

Mathematical Staircase, Inc.

MathILy

MathILy 2026 Final Report

Preface

As always, MathILy was composed of excellent students who learned a lot of mathematics and a lot about how to think and speak and write mathematically.

Program Preparations

Promotions

Electronic: Individual emails were sent to prior participants and promising applicants. MathILy continues to be listed on several high-traffic webpages, including MIT Admissions' "Preparing for MIT" summer programs page. The web traffic range was 10,00–27,00 hits/month, with ~44% of the traffic from abroad.

Print: The Minion sent about 150 fliers to contests.

Other Activities: We held a {MathILy, MathILy-Er, MathILy-EST} Yearly Gather at the Joint Mathematics Meetings, where at least 125 participants team-solved a Jonah-designed set of five simultaneous Battleship-style vegetable-placing puzzles. In late March sarah-marie offered an Art of Problem Solving Math Jam (about 60 participants) on Decorative Borders that included a {MathILy, MathILy-Er} Q&A.

Applications and Admissions

Statistics: We received 2304 Short Forms, 1030 Not-as-Short Forms, 958 EARs, and 834 completed applications. We admitted 61 students, for an admissions rate of ~7%. Seventeen students declined, nine for other summer programs and one who withdrew the day before student arrival in order to work at a robotics startup. Thus, our current yield rate is roughly 72%.

Demographics: Applicants originated from at least 45 US states and 46 foreign countries (representing North/South America, Western/Eastern Europe, East/Central/South/Southeast Asia, West/North/South Africa, Oceania, and the Middle East). The data in the following table was measured where possible and approximated otherwise; the final row reflects a during-program demographic survey.

Percentage 2026	Female	NB	East Asian	South Asian	Latinx and indigenous	Middle Eastern	Black
Short Forms	31%	0.5%	44%	24%	4%	5%	1%
EARs	28%	1%	54%	20%	2%	2%	0.3%
Attending	39%	2%	48%	18%	2%	2%	0%

Financial Aid: We awarded $21,625 in financial aid to MathILy participants ($13,950 to domestic students and $7,675 to international students), and used used grants from Jane Street ($9,125) and the Carina Fund

($12,500) for this purpose. 18% of admitted students applied for financial aid; we met the demonstrated need of all applicants.

Personnel

Academic: Lead Instructors were dr. sarah-marie belcastro (Math Staircase Inc., PhD U of Michigan 1997), Dr. Thomas Hull (Franklin&Marshall, PhD U of Rhode Island 1997), Dr. Hannah Alpert (CCR La Jolla, PhD MIT 2016), Dr. Brian Freidin (University of San Diego, PhD Brown U. 2018), Dr. David Gonzalez (Notre Dame, PhD UC-Berkeley 2025, MathILy 2014), and Dr. Berit Givens (Cal Poly Pomona, PhD UW-Madison 2003). Apprentice Instructors were Ian Shors (graduate student at UCLA, MathILy 2018), Devin Brown (graduate student at UW-Madison, MathILy 2020), Frank Lu (graduate student at Harvard U, MathILy 2018), Kye Shi (graduate student at UCLA, MathILy 2015–2016), Saskia Solotko (doing Part III at Cambridge, MathILy 2019–2020), and Will Bender (entering graduate student at McGill, MathILy 2018–2020). Biographical information and prior experience are listed at Dramatis Personae.

Administrative: The Director was dr. sarah-marie belcastro. The excellent {MathILy, MathILy-Er} Minion was Madison Stuart (Smith College BA 2006 in math and German; graduate work in information science at the U of Michigan). The PRiME FACToRs (Protectors and Responders in the MathILy Environment and Facilitators of Activities and CriTiquers of wRiting) were Caroline Cashman (entering graduate student at Georgia Tech), Jadon Jones (Berry College graduate), and Alex Finn (Yale undergraduate, MathILy 2024). The PRiME FACToRs had academic roles as well.

Advisory Amalgam: These people were available for advice on academic and practical aspects of MathILy.
Dr. Douglas J. Shaw, mathematics faculty at University of Northern Iowa
Dr. Ruth Haas, (retired) mathematics faculty at University of Hawaii
James Cocoros, mathematics faculty at Hunter High School
Dr. Dylan Shepardson, mathematics faculty at Mount Holyoke College
Dr. Carol E. Fan, operations researcher (currently Operations Data Science Lead at Apple)
Dan Zaharopol, Executive Director of BEAM
Dr. James Tanton, mathematician
Dr. Joshua Greene, mathematics faculty at Boston College
Dr. Emily Peters, mathematics faculty at Loyola University Chicago
Wing L. Mui, Seattle-area comic store owner, artist, and former mathematics teacher
Dr. Thomas Hull, mathematics faculty at Franklin&Marshall College
Dr. Josh Laison, mathematics faculty at Willamette University

Student Demographics

US States represented by MathILy students, roughly from east to west: Massachusetts, New Hampshire, New York, New Jersey, Pennsylvania, Washington DC, Michigan, Illinois, Missouri, Minnesota, Texas, Arizona, Washington, Oregon, and California.
Countries outside of the US, roughly from east to west: South Korea, China, the UK, and Canada.
Gender breakdown: There were 16 female, 2 gender-nonconforming, and 26 male participants.
Ages: There was one 14-year-old, five 15-year-olds, fifteen 16-year-olds, twenty 17-year-olds, and three 18-year-olds.
Academic backgrounds: Three-fourths of the students had taken calculus II (and 38% had also taken multivariable calculus) and 32% had taken linear algebra. One student had not yet taken precalculus. Fifteen students had attended summer mathematics programs before.

What Happened at MathILy 2026?

Academics

Classes: Each weekday we had 4 hours of morning class, 1–1.5 hours of Daily Gather, and 3 hours of evening class, for at least 8 contact hours per day (not counting mathematical conversations outside of class). Weekends were, as always, a bit idiosyncratic, but the general Saturday template consisted of 4 hours of morning class and 2 hours of afternoon Life Seminar.

The basic curricular structure was two weeks of core curriculum, called Root Class (after the root of a graph theoretic tree, and after the idea that the material strengthens student grounding much as the roots of a tree do), followed by one week of short topical classes, called Week of Chaos, followed by two weeks of focused-topic classes, called Branch Class (after branches of mathematics, and after the idea that tree branches grow from a strong trunk nourished by roots).

Root Class: There were three Root classes, each with 14 or 15 students, one taught by {sarah-marie, Ian, Devin, Caroline}, one taught by {Hannah, Will, Alex}, and one taught by {Tom, Saskia, Jadon}. Our core curriculum consisted of linear and affine algebra and geometry (including equations and intersections of hyperplanes, span, linear independence, transformations, and dimension), combinatorics, graph theory, examples of groups, isomorphism for various categories, probability spaces and expected value, and basic cardinality. Of course, students gave full proofs for all of this material.

Week of Chaos: Students indicated which of 64 potential topics they would be excited to learn about, from which instructors decided on a list of 28 classes offered. These were: Surreal Archaeology, Geometries Gone Wild (non-Euclidean geometry), Fantastic Furtive Farmers (zero-knowledge proofs), Loops on Loops on Loops, All tangled up (generating functions), Spaces of shapes (moduli spaces of triangles and quadrilaterals), Don't tell! It's a secret (cryptography), Game Theory, Where's my Line? Redistricting in Boxville, Growing Grape Orchards on... (graph embeddings), Reflection Goops, Can you untie your shoes? (knot theory), Mandy and the Julias (the Mandelbrot set), IT'S MÖBIN' TIME (Mobius transformations), Information Theory, Architect-Artist (Ramsey theory), Surfin' Snails (network flows), Socially Selecting Silly Hats (voting theory), Cantor Set, A Cubic Formula, How do computers do things? Algorithmically!, Algebraic geometry without the algebra, *p*eculiar *p*numbers (*p*-adics), Math with Coloured Chalk (graph coloring), How Far You'll Go (random walks), Character assassination (representation theory), Meta (mathematical logic), and Fruit Propagation (the Banach-Tarski theorem). Student preferences guided placement of each student into 5 classes. Half of these classes used specific material from the Root curriculum, nearly 30% benefitted substantially from students' knowledge/understanding of linear algebra, and nearly 1/3 used technology in a significant way.

Branch Classes: The Branch classes were on convex geometry and polytopes (sarah-marie and Will and Saskia), on finite {fields, geometries} (Brian and Frank and Caroline), and on the mathematics of paperfolding (Tom and Devin and Jadon). All three Branch classes used linear algebra, all three used computer algebra systems, and all three introduced real-world applications.

Pedagogy: All classes were conducted using inquiry-based learning, with the bulk of the time spent with students working in groups or presenting their insights to each other and a much smaller amount of time used by faculty conducting discussion from the board. Students were assigned to take comprehensive notes for future class reference, and after instructor review (and revision) were copied and distributed to the class.

Feedback: Students received feedback in multiple ways. During class, they received instant verbal feedback on the correctness of their mathematical ideas, and also on use of notation, language, and presentation style. Likewise, students received daily written feedback on their mathematical writing. Near the end of Root and Branch classes, each student was asked to write an introspective self-evaluation. The self-evaluations were discussed by the student's instructors, and the instructors then held a 5–20 minute meeting with each student to give overall feedback on the student's progress at MathILy and advice for the future.

Daily Gathers: Each instructor gave a Daily Gather. We had seven external visitors. Each Daily Gather speaker (both visitors and staff) provided some insight into that person's perspective on the mathematical enterprise and/or way of being a mathematician. The Daily Gather timeslot was also used to show Math Movies once per week including expository films and animations.

Extracurriculars

Life Seminars: There were five weekend Life Seminars offered, many with time for open questions. The first was on practical matters, such as how to address faculty in person or by email and impostor syndrome. The second Life Seminar was on careers for people with mathematical science training and included visitors via Zoom. The third Life Seminar was about preparing for Branch, when to start research, and issues surrounding collection of demographic information. The penultimate Life Seminar was on how to choose colleges to which to apply. The final Life Seminar, held the following afternoon, was on how to readjust to the non-MathILy world post-MathILy.

All-program activities: At the end of the first week we we walked over to tour Haverford College; after Week of Chaos we trained to Philadelphia for the afternoon and the next day celebrated National Ice Cream Day by treating the program to ice cream at a local shop.

Social activities: Clusters of students climbed trees on campus together on arrival day. Both Frisbee and soccer were popular, including late-night games on the lawn outside our dorm. We reserved the basketball court twice per week, so that students could play unmasked. Games such as 3-2-1-Contact and Impostor were played at meals. There were a large variety of card and board games played in the dorm, with seemingly a new game happening every day. A new piano arrived in the dorm and was used enthusiastically. Bedtime Stories included *Among Ghosts* by Rachel Hartmann, "The Year without Sunshine" by Naomi Kritzer, "Disruption" by Samit Basu, and "When Robot and Crow Saved East St. Louis" by Annalee Newitz.

An activity that started early in the program and continued throughout was timed egg-peeling where students reported times in a dedicated Slack channel, with specialized events (two people/two hands, membrane intact, behind the back, blindfolded, ...) and corresponding emoji. A group walked 45 minutes to get bubble tea and were caught in a downpour on return. They were of surprisingly good cheer in this circumstance! A couple of weeks later a different (larger) group of students and staff again walked to boba, this time verifying in advance that no rain was expected.

A student hosted outdoor fruit-sharing parties so that anyone who wanted to could taste durian. A pair of students (one boy, one girl) played Minecraft versions of NYT daily games aloud at meals. Most Saturdays a particular student posted a poll on Slack to vote on what movie that student would stream that night in the large classroom. There were a few instances of students posting geoguessr-style queries on Slack, showing headless photos of fellow students. A student brought to Philadelphia a big backpack with many Rubik's cubes and variants, and handed them out to group members; at one point these students were all solving puzzles in Brandy Melville (a petite-teen-girl-oriented store).

Late in the program a couple of students organized a sequence of hide-and-seek games in our classroom building. The classroom building has a section where all the exterior walls are floor-to-ceiling windows, so outdoor observers could see students hiding behind curtains or behind couches.

Administrative matters

COVID-19 precautions: Because there have been COVID-19 surges nationally every summer, we did daily testing of all staff and participants for the first 5 days. We continued to mask around concentrations of other people and to eat outdoors, and we prohibited students from leaving campus unless accompanied by a staff member. By and large, students and staff were compliant, though some people wore surgical rather than KN-95 masks. The nationwide hospitalization curve was at about 1/10 the height of last year's.

Campus Location: Bryn Mawr is a safe and tree-filled suburb of Philadelphia, located on a major train line into the city. Bryn Mawr College is a few blocks away from the Bryn Mawr train station (which hosts a farmers market on weekends), and also nearby shops that supply toiletries and foodstuffs.

Facilities at Bryn Mawr: Again, everyone liked the facilities and the campus as a whole. We were assigned our favorite dormitory with air-conditioned rooms and our favorite classrooms in Park Science Center (one with floor-to-ceiling blackboards). Janitorial service is extensive at Bryn Mawr; every (early) morning chalkboards were cleaned and the rooms were tidied. The dining hall staff made a variety of extra dishes just for MathILy.

Post-Processing

Post-program meetings: As usual, the staff convened after the students left (first in person, then over Zoom) to evaluate various aspects of the program and to discuss how we could improve the workings of MathILy.

Impact: Many students commented that they were happy that they were able to learn entirely new areas of mathematics, to understand difficult mathematics better, and to make new friends who also enjoy mathematics. They noted growth in proof writing and presentation skills and mathematical thinking ability. Several specifically mentioned that this was their first exposure to mathematics outside of high-school mathematics.

Finances summary:

The income from student fees (some discounted) was $258,703.
Donations from Jane Street for financial aid and visitor travel were $9,125+$2,332.
Donations from the Carina and Polynera funds for financial aid were $12,500.
Tom Hull's NSF standard grant contributed $13,337 (pending).
Max Engelstein's NSF CAREER grant contributed $15,200.

Total MathILy income: $311,197.

Administrative expenses (insurance, fliers, etc.) totaled approximately $5,337.
Total wages (instructors, PRiME, Minion, Director) were approximately $115,030.
Wage-related administrative costs (payroll taxes, etc.) were $4,373.
Travel costs (visitors, instructors) were $7,878.
Program expenses (supplies, MAA membership) were approximately $6,753.
Site expenses from Bryn Mawr were $159,662.

Total MathILy expenses: approximately $299,032.

We were fortunate to receive donations of software from Wolfram Research worth $18,172, and volunteer time worth roughly $1,320. The net income of approximately $12,165 comes mainly from two students who each withdrew well after the refund deadline and secondarily from additional money unexpectedly available from grants. It (more than) offsets last year's net loss.