

# MORAVIAN UNIVERSITY

## Student Mathematics Conference

Saturday February 18, 2023  
Moravian University, Bethlehem, PA

Sponsored by  
the Moravian chapter of Pi Mu Epsilon  
and  
Moravian University





# MORAVIAN UNIVERSITY

## STUDENT MATHEMATICS CONFERENCE

February 18, 2023

- 9:00 am    *Registration*  
              Sally Breidegam Miksiewicz Center for Health Sciences (SMC) Second Floor
- 9:30 am    *Welcoming Remarks*  
              Diane Husic,  
              Dean of the Center for Scholarship, Research, and Creative Endeavors  
              Moravian University
- 9:45 am    *Mathematical Jigsaw Puzzles*  
              Darren A. Narayan,  
              Professor of Mathematics,  
              Rochester Institute of Technology
- 10:45 am   *Coffee Break*
- 11:00 am   *Student Talks* – Two parallel sessions
- 12:00 pm   *Lunch*
- 1:00 pm    *Social Event*

*Darren A. Narayan*  
*Mathematical Jigsaw Puzzles*

Tilings problems are the jigsaw puzzles of a mathematician. For hundreds of years such problems have produced an array of beautiful and intriguing patterns. Problem B-3 from the 1991 William Lowell Putnam Examination asked: "Does there exist a natural number  $L$ , such that if  $m$  and  $n$  are integers greater than  $L$ , then an  $m \times n$  rectangle may be expressed as a union of  $4 \times 6$  and  $5 \times 7$  rectangles, any two of which intersect at most along their boundaries?" The answer is yes, and a solution appeared in the Monthly showing that  $L = 2213$  suffices. However, using an array of different algebraic and combinatorial tools, we will show that  $L$  can be significantly reduced to 33.

\* This is joint work with Rachell Ashley, Aisosa Ayela-Uwangue, Frances Cabrera, Carol Callesano, Grant Dietert, and Allen Schwenk

*About our Conference*

This conference sponsored by Moravian University and is organized by the Pennsylvania Omicron (Moravian University) chapter of Pi Mu Epsilon, the national mathematics honorary. The members of the chapter are:

Gabrielle Demchak  
Shane Houghton  
Garrison Koch  
Matthew Perez  
Victoria Samuels  
Justin Szaro  
Calum Taft-Lockard

## Student Talk Schedule

	SMC Room 223	SMC Room 129/131
11:00 to 11:15	Optimizing the distance between tomato plants to limit aphid infestations through volatile compounds Mary Ball Lafayette College	Average Class Number of Almost Pythagorean Triples Cathy Barrish, Charles Ohanian, and Amanda Sodl Muhlenberg College
11:20 to 11:35	Identifying critical thresholds for crown of thorns starfish concentration in reefs Julianna Hoitt Lafayette College	Sierpinski and Riesel Numbers in Narayan's Cow Sequence Katherine Franzone Cedar Crest College
11:40 to 11:55	The Colimitation Theory of Mutualism Connor Ritchie Syracuse University	Knight's Tours on Non-Orientable Surfaces Zachary Lague Stockton University

Mary Ball, *Lafayette College*

**Optimizing the distance between tomato plants to limit aphid infestations through volatile compounds**

Plants can warn neighboring plants about infections and herbivory through volatile compounds. Volatile compounds could be used in agriculture as a sustainable form of pest control. This model optimizes the distance tomato plants should be placed to limit aphid infestations using methyl salicylate, a naturally produced volatile compound.

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Cathy Barrish, Charles Ohanian, and Amanda Sodl, *Muhlenberg College*

**Average Class Number of Almost Pythagorean Triples**

An Almost Pythagorean Triple is a set of 4 integers,  $a, b, c, D$ , that satisfies  $a^2 + b^2 = c^2 + D$ . Inspired by Gauss' work with average class numbers, we set out to develop a formula for the average class number of Almost Pythagorean Triples (APT's), specifically when  $D < 0$ . Using a double summation method, we found that the average class number of APT's with  $0 < -D < N$  can be approximated using  $\pi/6\sqrt{N}$  when  $N$  is large.

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Katherine Franzone, *Cedar Crest College*

**Sierpinski and Riesel Numbers in Narayana's Cow Sequence**

Narayana's Cow Sequence is defined by the recurrence relation  $N_1 = 1, N_2 = 1, N_3 = 1$ , and  $N_t = N_{t-1} + N_{t-3}$  for all  $t > 3$ . A Sierpinski number is an odd integer  $k$  for which  $k * 2^n + 1$  is composite for all positive integers  $n$ . Similarly, a Riesel number is an odd integer  $k$  for which  $k * 2^n - 1$  is composite for all positive integers  $n$ . In this talk, we will show that there are infinitely many Sierpinski numbers and infinitely many Riesel numbers in Narayana's Cow Sequence.

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Julianna Hoitt, *Lafayette College*

**Identifying critical thresholds for crown of thorns starfish concentration in reefs**

Crown of thorns starfish are a serious threat to reefs that must be controlled before they cause irrevocable damage. Using mathematical optimization, the population size that should be monitored the closest was determined. This result may allow conservationists to allocate resources most effectively to save reefs from further destruction.

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Zachary Lague, *Stockton University*

**Knight's Tours on Non-Orientable Surfaces**

A closed knight's tour is a loop formed by a knight traveling to every square on a chess board and back to its starting position. This research generalizes this concept to non-orientable surfaces and attempts to determine which homotopy classes of loops formed by closed knight's tours are possible. This talk will discuss which dimensions of Möbius strip and Klein bottle chess boards allow a null-homotopic tour. Informally, a knight's tour is null-homotopic if the loop along which the knight traveled can be shrunk to a point by continuously deforming the path on the board.

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Connor Ritchie, *Syracuse University*

**The Colimitation Theory of Mutualism**

My talk will concern modelling interactions between two cooperating species, using methods from differential equations and game theory to describe changes in population and other parameters.

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*Participating Institutions*

Cedar Crest College  
DeSales University  
East Stroudsburg University  
Franklin & Marshall College  
Lafayette College  
Messiah University  
Moravian University  
Muhlenberg College  
Stockton University  
Syracuse University