Abstracts

Research Presentations

Shemsi Alhaddad
Best practices for creating data embroidery.

Data embroidery is a type of fiber art in which data is used to create embroidered art pieces. In this presentation, I will give an overview of data visualization best-practices that apply to data embroidery designs. I will also show examples of finished pieces.

Ben Blumson
Gluts, Knights and Knaves

On the island of knights and knaves, knights always tell the truth, but knaves always lie. What if an islander says "I am a knave"? According to classical logic, this is not possible, but here we answer this and other puzzles in the context of para-consistent logics, which allow true contradictions.

Leon Brin
Rep-tiles and the Geometric Mean

A replicating tile is a plane figure that tiles the plane and also tiles itself. Some number of copies of the shape fit together to form a similar but larger replica. Admitting replicas of different sizes allows construction of an infinite family of trapezoidal rep-tiles often requiring a geometric mean relationship among the side lengths.

Hayes Brown, Eillis Edinkrah, Joey Maness
Polyominos, Puzzles, Proofs, and Programming

In this talk, we will consider several types of commercially available puzzles that relate to the placement of polyominos (shapes formed by joining squares edge to edge). Employing ideas from discrete mathematics and operations research, we examine both solvability and optimality of these puzzles.

Barry Cipra
Oh What a Complex Rug We Weave...

Surprising patterns emerge when we obey a simple mathematical rule, borrowed from knot theory, for tricoloring a square weave of "ribbon" or "thread," starting from specified "fringe" conditions across the top and left edges. We report on some of what we've observed and appeal for help in proving that the patterns persist as the weaving goes to infinity.

Daniel Cowan

From Pixels to Play: Creating Image Approximations with Tangle Fidget Toys

What do you get when you combine toys, Prim's algorithm, and Abe Lincoln? Art! This talk discusses how math is used to recreate iconic images using the famous Tangle fidget toy.

Emily Dennett

Randomizing Your Digits: Generatively Knit Mittens

I will discuss my explorations in generating patterns for two-color mittens as they were knit. By combining the techniques of stranded knitting and generative art, I was able to develop patterns that are both pleasurable to knit and produce interesting patterns on the finished mittens.

Shiying Dong

Sculpting Mapping Cylinders: Seamless Crochet of Topological Surfaces

I will share my experience of crocheting topologically nontrivial surfaces by building appropriate ribbon graphs from foundation chains. This technique perfectly matches the concept of mapping cylinder of degree 2 branched covering in algebraic topology. Examples include surfaces bounded by torus knots and links, regular polylinks, and more.

Hester Graves

Imaginary Numbers in Binary! Using Doilies?!!?

The world runs on binary, but how do we write complex numbers 'in binary?' We use base $(1 + i)$, but figuring out the bast way to write a complex number in base $(1 + i)$ is tricky. The answer lies in drawing, cutting, and pasting lacy diagrams in the complex plane.

John Harris

Harmony in Hanabi: Fireworks without the Fireworks

The card game Hanabi is an award-winning cooperative game in which players have full knowledge of other players' cards but no knowledge of their own. With limited hint-giving ability, players try to build an optimal collection of point-scoring fireworks cards. In this talk we will investigate several helpful strategies.

Laura Hart

A Tool to Think With – the Finch Robot

Robofun and Teachers College are partnering to improve the teaching of mathematics using a small robot called the Finch through culturally relevant robotic activities. Come learn about our journey teaching teachers and learning to affect change in 2 NYCDOE schools in Brooklyn.

Brian Hopkins

Exploring Bipartition Dominoes

Consider dominoes marked not with pips but with a partition on each side, where all the numbers in the two partitions sum to a fixed value (say, 6). After tweaking the rules for connecting dominoes, can we put them all in row? How many bipartition dominoes are there, anyway?

Tanya Khovanova

Teaching Math with Crochets

I will bring my collection of crochets that I use in my teaching at PRIMES STEP. The collection includes hyperbolic surfaces, knots, links, and two more objects that I am keeping secret.

Ed Lamagna, Ventsi Gotov, Madhukara Kekulandara
Gerrymandering is Not a Game – Except When It Is

Distrix is a board game based on political redistricting. The game can be played competitively by two players, or in solitaire mode with the goal of gerrymandering the board for one party or creating a fair districting plan. Mathematical and algorithmic challenges presented by the game are discussed.

Liz McMahon, Gary Gordon
The SET Daily Puzzle: Combinatorial and Geometric Structure

At MOVES 2022, we discussed the structure of the SET Daily Puzzle (12 cards, six sets). We have proven that there are 93 different puzzles, considering card/set incidence relations. We'll discuss other ways to measure equivalence and look at data from the SET website's actual daily puzzles.

Saad Mneimneh
Three Points Make a Right Triangle.

Given $n \geq 1$ and $2n-1$ points in Z_n^2, three points must make a right triangle. We will prove this fact using pigeonhole. We will also describe an algorithm to identify a right triangle in constant time after a point moves. Finally, we explore the minimum and maximum number of triangles formed.

Colm Mulcahy
A New Two-Person Mathemagical Entertainment with Coins

Early in 2023, a popular UK newspaper presented an ingenious puzzle which naturally adapts to a very surprising two-person magic entertainment. It was originally conceived using a chessboard sized-array of identical coins; we suggest a presentation using four random coins. It's fun (and baffling) for adults and children alike.

Uyen Nguyen
Modeling Equations in Origami Using the Miura-ori Pattern

This talk demonstrates a method for designing origami representations of various functions by using the Miura-ori fold and adjusting the spacing between creases. Limitations and design suggestions are discussed.

Brittany Ohlinger
Self-similar structure of $\mathcal{P}$-positions of the game Euclid

Euclid is a Nim-type combinatorial game in which the game moves can be thought of as traversing branches of the Calkin-Wilf tree. We will investigate the self-similar structure of the $\mathcal{P}$-positions within the tree and the game positions that require the maximum number of moves in optimal play.

Medha Ravi
How Less is More: Origami in Mathematics

This paper presents a new proof of the impossibility of doubling a cube's volume with straightedge and compass. Unlike previous methods that rely on Field Theory, the proof uses simple geometry and induction, offering an alternative general approach to solving origami math problems, including the other two Delian problems.

Henry Segerman
Mathematical dice design

Robert Fathauer and I started making injection molded dice as "The Dice Lab" in 2014, and have since produced over 30 different dice designs. I'll talk about the mathematical, functional, and aesthetic aspects of our work.

Rik Sengupta
Fairness on Graphs

The theory of allocations of indivisible goods is growing. We describe this problem by putting numbers on a graph, in order to achieve different objectives. The set-up is accessible and easy to describe, but also surprisingly deep. It can be stated as a puzzle, with proofs using only high-school mathematics.

Jorge Nuno Silva
Three Moments in the History of Numerical Calculations

The use of abacuses and calculation tables is well documented. However, we do not know exactly how the calculations were performed. We will address, with new ideas, the Roman period (roughly 2000 years ago), Gerbert's abacus (10th century), and the Inca abacus Yupana (17th century) and its incredible potential.

Robert Vallin
Investigating the Australian Shuffle

The mathematical study of shuffling is nothing new. This talk concentrates on the Australian Under-Down Shuffle. We introduce the shuffle and answer a question from E. Behrends on a variation. This results in a new sequence for the OEIS which we dissect from a couple of points of view.

Elizabeth Wilmer
Knitted origami

Methods will be presented for embedding horizontal, vertical, and diagonal crease lines into garter stitch knitted fabric. While these techniques are mostly based on standard knitting stitches, horizontal creases required novel methods. This crease library suffices to knit a square twist, a foundational origami tessellation unit

Wing Hong Tony Wong
Probabilistic chip-collecting games with modulo winning conditions

In this talk, we study a probabilistic chip-collecting game, where Alice and Bob take turns to collect chips: if Alice collects x chips, then Bob collects y chips, and vice versa. The first player who collects a positive multiple of n chips is the winner.

Family Activities

Skona Brittain
Brainy Braiding

Braiding - whether thread, ribbon, hair or dough - usually involves starting at the fastened end, repeatedly overlapping strands in a straightforward fashion, and then fastening the loose strands at the other end. But if you start with both ends already fastened, can you still make a braid? Such braiding puzzles, designed by James Tanton, require using our brains as well as our hands.

Bronna Butler, Jessica Sklar
Euler's Cat

We provide a brief history of Leonhard Euler and the Königsberg Bridge problem, noting their role in the development of graph theory, and define Euler paths. We then present and discuss two original art pieces, and invite participants to look for Euler paths in graphs via a hands-on fiber activity.

Jordan Emmart
Weaving Meaningful Patterns

In this hands-on experience, participants will learn to use weaving as a visual representation of mathematical concepts. From patterning to cryptology, families will explore the intersection of the creative and the concrete. This activity is aimed at the elementary grades but also applies to higher order thinking.

Vanessa Landgraf
Magic Key-Ring-Chain

Simple key-rings turn into a magical "running" chain - if woven the right way. We will weave such a magic key-ring-chain and learn something about its mathematical and historical background.

Brittany Ohlinger
Coloring the losing positions of the game Euclid

Euclid is a Nim-type combinatorial game that can be played on a binary tree shaped game board. We will explore which positions in the game are winning and losing positions by creating a weaving of the board.

Eric Olson
Oloidmania

Participants in this session will investigate construct and decorate paper oloids. Oloids are fascinating geometric objects that can be easily made with paper, scissors, and glue. Though constructed from a single sheet of paper, they form a 3-D object they can easily roll in a fairly straight line providing an excellent invitation to consider a number of STEM concepts such as stability, symmetry, and scale among many others.

Elana Reiser
The Geometry of God's Eye

A God's Eye is a craft made from wrapping yarn around popsicle sticks. In this session you will learn a brief history of them and then create your own. We will study the geometry of the God's Eye and see how to create different shapes.

Helen Rodney
Using Origami to Introduce the Properties of a Square

We will use the ancient art of Japanese paper folding (origami) to discover and prove the properties of a square by using origami paper (which is always a square), pencils and markers. The properties of a square will be written on one of the finished origami models.

Adam Shavit, Jonathan Shavit
Bayesian Murder Mystery: Visualizing Likelihood with New Evidence

In this activity, we will engage participants in a mathematical exploration of Bayesian statistics through an imaginary mystery scenario. By presenting the premise (crime scene details, and suspects) and the desired goal (identifying the culprit), we aim to demonstrate an application of Bayesian reasoning. Participants will provide their initial intuition and consider the impact of new evidence. We will collect estimates from participants and calculate the likely suspect using the Bayes formula. By contrasting the formal solution with participants' intuitive estimates, we can facilitate a deeper understanding of Bayesian statistics. We will visually demonstrate how the data fits the Bayesian formula by dividing grids of suspects and rearranging of data pieces.

Marie Sheckels, Emily Sheckels
Designing Log Cabin Quilts/Afghans

This session will explore ways mathematics can be used to design log cabin quilts. Presenters will share examples of quilt patterns and briefly discuss how various mathematical topics, especially rigid motions, are relevant to their designs. Participants will then be given materials to design their own quilts.

Melissa Silk
Mobifold

Participants will play with the Möbius Strip to explore the mysteries inherent in this magical mathematical object. Using patterned papers, they will fold a strip into small sculptures or unique wearables. This investigation of surface, edges and patterning affords participants an understanding of mathematical concepts and their influence on design.

Melissa Silk
Bucky's Circus

Bucky's Circus combines modular origami, geometry, engineering and sculpture, to create a new interpretation of the Vector Equilibrium. Drawing on Buckminster Fuller's principles, the workshop relies on participants' willingness to experiment, play and construct with the annulus shape, while exploring the inherent geometry related to a colorful materialization of structural rigidity or flexibility.

Emil Simeonov
PENTRAM - the next-level of Tangram

Pentram is a special dissection puzzle invented by Emil Simeonov. It is based on a regular pentagon that can be used to extend mathematical knowledge beyond that of the well-known Tangram shapes. The golden ratio hidden in the pieces leads to the forming of many aesthetically appealing images.

Suzanne Sumner
Fish and Fowl: Weaving Ribbon

This session will demonstrate two crafts: weaving ribbon fish and ribbon birds. Each year UMW faculty make crafts to experience learning something unfamiliar, what we often ask our students to do. These exercises teach faculty lessons about themselves as learners and as teachers.

Cindy Zhang
Crochet a hyperbolic plane

Learn basic crochet stitches to make a hyperbolic plane! Discover and create different surfaces by varying the rate of increase of single crochet stitches.

Érika Roldán, Manuel Estevez
Games, Gamers, and Mathematics

We will explore the mathematical and computational modeling of some games, video games, and puzzles developed as part of research projects in mathematics and computer science. These include sliding puzzles and art gallery problems with towers and queens. Come and play with us and do a bit of mathematical modeling to find the right winning strategies... though they might not exist!