Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Paper Session Abstracts

University of the Sciences in Philadelphia

November 7, 2009

Graduate Student Speakers

Christopher Godbout, Lehigh University
Title: Lie Algebras and Parallel Parking
Session: IV Room 137
Abstract: Using properties of Lie algebras, I show how it is possible to parallel park into any space that is longer than your car.

Jonelle Hook, Lehigh University
Title: Star-Avoiding Ramsey Numbers
Session: I-B Room 237
Abstract: As Theodore S. Motzkin clearly stated, "Complete disorder is impossible." This quote embodies the fundamental notion of an area of combinatorics and graph theory called Ramsey Theory. The (graph) Ramsey number $R(G, H)$ is the smallest integer n such that every 2-coloring of the edges of K_n contains either a red copy of G or a blue copy of H and there exists a *critical* 2-*coloring* of K_{n-1} that does not contain a red copy of G or a blue copy of H. These facts propose a question. What is the largest star $K_{1,k}$ that can be removed from K_n so that the underlying graph is still forced to have either a red copy of G or a blue copy of H? We have determined this integer for various classes of graphs G and H where $R(G, H)$ is known. For these Ramsey numbers, we have also classified the critical 2-colorings.

Henok Z. Mawi, Temple University
Title: The Refractor Problem with Loss of Energy and the Monge-Ampere Equation
Session: I-B Room 237
Abstract: Refraction occurs when a light ray changes mediums. Consider two homogeneous isotropic media I and II, and two subsets $\Omega,\ \Omega^*$ of the unit sphere in $\{R\}^{\{}n\}$. Suppose that light emanates from a source at the origin O, in medium I. Assume that the ray in the direction of $x,\ x \in \Omega$ has intensity $g(x)$.
In this work we will construct a refractor $\mathcal{R}$, separating the two media in such a way that a ray in the direction x is refracted off $\mathcal{R}$, according to {Snell's Law}, into a ray which has a direction in Ω^* and the prescribed illumination intensity received in the direction $m \in \Omega^*$ is $f(m)$. Moreover, we notice that this refractor is a graph to a solution of a nonlinear partial differential equation.
This is joint work with Prof. C.E. Gutierrez.

Juan Pablo Ortiz, Lehigh University
Title: Constructions of Coverings of the Integers: Exploring an Erdos Problem
Session: I-B Room 237
Abstract: In this talk, we present necessary conditions for small sets of congruences with distinct moduli to cover the integers, and we construct larger covering systems that address a problem of Erdos: "What is the largest minimum modulus needed for a set of congruences with distinct moduli to cover the integers?" We show that the fewest number of distinct moduli necessary to cover the integers is 5, and that there is only one set of distinct moduli with which to construct a covering with only 5 congruences. We determine which natural numbers less than 50 can be the least common multiple of the moduli of a covering. We establish that the minimum modulus for a covering system of distinct moduli is at least 11.

Caroline Shapcott, Drexel University
Title: Product of Parts of Random Integer Compositions
Session: IV Room 137
Abstract: A composition of n is an ordered partition of the positive integer n. Let B be the product of all parts of a randomly selected composition. Then the average value of B is given by $F(2n)/2^{\{}n-1\}$ where $F(2n)$ denotes the 2n-th Fibonacci number. I will give a brief introduction to compositions and describe the methods used to obtain the formula.

Undergraduate Student Speakers

Harsh Amin, Christian Tooley, University of the Sciences in Philadelphia
Title: Combinatorics in Mathematical Chemistry
Session: III Room 137
Abstract: Chemistry is a branch of science that is associated with discrete mathematics. The use of computers in theoretical chemistry for solving chemical problems has bridged the gap between chemistry and discrete mathematics. The development of graph theory and group theory is used for spectroscopy. Algebra combinatorics in mathematical chemistry is a branch of mathematical chemistry that is closely related to discrete mathematics. Combinatorics in mathematical chemistry is associated with chemical modeling in structural chemistry, which deals with the algorithms associated with coarse graining computational simulations. Molecular design, computational synthesis of molecular structures and reaction synthesis simulations are all calculated using combinatorics or computer modeling, which use discrete mathematics as a base.

Stephanie Bann, Nicolina Coppola, Joanna Verzosa, Melinda Gayle, Mercy College
Title: Quantitative Analysis of Color Deficiency (Colorblindness)
Session: II Room 137
Abstract: Genetic disorders are a result of abnormalities in genes or chromosomes. Different types of color deficiencies involve mutations in genes that encode different wavelength photoreceptors than the normal which reduce the individuals vision capabilities. This genetic disorder can be examined using Mendelians punnett square to demonstrate the probability of transmission of heritable traits. A comparative analysis depicts the prevalence of males being more susceptible to this genetic disorder than females because of the x chromosome. Being unable to distinguish colors can make color deficient people feel handicapped in everyday tasks such as coming to a stoplight. Human relations to gene therapy in monkeys (primates) have been conducted successfully.

Phillip Gaudreau, Moravian College
Title: Component Order Edge Connectivity for Graphs of Fixed Size and Order
Session: III Room 137
Abstract: Reliability is an important property used to describe the capability of a network to work properly under different conditions. By representing a network as a graph, we can talk about aspects of that network in terms of nodes and edges. In communications networks, in particular, we are likely to see that the nodes of the network are perfectly reliable while the edges are prone to failure. One measure of the reliability of this type of network then is the component order edge connectivity of the network. The component order edge connectivity number, λ, of a graph is the smallest number of edges that must be removed from a graph such that the resulting subgraph has all components with order less than some predetermined value k. My research results involve finding minimum and maximum values of λ; for the collection of graphs of fixed size and order for certain values of k.

Sarah Janssen , Hiu Yan Cheng , University of the Sciences in Philadelphia
Title: The Four Color Theorem
Session: I-A Room 137
Abstract: Our presentation will be discussing the history and conception of the four color theorem applied to maps. We will discuss the proof for this theory along with general knowledge of what this theory is applied to in common practice.

Jonathan Jaquette, Swarthmore College
Title: Existence of Topological Entropy Preserving Subsystems Weakly Embeddable in Symbolic Dynamical Systems
Session: I-A Room 137
Abstract: The topological entropy of dynamical systems is known to be equal to or greater than all of its subsystems. We show conditions in which subsystems will have equal topological entropy. Furthermore, we characterize systems containing invariant subsets of equal entropy that are weakly embeddable in a symbolic dynamical system. Positively expansive topological dynamical systems on compact metric spaces are such systems.

Rachel Lemmey, Christina Tawfik, Gayatri Samnarain, Mercy College
Title: Mathematical Modeling for Anaysis of Genetic Disorders: Cystic Fibrosis
Session: II Room 137
Abstract: Conducting research provides a great way to explore and learn about new topics. Our topic is genetic disorders. Genetic disorders are diseases that are caused by an abnormality in an individual's DNA. Two major genetic disorders are sickle cell anemia and cystic fibrosis. Sickle cell anemia is a disorder that affects the red blood cells. More than 80,000 Americans are living with the sickle cell disease. Cystic fibrosis is a hereditary disease affecting the exocrine gland of the lungs. Approximately 1 in every 3,900 Americans suffers from cystic fibrosis. We will use mathematical modeling to analyze cystic fibrosis by ethnicity and to examine how gene therapy can help prevent the spread of genetic disorders.

Saniya Merchant, Gurleen Dhingra, University of the Sciences in Philadelphia
Title: Discrete Fourier Transform
Session: II Room 137
Abstract: Fourier Transform is a mathematical concept (and associated equation) concerned with transforming the domains of functions from space and/or time to frequency. This kind of a transform is performed via a complex integral. However, many algorithms and computer programs do not work well with continuous integrals. In order to accomplish Fourier Transforms via algorithms, the equation must be re-written as a discrete summation. Discrete Fourier Transform is much easier to work with mathematically and finds broad practical applications in image filtering and compression, signal translation, processing of audio and video, astronomy, and optics.

Gina Mulranen, Cabrini College
Title: Springing into the Wave Equation
Session: I-A Room 137
Abstract: In my talk, I'll derive the solution of the wave equation for a string with mass-spring systems at both ends of the string. I'll find the eigenvalues, eigenfunctions and the coefficients of the Fourier Series that represent the solution.

Kamal Tambakuwala, David Scala, University of the Sciences in Philadelphia
Title: The Wonders of Fractals
Session: II Room 137
Abstract: A fractal is an image that contains fragments, which resemble the whole image, that are a reduced-size copy of the entire figure. Fractals were first discovered in the 19th century. However, a mathematician known as Benoit Mandelbrot first gave them their name in 1975. Several features and properties define fractals. As a result, according to its definition and features, they appear regularly in nature despite their complexity. In this presentation, you will learn about the history of fractals and the properties that demonstrate their complexity, and engage in an in depth analysis of examples of fractals that occur naturally.

Jared Wasserman, Jason Franck, Vinay Daryani, University of the Sciences in Philadelphia
Title: Partition Theory
Session: I-A Room 137
Abstract: This presentation will cover the basics of partitions and partition functions. It will begin with what a mathematical partition is and how to properly use Ferrers diagrams to represent them. The presentation will include several different methods used to calculate a number's partition. The presentation will cover the Intermediate Function of partitions, which determines the number of partitions containing only natural numbers larger than a specified value and the Rademachers Series, which can give a quick estimate of the number of partitions a particular number has. Finally the presentation will end with a brief explanation of partition theorys relation to other fields of combinatorics.
