Eastern Pennsylvania and Delaware Section
of the Mathematical Association of America

Student Contributed Paper Session Abstracts

Cedar Crest College
April 5, 2008

Graduate Student Speakers

Christopher Godbout, Lehigh University
Title: Group Theory and the Rubix Cube
Abstract: An interesting application of permutations and group theory is in solving a Rubix Cube. In this talk, I will briefly go over how group theory applies to the Rubix Cube and some moves that are impossible.

Joel B. Mohler, Lehigh University
Title: Seeing the Future with Binomial Coefficients
Abstract: Integer sequences have been a research tool and casual amusement for generations of mathematicians. This talk will exhibit a difference-analysis method of determining the next term of an integer sequence assuming that the sequence comes from evaluating a polynomial at integer points. The binomial coefficients provide a way to utilize difference analysis to recover the generating polynomial.

Undergraduate Student Speakers

Taha Alsardary, Michael McInerney, University of the Sciences in Philadelphia
Title: Crytography
Abstract: Cryptography is the practice and study of hiding information. In modern times, cryptography is considered to be a part of mathematics, computer science, information theory, computer security, and engineering. In this talk we introduce the history of Cryptography and give some of its applications.

Stephen Carter, Millersville University of PA
Title: Double Bubble Experiments in the 3-Torus
Abstract: In the spring of 2007, our undergraduate research seminar directed by Drs. Ron Umble of Millersville University and Frank Morgan of Williams College studied surface-area-minimizing double bubbles in the three-torus. A double bubble is formed when two bubbles are joined together separated by a shared membrane. The three-torus can be thought of as a cube with opposite sides identified. In 2001, Miguel Carrion, et al. conjectured that a surface-area-minimizing double bubble in the three-torus is one of ten distinct topological types. The goal of our project was to determine whether or not these ten types can physically exist. To do this, we constructed two Plexiglas box models of the three-torus then blew soap bubbles into the boxes. By successfully producing each of the ten conjectured topological types, we proved that each type can physically exist. In this talk we describe the techniques we used to produce these ten particular types.

Sean Evans, Millersville University of PA

Title: New Examples of A_∞-bialgebras

Abstract: A *bialgebra* is a vector space H equipped with a compatible multiplication $\mu : H \otimes H \to H$ and a comultiplication $\Delta : H \to H \otimes H$. An A_∞-*bialgebra* is a vector space H equipped with a family of compatible operations $\{\omega^{j,i} : H^{\otimes i} \to H^{\otimes j}\}$. This talk examines examples of vector spaces equipped with three operations: a multiplication μ, a comultiplication Δ, and an operation $\omega : H \otimes H \to H \otimes H \otimes H$. We verify that our examples satify the compatibility axioms of an A_∞-bialgebra. These are the first examples of this particular structure discovered. We are interested in A_∞-bialgebras because every loop space has an associated A_∞-bialgebra model. Whether or not every A_∞-bialgebra models some loop space is an open question.

Matthew Greech, King's College

Title: The Snowflake Curve

Abstract: This presentation will focus on the Snowflake Curve, a figure that is analyzed through fractal geometry. Details regarding the area and perimeter of this structure will be examined after formulas are derived for each measurement. The formulas will represent either a sequence after n steps or as a sum of terms. After deriving these formulas for the perimeter and area, we will attempt to discover whether or not the given measurements converge to a given number or diverge. Furthermore, we will examine other interesting details about the Snowflake Curve concerning the increment rate from step $n + 1$ to step n of the number of vertices, edges, and triangles.

Jeremy Hauze, Kings College

Title: A Small Axiom System

Abstract: This will be a brief discussion on an axiom system that was constructed and several theorems that can be formulated based on a few basic axioms. Consistency models, independence models, and some basic proofs will be covered.

Amanda Hussey, Kendra Gouse, University of the Sciences in Philadelphia

Title: Four Color Theorem

Abstract: Graphs, charts, and maps provide a visual method of depicting information. A problem arises in how to color a map so that the information can be seen easily, and that no two adjacent borders have the same color. This presentation will inform about the four color theorem, its history, and provide applications of its use.

Christian Millichap, Dickinson College

Title: The Topology of Robots Moving on Graphs

Abstract: Suppose there is a large factory floor with a track laid down on the floor, which we can think of as a graph. On this track, there are a certain number of mobile robots, transporting items from place to place. The robots must be programmed so that they will not collide and still be able to efficiently transport items around the factory floor. To ensure that there are no collisions, we place the following restriction on the robots: any two robots must be at least one edge apart. This problem has a topological solution - construct the space of all possible arrangements of the robots on the factory floor and remove all the arrangements that could potentially result in collisions.

We call this space the Discretized Configuration Space of a graph. These spaces are cell-structures that when glued together form interesting topological spaces.

Devin J. Pohly, Messiah College

Title: To Each His Own: Personalized Version Control

Abstract: A principal frustration among team programmers is the need to abandon their personal programming styles in deference to a common team standard. As a consequence, effort is wasted readapting carefully cultivated programming practices and fixing coding errors precipitated by such adaptation. This presentation discusses the possibility of eliminating the need for team coding standards by implementing a version control system that fosters interactive programming without forsaking individual preferences.

Patrick Schofield, Vasandra Pendleton, Thu Duong, University of the Sciences in Philadelphia

Title: The Dartboard Sequence

Abstract: The topic we will be discussing is the dart board sequence. We will begin the presentation by giving a brief history of the dart board. Also, we will give a brief explanation on how the game is played. The presentation will then discuss the mathematical reasoning behind the arrangement of the numbers on the dart board to minimize chance and improve accuracy.

Bradley Schuster, King's College

Title: The Automorphism Group of Z_n

Abstract: This presentation is in the field of group theory. We begin by introducing the notion of an automorphism, an isomorphism from a group to that same group. Then we consider the set of all possible automorphisms and claim it is a group along with the operator of function composition. We specifically focus on the automorphisms of Z_n. What could $\mathrm{Aut}(Z_n)$ be isomorphic to? We manually work out the first few Z_n groups in a hope to find a recognizable pattern. A pattern is indeed found and it leads us to hypothesis that $\mathrm{Aut}(Z_n)$ is isomorphic to $Z_{\ddot{O}(n)}$ where $\ddot{O}(n)$ is Eulers Phi function. However, we soon thereafter discover a contradiction and must reform our hypothesis. Finally, we then find a suitable and well-known group that $\mathrm{Aut}(Z_n)$ is indeed isomorphic to.

Nicole Stawasz, King's College

Title: How to Create a Small Axiom System

Abstract: I am going to be explaining how to create your own small axiom system. I will do this by explaining what an axiom system is, as well as, defining consistency and independence. I will use a small axiom system that I have already created, and will use the models in my system to help explain how to create your own system.
