Department of Mathematics
Newsletter

Spring 2024

## Inside ›››

Axioms for Studying Mathematics

Axiom 1. Mathematical potential is equally present in different groups, irrespective of geographic, demographic, and economic boundaries.

Axiom 2. Everyone can have joyful, meaningful, and empowering mathematical experiences.

Axiom 3. Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs.

Axiom 4. Every student deserves to be treated with dignity and respect.

Federico Ardila – Todos Cuentan
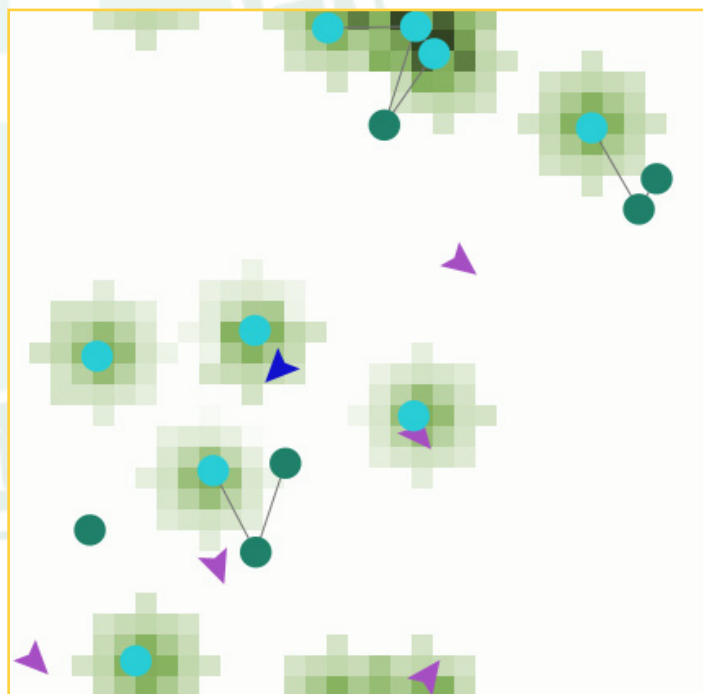
The image is from Professor Kamila Larripa's undergraduate student research group's agent-based model of Alzheimer's disease progression. The image shows the group's sub-model that includes microglial sensing. Green areas represent inflammation from damaged neurons, with darker shades indicating higher levels of inflammation. Microglia are able to sense these inflammation levels, and will move towards higher inflammation concentrations with some probability. See page 7 for more about this project.

Cal Poly Humboldt.

A Note From the Department Chair - Mark Rizzardi

As the outgoing department chair, I would like to say hello to the Humboldt Math, Data Science, and Statistics community! I stress the singular, because that is what the Cal Poly Humboldt Mathematics Department is - a single community made up of many different minds that work together. Our new Data Science program particularly highlights this notion of minds coming together. After all, data science is mathematics, statistics, and computer science blended together to explore and answer questions from just about any field, whether it be forestry, medicine, sociology, or even music. As an applied statistician at heart, I find the opportunities data science offers for exploration and application to be very exciting.

You may wonder what has been happening with the Mathematics Department from the department chair's perspective. For over a dozen years, the Mathematics and Computer Science (CS) Departments were co-administered and shared the same department chair. This was set up when the departments both moved to the Behavioral and Social Science (BSS) building in 2007. In fall 2023, Math added Data Science, and CS added Software Engineering, prompting the decision to no longer co-administer them. Our instructors' offices will continue to be commingled in the BSS until CS and Software Engineering move into the future Engineering building, construction of which will begin in June 2024.

Another current focus is increasing student success in our General Education (GE) courses. The California State University is prioritizing efforts to help freshmen complete their Math and English GE requirements more quickly. The Math Department teaches many GE courses, and many university students struggle with their first university math course, whether they are an engineering major or a music major. As a department, we are committed to student success, and we are actively engaged in making sure our curriculum meets the needs of our students.

Recruiting more Math and Data Science majors is also a hot topic. The number of students at Humboldt, although now climbing slowly, is down to below 6,000 students after being above 8,000 a decade ago. Our Math major count has reflected this decrease in university-wide enrollment, perhaps compounded by other reasons. (Students choosing CS over math these days? K-12 teaching not being a field of choice since the pandemic? No one knows for sure…) Regardless, having a healthy number of Mathematics majors is vital to the variety and frequency of upper-division courses that we can offer. So, not to be shy, if you know someone interested in Mathematics or Data Science as a major, please direct them to call or email our department and we'd be happy to talk to them.

Are you interested in some exciting department news? We have recently been discussing the possibility of renaming our department to reflect the addition of a Data Science major. Ideas being floated are: "Department of Mathematics and Data Science," "Department of Mathematical and Data Sciences," "Department of Mathematical Sciences." One question raised by one professor: "Is mathematics a science?" I'll let you Google that question!

I've enjoyed my recent two years as Department Chair. Although I won't miss struggling to keep up with (or not keeping up with) all the email and to-do items, it's been especially great to help students navigate the university and, of course, working with my colleagues. I am also looking forward to being back with more students in the classroom and applying the new teaching techniques we've been learning to help them become better at understanding and applying statistics and mathematics.

New Faculty

Dr. Rosanna Overholser

It is our pleasure to welcome Professor Rosanna Overholser to the Mathematics Department! Dr. Overholser is originally from Bakersfield, California.

Dr. Overholser has experienced all three systems of public higher education in California, having earned degrees from Bakersfield College (AS in math), Cal Poly San Luis Obispo (BS in math) and UC San Diego (MS & Ph.D. in math). She provided statistical support to healthcare and other researchers through consulting centers at UC San Diego, Ghent University in Belgium and Umea University in Sweden. After living in Canada, Belgium, the UK, and Germany, Dr. Overholser settled down to teach math, statistics, and data science at Oregon's Institute of Technology. She joined the Mathematics faculty at Humboldt in 2022.

According to Professor Overholser, it's both exciting and a bit scary to be a part of Humboldt State's transition to a polytechnic. "Our state has a rich history of supporting higher education and preceding generations of faculty, students and staff have set a high bar for achievement. Californians have much to be proud of, but future generations will likely confront multiple challenges, including rapidly changing technologies, environmental concerns and mounting societal injustices. Our education system must balance teaching foundational skills and fostering creativity to overcome these challenges."

Along with many others on-campus, Dr. Overholser thinks about what sets a polytechnic apart from other institutions. "So far, I think a polytechnic might be a place where, when students, faculty and staff see a problem, they get so focused on solving it that they forget who is who; questions of status, number of publications, rank, tenure, wealth, hometown, etc. fade into the background as possible solutions are derived and discussed, assessed and acted upon." Dr. Overholser is interested in student and alumni input on this matter as well. She welcomes your responses to questions such as "What do you want our newest polytechnic to be?" and "What do you hope will be said of our graduates?"

We are very excited to welcome Professor Overholser to Cal Poly Humboldt!

Dr. Bethany Johnson

We are delighted to welcome Professor Bethany Johnson to the Math department at Cal Poly Humboldt. Originally from Fresno, California, Dr. Johnson brings a diverse academic background and a wealth of experience to our university.

Dr. Johnson began her education at Clovis Community College, where she earned an AS-T degree in Math before continuing her studies at Sonoma State where she earned both a B.A. in Mathematics, and a B.S. in Applied Mathematics! Dr. Johnson completed her Ph.D. in Applied Mathematics at UC Santa Cruz.

Before joining Cal Poly Humboldt, Dr. Johnson served as a research fellow at the National Marine Fisheries Service, where she focused on developing data-driven methods to improve the management of marine species. Dr. Johnson also worked for one year as a machine learning resident at X, the Moonshot Factory, a division of Alphabet Inc.

Dr. Johnson's research interests lie in developing data-driven methods to forecast nonlinear dynamics and optimize decision-making, particularly in ecological contexts such as fisheries management and biodiversity conservation. In her teaching, she prioritizes inclusive practices to foster a sense of belonging among her students.

Dr. Johnson enjoys teaching data science and calculus courses, and she aspires to teach differential equations and math modeling in the future.

Outside of academia, Dr. Johnson's hobbies include embroidery and sewing, as well as exploring the natural beauty of Humboldt County.

We are thrilled to welcome Dr. Johnson to our department!

Victoria Petrillo

We are pleased to introduce Victoria Petrillo, our new Administrative Assistant. Originally from Diamond Bar, CA, Victoria spent four years at Cal State University, Fullerton before moving to Humboldt County. She joined the Cal Poly Humboldt staff two years ago and began working in the Mathematics Department in the Spring 2023 semester.

Victoria provides essential support services for our faculty and students, including appointing student employees. She is the welcoming face of our department office, always friendly and ready to assist. When not at work, Victoria enjoys gardening, kayaking, and exploring the beautiful beaches and forest trails of Humboldt County with her Australian Shepherd.

We are happy to have Victoria as part of our team and appreciate the positive energy and dedication she brings to our department.

Fresh New Major

A Redesigned Mathematics Major - Chris Dugaw

The first cohort of students in our newly redesigned math major will graduate this Spring. The new major emphasizes community and the Cal Poly ethic "learn by doing." No longer are students spread across separate applied, pure, and math education tracks, but instead all math students take their courses together as they move through the program. In the revamped course Mathematical Experimentation and Proof (formerly MATH 240), students use computers to make their own mathematical conjectures and learn how to prove them. Students get a research-like experience by exploring open-ended questions and learn how to present mathematics in writing. Throughout the program majors are exposed to the diversity of mathematics, giving them the breadth to succeed in their future pursuits. In their final semester, students take the Mathematics Capstone where they complete semester-long research projects in small groups.

Department Launches New Data Science Major - Kamila Larripa

In Fall 2023, we welcomed our inaugural cohort of Data Science majors. We are thrilled to have them on campus after many years of planning the program, and are excited for our department to be expanding into this rapidly growing field. The program has an emphasis of "data for good" and seeks to weave social and environmental justice data sets and prompts throughout the curriculum. Current data sets investigated in lower division classes include housing data sets to interrogate how racial disparities in homeownership impact economic security. Climate justice modules are also used to probe how the impacts of climate change will be borne, obviously not equally or fairly, between all. We are currently curating project partners for semester-long projects related to issues in the State of California (e.g., sea level rise).

Students in the major select an area of application, which allows them to customize their degree and align their coursework with their passions and career goals. The program also has career preparation built into courses so that upon graduation, students will have created a portfolio showcasing their work. This academic year, the program offered the first two data science courses in the major, both taught by Dr. Bethany Johnson.

Dr. Johnson escorted two teams of students from this cohort to participate in DataFest at Chico State. This competition gives teams of students a large and complex data set and less than 48 hours to glean the best insights and present them to the audience and judges. This was a wonderful culminating experience for our students, and an opportunity to show how much they have learned in their first two major courses. We are proud to announce that one of the two Cal Poly Humboldt teams won the award for "Best Analysis"!

Cal Poly Humboldt teams at the 2024 Data Fest competition at Chico State. Pictured are (left to right) Aiden Thakur, Evan Blem, Jaiden Roe, Elio Piccagli, Dr. Bethany Johnson, Aster Espinosa, Astra Mattingly, Bridget Acosta (front) and Chan Rain (back).

Mathematical Contests

Mathematical Contest in Modeling - Kamila Larripa

The Mathematical Contest in Modeling occurred February 1-5, 2024. This annual event challenges teams of three to analyze, model, solve and present solution papers to an open-ended application problem over an intense four day period. The contest is hosted by the Consortium for Mathematics and its Applications. This year, our Department had two teams participate.

Amanda Case, **Emmanuel Mezzulo** and **Jaxon Tuggle** joined forces and addressed a continuous time problem related to the sex ratios of lampreys (a type of fish), which is based on external circumstances (e.g., availability of food). Their work predicted the impact on the larger Great Lakes ecological system if the sex ratio is altered, and used an agent-based modeling approach.

Elio Piccagli, **Evan Blem**, and **John Gerving** selected a data-driven problem to estimate the role of "momentum" in sports (e.g., winning streaks) by using a data set containing every point from all Wimbledon 2023 men's matches after the first two rounds. In addition to conducting an exploratory analysis, the team used a neural network to evaluate the role of momentum in tennis. This team was able to use material just taught in the department's new Data Wrangling and Visualization course!

Congratulations to our competitors for completing this challenging event and taking their mathematical modeling skills outside of the classroom!

Photo by Kellie Brown
Students (left to right) John Gerving, Evan Blem and Elio Piccagli working in BSS 312 during the MCM.

The Putnam Exam - Walden Freedman

The 84th William Lowell Putnam Mathematical Competition took place on Saturday, December 2, 2023 across North America. The exam consisted of twelve questions, six in the morning and six in the afternoon. Each question was worth 10 points, allowing for a total possible score of 120. Altogether, 3,857 students from 471 institutions participated. The average score was approximately 13 and the median score was 10. Three students from Cal Poly Humboldt participated: **Desmond West-Hedlund**, **Alex Moore**, and **Sela Raisl**, with the test proctored by Professor Freedman. Participants were recognized at the annual student awards ceremony at the end of the spring semester.

Here is the first problem (A1) from the competition (usually the most accessible!):

> For a positive integer n, let $f_n(x) = \cos(x)\cos(2x)\cdots\cos(nx)$. Find the smallest n such that
> $$|f_n''(0)| > 2023.$$

Photo by Kellie Brown
Students (left to right) Amanda Case, Emmanuel Mezzulo and Jaxon Tuggle working in BSS 312 during the MCM.

Puzzle Corner

Puzzle Editor - Walden Freedman

In how many ways can the letters in

CALPOLYHUMBOLDTMATH

be arranged with the vowels in the same order, that is, AOYUOA?

(See page 10 for the solution.)

Local Mathematics Contests Resume
- Tyler Evans

The 2023-24 academic year saw the welcome return and continuation of some of our favorite locally administered mathematics contests.

The **Integration Bee** buzzed back into action in November under the steady wings of its founder and organizer, Professor Jeff Haag. In the contest, participants compete to solve integration problems accurately and quickly. Eight contestants faced off against each other, and the clock, calculating both definite and indefinite integrals under pressure! This year's first and second place winners were **John Gerving** and **Sela Raisl**, respectively. The other participants were (in alphabetical order): **Bailey Allott**, **Karina Bernbeck**, **Chase Loughmiller**, **Elio Piccagli**, **Aaron Ramirez**, and **Ryan Stevens**. Congratulations to all participants, and we'll +C you next year!

Photo by Tyler Evans

Photo by Tyler Evans

$$\mu\alpha\theta$$
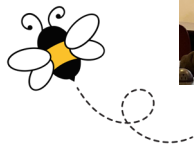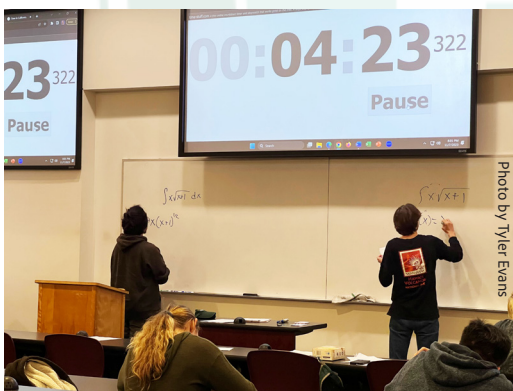
The spring 2023 semester saw the return of the **Mu Alpha Theta** contest, and the contest took place again this year on April 6. Written and directed by Professors Walden Freedman and Peter Goetz, students tackled written mathematics problems in one of two categories: Category A problems for students who have completed at most one upper-division course in mathematics, and Category B problems for those who have completed more than one upper-division mathematics course. This year, six contestants gathered in the BSS building on a crisp, sunny Saturday morning to compete. The Category A contestants were (in alphabetical order): **John Gerving**, **Jacob Henn**, **Chase Loughmiller, Evan Rosales,** and **Sander Swenson**. The sole contestant in Category B this year was **Desmond West-Hedlund**. Congratulations to all participants!

The following problem appeared on both the A and B exams. It was modified from a problem from the first ever Mu Alpha Theta contest at Humboldt back in 1984.

Determine the value of the integral:

$$\int_{-\infty}^{\infty} \frac{1}{e^{x+2023} + e^{2025-x}}\, dx$$

H.

Student Research Experiences

Undergraduate Student Research Group Addresses Alzheimer's Disease Progression with Agent-Based Models - Kamila Larripa

Four undergraduate students are working with Dr. Kamila Larripa on a project funded by the National Science Foundation Mathematical Biology program (Award Number 2245839). The project models the interaction of immune cells and neurons in the brain and seeks to understand specific mechanisms which lead to neurodegeneration. **Amanda Case**, **Emmanuel Mezzulo**, **Abigail Penland** and **Cheyenne Ty** are the lab members, and will present their results at the CSU Research Competition in April at Cal Poly San Luis Obispo. The team is currently working on a manuscript for publication.

The diagram shows the roles microglia play in the central nervous system, alongside their different phenotypes. The figure was made with Biorender.


Photo by Kellie Brown
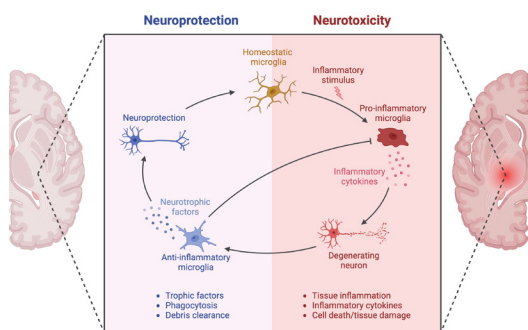
Student researchers (left to right) Abigail Penland, Amanda Case, Emmanuel Mezzulo and Cheyenne Ty with Professor Kamila Larripa (far right).

Cal Poly Humboldt Students Harness Supercomputing Potential - Ken Owens

In Fall 2023, students from the Cal Poly Humboldt Supercomputer Group built a supercomputer cluster called Fusion under the supervision of Professor Ken Owens. The cluster is capable of performing 24 trillion single precision operations per second. The group utilized specialized components, including 12 Nvidia K20 graphics cards and AMD Opteron CPUs, and used the university's makerspace to 3D print custom couplers that connect the graphics cards to cooling fans. The group is currently working on upgrading Fusion with even more powerful Nvidia K80 graphics cards, faster 100GB ethernet connectivity, and 8TB of high-speed NVME storage. The students' innovative work has attracted the attention of industry professionals. Recently, the group had an opportunity to share their experience developing parallel software for the supercomputer with Eric Brower, Senior Software Manager at NVIDIA. Additionally, the students met with Eric Sutter, the 3D printing production manager from Eel River Coral, who generously donated 3D-printed cases for the NVIDIA Nano microcomputers used in the group's CS 280, Accelerated Computing, course.

Photo by Ken Owens

Photo by Ken Owens

Photo by Ken Owens
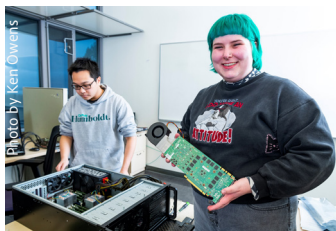
Top: Students Laban Tran (left) and Charlin Duff (right) install Nvidia graphics cards into one of Fusion's bays.
Left: Students from the Supercomputer Group pose with Eric Brower (far left), Senior Software Manager at NVIDIA.
Right: Fusion glows while running student Charlin Duff's fractal generating code.
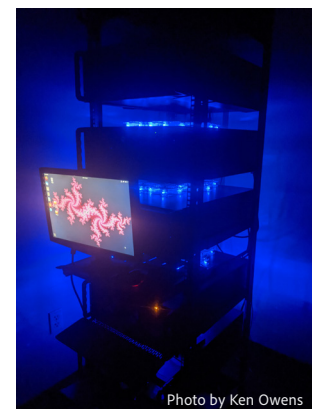
Faculty Research

Chris Dugaw

I have been more focused on the undergraduate curriculum lately and am particularly interested in Open Education Resources. I wrote Octave code to be used in our MATH 245 Mathematical Experimentation and Proof course. Octave is a free open source alternative to Matlab. In Fall 2023, I took a sabbatical to create a new edition of the text Laboratories in Mathematical Experimentation: A Bridge to Higher Mathematics which is also used in MATH 245. The book will soon be published by The Press at Cal Poly Humboldt under the Creative Commons license, which means students will be able to download a PDF for free.

Tyler Evans

I have an ongoing research program with my colleague, Professor Alice Fialowski (Eotvos Lorand Tudomanyegyetem, Budapest, Hungary) in which we compute explicit descriptions of the 1- and 2-cohomology spaces for various restricted Lie algebras. This work has been particularly satisfying as it builds on the work I started in my Ph.D. dissertation. I enjoy spending two or three months per year in Budapest, where I continue to improve my Hungarian language skills in addition to working on our mathematical research.

Walden Freedman

My Ph.D. research was in the area of functional analysis, mainly Banach space theory. I am still interested in Banach spaces, but having taught vector calculus several times, I am interested in learning more about mathematical physics, as well as discrete versions of vector space theory, and the interplay between measure theory (abstract theory of integration) and the kind of integration one encounters in vector calculus.

Peter Goetz

I am researching noncommutative graded algebras with Dr. Andrew Conner (Saint Mary's College of California). Given such an algebra, there is an associated system of projective schemes, and our project studies this correspondence. In joint work with Dr. Ellen Kirkman (Wake Forest University), Dr. Frank Moore (Wake Forest University) and Dr. Kent Vashaw (Massachusetts Institute of Technology), we prove results on the ring-theoretic properties and algebraic geometry associated with several new examples of Artin-Schelter regular algebras of dimension 4. I presented at the Joint Mathematics Meeting in San Francisco in January, and attended a week-long workshop on Noncommutative Algebraic Geometry at the **Simons-Laufer Mathematical Institute (formerly MSRI)** in February.

Kamila Larripa

My research is generally motivated by biological problems in cell biology. I am currently working with four undergraduate students on an NSF-funded project related to microglia activation and its role in Alzheimer's Disease by developing and analyzing multi-scale models. I am also working with a Women in Data Science and Mathematics group on dimension reduction and machine learning for tensors, with applications ranging from imaging to medicine. I had the opportunity to work for a week at the **American Institute of Mathematics** with research collaborators from Norway and North Carolina in October 2023. The group (which includes mathematical biologists Susanna Roblitz, Anna Frank and Hwayeon Ryu) is building a population model of cancer and immune cells to better understand the interactions in a solid tumor and to inform the development of potential immunotherapies. The American Institute of Mathematics is an NSF supported research institute located on the Caltech campus in Pasadena.

Ken Owens

I am currently developing a physics-based particle-in-cell simulation of burning plasmas, which are found in extreme environments such as at the center of the Sun. This simulation consists of modeling the plasma equations with MPI/CUDA code and running the model on Nvidia graphics cards in a supercomputer. I am also working with students on an NSF-funded project to upgrade Fusion, the supercomputer we built at Cal Poly Humboldt.

Learn By Doing: Science 100

Place-Based Learning Community for Our Majors
- Kamila Larripa

Representing Realities is a place-based learning community combining freshmen Math, Computer Science, Data Science, Geospatial and Software Engineering majors for a year-long experience. As part of the cohort, students take an introductory science class to learn what it means to be a scientist or technologist in the twenty-first century. This fall, Professor Ken Owens redesigned the course with an eye towards developing necessary skills for our students' future careers. Students worked collaboratively to design and write code to create a video game over the semester. In the course of this project-based learning experience, students were exposed to fundamental ideas from coding, linear algebra, and version control. The semester culminated in a student demonstration of their unique video games and a chance to play their classmates' creations. Student **Enrique Lopez** said of this experience, " ... this class was nothing short of wonderful … we learned to work as a team and approach problems as professionals."

Photo by Kellie Brown

Professor Ken Owens supervises students creating video games in Science 100.

Opening Doors in STEM: Stretch Calculus

Professor Sonja Manor looks on as Stretch Calculus students investigate a volume optimization problem.

Stretch Calculus Pilot - Sonja Manor and Tyler Evans

This year, twenty-four first year students majoring in Astronomy & Physics, Chemistry, or Mechanical Engineering had the opportunity to shorten their pathway through the mathematics requirements in their majors by participating in a "Stretch Calculus" pilot course. Modeled on a course developed at Sonoma State University, and funded by a grant from California Learning Lab (Award Number N4827) the project seeks to improve learning outcomes and close equity gaps in our calculus for STEM majors sequence. Prerequisite course sequences are not always effective, and placement into non-major mathematics courses can hinder students' sense of belonging in their major. To address this, the Stretch Calculus project took students who would have been placed into a College Algebra - Trigonometry prerequisite sequence, and placed them directly into calculus. The topics covered in a first semester of calculus are "stretched" over two semesters, and students in the course remain together in the same class for an entire year. The model includes building a sense of community in the classroom, active learning and a culturally responsive curriculum. The pilot course was team-taught by Professors Sonja Manor and Tyler Evans.

Photo by Tyler Evans

The project also supported the creation of a faculty learning community, where mathematics faculty and colleagues from related disciplines explored and developed strategies for promoting equity and access in our calculus courses. The community participated in a semester-long workshop where they explored issues around fairness and inclusion in STEM. Additional workshops featured presentations on culturally responsive curriculum by Dr. Aris Winger (Georgia Gwinnett College) and Drs. Brigitte Lahme and Martha Shott (Sonoma State University).

The course will be offered again in the coming academic year under a permanent course number sequence MATH 109B - MATH 109C. Professor Manor will continue teaching the course. The department is excited about the opportunity to expand access to STEM degrees!

LEARNING LAB

Charlie Biles

Carolyn and I moved to Rohnert Park, just across the street from Sonoma State University, about 6 years ago. I stay active by doing ancestry and research about the history of congressional apportionment. Santa Rosa Junior College offers several courses through its Continuous Learning program, including a suite of ancestry courses in which I give presentations about DNA and genetic genealogy.

Phyllis Chinn

I am enjoying retirement and my visits to NYC to see children and grandchildren. I am a volunteer with the Red Cross and CERT (Community Emergency Response Team). I still work with Stuart Moskowitz, and we are currently working on a joint paper about mathematics in the writing of Lewis Carroll.

Martin Flashman

I am now living in Tucson, AZ, in a townhouse with its backyard bordering on the Rillito River. I am still active with math projects related to visualization with mapping diagrams, performing with guitar and some chamber music on the cello, and attending musical events of all kinds. Summers are open to travel away from the Arizona heat.

Jeff Haag

After 31 years as a full time professor at Humboldt, I semi-retired in 2022. I will teach Fall semesters for a few more years. It's exciting to do so while the Math Department grows and evolves. I am particularly pleased that students are studying linear algebra earlier in their degree programs. That subject, a favorite of mine, is beautiful and deep and indispensable in a wide variety of applications. When I am not teaching or learning, I spend a lot of time running, skiing, and playing softball. And thinking about teaching.

Rollie Lamberson

I haven't done much mathematics in recent times. When I retired, I started building furniture, so most of the math I've done since then is related to furniture design. Most of the furniture is auctioned off by various charities to raise money. I still own the small ranch in Nebraska, and we get back there two or three times each year. We always spend the fall there. We also do quite a bit of travel abroad including a recent trip to Svalbard, a Norwegian island 700 miles from the North Pole where I got some great polar bear photos.

Stuart Moskowitz

I spend most of my retirement time doing gardening and forestry on my 12 acres in the hills above Sunnybrae. Academically, my puzzles have become the focus of my research, with an emphasis on the mathematical puzzles of Lewis Carroll. I am reviewing puzzle/math books for the Lewis Carroll Society, and currently collaborating on a related paper with Prof. Phyllis Chinn. For fun, I regularly attend the Mathematics Department weekly Colloquia.

Dale Oliver

In August of 2021, after serving as the college dean for 3+ years, I returned to the Mathematics Department as a half-time professor. For something completely different, in August of 2022 I started a 1-year term in Washington DC as an AAAS Science and Technology Policy Fellow at the National Science Foundation. It was a great opportunity, but I happily returned to the university in August of 2023, teaching a little, chairing the Computer Science Department, and enjoying life in Humboldt County.

Ken Yanosko

I continue to attend the Math Colloquium regularly, when I'm in town. When I'm not, I am frequently on astronomy-related trips, such as to the Chilean Desert to see the Las Campanas Observatory, to Southern Italy where I drafted my tour group to participate in International Observe the Moon Night, or to my birthplace in Ohio for the recent Total Eclipse (see photo on page 11).

Puzzle Solution

There are 19 letters in the given "string" where the letters A, O, H, M, T each occur twice and L occurs three times. The number of distinct arrangements of the letters is therefore $\frac{19!}{2!2!2!2!3!}$. On the other hand, there are $\frac{6!}{2!2!}$ distinct arrangements of the string AOYUOA of vowels, so the desired number of arrangements of the given string CALPOLYHUMBOLDT with the vowels in the same order is

$$\frac{19!}{2!2!} \cdot \frac{6!}{2!2!2!2!3!} = 3{,}519{,}823{,}507{,}200.$$

Cal Poly Humboldt
H. Mathematics

Photo by Tyler Evans
2023 Commencement

Photo by Tyler Evans
2023 ITEPP All Native Sash Ceremony

Photo by Tyler Evans
Math and Data Science table at the 2024 Spring Preview

$$\langle T(x), y \rangle = \langle x, T^*(y) \rangle$$
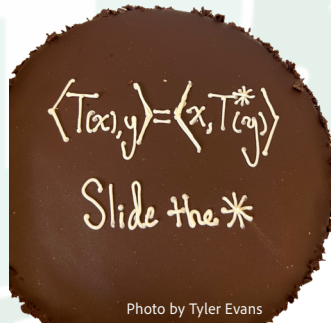Slide the $*$
Photo by Tyler Evans
An adjoint torte

Photo by Ken Yanosko
Total eclipse of the Sun in Ohio on April 8, 2024

Photo by Tyler Evans
Spring 2023 MATH 344 - Linear Algebra

Thank You For Your Support!

Humboldt has a strong sense of community, and the many donors who help support our efforts are an important part of that community.

To ensure students continue receiving the highest-quality mathematics education possible, we recommend **three key areas** where donors can make the greatest impact:

Learning by doing, which is critical in preparing students for their careers by taking education beyond the classroom where they can apply their learning in a real-world setting. Examples of learning by doing include participating in the MCM mathematical modeling contest and participating in DataFest.

Student research, which is a valuable experience for students pursuing competitive jobs and post-graduate programs in the sciences. There are several ways, such as covering travel and equipment expenses, in which donors can help.

Scholarships, which, based on need or a combination of other criteria, support students with financial resources to pursue their dreams.

With your support in these key areas, our students will have the experiences they need to learn, grow, and help create a more sustainable future for our planet.

Whether it is special learning opportunities like contests or conferences, access to new technologies, labs, or improved facilities, donors like you have the power to enrich the student experience at Cal Poly Humboldt.

To learn more about giving visit https://math.humboldt.edu/giving or call (707) 826-5200.

Alumni - Drop Us A Line!

If you graduated with a mathematics degree from Humboldt, we would love to hear from you! Send an email to math@humboldt.edu and let us know what you're up to. Next year's newsletter will have a column with updates from alumni, and we would love to include you! You can also submit an update online at https://now.humboldt.edu/node/add/alumni_updates. If you would like to be featured on our department website, you can submit your information at https://www.humboldt.edu/new-alumni-profile.

Cal Poly Humboldt Department of Mathematics