Spring 2025 MD-DC-VA Section Meeting Abstracts

Abstracts are in chronological order. All talks are Saturday, except the workshop and banquet talk.

Workshop

Integrating 3D Printing into Mathematics Classroom: A Hands-On Workshop

Rebin Muhammad (on behalf of MAA MD-DC-VA COMMIT) , Montgomery College

4:00-6:00, JC Cinema

This interactive workshop explores practical approaches to teaching mathematical concepts through 3D printing technology. Drawing from classroom implementations and student projects, participants will learn how to transform abstract mathematical ideas into tangible learning tools using freely available educational resources. The session will showcase applications including Riemann sums, volumes of revolution, centroids, parametric equations, and infinite series representations and others.

Banquet Talk

We Integrate Differentials, Not Functions

Eugene Boman & Robert Rogers , Pennsylvania State University, Harrisburg & SUNY Fredonia

8:00-9:00, JC Bistro

The standard approach to teaching integration begins with a rigorous definition featuring limits of Riemann sums. This is curious considering that the notation ¡i¿∫ y dx¡/i¿ developed by Leibniz (1675) predates Cauchy's and Riemann's formulation of integration (1823) by nearly 150 years. The ideas of summing infinitesimals and the Fundamental Theorem of Calculus are even older. We propose that starting an Integral Calculus course by defining the integral as the limit of Riemann sums is not only historically inaccurate – Riemann used his sums to investigate integrability conditions – but more importantly it is pedagogically unsound. Rigor has its place for sure, but its place is not at the beginning of the course where it hinders students' use of integration as a problem-solving tool. We will provide examples, problems, and approaches which will demonstrate the power of integrating differentials to solve (not necessarily calculus) problems. It will also provide motivation for the study of power series and ultimately numerical series and sequences as approximation techniques. Rather than treating these as a separate topic, which is often the norm, they can serve to begin the "crossover" into the abstraction and rigor of Riemann sums and power series.

Pre- and Post-COVID Relationships between Crime and Travel Patterns in Baltimore City

Jay Calkins, Towson University

8:20-8:40, Enterprise 173

(student talk)

Understanding factors that affect crime is an essential part of crime prevention. The goal of this project is to better understand how travel patterns and crime are related, as well as how the relationship changed before and after the COVID-19 pandemic in Baltimore City. The United States

Census Bureau divides the country into census tracts, and then those tracts are further divided into census block groups (CBGs). A linear regression was run on travel patterns and crime at the CBG level, and the slopes of the linear regressions were collected using Python. The slopes represent the crime rate of each CBG. The crime rates were categorized, and a chi-square test was run on the pre- and post-COVID crime rates for each CBG. The results showed that the crime rates before COVID were statistically independent from the crime rates after COVID. Another chi-square test was run on the pre- and post-COVID data to determine whether adjacent CBGs have statistically independent crime rates. The results showed that adjacent CBGs did have statistically independent crime rates before COVID but did not have statistically independent crime rates after COVID. Overall, these results show that the COVID-19 pandemic has significantly changed the relationship between both crime and travel patterns and the relationship between crime rates in adjacent CBGs.

Obsidian for Educators

Pallavi Bhale, Montgomery College
8:20-8:40, Enterprise 174

Obsidian is a versatile and robust tool for educators, offering an innovative approach to organizing teaching materials and enhancing the overall teaching and learning experience. In this session, I will explore key features of Obsidian that I used in the creation of my book College Calculus Preparation.

Modeling Acoustic Loads on Rockets at Takeoff

Joseph Samson Ungerleider, Valentina Paz Soldan Viscarra
James Madison University
8:20-8:40, Enterprise 274
(student talk)

Rockets are powerful vehicles that play a critical role in space exploration, satellite deployment, and scientific research. Their value lies in their ability to overcome the challenges of Earth's gravity and enable human exploration of space. However, a major challenge in rocket launches is the threat of the massive acoustic loads that occur during liftoff. These acoustic loads can be caused by many factors, including engine exhaust, aerodynamic turbulence, and shock waves. Predicting acoustic loads on rockets is crucial because the excessive noise and vibration can cause damage to the vehicle's structure, equipment, and payload. By accurately predicting these loads, engineers can design rocket structures to withstand such vibrations, and minimize damage. With the recent surge of interest in reusable rockets, predicting loading is especially important for rockets subject to a high number of cycles.

A semi-empirical model, NASA SP-8072, was developed in 1971 using existing rocket data to predict the acoustic power generated by a supersonic rocket exhaust. Despite being over 50 years old, it is still the best model available today for acoustic load prediction on rockets. This paper will discuss and compare possible improvements upon the NASA SP-8072 model.

A Cutthrought Game of Red-Blue Cherries

Hannah Marron, St. Mary's College of Maryland
8:20-8:40, Enterprise 275
(student talk)

The games RED-BLUE CHERRIES and CUTTHROAT are played on an undirected, unweighted graph with each vertex colored either red or blue. Previous work covers game values for each of these games independently. Here, we will apply the rules of both games to create CUTTHROAT CHERRIES, a new game with unique game values. We will compare CUTTHROAT CHERRIES to both of the original games to see what features carry over and what new patterns emerge.

Introduction to Mathematics Applications: Optimization and Mathematical Modeling

Chloe Garnish, St. Mary's College of Maryland
8:20-8:40, Enterprise 276
(student talk)

Throughout this talk we will showcase various mathematical modeling and optimization applications using numerous concepts that college mathematics majors will encounter during their undergraduate education. Our goal for the talk is to bring awareness to the importance of applications of mathematics, as college classes are often focused on methods of computation or theory. In the talk we will touch on applications utilizing linear, non-linear, and theoretical mathematical methods. The examples covered will range from theoretical mathematics topics such as graph and set theory to more applied concepts relating to physics, chemistry, biology, and economics.

Hamilton and the Quaternions: A Case Study in Mathematical Creativity

Jeff Suzuki, Brooklyn College CUNY
8:20-8:40, Enterprise 277

At some point, math students have to make the transition from learning about mathematics to creating their own. But you can't teach creativity, so how can we learn it?The history of mathematics offers a number of "case studies" of how mathematicians came up with new ideas. We'll discuss Hamilton's creation of the quaternions and suggest ways it could be used to promote creative thinking.

Modeling Crime on Baltimore City Road Network

Natalie Brownlowe, Jeffrey Bowerman
Towson University
8:45-9:05, Enterprise 173
(student talk)

This project aims to estimate and predict crime intensities for small geographical regions in Baltimore City. Previous research utilized a parametric approach and determined that crime intensity could not be estimated by a constant rate for regions of any size across Baltimore. Expanding on this, we take a non-parametric approach and assume that crime intensities in Baltimore City are determined by a probability function dependent on the city's road network. Utilizing Baltimore City Police Department and OpenStreetMaps data, we explored two methods for modeling crime intensity: (1) Kernel Density Estimation and (2) Diffusion Model on Road Network. Examining

the similarities and differences between the well-studied kernel density estimation and our diffusion algorithm, we explore the significance of both findings.

Designing Web-based Mathematical Games to Enhance Understanding and Enjoyment

Mona Hajghassem, Rebin Muhammad, Camilo Diaz
Montgomery College
8:45-9:05, Enterprise 174

In this talk, we will share our journey in creating web-based mathematical games for our math classes at MC. These games can be integrated into Blackboard or any LMS platform. The main goal of developing these games is to increase student engagement with the material by creating fun, engaging, and rewarding experiences. Through elements of enjoyment such as rewards, challenges, and exploration modes, students gain insights into math topics and deepen their understanding

Immune cell dynamics during a flu infection

Hai-Hsin Huang, Virginia Military Institute
8:45-9:05, Enterprise 274
(student talk)

Current research has sparked interest in understanding the contribution of natural killer (NK) cells and their role in the resolution of viral infections, including influenza infections, commonly referred to as the flu. Despite their significance, NK cells' precise mechanisms, immune functions, and the correlation with cytokines like interferon gamma (IFNg) remain unclear. We aim to model immune dynamics using delayed differential equations, linear chain trick with ordinary differential equations, and traditional ordinary differential equations. Our study integrates immunology and mathematics to investigate the roles of NK cells, T cells, and IFNg in influenza infections by utilizing data from the University of Tennessee's Department of Pediatrics. These models will allow the exploration of possible mechanisms related to IFNg production during an infection.

Some Properties of Currie's Curious Function

Dan Kalman, American University (ret)
8:45-9:05, Enterprise 275

The remarkable fact that $2^n\sqrt{2-\sqrt{2+\sqrt{2+\cdots+\sqrt{2}}}} \to \pi$ as $n \to \infty$ where n is the number of nested radicals, inspires an obvious question. What other similar sorts of results hold? This leads first to an entire family of related sequences, such as $\sqrt{6}^n\sqrt{3-\sqrt{6+\sqrt{6+\cdots+\sqrt{6}}}}$ and $4^n\sqrt{8-\sqrt{56+\sqrt{56+\cdots+\sqrt{56}}}}$, and then to a curious function $C(x)$ that encompasses them all. Numerical and graphical investigation suggest many conjectures about $C(x)$. Some of these we have managed to prove, but most have stubbornly resisted our efforts.

A Radial Basis Function - Finite Difference Approach for Inverse Heat Conductivity Problems

Nadun Kulasekera Mudiyanselage, Mount St Mary's University
8:45-9:05, Enterprise 276

Inverse problems in time-dependent heat conductivity models pose significant challenges due to their ill-posed nature, where small perturbations in data can lead to large deviations in solutions. This work presents a novel numerical framework leveraging the Radial Basis Function - Finite Difference (RBF-FD) method to approximate heat conductivity coefficients and solutions of parabolic partial differential equations. The RBF-FD approach offers a computationally efficient, higher-order alternative that enhances stability and accuracy while mitigating the limitations of conventional numerical methods, such as instability and excessive computational costs. Through numerical experiments, we demonstrate the effectiveness of the proposed method in addressing inverse parameter identification problems, highlighting its robustness and potential for broader applications in heat conduction modeling.

Flood Warning! What Combinatorics and Algebra Tell us About Graphs

Jackson Wills, Trey Wilhoit
Roanoke College
8:45-9:05, Enterprise 277
(student talk)

In this talk we will discuss how we can use algebraic combinatorics to model the flooding properties of graphs. The flood polynomial, which encapsulates how a graph floods, can be used to reveal properties about the graph. A few families of graphs even have ties to popular sequences, such as the Fibonacci and Lucas sequences.

Utilizing Kernel Density Estimations and Principal Component Analysis to analyze crime, population, and travel patterns.

Alex Holtzman, Towson University
9:10-9:30, Enterprise 173
(student talk)

Does population density correlate to crime rates and travel patterns in Baltimore City? Understanding how these three variables are related can help cities allocate resources effectively to reduce crime rates. These three variables are strongly correlated, so changes in one of the three variables: crime, mobility, and population are likely to affect the other two variables. Conducting a Kernel Density Estimation on the crime data produces the crime intensity. This crime intensity data is then split into each Census Block Group in Baltimore City. Mapping the crime intensity, mobility, and travel pattern data to each Census Block Group allows for a Principal Component Analysis to be conducted. 90 percent of the variance is captured by the first two components of our Principal Component Analysis. Therefore, the three data sets representing crime intensity, travel patterns, and population are interdependent, demonstrating that there is a strong correlation between the three variables.

Precalculus Teaching Squares

Deepa Ramakrishnan, Frederick Community College
Spencer Hamblen, McDaniel College
9:10-9:30, Enterprise 174

During the Fall 2024 semester four Precalculus instructors from different schools participated in a "Teaching Square": sitting in on each other's courses and discussing what they observed and learned from the observations. We will discuss the results of the Teaching Square, lessons learned from the observations, and plans for future collaborations between instructors across schools.

A Quantitative Schlieren Image Investigation of the Coanda Flare Jet Boundary

Josiah Walker, James Madison University
9:10-9:30, Enterprise 274
(student talk)

Rocket liftoff and Coanda Flares used to burn excess gas have one thing in common: harmful Shock Associated Noise (SAN) from Coanda flows. Coanda flows are flows that follow a curved surface, and the shock cell structure determines the SAN characteristics present in such a flow. This paper aims to expand efforts to model the poorly understood shock cell structure of turbulent supersonic Coanda jets, enabling accurate SAN predictions. While the Coanda Flare is used here, methods developed can then be applied to other Coanda Flows, such as the noise emission from rocket flame trenches. Previous work has developed an equation for the Jet Boundary of the Coanda flare from hand-digitized flow visualization (Schlieren) images. Understanding the jet boundary enables the modeling of the shock cell structure. The Jet Boundary model currently has a 2-8error and must be improved to understand SAN from Coanda flows better. This error resulted from poor Schlieren image quality combined with human error in manually digitizing images. The current work aims to capture more precise images of the Coanda Flare Jet boundary at various operating conditions and automate the digitization process to develop a new Jet Boundary equation. This paper discusses methods of improvement, including the upgrade of a Z-type Schlieren system, the development of a 2D Coanda Flare, and the implementation of Canny Edge detection to digitize the jet boundary.

The space of shape of rank 3 unit lattices in certain number fields

Sara Chari, St. Mary's College of Maryland
9:10-9:30, Enterprise 275

Given a number field K, the set of units forms a lattice. We say that two lattices have the same shape if they are the same up to isometry and scaling. We discuss the space of rank 3 lattices along with an algorithm to determine which part of the space a given unit lattice lies. The goal is to study which parts of the space are filled by rank 3 unit lattices, and which restrictions on the Galois group lead to different shapes of lattices.

MINIMUM QUANTUM DEGREES WITH MAYA DIAGRAMS

Ryan Shifler, Salisbury University
9:10-9:30, Enterprise 276

We use Maya diagrams to refine the criterion by Fulton and Woodward for the smallest powers of the quantum parameter q that occur in a product of Schubert classes in the (small) quantum cohomology of partial flags. Our approach using Maya diagrams yields a combinatorial proof that

the minimal quantum degrees are unique for partial flags. Furthermore, visual combinatorial rules are given to perform precise calculations.

On the Quantum Parameter in the Quantum Cohomology of a Family of Odd Symplectic Partial Flag Varieties

Caleb Shank, Salisbury University
9:10-9:30, Enterprise 277
(student talk)

We will consider a particular family of odd symplectic partial flag varieties denoted by IF. In the quantum cohomology ring $\mathrm{QH}^*(\mathrm{IF})$, we will show that $q_1 q_2 \cdots q_m$ appears m times in the quantum product $\tau_{Div_i} \star \tau_{id}$ when expressed as a sum in terms of the Schubert basis.

Crime Intensity in Baltimore City: Calculating, Graphing, and Re- lating to Travel Patterns

Timothy DeLloyd, Towson University
3:30-3:50, Enterprise 173
(student talk)

s there a relationship between crime intensity and travel patterns in Balti- more City? We create a spatiotemporal model of crime intensity in Baltimore City using kernel density estimation. For this model, we use an established rule-of- thumb to determine the appropriate bandwidth, calculate edge corrections using Diggle's equation, and run chi-squared tests to verify the model. We implement the model into Python to visualize crime intensity with graphs and to perform statistical tests comparing crime intensity and travel pat- terns using publicly available data sets. Finally, we use Kullback-Liebler Divergence to compare the two data sets.

Innovative Use of Technology in Textbooks: Case in Point - ODEs

Stephen Saperstone, GMU
Max Saperstone, Steampunk, Inc.
3:30-3:50, Enterprise 174

We will discuss some of the underlying technologies used in my introductory, browser-based, interactive digital textbook "Interacting with Ordinary Differential Equations" (IODE), and how to take advantage of technology in revolutionary ways to improve understanding and comprehension of ODEs. The text brings to life static and dynamic behavior of ODEs. By using embedded content to reveal details of calculations and proofs that support the main expository thread, students have more information at their fingertips to fully grasp concepts. Additionally, by using Mathematica-based Interacts, readers can watch a movie which illustrates concepts as they read, or they can, in real time, adjust parameters and initial conditions in the models under discussion. While this text is an example of the exciting and innovative new vision for what a textbook can be in the Internet age, we will discuss next steps, and other future technology that can enhance the learning experience.

Data and Statistics in Basketball

Gabby Krystofiak, Shenandoah University

3:30-3:50, Enterprise 274

(student talk)

This research is centered around the NBA team, the Boston Celtics. Its focus is centered around finding out where the statistics for the Celtics need to be in order to win a NBA Championship. I have gathered data from past Celtic's season where they have lost in different rounds of the playoffs and won different rounds. All of that data was used in a cluster analysis/regression model to help me find an outcome for this research question; Where does the Celtic's statistics need to be in order to win a championship?

Directed tilings of the Euclidean and hyperbolic plane

Brandon Shapiro, University of Virginia

3:30-3:50, Enterprise 275

Euclidean and hyperbolic tilings decompose the plane into vertices, edges, and polygon tiles similarly to simplicial or cubical methods for constructing spaces out of basic cells. Modern tools from algebraic topology and category theory require the edges in these cell decompositions to be directed, which motivates a purely combinatorial question: given a tiling of the plane with n different m-gons at each vertex and a fixed pattern for edge-directions in a single m-gon (for instance, all edges pointing clockwise), how can the edges of the tiling be directed so that every tile fits this pattern? In joint work with Catherine DiLeo and Preston Sessoms arising from the UVA Topology REU, we construct a general method for building these "directed tilings" by reversing edge directions, and a define a large family of "reflection-generated" directed tilings with elegant symmetry properties.

5 Levels of Machine Learning Examples for Layfolk through Linear Algebraists

Katherine Socha, Northeastern University Arlington

3:30-3:50, Enterprise 276

Over the past decade, YouTube has hosted over two dozen videos in which an expert "explains one concept in 5 levels of difficulty" on the Wired channel. Inspired by this idea and by being a mathematician in a computer science college, the speaker will give five examples of mathematical tools we regularly teach that form standard (and understandable) machine learning techniques. For example, Euclidean distances among points in the plane are used for "k-means" clustering algorithms, suitable for college algebra/precalculus students. Examples will be drawn for each of the 5 levels: Layfolk, College Algebra/Precalculus, Differential Calculus, Multivariate/Vector Calculus, and Linear Algebra. Attendees will come away with examples to use in their own classes.

Orders of Quaternion Algebras and their Properties

Henry Pratt, St. Mary's College of Maryland

3:30-3:50, Enterprise 277

(student talk)

Quaternion algebras and their orders are four-dimensional noncommutative algebras. They have been studied since the mid-19th century, most notably by Hamilton, who sought a way to model three-dimensional space that has a length-preserving multiplication operation. Due to their non-

commutivity, phenomena such as factorization and metacommutation in orders can be studied in depth, and we will investigate such properties.

MCMC diagnostics presented in interactive Quarto slides

Deepak Bastola, Salisbury University

3:55-4:15, Enterprise 173

This talk explores the critical role of MCMC convergence diagnostics in Bayesian time-series modeling, using a multivariate VAR(1) framework with an inverse-Wishart prior for the error covariance matrix as a case study. We demonstrate how to implement a Gibbs sampling algorithm via the MCMCpack package in R and we illustrate key convergence challenges such as high autocorrelation, poor mixing, and the influence of prior specifications on the sampling behavior. Attendees will learn to employ visual tools (e.g., trace plots, autocorrelation plots) and quantitative metrics—such as effective sample sizes—through examples presented in vibrant, interactive Quarto slides using R.

Mathemalchemy: Student Experiences at the National Academy of Sciences

Alice Petillo, Marymount University

3:55-4:15, Enterprise 174

This spring, The New York Times featured Ingrid Daubechies and the Mathemalchemy exhibit. This (https://www.nytimes.com/2025/03/14/science/mathematics-daubechies-mathemalchemy.html?smid=url-share) This session will describe the experience of visiting the Mathemalchemy exhibit at the National Academy of Sciences while the exhibit was in Washington DC. The Mathemalchemy exhibit features contributions from some members of our MD-DC-VA section. Approximately 25 undergraduate students and faculty from Marymount University (MU) in Arlington, VA attended the Mathemalchemy exhibit as a field trip. The students, mostly undergraduates enrolled in a liberal arts mathematics class, completed a pre-reflection, photo story, and post-reflection in conjunction with the field trip. The session will share these items, practical suggestions, and sample student responses. (Marymount University IRB approved #670)

Air Force's Combat Logistics: Responding to Threats in the Pacific Theater

Ben Bierstine, Virginia Military Institute

3:55-4:15, Enterprise 274
(student talk)

The Air Force's Combat Logistics Branch has over 200 bases that may be leveraged for contingency operations in the Pacific region. Data from the National Geospatial-Intelligence Agency's ACES 2.0 Automated Airfield Intelligence File (AAFIF) is used to determine in operational readiness of a base to launch a specific air frame. This analysis focused on runway length, runway width, runway load classification number (LCN), and fuel storage as key determinants. This data was used to create a linear program to determine the optimal base assignment for various airframes to minimize the time to a specific target.

Lattices in Type B

Stephen Barr, Salisbury University
3:55-4:15, Enterprise 275
(student talk)

Flag varieties are widely studied abstract spaces with physical interpretations. Curves in these spaces do not behave in ways more familiar to us in the plane or Euclidean three-space. Here we interpret the geometry of curves combinatorially, and show the curves behavior aligns with lattice structures.

Limit Properties of Averages of nth Iterates

Kubilay Dagtoros, Sujan Pant
Norfolk State University
3:55-4:15, Enterprise 276

In this talk, we will explore the limiting behavior of the average of the nth iterate of an increasing function. When the function displays periodic characteristics, the limit of the average at 0 governs the average at any given point. Furthermore, this result persists even if the limit exists at an arbitrary point, provided the limit of the average remains consistent across all points.

Quantum Combinatorial Game Extensions

William Lambert, St. Mary's College of Maryland
3:55-4:15, Enterprise 277
(student talk)

Combinatorial games are games that possess no elements of randomness, and perfect information. For any combinatorial game, there may exist multiple, natural definitions for movement on a game position that will yield isomorphic gameplay under classical conditions; which we shall call 'quantum interpretations' of a classical game. These interpretations of combinatorial games are highly sensitive to how moves are defined, meaning that multiple games may result from 'natural' quantum adaptation performed on a classical combinatorial game. In this presentation, we discuss this phenomenon with examples from Nim and Hackenbush.

Parameter Estimation with Dense, Convolutional, and Autoencoder Neural Networks Applied to the FitzHugh–Nagumo ODE

Aidan Chadha, Virginia Tech
4:20-4:40, Enterprise 173
(student talk)

We are investigating parameter estimation techniques for the FitzHugh-Nagumo ordinary differential equation (ODE) using three different neural network architectures: dense neural networks, convolutional neural networks (CNNs), and autoencoders. The FitzHugh-Nagumo model, which describes neuronal dynamics through membrane potential and recovery variables, presents an inverse problem where unknown parameters must be estimated from different variants of observational data. The research implements a three-stage workflow: (1) time series data collection using the Runge-Kutta method with parameters sampled from prior distributions, (2) neural network model training with various data variants including noise-free and noisy conditions, and (3) model evaluation using unseen time series data. Results demonstrate that CNNs achieve superior performance in parameter

estimation, with optimal architectures showing squared bias (C-MSE) as low as 6.6×10^{-7} and R^2 values exceeding 0.99 for noise-free data. We also explore dimensionality reduction through autoencoders, though this approach presents challenges in hyperparameter tuning and requires substantial training data.

Playing Minecraft like a Mathematician!
Michael Weselcouch, Roanoke College
4:20-4:40, Enterprise 174

In this talk we will use Minecraft to give numerical approximations of pi and sqrt(2). WARNING: if you hate fun, this talk is not for you!

Application of Hof's Dynamic Stability Model Through the Lens of a Countermovement Push-Up Trial: Derivation and Preliminary Results
Rebecca Go, Stevenson University
4:20-4:40, Enterprise 274
(student talk)

Background: The leading cause of mortality in older adults is fall-related injuries. Arresting a fall using the hands may prevent fall-related injuries. This research evaluated the feasibility of assessing forward fall arresting stability using the arms and tested for age-related changes. Methods: Younger (n=14) and older (n=10) adults performed a push-up as fast as possible three times. The margin of stability and time to contact based on Hof's model were estimated. A mixed-effects model tested age-related differences in time to contact and margin of stability during the downstroke of the push-up. Results: The time to contact was significantly different for younger adults (0.34 (0.12) s) compared to older adults (0.52 (0.21) s, p¡0.05). Younger adults (-0.039 (0.025) m) exhibited a significantly smaller margin of stability compared to older adults (-0.027 (0.018) m) (p=0.00783). Discussion: Younger adults demonstrated a shorter time to contact, indicating a greater ability to "catch" themselves during a forward fall. The age-related differences in margin of stability suggest that younger adults experience greater instability than older adults. These findings ultimately suggest Hof's margin of stability may be extended to assess forward fall arrest capacity and identify age-related differences connected to increased fall-injury risk.

Symmetry in graphs: bicoset digraphs
Rachel Barber, Hood College
4:20-4:40, Enterprise 275

This talk explores bicoset digraphs, a variation of Cayley digraph. We will discuss how their structure can be recognized and explore their symmetry. No prior knowledge of bicoset digraphs is required, just curiosity about graphs and symmetry.

Dual Necessary Conditions for Minima of Nonsmooth Scalar Optimization Problems with Inequality Constraints
Elena Constantin, University of Pittsburgh at Johnstown
4:20-4:40, Enterprise 276

In this talk we deal with the following scalar optimization problem (P)

$$\text{Minimize } f_0(x) \text{ subject to } x \in D = \{x \in U : \ f_i(x) \leq 0, \ i = 1, 2, ..., m\},$$

where $f_0 : U \to \mathbb{R}$, $f_i : U \to \mathbb{R}$, $i = 1, ..., m$, and U is an open set in $\mathbb{R}^n$.

The goal of this talk is to provide second-order dual necessary conditions for the existence of a local minimizer for the nonsmooth scalar optimization problem (P).

The objective function and the active inequality constraint functions are assumed to be locally Lipschitz near the local minimizer $\bar{x}$ and differentiable only at $\bar{x}$.

Our conditions are formulated in terms of generalized derivatives.

We do not require any kind of second-order differentiability of any of the functions.

Our results are illustrated by some examples.

Stitching pants with stripes: Generating nested cobordisms
Shruthi Sridhar Shapiro, University of Richmond
4:20-4:40, Enterprise 277

Two manifolds of the same dimension are said to be cobordant if there exists a manifold one dimension higher whose boundary is the disjoint union of the two original manifolds. For instance, a pair of pants provides a cobordism between two circles (at the legs) and a single circle (at the waist). In this talk, I will explore how we generalize the concept of cobordism to include "sub-cobordisms" - such as stripes running from the waist to the legs of the pants - embedded within the larger cobordism. I will go on to describe the cobordisms that are the basic building blocks and the relations between them that determine when different combinations should be considered the same.