NEWSLETTER

MATHEMATICS

Harvard University Department of Mathematics

Academic Year 2024–2025

DEPARTMENT OF MATHEMATICS
HARVARD UNIVERSITY

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Message From the Chair

Michael J. Hopkins

George Putnam Professor of Pure and Applied Mathematics

Mathematics Department Chair

Dear Friends of the Harvard math department,

It has been another eventful and exciting year for the math department. The number of our students continues to grow and our hallways, classrooms, and common room seem always to be filled with people talking about mathematics and other things.

In March we held the conference "The Legacy of John Tate, and Beyond" in honor of the 100th birthday of John Tate. The conference featured 19 leading mathematicians, and gave us a chance to reflect not only on the extraordinary legacy of John Tate, but on the history of the Harvard Department of Mathematics.

Our "Current Developments in Mathematics" conference was held in early April, featuring inspirational talks by Michael Chapman (NYU), Pazit-Haim-Kislev (IAS), Jianfeng Lin (Tsinghua University), Laura Monk (University of Bristol, and Ramon van Handel (Princeton).

Our Introductory Math team continues to develop innovative curricula. In this year's newsletter you will find an article about Eva Politou's use of an AI tutor in the workshop portion of Math 21a, and another about a trio of new introductory math classes.

Our faculty continue to receive high recognition. This past year, Melanie Matchett Wood wes elected to the National Academy of Sciences, and Lauren Williams was elected to the American Academy of Arts and Sciences.

Among our undergraduate concentrators, Harvard placed 2nd in the Putnam Competition this year, and a record 28 Senior theses were produced.

This year, we celebrate fifteen graduate students who received their PhD's and twelve new graduate students. Five outstanding young mathematicians started as Benjamin Peirce Fellows.

I'm also delighted to announce the newly created Benedict H. Gross Distinguished Visitor Program, funded by a generous donation from Will Hearst. Will's vision is that this will allow us to bring to Harvard both leading figures in mathematics, and rising stars with whom we wish to build a connection. This all came together just before this newsletter goes to press, so you'll have to wait until next year's issue to read all about it.

In this year's newsletter, you will find profiles of several members of our community, and pieces highlighting the accomplishments of others. I hope you enjoy reading about some of the wonderful things that happened in our department.

Finally, this is my last year as chair. I am grateful to have been trusted to head this remarkable department. It has been an experience of growth for me, and I have a new understanding of just how much this department excels at everything it does. Our next chair will be Joe Harris. The department will be in great hands with Joe.

With Best Wishes,

Mike Hopkins

Message From the Director of Undergraduate Studies

Laura DeMarco

Professor of Mathematics and Radcliffe Alumnae Professor at the Radcliffe Institute for Advanced Study

Director of Undergraduate Studies

Dear Friends,

As this academic year ends, so does my first year as Director of Undergraduate Studies. It has been a particularly eventful year, and the number and quality of math concentrators continues to impress and inspire. The students taking our courses are fearless and creative in their pursuit of mathematical knowledge and innovation. This is made clear in the range of thesis topics our math concentrators tackled. Most of them will be available in PDF format by summer at the page below:

math.harvard.edu/undergraduate/online-senior-thesis

We had 28 thesis writers this year—more than ever before:

- *Atomized Semilattices, Semantic Embeddings, and Algebraic Learning Algorithms through Object Detection* by Trace Baxley
- *Quadratic Dynamics, the Mandelbrot Set, and Local Connectivity* by Quinn Brussel
- *Toric Geometry and Maximum Likelihood Degree* by Emma Cardwell
- *Evaluating the Limits of Mathematics Education from Calculus to Analysis to Topology: Insights from the Harvard Undergraduate Mathematics Program* by Margaret Caris
- *The Problem of the In-and-Circumscribed Triangle* by Tyler Chamberlain
- *Discrete Systolic Geometry* by James Chen
- *A Lattice of Comparisons of Signals* by Yunseo Choi
- *Algebraic Relations and Analytic Symmetries in Complex Dynamics* by Zach Halberstam
- *3-Torsion in Class Groups of Orders in Number Fields* by Eliot Hodges
- *Succinct Verification through Reed-Solomon and Folded Reed-Solomon Codes* by William Hu
- *Delocalization of Eigenvectors in Random Matrices* by Georgi Ivanov
- *Nim in Disguise Proving the Sprague-Grundy Theorem and Applying it to Impartial Games* by Nora Kallersjo
- *Poncelet's Theorem: A Brief History* by Alex Karbowski
- *Geometry, Topology and Exotic Spheres* by Lev Kruglyak
- *Superconcentration for Orthogonally Invariant Spin Glasses* by AJ LaMotta
- *Chess Billiards and Fermat Curves* by David Li
- *Cluster Algebras and Surfaces: The Perfect Match* by Gregory Li
- *Identifying Subjective States: From Riesz Representations to Utility Representations* by Cheaheon Lim
- *Topological Dynamics, Ergodicity, and a Special Case of Szemerédi's Theorem* by Peter Luo
- *Keep it on the DL: Invariants in Low-Dimensional Topology* by Calvin Osborne
- *Spectra and Similarity: On Jordan Canonical Form and Matrix Equivalence* by Jessie Pitsillides
- *Enumerative Geometry, Gromov-Witten Theory and a Glimpse of Mirror Symmetry* by Ignasi Vicente Segura
- *A Friendly Introduction to Heegaard Floer Homology* by Eric Shen
- *Mixed Hodge Structures: Hodge Theory From Deligne to Du Bois* by Jarell Cheong Tze Wen
- *The Hadwiger-Nelson Problem and Graph Neural Networks* by Knut Vanderbush
- *Ollivier-Ricci Curvature: from Riemannian Manifolds to Directed Graphs* by Eleanor Wiesler
- *Moduli Spaces in Bordered Heegaard Floer Homology* by Jessica Zhang
- *On the Power of Proof: Characterizing the Gap Between Provability and Truth* by Ava Zinman

This year, 58 seniors will graduate with a mathematics concentration, plus another 30 students that selected mathematics as their allied field for a joint concentration and 21 that opted for a secondary in the Mathematical Sciences (which is a combined program with Applied Math). Our numbers are going up and up! Congratulations to all of the May 2025 graduates!

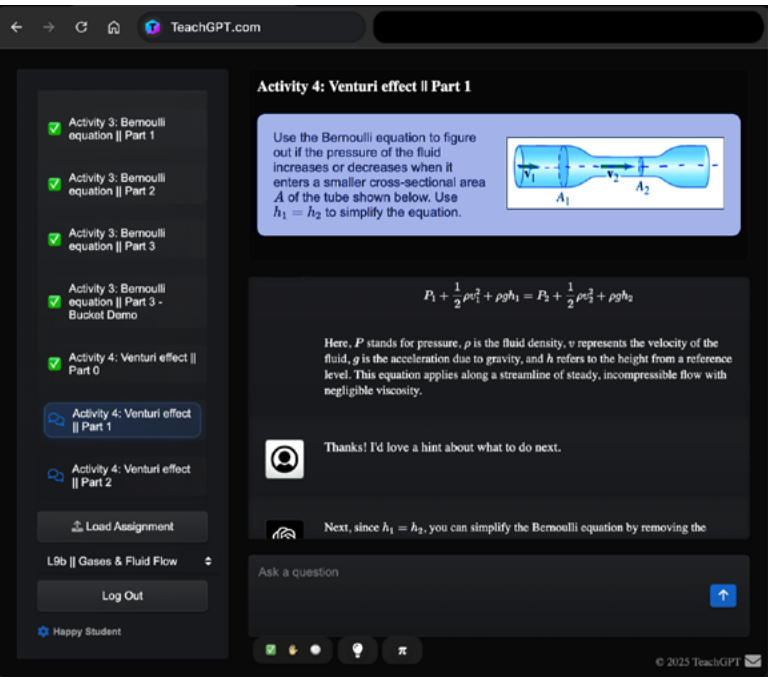
Starting July 1, William Petschek Professor of Mathematics Cliff Taubes will resume the role of Director of Undergraduate Studies as I join the Radcliffe Institute for the year. Please give him a warm welcome back!

With Best Wishes,

Laura DeMarco

The Role of AI in the Future of Math Education

Harvard Math Preceptor Incorporates AI Tutor in Class Workflow



TeachGPT, from a student's perspective.

Origin Story

In January, 2024, Harvard math Preceptor Eva Politou attended "The revolutionary impact and emerging challenges of generative AI in STEM research and education," a symposium hosted jointly by Harvard's Division of Science and MIT's Department of Physics. Politou had been thinking about the place of AI in the classroom for some time, as to her it seemed like an inevitable part of the future of education. "It's part of our lives," she said. "People will use it. So how do we help them use it in a constructive and critical way?" It just so happened that one of the symposium speakers, Harvard physics lecturer and Associate Director of Science Education Greg Kestin, had a possible answer to Politou's question.

Kestin developed a customizable AI tutor framework enabling instructors to create AI-powered lessons and assignments; he used it to deploy an AI tutor in his class, leveraging research-based prompt engineering and "scaffolding" to ensure accurate and well-structured lessons. The framework, called TeachGPT, provides access to multiple LLMs via application programming interfaces and is structured so that conversations—including the AI tutor's behavior and quality of feedback—are pre-vetted.

So rather than defaulting to ChatGPT behaviour, the custom tutor would provide users with information guided by content-rich prompts refined and placed into the framework. It could be used, for example, to effectively teach introductory material to students outside of class, allowing precious class time to be spent developing higher-order skills, such as advanced problem-solving, project-based learning, and group work.

Politou saw the potential in Kestin's creation. She quickly got to work to introduce a version of his AI tutor to the workshop portion of Math 21a, "Multivariable Calculus," an introductory class taught in the fall.

Training Montage

Using course innovation funds from the Harvard Office of Undergraduate Education, Politou hired two undergraduate students over the summer of 2024. Ari Kaufman '27 and Milan Naropanth '27 had both been a part of Harvard math professor emeritus Robin Gottlieb's first-year seminar, "Appraising and Reimagining Middle and High School Mathematics Education," and came to Politou highly recommended. Naropanth is a computer science concentrator, and Kaufman is a social studies concentrator with a math secondary concentration. Both were eager and excited to be a part of Politou's project. In fact, Kaufman had taken Math 21a as a freshman so he had first-hand experience with student needs in the workshop portion of the class.

Naropanth, Kaufman, and Politou had weekly meetings throughout the summer. The students would train the AI tutor by providing solutions, common misconceptions, different ways that students might approach a problem, and more. "We provide it with the same information that you would give to a real life tutor if you were training a CA," Politou said. On her part, she managed the workflow and handled the final round of refining as the semester kicked into gear. Thankfully, Kestin's platform was pretty straightforward and only got better with use. Kestin himself was readily available to make adjustments as needed based on the feedback Politou, Kaufman, and Naropanth provided over the course of the summer.

One of the most challenging aspects of the process was teaching the AI tutor the difference between simply providing students with information, and guiding them to the correct answers. "Sometimes it was frustrating," Politou admitted. "But it really brought out the educator's perspective for me. It's not something you can get angry with, you just have to be as clear as possible and really break down step by step what you want it to do."

It turned out that small tweaks to the prompt engineering

could result in a big impact on how the model behaved regarding the amount of help it gave. “Something as simple as changing a phrase in the persona of the chatbot from “You’re a math tutor” to “You’re the world’s best math tutor” and telling it things like “think carefully through the problem step-by-step when helping students” made a visible difference in answer quality,” Kaufman recalled. Listing the skills and concepts that a student is expected to learn from each problem also helped the AI tutor respond in a way that nudged students in the right direction without offering too much help.

Test Flight and Lessons Learned

In the fall of 2024, Politou gave her Math 21a students two options for the workshop portion of the class. They could stick with the familiar format of in-person CAs, or try interacting with the freshly built-out AI tutor. To Politou’s initial surprise, around three-quarters of the students chose in-person tutoring. Looking back, she can see some of the reasons behind that choice. “This is their first year,” she said.“Students come to class to meet people and make friends.” It made sense that they would want to engage with their peers and so were drawn to the social quality of in-person tutoring.

Students were, however, given the option to switch modality mid-semester. A trend soon emerged: more people chose to switch to the AI tutor from in-person sessions than the other way around. Students commented on the level of flexibility the AI tutor offered. They could work with it in their own time and have it easily fit into their schedules. Students also appreciated the private, one-on-one help the AI tutor provided. This allowed them to target specific questions and address personal roadblocks they encountered in the workshop. Finally, students had the opportunity to work with one of the primary aspects of the AI tutor: inquiry-based studying.

“The only way you can interact with the AI tutor is if you ask it questions,” Politou said, referring to the version of the AI tutor that she had refined to behave this way.. “Thinking about what they have to ask is something that students sometimes don’t do very much.” She was very interested to see how question-posing changed from the first to the last workshop.

Something Politou noticed while going over the interactions between students and their AI tutor was that, after the initial prompt, the AI tutor kept asking follow-up questions. This is something she hopes to adjust next year. The goal is to lower the number of follow-up questions from the side of the AI tutor in order to support more student question generation.

In the meantime, faced with a chatbot that could only respond when prompted, students found themselves in charge of judging when they had received enough information. “It’s giving you answers, but you have to decide if you understand those answers and are ready to move on,” Politou said.

Future Goals

Before the AI tutor had officially debuted in Math 21a, Politou reached out to Harvard math department Educational Research Scientist Megan Selbach-Allen. Together, they approached the Institutional Review Board (IRB) to frame the implementation of the AI tutor as an external research project. Throughout the semester, they gathered data from those students who consented to be part of the project.

Selbach-Allen attended and filmed in-person Math 21a workshops to get a sense of the environment, as well as how students were engaging and what they were discussing. She collected data from the logs showing student interactions with the AI tutor, what they were asking it, how they responded to it, and what they were getting out of the process. She also has survey data about students’ backgrounds, their broader coursework, and how they feel about Math 21a.

“We’re still in the preliminary stages of data analysis,” Selbach-Allen said. “But we’re hoping to write it up and submit a paper by the end of summer. We’re expecting the results to be nuanced.”

Regardless, AI tutors based on Kestin’s framework seem like they’re here to stay. They’ve already been implemented in a number of Harvard classes across multiple disciplines including physics, chemistry, math, engineering, foreign language, medicine, and more. They’ve even been deployed at select peer institutions interested in pedagogical exploration and research such as Yale, MIT, and Stanford.

Kestin’s wish for the future of his creation is two-pronged. On one hand, he wants it to aid certain aspects of teaching like re-explaining definitions or basic skills. This would free teachers to focus on more personalized interactions with students, such as helping them apply concepts they’ve learned to real-world applications or having nuanced conversations starting where the AI tutor left off. On the other hand, Kestin wants his framework to serve as a place of community for faculty where they can share quickly advancing AI-based pedagogical approaches and AI-powered assignments. He hopes this will make teaching more engaging, efficient, and personalized, and he is already seeing evidence in support of this.

Having worked on training the AI tutor while simultaneously being students themselves, Kaufman and Naropanth were surprised to learn exactly how niche generative AI solutions in education still are. “Education often gets a bad rep for being slow to adopt technology and innovation, but with AI, I expect we’ll see this adoption happen much quicker than most people expect,” Kaufman said. “Students and teachers are initially uncomfortable with the idea of using AI in their workflow, but this discomfort also seems to fade away much quicker than one would expect.” The fact that he’s using cutting-edge AI technology to help students like himself thrills Naropanth. “It gives me hope that my Harvard computer science education will teach me the skills necessary to continually improve student learning,” he said.

Lev Kruglyak

‘25, Mathematics | Friends Prize Recipient

When and how did you discover your love for mathematics?

I’ve always been interested in math, but I really got into it right around 9th grade. That’s when I first learned about pure and theoretical math. There was this reference book of formulas with a small, one-page section on group theory and I remember reading the statement of Lagrange’s theorem. I was blown away by the structure it revealed and how math is not just a tool for computation, but has a mathematical beauty in and of itself. Math was also very portable. You can’t sneak an oscilloscope into class and play with it while the teacher is talking, but you can totally do math in the margins of your assignment.

What brought you to Harvard?

I did the MIT PRIMES program during high school and I was mostly focused on MIT during the application process, but after getting into Harvard I have zero regrets. After learning more about the Harvard math department, I really like how flexible the program is. You can just jump right into a class, even if it’s arguably a bit above what you know. It’s fun to drink from the firehose just to see what’s possible, and it was very conducive to me learning math.

How did you grow as a mathematician while at Harvard and where do you see yourself in the future?

Before coming to Harvard, I didn’t do a lot of math competitions. I mainly read textbooks and tried to figure things out myself. Especially in my freshman year, a lot of my classes included things I’d seen before but felt like I didn’t really understand on a deep level. I now feel that I have a much more solid mathematical foundation. I took Math 55 and I ended up CA-ing for it. That was a great experience. It’s always fun because the generation of students I was CA-ing are now the CAs for Math 55.

Sophomore year I took algebraic Topology, which is a graduate class. There are a lot of undergraduate students taking graduate classes here. I’m not sure how it is at other schools; I always thought it would be some kind of difficult placement test, but you can just jump right in. If you’re way in over your head, you can always take another class. But I really liked how easy it was to access any aspect of the math department as an undergrad.

My interests have also definitely shifted. In my junior year, Professor Dan Freed joined the department and I’ve taken a course with him every semester since. He’s been very inspirational and steered me more toward mathematical physics and geometry.

Tell me about your senior thesis, “Geometry, Topology and Exotic Spheres.”

Junior year, I took a course that introduced me to the beautiful connections between homotopy theory and geometry. I reached out to the instructor about a thesis and he suggested the homotopy theoretic classification of exotic spheres. While I was reading, I was surprised at how much geometry I was finding. And at the same time, I was also getting more and more interested in geometry, so I switched the thesis from this abstract study of exotic spheres to have more concrete examples, constructions, and methods of detection. In my thesis I talked about using index theory to detect exotic spheres, as well as four different ways to construct exotic spheres: twisted Hopf bundles, plumbing, Brieskorn manifolds, and twisted spheres. To visualize any hard object in math, it’s good to have as many perspectives as you can. One perspective alone is useful, but with multiple perspectives you can combine intuition from many areas of math.

What does the Friends Prize and the talk you will give as part of receiving it mean to you?

It was a huge honor to receive and I hope I can do justice to the math department in front of the Friends. It’s exciting to give a lecture. I haven’t given that many talks in my time at Harvard, and this is a really cool opportunity and a really good learning experience on how to give mathematical talks. It’s a difficult skill to be able to condense something into a short amount of time.

What are your plans for the future?

I’ll be backpacking through the Alps for a few months in the summer. After that, I’m going to be working at Nvidia, shifting gears completely and doing low-level systems programming. That’s one of my other interests. But I really want to stay mathematically active and hopefully come back to grad school in a few years.

Ava Zinman

‘25, Mathematics | Friends Prize Recipient

When and how did you discover your love for mathematics?

I didn’t feel that I was very good at math until my junior year of high school, when I started taking calculus. I think something clicked as the math got harder. I was actually initially interested in competitive debate and public policy, and saw myself taking a much more humanities-focused trajectory. But I ended up discovering that a lot of the aspects of debate that I loved—creating a logical syllogism, being more time-efficient than my opponent—were highly mathematical. I found math in the things I already liked and decided to truly pursue it in college.

What brought you to Harvard?

I applied to Harvard because they have an incredible debate program. It’s funny, though, because I have not competed in debate since my freshman spring. So I ended up not pursuing the thing that had brought me to Harvard, but it worked out!

How did math become your concentration?

I applied tentatively as a math concentrator, but I never thought it would pan out. I made a deal with myself that I would try majoring in math until it got too hard. While it did get hard, it never got hard enough to the point that I thought I couldn’t do it, and now I’m about to graduate!

How did you grow as a mathematician while at Harvard and where do you see yourself in the future?

I think the biggest area of growth is in my confidence as a mathematician. I started majoring in math with the assumption that I wouldn’t be smart enough and I would have to quit. Looking back, I now see how silly that is. As the years went by, I found myself trusting my intuition more, asking more questions in class, and being able to answer other questions in turn. I’ve felt much more engaged with my math classes as I’ve continued through college because I understand more and more what’s happening.

Tell me about your senior thesis, “On the Power of Proof: Characterizing the Gap Between Provability and Truth.”

My thesis seeks to separate our understanding of what’s provable and what’s true. The common understanding is that these terms are synonyms: everything that’s true must be provable, and everything that’s provable must be true. My thesis shows that neither of these relationships necessarily hold. A proof is a method by which we access truth, but it is not the truth itself. I ultimately characterize the gap between proof and truth as the gap between natural truth and human ability to access it. At the end of my thesis, I liken a mathematician to an astronomer looking at the stars and understanding the galaxy. We, as mathematicians, can look through our telescopes and get as much understanding of space as we can from our perspective on Earth, but we can’t actually touch the Sun or be inside a black hole. That’s not physically possible. So, for those objects, we can only imagine and theorize. Similarly, we can access a lot of math, but not all of it. Some of it we can only talk about and conceptualize without ever really touching.

What does the Friends Prize and the talk you will give as part of receiving it mean to you?

It’s a very full-circle moment for me. Coming into school, I didn’t even know if I’d be able to keep up in my math classes. I feel very honored to be representing Harvard math and to be a part of this institution three years later. When I started, I felt like a visitor to the math department—now I feel like I’m a part of it.

What are your plans for the future?

It’s bittersweet because this is probably the end of my academic pursuit of pure mathematics. But I think the skills I’ve taken from pure math—especially skills from logic—I’ll take with me wherever I go. I see everything through such a mathematical lens now. Math, to me, is more about a method by which I approach things and less about the content itself. As for my plans after graduation, I’ll begin work in consulting and possibly end up going to law school.

A Modern Math Curriculum

New Courses Offers Students Support in Transferring Math Skills, Knowledge Across Disciplines

Math Q students and their instructor, Brendan Kelly, on the last day of class for the Spring 2025 semester.

Three years ago, Harvard math Senior Preceptor Brendan Kelly became the first Director of Introductory Mathematics. The department's introductory courses have always played an important role in preparing students for the quantitative rigor in their chosen field of concentration. In his newly created role, Kelly has worked with members of the department to make the role that mathematics plays in STEM more visible to first-year students.

A pair of recently introduced courses highlights these efforts. Math Q, "Quantitative Analysis for Economics and the Social Sciences" and Math LS, "Mathematics of Biological Systems: A Calculus-Based Approach" showcase the way mathematics supports students in exploring their STEM interests, Kelly said.

Before the introduction of Math LS and Math Q, students were limited in their choice of math courses. If they started in Math MA, "Introduction to Functions and Calculus I," their only other option was Math MB "Introduction to Functions and Calculus II." Math MB, however, is heavily focused on preparing students for Math 1b, "Integration, Series, and Differential Equations." Not all students continue onto Math 1b, so the goals of that course didn't necessarily align with students' needs.

"The topics in Math MB are very important for students moving on to the introductory math sequence, but not necessarily interesting or relevant to students who don't plan to take Math 1b," said Senior Preceptor Janet Chen, who taught Math LS this spring. "Math LS and Math Q aim to give those students options that better align with their interests."

Helping facilitate the transfer of knowledge and skills taught in math classes to other disciplines is at the core of what Kelly hopes to accomplish with this selection of courses. "We're also trying to support students' motivation and academic identity," he continued. Young people are excited and interested in the world, and aligning mathematics with their interests is going to create a deep motivation to study the subject. And some students might not think of themselves as a "math person", but seeing the role math plays in questions of business, economics, medicine, and more, can help them think more expansively about how they interface with mathematics.

To that effect, Kelly and his team have worked with different Harvard concentrations to understand their quantitative needs and design classes that are carefully attuned to what students expect they will be doing in the future. Kelly, who co-taught Math Q this spring, doesn't expect his students to take Math 1b, but he does expect them to take ECON 50, "Using Big Data to Solve Economic and Social Problems," Gov 50, "Data Science for the Social Sciences," or any other class doing quantitative analysis across social science and economics.

"We want to create empowering mathematical experiences for students," he said. "That clearly means that students should see ways in which mathematics helps them answer questions that are important to them. You can't feel empowered unless you see the relevance of the math you're doing to your own interests."

In addition to making mathematics relevant to students, Kelly is invested in making it accessible. The COVID pandemic had a well-documented impact on opportunities to learn math and students are entering college with less mathematical preparation than they may have had in the past. The strategy

to support these students was to develop a version of Math MA called Math MA5, “An In-Depth Introduction to Functions and Calculus.” This honors the fact that a group of students could be ready for the rigor of calculus, but could also benefit from just-in-time support when it comes to the more advanced algebraic or geometric concepts that often stand in the way of their success.

With the solid foundation the course provides, students on a more mathematically inclined track can comfortably enroll in Math MB in their second semester. Or they can take their pick of Math Q or Math LS, two classes meant to help launch them into their discipline of choice.

Math Q

Math Q was first offered as a year-long course in the fall of 2021, but was reformatted to a semester-long class in the spring of 2025. “We wanted to make sure students have their first semester to decide where they want to go in their mathematical education,” Kelly said. He taught Math Q alongside Preceptor Matthew Cavallo, who described the course as an opportunity for students—primarily those with an interest in economics and social sciences—to see how and why the calculus they experienced in Math MA matters in the world. Kelly and Cavallo utilized Google Colab, Google Sheets, and R, an open-source programming language primarily used for statistical computing, data analysis, and visualization. With this toolkit, students were able to perform computations using an analysis of real world data that would be impossible to perform by hand.

“Probably the most dramatic example of that would be when, for our second unit, students did this original analysis from a spreadsheet that was sent to us by our partners at L.L.Bean,” Cavallo recalled. “It had something like 390,000 rows and 85 columns.” In another unit, students performed calculations related to loan amortizations. To write out a closed-form algebraic formula for something like that would be quite messy, but Google Sheets allowed them to focus on the conceptual core of the material: each month accrued interest is increasing the balance and monthly payments are decreasing the balance, but at the end of the term of the loan the balance should be zero. Most recently, Kelly and Cavallo are using the same concept of flows to have students consider electrifying the U.S. auto fleet and the impact on the carbon budget.

These concrete examples and applications are vital in giving students a broader perspective of how math can impact their day-to-day lives and inform other coursework. This is particularly important given the high likelihood that Math Q will be the last math course many of those students take as they continue into their chosen disciplines. That’s not to say that the overall interest for math disappears, however. Cavallo has had conversations with students who’ve experienced a renewed appreciation in how math can be used to tell stories.

“I’ve been teaching for 11 years in higher education and I don’t often have students come into a math classroom and say, hey, I’m really interested in this real-world thing that just happened over the weekend, and I want to talk about it in this math course,” Cavallo said. “It’s been a really rewarding thing to have happened.”

Math LS

The idea for the course traces its origins back to the summer of 2023, when Harvard hosted the first summer “Master Class in Teaching Math Modeling for Life Sciences,”* a workshop focused on math modeling for life science students as an alternative to introductory calculus. Inspired by the workshop, Chen developed Math LS.

The class was offered for the first time this spring semester and uses concepts from calculus alongside computer tools to build and analyze differential equation models of biological systems. “This type of modeling has a number of applications,” Chen said. “For example, mathematical models of HIV replication have informed the way doctors treat HIV, and mathematical models of disease outbreaks enable epidemiologists to estimate how many people we need to vaccinate to control epidemics.”

Math LS students use a combination of ChatGPT and Python, a versatile, high-level, general-purpose programming language known for its readability and ease of use. According to Chen, it’s impossible to write down analytic solutions to most systems of differential equations, so researchers often use numerical methods to approximate solutions. While the standard computational tools for doing this aren’t easy to learn, generative AI tools such as ChatGPT have dramatically lowered the barrier to entry. Once students have written down a model, they can ask ChatGPT to give them code that numerically approximates the solutions. From there, they can focus on interpreting the results.

“The students this year have described a range of relationships with math,” Chen said. “One thing some of them have shared with me is that prior math classes have felt abstract and not directly applicable to their interests. I hope Math LS can help them see a different side of math.”

Math MA5

The “5” in Math MA5 stands for the five days a week the class meets. This course follows the syllabus of Math MA, a class that introduces functions and derivatives as a way to study relationships between quantities and their rates of change. The approach is to build a library of functions similar to those in a precalculus class, while also investigating the rate of change of various function families by leveraging the ideas of differential calculus. Math MA5 promotes a thorough understanding of differential calculus and is meant to be an enriching experience.

The extra time provides students the space and opportunity to get the right type of support; to address a specific need or situation for an individual student. “If an upcoming lesson is going to make use of solving systems of equations, the instructor can do an activity on the extra day that makes sure that knowledge is refreshed for students and they feel comfortable stepping into the lesson,” Kelly said. After all, outside of the extra day added to their schedule, students in Math MA5 have the exact same homework, take the exact same exams, and get the exact same grading structure as students in Math MA.

**You can read the full story about the “Master Class in Teaching Math Modeling for Life Sciences” in the 2023-2024 issue of our newsletter.*

Paul Bamberg

Senior Lecturer

Paul Bamberg received his bachelor's degree in physics from Harvard in 1963. Between 1967 and 1995, he held positions with the Harvard Department of Physics and the Division of Continuing Education ranging from instructor through senior lecturer. Bamberg was Vice President of Research and Dragon Fellow at Dragon Systems—now known as Dragon Speech Recognition—from 1980 until 2000, where he developed the acoustic models for Dragon Dictate, the world's first large-vocabulary isolated-word recognizer for personal computers. He officially joined the Harvard math department in 2001 as a senior lecturer.

Discovering Mathematics

Harvard had always been Bamberg's first choice. His undergraduate work and all his teaching have been done here, even if his time has been somewhat split across various departments. After all, he was originally a physics concentrator. "I got to Harvard, looked around at my classmates, and found a fair number of people I regarded as better mathematicians than myself," Bamberg recalled. "But I couldn't find anyone who looked like a better physicist." In those years, his main extracurricular activities included running lab sections and grading homework for the introductory physics courses. It was his first brush with teaching.

In 1963, Bamberg went to Oxford as a Rhodes Scholar and got his doctorate in theoretical physics. However, the field was developing so quickly that unless he was prepared to spend all of his time on research, he knew he was just going to get left behind. And in any case, by that point Bamberg had come to realize that what he really wanted to do was teach. He wrote to Harvard physics professor Wendell H. Furry, with whom he had taken Physics 232, and joined the university's teaching staff.

Over the years, Bamberg developed experimental self-paced courses and taught alongside math department faculty including Andrew Gleason, Shlomo Sternberg, and Raoul Bott in Math 22. Bamberg and Sternberg co-authored the two-volume *A Course in Mathematics for Students of Physics*. Eventually, he was given the title of Director of Science Instruction Development for the Science Center. "I viewed this as a license to meddle in the affairs of other departments," he joked. "I liked to create courses that had never existed before or teach existing courses in novel style." He also taught himself PDP-11 assembly language and data structures, built up the computer science program at the Extension School, and taught Computer Science 20, "Discrete Mathematics for Computer Science" and Computer Science 124, "Theory of Algorithms." "I think I'm one of the few people at Harvard who's ever taught courses in three different departments," Bamberg said.

After a foray into entrepreneurship and computer speech recognition with Dragon Systems, Bamberg joined the Harvard math department. Between a doctorate in another subject and being "thoroughly out of tune" with current trends in mathematics research, he admits that he's not a mathematician in the normal mold of the department. But he knows how to develop a math course that will attract an economics concentrator. "If you look at the new 100-level courses that have come into existence since 2000, I think that more than half I created from scratch," he said. One of his favorites was Math S-139, "Reading Euclid in Ancient Greek," which he taught in the Summer School.

Outside Mathematics

Bamberg played the baritone in the Harvard Band as an undergraduate and junior faculty member. He now plays the same instrument in a Christian rock band. Bamberg is also an avid video game player. He's played "Guild Wars" with his students and he's currently going through "Path of Exile" with his grandson. He's even invited AI in on the fun. "I was quite interested when AI came around and I figured I'd ask it a question that it couldn't possibly answer," Bamberg said. "So I asked, what's the "lion king defense" in the online game Caesar III?" He was shocked when the AI came back with a perfectly correct answer and even more shocked when he followed the reference it had included. "It led to a 1999 forum post by Dragon2," he said. "Dragon2 was me." The AI had copied whole sentences from his post and deleted the name of the original author.

Aaron Landesman

Post Doctoral Fellow

Aaron Landesman joined our department in 2021 by combining two offers; a fellowship from the National Science Foundation (NSF) and a Moore instructorship from MIT. Before that, he was a Harvard math undergraduate student and a Stanford University graduate student.

Discovering Mathematics

Landesman's relationship with math features a number of formative moments. Many include his father, who has a PhD in differential Galois theory and who taught him math as a child. Landesman vividly remembers the moment that helped shape his current field of research. His father had gone to a conference in Columbia about the Stacks Project, an open source reference on algebraic geometry. Landesman, at the time a high schooler, asked him what a "stack" was. That question opened a whole can of mathematical worms. Before he could understand what a stack is, Landesman was told he'd have to learn what a scheme is. And in order to learn what a scheme is, he'd first have to learn what a sheaf is. Rather than discouraging him, this winding roadmap became a challenge to be conquered.

To this day, Landesman enjoys exploring topics flowing from one area of math to another based largely on where his studies take him next and what sparks his interest. In graduate school, he was looking for a new project when he learned how to solve the quartic equation. He'd taught a class on how to solve it at Canada/USA Mathcamp. "Later, I learned that there was a connection between solving this quartic equation and a topic in number theory called arithmetic statistics," Landesman said.

Another mathematical topic he's been researching is representations of fundamental groups of curves. It started when he posted an expository article, which explicitly computed the derivative of the Torelli map, to arXiv. University of Toronto Assistant Professor Daniel Litt came across that paper while contemplating the Putman-Wieland conjecture. Litt realized that Landesman's paper was related to his idea for solving the Putman-Wieland conjecture and approached him for a collaboration. There were a few times when the two mathematicians believed they were close to solving the Putman-Wieland conjecture but each time it turned out their approach used incorrect results from someone else's paper. Fixing these mistakes led them to many new beautiful results. While they didn't achieve their original goal, they made plenty of progress.

Landesman would typically describe his areas of study as algebraic geometry and arithmetic topology, fields of math that indicate he likes to think about a broad range of topics. But someone recently told him they think of themselves simply as a mathematician, not bothering to pick a specific category. "I like that description," Landesman said. "It's fun to learn about different areas of mathematics and see how they can combine in interesting ways."

About Harvard

His father was a Harvard alum, so Landesman was already partial to the university. He'd also heard about the famed introductory math course, Math 55, from friends who'd had fun taking it. During his years as an undergraduate student, Landesman was a CA for Math 137 "Algebraic Geometry," Math 55a "Honors Algebra," and Math 55b "Honors Analysis." He received a Certificate of Distinction in Teaching award and the David Mumford Undergraduate Mathematics Prize, given annually to the most promising Harvard senior concentrator in mathematics.

His time as a Harvard postdoc has been a lot less structured than his carefully scheduled student days, but Landesman has come to appreciate the space and freedom to think about math. He's gotten the chance to travel for math talks and conferences, and help organize seminars.

Outside Mathematics

In his free time, Landesman enjoys puzzles, chess, and triathlons. He played chess as a child and still loves watching chess tournaments. Triathlons, on the other hand, keep him healthy and in a good mood. He completed the 2024 Boston triathlon and the Cambridge half-marathon.

Message From the Director of Graduate Studies

Melanie Matchett Wood

William Caspar Graustein Professor of Mathematics

Director of Graduate Studies

Dear Friends,

This year our graduate program is made up of 61 students with just over half of our students hailing from countries other than the US. Thirteen countries are represented by 32 international students. In fall 2024, 12 students joined the program, and you can read about their background and interests in the following pages.

The current student body is doing work in many different areas of math. In addition to institutional aid from Harvard University and the Department of Mathematics, their research is supported by the National Science Foundation (NSF) Graduate Research Fellowship Program, the Jack Kent Cooke Foundation, the Ezoe Memorial Recruit Foundation, and the Jane Street Graduate Research Fellowship.

In particular, the Putnam family has been a long-time supporter of the department and has generously provided for the graduate program. Over this year, their gifts have impacted 29 students, enabling them to further their research and mathematical discovery.

When not immersed in original research, graduate students hold teaching fellowship positions, which support the introductory mathematics program for undergraduate students. Engaging in classroom teaching for calculus and other math courses offers an opportunity for students to develop a well-rounded portfolio of academic credentials to serve them at Harvard and beyond.

Looking ahead to May 2025 graduation, 15 students will receive their PhD degree this spring. After years of hard work and dedication to mathematics research, we celebrate the accomplishments of these students who studied remotely in their early years due to pandemic restrictions. Their success on the job market is reflected further along in the newsletter in a section that provides a snapshot of each of our graduates.

Warm regards,

Melanie Matchett Wood

Graduate Student Spotlight

Sanath Devalapurkar

Sanath Devalapurkar is a '25 graduate of the Harvard University Department of Mathematics doctoral program. Devalapurkar will be a Dickson Instructor at the University of Chicago in Fall 2025-Spring 2026, a member of the School of Mathematics at the IAS in Fall 2027, and a tenure-track assistant professor at Johns Hopkins University in January 2027.

When Sanath Devalapurkar was in the 3rd grade, he spent a year living in a town near London called Croydon. One of his clearest memories of that time is visiting the library with his parents a few times a week. During one of those visits, he came across a calculus book. It was a completely different kind of math compared to what he'd been learning at school and he was immediately hooked. "I had no idea that there was so much more to math," Devalapurkar said. "For the longest time I believed that calculus was all that people did."

When his family moved to the United States in 2013, Devalapurkar got the chance to audit courses with a postdoc at UCLA, Marcy Robertson. More and more, doing math for a living seemed like a realistic goal to him. "Most of my family is in engineering or law," Devalapurkar said. "It's very surprising to them that you can have a career in math." The specific field of math that interested him then and still does to this day is algebraic topology. He liked it because, when he first started learning, what he was reading was very geometric in nature. The more he's learned, however, the less geometric the field of algebraic topology has become for him. "But the more I've grown as a mathematician, the less geometric I've become," he said. "So it works out well."

Devalapurkar chose MIT for his undergraduate degree, majoring in math with a minor in physics. During those years, he'd frequently come to Harvard for seminars or to talk to friends about math. He also read papers by "this guy, Mike Hopkins," he recalled, who seemed like "the scariest, most intimidating guy who's done so much." Devalapurkar had never been happier to have his assumptions proven wrong, however, than when he actually met Hopkins, Harvard math professor and department chair. "He was just the nicest person," Devalapurkar said. "It was clear that he cared a lot about students and making them feel welcome. He had such amazing ideas and was so open with them. I knew I wanted to go to Harvard once I talked to him."

Hopkins became the first of Devalapurkar's PhD advisors. He met his second advisor, then Harvard professor Dennis Gaitsgory, during a graduate student visiting event. Devalapurkar remembers he just walked into Gaitsgory's office and, while he didn't fully understand everything they spoke about at the time, Gaitsgory's passion drew him in. In general, the personalities and warmth of the people he's met while at Harvard have had a huge impact on his experience. So has the fact that he's surrounded by people more than happy and willing to talk math at the drop of a hat.

"I always learn a lot by talking to everyone in the department," Devalapurkar said. "There is a lot of math research that happens orally. Things don't always tend to get written down in papers. There's a lot of intuition and people communicating informally." He's had plenty of first-hand exposure to that kind of research at Harvard. After all, why read a 200-page paper to get an idea of the most current developments in a field of mathematics, when he can just turn around and talk to one of the local experts?

Over the course of his time as a graduate student, Devalapurkar's research interests have grown. "I started trying to learn about number theory, representation theory, the Langlands program, even some analysis,"

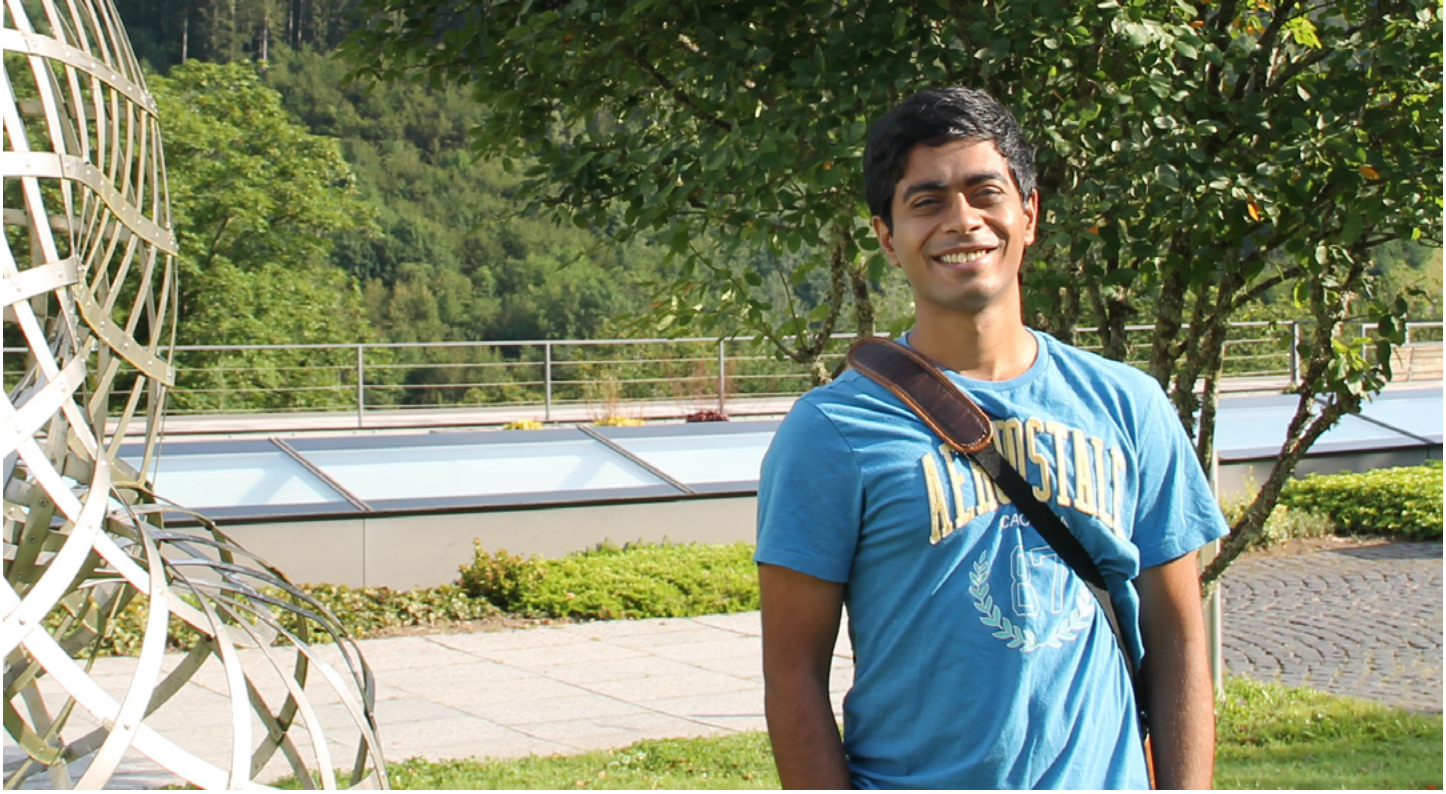


Photo courtesy of the of Archives of the Mathematisches Forschungsinstitut Oberwolfach.

he said. “Now I see the algebraic topology that I learned as an undergraduate student not as a thing to study in and of itself, but as a tool to be applied to other parts of math.” Devalapurkar considers himself a much broader mathematician these days. His time at Harvard has broadened the horizons of what he perceives to be interesting and helped him understand just how universal math is. He would find himself talking with people in completely different fields of study from his own, only to realize they were speaking about the same thing. He sees this as a testament to the way that humans can discover the same patterns in different ways.

Currently, he has two main research interests, both of which are about connections between algebraic topology and number theory. One concerns the Langlands program—a set of conjectures about connections between number theory and geometry—and studies the dual nature of objects called compact Lie groups, which are ways of capturing the amount of symmetry that an object has. “For example, you can rotate a circle by some angle and the collection of all possible angles is a compact Lie group,” Devalapurkar explained. Lie groups have both an algebraic nature, and a geometric/topological nature. The way Devalapurkar perceives the Langlands program is related to how these two different dual natures are connected to each other.

Devalapurkar’s other research interest is about the recent introduction of prismatic cohomology into number theory to study the latter. Devalapurkar’s dissertation is titled “Spherochromatism in representation theory and arithmetic geometry.” In it, he explores some interesting phenomena in geometric representation theory and arithmetic geometry that arise from adopting a more universal notion of “linearization” coming from stable homotopy theory. In particular, understanding how the “chromatic viewpoint” from homotopy theory gives a different way to organize calculations in these other fields.

Outside of research, Devalapurkar’s time at Harvard has been enriched by his experiences with teaching. He has been a CA for Math 223a “Algebraic number theory” and Math 231br “Algebraic topology II,” as well as a TA for Math 1B “Integration, Series and Differential Equations” and Math 99 “Integrable Systems.” For Devalapurkar, teaching is a way to give back and honor the amazing mentors without whom he himself would never have been a graduate student. It’s also just fun. “Sometimes you get stuck in your research and you get down, you don’t really know what to do,” he said. “But then you talk to these kids and they’re so excited and passionate. They have all these ideas and want to ask you all these questions. It rekindles your enthusiasm.” While Devalapurkar’s first priority is research, he never wants to be completely isolated from teaching. Many of his closest friends are staying in academia and being surrounded by people set on doing so has helped him feel more confident in the idea that some day he’d want to be a professor.

In his limited free time, Devalapurkar enjoys playing the drums and listening to—mostly instrumental—prog metal. He has an electronic drum kit in his room that he uses from time to time, but he tries not to overdo it in deference to his neighbors. He played in bands as an undergraduate student and his preferred style is firmly on the rock side of the musical spectrum. “You have all these interesting fills and rhythms,” Devalapurkar said. “Sometimes you have to think really hard because there’s weird syncopation and, if you lose focus, you can lose the entire beat.” He finds the experience meditative. Having to focus so hard on his drumming pattern means he can’t slip into thinking about math, which he admits he tends to do quite frequently.

First-Year Graduate Students

Owen Brass

Undergraduate Affiliation
Stanford University
Research Interests
I am interested in smooth four-manifolds, including their gauge-theoretic invariants, exotic smooth structures, and embedded surfaces.

Hang Chen

Undergraduate Affiliation
Peking University
Research Interests
I'm interested in arithmetic geometry, especially p-adic geometry and p-adic Hodge theory.

Stephanie Chen

Undergraduate Affiliation
California Institute of Technology
Research Interests
I am broadly interested in algebraic geometry.

Oakley Edens

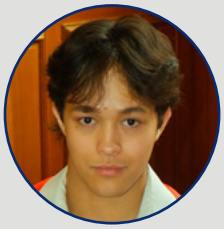
Undergraduate Affiliation
University of British Columbia
Research Interests
I am interested in p-adic geometry and p-adic Hodge theory.

Xinyu Fang

Undergraduate Affiliation
National University of Singapore
Research Interests
I am broadly interested in arithmetic geometry and number theory.

Tyler Lane

Undergraduate Affiliation
Brown University
Research Interests
I am interested in algebraic geometry and homotopy theory.



Matthew Niemiro

Undergraduate Affiliation
University of Illinois at Urbana-Champaign
Research Interests
I am interested in algebraic topology and K-theory, in particular the use of homotopy theory to capture and study the (higher) algebra of the situation.

Daniel Santiago-Alvarez

Undergraduate Affiliation
MIT
Research Interests
I am interested in Gauge Theory and its applications in geometry and topology. I am also learning Geometric Representation theory, and love to think about connections between both areas.

Elias Sink

Undergraduate Affiliation
University of Massachusetts-Amherst
Research Interests
I'm interested in algebraic geometry, especially derived categories, birational geometry, and moduli.

Bryan Wang Peng Jun

Undergraduate Affiliation
National University of Singapore
Research Interests
I'm broadly interested in what I like to call "quantum mathematics," which includes aspects of representation theory and harmonic analysis, geometry and topology, quantum algebra, and analogous ideas in number theory. I enjoy learning about mathematics with connections to various parts of theoretical physics.

Franklin Shiyi Wang

Undergraduate Affiliation
National University of Singapore
Research Interests
I am interested in game theory, in particular games of many players and auction theory.

Sunny Zhang

Undergraduate Affiliation
Cornell University
Research Interests
I am interested in studying symplectic geometry and low-dimensional topology, more precisely homological mirror symmetry and pseudoholomorphic curves.

Graduating PhD Students

Grant Barkley
Advisor: Lauren Williams

Dissertation
Infinite root systems in algebra and geometry
What's Next
NSF Research Fellow and Parekh Research Assistant Professor at the University of Michigan.

Amanda Burcroff
Advisor: Lauren Williams

Dissertation
Positivity in cluster algebras and their generalizations
What's Next
School of Science Dean's Postdoc & NSF Postdoc at MIT, and UC President's Postdoc at UC Davis this summer.

Jaewon Chang
Advisor: Denis Auroux

Dissertation
Distinguished bases for Floer cohomology groups of Lagrangian surfaces
What's Next
Senior researcher at the Institute for Basic Science, Center for Geometry and Physics (IBS-CGP) in Pohang, Korea.

Sofiia Dubova
Advisor: Horng-Tzer Yau

Dissertation
Spectral statistics of Hermitian and non-Hermitian random matrices
What's Next
Boas Assistant Professor at Northwestern University.

Sanath Devalapurkar
Advisor: Mike Hopkins and Dennis Gaitsgory

Dissertation
Distinguished bases for Floer cohomology groups of Lagrangian surfaces
What's Next
Dickson instructor at the University of Chicago Fall 2025-Spring 2026, member in the School of Mathematics at the IAS in Fall 2027, a tenure-track assistant professor at Johns Hopkins in January 2027.

Dingding Dong
Advisor: Yufei Zhao (MIT)

Dissertation
Several Problems in Extremal Combinatorics
What's Next
Postdoc at Caltech (Taussky-Todd Teaching Fellow).

Jiyang Johnny Gao

Advisor: Lauren Williams

Dissertation
Tilted Richardson varieties and Rhomic tableaux
What's Next
Quantitative Research Analyst at Citadel Securities.

Keeley Hoek

Advisor: Denis Auroux

Dissertation
A Morse-theoretic approach to family Floer homology
What's Next
Postdoctoral Research Associate at the University of Sydney.

Yuhan Jiang

Advisor: Lauren Williams

Dissertation
Enumeration in stochastic process and polyhedral geometry
What's Next
Morrey Visiting Assistant Professor at UC Berkeley.

Jenny Kaufmann

Advisor: Madhu Sudan

Dissertation
The fine-grained complexity of approximating min-distance parameters in DAGs
What's Next
Considering options in quantitative finance and biotech/pharma

Michael Kural

Advisor: Melanie Matchett Wood

Dissertation
Distinguished bases for Floer cohomology groups of Lagrangian surfaces
What's Next

Jiakai Li

Advisor: Peter Kronheimer

Dissertation
Seiberg-Witten theory and reality
What's Next
Szegö Assistant Professor at Stanford University.

Wyatt Reeves

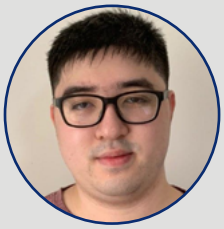
Advisor: Dennis Gaitsgory

Dissertation
Geometric Arthur parameters
What's Next
Postdoctoral Fellow at the Max Planck Institute for Mathematics.

Duc Vo

Advisor: Mihnea Popa

Dissertation
Du Bois complexes and singularity theory
What's Next
Ritt Assistant Professor at Columbia University.



Jit Wu Yap

Advisor: Laura DeMarco

Dissertation
Quantitative aspects of Arakelov theory in arithmetic dynamics
What's Next
One year at MIT as a postdoc followed by to a NUS Presidential fellowship in Singapore.

Faculty Spotlight: Joe Harris

Higgins Professor of Mathematics

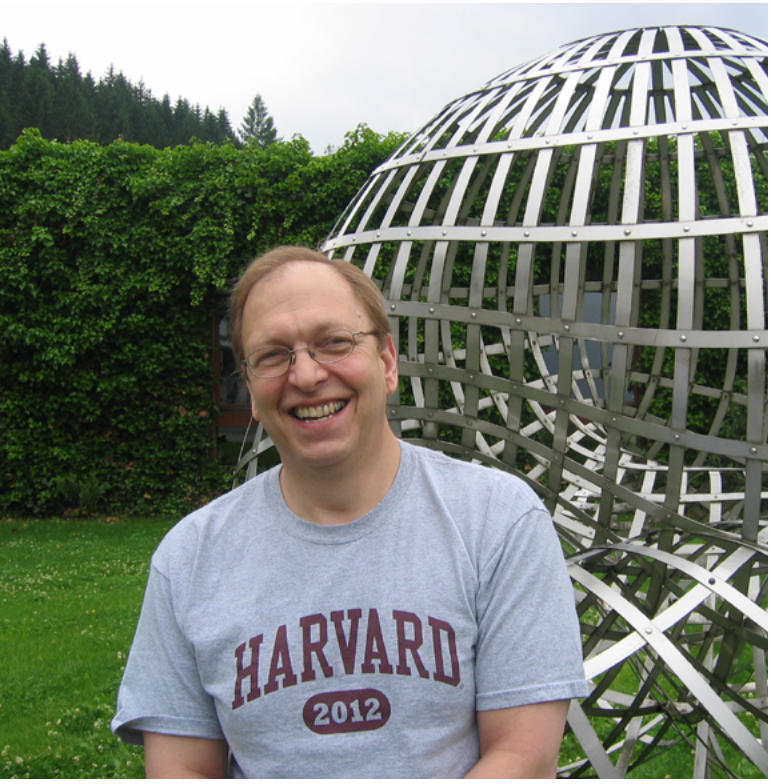


Photo courtesy of the of Archives of the Mathematisches Forschungsinstitut Oberwolfach.

Joe Harris received both his undergraduate and graduate degrees from Harvard. He spent a few years on the faculty at MIT and Brown University before returning to his alma mater as a professor in 1988. In the years since, Harris has amassed over 15 cumulative years of service as Director of Graduate Studies. He was Chair of the math department from 2002 to 2005 and will once again assume the position this year. Harris' work has historically leaned toward the classical side of algebraic geometry, dealing with questions about the geometry of varieties in projective space and their moduli or parameter spaces. He is well-known for his books on algebraic geometry, notable for their informal presentation.

Harris knew he wanted to be a mathematician since he was five years old, long before he had any real idea of what mathematicians actually did. He freely admits this aspiration was influenced by his father who loved mathematics but—between the quota universities imposed on the number of Jewish faculty they hired in the '30s and the Depression—ended up working in immunology, conducting research in his own lab. He hired Harris' mother as a technician during World War II, when there was a shortage of technical staff. The couple raised their son in Philadelphia, where the majority of their tightly-knit extended family lived. By the time he was ready to choose a college, Harris was raring to explore the world beyond his home city. "My parents were on the faculty at University of Pennsylvania, which provided reduced tuition for children of their own faculty," Harris recalled. "So if I were to go someplace else, it would cost my parents a significant amount of money. The only place they considered to be worth it was Harvard."

Harris landed in Harvard in the late '60s, during the period when Alexandre Grothendieck was revolutionizing the subject of algebraic geometry by providing tools that were potentially far more powerful than the ones that had been available to the classical 19th century algebraic geometers. The end result was that many problems that had been beyond the scope of mathematicians a century ago, were now possible. "Algebraic geometry was what all the cool kids were doing back then," Harris said. "And I wanted to do it, too, until I actually started doing it and realized that I had no aptitude whatsoever for it." Harris sometimes thinks that if any other attractive alternative had come along during his undergraduate days, he would have taken it.

Thankfully, he persisted. Things finally clicked in his second year of graduate school when he took a course about—ironically—a classical, pre-Grothendieckian approach to algebraic geometry with Professor Phil Griffiths, who would go on to become Harris' advisor. "For the first time I had a sense that I knew what I was doing and I could do it," Harris said.

Around that time, Griffiths asked Harris to take notes for his Math 260 class (now Math 232, "Introduction to Algebraic Geometry"). Harris did so, taking the time after the fact to write the notes up in a more intelligible form. As he was doing this, he realized writing was something that came naturally to him. "At some point I went beyond what was in the lectures and I kept writing," Harris said. For the next three years, he worked alongside Griffiths on his first book, *Principles of Algebraic Geometry*. Harris still keeps a first edition copy in his office. It was by no means his last published book; he's collaborated on a number of volumes over the years. Two of them he wrote alongside his fellow Harvard alumnus, colleague, and friend Dick Gross. *Fat Chance: Probability from 0 to 1* is an introductory undergraduate-level textbook on probability theory centered on the metaphor of games of chance, and *The Magic of Numbers* is a math book for non-math people about the mathematical view of the world and what attracts people to the subject in the first place. Harris' last book, *The Practice of Algebraic Curves: A Second Course in Algebraic Geometry*, was published as recently as the end of 2024.

Joe Harris and his wife at the Boston Public Garden in the '70s.

Outside of writing, however, Harris' passion lies in teaching. "To me, being entrusted to bring up the next generation of mathematicians is a tremendous honor and privilege," he said. "And that's true at both the undergraduate and graduate levels." A framed poster is in place of pride on Harris' office wall at the Science Center, listing some of the graduate students he has advised over the years. "I think I'm up to 300 descendants," he said. According to the Mathematics Genealogy Project website, Harris has had 58 direct graduate students and 324 descendants.

One of his former graduate students is Brendan Hassett, currently the Nelson University Professor of Mathematics at Brown and Director of the Institute for Computational and Experimental Research in Mathematics. "I remember Joe saying during orientation for new graduate students in 1992, "We are all mathematicians here. The only difference between you and me is that I've written a few more papers,"" Hassett recalled. These words made him feel a part of a community of scholars, one where what he did mathematically was more important than how smart he was or where he came from. Hassett's 13-year-old son recently came across Harris' Math 55 lectures online and asked his father if he'd heard of Harris. "I was proud to say that I have," Hassett said.

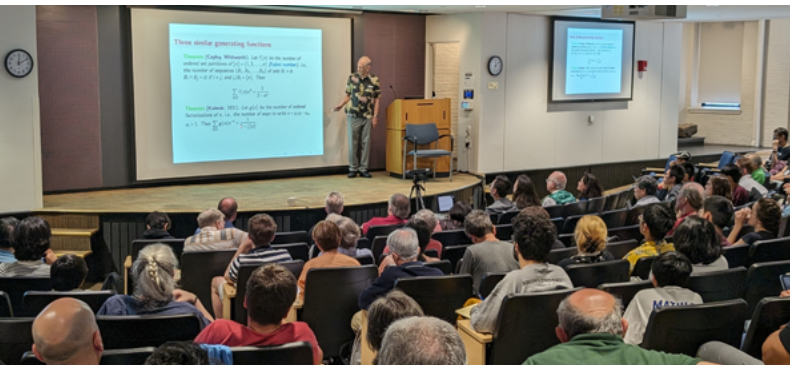
Dawei Chen, a math professor at Boston College, is another of Harris' former graduate students. He remembers Harris for his incredible patience and his ability to make even complex problems accessible. Although he graduated and left Harvard years ago, working in Boston allows him to occasionally see his former advisor. "Whether in math or life, Joe is a lifelong mentor to me," Chen said.

Ashvin Swaminathan, a Harvard Benjamin Peirce Fellow, was one of Harris' undergraduate advisees. "I could always count on Professor Harris' positivity and encouragement," Swaminathan said. "As much as I learned about geometry from him, the biggest lesson he taught me was how to be kind and supportive to students."

Teaching inspires Harris. He believes that students today are better prepared than when he was in their shoes. They begin learning abstract math earlier and, by the time they're ready for graduate school, they have a much better idea of what mathematical research is about. Harris taught Math 55 for the first time some six years ago and was thoroughly impressed by the students' quality. "They were just starting out, but you could tell they had that ability and passion for the subject," Harris said. "Being the first person that they would see in front of a lecture hall in Harvard, that was just a great feeling."

Harris returns to the role of department chair this year, 20 years after he last occupied the position. He's apprehensive; the job is very different from what it was a quarter century ago. There was a lot less bureaucracy to contend with. "But I believe the role of the chair is fundamentally the same as it was," Harris said. "To communicate the views of the department to the administration, and to communicate the views of the administration to the department."

Notable Department Events



The Many Combinatorial Legacies of Richard P. Stanley: Immense Birthday Glory of the Epic Catalonian Rascal
June 3–7, 2024

A conference in honor of Richard P. Stanley's 80th birthday.

Speakers: George Andrews (Penn State), Sara Billey (U. Washington), Persi Diaconis (Stanford), Sergey Fomin (U. Michigan), Phil Hanlon (Dartmouth), Takayuki Hibi (Osaka), Donald Knuth (Stanford), Christian Krattenthaler (Vienna), Isabella Novik (U. Washington), Soichi Okada (Nagoya), Igor Pak (UCLA), Jim Propp (UMass Lowell), Alan Sokal (U. College London), Kenneth Stanley (Maven), Richard Stanley, Sharon Stanley (U. Memphis), Michelle Wachs (U. Miami), Stephanie van Willigenburg (UBC), Peter Winkler (Dartmouth), Catherine Yan (Texas A&M)

DDC@Cambridge: FRG Workshop on Definability, Decidability and Computability
July 28–August 2, 2024

A workshop organized by the Principal Investigators of the NSF funded Focused Research Group on Definability, Decidability and Computability over Arithmetically Significant Fields DMS-2152304.

Speakers: Sylvy Anscombe (Institut de Mathématiques de Jussieu–Paris Rive Gauche), Philip Dittmann (Technische Universität Dresden), Arno Fehm (Technische Universität Dresden), Natalia Garcia-Fritz (Pontificia Universidad Católica de Chile), Franziska Jahnke (Universität Münster), Karen Lange (Wellesley College), Hector Pasten (Pontificia Universidad Católica de Chile), Bjorn Poonen (MIT), Theodore Slaman (UC Berkeley), Adam Topaz (University of Alberta), Henry Towsner (University of Pennsylvania)

MASTER CLASS IN
TEACHING MATH MODELING FOR LIFE SCIENCES

Master Class in Teaching Math Modelling for Life Sciences
June 23–28, 2024

A workshop designed for faculty members interested in launching a new mathematical modeling course that will serve as an alternative to introductory calculus.

Instructors: Alan Garfinkel (UCLA), Eric Deeds (UCLA)

Advances in Probability Theory and Interacting Particle Systems
August 26–28, 2024

A conference in Honor of S. R. Srinivasa Varadhan.

Speakers: Yuri Bakhtin (Courant Institute), Gérard Ben Arous (Courant Institute), Sourav Chatterjee (Stanford), Amir Dembo (Stanford), Peter K. Friz (TU-Berlin), Nina Holden (Courant Institute), Jiaoyang Huang (University of Pennsylvania), Elena Kosygina (City University of New York), Claudio Landim (IMPA), Eyal Lubetzky (Courant Institute), Chiranjib Mukherjee (Uni Münster), Stefano Olla (Université Paris Dauphine), Jeremy Quastel (University of Toronto), Kavita Ramanan (Brown), Alejandro Ramirez (NYU Shanghai), Fraydoun Rezakhanlou (Berkeley), Sunder Sethuraman (University of Arizona), Nike Sun (MIT), Atilla Yılmaz (Temple University), Ofer Zeitouni (Weizmann Institute)

Jameel Al-Aidroos Mathematical Pedagogy Lecture Series
October 7, 2024

The third annual Jameel Al-Aidroos Mathematical Pedagogy Lecture Series.

Speakers: Dan Rothstein (The Right Question Institute and Harvard Graduate School of Education), Tomoko Ouchi (The Right Question Institute)

Ahlfors Lecture Series
June 23–28, 2024

The Ahlfors Lecture Series is presented by the Harvard University Math Department in memory of our distinguished colleague, Professor Lars Ahlfors.

Speaker: Akshay Venkatesh (Institute for Advanced Study)

The Legacy of John Tate, and Beyond
March 17–21, 2025

A conference to mark the centennial of John Tate's birth with lectures related to his work and recollections from colleagues, family and friends.

Speakers: Yves André (Institut de Mathématiques de Jussieu Paris Rive Gauche), Jennifer Balakrishnan (Boston University), Bhargav Bhatt (Institute for Advanced Study), Joe Buhler (formerly of CCR La Jolla), Frank Calegari (University of Chicago), Dustin Clausen (IHES), Brian Conrad (Stanford), Henri Darmon (McGill University), Michael Harris (Columbia University), Wei Ho (Institute for Advanced Study), Jacob Lurie (Institute for Advanced Study), James Milne (University of Michigan), Bjorn Poonen (MIT), David Saltman (CCR Princeton), Chris Skinner (Princeton), Andrew Sutherland (MIT), Richard Taylor (Stanford) Felipe Voloch (University of Canterbury), Jared Weinstein (Boston University)

Current Developments in Mathematics
April 4–5, 2025

An annual conference jointly hosted by Harvard University and the Massachusetts Institute of Technology, and devoted to surveying the most recent developments in all areas of mathematics.

Speakers: Michael Chapman (NYU), Pazit Haim-Kislev (Institute for Advanced Study), Jianfeng Lin (Tsinghua University), Laura Monk (University of Bristol), Ramon van Handel (Princeton)

Department Honors and Awards

American Association of Arts and Sciences Elected Member
Lauren Williams, Sally Starling Seaver Professor at the Harvard Radcliffe Institute and Dwight Parker Robinson Professor of Mathematics

Association for Women in Mathematics (AWM) Dissertation Prize
Naomi Sweeting ’24, Harvard Math Ph.D. Graduate

Dean’s Distinction
Kate Penner, Preceptor

Harvard College Professorship
Denis Auroux, Herchel Smith Professor of Mathematics

National Academy of Sciences Elected Member
Melanie Matchett Wood, William Caspar Graustein Professor of Mathematics

Presidential Early Career Award for Scientists and Engineers (PECASE)
Melanie Matchett Wood, William Caspar Graustein Professor of Mathematics

Simons Fellows
Peter Kronheimer, William Caspar Graustein Professor of Mathematics
Curtis McMullen, Maria Moors Cabot Professor of the Natural Sciences

Undergraduate Achievements

Alexander Prize
Quinn Brussel ‘25

Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman
Katherine Tung ‘25

David Mumford Prize
Shared by Elliot Hodges ‘25 and Jessica Zhang ‘25

Friends Prize
Shared by Lev Kruglyak ’25 and Ava Zinman ‘25

Putnam Competition
Harvard undergraduate students who finished in the top 500 out of almost 4,000 students taking the exam:
Alan Bu ‘28 | Preston Bushnell ‘26 | Kevin Cong ‘26 | Kevin Du ‘25 | Samuel Engel ‘28 | Andrew Gu ‘26
William Hu ‘25 | Tri Le ‘28 | Radu Andrei Lecoiu ‘27 | Jacob Paltrowitz ‘27 | Eric Shen ‘26 | Easton Singer ‘26
Aquila Wolff ‘27 | Gabriel Wu ‘25 | Henry Xie ‘26 | Haozhe “Stephen” Yang ‘27 | Alexander Zhang ‘25 | Sophie Zhu ‘27

Robert Fletcher Rogers Prize
First place to Calvin Osborne ‘25 | Second place to Josh Rooney ‘26

Wister Prize
Jarrell Cheong Tze Wen ‘25

Visit our website for the full list of honors and awards, including those announced after May 14, 2024.

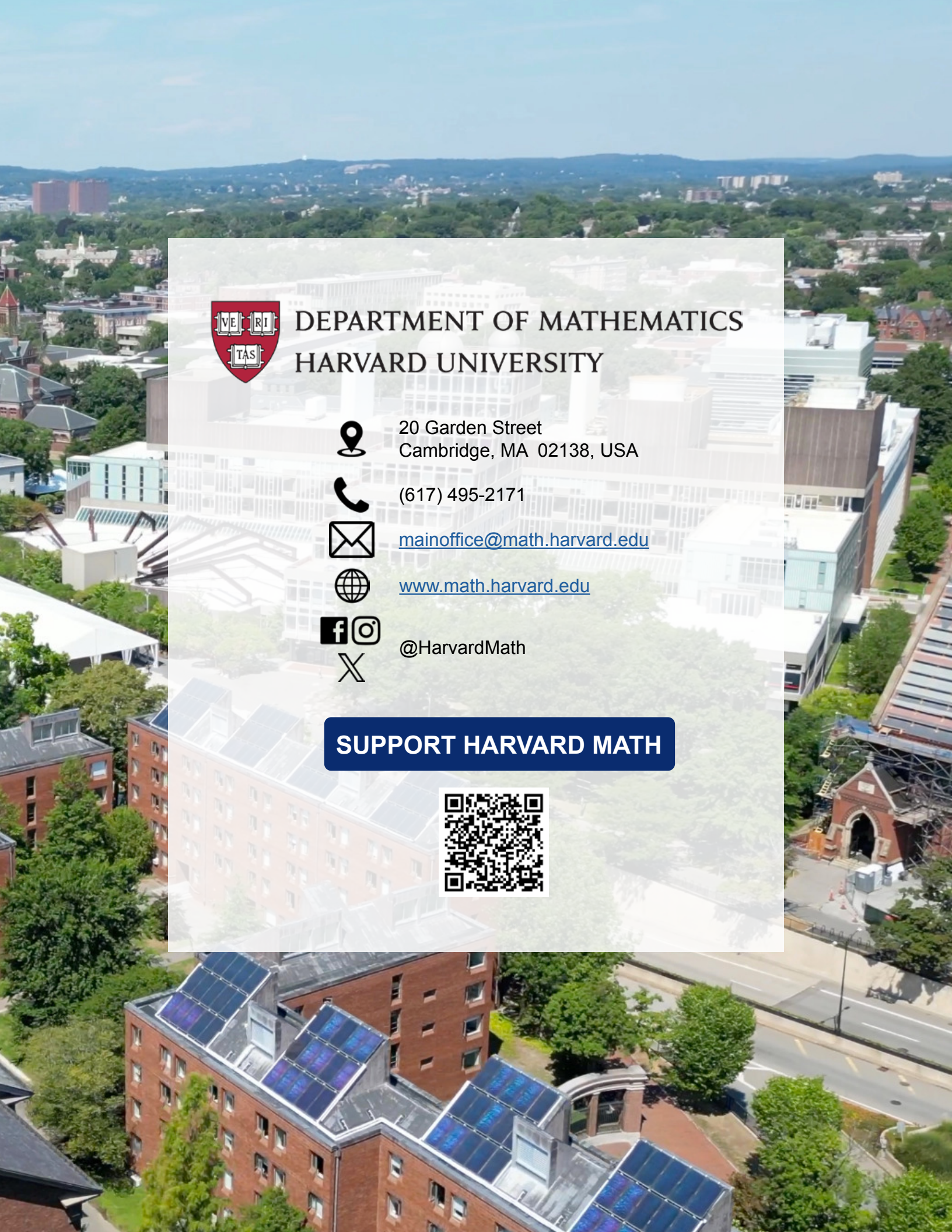
Credits

PRODUCTION MANAGER

Anastasia Yefremova | Communications Specialist

CONTRIBUTORS

Maureen Armstrong | Publications Coordinator (CMSA)
Marjorie Bell | Graduate Program Administrator
Laura DeMarco | Professor of Mathematics, Director of Undergraduate Studies
Michael Hopkins | Professor of Mathematics, Department Chair
Cindy Jimenez | Undergraduate Program Coordinator
Oliver Knill | Preceptor, Undergraduate Concentration Support Specialist
Irene Minder | Executive Director
Melanie Matchett Wood | William Caspar Graustein Professor of Mathematics, Director of Graduate Studies



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