The Colorado State Torus

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The Intersection of Mathematics and Art:

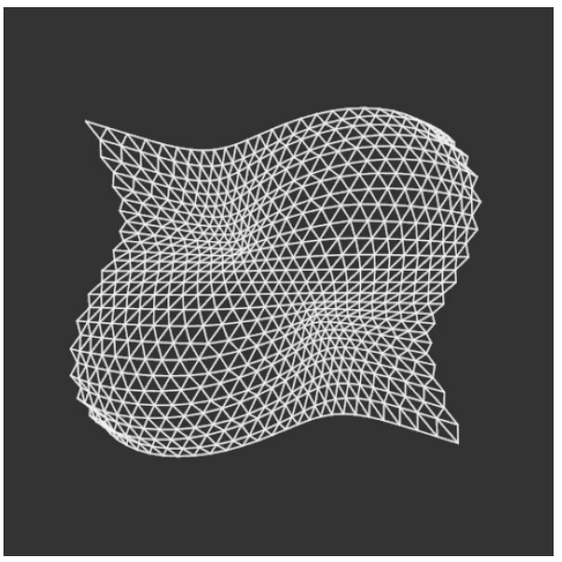
A Q&A with Associate Professor Clayton Shonkwiler

Lisa Streeb Case

While trying to illustrate a point in a lecture, Associate Professor Clayton Shonkwiler of mathematics created his first mathematics animation. Now, years and hundreds of GIFs later, Shonkwiler's math-inspired artwork has become a dedicated hobby, leading to art exhibitions and innovative teaching curriculum.

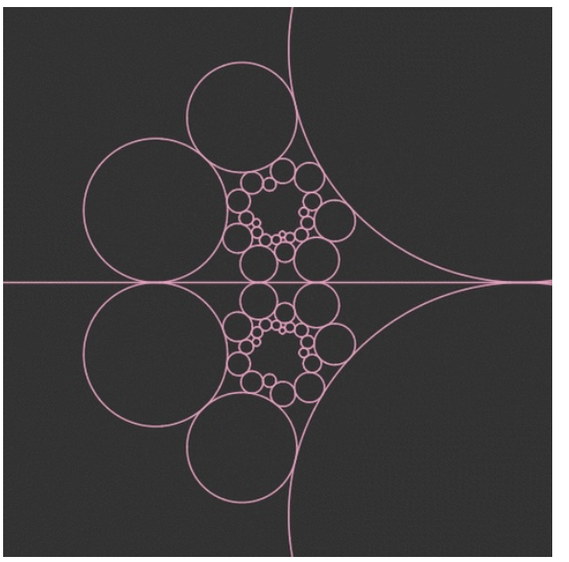
What is your background in mathematics?

My training is in differential geometry, which, for example, is the math behind general relativity, and so the idea there is to understand the shape of spaces. These days I call myself an applied geometer: I work with a physical system that someone is interested in and take all the possible states of that system and think of those as points in the space. The goal is to understand the geometry of that space, which in turn gives us information about the system.



How did you discover your interest in mathematics inspired art?

The first animation that I made was to just try to illustrate something for a research talk, and I realized "Oh, I can actually make something that will show the audience what I am talking about." From there I realized that I could create anything that I wanted.



How has your work in mathematical art evolved from that first animation to now?

When I was a postdoctoral researcher, I was asked to cover a class for one of the faculty members on the topic of Euclidean and non-Euclidean geometry. That day the course was going to talk about the hypersphere, and I thought that I could make an animation to illustrate what this is. The students thought it was cool and wanted to know more about how I did it.

My interest evolved from there; I spent the next couple of years thinking about what random mathematical concepts I could turn into animations. I started posting these online and saw interest from viewers who liked them.

Eventually, I submitted art to exhibitions at the Bridges Conference, which is run by the primary math art group

the Bridges Organization, and the annual Joint Mathematics Meeting hosted by the American Mathematical Society. My work was selected by juries and displayed at those conferences several times.

I have also had my artwork accepted into GIF exhibitions at the Boulder Museum of Modern Art and the Electronic Language International Festival, FILE, in Brazil.

How has mathematical art influenced your teaching and your students?

I use a lot of animations when I teach, especially in the undergraduate differential geometry course and when I teach complex analysis. Having animations as a resource to show students a moving picture of what they are reading about in the textbook is a very valuable learning tool. That has had a big influence on how I teach.

A lot of recent animations have grown out of something I was trying to explain in the complex analysis course. I now have a library of animations that I can source from to teach these courses, and then inevitably the course discussion will lead to a new idea for an animation, and this creates a nice feedback loop.

Tell me more about how this applies to geometry and real-world problem solving.

One of the big things that I think about these days is the chemical composition of polymer models. This is something that I have worked on for over a decade now. When a polymer forms a loop, it becomes a complex shape because you have added a constraint that you have to get the end back to the beginning after some number of steps.

What I do is look at this space and all the possible configurations of the loop with n edges in it. I try to answer how we can generate random outcomes or compute expected values. This process uses an idealized model that acts as a first approximation that is easy to compute. The idea is to develop models that you can compute with on your laptop and make a first pass of what we expect to happen. Then, a materials scientist or polymer scientist can take the most promising outcomes, put it on a supercomputer, and do a molecular dynamics simulation. These very idealized mathematical models account for 70-80% of what you see in the supercomputer — you can run it on your laptop in a few seconds vs. a supercomputer which would take hours and be much more expensive.

February PotM

Provided by **Sandra Nair**

Let $Q(n)$ denote the sum of digits of n (in base 10). For any positive integer k, show that there is a non-zero multiple n of k such that $Q(n) = Q(n^2)$.

Opinions

The Torus aims to be an outlet for the constructive opinions of those in the department. The published opinions do not necessarily represent the feelings of the Torus. If you have any opinions you wish to share you can send them to our email address or submit them anonymously via locker #7.

Adult Responsibilities with Child-Like Restrictions:

The Mixed Messages of Being a Math Graduate Student at CSU

This opinion was provided by a group of graduate students who wish to remain anonymous.

As most of us are aware, a new personal leave policy—specifically aimed at graduate students—has been implemented in the math department. As graduates, we are extremely disheartened by the details of this policy. We are not calling for the absence of a policy, but rather one that is more reasonable. As it stands, the new policy is a breach of our privacy. It requires specific reasons for any number of absences, even if we want/need to miss only one day of class. Of course, if someone is abusing the flexibility of our job, scrutinizing their absences makes sense. However, this blanket policy is one that signifies a lack of trust in both our commitment and judgement as instructors and researchers.

It is known that graduates at CSU are in a unique position as primary instructors for undergraduate math courses, something that is not common in other departments or at other universities. In fact, for many of us, this was an influencing factor to join CSU's program. As instructors, our teaching responsibilities are practically the same as those of faculty members, with the exception of writing exams, homework, and syllabi for (some) coordinated courses. Instructing these courses comes with a heavy workload, not to mention the workload that comes with teaching courses that fall outside of the 'typical' assignments. Atypical assignments include teaching uncoordinated courses, multiple sections of a course, classes of 100+ students, or a fun cocktail of multiple of these. Many graduate students have taught such courses despite our handbook stating that we will have "one section" of "about 30 to 35 students each".

At this point, some of you might be thinking "Okay, okay, we get it; graduate school is hard and being a primary instructor adds to the stress... What's your point?" Our answer is just that—the expectations of a graduate student in general, but especially at CSU, are extremely high. It is a compliment that the department believes in us enough to have us teach an undergraduate class while maintaining our own courseload and research. This combination of responsibilities implies a great trust in our abilities not only as mathematicians, but also as instructors. Every week we make judgments about teaching that impact our students' learning experience, and the department seems to feel that we can do this effectively while juggling other graduate school obligations.

So, if the department can trust our judgement enough to let us run a class four days a week, why does that trust in judgement end at our discernment about when it's appropriate to miss a day of teaching? The new personal leave policy begs this question. Every expectation of us indicates that the department has deemed us capable of making the adult decisions it takes to run a classroom... But maybe that applies only to the decisions that directly impact our students for, say, the 58 days a semester that we are in class and not the decisions that influence them on the 2 days of the semester where we instead find a substitute. These substitutes are, by

the way, other graduate students who have been entrusted by the department to teach a different section of the same course.

We appreciate that the department cares about the education of its undergraduates—which is the reason cited for the policy. However, in many of our graduate courses, professors have canceled class for one or multiple days without a substitute. This includes a class that was cancelled for nearly two weeks. To be clear: we are not upset about this. In fact, we want our professors to have the freedom to cancel class or find a substitute as they deem fit. But, if the department recognizes that faculty can cancel class while still providing students with a good learning experience, why can't it recognize that graduates can do the same (except instead of canceling class, finding a substitute)? The new personal leave policy states that graduates will only be excused for research, sickness, emergency situations, and once-in-a-lifetime events as determined by the department. While technically the new leave policy applies to all instructors, it is stated that leave is scrutinized more for GTAs than faculty. This discrepancy is baffling.

In short, we find the department's faith in our abilities as graduates to take on immense teaching, research, and course responsibilities at odds with their lack of faith in our ability to make appropriate judgments about missing class. Sometimes we do not feel comfortable disclosing personal information to the department to justify an absence. Other times we have life events that might not be subjectively important enough to the department for an absence. It would be nice to have confidence that we would be granted personal leave a couple of times a semester (as most professions do) but the new restraints suggest that we can't. This policy is unlikely to change the undergraduate experience in our courses. However, it certainly has resulted in an exacerbation of the tensions between the department and its graduates.

Milestones

We want to congratulate the following people for their successful defenses and preliminary exams during December and January.

- Jerett Cherry successfully defended their work on "A Time Averaged Parallel-in-Time Integration Scheme for Hyperbolic Partial Differential Equations."

- Andrew Reimer-Berg successfully defended their work on "Insertion algorithms for moduli spaces of curves."

- Chris Rocheleau passed their preliminary exam on "Anatomically Informed Linearized Reconstruction Methods in Electrical Impedance Tomography for Cardiopulmonary Function."

- Emily Varney passed their preliminary exam on "Making number theory realistic: a case study of undergraduate students' embodiments and emotions for modular arithmetic."

- Kaylee Fantin-Hardesty passed their preliminary exam on "Supporting Mathematics Departments to Enact Critical Transformations."

- Kristina Moen passed their preliminary exam on "Shape and Texture Analysis of Satellite Imagery for Weather Prediction."

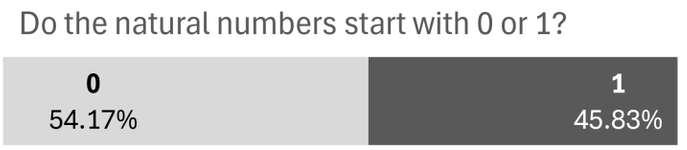
- Kylie Schnoor passed their preliminary exam on "Frames with Rational Eigensteps."

- Ian Jorquera passed their preliminary exam on "Equiangular Tight Frames and Mutually Unbiased Bases over Finite Fields!"

- Kelsey Brown passed their preliminary exam on "Local coswitching on d-complete posets."

December Question of the Month Results

In December, we asked if the natural numbers started with 0 or with 1. Here are the long-awaited results!



Overall, with a small sample size of 24, we have a pretty even split with 0 only just winning over the majority.

Interestingly, many votes that were received were not on the official Torus ballots. In case you are interested, here is the distribution of votes on official vs nonofficial ballots.

		Torus Vote Slip	
		Official	Nonofficial
Vote	0	41.67%	12.50%
	1	16.67%	29.17%

So, 0 was the most popular choice among official ballots, and 1 the most popular among nonofficial ballots.

Your opinion only matters if you vote! So remember to vote in every election!

At the bottom of the final page you will see a new question of the month.

Sports

After a competitive fall season, the Sitting Ducks are back for spring intertube water polo! Two of the star players, Matthew Williams and Madelyn Geisz, have moved on to retirement. After many intense rounds of try-outs, veteran Ducks Ashley Armbruster and Jacob Cleveland earned spots on this year's roster. Despite a five point deficit at halftime, the Ducks made a dramatic comeback to win their first game on Monday.

The Sitting Ducks after their first victory.

The curling team won western regionals with a win rate of 6-1.

David Aristoff won first place in the Colorado toe wrestling competition hosted at CU Boulder.

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February Question of the Month

Please answer and cut out this question and drop it in locker #7 near the upstairs graduate offices. Check back next month to see the results!

There are three identical roads in front of you. Which do you take?

(A) Left

(B) Middle

(C) Right

For more info, see Kristina

Department Concert Calendar

**Jedi Jazz Experience*	*Konstruct Brewing*	*2/5, 6:30pm*
The Retake and The Oregon Trail Trio	*Avo's*	*2/6, 8:30pm*
**Health and Wellness Community Orchestra*	*Griffin Hall*	*3/8, 4pm*
**Choice City Seven*	*Salt Road Brewing*	*3/28, 7pm*

**Free admission!*
If you wish to have any events listed (music or other arts), please email hilary.tanner.freeman@colostate.edu

Seminars and Clubs

Spring 2026

Seminar	Time
Applied Category Theory	On break
Topology	Tue 4–5pm
Mathematics Education (bi-weekly)	Wed 2–3pm
PAL Pattern Analysis Laboratory	Wed 4pm
Number Theory	Thu 12–1pm
Greenslopes	Thu 11am–12pm
MMARGS/MERG Moduli and Enumeration Research Group	Thr 2–3pm
Inverse Problems/Data Science/Applied Math	Thu 3–4pm
FRAGMENT: Front Range Geometry and Number Theory	Thu 3–4:30pm
Algebraic Combinatorics	TBD

Clubs	Time
Math Club	Wed 4–5pm
Student Chapter of AWM	First Monday of the Month
Putnam	Mon 3-4pm
Student Chapter of SIAM	See online schedule

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From the Editorial Board of the Torus

We hope you have enjoyed the eighth edition of The Colorado State Torus! We are now back to our normal monthly publishing schedule. The success of the Torus requires article submissions from our readers, do you have an idea for an article or comic but just haven't had the time to write it? We hope you take the chance to do something creative over the next month and submit a contribution for a future article: You can email your submission to our email address **MATH_ColoradoStateTorus@mail.colostate.edu**. The deadline to submit your work for the March addition is February 26th. We also want to remind our fellow graduate students that participation in the newsletter is required for graduation, this is a threat.

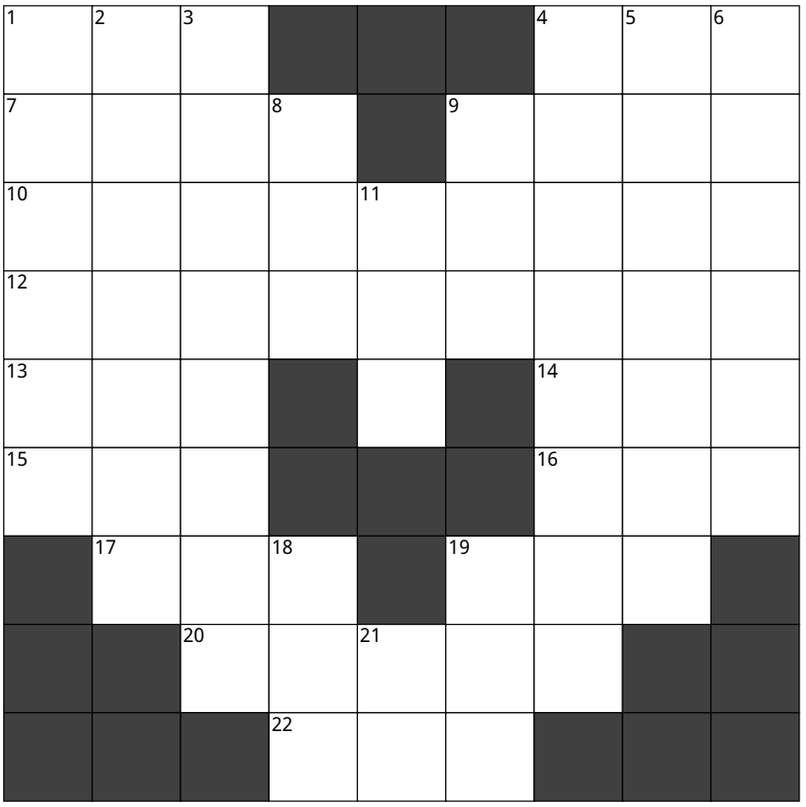
Love from your editors,
Ian, Joe and Page

February '26 Crossword

Tatum Rask

ACROSS

1 Opposite of NNE
4 Includes on an email
7 Thing
9 In Hamilton: "I'm not throwing away my ___"
10 Super-hoppy craft brew
12 Drill leaders
13 Multivolume ref.
14 Outdoor retailer
15 In a proof by induction, assume up to the ___ case and prove the (N+1)st case
16 Hosp. areas
17 Total
19 Battleship letters
20 Shape of this puzzle
22 Trig function, abbr.
18 Enero, por ejemplo
19 Samovar
21 Modern technological tool



DOWN

1 Suppresses
2 Sherwood and Remington, in Fort Collins
3 "Isn't that strange?"
4 Violin attachment
5 Whirlybirds
6 Equilibrium
8 Fuel efficiency stat
9 Poseidon's realm
11 Was ahead

December Solutions

1 S	2 L	3 A	4 L	5 O	6 M	■	7 S	8 W	9 A	10 P
11 C	O	G	I	T	O	■	12 N	A	I	L
13 A	R	A	B	I	A	■	14 O	N	T	O
15 R	E	T	■	16 S	N	17 O	W	D	A	Y
18 A	A	H	19 S	■	20 A	R	M	■	■	■
21 B	L	A	N	22 C	■	23 B	A	24 L	25 S	26 A
■	■	■	27 O	U	28 T	■	29 N	E	T	S
30 S	31 N	32 O	W	P	E	33 A	■	34 B	O	S
35 I	I	R	C	■	36 P	I	37 E	R	R	E
38 N	C	A	A	■	39 I	D	I	O	M	S
40 G	U	L	P	■	41 D	E	N	N	Y	S