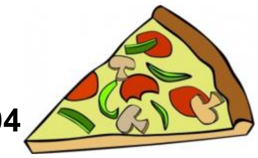
UNDERGRADUATE MATH SEMINAR

The next seminar of the winter term will be



DATE: **THURSDAY, February 5**

Time & **12:30 –** Refreshments in **Bailey 204**

Location: **12:50 – 1:45** Seminar in **Bailey 207**

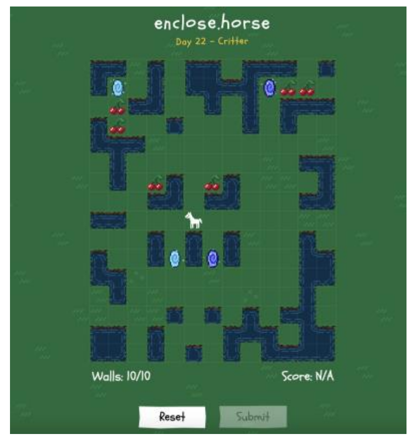
Professor Christina Tønnesen-Friedman

In this seminar, **Professor Christina Tønnesen-Friedman,** a differential geometer in the Union College Math Department, will present the following talk.

Title: Enclose the Horse, or The Isoperimetric Inequality for Plane Curves

Abstract: Suppose we have a fixed amount of fencing available to enclose a region of land for a horse. What would be the optimal shape of the region if our goal is to get the maximum amount of area for the horse?

If we have to stick to rectangular shapes, we can use differential calculus methods to show that a square would be optimal. But a quick calculation shows that a circle would be even better. If we get to choose any shape we want, is the circle the best we can do? In this talk we will give a classical proof that this is in fact the case (with some small mathematical fine print assumptions). The proof, due to E. Schmidt (1939), is simple and elegant and uses the very powerful Green's Theorem from multivariable integral calculus.



enclose.horse
a fun online mathy game

Pieces from Thesis: Sarah Lehan-Allen

Sarah wrote her senior thesis this past fall under the guidance of ***Professor Leila Khatami***

One of the first fundamental matrix properties that students are taught in algebra is that matrix multiplication is not commutative, that is, given two matrices A and B, we cannot claim that AB=BA. But we can ask under what conditions this is true. Are there certain types of matrices that commute with each other?

Through my thesis, I explored this idea: which types of matrices which commute with each other. I explored Jordan types as well as nilpotent matrices to explore commutativity relationships. Jordan types are matrices with any one value along the main diagonal, all entries directly above this main diagonal are 1, and all other values are 0. A nilpotent matrix is a nonzero matrix A such that $A^k = 0$ for some $k \geq 1$. The majority of my thesis focused on combining these two types of matrices and using nilpotent Jordan types. These nilpotent Jordan type matrices can also be broken down into partitions. We define a Jordan type matrix of partition (3,2,1) to be a 6x6 nilpotent Jordan matrix where the main diagonal is split into a 3x3 nilpotent Jordan matrix, a 2x2 nilpotent Jordan matrix, and a 1x1 nilpotent Jordan matrix, written as shown to the right:

$$J_{(3,2,1)} = \left[\begin{array}{ccc|cc|c} 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \hline 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \hline 0 & 0 & 0 & 0 & 0 & 0 \end{array}\right]$$

Turn the page!
Sarah's article continues.

(continuation of Sarah's thesis article)

In my work, I used partitions of 3x3, 4x4, 5x5, 6x6, and even 8x8 matrices of this form to observe patterns between the products of these matrices. I also determined the commutator, that is, the form of a square matrix which commutes with each partition of 3x3, 4x4, and 5x5 matrices. For example, a Jordan type matrix of partition (3,1) commutes with all matrices of the form

$$\begin{bmatrix} 0 & a & b & c \\ 0 & 0 & a & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & d & 0 \end{bmatrix}.$$

From here, I determined which partitions of 4x4 and 5x5 matrices commute with each other. The following tables show which partitions do in fact commute with each other.

	(4)	(3,1)	(2,2)	(2,1,1)	(1,1,1,1)
(4)	Yes	No	Yes	Yes	Yes
(3,1)	No	Yes	No	Yes	Yes
(2,2)	Yes	No	Yes	Yes	Yes
(2,1,1)	Yes	Yes	Yes	Yes	Yes
(1,1,1,1)	Yes	Yes	Yes	Yes	Yes

	(5)	(4,1)	(3,2)	(3,1,1)	(2,2,1)	(2,1,1,1)	(1,1,1,1,1
(5)	Yes	No	Yes	No	Yes	Yes	Yes
(4,1)	No	Yes	No	Yes	Yes	Yes	Yes
(3,2)	Yes	No	Yes	Yes	Yes	Yes	Yes
(3,1,1)	No	Yes	Yes	Yes	Yes	Yes	Yes
(2,2,1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(2,1,1,1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(1,1,1,1,1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Hence, we see the patterns between which partitions commute with each other for matrices of size 4x4 and 5x5.

Free Peer Tutoring in Calculus Courses

CALCULUS HELP CENTER!

Sunday - Thursday: 7:30 – 10:00pm

Sorum House Seminar Room

Summer Job in Math with AOP! Deadline: Friday, Feb 6

The Academic Opportunity Program (AOP) is looking to hire two summer tutors/community advisors (TCAs) in math, one for precalculus and one for calculus. Math TCAs must have completed Math 199 by the end of Spring 2026 and have an overall GPA of 3.0 or better.

For a description of the position responsibilities and to apply, follow the QR code in the advertisement below, or contact Julissa Boyer (boyerj2@union.edu) in the AOP office.

[Tell your non-math friends, too! The AOP/HEOP program is also hiring English, Political Science, Chemistry, and Engineering TCAs.]