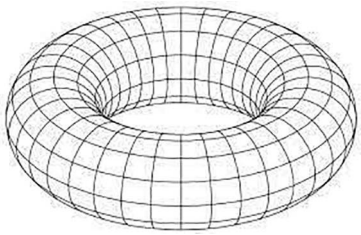
Atari and the Multiverse of Doughnuts

What do a math lecture and a video game have in common?



In Atari's Asteroids, you fly a spaceship that destroys asteroids with a ray gun. When you fly off the top of your TV, you reappear from the bottom. When you fly off the right, you reappear from the left. The top of TV is "glued'" to the bottom, making a cylinder, and the left end of the cylinder is "glued" to the right end, making a doughnut. The Asteroids universe is a doughnut.

TVs used to have 4:3 aspect ratios, and now they're usually 16:9. We can play Asteroids on both. Both universes are doughnuts, but they're different shapes. If we took the ship captain out of her universe, and marooned her in a new one, would she be able to tell? Could different TVs give her the same universe? Are there directions she can fly that take her to every point in her universe?

These are basic versions of questions that mathematicians study: What are the possible shapes of a given object? Can we tell two objects apart by studying their geometry from within, as in our marooned captain's dilemma?

Autumn Kent used this video game as a jumping off point to discuss the topology of moduli spaces, and created a downloadable JavaScript version of the game to show what it would be like to live in some of these surfaces.

This talk was given at the University of North Carolina at Asheville on October 27, 2022. It was the Parsons Lecture, funded to provide the UNC-Asheville community with the ability to attend a presentation by a nationally renowned mathematician speaking on a topic accessible to the general audience. Kent is an alumna of UNC-Asheville. Want to have a look? Check out the Youtube link below!

Youtube Link: https://www.youtube.com/watch?v=rz0rKcDasEw

Downloadable video game: https://people.math.wisc.edu/~kent/GoldenAsteroidsHot

COMAP Mathematical Modeling Contest

Every year, over ten thousand teams of up to three undergraduate students compete in a 96 hour international mathematical modeling contest focusing on complex real-world problems. Participants must develop a mathematical model, derive and/or compute solutions, and present the results in a formal paper. Clarity, analysis, and design are of critical importance.

This year the department fielded six teams. The team composed of undergraduates Donald Conway, Jimmy Vineyard and Ethan Yang earned a Meritorious designation (top 10%), the department's seventh such success. Additionally, Braeden Bertz, George Ekman and Marlin Lee (pictured) earned an Honorable Mention placement. Here's what Donald, Jimmy, and Ethan had to say:

"We analyzed a dataset on Wordle that contained data from a year of Wordle results, including the daily word, the number of participants, and the percent of participants who guessed the solution right in 1-6 guesses. We started by plotting and exploring the data. Ethan built linear regression models to understand how different properties of the word impacted the average number of guesses it took people to get the word correct. Jimmy shouldered the burden of writing up our final report in LaTeX. I worked hard on literature search. Our analysis of the number of players over time was inspired by a math paper that modeled internet meme popularity over time." – Donald Conway

"We put a huge effort into this competition. We worked together in the basement of Van Vleck to the point of exhaustion. But we were pleasantly surprised by our commitment and the ability to meet the challenges before us." – Ethan Yang

"This competition is easily the most difficult thing I have ever done. We spent almost half a day just figuring out exactly what we were being asked to do, and over 2 days trying to come up with models that could accomplish the requirements. A lot of our initial attempts failed to do anything, and our final models were definitely imperfect. Despite these difficulties and imperfections, on the last day of

the contest we stopped modeling and wrote. We poured hours upon hours into the write-up. Things that probably worked in our favor during judging were the clarity and readability of the write-up, and our honesty with regards to our models. We did not exaggerate the quality of our models. We simply stated how they worked, their shortcomings, and what they predicted. The contest was an incredible experience. It taught us more about working on a project under pressure than any course ever had, or likely ever will. It has certainly been the highlight of my undergraduate education so far, and I'm excited to do it again next year!" – Jimmy Vineyard

Financial support for these students was provided by the math department and the AMEP program; preparation and organization was provided by faculty members Saverio Spagnolie and Amy Cochran. For more details see https://go.wisc.edu/comap.