# Abstracts
# Senior Seminar
# Fall 2006 and Spring 2007
# Simpson College
# Mathematics Department

***Origami Constructions: Paper Folding and Euclidean Constructions*** **by Scott Bonz**

When people hear the word origami, it is easy to think of simple paper folding in which objects are created. Little is known about the mathematical applications that can be directly applied to origami. Utilizing both paper folding and Euclidean axioms, mathematics is applied to the area of origami.

The main focus is discovering that a cubic equation can be developed by simple paper folding techniques. This area shows that paper folding techniques and applications is an area that goes beyond practical Euclidean geometry.

***Benford's Law: It's the ONE to Look Out For*** **by Natalie Chizek**

Benford's law is a distribution that analyzes the first significant digit of every data value in a data set. In order for a data set to follow this distribution the data can not be totally random or overly constrained. A data set that satisfies Benford's law will also be sum and scale invariant. In my senior seminar presentation I will present some examples of data sets that follow Benford's law. I will show a mathematical proof of why Benford's law is scale invariant. I will also provide some practical applications of Benford's law.

***L(d,2,1)-Labeling of Simple Graphs*** **by Jean Clipperton, Honors Thesis**

An $L(d,2,1)$-labeling is a simplified model for the channel assignment problem. It is a natural generalization of the widely studied $L(2,1)$ and $L(3,2,1)$-labeling.

An $L(d,2,1)$-labeling of a graph $G$ is a function $f$ from the vertex set $V(G)$ to the set of positive integers such that for any two vertices $x,y$, if $d(x,y) = 1$, then $|f(x) - f(y)| \geq d$; if $d(x,y) = 2$, then $|f(x) - f(y)| \geq 2$; and if $d(x,y) = 3$, then $|f(x) - f(y)| \geq 1$. The $L(d,2,1)$-labeling number $k_d(G)$ of $G$ is the smallest positive integer $k_d$ such that $G$ has an $L(d,2,1)$-labeling with $k_d$ as the maximum label. This paper presents an upper bound for $k_d(G)$ in terms of $d$ for various graphs, $G$ .

***Graceful Labeling of Graphs*** **by Andrew Gorton**

My senior seminar presentation will survey different types of graphs that can and cannot be gracefully labeled. It will focus on special subsets of trees. A proof that every path can be labeled gracefully will be given.

***Conformal Mapping and Its Application to Steady State Temperature*** **by Randall Meyer**

In my senior seminar presentation I will give a brief overview of conformal mapping. Specifically, I will discuss the Dirichlet Problem and how conformal mapping can be used to solve such problems for steady state temperatures. From the results it is possible to see the different temperature isotherms, and also the specific temperature for any particular point.

***The Mathematics of Origami: Local Flat Foldability and Quadrilaterals*** **by Laura Preston**

The art of origami is so much more than just folding decorative cranes, stars, and flowers. Through our research, we introduce the complexity of determining whether a given crease pattern

can be folded into a flat origami. This includes proofs of various theorems used to verify that a crease pattern with a single interior vertex is locally flat foldable. Then, by the application of these theorems, we create our own theorem in which, from a convex quadrilateral, we can create a flat foldable crease pattern in which the given quadrilateral can be folded and cut out with one simple cut. Through the process of induction, we propose that one can then create a flat foldable crease pattern for any given convex polygon to be cut out with one cut. Finally, switching directions, we also focus on the convex quadrilateral, with particular emphasis on a cyclic quadrilateral. Specifically, we concentrate on one theorem in which we prove that the opposite sides of a cyclic quadrilateral meet at right angles.

***Bidding Games*** **by Mike Tiano**

In my senior seminar presentation I will analyze the common English and Dutch auctioning methods from a Game Theory prospective. This analysis will use a uniform distribution to model the assignments of valuations for an object. The results from the analysis will show what the buyer and seller should expect for final outcomes and that the two auctioning systems are mathematically equivalent.

***Applications of Conformal Mapping*** **by Jeff Travis**

In my senior seminar presentation, I will discuss the basics of conformal mapping. I will show how angles are preserved from a tangent line of a curve to a horizontal line, and between two curves when mapped to different plane. It will also illustrate what a conformal map looks like after it is mapped, using a transformation, from a real plane to an imaginary plane.

***Point-Set Topology*** **by Alicia Uhde**

Many people have probably never ever heard of point-set topology before, so we will begin by defining a topological space, open and closed sets, neighborhoods, limit points and closure. Results related to these concepts will be shown and separation properties of sets will be introduced. Through several proofs and examples we will gain a better understanding of what point-set topology really is and how it can be used to study the structure of sets.

***Bets Off: Stopping Strategies & Gambler's Ruin*** **by David Williams**

In my senior seminar presentation I will investigate different stopping strategies and the role these strategy choices play in calculating the probability of losing it all commonly referred to as Gambler's Ruin. In my analysis you will see a neat application of recurrence relations and their corresponding characteristic equations as well as matrix algebra in calculating the outcome probabilities.