canada/USA

2020 Year-End Report

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Mathcamp is a project of the Mathematics Foundation of America, EIN 57-1035414.

Looking back: Mathcamp 2020 at VMC



"My expectations were blown away as I truly felt immersed, welcomed, and part of a truly alive online community."

– Quinn Perian (Boulder, CO)



Mathcamp 2020 was held July 5-August 9 online at our Virtual Mathcampus.

From Sublette, Kansas, to Pointe-Claire, Quebec; from Lima, Peru to Ouagadougou, Burkina Faso, this year's campers came together during the COVID-19 pandemic for a virtual summer of Mathcamp, joining us online from 29 U.S. states, 3 Canadian provinces, and 14 other countries. There were 54 girls, 5 non-binary students, and 61 boys; 58 alums, and 62 fantastic new campers, selected through a competitive application process (from 461 applicants!) based on their excellent essays, recommendations, and Qualifying Quiz solutions.

Challenge yourself with a Quiz problem!

Here is a table of remainders when powers of 10 are divided by 2020:

k	10^k	Remainder	k	10^k	Remainder
0	1	1	5	100,000	1,020
1	10	10	6	1,000,000	100
2	100	100	7	10,000,000	1,000
3	1,000	1,000	8	100,000,000	1,920
4	10,000	1,920	9	1,000,000,000	1,020

We see that the remainders repeat every four steps (period 4), with two exceptions at the beginning, 1 and 10. We will call a sequence that repeats with period 4, with two exceptions at the beginning, a *fortuitous* sequence (four-two-itous). Sequences that have periods smaller than four (e.g. sequences that repeat every two steps) do not count as fortuitous.

(a) In addition to 2020, for what other values of m is the sequence of remainders when 10^k is divided by m a fortuitous sequence?

(b) In addition to 10, for what other values of a is the sequence of remainders when a^k is divided by 2020 a fortuitous sequence?



"Not only is Mathcamp a wonderful place to learn math, it has also become my home."

- Yuyuan Luo (Ada, MI)



Math at Mathcamp 2020



Classes

Mathcampers begin each summer by talking with their academic advisor, whose role is to help address the question: What kind of academic experience do you want to create this summer? The possibilities aren't endless, but they're vast: from "A Rubik's cube-based approach to group theory" to a series of classes honoring the late John H Conway, students had over 100 classes to choose from. Here is just one example, from mentor Ben Dees:

Functions you can't integrate.

In AP calculus, it always seems as if differentiation is a lot easier than integration. In particular, for all of our old friends like sine, cosine, e^x and so forth, we can take their derivatives and write them down in terms of other old friends by following some simple rules. Integration, on the other hand, has a lot more "tricks" and weird techniques. Here, we'll explore these difficulties in integration, and prove that some easy-to-write-down functions, such as e^{x^2} , don't have an easy-to-write-down integral. To show this, we won't be doing any sort of analysis: there will be no ε s or δ s in this course. Instead, we'll be using the tools of ring theory to study this question. Along the way, we'll see a very nice way to describe the "functions we can write down" or the so-called "elementary functions" in terms of field extensions.

Projects

The Project Fair is when our work outside classroom hours comes together. Some students presented posters on mathematical topics like Graph Minors and *p*-adic Numbers. Others shared results from their data science and programming projects, like "High-achieving girls in math: what do the data say?" and "Project Euler in Google Sheets." Modular origami was a colorful big hit!



"VMC was by far the brightest five weeks I've had during the pandemic. The teaching was top-notch, the schedule flexible and accommodating, and the culture vibrant and accepting."

– Noam Scully (Brookline, MA)



"The five weeks of Mathcamp were the best five weeks of my life so far and gave me direction for my future. Now I'm sure that I want to study math my whole life."

– Natali Gogishvili (Tbilisi, Georgia)



Outside the Classroom at Mathcamp 2020



Social Activities

Both staff and students organized events all summer. We mailed one another postcards, and attempted to collectively run the distance from Oregon to Colorado. We made pancakes; went "bowling" with blue tape; held anti-racism book group disucssions; recorded songs together; and played and ranked 90 different variations of solitaire (as a group). Even in this format, the community came up with so many ways to connect.

Annual Puzzle Hunt

"I can't even put into words how grateful and happy I am to be given the opportunity to come here each year."

– Kalina Jasińska (Gdańsk, Poland)



Each year, the staff design a day-long Puzzle Hunt, heralded as one of our best field trips. This year's Hunt was themed around a strange cult discovered by the "Department of Occult Investigations." For a challenge, try to solve the puzzle below: "Not A Word Find."

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SiO_2 : Fe	N	G	Т	Н	Е	Е
$CaCO_3$	Т	S	F	0	Т	0
SiO_2 : TiFeMn	A	D	Е	K	Т	S
$Al_2O_3: Cr$	R	С	Е	R	0	Y
$Al_2O_3: TiFe$	L	D	Т	Р	L	N
Steven	I	N	U	W	I	N

 $\begin{array}{l} ({\bf Ca},{\bf Mg},{\bf Fe},{\bf Mn})_3^{2+}({\bf Al},{\bf Fe},{\bf Cr})_2^{3+}({\bf SiO}_4)_3\\ {\bf SiO}_2:{\bf nH}_2{\bf O}\\ {\bf CaCO}_3\\ {\bf SiO}_2:{\bf TiAu}\\ {\bf SiO}_2:{\bf TiAu} \ 2.0\\ ({\bf Mn}^{2+},{\bf Fe}^{2+},{\bf Mg},{\bf Ca}){\bf SiO}_3\\ {\bf Al}_2{\bf O}_3:{\bf Cr}\\ {\bf SiO}_2:{\bf Si}\\ \end{array}$



"Everyone always talks about the Mathcamp community being amazing – and, yes, it is, but the thing is that it's so amazing that I can't even begin to explain how amazing it is."

– Jasmine Zhang (Newtown, PA)



Supporting Mathcamp



FY 2019–20 Revenue

A Tuition (after financial aid)	\$ 133,100
B & C: AMS, NSF Grants	\$ 17,835
D Scholarship Fund Gifts	\$ 27,865
E Unrestricted Individual Gifts	\$ 150,293
F Corporate Donations	\$ 17,873
G In-Kind Donations	\$ 31,999
H Misc income (includes PPP)	\$ 31,952



Mathcamp 2021 is already in the works. Given the uncertainty of the pandemic, we're planning for lots of different possible formats. We look forward to welcoming new campers and alumni from all walks of life, and from all over the world, all sharing a love of math!

Mathcamp gives a formative intellectual and social experience to incredible kids, and one of our guiding principles is that camp should be accessible to every qualified student – whether or not they can afford the tuition. Admission is irrespective of financial aid, and we fully meet the need of every Mathcamper.

Donations keep Mathcamp open to all.

Mathcamp is *free* for U.S. and Canadian families with household incomes of \$65,000 and below, and we even offer *travel grants* (if residential) and *technology grants* (if online). Need-based financial aid is also available for middle-income families and international students. The first \$17,835 of our aid budget comes from the National Science Foundation and the American Mathematical Society, and the rest comes from the program's supportive alumni, families, and friends.



FY 2019–20 Expenses

A Mathcamp 2020	\$ 376,071
• Virtual Campus - 5%	
• Staff Salaries - 64%	
• Other Camp Expenses - 30%	
B Alumni Programming	\$ 2,023
C Administrative	\$ 19,092
D Fundraising	\$ 15,686



Give today: www.mathcamp.org/donate