



November 10, 2024
Education Events

Education Events Schedule

Campus Map: <https://map.harvard.edu/>

Time (EST)	Sever Hall 102	Sever Hall 103	Sever Hall 106
8:00 AM – 8:50 AM	Breakfast Boylston Hall - Ticknor Lounge		
9:00 AM – 9:50 AM	Damon Peterson <i>Beyond Formal Undergraduate Math Education: Early Applications and Research</i>	Ryan Chen <i>Sphere Packing</i>	Ophelia Sommer <i>Effective Theories, Phases of Matter and the Renormalisation Group</i>
10:00 AM – 10:50 AM	Anand Natarajan <i>A Lightning Overview of Bell's Theorem</i>	Bjorn Poonen <i>Fast Multiplication</i>	Shaoyun Bai <i>Rectangles and Curves in the Plane</i>
11:00 AM – 11:50 AM	Po-Shen Loh <i>Social Entrepreneurship Through Math</i> Emerson Hall 210		
12:00 PM – 12:50 PM	Lunch Emerson Hall 210		
1:00 PM – 1:50 PM	College Life Panel <i>Once You're In!</i>	Kenta Suzuki <i>How (knot) to braid your hair</i>	Vasiliy Nekrasov <i>Geometry and Dynamics of Continued Fractions</i>

9:00 AM – 9:50 AM

Damon Peterson

Beyond Formal Undergraduate Math Education: Early Applications and Research

Location: Sever Hall 102

What are some paradigms that are useful in approaching applied mathematics? I will talk about how to approach applied math education from my own perspective, with a focus on creativity, research, and ignoring traditional limitations. There also are some common themes (in my humble experience) that are both fascinating and broadly applicable to almost all domains. I will also touch on those, as well as give a high level overview of some of my own research.

Damon Peterson is a PhD student and researcher at MIT working on fun stuff: multimodal architectures, domain aware constrained dimensionality reduction (factor representations), dissecting and evaluating linear models, implications of LLM entropy in decision making, and evaluating financial

Ryan Chen

Sphere Packing

Location: Sever Hall 103

Can we find an optimal way to pack equally sized spheres in n -dimensional Euclidean space? This is known for $n=1,2,3,8,24$ but is open otherwise. In 2016, the cases of dimensions 8 and 24 were solved in the work of Viazovska and Cohn--Elkies, and the subsequent extension by Cohn--Kumar--Miller--Radchenko--Viazovska. I introduce some of the mathematical characters in this beautiful story, including the E_8 lattice, modular forms, and the Riemann zeta function.

Ryan Chen is a fifth year math PhD student at MIT working with Prof. Wei Zhang, with a masters degree from Cambridge and an undergraduate degree from Princeton. Ryan works in arithmetic geometry and automorphic forms, which are areas drawing from number theory, algebraic geometry, representation theory, and harmonic analysis.

Ophelia Sommers

Effective Theories, Phases of Matter, and the Renormalisation Group

Location: Sever Hall 106

It is deeply puzzling that at the microscopic level, the electrons in iron and nickel behave very differently, but to the naked eye, both are ferromagnets. But heat either of them up past their Curie point and they cease their magnetism, despite the electrons in any single atom hardly noticing. In this talk we will understand this emergent universality by considering how scientific theories come with a length scale of applicability, and by studying how this effective theory changes as we zoom out. Through the lens of this procedure we can understand why phases of matter such as solids, fluids and various kinds of magnets can be understood without knowing anything precise about what the atoms are actually doing.

Ophelia Sommer is a third year PhD student at Harvard University working with Prof Ashvin Vishwanath. Her research interests range broadly within theoretical condensed matter and quantum many body physics, with a current focus on the classification of topological phases of matter. Before her PhD she was an undergraduate at Trinity College, University of Cambridge, where she won numerous prizes, including the Hartree and Clerk Maxwell prize, the Ver Heyden de Lancey Prize, and the AC5 International Union of Pure and Applied Physics Early Career Scientist Prize.

10:00 AM – 10:50 AM

Shaoyun Bai

Rectangles and Curves in the Plane

Location: Sever Hall 106

Drawing a closed curve without self-intersections in the plane, is it possible to find a rectangle whose vertices all lie on this curve? Despite the simplicity of the statement of this question, it had remained open until 2020, when mathematicians Joshua Greene and Andrew Lobb finally answered this question positively. This talk is an exposition of ideas surrounding this problem, with a view toward symplectic geometry.

Shaoyun Bai joined the Department of Mathematics at MIT as an Assistant Professor in July 2024. His research interest is symplectic topology. He completed undergraduate study at Tsinghua University in 2017 and earned his PhD in Mathematics from Princeton University under the supervision of John Pardon in 2022. He was a Ritt Assistant Professor at Columbia University during the academic year 2023-2024 before joining MIT.

Anand Natarajan

A Lightning Overview of Bell's Theorem

Location: Sever Hall 102

Quantum mechanics is unsettlingly counterintuitive: it tells us that measurements don't have deterministic outcomes, and it's impossible to simultaneously know the position and momentum of a particle. Are these just features of an incomplete theory, to be replaced by a better theory of physics? In 1964, John Bell came up with a simple experiment to prove that any theory describing our world must be as weird as quantum mechanics, and the Nobel Prize in Physics in 2021 went to the physicists who carried out this experiment in the lab. In this talk I will present Bell's ideas, which can be understood with just high-school probability, a little trigonometry, and a teeny bit of quantum mechanics.

Anand Natarajan is an assistant professor in the theory of computation group in the EECS department at MIT. His research focuses on quantum computing and computational complexity theory. His education was in physics, with a PhD from MIT under Aram Harrow and a BS from Stanford.

Bjorn Poonen

Fast Multiplication

Location: Sever Hall 103

What is the fastest way to multiply really big integers? Around 1960, Kolmogorov conjectured that the schoolbook method was optimal, but his student Karatsuba proved him wrong. I will discuss a recent breakthrough yielding an algorithm that might be optimal, as well as open problems about multiplying polynomials and matrices.

Bjorn Poonen holds the title of Distinguished Professor in Science in the MIT Mathematics Department. He earned degrees from Harvard and U.C. Berkeley, and held positions at Princeton and Berkeley before moving to MIT in 2008. He is a 4-time Putnam Fellow who has also served on the committees writing problems for the USAMO and Putnam Competition. His research is in number theory and algebraic geometry; his book "Rational points on varieties" received the Doob Prize. For his teaching and development of 18.03, he received the MIT School of Science Prize in Undergraduate Teaching. Twenty-six mathematicians have received the Ph.D. degree under his supervision.

11:00 AM - 11:50 AM

Po-Shen Loh

Social Entrepreneurship Through Math

Location: Emerson Hall 210

The speaker is on a campaign to build a more thoughtful world (analytical intelligence + social conscience), which also has more equitable access to educational opportunity. Unfortunately, the world is big. Fortunately, the deep thinking skills that help you to invent a math proof and formulate useful math definitions, are transferable to inventing win-win ecosystems to address large-scale real-world problems. The speaker will raise the hood and share stories of challenges he has faced, as well as the reasoning that ultimately led to solutions. Along the way, he will touch on some of his inventions, the most recent of which was covered in CNN earlier this year: bringing together math people and actors, in a collaboration that can inspire math in any corner of the world. (He will also explain what he did to get on CNN).

Po-Shen Loh is a social entrepreneur and mathematician, with a track record of inventing incentive-aligned solutions to timely population-scale real-world problems, from pandemic control to helping human society thrive in the AI era. He is a math professor at Carnegie Mellon University, and served a decade-long term as the national coach of the USA International Mathematical Olympiad team from 2013–2023, which ranked #1 in the world 4 times during that period. Since 2023, he has been the Vice President of the IMO Foundation, as the founder and organizer of the annual IMO Alumni Reunion. His latest research innovation brings together math stars and professional actors, to mass-produce live-streamed creative problem-solving lessons that match the engagement level of online video entertainment. His awards range from an IMO silver medal to the USA Presidential Early Career Award for Scientists and Engineers. His research and educational outreach takes him to cities across the world, reaching over 10,000 people each year through public lectures and events, and he has featured in or co-created videos totaling over 20 million YouTube views. His academic degrees are from Caltech, Cambridge, and Princeton.

1:00 PM – 1:50 PM

Kenta Suzuki

How (Knot) to Braid Your Hair

Location: Sever Hall 103

A classic problem in combinatorics asks: how many ways are there to permute n objects? We know there are only finitely many (in fact, as some of you may know, $n!$) ways to do this. But what if we consider a world where swapping A and B , then swapping again doesn't get you back to where you started? This leads us to the braid group, which is an infinite set parameterizing all ways to braid your hair. Braid groups connect to advanced topics in topology (knots) and group theory (integer matrices), which we will explore. By the end, you may even learn how to braid your hair.

Kenta Suzuki is a senior at MIT studying math. He is interested in representation theory—an area in the intersection of algebra and geometry. In his free time, he enjoys running and reading books.

Vasiliy Nekrasov

Geometry and Dynamics of Continued Fractions

Location: Sever Hall 106

In this talk, we look at continued fractions from a geometrical point of view. We start with two vectors, horizontal and vertical, and see how we can get the continued fraction expansion of any given number just through a sequence of pictures. Then, using even more pictures, we prove some classical algebraic facts almost without any calculations. If time permits, we will change gears, and look at the geometric means of the partial quotients and try to understand the reason why almost all of them behave in a very similar way.

Vasiliy Nekrasov earned his specialist degree in math from Moscow State University, where he worked in classical Diophantine approximations under the supervision of Nikolay Moshchevitin. While there, he became an instructor at a specialized math school called AESC MSU, starting his long journey as a math educator. Since then he has developed and taught various math classes, training high school teams for olympiads and math competitions. Currently Vasiliy is a PhD student at Brandeis University, working in Diophantine approximations and homogeneous dynamics with Dmitry Kleinbock. These two different areas have a lot of interesting open questions, and Vasiliy is trying to solve some of them!

College Life Panel

Once You're In!

Location: Sever Hall 102

All too many talks, webinars, and YouTube tutorials focus on the “how” of getting into schools like Harvard and MIT. But once you're actually in, how can you navigate the intricacies of student life? Avoiding 9 AM classes, not embarrassing yourself in front of a large tour group, or juggling academics and extracurriculars, how do these six talented students manage to do it all? In this panel, we'll be asking students who have not just excelled in mathematics but also distinguished themselves as bonafide students of Harvard and MIT what life is like on these two campuses.

Panelists: Serena An (MIT '26), Nickolas Ellison (Harvard '27), Andy Jiang (MIT '26), Jacob Paltrowitz (Harvard '27), Alena Zhang (MIT '27), Grace Zhou (Harvard '27)