Eastern Pennsylvania and Delaware Section of the
Mathematical Association of America

Student Contributed Paper Session Abstracts

St. Joseph's University

November 9, 2013

Student Speakers

Undergraduate Session I-A
SC 200

Brian Munoz, Stella Koiki, University of the Sciences
Title: Fractals
Time: Session I-A 1:00pm SC 200
Abstract: *Fractals, which are mathematical sets that consists of fractional dimensions, is not only found in mathematics, but can be seen all around us in the world today. Examples of fractal shapes can be seen in clouds, the coastlines, the blood vessel system, etc., which can be described through fractal mathematics. Our aim is to further describe and explore what fractals are and how fractal mathematics can be applied to our everyday lives.*

Vincent Castro, Melissa White, University of the Sciences
Title: Algorithms for Computational Chemistry Simulations
Time: Session I-A 1:12pm SC 200
Abstract: *In this presentation, we will talk about an application and the development of algorithms for computational chemistry simulations. This is a study for creating and simulating many particle systems using Python.*

Tyler Ki, Michael Watkowski, University of the Sciences
Title: Binary Coding
Time: Session I-A 1:24pm SC 200
Abstract: *We will be discussing what the binary numeral system is and what is its purpose. We will discuss its historical significance and how it has effected the area of discrete mathematics. Lastly we will discuss how to use the decimal system and its practical applications in problem solving.*

Jessica Yau, Abigail Baltz, University of the Sciences
Title: Rene Descartes
Time: Session I-A 1:36pm SC 200
Abstract: *Who is Rene Descartes? Our presentation will provide a short biography on Descartes' life and highlight his contributions to mathematics such as the Cartesian rule of signs. Furthermore, his studies in Analytical Geometry led to the Cartesian coordinate system.*

Undergraduate Session I-B
SC 300

Michael Elton, Morgan Dunn, University of the Sciences
Title: Genetic Algorithm
Time: Session I-B 1:00pm SC 300
Abstract: *Natural selection is the process by which the fittest organisms in a population are selected to have the highest reproduction potential. We will explain how the genetic algorithm can be used to predict the outcome of natural selection.*

Megan Mohadjer Beromi, Meghan Roig, Katarina Rohlfing, University of the Sciences
Title: Functions Modeling Oxygen Binding Affinity of Myoglobin and Hemoglobin
Time: Session I-B 1:12pm SC 300
Abstract: *Although the proteins myoglobin and hemoglobin both function physiologically as oxygen transporters, myoglobin only binds one oxygen at a time, whereas hemoglobin can theoretically bind up to four. The implications of this cooperativity are evident in the functions corresponding to binding curves and Hill plots of myoglobin versus hemoglobin. For myoglobin, the oxygen-binding curve is hyperbolic and the Hill plot has a slope of 1, indicating no cooperativity. However, hemoglobins plots display sigmoidal dependence on oxygen concentration in both cases. Here, the functions corresponding to both proteins will be discussed as well as the functions abilities in modeling the physiological activity of the two species.*

Yatong Li, Bryn Mawr College
Title: F-statistics in Genetics
Time: Session I-B 1:24pm SC 300
Abstract: *F-statistics are estimators measuring genetic variation within and among populations, and thus give insights into evolutionary population structure. By looking at the estimates of F-statistics through human genome, we would be able to gain insights into the regions on which selection force has been exerted, the phylogenetic history of populations, and correlation between genetic structure and certain human diseases, etc.*

Atticus Graven, Ursinus College
Title: Parameter Testing of an Economic Learning Model
Time: Session I-B 1:36pm SC 300
Abstract: *This talk focuses on the creation of a model that will use forthcoming experimental data to test the economic theories of "learning". In brief, Learning theorists believe that economic agents base their future expectations on approximately linear regressions based on current data. This project will describe the process of deriving the model and defining the range and effects of its parameters. Analysis includes bifurcation values, as well as parameter value ranges rarely observed in real world data. Future work will compare this model against real experimental data to test its accuracy.*

Graduate Session I-C
North Lounge

Christian Millichap, Temple University
Title: Proving There Are Infinitely Many Primes Using... Topology!
Time: Session I-C 1:00pm North Lounge
Abstract: *Around 300 B.C., Euclid first proved that there are infinitely many primes. Since then, many new proofs have been given, using a variety of mathematical tools - divisibility arguments, geometric series, and algebraic number theory to name a few. In this talk, we will examine a proof that actually uses point-set topology! We will cover the basic background in topology needed to understand this proof, so this talk should be accessible to a general audience.*

Hussein Awala, Temple University
Title: On the Mixed Boundary Value Problem for the Laplacian in Polygonal Domains in Two Dimensions
Time: Session I-C 1:18pm North Lounge
Abstract: *Boundary value problems with mixed Dirichlet and Neumann boundary conditions model a series of physical and engineering phenomena such as conductivity, heat transfer, wave phenomena, electrostatics, metallurgical melting, and stamp problems in elasticity and hydrodynamics. In this talk I will discuss some recent results about the well-posedness of the mixed problem for the Laplacian on curvilinear polygons in two dimensions. The tools employed to obtain these results are a mixture of Calderon-Zygmund theory and Mellin transform techniques. This is joint work with Irina Mitrea and Katharine Ott.*

Luca Pallucchini, Temple University
Title: On Solvability of PDEs
Time: Session I-C 1:36pm North Lounge
Abstract: *The most natural question one can ask about PDEs is whether there exists a solution of it. For ODEs we have satisfactory theorems about the existence of solutions (at least locally). Malgrange and Ehrenpreis have proved that all constant coefficient linear partial differential equations have local solutions, and that, by Cauchy-Kovelevsky Theorem, all analytic partial differential equation have local analytic solutions. Therefore, it came as a complete surprise when in 1957 Hans Lewy discovered the first non-solvable operator.*

Undergraduate Session II-A
SC 200

Andrew Miller, Franklin and Marshall College
Title: Hyperbola Under Construction
Time: Session II-A 2:00pm SC 200
Abstract: *This talk uses projective geometry to understand how the perspective image of a building under constructions can give rise to a hyperbolic curve. We will discus a mathematical graphing device called a linkage, and the role it plays in understanding this specific construction.*

Elana Machlis, Franklin and Marshall College
Title: An Exploration of Projective Invariants in Perspective Art
Time: Session II-A 2:12pm SC 200
Abstract: *We will be investigating the projective invariants known as Casey Angles. We will then explore the applications of these invariants in perspective art.*

Orsola Capovilla-Searle, Bryn Mawr College
Title: Multi-Crossing Knots
Time: Session II-A 2:24pm SC 200
Abstract: *Traditionally, knots have been tabulated according to their crossing number, which is the least number of crossings in any projection of the knot. Recently, these traditional crossings have been extended to n-crossings, where n strands of the knot intersect in the projection. We will discuss bounds on n-crossings, also known as multi-crossings. Furthermore, we investigate how the multi-crossing number behaves under composition.*

Undergraduate Session II-B
SC 300

Cara Sulyok, Ursinus College
Title: Mathematical Modeling, Sensitivity Analysis, and Optimal Control of Agroecosystems
Time: Session II-B 2:00pm SC 300
Abstract: *This project develops mathematical models and computer simulations for cost-effective and environmentally-safe strategies to minimize alfalfa damage from pests. Predator and plant diversity can control potato leafhopper (PLH) damage to the host-plant alfalfa. A mathematical model including eleven size- and time-dependent parameters was created using a system of non-linear differential equations. The model was shown to accurately fit results from open-field experiments and thus predict outcomes for scenarios not covered by the experiments. Steady state solutions were determined and a sensitivity analysis established the relative importance of each parameter to reduce the plant damage. Optimal control theory led to designing practical controls on the diversity levels to minimize the plant damage while preserving the plant production in a polyculture setting. In conclusion, the project provides a framework for designing cost-effective and environmentally-safe strategies to minimize alfalfa damage, determine critical parameters, and utilize the enemies hypothesis and polyculture diversity.*

Louis Graup, Temple University
Title: Optimization of Macroscopic Models for the Approximation of Microscopic Traffic Flow
Time: Session II-B 2:12pm SC 300
Abstract: *Microscopic traffic models are models that focus on individual car's behavior, such as velocity and position on the road. These models are used to produce waves that represent phantom traffic jams, which are traffic jams that arise from unforseen external perturbations, much like what one might encounter in familiar stop-and-go traffic. Different models, such as the Optimal Velocity Model and the Follow the Leader Model, have different approaches to model traffic, but the end result is the same, waves. Macroscopic models look at the road as a whole, studying characteristics such as density and flow. In order to better understand traffic, there needs to be a link between micro and macro models. This is accomplished by scaling microscopic models in order to converge to a macroscopic limit. From there, the macroscopic model can be optimized to better approximate the microscopic model.*

Claire Zajaczkowski, Gettysburg College
Title: Solution Behavior of a Periodic Boundary Value Problem
Time: Session II-B 2:24pm SC 300
Abstract: *We study a type of second order nonlinear discrete periodic boundary value problems. The existence and uniqueness of positive solutions are discussed. The parametric dependence of the solutions are also investigated. Two examples are given as applications of the results.*

Graduate Session II-C
North Lounge

Jessica Hamm, Temple University
Title: Multiplicative Invariant Theory
Time: Session II-C 2:00pm North Lounge
Abstract: *I will give an introduction to the field of multiplicative invariant theory. Though polynomial invariants have been studied at great length, the field of multiplicative invariant theory is relatively new and has many open problems available.*

Brian Paljug, Temple University
Title: A Buffet of Algebras, With an Eye Towards Operads
Time: Session II-C 2:18pm North Lounge
Abstract: *Many different types of algebras arise naturally in all areas of mathematics - some are relatively simple to define, and others are more exotic. In this talk, several different types of algebras and examples will be discussed - associative, commutative, Lie, and more. We will then move to the common idea that these algebras are defined in terms of generating operations and relations, presenting this idea in a simple, pictorial manner. This leads naturally to the notion of an operad, a kind of combinatorial gadget that describes algebras.*