Proper Cycles*
SPEAKER: **Drew Schmidt**
INSTITUTION: Clayton State University
EMAIL: drew.john.schmidt@outlook.com
ABSTRACT: We consider the problem of finding the minimum order of any complete graph so that for any coloring of the edges by k colors it is impossible to avoid a properly colored cycle of length five. If we consider the condition of excluding some family of monochromatic graphs H in the above definition, we produce the *pattern Ramsey number*, $pr_k(C_5; H)$. We determine this function in terms of k when H is a triangle, as well as a triangle and a path on five vertices. In particular, we find that $pr_k(C_5; K_3) = k+4$ and $pr_k(C_5; K_3, P_5) = k+3$.

---

37. TITLE: *On the Stability of Ring Structures in Direct Limits*
SPEAKER: **Nicolas A. Smoot**
INSTITUTION: Armstrong Atlantic State University
EMAIL: ns0566@stu.armstrong.edu
ABSTRACT: In this talk all rings are commutative with 1. It is known that the direct limit of a directed partially-ordered set of rings (domains) and ring homomorphisms is itself a ring (domain). We wish to consider these types of direct limit constructions. In particular, we will be interested in determining whether certain properties which are shared by every ring in a directed partially-ordered set are necessarily preserved in the direct limit.

---

38. TITLE: *Using MOOCs in Precalculus*
SPEAKER: **Tatyana Sorokina**
INSTITUTION: Towson University
EMAIL: tsorokina@towson.edu
ABSTRACT: We share our experiences in teaching Precalculus using Coursera online materials. It is a hybrid course that includes online lectures and flipped classroom components.

---

39. TITLE: *The Coupon Collector Problem: Analysis of Multiple Collections*
SPEAKER: **Michael Thomas**
INSTITUTION: Kennesaw State University
EMAIL: mthom130@kennesaw.edu

ABSTRACT: Suppose that every time you purchase a box of cereal from a certain manufacturer, there is a collectable coupon inside the box. A complete collection of coupons has 'm' different coupons, each being found with different probabilities inside the cereal boxes. How many purchases are required, on average, in order to get a complete collection? How many are needed to complete multiple collections? Probabilistic and empirical results are used to describe the probability distribution of the number of purchases necessary for a full collection as coupon number and collection number increase. We present a simulation program that allows us to examine the empirical results.

---

40. TITLE: *Dominating Sets in* $Cay(\mathbb{Z}_n, \{\pm 1, \pm 3, \pm 5, \ldots, \pm(2k-1)\})$
SPEAKER: **Jon Woltz, Matthew Lee Force,** and **Joe DeMaio**
INSTITUTION: Kennesaw State University
EMAIL: jwoltz@students.kennesaw.edu
ABSTRACT: The circulant graph $Cay(\mathbb{Z}_n, C)$ has as its vertex set the group elements of $\mathbb{Z}_n$ and the $i \to j$ arc exists if and only if $j - i \in C$. If C is closed under inverses then $Cay(\mathbb{Z}_n, C)$ is a graph rather than a digraph. Circulant graphs are a type of Cayley graph. The simplest possible circulant graph is the cycle graph with n vertices, $C_n = Cay(\mathbb{Z}_n, \{\pm 1\})$. It is well known that $\gamma(C_n) = \lceil \frac{n}{3} \rceil$. In 2009, Rad computed $\gamma(Cay(\mathbb{Z}_n, \{\pm 1, \pm 3\})) = \lceil \frac{n}{5} \rceil$ for $n \not\equiv 4 \pmod 5$ and $\lceil \frac{n}{5} \rceil + 1$ for $n \equiv 4 \pmod 5$. In this talk we classify $Cay(\mathbb{Z}_n, \{\pm 1, \pm 3, \pm 5, \ldots, \pm(2k-1)\})$ as either $\lceil \frac{n}{2k+1} \rceil$ or $\lceil \frac{n}{2k+1} \rceil + 1$.

Friday, November 8, 2013	
2:00–6:00 pm	Registration (CL 1000 Atrium)
3:00–4:00 pm	Math Scavenger Hunt
4:00–4:10 pm	Opening Remarks (CL 1010)
4:10–6:00 pm	Plenary Lecture 1: **Robert Beeler** (CL 1010) *Games, Mathematics, and Other Harmless Diversions*
6:00–7:00 pm	Movie: *Julia Robinson and Hilbert's Tenth Problem* (CL 1009) popcorn and soda provided

Saturday, November 9, 2013			
8:00–10:30 am	Registration (Breakfast served at 8:00 am) (SL 1001 Atrium)		
	Contributed Talks		
Judges & Moderators:	ALGEBRA/DISCRETE MATH (CL 1010) Beeler & DeMaio	ANALYSIS/APPLIED MATH (CL 1008) Babenko & Ellermeyer	PROBABILITY (CL 1009) Bell & Gadidov
8:30–8:45 am	M. Force	L. Allen	Z. Carter, N. Song
8:50–9:05 am	J. Woltz	L. Allen	J. Reinoehl, L. Richards
9:10–9:25 am	E. Moore	J. Hughes	M. Thomas
9:30–9:45 am	N. Smoot	R. Mady	L. Dunn
9:50–10:05 am	M. Jackson	S. Eccleston	D. Schmidt
10:10–10:30 am	Coffee Break (SL 1001 Atrium)		

Saturday, November 9, 2013 (cont'd)			
	Contributed Talks		
Judges & Moderators:	ALGEBRA/DISCRETE MATH (CL 1010) Castle & Krop	ANALYSIS/APPLIED MATH (CL 1008) Adhikari & Westlund	PEDAGOGICAL (CL 1009) Derado & Watson
10:30–10:45 am	J. Eubanks	E. Couch, B. Graves	T. Sorokina
10:50–11:05 am	J. Fisher	M. Beaver, A. Edwards	A. McMunn
11:10–11:25 am	S. Molitoris Miller	N. Phan	A. Johnson
11:30–11:45 am	B. Hoffmann	J. Du	Garner, Rudchenko, Watson
11:50–12:05 pm	Middlebrooks, Taylor	P. Laval	C. Sass
12:10–12:25 pm	P. Anschutz, M. Rafay	N. Dowling	J. Derado
12:30–1:30 pm	Lunch (SL 1001 Atrium) — check out the origami table!		
1:30–2:00 pm	Poster Session (SL 1001 Atrium) Judges: Espinoza & Johnson **V. Awokunle** *Improving Existing Tumor-Growth Models* **K. Cline** *Research Experience for Undergraduates 2013* **J. Dollar** *An Inquiry-Based Approach to Teaching Parameterization* **C. Hanks** *2011 USG Faculty Salary Analysis* **T. Kindred** *Energy Efficiency of Buildings* **A. Madewell** *Research Experience for Undergraduates 2013*		
2:00–2:10 pm	Department Chair's Welcome (SC 109)		
2:10–3:00 pm	Plenary Lecture 2: **Martin Golubitsky** (SC 109) *Patterns and Symmetry*		
3:10–4:00 pm	Panel Session — Careers with Mathematics (SC 109) **Jeffrey Berman** (Lockheed Martin), **Matthew Graham** (Home Depot), **Warren Hearnes** (Cardlytics, Inc.), **Sean Hilden** (Bank of America), **John Jacobson** (Link Analytics), **James Piekut** (Wellpoint)		
4:00–4:30 pm	Coffee Break (SL 1001 Atrium)		
4:30–5:20 pm	Plenary Lecture 3: **Tatyana Sorokina** (SC 109) *In the Barycentric World*		
5:20–5:30 pm	Closing Remarks and Awards Ceremony (SC 109)		