SPRING 2026 PI MU EPSILON CONFERENCE PROGRAM

All presentations will occur in **PENGL** on the Saint John's University campus. Below is the schedule of talks, with room information and Zoom links provided, followed by the abstracts (beginning page 2) for each talk. The Zoom information has also been posted to the conference webpage.

SCHEDULE FOR FRIDAY, APRIL 10.

Student research presentations:

Time/Room	PENGL 229
6:30-6:55pm	Parker Pollis, Chelsi Valerio Tatis
7:00-7:25pm	Karli Miguel, Kunga Tsering
7:30-7:55pm	Fatima Abdi

Keynote Address #1: Dr. Lily Khadjavi
Time: 8:00pm - 9:00pm CST
Room: PENGL 269 (or via Zoom)

SCHEDULE FOR SATURDAY, APRIL 11.

Open problem session: Breakfast with a side of math
Time: 8:00am - 8:55am CST
Room: PENGL 269

Student research presentations:

Time	PENGL 229	PENGL 232
9:00-9:25am	Aspen Meissner	Collin Smolke
9:30-9:55am	Maxwell Sheridan	Arabella Fuzak
10:00-10:25am		Per Johnson

Keynote Address #2: Dr. Lily Khadjavi
Time: 10:30am - 11:30am CST
Room: PENGL 269 (or via Zoom)

PRESENTATION ABSTRACTS - FRIDAY APRIL 10.

Student presentation - Friday, April 10, 6:30pm in PENGL 229.
Speaker: Parker Pollis, Chelsi Valerio Tatis (College of St. Benedict and St. John's University)
Differential Privacy: The Noisy Anonymizer - Data sets contain useful statistical information but also carry sensitive personal details about people. Differential Privacy is a newer mathematical approach that protects individuals by adding controlled noise to published statistics, though it is not yet widely understood or applied. Our project tests how Differential Privacy performs on data sets of different sizes and types. We will be running simple python code and comparing the "noisy"/Differentially Private averages to the data set's original average and standard deviation. We will compare these results and visualize how accuracy changes as privacy increases. By providing clear examples and graphical evidence, our work shows when Differential Privacy produces reliable statistics and when it begins to break down. Our goal is to show how and why a certain level of privacy is important for certain data sets to keep information such as names, dates, etc. private. This will help future users to choose appropriate privacy levels for real-world data. .

Student presentation - Friday, April 10, 7:00pm in PENGL 229.
Speaker: Karli Miguel, Kunga Tsering (College of St. Benedict and St. John's University)
Bounding the Base Size of a Finite Permutation Group - Let G be a finite permutation group on n letters. We can define $\mu(G)$ to be the smallest support of any nontrivial element , and we can define $b(G)$ be the minimal size of a subset B of $\{1, 2, \ldots, n\}$ such that the identity is the only element that fixes every element of B pointwise. Mastrogiacomo recently reproved that $\mu(G) \cdot b(G) \leq n \log(n)$ for all finite permutation groups, and that this is the best possible bound. We will talk about when this bound can be improved by looking only at particular families of permutation groups.

Student presentation - Friday, April 10, 7:30pm in PENGL 229.
Speaker: Fatima Abdi (Augsburg University)
Forecasting soil carbon fluxes with machine learning at sites in the National Ecological Observatory Network - Soil carbon flux is a key component of the terrestrial carbon cycle and is essential for understanding carbon exchange between ecosystems and the atmosphere. This research explores how machine learning can be used to forecast soil carbon flux by using environmental data from the National Ecological Observatory Network (NEON). Using environmental predictors including soil temperature and soil water content, we trained models to predict soil carbon dioxide flux values for 2025 across diverse ecological regions. Our findings highlight how important training data and site-specific conditions are when forecasting soil carbon dioxide flux. They also show that machine learning can be an effective tool for modeling carbon dynamics across diverse ecosystems.

Keynote Address #1 - Friday, April 10, 8:00pm in PENGL 269.
Speaker: Dr. Lily Khadjavi
Race, Policing, and the Fourth Amendment: What do numbers reveal? - We know all too well that encounters with law enforcement make national headlines when they end in tragedy. While these events draw intense public attention, most police stops occur outside of public view. How can we better understand everyday policing beyond the cases in the national spotlight? Many agencies collect data, but what can we learn beyond simply counting who is stopped? When a driver is pulled over, the stop may include a frisk or search, but only under specific legal conditions. This naturally raises questions: Who is searched, and under what basis? Are drivers asked to give consent to a search, thereby waiving their Fourth Amendment rights? Who agrees, and who declines? Our window in can not only illuminate racial and ethnic disparities but can also point to concrete policy recommendations. We will see that mathematics and statistics have a critical role to play in understanding questions of justice and shaping public policy in our own communities.

PRESENTATION ABSTRACTS - SATURDAY APRIL 11.

Open problem session - Saturday, April 11, 8:00am in PENGL 269.
This morning session will be held in the room where the breakfast/refreshments will be available. It is meant to be time during which participants can explore math problems together. The problems have a low entry point, i.e. minimal to no technical knowledge is required. You are also welcome to share a problem you find interesting (whether you know a solution or not) during this session.

Student presentation - Saturday, April 11, 9:00am in PENGL 229.
Speaker: Aspen Meissner (MN State Univ - Moorhead)
A Modernized Proof of Jan Lukasiewicz's Shortest Axiom for the Implicational Calculus of Propositions - Implicational Propositional Calculus, or implicational logic, is a field of mathematics that studies logical propositions made of only implications; that is, statements of the form "if p, then q." In 1937, Jan Lukasiewicz first proposed a single short axiom that could produce all of implicational logic. We synthesize his 1948 paper consisting of a proof for this axiom with original research that expands this axiomatic system to include negation, which produces all of formal logic.

Student presentation - Saturday, April 11, 9:00am in PENGL 232.
Speaker: Collin Smolke (Concordia - Moorhead)
Resonance Induced Hyers Ulam Instability in Undamped Spring Mass Systems - A recent study employing Fourier transform techniques presents an incomplete treatment of the Hyers-Ulam stability of linear differential equations with constant coefficients, particularly in the context of the second-order undamped harmonic oscillator (i.e., the spring-mass system). That paper asserts that such systems are universally Hyers-Ulam stable. This paper aims to clarify that the Hyers-Ulam stability of these equations is, in fact, more nuanced and critically dependent on system parameters such as the mass, damping coefficient, and spring constant. Specifically, the undamped spring–mass system is Hyers-Ulam unstable when the mass and spring constant are both positive or both negative. This instability arises due to resonance phenomena in the perturbed system. We also discuss and illustrate additional instability cases to provide a more complete stability analysis.

Student presentation - Saturday, April 11, 9:30am in PENGL 229.
Speaker: Maxwell Sheridan (MN State Univ - Moorhead)
On the Displacement Statistic of Cayley Permutations - We define Cayley permutations as tuples of positive integers with the property that if k appears in the tuple, all integers smaller than k also appear in the tuple, and show that Cayley permutations are a subset of parking functions.

We study the displacement statistic of Cayley permutations by constructing a mapping from Cayley permutations to their displacement tuples and prove that when restricted to weakly increasing Cayley permutations, the mapping is bijective. This results in the displacement tuples satisfying the Cayley property for nonnegative integers.

From this, we establish that generating weakly increasing Cayley permutations is analogous to generating integer partitions. We also give a bijection between weakly increasing Cayley permutations of length n and binary words of length n-1, which provides a displacement enumerator in terms of strict integer partitions.

Finally, we derive a closed-form displacement enumerator for all Cayley permutations by permuting the entries of the weakly increasing ones, identify classical sequences appearing in the terms of the enumerator, and conjecture formulas for the enumerations of Cayley permutations intersected with other families of parking functions, namely Fubini rankings and unit-interval parking functions.

Student presentation - Saturday, April 11, 9:30am in PENGL 232.
Speaker: Arabella Fuzak (College of St. Benedict and St. John's University)
An Analysis of a Family of Root-Finding Methods - This thesis analyzes the behavior of a family of iterative root-finding methods, the Hansen-Patrick Family, which has a parameter, alpha, to create methods such as Newton's methods, Halley's method, and Euler's method. By varying the

parameter alpha, with both real and complex values, this project examines how the parameter can change convergence, divergence, and stability for different functions. This is shown by basin maps and Mandelbrot-like sets to visualize this behavior and classify points based on whether they converge to a root, diverge to infinity, or remain bounded without converging.

Student presentation - Saturday, April 11, 10:00am in PENGL 232.
Speaker: Per Johnson (College of St. Benedict and St. John's University)
Palindromes in Finite Groups - A palindrome is a string that reads the same forward and backward, such as "noon" or "taco cat." Given a finite group and a generating set, we seek to determine which elements of the group can be written as a palindrome in the generators. For instance, consider $\mathbb{Z}_{12}$ with generating set $S = \{2, 3\}$. It is clear that 7 can be written as a palindrome in S, since $7 = 2+3+2$. However, it isn't obvious that 5 can be written as a palindrome, since the natural way of writing 5 would be $5 = 2 + 3$, which is not a palindrome. We consider different generating sets for several families of finite groups.

Keynote Address #2 - Saturday, April 11, 10:30am in PENGL 269.
Speaker: Dr. Lily Khadjavi
Why $a + b = c$ is harder than it looks: Exploring the ABC Conjecture - The ABC Conjecture is one of the most famous problems in number theory, connecting the simple equation $a + b = c$ to deep properties of whole numbers. This conjecture has even been called a "holy grail" of the field because it is so prized yet so elusive. In this talk, we'll explore the conjecture through concrete examples, seeing why mathematicians find it so compelling and how it predicts strong limitations on solutions to familiar equations. In recent years, the conjecture has also raised a broader question: When can we consider a theorem to have truly been proved? Excitement and debate surrounding a possible proof by Shinichi Mochizuki illustrate how subtle this issue can be. Time permitting, we'll also see how ideas from geometry, especially elliptic curves, can be used to study this problem about numbers, including work of Noam Elkies that generates interesting examples.