Abstracts for Contributed Paper Presentations

Jennifer Anderson
University of Texas at Arlington
An Introduction to Quandles

Abstract: A *quandle* is a binary algebraic structure $\langle Q, \triangleright \rangle$ satisfying idempotence,right self-distribution, and invertibility. We will discuss definintions, examples, and results from summer research.

Candace Andrews
University of Texas at Tyler
Finite C-Groups

Abstract: In this talk, discussion will focus on known results concerning the characterization of Finite C-Groups. Methods for determining C-Groups will be explained and terminology will be introduced.

Maria Asencio
University of North Texas
Seedling Distribution and Mortality Model in Response to Fire and Torrential in Mediterranean Gorse Shrublands

Abstract: One of the major ecological challenges in the Mediterranean region of South Eastern Spain is occurrence of intense fire events on abandoned, formerly agricultural land. These fires can cause irreversible effects in the environment, destroying ecosystems and natural resources. One of the solutions is to find an efficient and effective-fire management practice. Our mathematical model will provide guidance to manage fire-prone vegetation through effective prescribed burns and/or mechanical mowing.

James Branch
Sam Houston State University
Curves and Surfaces: The Development of CAGD

Abstract: Since ancient times, curves as tangent continuous circular arcs have been widely used in design and manufacturing objects with free-form surfaces. As time went on, further developments were made to refine, advance, and make these techniques more precise. This presentation is to give a short history of curves as the area of Computer Aided Geometric Design came into use, and some applications of them. Topics include historical techniques and modern use of Bezier curves, B-splines, and NURBS in particular.

Angela Brown
University of Texas-Arlington

A Short Introduction to Knot Theory and How it Applies to Celtic Knots

Abstract: We will give an introduction to certain definitions required to discuss knot theory and their usage in developing a mathematical definition of a Celtic knot. We will also give some results concerning which knots are mathematically Celtic. This is work that was completed for my MS degree at Sam Houston State University.

Phillip Couch
Lamar University

Controlling the Flow of Traffic for School Zones or Other Specialty Traffic Areas

Abstract: Many intersections in modern cities are regulated by traffic lights. In certain districts, there is a need for traffic to be monitored more closely for the safety of pedestrians and people who are otherwise at risk of being harmed by a motor vehicle traveling on a busy roadway. Most notably, public schools, when placed on or near busy streets and/or intersections, preoccupy the traffic system with buses, parents, and students during certain periods of the day. This study is conducted on a "school zone", or length of roadway which has a lower speed limit immediately before and after school to ensure the safety of the children and their parents and teachers. The aim of this study is to devise a method to regulate the timers for traffic light intervals in these areas without the use of motion or weight sensors (which can often be misled by vehicles of non-standard size, e.g. motorcycles, industrial vehicles, etc.). By properly controlling flow of traffic in these areas, ease of transit can be maximized for both the patrons and workers at the local institution and the commuters who must traverse the area in order to reach their respective destinations.

Eric Daniel
University of Texas at Arlington

The Use of Representation Theory in Particle Physics: A Historical Interpretation

Abstract: In 1961 Murray Gell-Mann arranged the known hadrons in a classification scheme called the Eightfold Way, which is based upon the Lie group $SU(3)$. In 1964 the properties of $SU(3)$ led Gell-Mann to postulate the existence of quarks, which were discovered experimentally three years later. This is an example of the study of physics being driven by knowledge of mathematical structures that were developed independently of physical concerns, contradicting a common assumption that mathematics develops at the behest of the physical sciences. I conclude that as the objects of our inquiry become extremely small, the importance of mathematics in guiding our inquiries is paramount. This discussion is primarily historical, and no knowledge of representation theory or particle physics is assumed. After a brief survey of the history of atomic physics, an informal introduction to the Lie algebra $su(3)$ and its representations will be given along with an explanation of its role in the Eightfold Way. Emphasis will be on the way in which the properties of the fundamental representation of $su(3)$ led Gell-Mann to propose that hadrons were composed of three simpler particles (quarks) and the role that this result played in future theory.

Adam Drake
University of Houston-Downtown
Primordial Black Holes and Structure Formation

Abstract: Primordial Black Holes (PBHs) were first proposed by Zel'dovich & Novikov (1967) and Hawking (1971) as a consequence of the extremely high densities that occur in the Big Bang model. They differ from other black holes in our universe in that they do not have stellar progenitors and have a wide range of possible masses $M_{\rm PBH} \sim 10^{-5}g$ and $M_{\rm PBH} \geq 10^{15}g$. It is also well-established that supermassive black holes (SMBHs) with masses in the range of $10^6 - 10^{9.5}M_\odot$ reside in most galactic centers. These SMBHs have grown largely through accretion but it is still unclear how they formed. We examine the possibility that PBHs are the seeds from which SMBHs grow and attempt to determine the viability of PBHs as a dark matter candidate.

Adam Drake
University of Houston-Downtown
Enumerating Non-Graceful Graphs Using Rosa's Parity Condition

Abstract: A simple graph G is a graceful graph if there exists a graceful labeling of the vertices of G. If we cannot gracefully label the vertices of G, then G is a non-graceful graph. A result by Rosa provides a sufficient condition for a graph to be non-graceful: "If a graph G is simple, even, and has e edges, with $e \equiv 1$ or 2 (mod 4), then G is not graceful." This condition implies an infinite subclass of non-graceful graphs, which we define to be $\mathcal{R}$. By the degree-sum formula for graphs, the sum of the degrees of G is equal to $2e$. We systematically enumerate graphs in $\mathcal{R}$ by first generating all even partitions of $2e$ (where $e \equiv 1$ or 2 (mod 4)) using Maple. We then use the Havel-Hakimi procedure to determine which of these number sequences are graphic. These graphic sequences determine all of the simple, even, graphs in $\mathcal{R}$ (both connected and disconnected) with $e \equiv 1$ or 2 (mod 4)) edges.

Megan Gallant
Trinity University
Semi-Transitive Orientations of Graphs

Abstract: A graph is semi-transitive if there exists a subset G of the automorphism group of the graph such that G acts transitively on vertices and on edges, but not on darts. That is, we can find enough symmetries in G to take any 1 vertex of the graph onto all other vertices, any 1 edge onto all other edges, but we can't send any directed edge to all other directed edges. A semi-transitive orientation of a graph is the orbit of a directed-edge of the graph under G. So an orientation is a directed graph with one dart on each edge of the original graph. A semi-transitive graph can have multiple non-isomorphic orientations. Given any semi-transitive graph, how do we find an orientation of that graph? How do we find all orientations of the graph?

Sarah Hall
Lamar University
Revisiting Uncountable Infinity

Abstract: Uncountable infinity theory utilizes cardinal sets for functions to show that intervals have an infinite number of one-to-one points. This study arrives at uncountable infinity theory in a slightly different way by investigating the precision of limits and comparing the bijections of two separate functions over varying intervals.

Megan Jennings
Lamar University

The Probability Behind Craps

Abstract: The probabilities of the game board in a game of craps have been studied for decades. In this talk the thoery of getting the odds for the casions will be presented. The probability of rolling certain combinations of numbers will be discussed. The pictures and the formulas used to derive the information will be presented.

Dustin Jones
Sam Houston State University

An Analysis of Volumetrically Correct Cups

Abstract: Sets of nested, volumetrically correct cups are available commercially as toys for young children, but the possibilities for mathematical analysis of these materials span far beyond prekindergarten into calculus. A set of cups C_i, $i = 1, 2, 3, ..., n$, is said to be *nested* if C_i will physically fit inside of C_j for all $i <$(inner radius of C_j) for all $i < j$. A set of cups is *volumetrically correct* if V_i, the volume of cup C_i, is equal to $i \cdot V_1$ for all i. In this presentation, I compare a physical set of cups that claim to be volumetrically correct with a special case in which the sequence of radii of the cups is arithmetic. Additionally, I discuss the sequence of heights of cups, the physical limitations of the idealized model, and the possibility for other sets of nested, volumetrically correct cups.

Mark Lane
Sam Houston State University

Magic Connections Between Squares and Graphs

Abstract: There is a one-to-one correspondence between the set of all $n \times n$ symmetric semi-magic squares and the set of all magic labelings of the complete general graph Γ_n on n vertices. It was shown later that a one-to-one correspondence exists between the set of all $n \times n$ magic squares and the set of all magic labelings of the complete bipartite graph $\Gamma_{n,n}$ on n vertices. We will present the methods and the mathematical tools that are used to show each correspondence.

Juan C. Leon
University Of Houston-Downtown

Behavior of Cancer Cells in a Mathematical Model

Abstract: A system of ordinary differential equations is used to describe specific components of the mammalian cell cycle network. The system concentrates on seven different proteins which are known to be significant players in the development of cancer. We focus particularly on the effects of two tumor suppressor proteins - p21 and p53 - on the cell cycle. We present simulation results which may provide insight into prospective biological studies of the cell cycle and cancer.

Rooholah Majdodin
Sharif University of Technology
A Novel Solution to the $(n^2-1)-$Problem

Abstract: We have presented a new and easy proof to the $(n^2-1)-$puzzle. Also we have demonstrated an elegant and flexible algorithm that when possible, solves the puzzle by meeting the squares in any given order and bringing them their due pieces.

Frank Mathis
Southern Methodist University
On Eigenvalues and Eigenvectors of the Laplacian of a Graph

Abstract: We consider the classification of simply-connected graphs that represent the linearization of a system of differential equations, by the eigenvalues and eigenvectors of their Laplacians. We further examine the characteristics of the laplacians and the graphs to determine what causes them to form these areas of classifications. We investigate two cases for graphs sharing the same eigenvectors, simple edge addition and edge addition with permutation. Examples are given in both cases, in particular, the case of simple edge addition for the set of graphs with five nodes.

Melissa Mauck
Sam Houston State University
Fingerprints: Are They Your Own?

Abstract: We will be investigating fingerprints and the accepted fact that everyone has a different set of fingerprints. We will look at the history of fingerprinting and see why it is the accepted form of identification. We will provide a background of the process of fingerprinting and the comparison process used in the criminal justice system. We will investigate the probability that two people could have the same set of fingerprints. We will then look at different mathematicians perspectives and how they proposed to solve this matter.

Rim Mohamed
University of Houston–Downtown
Graphs of Weighted Rational Functions

Abstract: In this research project, I give graphical representation of weighted rational functions of the form $rn(x) = \dfrac{e^{\delta nx} pn}{qn}$, where pn and qn are real algebraic polynomials of degree at most n. These functions oscillate (change sign) on the interval $[0, 2\delta]$ frequently, which is used to show that the constant functions cannot be uniformly approximated on $[0, 2\delta]$ by such weighted rational functions. I also make conjectures based on the graphs of the weighted rational functions. The zeros and the poles of these rational functions are obtained by discretizing a logarithmic potential.

Alexis O. Olson
U. T. Arlington
The Determination of Sound Pressure at the Lips From the Shape of a Vocal Tract

Abstract: A persons vocal tract takes a particular shape during the utterance of each phoneme. In our research we examine the sound propagation in vocal tracts for five American English vowels (/a/, /u/, /e/, /i/, and /ae/), and we evaluate the corresponding air pressure at the lips as a function of frequency.

Amy Potter
Sam Houston State University
Sabermetrics, or Which Astro is the Most Valueable Player

Abstract: In this talk we shall discuss how simple statistical concepts can help us obtain the objective knowledge of a baseball game, help compare the performance of players in a team, and predict future results. Using sabermetrics, we will analyze the Astro's past seasons performance. We will analyze the value of each player in terms of how much they added to the team's offense. We will also discuss how the Astros performed compared to how they should have done based sabermetrics. Basted on the past performance evaluation, we shall also predict the Astros future performance.

Michael Puente
University of North Texas
Vocal Tract Acoustics: Finding the Sound Pressure

Abstract: The research to be presented is based on findings conducted during the 2006 summer NREUP at the University of Texas at Arlington. The purpose is to determine the sound pressure throughout the human vocal tract as a function of frequency when the sound corresponding to a phoneme is produced. Given only the shape of a human vocal tract, we use a piecewise-constant approximation for the relative concavity of the tracts radius as a function of the distance from the glottis. Under this approximation, an explicit expression for the pressure is obtained from the acoustic equations.

Mauricio A. Rivas
Sam Houston State University
Art and Mathematics

Abstract: In this talk we will explore different connections between art and mathematics. We will discuss various artwork from various artists throughout history and how these pieces of art can be seen as mathematical endeavours.

John Snow
Sam Houston State University
Physics Animations with Constraints

Abstract: We will describe how to use basic concepts from Calculus III (gradients) and Linear Algebra (row space, null space, least squares) to numerically model the motion of a collection of point masses subject to constraints.

Jahn Veach
UT–Tyler
Squaring the Square (and Other Related Shapes)

Abstract: A square tiling is defined as the dissection of a shape into a number of smaller squares with no two squares sharing the same size. The ultimate goal is to discover the mininum number of different squares required to tile a given shape. Rectangles were the first shapes to be investigated, with the minimum being proved in 1940. The minimum proof for squares followed in 1978. By taking a square and allowing the edges to wrap around in certain ways, square tilings can be made for the resulting shapes, such as the cylinder, torus, Mbius band, Klein bottle, and projective plane. This talk discusses the methods by which these tilings are discovered, shows examples of currently known tilings, and attempts to make progress on certain unsolved questions.

Shaun Williams
The University of Texas at Tyler
n-Colorings of Twist Knots

Abstract: In this talk we give necessary and sufficient conditions on n for the twist knot $(2k+1)_1$ to be n-colorable. In addition, if the knot $(2k+1)_1$ is n-colorable, then all solutions for such a coloring are found.