Talk Abstracts 2007

Name: Josh Abbott
School: Humboldt State University
Advisor: Tyler Evans
Title: *Variations on Conway's Game of Life*

Abstract: We define a cellular automaton (CA) as a discrete dynamical system consisting of a lattice of cells, where each cell assumes values from some finite alphabet, and a local update rule that determines the value of each cell at the next time step. A simple graph's adjacency matrix can be viewed as a lattice of cells with an alphabet of {0,1}. We will show that certain CA update rules acting on this adjacency matrix yield other simple graphs. Conway's Game of Life is one example of a CA that preserves a graph structure but does not maintain graph isomorphism. We create a general class of "life-like" update rules that do retain graph isomorphism and demonstrate the evolution of graphs within this class of rules.
Key words: cellular automata, Game of Life, isomorphism

Name: Miranda Braselton
School: San Jose State University
Advisor: Bem Cayco
Title: *Improved Linear Algebra Techniques For Photometric Redshift Calculation*

Abstract: The calculation of redshifts of galaxies from photometric filter data often requires the solution of a non-sparse linear system of n equations in n unknowns, where n is very large. Gaussian elimination is not only time consuming, but it also requires a lot of memory and storage capacity. By taking advantage of the special structure of the matrix, we present a fast, direct algorithm that solves the linear system quickly and efficiently.

Name: Andrew Carter
School: Southern Oregon University
Advisor: Sherry Ettlich
Title: *Dynamics of Simple Epidemiology Models*

Abstract: I will discuss several versions of the basic S-I-R epidemiology model with the goal of illustrating how refinements of the model produce different results.

Name: Michael Casolary
School: University of the Pacific
Advisor: Sarah Merz
Title: *Optimizing Healing in "World of Warcraft" Using Linear Programming*

Abstract: The popular video game "World of Warcraft" is more than just an entertaining diversion. Hidden within the mechanics of the game lie complex mathematical formulae that govern everything from combat to commerce. Healing allies is a core facet of gameplay, and many consider it an art when performed efficiently and effectively. This project aims to utilize linear programming concepts to analyze healing from a mathematical standpoint with the objective of maximizing any given healer's abilities. A computer program developed for this project has proven capable of accurately suggesting strategies of spell selection to optimize time spent, mana used, and hit points healed under a variety of constraints and conditions.

Name: Paul Craciunoiu
School: San Jose State University
Advisor: Bem Cayco
Title: *What If You Built a Machine To Predict Hit Movies?*

Abstract: Research and ingenuity can bring the mathematical sciences even to the most unexpected places: Hollywood. Mathematical patterns found in music and movies can be used to predict which songs will make it to the top of the charts and which movies will be block busters.

Name: Daniel DeWoskin
School: University of California, Berkeley
Advisor: Javier Arsuaga
Title: *Uncovering Nuclear Geometry Through Ionizing Radiation Signatures*

Abstract: During interphase, individual chromosomes occupy their own sub-nuclear volumes called chromosome territories. Radiation assays have shown that territories are randomly positioned with respect to each other except for several groups of chromosomes that form clusters. We will present our mathematical methods to look at the effects of different types of radiation on individual chromosomes, and their signatures on chromosome clusters.

Name: Aaron Donahue
School: Sonoma State University
Advisor: Ben Ford
Title: *Quivers… What Are They?*

Abstract: In the last century, math has seen a giant surge in mathematical structures and concepts. The field of Modern Algebra has benefited greatly from this surge. One such way is through Quivers. Quivers are path algebras, and their use in Modern Algebraic technique are still being discovered. The speaker will discuss the basic structure of a quiver, and applications in the field of linear algebra.

Name: Nick Dowdall
School: Sonoma State University
Advisor: Advisor: San Brannen
Title: *Barycenters, Cevians and the Pythagorean Theorem*

Abstract: Given any triangle, two cevians from distinct vertices will partition the triangle into four convex polygons. We prove a necessary and sufficient condition for two of these polygons to have equal area using barycentric coordinates. The well-known median concurrence and median partitioning theorems are shown as corollaries. Finally, it is shown that the Pythagorean Theorem is a special case when one of the barycentric coordinates is zero with the barycenter the point of intersection between the angle bisector and the hypotenuse of a right triangle. In particular, we show that this proof of the Pythagorean Theorem is, in a sense, a "projection" of the proof given by Euclid in the Book of Elements.

Name: HannaH Fournier
School: Sonoma State University
Advisor: Sam Brannen
Title: *Duplicating the Cube*

Abstract: There were three problems that fascinated ancient Greek mathematicians: Squaring the Circle, Trisecting the Angle, and Duplicating the Cube. It is now known that none of these constructions can be done with an unruled straightedge and collapsible compass. However, the cube can be duplicated with a ruled straightedge and collapsible compass. We will demonstrate such a construction using *Geometer's Sketchpad*.

Name: Abe Goldman
School: Sonoma State University
Advisor: Izabela Kanaana
Title: *Poker Over the Telephone*

Abstract: Can you play poker over the phone and know your opponent isn't cheating? What about flipping a coin? With the help of a few large prime numbers and a little knowledge of cryptography, it’s possible!

Name: Chad Griffith
School: Santa Rosa Junior College
Advisor: Jean Bee Chan
Title: *Use of the Gradient Vector in the Construction of a Solar Electric Array*

Abstract: We will discuss how, in the design of a hillside mounted solar electric system, we were able to determine the direction of maximum descent of that hillside and the rate of that descent from a slope measurement in the East-West direction and a slope measurement in the North-South direction. The direction of maximum descent and value of that descent was required by the structural engineer to complete the structural engineering specifications and thus build the racking system. The calculation was made by turning the slope measurements into vectors and taking the cross product of these vectors to obtain a normal vector and an equation of a plane (which represented the hillside). The gradient value determined the max rate of ascent and the directional derivative determined the rate of that ascent. Rotating these values 180 degrees provided the max rate of descent and the rate of that descent.

Name: Ryan Hake
School: California State University, Chico
Advisor: Thomas Mattman
Title: *Intrinsic Knotting of Partite Graphs*

Abstract: We examine the property of intrinsic knotting (IK) and demonstrate that a particular graph does not have this property. Additionally, we examine new sufficient conditions for IK graphs.

Name: Martini Machado
School: Southern Oregon University
Advisor: Kemble Yates
Title: *Free Groups and Generators and Relations*

Abstract: I will begin with the development of free groups using the common alphabet analogy. From there, I will discuss the Universal Property of Free groups and show how it leads to the generators and relations notation that is often used in group theory.

Name: Sean MacRae
School: Sonoma State University
Advisor: Cora Neal
Title: *Algorithms for generating* P(n), *the sequence of partition numbers*

Abstract: Given a positive integer, how many different ways exist to express it as the sum of other positive integers? What at first appears to be a reasonable combinatorics problem soon becomes quite involved. Leonard Euler is credited with the first discoveries of any depth in the 17th century, but it was not until the 20th century that Hans Rademacher, with the help of Hardy and Ramanujan's work, derived a formula for *p(n),* the number of partitions of an integer *n.* In this exposition I will discuss the very interesting history of partition theory and demonstrate, through the use of computer programming, several different methods to determine how many partitions of an arbitrary integer exist.

Name: Kathleen Mingoia, Kevin Dowdey, Sarah West
School: Sonoma State University
Advisor: Sunil Tiwari
Title: *Drink Up*

Abstract: In California, the legal blood alcohol concentration limit for driving is .08%. In this demonstration, we will use a mathematical model to illustrate the effects of different alcohol consumption patterns on the blood alcohol concentration of the drinker. The blood alcohol concentration at which coma and death occur will also be examined.

Name: Esteban Adam Navas
School: University of California, Riverside
Advisor: Dimiter Vassilev
Title: *The Shape of Water Droplets in the 3-Dimensional Case*

Abstract: Complex functions of the form f(z) = p â€“ iq can be used to describe the two-dimensional velocity v = (p,q) of inviscid, incompressible and uniform fluid flow, where p = p(x,y) and q = q(x,y) are parametrizations of the space coordinates x and y in R2 . If we let the velocity be defined by a complex number V = p + iq, then the complex function f(z) = p â€“ iq (the conjugate of V) is holomorphic; i.e., f(z) satisfies the Cauchy-Riemann equations. The velocity potential and stream function can be defined in terms of partial derivatives of p and q, and by the use of quaternions one can develop complex velocity potential in three dimensions. From such properties of these fluid flows, we try to determine the shape of droplets in two dimensions and then generalize these results to three dimensions by the use of quaternions.

Name: Tri Nguyen
School: Evergreen Valley College
Advisor: Chungwu Ho
Title: *Tic-Tac-Toe and Its Related Games in Higher Dimensional Spaces*

Abstract: In a regular Tic-Tac-Toe game, the first player making three in a line wins the game. We will consider a variation of this: the first player making three in a line loses the game. Thus, the game is to force the opponent to make three in a line first. We will call this new game a Toe-Tac-Tic game. We will show that in a three dimensional Toe-Tac-Tic game the first player has a winning strategy. This is a little surprising since the first player, having one move ahead, seems to be in a disadvantage position.

Name: Nicholas Normandin and Andrew Hermann
School: San Francisco State University
Advisor: Mariel Vazquez
Title: *Movement of Lattice Knots and DNA*

Abstract: Knot theory is a useful tool to understand and model the properties of circular DNA. In this talk, we introduce knots as polygonal chains in the simple cubic lattice, and explain how to generate different knotted configurations using the BFACF algorithm. We illustrate the BFACF moves using Rob Sharein's software Knotplot. Finally we present properties of knots stemming from our calculations, as well as discussing applications of knot movement to DNA.

Name: Juliet Portillo
School: San Francisco State University
Advisor: Mariel Vazquez
Title: *A Model for DNA Unknotting*

Abstract: Our group studies the process of unknotting by type II topoisomerases using knot theory and computational methods. We model DNA as lattice knots. First, we sample the space of conformations for each knot type using the BFACF algorithm, and we label these conformations using Dowker codes. We then perform random strand-passage at the Dowker code level and show that iterated rounds of strand-passage result in unknotting. We will also report on measurements of writhe for our lattice knots.

Name: Kristen Roland
School: Sonoma State University
Advisor: Edie Mendez/Sam Brannen
Title: *Khipu: The Code of the String*

Abstract: The Incas used a collection of strings and knots called khipu to record important quanitifed information. We will discuss what is known about these devices and their significance.

Name: Jason Smith
School: CSU Sacramento
Advisor: Gary Shannon
Title: *So, What is Turing Computability?*

Abstract: There exist more functions on the Natural Numbers than there exist algorithms to compute them. I will prove this fact and then discuss some examples of uncomputable functions.

Name: Allen Stewart
School: Humboldt State University
Advisor: Jeff Haag
Title: *New Graphs From Star Graphs*

Abstract: Given a Star Graph one can derive a new graph by applying a single rule from a particular set of 2-d Cellular Automaton rules on the adjacency matrix of the Star Graph. An example of one of these rules is the 9-term binary addition rule. This talk will present the features of this rule as well as some preliminary results regarding the properties of the derived graphs and the periodicity of the process when it is iterated.