Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Paper Session Abstracts

Temple University

March 24, 2018

Student Speakers

Graduate Session I-A
Anderson Hall 102

Taposh Biswas, Delaware State University

Title: Principles of Graph Cuts and Their Applications to Image Segmentation and Object Detection

Time: Session I-A 2:00pm Anderson Hall 102

Abstract: *Image segmentation is a popular research area of image analysis with significant applications to the medical imaging and computer vision domains. In image segmentation, the basic idea is to create a partition of the image scene into objects. We study and develop image segmentation methods using graph cuts. This technique produces segmentation of an image into regions by creating graph partitions and finds the optimal graph partition by minimizing an energy function that consists of data and smoothness terms. Graph cuts represent the set of pixels in the image using graph vertices. Relationships between pixels are represented by graph edges and expressed by a smoothness function. Source and sink nodes are introduced to model region prior information in the data term. We perform image segmentation on datasets of generic and biomedical images with reference region masks to illustrate and evaluate the applicability of this method.*

Azubuike Okorie, Sokratis Makrogiannis (PhD), Delaware State University
Title: Joint Shape and Appearance Features for Registration of Remote-Sensing Imagery
Time: Session I-A 2:18pm Anderson Hall 102
Abstract: *We propose a joint region feature set and a matching cost function for registration of satellite images. Our joint region descriptor is a combination of histogram, intensity and shape features. In this method, we first delineate the input and reference images into regions by segmentation and calculate the centroid of each region. Next, we extract joint features by calculating the combination of the histogram of region intensities, intensities of a square block centered at the centroid, and shape parameters. We then normalize the features by calculating relative frequencies for histogram features and standard normal scores for intensities and shape descriptors. We match the features based on the calculation of weighted sums of the histogram intersection complement, and Euclidean distances, and determining similarity based on minimum costs. Finally, we estimate the geometric transform by the maximum-likelihood sampling consensus (MLESAC) technique. We applied the method to both synthetic and satellite datasets. We validate our results by calculating the root-mean-squared error (RMSE) between the ground truth and the estimated transformation. Our results indicate that joint histogram, intensity and shape features can be used to register remotely sensed satellite images.*

Yilin Wu, Temple University
Title: Mathematical model for biofilm growth
Time: Session I-A 2:36pm Anderson Hall 102
Abstract: *A biofilm can be defined as a group of microorganisms that adhere to solid surfaces in aqueous environments. The cells in the microorganisms become embedded within a glue-like extracellular matrix composed of extracellular polymeric substances (EPS). Thus, a biofilm is made of water, microbial cells, and EPS. With EPS, biofilms can anchor themselves to all kinds of material, such as stone, plastics, medical implant materials, and human or animal tissue. It is estimated that* 80% *of the earth's microbial biomass resides within biofilms. Therefore biofilms appear to facilitate the survival of bacterial pathogens in their environment and their host. The presence of biofilms has both bright and dark sides, such as treatment of wastewater and causing decay of tissue. In my research I'm focusing on the hypoxia (deficiency in the amount of oxygen reaching the tissues) phenomenon arising by biofilm in human or animal tissue and bioprotection or biodeterioration with biofilm for monument conservation.*

Xinli Yu, Temple University
Title: Asynchronous algorithms
Time: Session I-A 2:54pm Anderson Hall 102
Abstract: *With the advent of parallel computers, many new algorithms were devised or rediscovered for the new architectures. Asynchronous parallel solvers are new techniques that speed up the computation time. The main character of asynchronous algorithm is that the local algorithms do not have to wait at predetermined points for predetermined messages to become available. Asynchronous method has wide applications. In this talk applications of asynchronous iterations to different areas will be discussed including solving nonsingular linear systems, Nonlinear equations and Waveform relaxation will be briefly introduced.*

Graduate Session I-B
Anderson Hall 105

McFeely Jackson Goodman, University of Pennsylvania
Title: On the Moduli Spaces of Metrics with Nonnegative Sectional Curvature
Time: Session I-B 2:00pm Anderson Hall 105
Abstract: *The Kreck-Stolz s invariant is used to distinguish connected components of the moduli space of positive scalar curvature metrics. We use a formula of Kreck and Stolz to calculate the s invariant for metrics on S^n bundles with nonnegative sectional curvature. We then apply it to show that the moduli spaces of metrics with nonnegative sectional curvature on certain 7-manifolds have infinitely many path components. These include the first non-homogeneous examples of this type and certain positively curved Eschenburg and Aloff-Wallach spaces.*

Thomas Ng, Temple University
Title: Survey of weak hyperbolicity in groups
Time: Session I-B 2:18pm Anderson Hall 105
Abstract: *Negative curvature for general metric spaces was first introduced by Gromov in the 1980s as a large scale notion of negatively curvature for Riemann manifolds and has been an incredibly fruitful concept in the study of geometric group theory. We will see why these spaces enjoy a host of desirable properties such as a notion of a topological boundary at infinity and almost uniqueness of geodesics. Further, based on examples of Cayley graphs for groups, we will see various algebraic implications of these properties as well as weakenings of Gromov's original hypotheses for which the algebraic and geometric consequences continue to hold.*

Ramy Yammine, Temple University
Title: Observations on the adjoint representation of Hopf algebras
Time: Session I-B 236pm Anderson Hall 105
Abstract: *In this talk we present a brief introduce to Hopf algebras and discuss some familiar examples of such structures (Group algebras, enveloping algebras of Lie algebras . . .). We will be concerned with the action of a Hopf algebra H on another algebra A (Quantum invariant theory); the main focus will be the adjoint action of H on itself. We discuss some results that are known for group algebras and speculate on possible extensions to more general classes of Hopf algebras. The concept of "local finiteness" of an action will be important; it allows us to reduce the problem to subalgebras that are better behaved and more understood.*

Huilin Chen, Temple University
Title: Every finite division ring is a field
Time: Session I-B 2:54pm Anderson Hall 105
Abstract: *Some of the fundamental concepts in abstract algebra are that of a ring and of a field. While a field is always a division ring, the converse is not necessarily true with the missing piece being the commutativity property for the multiplication in the division ring. In this talk I will discuss a classic and self-contained proof from 1931 by Ernst Witt that every finite division ring is a field which relies on linear algebra, basic group theory and the basic properties of the field of complex numbers.*

Graduate Session I-C
Anderson Hall 107

Nayeong Kong, Temple University
Title: Convergence Rates of Spectral Distribution of Random Inner-Product Kernel Matrices
Time: Session I-C 2:00pm Anderson Hall 107
Abstract: *In this talk, we focus on random inner product kernel matrices. There are many research papers which have proved that the limiting empirical spectral distribution (ESD) of such matrices A converges to the Marchenko-Pastur distribution. The main purpose is to establish the corresponding rate of convergence. The strategy is as follows. First, we show that for* $z = u + iv \in \mathbb{C},\ v > 0$, *the distance between the Stieltjes transform* $m_A(z)$ *of ESD of matrix A and Machenko-Pastur distribution* $m(z)$ *is of order* $\mathcal{O}\left(\frac{\log n}{nv}\right)$. *Next, we prove the Kolmogorov distance between ESD of matrix A and Marchenko-Pastur distribution is of order* $\mathcal{O}\left(\sqrt[3]{\frac{\log n}{n}}\right)$. *This uses a Berry-Esseen type bound that has been employed for similar purposes for other families of random matrics.*

Brandi Henry, Temple University
Title: Be There or Be the Sum of Two Squares
Time: Session I-C 2:18pm Anderson Hall 107
Abstract: *Sums of squares of numbers are a recurring phenomenon in mathematics. Natural numbers can be written as a sum of two squares if their prime factorization follows a particular format. This property is contingent upon certain primes in the factorization being sums of two squares. The proof of this requires that certain properties of the integers hold for the Gaussian integers as well. However, as is the case in most of mathematics, the proof does not offer an algorithm to find the squares whose sum is equal to that prime. An articulation of the algorithm proved by Stan Wagon in the context of an example will allow us to find the two squares whose sum is 2,506,096,430,089,197,719,125.*

Khanh Le, Temple University
Title: The whole is greater than the sum of its parts. Generating function.
Time: Session I-C 2:36pm Anderson Hall 107
Abstract: *Counting is one of the most basic and fundamental activity in mathematics. Formally speaking, given a collection of finite sets S(n) indexed by the natural numbers, count the number of elements, f(n), of S(n). A philosophical question arises. What counts as an answer for f(n)? Is a closed formula for f(n), if exists, always a satisfactory answer? What can we do if no such formula exists? In this talk, we will introduce a way to associate the sequence f(n) with one single generating function. We will discuss and see through examples that this idea of encoding an infinite sequence of numbers into one single object gives us one of the most powerful tools in enumerative combinatorics.*

Isaac Craig, Bryn Mawr
Title: On Fibering 3-manifolds
Time: Session I-C 2:54pm Anderson Hall 107
Abstract: *In 1962, J. Stallings gave sufficient conditions to determine whether a given 3-manifold fibers over the circle. We will motivate Stallings' theorem and give an outline of the proof.*

Graduate Session I-D
Anderson Hall 108

Zachary Cline, Temple University
Title: On Godel's Incompleteness Theorems
Time: Session I-D 2:00pm Anderson Hall 108
Abstract: *Is it possible that some unsolved problems, such as the Riemann Hyposthesis or Goldbach's Conjecture are true, but unprovable? In 1931, Kurt Godel showed that every logically consistent formal axiomatic system from which basic arithmetic can be deduced is incomplete, that is, there will be true statements that cannot be proven. He also showed that any consistent system cannot demonstrate its own consistency. We briefly discuss these Incompleteness Theorems and their possible implications.*

Timothy Morris, Temple University
Title: Cosmetic Surgery Conjecture
Time: Session I-D 2:18pm Anderson Hall 108
Abstract: *In the 1980's Cameron Gordon asked if Dehn Filing on a knot complement was completely determined by the filing slope. In this talk we attempt to provide the listener with the proper background to understand Gordon's conjecture. We also discuss some work that provides us with a positive resolution to the conjecture. Lastly we discuss an original method to determine if any such counterexamples to the conjecture could exist, and we will also provide examples for which the cosmetic surgery conjecture holds.*

Timothy Faver, Drexel University
Title: Nanopteron-stegoton traveling waves in mass and spring dimer Fermi-Pasta-Ulam-Tsingou lattices
Time: Session I-D 2:36pm Anderson Hall 108
Abstract: *A Fermi-Pasta-Ulam-Tsingou lattice is a one-dimensional chain of particles connected to their nearest neighbors by nonlinear springs. We study two species of materially heterogeneous lattices: mass dimers, in which the masses of the particles alternate between two values but all springs exert the same force, and spring dimers, in which the spring forces alternate but the masses are all the same. For each species, we prove the existence of nanopteron traveling wave solutions to the lattice equations of motion. These waves are the sum of an exponentially decaying term and a periodic term, so that the nanopteron may asymptote at spatial infinity to a nonvanishing oscillation. Our existence proof relies on a quantitative contraction mapping argument that incorporates a singular perturbation inherent to the dimer traveling wave equations.*

James Rosado, Temple University
Title: A table of definite integrals from the marriage of power and Fourier series
Time: Session I-D 2:54pm Anderson Hall 108
Abstract: *In this talk we show an unusual way to obtain values for a particular class of definite integrals. Our method is indirect in that we do not start with the integral. The integral is obtained as the end result of a process that did not visualize the integral at the start. We begin with an analytic function, and obtain our integrals by comparing the coefficients of related power series and Fourier series.*

Undergraduate Session II-A
Anderson Hall 23

John Kampmeyer, Elizabethtown College
Title: Finding a Sum using Lots of Calc and a Little Complex
Time: Session II-A 2:00pm Anderson Hall 23
Abstract: *The reciprocal sums of polygonal numbers are of great interest in number theory. While many of these sums are known, not much attention has been given to their alternating series counterparts. In this talk, we consider the alternating sum over the reciprocal pentagonal numbers and apply methods from all levels of calculus and a little bit of complex analysis to find its value.*

Taylor Stefovic, Elizabethtown College
Title: Zero Knowledge Proofs
Time: Session II-A 2:12pm Anderson Hall 23
Abstract: *An introduction to Zero Knowledge Proofs will be explored. Along with an overview of the topic, an example using Number Theory will be discussed, which involves the use of Quadratic Residues to prove to a verifier that one knows the primes p and q of a large integer n without giving any information as to what p and q are.*

Brian Stottler, Elizabethtown College
Title: Improvements to Correlation Attacks Against Non-Linear Combiners
Time: Session II-A 2:24pm Anderson Hall 23
Abstract: *Stream ciphers are a class of modern, symmetric key ciphers designed to provide bit-by-bit encryption of arbitrarily long messages. These ciphers are especially applicable in high-speed environments like real time communication. A broad category of stream ciphers based on linear feedback shift registers (LFSRs) and non-linear combiner functions have been a frequent target for cryptanalysis over the last forty years. We present an overview of these LFSR-based systems, describe a classical method for performing correlation attacks against them, and present our own novel improvements to these attacks. Our results include the development of a more powerful statistical model and a special class of combiners admitting "impossible pair" attacks.*

Angela Wesneski, Elizabethtown College
Title: A Simple Probability Paradox
Time: Session II-A 2:36pm Anderson Hall 23
Abstract: *The best defense is a good offense, right? By this logic, the way to be successful in any game is to attempt to win and accept nothing less. Surprisingly, this old adage can lead you astray when considering games where tying is an option. Game theory can give counter-intuitive results, and I will present an example of a game in which those who accept ties win more often than those who only play to win.*

Dan DeRemigi, Muhlenberg College
Title: Diophantine Approximations of Romik Systems
Time: Session II-A 2:48pm Anderson Hall 23
Abstract: *We study dynamical systems that were originally constructed in 2008 and studied again in 2016, which have many similarities to the classical dynamical system concerning Pythagorean triples. Particularly, we study the irrational points that fall on the unit interval that arise from continued fractions that define it. In the spirit of Diophantine approximation, we can rank of the error between irrational points on the unit interval and their rational approximations defined by the dynamical systems. Since these later-defined dynamical systems have properties that align with the classical case, we extend this idea to two other systems to perform an analysis of these approximations.*

Yusuf Qaddura, Swarthmore College
Title: Analysis of the spread of vector borne diseases with delay differential equations
Time: Session II-A 3:00pm Anderson Hall 23
Abstract: *We are concerned with the stability of equilibrium solutions for a two-lag delay differential equation which models the spread of vector-borne diseases, where the lags are incubation periods in humans and vectors. The model we consider is an extension to another previously studied one by Kenneth Cooke who considers an incubation period (delay) in vectors only. We show that there are some values of transmission and recovery rates for which the reproduction number of the disease is less than one so that the disease dies out. On the other hand, we show that the disease spreads into an endemic when the reproduction number is greater than one for other values of transmission and recovery rates; the stability analysis is based on looking at roots of certain transcendental equations. Furthermore, we observe, through MATLAB simulations, that the solution could possess chaotic behavior and sometimes un-boundedness.*

Undergraduate Session II-B
Anderson Hall 24

Eric Albers, Temple University
Title: Integers Who Can be Written as the Sum of Two Squares
Time: Session II-B 2:00pm Anderson Hall 24
Abstract: *We use the Gaussian Integers as a Unique Factorization Domain equipped with the norm $a^2 + b^2$ for $a + bi$, to find the prime elements in $Z[i]$. This is used to show that an integer, n, can be written as the sum of two squares if and only if for every q congruent to 3 mod 4 in n's prime factorization, q occurs with an even exponent.*

Sujay Rajkumar, Temple University
Title: An Algebraic Analysis of Impossible Constructions in Euclidean Geometry
Time: Session II-B 2:12pm Anderson Hall 24
Abstract: *Euclidean Geometry or Classical Geometry is an academic discipline as old as mathematics itself. For centuries, ancient mathematicians had developed an understanding of geometry using simple construction methods (i.e. straight edge & compass) making great progress that we continue to use in elementary geometry today. Over time however, it became apparent that there were three constructions problems that proved to be difficult time and time again. These problems are Doubling the Cube, Trisecting the Angle and Circling the Square. As simple as they may seem, modern algebraic analysis shows us that these problems are impossible to solve using classical geometric means. Today's discussion will explore the proofs behind two of these three problems.*

Nart Shalqini, Franklin and Marshall College
Title: Achieving incompleteness with self-reference
Time: Session II-B 2:24pm Anderson Hall 24
Abstract: *Kurt Gödel's Incompleteness Theorem was a ground-breaking discovery about the foundations of mathematics and limitations of any powerful axiomatic system. This theorem requires a lot of sophistication to understand; however, with some careful examples we can express it in everyday English. Gödel used self-reference as a base for proving his theorem. In other words, he made math talk about itself. This presentation explores various ways to achieve self-reference without using indexical words. Gradually, we can evolve from everyday English to mathematical language by making English unambiguous. Then, introducing some symbols and mixing them with everyday English, and, in the end, removing English completely and sticking to symbols only. Similarly, we will first try to form a self-reference in English without using indexicals, and then introduce a new symbolic language that talks about itself! And there we have Gödel's famous accomplishment: creating a system that describes itself.*

Fangzhou Wei, Franklin&Marshall College
Title: The Monty Hall Problem
Time: Session II-B 2:36pm Anderson Hall 24
Abstract: *People usually feel pretty confident about some seemingly reasonable decisions that are actually mistaken, which, for example, cause them to lose a chance of winning "a shiny new car"?. The Monty Hall Problem derives from a television show Let's Make a Deal. It illustrates an interesting paradox that makes people want to pause and think about it, and then praise how amazing probability could be. Understanding the mechanism of the Monty Hall problem is not hard, however, people can be deceived easily. In this talk, we will go through the Monty Hall Problem in detail.*

Anton Arapin, Franklin and Marshall College
Title: The Shape of a Mirror
Time: Session II-B 2:48pm Anderson Hall 24
Abstract: *Our project focuses on determining the exact shape of a mirror given a photograph of the mirror given some mild assumptions about its shape. We also explore multiple properties of rotationally symmetric convex mirrors. To do this we define and use the concept of vanishing ring of the mirror. Furthermore, we define one-to-one functions that map points from the image plane on to the real world plane and from the real world plane onto the image plane based on the reflections in the mirror. Moreover, we explore the shape of the reflections in the image plane of straight lines in the real world. We look at the examples of aforementioned analysis for conical, parabolic and spherical mirrors.*

Yu Wan, Franklin and Marshall College
Title: The Königsberg Bridge: A Puzzle from Graph Theory
Time: Session II-B 3:00pm Anderson Hall 24
Abstract: *Graph theory is an important branch of mathematics and has several applications outside the mathematics. In this session, to gain a basic understanding of graph theory, we will virtually go back to 1736 and solve the famous problem "The Seven Bridges of Königsberg" with Mathematician Leonhard Euler.*

Undergraduate Session II-C
Anderson Hall 25

Shannon Golden, Kutztown University of Pennsylvania
Title: Coloring the Integers
Time: Session II-C 2:00pm Anderson Hall 25
Abstract: *Schur's Theorem states there exists a least positive integer s such that for every coloring of the integers from 1 to s, there is a monochromatic solution to $x + y = z$, i.e. where x, y, and z are all the same color. For example, given two colors, it can be proven that $s = 5$. In this talk, we will first motivate our study with classic theorems within Ramsey Theory. We will then explore a theorem that expands Schur's Theorem with two colors to $(w)x + y = z$ where $w \in \mathbb{N}$ is a fixed coefficient. Finally, we will investigate a two-player game that involves a dichotomous coloring of the equation $(w)x+y = z$ where, assuming optimal play, we determine which player has a winning strategy.*

Emily Thomas, King's College
Title: Sprague-Grundy Numbers of a Game with Dominoes
Time: Session II-C 2:12pm Anderson Hall 25
Abstract: *A two player impartial game, is a game where both players have the same set of rules. We define a game where players place a domino on a $1 \times n$ chessboard. The last player to place a domino wins. Octal games are a class of impartial games where players select rocks from heaps. The player that picks the last rock or set of rocks wins the game. We will discuss the Sprague-Grundy numbers of the domino game and its relationship to octal games.*

Dylan Koch, King's College
Title: The Koch Axiom System
Time: Session II-C 2:24pm Anderson Hall 25
Abstract: *During the first semester as a student in the King's College Mathematics department, I took a course on Logic and Axiomatics. As the final project for that course, I developed an Axiom System of my own. Now, as a junior math major, I have revisited and refined that same project, and will present: the system, it's consistency and independence models, as well as a proof of one of four theorems I have derived.*

Noelle Fromuth, King's College
Title: Axiom System Project
Time: Session II-C 2:36pm Anderson Hall 25
Abstract: *Two years ago, I created an axiom system for my Logic & Axiomatics class at King's College. Now, after taking numerous college-level math classes, I am revisiting this project in order to make changes and corrections for my junior seminar. I have worked hard at creating these axioms, theorems, and models that I am presenting today. I have also enjoyed getting to work on this project over the past three years and getting to see it all come together.*

Kelsey Gabriele, King's College
Title: My Axiom System
Time: Session II-C 2:48pm Anderson Hall 25
Abstract: *One of the first classes mathematics majors at King's College must complete is Logic and Axiomatics. The end project was to create an axiom system, including consistency models, independence models, theorems and proofs. Fast forward two years, and third year math students must revisit their axiom systems. Now that I have a better understanding of abstract math concepts, I have examined and corrected issues in my axiom system. My presentation will display the progress and completion of my axiom system, including a proof of a complex theorem.*

William Cameron, King's College
Title: My Axiom System
Time: Session II-C 3:00pm Anderson Hall 25
Abstract: *During freshman year in intro to logic course, we constructed our own axiom systems, which consisted of, axioms, consistency models, independence models, and a theorem or two. We went on to prove our theorem(s) using the axioms we constructed. For our Junior Seminar course at Kings, we revisited the same axiom system to see the progress we have made as mathematicians.*

Undergraduate Session II-D
Anderson Hall 26

Tianyi Wang, Gettysburg College
Title: For m = 2, there is no perfect s-bases in finite cyclic group G for $s = 2$, and $s \equiv 2, 3(\mod 4)$
Time: Session II-D 2:00pm Anderson Hall 26
Abstract: *By definition, a subset A of a group G of size n for which $[0, s]A = G$ for some nonnegative integer s is called a s-basis for G. We are investigating the perfect s-bases, which are s-bases of size m with $n = ((m + ss))$. There has already been proved that for s-$\{2, 3\}$ there are no perfect s-bases in G of size $m = 2$. I am going to prove that when $m = 2$, there are no perfect s-bases in finite cyclic group G for $s = 2$, and $s \equiv 2, 3(\mod 4)$.*

Emma Gruner, Gettysburg College
Title: Characterizing subsets of abelian groups with size $\chi(G, h) - 1$
Time: Session II-D 2:12pm Anderson Hall 26
Abstract: *For a fixed abelian group G and positive integer h, the h-critical number, or $\chi(G, h)$, is the minimum value of m for which the h-fold sumset of every m-element subset of G is G itself. When n is even and $h = 2$, $\chi(G, h) = n/2 + 1$, so for every group G of even order n, it is possible to find a subset A of size $n/2$ for which $hA = G$. It is conjectured that when $h = 3$, this subset A must be equal to either H or $G \setminus H$, with H being a subgroup of G with order $n/2$. We will prove this conjecture for special cases of G.*

Zijun "Candice" Kong, Gettysburg College
Title: The minimum sumset size of restricted sumsets with limited number of terms
Time: Session II-D 2:24pm Anderson Hall 26
Abstract: *Given a cyclic group G, and an m-element subset A of G, $\hat{\rho}(G, m, [0, s])$ allows to only add up each element in A for once within 0 to s times to add an element, what is the smallest sumset size? We can find and prove some upper-bounds given by special groups for $\hat{\rho}(G, m, [0, s])$. Especially the cyclic group with size of a prime number, the inequality of $\hat{\rho}(G, m, [0, s])$ and the upper-bound becomes equality. Moreover, other cyclic groups have some other upper-bounds given by groups related with the special groups.*

Aidan Lorenz, Temple University
Title: Braid Groups and Free Groups
Time: Session II-D 2:36pm Anderson Hall 26
Abstract: *This talk will be a brief introduction to Braid groups, the canonical homomorphism to symmetric groups, and how to obtain "pure" braid groups from this homomorphism. It will also cover free groups and the universal property of free groups. We will then link pure braid groups with free groups by showing the isomorphism of PB_3 with the product of F_2 and the group of integers.*

Matthew Wynne, Temple University
Title: Algebras and their Deformations
Time: Session II-D 2:48pm Anderson Hall 26
Abstract: *In this talk, we will develop a working definition of a real algebra given only the notion of an abelian group. We will then intuitively explore quotients of algebras, and when one algebra is said to be a deformation of another. Lastly, we will define a quadratic monomial algebra, and if time permits present a new theorem regarding deformations of such algebras.*

Undergraduate Session II-E
Anderson Hall 27

Levi C Nicklas, Shippensburg University
Title: Modelling the Mediterranean: Pycnoclines and Plankton
Time: Session II-E 2:00pm Anderson Hall 27
Abstract: *Climate change has profound effects on the ocean. Once of these effects is the increase or decrease in ocean stratification. Some research suggests this change in stratification can lead to the opportunity of an increased number of algal blooms. These algal blooms can be toxic to other animals as well as humans, as well as altering the dissolved oxygen content in the water. By using available data on water salinity and temperature in the Mediterranean we can construct density curves and find the stratification point– the pycnocline.Through methods including calculus, interpolation, and some data science it will be explored whether or not the algal blooms are correlated with the change in ocean stratification conditions.*

Jonathan Oster, Penn State Harrisburg
Title: Euler's Exotic Infinite Series
Time: Session II-E 2:12pm Anderson Hall 27
Abstract: *Leonhard Euler solved the Basel Problem in 1734 and found the exact sum of the reciprocals of squares of all the natural numbers. In 1735 he published his original three solutions to the problem. All three were based on the same basic ideas and observations. Euler considered the Taylor Series for sine to be an "infinite polynomial" with infinitely many roots. He took formulas that show the relationship between the coefficients and roots of an ordinary polynomial and applied them to "infinite polynomials". Using this method Euler solved the Basel problem and was also able to find the exact sum of several other conventional infinite series including the Leibniz series for Pi. But Euler's second solution indirectly solved the Basel Problem and also found the exact sum to some more exotic infinite series including an alternating series in which none of the denominators are divisible by three. The sum of every series that Euler evaluated using this method includes the number Pi.*

Ronald Berna, Villanova University
Title: Optimal Batting Order in Baseball
Time: Session II-E 2:24pm Anderson Hall 27
Abstract: *In this talk, we address the problem of finding the optimal batting order for a team of nine baseball players. We introduce a Markov-chain-based Monte Carlo approach for simulating runs scored in a standard nine-inning game, and present a validation of this model. Then, we introduce standard player-types to assess the optimal location of particular player-types within a nine-man lineup. We also assess lineups of 9-x average players and x players of a different type, and then we examine some more complex combinations of players. We conclude with an analysis of the optimal lineup of the starting eight players (+ one average pitcher) on the 2016 Phillies.*

Shantel Silva, Villanova University
Title: Turning Against One Another: An Analysis of Socioeconomic Inequality and Hate Crime
Time: Session II-E 2:36pm Anderson Hall 27
Abstract: *Political commentary has recently focused on the increase of hate crime rates in the United States. Although political climates are hard to quantify, socioeconomic factors are easily obtainable. In a society where money is a common stressor for its residents, can different socioeconomic factors lead to different rates of violent eruptions in behavior, resulting in hate crimes? Furthermore, how does the inequality of socioeconomic factors within a state, rather than only magnitude, influence hate crime rates? This project's objective is to perform a panel data, multivariate regression analysis of the States to examine the potential relationships between the inequality of socioeconomic factors and hate crime rates. This talk will cover the research process, data manipulation, model formulations, and subsequent results of this project.*

Tasha Boland, Villanova University
Title: The Kelly Criterion 2.0
Time: Session II-E 2:48pm Anderson Hall 27
Abstract: *The Kelly Criterion is a formula that defines optimal betting strategies, with applications ranging from the stock market to the blackjack tables of Las Vegas. The Kelly Criterion has been proven mathematically and in practice to yield lucrative results for many. However, in the presence of a time limit and a cap on future winnings, the Kelly Criterion is not the optimal strategy. In such scenarios, a new approach, "The Functional Kelly Criterion,"? leads to higher returns and lower risk than the traditional Kelly Criterion. In this talk, we discuss the derivation of the Functional Kelly Criterion and demonstrate its strength using Monte Carlo methods.*

Undergraduate Session II-F
Anderson Hall 28

yingzi Wang, Arcadia University
Title: Multi-commodity Flows in Planar Graphs
Time: Session II-F 2:00pm Anderson Hall 28
Abstract: *Suppose that G is a connected graph, and $(s_i, t_i)(1 < i < k)$ are pairs of vertices (source/sink pairs), every edge has a real-valued capacity; and $q_i(1 < i < k)$ are real-valued demands. Okamura and Seymour solve the multi-commodity flow problem in the general case that all the vertices $s_1, \ldots, s_k, t_1, \ldots, t_k$ are on the outer face of the infinite face of a planar graph. Based on their method, we make a special case that $s_2, \ldots, s_k, t_2, \ldots, t_k$ are on the outer face of the infinite face, except one pair s_1, t_1 with one on the outer face and the other one in the center.*

Terrell Nowlin, Temple University
Title: The Math of Machine Learning
Time: Session II-F 2:12pm Anderson Hall 28
Abstract: *In recent years, machine learning has taken the world by storm. Machine Learning is a cross-disciplinary field that is deeply rooted in applied mathematics. In this talk, I will briefly explore the mathematics underlying many of the famous algorithms and practices of machine learning, particularly, multi-variate calculus, linear algebra, and probability theory. I would like to close with where machine learning can be seen in every day life, where it is going in the near future.*

Sarah Connahan, Temple University
Title: Idea to Reality: Starting a Student Organization
Time: Session II-F 2:24pm Anderson Hall 28
Abstract: *In this presentation I will be discussing my experience running the Association for Women in Mathematics Student Chapter; a mathematics student organization at Temple University. Topics will include:best organizational practices, ideas for student activities, and impact on the professional development of the student members.*

Joe Azzarano, Gwynedd Mercy University
Title: Non-Newtonian Fluids: Thixotropic Flow and Coiling
Time: Session II-F 2:36pm Anderson Hall 28
Abstract: *Thixotropic non-Newtonian fluids are fluids whose viscosity decreases with constant stress over time. Thixotropic fluids are able to undergo the liquid rope coil effect, which is an interesting ability to form a coil on a surface after falling from a height. There are four different regimes that exist when the fluid falls from varying heights, each with a different behavior: Viscous, Gravitational, Inertio-Gravitational, and the Inertial regime. The mathematical equations that describe these regimes have been derived and are known for all but the inertio-gravitational regime. The inertio-gravitational regime does not produce uniform coils like the other regimes. Instead it produces seemingly erratic flower patterns and can have up to five different coiling frequencies for a single drop height.*

Robert DiPierro, Gwynedd Mercy University
Title: Mandelbrot Set
Time: Session II-F 2:48pm Anderson Hall 28
Abstract: *Fractals are self-similar geometric figures that occur naturally in nature. Varying from trees, rivers, lighting, and shorelines. In the mathematical world, one of the most intriguing fractals is the Mandelbrot set. Created by the iterations of a simple quadratic on the complex plane. In my presentation, I will briefly discuss how the Mandelbrot set is created and give an overview of the Mandelbrot's structure and how the Mandelbrot set's boundary is closed.*