



## MathILy-Er 2017 Final Report

### Preface

This was the third year of MathILy-Er, and it was our easiest year yet. As always, our students were awesome and we all did a ton of math.

### Program Preparations

#### Promotions

*Emails:* Individual emails were sent to promising applicants from 2016 inviting them to apply for 2017. MathILy-Er 2016 participants were emailed as a group notifying them when the EAR became available.

*Webpage hits:* During Fall 2016, MathILy-Er-specific pages accounted for about 11% of traffic on [mathily.org](http://mathily.org), and in Spring 2017, MathILy-Er-specific pages accounted for about 5% of the traffic.

*Impacts:* About 44% of applicants found {MathILy, MathILy-Er} on a summer program list, 28% via a web search, 26% from a parent or guardian, 21% from a teacher, and 2% from a flier. Fewer students found {MathILy, MathILy-Er} via a summer program list than last year, but these percentages are otherwise consistent with those for the 2016 season. About 6% of applicants said they heard about {MathILy, MathILy-Er} from a friend or sibling who had attended.

#### Applications

*Statistics:* Eighty-five of the 184 completed applications were forwarded for MathILy-Er consideration, and of those 32 were admitted and 26 attended. That's an admissions rate of 38% and a yield of 81%.

The data in the following table was measured where possible and approximated otherwise.

Percentage 2017	Female	East Asian	South Asian	Latin@	Other of color
Short Forms	37%	39%	17%	3%	4%
EARs	31%	43%	13%	1%	3%
Attending	46%	31%	4%	0%	4%

*Financial Aid:* We were awarded an AMS Epsilon Fund grant for \$9,000. We awarded \$18,975 in need-based financial aid to MathILy-Er participants (\$12,125 to domestic students and \$6,850 to international students). All admitted students' demonstrated need was met.

## Personnel

*Academic:* There were three Lead Instructors, Dr. Jonah Ostroff (University of Washington, Ph.D. Brandeis University 2013), Dr. Alice Mark (Arizona State University, Ph.D. University of Texas at Austin 2015), and Dr. Nathan Harman (University of Chicago, Ph.D. Massachusetts Institute of Technology 2017), with Nate teaching only during the third week. There were two graduate student Apprentice Instructors, Hannah Turner (University of Texas at Austin) and Lucas Van Meter (University of Washington).

*Administrative:* The Director was Dr. Jonah Ostroff. The {MathILy, MathILy-Er} Minion was Madison Stuart (Smith College B.A. 2006 in Mathematics and German; graduate work in information science at the University of Michigan). The Protector and Responder in the MathILy-Er Environment (PRiME) was Arianne Hermida (B.A. University of Washington 2017), who also took on some teaching duties this year.

*Advisory Amalgam:* These individuals gave advice on academic and practical aspects of MathILy.

[Dr. Douglas J. Shaw](#), mathematics faculty at University of Northern Iowa

[Dr. Ruth Haas](#), mathematics faculty at University of Hawaii

[James Cocoros](#), mathematics faculty at Stuyvesant High School

[Dr. Dylan Shepardson](#), mathematics faculty at Mount Holyoke College

[Dr. Carol E. Fan](#), operations researcher (currently Head of Data at [Blackbird](#))

[Dan Zaharopol](#), Executive Director of [BEAM](#)

[Dr. James Tanton](#), mathematician, currently Ambassador for the [MAA](#)

[Dr. Joshua Greene](#), mathematics faculty at Boston College

[Dr. Emily Peters](#), mathematics faculty at Loyola University Chicago

[Wing L. Mui](#), mathematics faculty at the Overlake School

[Dr. Thomas Hull](#), mathematics faculty at Western New England University

[Dr. Josh Laison](#), mathematics faculty at Willamette University

## Student Demographics:

*States represented by MathILy-Er students, from west to east:* Washington, California, Idaho, Arizona, Colorado, Texas, Illinois, Michigan, North Carolina, Virginia, Maryland, New York, New Jersey

*Countries outside the United States:* Canada, China, Singapore, Spain, Belgium, Poland

*Gender breakdown:* 12 female students, 14 male students.

*Ages:* There were two 13-year olds; three 14-year olds, one of whom turned 15 during the program; five 15-year olds; eleven 16-year olds, one of whom turned 17 during the program; four 17-year olds; and one 18-year old.

## What Happened at MathILy-Er 2017?

### Academics

**Classes:** Each weekday we had 4 hours of morning class, 1 hour of Daily Gather, and 3 hours of evening problem session, for at least 8 contact hours per day (not including mathematical conversations held outside of class). Weekends varied, but Saturdays usually consisted of 4 hours of morning class and 2 hours of 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 the Week of Chaos, followed by two weeks of focused-topic class, called Branch Class (after branches of mathematics, and after the idea that tree branches grow from a strong trunk nourished by roots).

*Root Class:* The seventeen students were split into two root classes (one taught by each LI). The material in the Root Class included matrix algebra and ring theory, enumerative combinatorics, graph theory, and combinatorial game theory. All of this material was treated with full proofs given by the students.

*Week of Chaos:* Students indicated which of 37 potential topics they would be excited to learn about. Instructors compiled these favorites into a set of fifteen courses. The courses offered were as follows: Markov Chains, Dessert Theory (fair division), Generating Functions, Hard Problems (algorithms and computability), Algebraists Anonymous, Methods of Proof, Cayley Graphs, Number Theory & Cryptography, Convex Geometry, Cardinals & Ordinals, Voting Theory, Surfaces, Fun with Fibonacci, Tour of Turing, and Symmetric Polynomials. Each student was placed into five of these classes according to their expressed preferences. A majority of these classes used material from the Root curriculum.

*Branch Class:* There were two Branch classes, on the topics of combinatorial game theory and non-Euclidean geometry.

*Pedagogy:* All classes were conducted through inquiry-based learning, with students writing on the board throughout most of the morning class, and almost zero time spent with instructors presenting at the front of the room.

*Feedback:* Students received feedback in several ways. Class presentations were met with instant verbal feedback from instructors and students, both for mathematical correctness and style. Students received written comments on their problem session work at the beginning of the following morning class. Near the end of Root and Branch classes, students wrote self-evaluations on their progress at MathILy-Er. Finally, individual interviews were held with the students on three points during the summer.

**Daily Gathers:** Each instructor gave several Daily Gathers. The Daily Gather time slot was occasionally used for other activities, such as math movies or combinatorial icebreakers. The remaining Daily Gathers were interactive presentations by visiting mathematicians, including three Willamette undergraduate research groups.

## **Extracurriculars**

*Life Seminars:* Two Life Seminars were held on weekend afternoons. Each of these was an unstructured two-hour period where students could ask the staff about applying and going to college, work as a mathematician, and general practical matters of life and adulthood.

*Other program-wide activities:* At the end of the first week, students and staff explored the Salem Farmers Market and nearby Riverside Park. Towards the end of the program, students and staff participated in an informal talent show and played a week-long game of Word Assassins.

*Non-program-wide activities:* Student recreational activities included running, table tennis, basketball, and piano. Students often played board games in the lounge.

#### **Administrative matters:**

*Facilities at Willamette:* Students and staff both agreed that the Willamette campus was excellent, although some of our classrooms had worse board space than the previous year.

*Salem:* Salem continues to be a fine location for MathILy-Er. There are a lot of options for food and recreation, but the town was small enough that students could safely leave campus in groups for shopping and eating. However, travel to Salem was expensive and inconvenient for most participants and visitors, and its distance from the airport made arrivals and departures difficult.

#### **Post-Processing**

*Post-program staff meeting:* On Saturday evening after students left, the staff met to discuss various aspects of the summer.

We were very happy with the route curriculum, but discussed ways in which the graph theory curriculum might be revised to better reflect the content of Branch classes.

Collectively, we felt that the students showed a promising amount of growth, and that many would be ready to attend MathILy should the apply in the following summer.

*Finances summary:* The income from student fees was \$97,117 and a grant for financial aid was \$9,000, for total MathILy-Er income of \$106,117.

Administrative expenses (insurance, fliers, etc.) totaled approximately \$1816.

Total wages (instructors, PRiME, Minion, Director) were approximately \$27,457.

Travel costs (Daily Gather speakers, instructors) were approximately \$1058.

Program expenses (supplies, program outings) were approximately \$1078.

The charges from Willamette were approximately \$60,107 for food, housing, and copying costs.

Thus, the total expenses are approximately \$91,516.