Mini-Focus

THE NEWSLETTER OF THE GOLDEN SECTION OF THE MAA

January 2022
Issue 47

MINI-FOCUS is published by the Golden Section of the Mathematical Association of America, serving Northern California, Northern Nevada, Hawai'i, and the US Pacific Islands.

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Nicolette C. Meshkat Wins Section Teaching Award

Nicolette C. Meshkat, of Santa Clara University, won the 2021 MAA Golden Section's Distinguished College or University Teaching of Mathematics Award. The award was presented at the 2021 Golden Section Meeting held online, on February 29, 2021. (See Nicolette Meshkat's complete award citation online.)

Nicolette Meshkat (Nikki) excels in teaching and research in mathematical modeling and in teaching statistics courses. These areas are closely related by their current and potential applications, particularly to biology, but their techniques differ significantly.

Nikki's students profusely praise her teaching. A former statistics student, now doing graduate work in data science, described her as "the best mathematics professor I have ever had at Santa Clara University." (That department is filled with extraordinary, popular teachers: six are pre-

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Alison Lynch Wins Section Award for New Teachers

Alison Lynch, of CSU Monterey Bay, won the 2021 MAA Golden Section's Distinguished College or University New Teacher of Mathematics Award. The award was presented at the 2021 Golden Section Meeting held online, on February 29, 2021. (See Alison Lynch's complete award citation online.) As a graduate student, Alison Lynch learned the discipline of scientific research and teaching, applied to the purely mathematical field of linear algebra and to the study of mathematics education. She has built both into her career. Her research-based teaching methods encourage students to take ownership of their own learning and do more of the intellectual work, rather than simply listening. Her classes have high student engagement, with students spending the majority of class time working in groups. When she brings them together she often asks, "What do you wonder?"

Alison received her PhD in mathematics in 2015 at the University of

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Meshkat: Teaching Award

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vious winners of this award!) Another student, asked what practice Nikki should continue, answered simply, "Being happy!" A third commented, "Whoever gets you as a professor is blessed!"

After undergraduate and doctoral study at the Universities of California at Berkeley and Los Angeles, Nikki held a temporary position at Santa Clara, then a three-year postdoctoral fellowship at North Carolina State, working with a leader in her field. Nikki returned to Santa Clara as an assistant professor in 2015. She continued intense research activity, helping organize several symposia with nationwide participation, presenting more than thirty invited talks, and co-authoring eight papers in major journals and conference proceedings.

Along with teaching the standard courses at Santa Clara, Nikki designed new ones close to her specialty: Calculus for Life Sciences and Mathematical Models. Until the latter was developed, interested students could only pursue individual supervised study. Besides that, Nikki provided expert consultation to advanced students at nearby San Jose State University and at the Bay Area Discrete Mathematics conferences.

Nikki is a popular instructor in upper-division statistics courses, although that's not her specialty. One of those students, a bioengineering major, learning that Nikki's research was really based on advanced abstract mathematics, took two courses of that sort, then proposed an independent study in mathematical biology. The student reported, "Nikki has been an amazing mentor for me as an undergraduate researcher ... she appreciated my background in computer science and pushed me to improve my programming skills." Nikki's instruction and counsel led to that student's immediately obtaining employment at a research laboratory. She has also started graduate study in data science and claims, "The theoretical understanding I gained from Nikki's classes aids my intuition and helps me avoid the trap of seeing statistics as disconnected formulas."

The Golden Section congratulates Nicolette Meshkat, an exceptionally effective mathematics researcher and teacher!

Lynch: New Teachers Award

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Wisconsin and published her results in a leading research journal. She then joined the Department of Mathematics and Statistics at California State University, Monterey Bay, where she quickly earned the appreciation and respect of both students and colleagues. Alison recognizes that students come with different backgrounds and different levels of interest, and that she must design her courses so that there is something for everyone. She applies techniques called "Reading Apprenticeship and Complex Instruction" now under development. A senior colleague observed that in Alison's calculus class, every single student was engaged throughout the session, actively making notes, talking with other students, and listening. One of them wrote, "teaching ... is her passion and she really cares ... a teacher who is so attentive is extremely motivating."

Dr. Lynch guided curricular redesign of the Calculus I and precalculus courses to incorporate these techniques, which require major shifts in practices and beliefs about how students learn mathematics. She has organized professional development for the instructors. Since 2018 eleven precalculus and seven calculus instructors have used her materials. The department reports significant decreases in the numbers of enrolled students not succeeding in these courses: 50% to 30%, and 30% to 20%, respectively. More recently, she has led her department's adaptation to the restraints imposed by the COVID-19 pandemic.

Dr. Lynch has successfully applied some of these methods to more advanced courses, and has guided some of those students in detailed studies of their effectiveness. Other faculty have adopted them, and at least three of the student researchers have proceeded to doctoral studies in mathematics and mathematics education.

The Golden Section congratulates Alison Lynch, an extraordinarily effective and inspiring new teacher!

Teaching Awards: Call for Nominations

2022 MAA Golden Section Distinguished College or University Teacher of Mathematics Award (General) & 2022 MAA Golden Section Distinguished College or University New Teacher of Mathematics Award

The MAA has two awards for distinguished college or university teaching of mathematics: the Deborah and Franklin Tepper Haimo Award (instituted in 1991) and, for beginning college or university teachers of mathematics, the Henry L. Alder Award (instituted in 2003). The recipient of the Golden Section Teaching Award (General) is nominated by the Section for the MAA Haimo Award. The recipient of the Golden Section New Teaching Award is nominated by the Section for the MAA Alder Award if the recipient holds a Ph.D. The Golden Section has a two-step nomination process that consists of (i) the initial nomination, and (ii) the full nomination. The initial nomination is very simple and requires the filling out of a one-page form together with a one-page summary that supports the nomination. After screening the initial nominations, the Teaching Awards Committee will invite the nominators of clearly competitive nominations to submit full nominations. Members of the Golden Section are encouraged to nominate their exceptional colleagues for the two Golden Section Distinguished Teaching Awards (New Teacher and General). The formal Call for Nominations and the Nomination Form files are available through the Golden Section webpage. These files describe the award and eligibility requirements. The initial nomination deadline is

May 31, 2022

Please direct questions to Elizabeth Gross, Teaching Awards Committee Chair, University of Hawai‘i at Mānoa

Previous General Teaching Award Winners

An asterisk precedes names of those who went on to win a national Haimo Award.

1992 G. D. Chakerian, UC Davis
1993 *Paul R. Halmos, Santa Clara Univ.
1994 Jane Day, San José State University
1995 *Edward M. Landesman, UC Santa Cruz
1996 G. Thomas Sallee, UC Davis
1997 Jean J. Pedersen, Santa Clara University
1998 Donald C. Pfaff, University of Nevada, Reno
1999 *Leonard F. Klosinski, Santa Clara University
2000 *Evelyn Silvia, UC Davis
2001 Wade Ellis, Jr., West Valley College
2002 *Paul Zeitz, University of San Francisco
2003 Peter Tannenbaum, Fresno State
2004 *Gerald L. Alexanderson, Santa Clara Univ.
2005 Russell Merris, Cal State East Bay
2006 Tatiana Shubin, San José State University
2007 William Fisher, Chico State University
2008 John B. Thoo, Yuba College
2009 *Allan J. Rossman, Cal Poly San Luis Obispo
2010 Dennis Smolarski, Santa Clara University
2011 Joseph Conrad, Solano Community College
2012 *Matthias Beck, San Francisco State Univ.
2013 Steven Blasberg, West Valley College
2014 Duane Kouba, UC Davis
2015 Michelle Manes, Univ. of Hawai‘i at Mānoa
2016 Serkan Hoşten, San Francisco State Univ.
2017 Jesús De Loera, UC Davis
2018 Frank Farris, Santa Clara University
2019 *Federico Ardila, San Francisco State Univ.
2020 Elaine Kasimatis, Sacramento State Univ.
2021 Nicolette Meshkat, Santa Clara University

Previous New Teaching Award Winners

An asterisk precedes names of those who went on to win a national Alder Award.

2016 Martha Shott, Sonoma State University
2018 Elizabeth Gross, Univ. of Hawai‘i at Mānoa
2019 Jordan Schettler, San José State University
2020 Kimberly Seashore, San Francisco State Univ.
2021 Alison Lynch, CSU Monterey Bay

Interested in hosting the section meeting or serving in a leadership role?
Please contact one of the officers listed on the cover for more information.
We want you!

News from the Section

Compiled by Walden Freedman, Mini-Focus Editor

Editor's Note: News is included from institutions who replied before the deadline. This year, the call for news was made via MAA Connect with the Golden Section Digest sent by email. To avoid being left out next year, please look for the call for news each fall season.

Cal State East Bay

The Department of Mathematics at Cal State East Bay is happy to have returned to in-person instruction for our entry level courses in Fall 2021, and we are looking forward to teaching entirely in person in Spring 2022. It is great to see one another and our students (!) in the halls and especially to welcome last year's new hires, Dr. Simone Sisneros-Thiry and Dr. Ryan Moruzzi, to our beautiful campus.

Just one of the many exciting new and ongoing projects at East Bay is the RUMBA (Research for Undergraduates on the Mathematics of the Bay Area) program. RUMBA provides opportunities for the creation of collaborative research projects which unite the skills of students (undergrad and grad), faculty, and Bay Area groups so that they may use mathematics to study the systems and characteristics of the Bay Area. The program is led by Dr. Andrea Arauza Rivera and Dr. Ryan Moruzzi and introduces students from all majors to research projects that demonstrate the power of mathematics in understanding and addressing challenges facing our community.

Humboldt State University

Development of a Data Science major is in progress. Meanwhile, the university is poised to become the third polytechnic university in the CSU system, with a final decision by the CSU Board of Trustees expected in January 2022, with a planned new name of California State Polytechnic University, Humboldt, or Cal Poly Humboldt, for short.

The Fall 2021 Kieval Lecturer was Dr. Stephen J. Trettel, currently of Stanford University, who spoke (in-person!) on "Optics, Mirages, and Curved Space".

Dr. Walden Freedman has a two new Wolfram Demonstrations Projects related to Fourier series approximations, one on approximations to an equilateral triangle and the other on approximations to the nth roots of unity.

Menlo College

Jakob Kotas is a new Assistant Professor of Mathematics at Menlo College. Before moving to California, he was involved with the MAA Pacific Northwest section and was a member of the Green '16 MAA Project NExT cohort.

Saint Mary's College

The Mathematics and Computer Science department at Saint Mary's College of California has made three new hires this year (two in math and one in computer science). They are Anastasia Chavez (math), Satbir Malhi (math), and Udayan Das (CS).

Santa Clara University

After hiring four new continuing faculty members in Winter 2020, we were grateful not to have to carry out major searches during the pandemic. The retirement of Edward Schaefer, a bit on the early side we think, and growth in our program led us to hire in temporary positions. Academic Year Adjunct Lecturers Shilpa Dasgupta, Shabeena Ahmed, and Hien Vu joined our department, as did Quarterly Adjunct Lecturer Gayathri Chakravarthy. Frank Farris accepted a second three-year term as chair.

Our yield of acceptances of incoming students was much, much higher than expected, leading us to scramble a bit as we welcomed students back to campus. We're happy we're popular, but this had led to very full classrooms. Still, being on campus has brought a sense of joy. We are still commenting on some of our firsts: Our first colloquium dinner! Our first outdoor picnic for students! We're grateful that our campus COVID team has kept us safe.

Our colloquium series has been held mostly in person, with online sessions scheduled when appropriate. Our public lecture series, Bay Area Mathematical Adventures (BAMA), offered jointly with SJSU, continues to be online. Our fall speakers were Gordon Hamilton of mathpickle.com, Theo Drane of Intel, and Allison Henrich of Seattle University. Since these will continue to be online for the spring, we invite people to sign up to receive announcements by sending an email to Frank Farris at ffarris@scu.edu.

Our new STEM building opened in the fall, but the Department of Mathematics and Computer Science has opted to remain in our classic building, O'Connor Hall.

Recognizing 25-year and 50-year Members

Congratulations to the following Golden Section members for their long-term MAA memberships!

25-Years

Beth L. Chance
Doreen Rona Naomi De Leon
Christopher J. Hillar

50-Years

William J. Barnier
Guy M. De Primo
Thomas A. Dowling
William R. Jones
Robert J. Kleinhenz
L. Raphael Patton
John M. Sawka
Gregory L. Stachnick

MAA Congress Report

by Walden Freedman, Congressional Representative

Due to the Covid-19 pandemic, the Congress of the MAA met virtually again on HopIn/Zoom for two and a half hours a day (11:30 am to 2 pm PT) on August 2 and 3, 2021. Here are some of the takeaways:

AMS Report on Inclusivity in the Profession

Francis Su co-chaired the task force that wrote the AMS report "Towards a Fully Inclusive Mathematics Profession" and he led a discussion about it. Remarkable statistic: nearly *half* of all Black math majors come through HBCUs (Historically Black Colleges and Universities), even though they enroll just 9% of all Black students and represent just 3% of all institutions. 24-30% of Black PhDs in STEM were HBCU graduates. Two questions we discussed were how can we, as leaders, make our math departments, sections, and MAA overall more welcoming to African Americans and other people of color, and how can our sections partner with HBCUs, including learning from them? Visit the following link for the 107 HBCUs along with lots of valuable information. Part of our pre-meeting homework was to read the preface with its moving story of William Claytor as well as chapters 1, 5, and 7 on findings and recommendations, the current climate for Black mathematicians, and the influence of HBCU's, respectively.

MAA Code of Conduct

Another homework assignment was to read the MAA Code of Conduct, which is subtitled "In Support of a Welcoming and Inclusive Community". This is a recently approved code of conduct from the AIMS (Advancing Inclusion in the Mathematical Sciences) task force. Some of the recommendations were that

Members should reaffirm their commitment to follow the code of conduct when joining or renewing their membership.

Participants in events agree to abide by the Code of Conduct at registration.

Standardize nomination processes for service roles, prizes, honors, awards so that a nominator can attest that the conduct of the nominee follows the code, to the best of their knowledge.

MAA should consider renaming awards and honors when the society determines that such a change is in the best interests of the field and the MAA's standards of professional/ethical conduct.

Board should review the Code of Conduct at least once every five years.

Budget Update

MAA Treasurer C. Allen Butler provided a budget update. MAA currently generates, and spends, roughly $11M per year. The primary revenue sources are membership, the American Mathematics Competitions, publications, grants, meetings, and donations. The year 2019 ended with actual net income exceeding the budget and reduced unrestricted operating expenses by more than $42K. The 2020 financial year, though extraordinarily distinct due to the pandemic, still proved to be successful. In 2019, the audited total revenue was over $11 M; the total expenses were about $10.1 M. As of the congress meeting, the MAA investment portfolio stood at about $13.5M. MAA recently sold their headquarters buildings, which generated approximately $12M (net, after taxes, brokers' fees, and other transaction costs). They expect to lease space in the Dupont Circle neighborhood, with income from investing the proceeds covering the costs.

President Jenny Quinn gave a presidential update highlighting the challenges of the past year and the actions the MAA has taken to support its members and the mathematical community.

I think we are all fervently hoping that the next meeting of the MAA Congress will be in person at MathFest in Philadelphia as planned!

Proposed New Golden Section Bylaws

by Ed Keppelmann

In a move which joined the Golden Section to the modern era we changed our long held one-page bylaws (from our founding in 1939) in 2010. It took a while but ultimately, through a Board of Governor's approval, these became official at the 2014 MathFest which was in Portland, Oregon. Today the MAA board of Governors no longer exists (we have the MAA Congress instead) so changes in bylaws are processed by the MAA Committee on Sections (COS). In a ten-year rotational scheme, our turn to update our bylaws came in 2020. So, while we are a bit late on this for our turn, thanks to great input by the current executive board, Frank Farris, Ken Ross, Cornelia Van Cott, and Bonnie Gold, we are very pleased to announce massive changes in our current bylaws. You can access a PDF of the proposal here. The proposed changes really do create a new era for the section that promises far more member involvement in section affairs. Instead of providing a detailed list of specific changes here, we summarize a few notable changes below and refer our members to our website if they are interested in a more thorough read of our current and proposed bylaws.

Contrary to current COS policy we are abandoning the use of zip codes to designate section boundaries. These are continuously changed by USPS and so we cannot stay current. Instead we seek to designate the county boundaries of our section which seems to be the intent of the zip code system anyway.

Current Section positions of Teaching Committee chair and Newsletter Editor are promoted to be full members of the executive board and we are adding to the executive board the new positions of Public Communications Officer, Student Outreach Coordinator and Past Chair. Although in theory some of these positions could be held by current executive board members, these changes represent a more than doubling of our executive committee size. Of particular new interest is the job of Student Outreach Coordinator which is fully described here. All of this will require our members to step forward and help out to a greater degree than before.

We are strongly committing to avoid implicit bias and break old habits and bring new blood to the leadership of the section.

Other technical changes involve distinguishing between Executive Committee meetings (which happen two times each year) and Business Meetings (which occur in conjunction with the annual section meetings).

Assuming we can get the approval and input from COS in time for our meeting, we will want all our section membership, whether they attend the annual meeting or not, to approve these new bylaws.

In the meantime, please send your concerns and thoughts to Secretary/Treasurer Ed Keppelmann at keppelma@unr.edu.

Report on the Free Virtual Section Meeting in Gather.Town, February 26-27, 2021

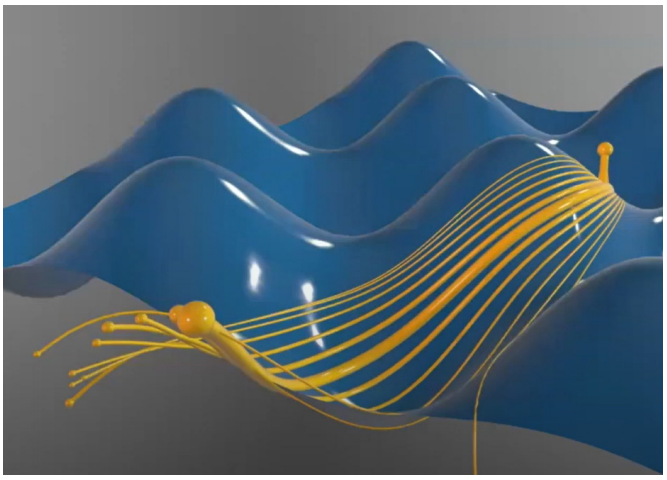
by Walden Freedman

Due to the Covid-19 pandemic, the Golden Section met virtually for the first time on gather.town over two days, starting on Friday, Feb. 26 at 6:30 p.m. to Saturday, Feb. 27 at 5 p.m. The setting of gather, with its retro video game look, was a fun and novel way to meet friends, make new acquaintances, and hear some fascinating mathematics, from a lineup of great speakers as well as via a student poster session and mathematical art exhibition! We can be proud that despite the Covid-19 pandemic, we persevere in pursuing mathematical knowledge and helping our students grow. Furthermore, the online setting made it easy to record the talks, which you can watch right here. Prior to 2021, the highest attendance at a Golden Section meeting was the UC Davis meeting in 2016 with 251 attendees, but the gather.town meeting had a staggering 351 registered, including MAA President Jennifer Quinn and Committee on Sections chair Lisa Murano.

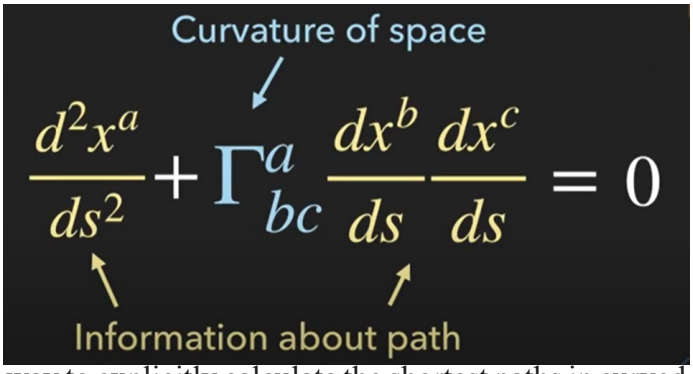
Stephen J. Trettel, currently Szegö Assistant Professor at Stanford University, got the meeting off to a great start with his talk "Ray optics, geodesics, and curved space" on Friday evening. Steve first mentioned how much he likes it when mathematical top-

ics, like in this case, differential geometry, optics, and general relativity all come together and their interconnections are revealed. In antiquity, light was understood in terms of three laws: light travels in straight lines; reflects off of surfaces; and refracts when entering new materials. The law of reflection says that the angle of incidence equals the angle of reflection. Pierre de Fermat, in 1662, came up with the unifying "principle of least time" which says simply that light always travels along a time-minimizing path. (Incidentally, you may enjoy the short story titled "Story of Your Life" by Ted Chiang, in which Fermat's principle comes up.) Interestingly, Fermat's principle implies antiquity's three laws of optics. But the fact that light travels faster in warmer air means that light may not travel in a straight line if it can move faster along a curve. Heat mirages (where the ground looks wet) are an example of this, being a reflection of the sky on the air! In Steve's words, "Mirages are a sign that light is doing something weird." Heat waves are another example of this phenomenon. Quantitatively, one can use the calculus of variations to compute such shortest paths that light takes. There are other mathematical and practical situations in which the shortest path between points is not a straight line, for example, a straight line drawn on a topographic map need not represent the shortest hike.

Although one might hike on a curved surface with a constant speed it would not translate to constant speed on a flat map. One of Steve's cool simulations showed how minimizing travel time leads to the same paths as that of light when it travels through air of varying temperatures.



Thus, the mathematics of light in a varying medium is the same as the mathematics of shortest paths (geodesics) in curved space! The geodesic equation gives a



way to explicitly calculate the shortest paths in curved space. The sign of the curvature – zero, positive, or negative – controls how geodesics spread out. For example, on a surface with negative curvature, like a Pringles potato chip, geodesics spread out. Whereas, on a sphere, the geodesics first spread out but then end up converging. For each kind, Steve ran a simulation of the Moon orbiting the Earth. Steve's personal favorite, Nil geometry, is a mixture of positive and negative curvature spread out in a symmetric way. This leads to some weird mirages like a second copy of the Earth forming a kind of toroidal ring around the "smaller" Earth (which is also upside down to boot!). Such kinds of phenomena occur in some of the images from the Hubble Space Telescope. Steve connected things back with optics, showing how this leads to some more fascinating mirages like the heat mirages discussed earlier. All of this leads to questions in cosmology such as, "Is the real world curved? and "How could we tell?" Steve finished up by considering what light does near a black hole with a simulation of the Earth and Moon orbiting a black hole. Mind-blowing stuff for sure. Go to 3-Dimensional.space to see some of these super cool simulations Steve created with his collaborators. To learn more about these fascinating topics, Steven highly recommends the book "Geometry and Light: The Science of Invisibility" by Ulf Leonhardt.

We reconvened Saturday morning after allowing the Earth to rotate on its axis for several hours. A brief section business meeting was held in which we voted to elect Mark Durst as the new vice-chair of the section. Congratulations to Mark!

Our first speaker of the day was Martin H. Weissman of UC Santa Cruz who spoke on "The modern life of ancient fractions". Martin's talk was divided into three parts: Fractions in ancient China, Mediant fractions and Ford circles, and Diophantine approximation and open questions. Fractions are essentially symbols or signs that represent rational numbers

though they are often treated as one and the same thing. Multiplication in ancient China (3rd-5th century CE) was (at least sometimes) done with rods on a grid where the product was placed on the middle row. Division was done similarly with the result placed on the top row. One of the Chinese sources, the Suàn shù shū (Writings on Reckoning), included methods for adding, multiplying, and dividing fractions. But the instructions are a bit cryptic, for example, the rule for simplifying fractions says: "Take the numerator and subtract it from the denominator; also take the denominator and subtract it from the numerator; the amounts of the numerator and denominator are equal, this will simplify it ...". Marty demonstrated the technique on the fraction $^{49}/_{91}$. One subtracts 49 from 91 getting the fraction $^{49}/_{42}$ and then subtracts 42 from 49, getting the fraction $^{7}/_{42}$. Repeating the process, you end up with $^{7}/_{7}$. In modern terminology, this shows that the greatest common divisor of the numerator and denominator is 7 which then allows you to simplify the fraction to $^{7}/_{13}$. This is similar to the Euclidean algorithm, but distinct from it in terms of its motivation and Marty cautioned us to resist translating such historical sources into modern terminology and as someone who teaches math history (upper division GE), I concur. The mediant of two fractions is what you get by adding them the "wrong" way. Marty uses the following notation below for this.

$$\frac{a}{b} \vee \frac{c}{d} = \frac{a+c}{b+d}.$$

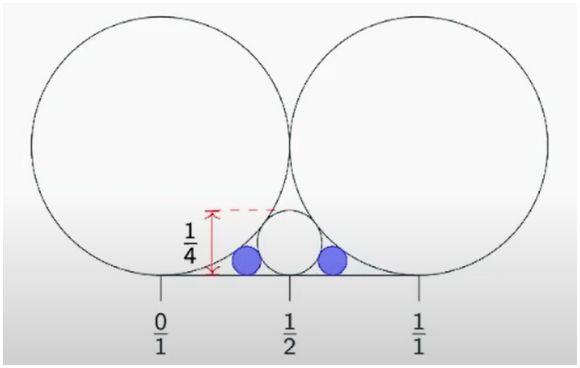
But the mediant is a function on fractions, not on rational numbers, as its not well-defined on rational numbers. For example, $\frac{1}{2} \vee \frac{1}{3} = \frac{2}{5}$ but $\frac{2}{4} \vee \frac{1}{3} = \frac{3}{7}$. If we assume the denominators are positive integers, Marty showed how one can use vectors to show that the mediant does lie between the fractions, so it is definitely a kind of median:

$$\frac{a}{b} < \left(\frac{a}{b} \vee \frac{c}{d}\right) < \frac{c}{d}.$$

One says the fraction a/b kisses the fraction c/d if $|ad - bc| = 1$, and cutely writes

$$\frac{a}{b} \heartsuit \frac{c}{d}$$

to signify this. If two fractions kiss, then it turns out (theorem) that they both kiss their mediant. So of course that process can be continued. Marty posed a nice series of questions about diameters of circles. In the figure below, new circles are inserted atop the number line, tangent to the old ones. Where are these located? What is their diameter?



One defines the Ford circle atop the fraction a/b to be the circle of diameter $1/b^2$. Ford's theorem from 1938 says that two fractions kiss if and only if their Ford circles are tangent. A corollary to that says that the "new circle" stuffed between two tangent Ford circles will be a Ford circle located atop the mediant fraction! This process beginning with 0/1 and 1/1, taking mediants, yields all reduced fractions between 0 and 1. This also gives a nice algorithm for deciding which of two fractions is bigger.

Diophantine approximation asks how closely we can approximate real numbers by rational numbers if it costs us something to use a given fraction. One says the price of a fraction a/b is b dollars. For example, if your budget is 10 dollars, you can approximate real numbers to within 1/20. But Dirichlet's Theorem says that for every irrational real number there are infinitely many fractions a/b whose distance from x is less than $1/2b^2$. Marty showed how can "see" the proof of Dirichlet's Theorem using the Ford circles he talked about earlier. One defines a Baker period (after Alan Baker) to be any real number that is equal to the integral of $P(x)/Q(x)$ from 0 to 1, where $P(x)$ and $Q(x)$ are polynomials with rational coefficients, and $Q(x)$ is nonzero on the interval [0, 1]. Baker periods can all be expressed in terms of natural logarithms

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THE MATHEMATICAL ASSOCIATION OF AMERICA – GOLDEN SECTION

Saturday, February 26, 2022, at the California State Maritime Academy

All talks are held in Rizza Auditorium; Lunch can be picked up at Simulation Center Lobby
Directions on how to get to CSU Maritime are available on the conference website under Venue.

NOTE: The following schedule is tentative and subject to change.

Time	Event	Presider
8:30 - 9:00	Registration in Rizza Auditorium Lobby	
9:00 - 9:10	Opening Welcome	Provost Lori Schroeder Section Chair Julie Simons
9:10 - 10:10	**Talithia Williams**, Harvey Mudd College *Power in Numbers: The Rebel Women of Mathematics*	Julie Simons
10:10-10:30	Golden Section Business Meeting: By-Laws Revision Vote and Elections	Ed Keppelmann Walden Freedman
10:30-10:45	Break	
10:45-11:45	**Sarah Koch**, University of Michigan *Title to be Announced*	Dean Gooch
11:45-12:45	Lunch (pick up at Simulation Center Lobby)	
12:45-1:45	**C. Allen Butler**, Daniel H. Wagner, Associates *Bayes' Theorem – Making Rational Decisions in the Face of Uncertainty*	Frank Farris
1:45-2:45	**Eric Hsu**, San Francisco State University *Letting Students Freely Choose Their First-Year Math Courses*	
2:45-3:15	Teaching Awards Presentation	
3:15-4:15	Poster Session and Art Exhibition	
4:15-5:15	**Emille Lawrence**, University of San Francisco *Exploring Mathematics Across Civilizations*	Ed Keppelmann
5:15-5:30	Closing Remarks	Outgoing Chair Julie Simons Incoming Chair Mark Durst

Program Abstracts

Talithia Williams, Harvey Mudd College, *Power in Numbers: The Rebel Women of Mathematics*

Abstract: The movie "Hidden Figures" brought visibility to the lives of African American women who served as NASA "human computers" in the 1960s, women who dreamed the impossible in a field where their presence was lacking. When it comes to inspiring the future productivity and innovation of our nation, women mathematicians are on the front lines. In this talk, I'll discuss my personal journey as a woman of color in mathematics and share ways we can excite public interest in mathematics, building upon the rich legacy of the Hidden Figures that have come before us. As we shift the fixed mindset around mathematics ability, we can begin conversations that improve public perception of STEM and bring people from all backgrounds into this important work.

Sarah Koch, University of Michigan, *To Be Announced*

Abstract: To Be Announced

C. Allen Butler, Daniel Wagner Associates, *Bayes' Theorem – Making Rational Decisions in the Face of Uncertainty*

Abstract: A statement of Bayes' Theorem can be written very succinctly, but this belies its far-reaching consequences. In this talk, I will provide a little of the history behind Bayes' Theorem, a derivation of the mathematical basis in probabilistic terms, and a description of the less formal basis where it is viewed as a form of evidential or inferential reasoning. I will illustrate the utility of Bayes' Theorem by describing applications from the work of my former company, Daniel H. Wagner Associates, Inc. One of these resulted in the location and recovery of the "Ship of Gold", the SS Central America, a side-wheel steamer carrying nearly six hundred passengers returning from the California Gold Rush, which sank in a hurricane two hundred miles off the Carolina coast in September 1857.

Eric Hsu, San Francisco State University, *Letting Students Freely Choose Their First-Year Math Courses*

Abstract: What happens when you give students the freedom and agency to choose their own first-year math courses? Will they rush into the quickest coursework and fail? Will they rise to the occasion? In Fall 2021, San Francisco State University moved from mandatory math support courses to a directed self-placement system. We'll discuss the motivations (including a COVID-caused defect in the system-wide multiple measures) and design of the advising process. We will also share the surprising results from the first semester and contemplate the way forward.

Emille Lawrence, University of San Francisco, *Exploring Mathematics Across Civilizations*

Abstract: Close your eyes and ask yourself, "Who are the greatest contributors to modern mathematics?" Do you have your answer? There is a good chance that one of Newton, Gauss, Euler, Galois, Cauchy, Cantor, or Noether appeared on your list. While these are indeed important figures in today's mathematical landscape, what is largely absent from our mathematics education are the contributions of African, Indigenous, Oceanic, and people from other non-European cultures. The aim of this talk will be to provide thought-provoking insight into the mathematics of cultures that are often overlooked in American schools and universities. We will also highlight how these ideas can be presented in our own teaching as we work towards culturally responsive ways to engage students and towards presenting mathematics as a diverse human experience.

continued from page 8

of algebraic numbers. One can define the mediant of two rational functions and define kissing rational functions as well. This leads to some interesting questions such as: Which inequalities among Baker periods can be obtained just from obvious ones, using mediants? Can one turn this into an algorithm for comparing Baker periods? Do "kissing fractions" of polynomials tell us about the space between Baker periods? What about integrals over the square, cube, etc., (Kontsevich-Zagier periods)?

Prior to the third talk, there was barely enough time to chat with friends, explore the online venue (go to the beach!), meet the poster presenters and mathematical artists, and visit with Steve Kennedy, the MAA Press acquisitions editor. But luckily one could still go and view the posters and artworks anytime on one's own.

Our third speaker was (MAA President-Elect and Associate Secretary) Hortensia Soto of Colorado State University on "Intentionally bringing diversity, inclusivity, & equity awareness into the classroom".

Tensia's motivation includes influences from her family and friends, the MAA Core Values of community and inclusivity, her professional experiences training future teachers, and her own personal experiences. Self-reflection is an important process in this work.

As a group, we did an exercise on desmos, making a graph of our awareness level regarding Diversity, Equity, & Inclusivity (DEI) from age fifteen onward. The graphs showed a general upward trend. Next, we thought about whether it is important to address DEI topics with students and colleagues. In this case, the x-axis indicated how much we believed it is important to address DEI topics and the y-axis indicated how comfortable we were discussing such topics with students and colleagues. So, the first quadrant was occupied by those who felt DEI topics are important to discuss and feel comfortable discussing with others. Most participants were in the first quadrant with a few in quadrant 4 and one on the negative y-axis. The next exercise asked us to indicate whether we feel we can use our voices to make informed decisions about DEI issues, and whether we think that only those from underrepresented or minoritized groups are capable of making informed decisions about DEI issues. We did a similar coordinate plane exercise with the x-axis representing how much we agree with the statement, "I think people make decisions about me based on the color of my skin, gender, sexual orientation, ..." and the y-axis representing how much we agreed with the statement "I think I make decisions about others based on he color of their skin, gender, sexual orientation, ...". In the last exercise, the x-axis represented how much we agreed with the statement "Others who are different from me have made an effort to help me feel a sense of belonging." and the y-axis represented how much we agreed with the statement, "I help others who are different from me to feel included." Most people placed themselves in the first quadrant again. How can we make others aware of DEI and how it impacts mathematics? How can we give everyone an opportunity to engage in mathematics? In teaching the history of mathematics, one can ask about any given time period: Who are the faces of mathematics? Who gets to do mathematics? What are the implications of this? Some of Tensia's course goals are for students to reflect on how mathematics is embedded in social and political contexts and by having them interact with a diverse set of mathematicians by interviewing them and hearing their stories. One of the first activities was to find three mathematicians they could identify with from the AMS/MAA book "Living Proof: Stories of Resilience Along the Mathematical Journey" (available free online, use the link above.) Tensia had students (mostly prospective teachers) write about the mathematicians they identified with and about their own mathematical journey. Tensia also has four mathematicians visit and talk about their research and its relation to the history of mathematics. Finally, each student interviewed a mathematician from an underrepresented group, record the interview (so they would be fully engaged in the experience), produce a paper, present it to the class and then reflect on the experience. For example, how the student did or did not identify with the mathematician, and how the interaction might influence the student's future role as a teacher/mathematician. Tensia shared some of the comments of students, who

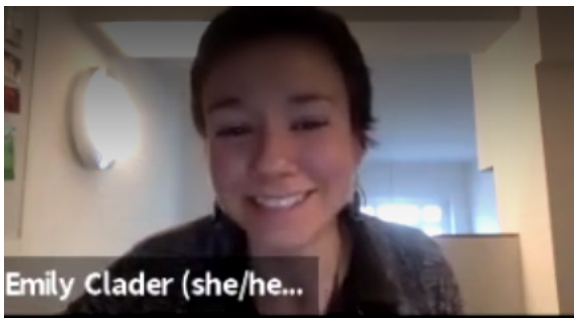
clearly found this an inspiring and enlightening experience. A question posed during the course in different time periods and places was "Who had access to mathematics?" The answer seemed to be usually men, and people of wealth. A rich discussion followed with members of the audience.

What seemed to come up the most is the importance of creating a sense of community in the classroom and having students not just hear about, but really reflect on DEI topics. We were left with the challenging question: How can we aspire to inspire our students regarding DEI, specifically in mathematics?

The final speaker at the meeting was Emily Clader, of San Francisco State University with her talk on "Why Twelve Tones? The Mathematics of Musical Tuning". Emily started off with a review of the twelve consecutive notes or tones one can find on a piano keyboard, played in order from left to right including the black keys:

C, C#, D, D#, E, F, F#, G, G#, A, A#, B.

The main two questions Emily considered in her talk: 1. Why do we use the same letter for notes that are an octave apart? 2. Why divide the interval in an octave into twelve (roughly) equal pieces?



When we mute or cut off part of a plucked string the note gets higher. When we cut off half, the higher note is an octave apart from the first one, which we can take as a definition of octave. In terms of sine waves, the note an octave apart has twice the frequency (reciprocal of the period) of the first. Plucked strings vibrate as an infinite sum of sine waves, rather than as a single sine wave, thereby producing a rich tone. The motion of a plucked string of length 1 is a sum of sine waves of frequencies 1, 2, 3, 4, ... whereas length ½ would have frequencies 2, 4, 6, 8, ... So, to answer question 1, the similarity of the Fourier series reflects why we think consider notes an octave apart as the "same" and use the same letter for them. We can think of a note as a positive real number, music-wise representing a frequency (reciprocal of the length). We identify notes if they differ by a power of 2, creating equivalence classes, in particular:

$$1 \sim 2 \sim 4 \sim 8 \sim \cdots$$

We get a new note by considering frequency 3 (one-third length). In the octave from 1 to 2, this would give us the note $3/2$. We continue to multiply by 3 and divide by powers of 2 in order to keep the note in the octave from 1 to 2, producing more notes: $9/8$, $27/16$, $81/64$, and so on. We can use the continued fraction representation of $\log(3)/\log(2)$ to figure out a good place to stop, when we get a note that is (sufficiently) close to 2. Good approximations of $\log(3)/\log(2)$ are $8/5$, $19/12$ and $65/41$. (Note the connection with Martin Weissman's talk!) So, using 5, 12, or 41 should yield a "good" scale, answering question 2. In particular, the 12-note scale (arranged in increasing order) is

$$1, \frac{3^7}{2^{11}}, \frac{3^2}{2^3}, \frac{3^9}{2^{14}}, \frac{3^4}{2^6}, \frac{3^{11}}{2^{14}}, \frac{3^6}{2^9}, \frac{3^1}{2^1}, \frac{3^8}{2^{12}}, \frac{3^3}{2^4}, \frac{3^{10}}{2^{15}}, \frac{3^5}{2^7}, 2.$$

Emily defines a b-note Pythagorean scale to be the set of numbers

$$1, \frac{3^1}{2^1}, \frac{3^2}{2^3}, \ldots, \frac{3^{b-1}}{2^\star}, 2 \in [1, 2].$$

Idea: The "best" b-note scales are the ones where b is the denominator of a continued fraction approximation of $\log(3)/\log(2)$. These are also those which are in a sense, the most evenly-spaced. Looking at the ratios of the consecutive notes, Emily defines a scale to have the N-step property if there are exactly N different ratios between consecutive notes. Keeping N small is desirable so we can shift the scale easily without the music getting distorted.

Emily's theorem states: Any b-note Pythagorean scale in which b is the denominator of a continued fraction approximation of $\log(3) / \log(2)$ has the 2-step property.

There are a number of questions to consider. How

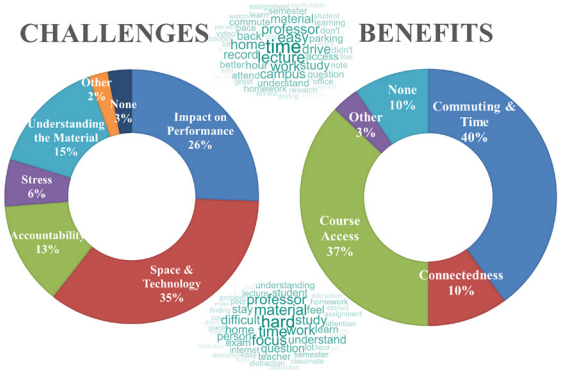
uneven are the other Pythagorean scales? Which scales built with notes of the form $3^a5^b/2^c$ have the 3-step property? Students interested in exploring these kinds of questions should contact Emily (eclader at sfsu.edu)!

There were ten student posters on a variety of subjects, but with five of them (maybe not surprisingly) related to the pandemic.

SwingBeats: *An IoT Haptic Feedback Ankle Bracelet (HFAB) for Dance Educatio*n, by **Navid Shaghaghi**, **Yu Yang Chee**, **Alissa LaFerriere**, and **Jesse Mayer** of Santa Clara University, looked at a device that helps would-be dancers know when and how to move their feet to the beat of the music.

Numerical Range of Block Toeplitz Matrices, by **Sarah Mantell** and **Linda Patton** of Cal Poly, San Luis Obispo, establishes some conditions on complex 2 × 2 matrices A_0 and A_1 so that the block Toeplitz operator with symbol $A_0 + zA_1$ has numerical range equal to a disk.

The Impact of Covid-19 on Mathematics Classes: *Voices of CSUF Students*, by **Chris Verville**, of CSU Fullerton, studied the benefits and challenges of taking courses during a pandemic. Students described the greatest benefit and challenge of virtual courses.



Analysis of the State of COVID-19 Pandemic in Florida, Montana, Hawaii, and Alaska using mathematical modeling, by **Allen Bryan**, **Kevin You**, and **David Zhang** of Junipero Serra, Palo Alto, and Mountain View High Schools, respectively, found that the prevalence of outside social activities and state regulations were the largest determining factors in the spread of Covid-19.

Applying Mathematical Modeling on Covid-19: *Examining and Predicting Trends in Covid-19 Cases in Washington State and Arizona Using Mathematical Modeling*, by **Andy Chen** of Saratoga High School and **Ryane Li**, of Valley Christian High School, identify three distinct periods in which the rate and spread of Covid-19 varied significantly.

Using Mathematical Modeling to Compare and Predict Trends Between Daily Covid-19 Total Cases and Deaths in New York, New Jersey, and Illinois, by **Cindy Wang**, **Kevin Zhang**, and **Owen Xu Li**, of Palo Alto High School, Mountain View High School, and American School Foundation, respectively, used a variety of functions such as quadratic and other polynomials to predict the association between virus cases and days from lock-down.

Topological Data Analyses of US Wildfires and Covid-19, by **Isaac Travers**, **Matthew Nicholson**, **Ryan Beck**, **Lily Schieberl**, **Lance Johnson**, and **Sandy Riley** of Humboldt State University used topological data analysis to study the following two questions: What is the visualization of wildfires in the US based on acres burned and location, and how does the visualization of ICU occupation differ between states? What does that say about their Covid-19 response?

Spheres of Planes in Generalized Quaternions, by **Ian Gallagher**, **Andy Hasse**, **Bailey Wickham**, with Dr. **Eric Brussel**, of Cal Poly San Luis Obispo look at 2-dimensional subalgebras isomorphic to C inside the quaternion algebra H. They also show that $M_2(R)$ contains a sphere of 2-dimensional subalgebras divided into three isomorphism types, forming three conjugacy classes. They use the resulting partition of the moduli space to make a probability distribution for the three classes of commutative planes in $M_2(R)$.

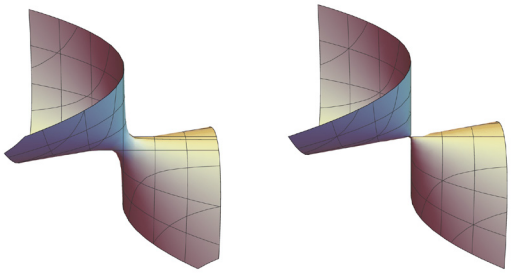


Figure: Moduli Space of $\mathbb{R} \times \mathbb{R}$ (Left) and Nilpotents in $M_2(\mathbb{R})$ (Right)

A Whole Lot of Values for Pi, by **Nikhil Henry Bukowski Sahoo** (currently a graduate student at Cornell University) gave an introduction to the classical result of Stanislaw Golab showing that the possible values of π in normed planes comprises the entire interval [3, 4]. A more recent result for norms with

quarter-turn symmetry is introduced and it is shown that the minimizing case provides a classification of inner product spaces.

Informing the Need of Critical Thinking in Mathematics, by **Alrlena Liryce Gavino**, of CSU Stanislaus found that word choice does not play a role in students' performance on nonsensical mathematics problems. The information in this study may help those who work in mathematics education create better materials for students.

Mathematical Art Exhibition on Gather

by Dan Bach, images by the artists

The whole February 2021 conference was online, and the Mathematical Art Exhibition was no different. There were *n* artists contributing *n* artworks each, for $n = 1, 2$, and 3. That works out to a tidy fourteen mathematical artworks, displaying a variety of visual styles and subject matter. Entries for the exhibition were submitted to me on a Google Form.

Exploring the Gather art gallery room that I put together was reminiscent of navigating in SecondLife or a retro video game—use arrow keys to move your avatar, approach others to enable their video and sound. This made for enough socializing (and distancing) to 'go around'.

This year's contributors and their artwork titles were:

Frank Farris: *A Seven-Color Torus*

Carlo Sequin: *CubOct 1 loop, 4 loops, 8 loops*

Aminur Rahman: *Chaos Gilet Map*, *Chaos Sigma-Map*

Phil Webster: *Vibration-6 Moss/Yellow*, *Vibration-8 Blue*

Dan Bach: *Hilbert Soap Film*, *Interpolation Surfaces*, *Divisor Spiral Stack*

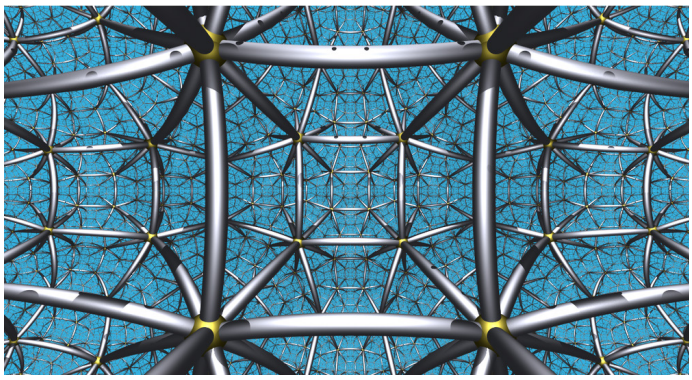
Zhao Liang: *Limit Set 5-4-4*, *Hyperbolic Tiling 7-2-3*, *Regular Hyperbolic Honeycomb* (*4-3-5*)

Visitors were able to browse the artworks in the Gather space, explore conversation corners, and even interact with most of the artists in the midday period. There was an artist lounge, an info booth, and links to artists' websites and other works. And beyond the gallery side doors one could access the Lecture Halls, Main Lobby, and Student Poster Session.

Here is a sample of the entries. See page 17 for more!

Artist: Liang Zhao

Title: Regular Hyperbolic Honeycomb (4, 3, 5)

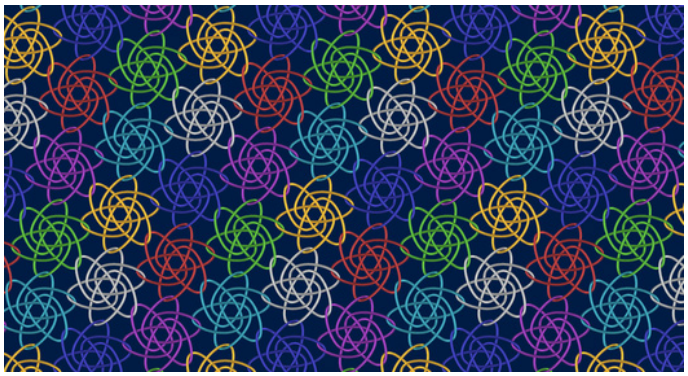


Over one million edges were computed in Python, and then rendered in POV-Ray, using the 'Coxeter group automaton' approach. Liang is a former math PhD candidate and now a software engineer in mainland China with interests in probability theory, representation theory and combinatorics. He likes making nice math images with code, especially some non-trivial math visualized.

Visit Liang's GitHub webpage for more information and a "tour in the wonderland of math with python".

Artist: Frank Farris

Title: A Seven-Color Torus (detail)



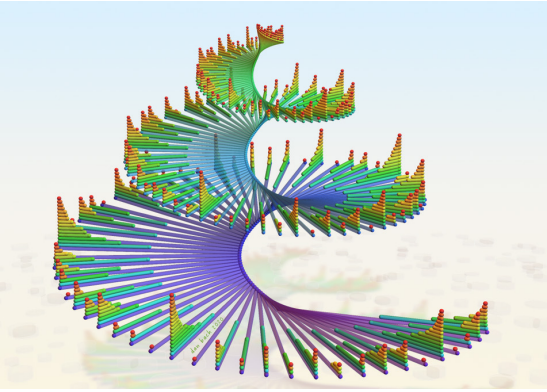
A repeating-tile closeup crop of Frank's image, showing a grid of linked knots with hexagonal symmetry. Opposite edges are glued together when the tile is bent and sheared around into a torus. (Picture the rhombus that joins the centers of the white stars.) Within that rhombus, there are knots of each of the seven colors and each one has six neighbors of every different color. This shows you could not color the configuration with fewer than seven colors.

Frank is interested in promoting the role of mathematical art in the broader community.

Visit Frank's webpage for more information.

Artist: Dan Bach

Title: Divisor Spiral Stack



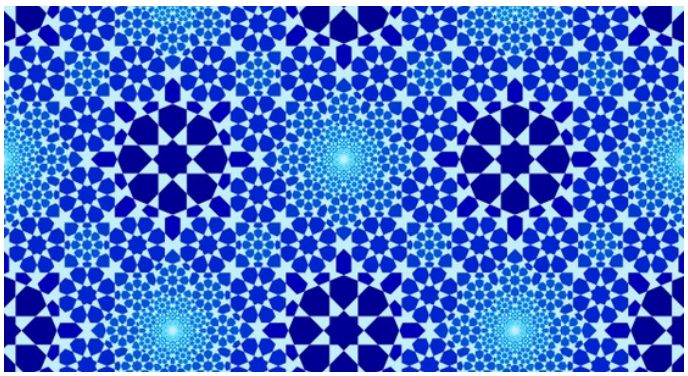
Two hundred horizontal spokes of length n wind down around a central axis, each with all their divisors stacked on top. The same number is the same color globally, e.g., 1 is always red. Can you spot the primes, or the super composites?

Dan is a former teacher at Diablo Valley College who used Mathematica for 25 years in the classroom, workshops, and conference talks.

Visit Dan's website, dansmath, for more information about Dan and his work.

Artist: Phil Webster

Title: Vibration 8-Blue (detail)

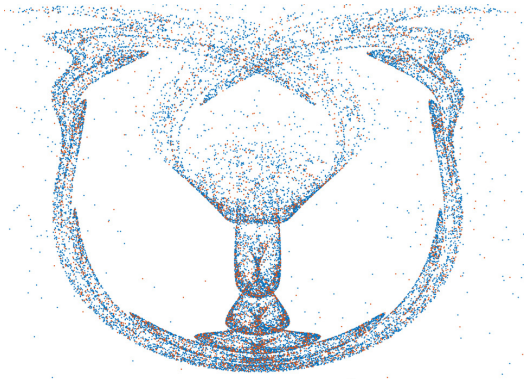


This features a fractal arrangement of eight-fold Islamic-flavor rosettes, repeated infinitely across the plane on a square grid. The shades from dark to light blue emphasize the geometric progression and give the piece a visual vibration reflected in the piece's name. Phil has had a life-long love affair with geometry and his "sweet spot" is taking ancient geometric traditions and combining them with modern concepts like fractals to create unique works.

Visit Phil's webpage for more information and artworks.

Artist: Aminur Rahman

Title: Chaos Gilet Map



A chaotic attractor from a model of walking droplets (hydrodynamic quantum analogs). Interestingly, the iterates form a tiger-like shape. Aminur is an applied mathematician who often applies the techniques of dynamical systems analysis. His research involves formulating mechanistic models that agree with real world observations. The models sometimes produce beautiful figures.

Visit Aminur's page at University of Washington for more information.

Spring 2022 Meeting at Cal Maritime

Cool Facts about Cal Maritime

- Founded in 1929 as the "California Nautical School". First located in Tiburon, then San Francisco, relocated to Vallejo in 1943.
- Became a member of the CSU in 1995.
- Serves around 1,000 students
- 500-foot Training Ship *Golden Bear* serves as a floating classroom/laboratory.
- The only degree-granting maritime academy on the west coast of the US. One of only seven in the US.

COVID-19 Protocol at Cal Maritime

Guests must ensure they have no COVID-related symptoms. Symptomatic people cannot access campus until cleared by a physician or have a negative COVID test collected in the last 72 hours.

Unvaccinated individuals are required wear a mask at all times while on campus.

Everyone MUST wear face coverings in all campus buildings, unless they are alone.

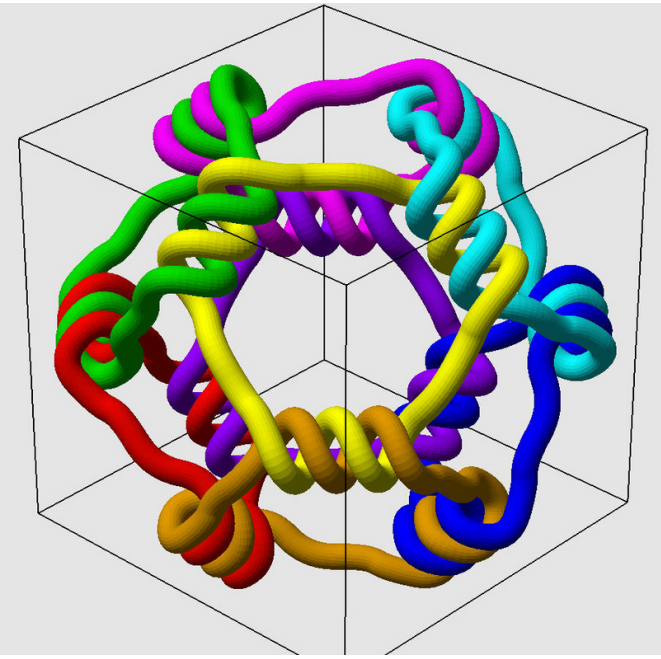
- ABS Lecture Hall AB
- Administration AD
- Admission Office AO
- Alumni Plaza AL
- Athletic Courts AT
- Boathouse BH
- Bodnar Field BF
- Career Services CS
- Classroom Building CL
- Compass Room CR
- Dining Center DC
- Enterprise Services/Conference & Events ES
- Extended Learning EL
- Faculty Offices FO
- Facility Services FS
- Felton Alumni House FE
- Financial Aid FA
- Health Center HC
- Information Technology IT
- Keelhauler Shops KS
- Keelhauler Shops Outlet KO
- Laboratory Building LB
- Library LI
- Lower Residence Hall LR
- Machine Shop MS
- Marine Programs and Naval Science MP
- Maritime North MN
- Mayo Hall MH
- McAllister Residence Hall MR
- Memorial Park ME
- Mini Park MI
- Peachman Lecture Hall PL
- Physical Ed & Aquatics Center PE
- Police Department PD
- Port Security Gate PS
- Quad QU
- Receiving RE
- Rizza Auditorium RA
- Simulation Center SI
- Staff Housing SH
- Student Center SC
- Student Services Building SS
- Tech Center TC
- Training Ship *Golden Bear* TS
- Upper Residence Hall UR

Call for Mathematical Art Works

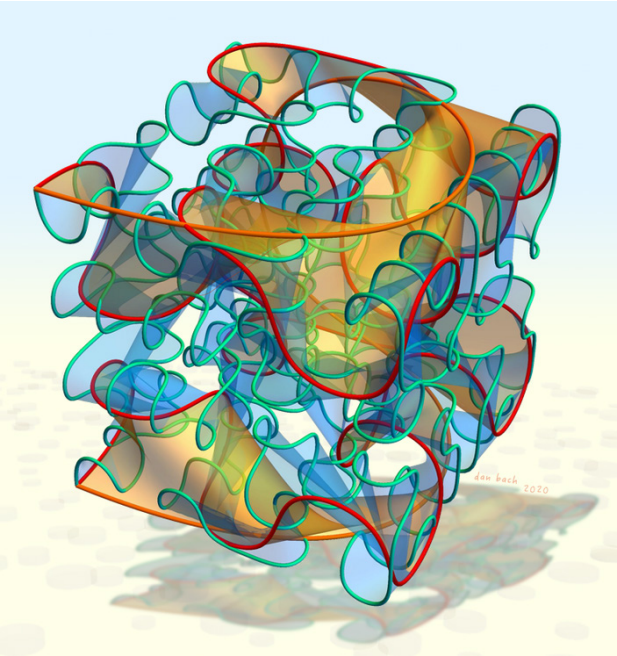
The exhibition will take place at the meeting at CSU Maritime Academy. The exhibition organizer is Gabriel Dorfsman-Hopkins (email link), currently at UC Berkeley. During the period from 2:30 to 3:30 p.m., artists are expected to be present to discuss their works with meeting participants. If you know anyone who produces art with a strong mathematical theme or content, please encourage them to submit their piece for consideration in the exhibition. Artists are expected to register for and attend the meeting.

Deadline to submit mathematical art works: Monday, February 1, 2022

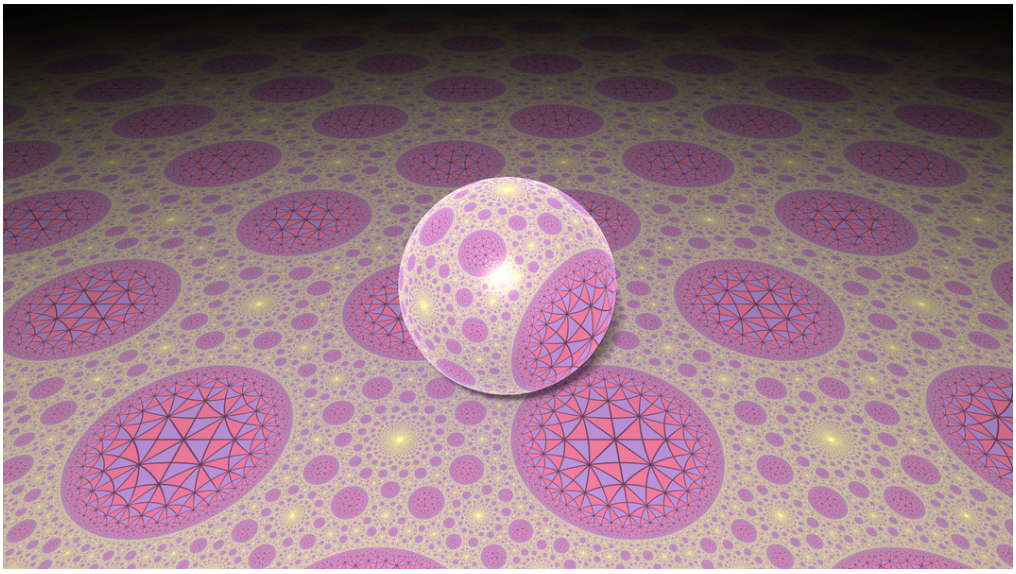
To submit a piece for consideration in the Mathematical Art Exhibition, fill out the Google Form by February 1, 2022. Artists can upload their images there along with brief descriptions of the pieces and a biography. Each artist can submit up to three pieces for consideration. Here are more images from the previous exhibition!



Cuboctahedron, 8 loops Artist: Carlo H. Séquin



Hilbert Soap Film Artist: Dan Bach



Limit Set of the Rank Four Hyperbolic Coxeter Group (5, 4, 4) Artist: Liang Zhao

Call for Student Posters

Who, When and Where

All undergraduate and graduate math students, on Saturday, February 26, 2022, at the annual meeting of the MAA Golden Section at Cal Maritime (California State University Maritime Academy) in Vallejo, CA.

What

Poster presentations of research, new approaches to old problems, solutions to problems from mathematics journals, results of class projects or mathematical modeling contests, historical investigations in pure and applied mathematics, mathematical topics outside the standard curriculum, or mathematical investigations arising from internship experiences.

Why

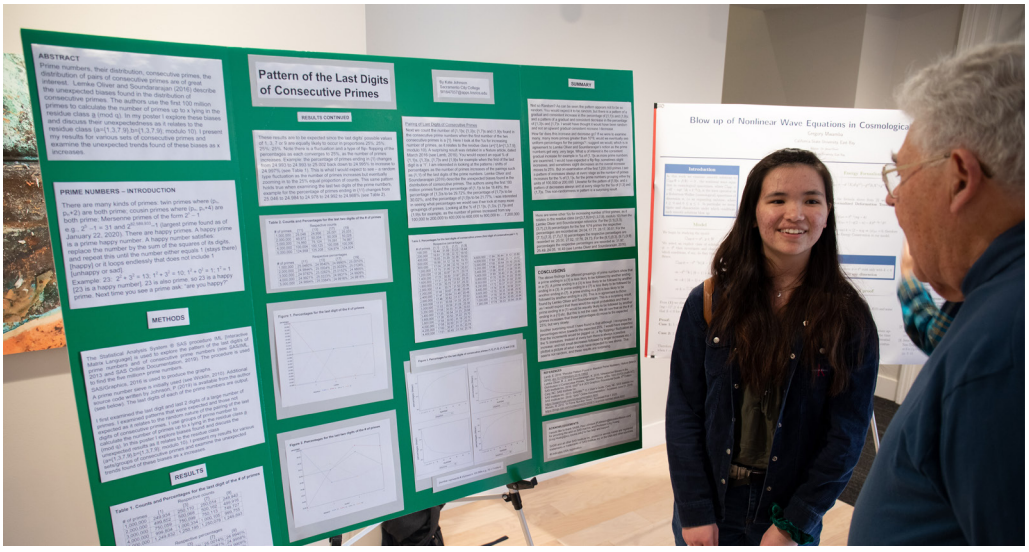
The meeting provides a great opportunity to learn about interesting and entertaining areas of mathematics, as well as to network with other students and professors. Student presenters receive **complimentary registration** and **Saturday luncheon**, plus a **free one-year membership to the MAA** or (for those who are already MAA members) a **free book**.

How

To submit an abstract, go to the following link, scan the QR code below or visit the webpage for the meeting. Applicants must have an email address, possibly through a faculty mentor, where they can be contacted. All posters should be typeset, illustrated, and displayed in landscape orientation and measure roughly 36 inches × 48 inches. Posters will be on display throughout the meeting, including during a scheduled poster session.

If you have any questions (for example, whether your idea is appropriate for presentation or what size font to use on your poster), contact Professor Ariel Setniker (email link), Department of Sciences & Mathematics, Faculty Office Bldg 106, CSU Maritime Academy, 200 Maritime Academy Drive, Vallejo, CA 94590
Office telephone: (707) 654-1747 Email: asetniker@csum.edu

Deadline to submit an abstract: Saturday, February 12, 2022



Pattern of the Last Digits of Consecutive Primes
by Kate Johnson Faculty sponsor: Ling Huang, Sacramento City College
2020 Mills College meeting