CLASS DESCRIPTIONS—WEEK 2, MATHCAMP 2015

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9:10 Classes

Abel's Theorem (Week 2 of 5). (Julian + Mira, Tuesday–Saturday)
We continue our explorations this week, looking at either Riemann surfaces or more advanced group theory. If you want to join the class this week, please come to speak with us.

Homework: Required

Prerequisites: None.

Aperiodic Tiling. (Steve, Friday–Saturday)
Don't you wish the floor went off to infinity?

A *tiling* of the plane is just a way of covering the plane with shapes which don't overlap (except at their boundaries). For example, floor tiles usually describe a tiling of the plane by squares, except for the part where you run out of floor.

For other examples, it's easy to tile the plane using triangles, parallelograms, or regular hexagons. With slightly more work, you can tile the plane using regular pentagons and appropriately-shaped triangles together, and it's a fun exercise to show that you can't tile the plane using pentagons alone. All the tilings I've mentioned above are kind of boring, though — they repeat themselves.

Don't you wish the floor was surprising and new?

In this class we'll look at two specific examples of *aperiodic* tilings: a hierarchical tiling, built out of L-shapes, and the *Penrose tiling*, made with two different types of rhombus. We'll learn how we can *prove* that a certain tiling cannot repeat itself, and see where (mathematically) aperiodic tilings come from.

Homework: Recommended

Prerequisites: None.

Related to (but not required for): Classifying Symmetry (W1); Tiling Problems (W4)

Continued Fractions (Week 1 of 2). (Susan, Tuesday–Saturday)
Suppose you wanted to find all of the integer solutions to the equation $x^2 - 18y^2 = 1$. Actually, let's make it easier: suppose you wanted to find just *one* integer solution to this equation. What would you do? Well, I'll tell you what I would do: I would calculate the continued fraction expansion of $\sqrt{18}$. Its expansion is given by

$$\sqrt{18} = 4 + \cfrac{1}{4 + \cfrac{1}{8 + \cfrac{1}{4 + \cfrac{1}{8 + \cfrac{1}{4 + \cfrac{1}{8 + \cfrac{1}{4 + \dots}}}}}}}$$

Because continued fractions are awesome, this tells me that one solution to the equation $x^2 - 18y^2 = 1$ is given by $x = 17$ and $y = 4$. And because Pell equations are awesome, this tells me that another solution is given by $x = 407$ and $y = 136$. In this class, I'll show you exactly how I figured that out. But more importantly, we'll explore why it works. We'll see how to find all of the solutions to any

Pell equation—an equation of the form $x^2 - Dy^2 = 1$. And in the process we'll get a tour of the world of continued fractions. We'll see what the expression above means, and find out why it repeats itself in an infinite alternating pattern.
Homework: Recommended
Prerequisites: None.
Related to (but not required for): Algorithms in Number Theory (W1); pNumber Theory (W4)

Functions of a Complex Variable (Week 1 of 2). (🌶🌶🌶, Mark, Tuesday–Saturday)
Spectacular (and unexpected) things happen in calculus when you allow the variable (now to be called $z = x + iy$ instead of x) to take on complex values. For example, functions that are "differentiable" in a region of the complex plane now automatically have power series expansions. If you know what the values of such a function are everywhere along a closed curve, then you can deduce its value anywhere inside the curve! Not only is this quite beautiful math, it also has important applications, both inside and outside math. For example, complex analysis was used by Dirichlet to prove his famous theorem about primes in arithmetic progressions, which states that if a and b are positive integers with $\gcd(a, b) = 1$, then the sequence $a, a + b, a + 2b, a + 3b, \ldots$ contains infinitely many primes. This was probably the first major result in analytic number theory, the branch of number theory that uses complex analysis as a fundamental tool and that includes such key questions as the Riemann Hypothesis. Meanwhile, in an entirely different direction, complex variables can also be used to solve applied problems involving heat conduction, electrostatic potential, and fluid flow. Dirichlet's theorem is certainly beyond the scope of this class and heat conduction probably is too, but we should see a proof of the so-called "Fundamental Theorem of Algebra", which states that any nonconstant polynomial (with real or even complex coefficients) has a root in the complex numbers. We should also see how to compute some impossible-looking improper integrals by leaving the real axis that we're supposed to integrate over and venturing boldly forth into the complex plane! This class runs for two weeks, but it should definitely be worth it. (If you can take only the first week, you'll still get to see one or two of the things mentioned above; check with me for details.)
Homework: Recommended
Prerequisites: Multivariable calculus (including Green's Theorem; if the MV crash course doesn't get to Green's Theorem, it will be covered near the beginning of this class)
Required for: Functions of a Complex Variable (Week 2 of 2) (W3)

Markov Chains to Support your Probabilistic Exploits. (🌶🌶, *Nina White*, Tuesday–Thursday)

Which properties in Monopoly are most often landed on? How do you decide when to attack in Risk? How long does a game of Chutes and Ladders typically last? All of these questions can be answered using the foundational probabilistic tool of Markov chains (and the help of a computer). In this course we'll progress from some basic examples of "game analysis" questions to more complex ones. We'll develop the tools of Markov chains along the way and use Matlab to help us. There may be opportunities to turn classwork into projects.
Homework: Required
Prerequisites: Basic linear algebra, basic experience with counting and discrete probability.
Related to (but not required for): Statistical Modelling (W1); An Intro to "Data Science" (W1)

Problem Solving: Combinatorics. (🌶🌶, Misha, Tuesday–Saturday)
Here are examples of the kinds of problems we will solve in this class:

- A fair coin is flipped 10 times. What is the probability that no outcome (heads or tails) comes up 3 times in a row?

- A convex polyhedron has 32 faces, each of which is either a pentagon or a triangle. At each of its V vertices, T triangular faces and P pentagonal faces meet. Find V, T, and P.
- Find an eight-letter word in the English language for which the probability is as small as possible that, in a random permutation of its letters, all the vowels are adjacent.

More generally, this class covers the application of combinatorics and graph theory to olympiad problem solving. We will spend most of our time solving olympiad problems by collective brainstorming, with some guidance from me.
Homework: Required
Prerequisites: None.
Related to (but not required for): Generating Functions, Catalan Numbers, and Partitions (W2)

10:10 Classes

Coloring in Space. (🌶🌶, *Moon Duchin*, Thursday–Saturday)
The Four Color Theorem is very famous, and it has a well-known statement in terms of graph theory: *for any planar graph, there is a way to assign each vertex one of four colors so that no two neighboring vertices share a color.* So coloring graphs is already kinda interesting. But graphs are just a tiny little corner of the world of metric spaces. How about coloring all points of a metric space as follows: pick your favorite number d and require that any two points whose distance is exactly d should not be the same color. Then it gets interesting... even the chromatic number of the Euclidean plane is unknown. Not content with a problem that is merely hard enough that nobody can solve it, we will then make it harder: the culmination of this three-day course will be coloring problems in negative curvature.
Homework: Recommended
Prerequisites: Metric spaces
Related to (but not required for): Metric Spaces (W1); Coloring Maps (W2)

Counting the Faces of Cut-Up Spaces. (🌶🌶, *Matt Stamps*, Tuesday–Saturday)
Suppose you cut a pizza into 10 pieces using 4 straight cuts so that each pair of cuts intersect somewhere in the interior of the pie, and without seeing the pizza, your friend Jane says "Hmm... three of the cuts must have gone through a single point." How did she arrive at this conclusion? Come to this class and find out! We'll study a whole collection of problems based on spaces that have been cut up by others.
Homework: Recommended
Prerequisites: None.

Fundamental Group. (🌶🌶🌶🌶, Sachi, Tuesday–Saturday)
"Before functoriality people lived in caves." — Brian Conrad

If you look at the equator of a sphere living in n-dimensional space, then the equator is itself a sphere of one dimension lower. It seems intuitive, at least in the only dimensions we can visualize, that you cannot retract the bigger sphere to the smaller sphere without cutting holes in the sphere. But, how do topologists prove something like that? One way is by using the powerful tool of functors. Functors give us a way of assigning groups or other algebraic objects to topological spaces. In this class we will look in particular at the functor called the fundamental group, which is the group of loops that one can draw on a space.
Homework: Recommended
Prerequisites: Point Set Topology, Group Theory
Related to (but not required for): Introduction to Groups (W1); Point-set Topology (W1); Braid Group (W3); Classifying Spaces (W3); Homotopy Theory (W4)

Generating Functions, Catalan Numbers, and Partitions. (🌶🌶🌶, Mark, Tuesday–Saturday)
Generating functions provide a powerful technique, used by Euler and many later mathematicians, to analyze sequences of numbers; often, they also provide the pleasure of working with infinite series without having to worry about convergence.

The sequence of Catalan numbers, which starts off $1, 2, 5, 14, 42, \ldots$, comes up in the solution of many counting problems, involving, among other things, voting, lattice paths, and polygon dissection. We'll use a generating function to come up with an explicit formula for the Catalan numbers.

A *partition* of a positive integer n is a way to write n as a sum of one or more positive integers, say in nonincreasing order; for example, the seven partitions of 5 are $5, 4+1, 3+2, 3+1+1, 2+2+1, 2+1+1+1$, and $1+1+1+1+1$. The number of such partitions is given by the partition function $p(n)$; for example, $p(5) = 7$. Although an "explicit" formula for $p(n)$ is known and we may even look at it, it's quite complicated. In our class, we'll combine generating functions and a famous combinatorial argument due to Franklin to find a beautiful recurrence relation for the (rapidly growing) partition function. This formula was used by MacMahon to make a table of values for $p(n)$ through $p(200) = 3972999029388$, well before the advent of computers!

Homework: Recommended

Prerequisites: Summation notation; geometric series. Some experience with more general power series may help, but is not really needed. A bit of calculus may be useful.

Related to (but not required for): Problem Solving: Combinatorics (W2); Summing Series (W2)

Introduction to Complexity. (🌶🌶🌶, Pesto, Tuesday–Saturday)
This is a class about what computers that don't exist can do. If you had a computer that could run forever (certainly much more than the lifetime of the universe), but only had a fixed finite memory, what could it do? What if you had a computer that could guess the answer to any question you ask it, but wasn't sure whether it had guessed correctly? What about a computer that could ask *those* computers for advice and get answers immediately?

We'll sort those computers by their power and classify problems according to which of those computers can solve them: for instance, we'll show that designing an optimal route for a traveling salesman (or even getting very close to it) is exactly as hard as solving a jigsaw puzzle, in that the same set of those computers can do so, but determining who wins a game of (generalized) chess is harder.

This is a class not only too pure (like the week 1 algorithms class) to look at actual code, but also too pure to look at actual algorithms. No coding experience relevant. Algorithms experience only relevant for a bit of flavor.

Homework: Recommended

Prerequisites: None.

Related to (but not required for): Algorithms (W1); Turing and his Work (W2); Cryptography (W3)

Required for: P vs NP (W4)

Tower of Hanoi. (🌶, Julian, Tuesday–Wednesday)

> In the great temple at Benares, beneath the dome which marks the centre of the world, rests a brass plate in which are fixed three diamond needles, each a cubit high and as thick as the body of a bee. On one of these needles, at the creation, God placed sixty-four discs of pure gold, the largest disc resting on the brass plate, and the others getting smaller and smaller up to the top one. This is the Tower of Bramah. Day and night unceasingly the priests transfer the discs from one diamond needle to another according to the fixed and immutable laws of Bramah, which require that the priest must not move more than one disc at a time and that he must place this disc on a needle so that there is no smaller disc below it. When the sixty-four discs shall have been thus transferred from the needle on which at the creation God placed them to one of the other needles, tower, temple and Brahmins alike will crumble into dust, and with a thunderclap the world will vanish.
>
> — *Henri de Parville (1884), translated by W. W. Rouse Ball*

So goes the legend. But what of the mathematics of the problem?

- What is the optimal solution (that is, the one which requires fewest moves) if we have n discs?
- What is the optimal way to get between two given (but arbitrary) legal states? (This is more subtle than it seems: many incorrect solutions to this question have been published! 'Legal' means that no disc lies on top of a smaller disc.)
- What is the optimal solution for moving n discs from one disc to another if there are 4 pegs instead of 3? Or 5 pegs? Or p pegs?
- What other interesting variants and corresponding problems can we suggest?

As we explore these questions and others, we will run into connections with fractals (!) and other pretty mathematics. We will see open problems and conjectures along the way; you might wish to explore one of these for a project.

Before class begins, you might wish to think about the following problem:

For a Tower of Hanoi with n discs (and 3 pegs) draw a graph showing all legal positions and moves between them. Can you find a nice way to present this graph?

Homework: None

Prerequisites: None.

11:10 Classes

Galois Cohomology. (🌶🌶🌶🌶, Ruthi, Tuesday–Saturday)
A lot of math is about figuring out when two things are the same — or rather, isomorphic. This turns out to sometimes be very difficult, so we do what mathematicians always do: we try to solve an easier question. From such an attempt comes group cohomology, and specifically Galois cohomology, which deals with profinite groups — bizarre groups that are almost finite… but not quite, and carry a weirdly unintuitive topological structure.

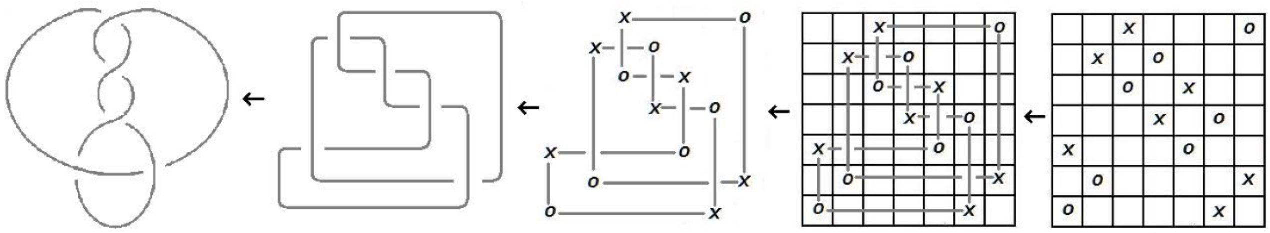
Galois cohomology turns out to be the right abstract tool to study certain aspects of advanced number theory, and if you put the content of this class together with other topics (algebraic number theory, quadratic forms, elliptic curves, to name only a few), you turn out to be able to solve interesting problems in beautiful, succinct ways.

Homework: Recommended

Prerequisites: Group theory, Point-set topology

Related to (but not required for): Algorithms in Number Theory (W1)

Intro Knot Theory. (🌶🌶, Nancy, Tuesday–Saturday)
Knot Theory!



Knot theory is the study of distinguishing when two knots are the same, or not. If this looks cool, come take my class!

If you've seen some knot theory before but are wondering whether you should take this class, here are some topics we'll be covering: Reidemeister's Theorem for classifying knots, tri-colorability, Seifert Surfaces, grid diagrams, Alexander Polynomial, braid group, and maybe more.

Homework: Optional

Prerequisites: Understand what a matrix is and how to take a determinant.

Related to (but not required for): Braid Group (W3)

Reflection Groups. (🌶🌶🌶, Don, Tuesday–Saturday)
A reflection group is a group generated, unsurprisingly, by reflections of $\mathbb{R}^n$. Many interesting families of groups are reflection groups, including dihedral groups, S_n, and the symmetry groups of polyhedra.

In this class, we'll study the basic properties of reflection groups, and do our best to classify the finite reflection groups. In particular, we'll see how to classify the crystallographic coxeter groups - groups which fix a lattice in the same $\mathbb{R}^n$ the group is acting on. These groups have deep and important applications, ranging from chemistry, to virology, to my own research - and yet their classification uses just a few families of (very simple) finite graphs.

Homework: Required

Prerequisites: Linear algebra, group theory

Related to (but not required for): Classifying Symmetry (W1); Polyhedral Symmetry in the Plane? (W1); Lie Algebras (W3); Representation Theory (W3–4)

Unsolved Problems in Cosmology. (🌶🌶 → 🌶🌶🌶, *Charles Steinhardt*, Tuesday–Saturday)
One of the wonderful things about astronomy is that modern astronomy is a very young field, with many important unsolved problems. In the past couple of decades, we have come to realize the vast extent of our fundamental ignorance about the nature of the universe: as it turns out, all of the physics that we have produced throughout history seems to be a good description of about 4% of the stuff that makes up the universe, with the rest composed of mysterious "dark matter" and "dark energy".

We'll go through some of the highlights of modern cosmology, focusing on the things we still don't understand and building up to trying to understand what happened in the first few instants after the Big Bang, and why it poses such a fundamental challenge to our view of the universe.

Homework: Recommended

Prerequisites: Some high school physics/chemistry (feel free to ask if you're not sure). Knowing differential equations will help for part of the course, but is not necessary.

1:10 Classes

Coloring Maps. (🌶, Jeff + Marisa, Wednesday–Saturday)
In a "properly" colored map, states that share a border are painted different colors. During an election year, when we paint the states in the US red and blue, no matter how carefully we rig the elections,

we'll never get a proper coloring – because Washington, Oregon, and Idaho will need three different colors. Even if the Green Party were to win many states, we would need more colors: consider Nevada and its neighbors! So, what's the minimum number of colors you need to properly color the US?

In this class, we will introduce graphs, a combinatorial structure underlying maps, and prove that any configuration of countries on the Earth can be properly colored with five colors.[1] Then we'll leave the Earth behind and consider what happens to our colorings when the planet is shaped like a donut.

Homework: Recommended

Prerequisites: None.

Related to (but not required for): Coloring in Space (W2)

Required for: Network and Combinatorial Optimization (W3); Graphs on Surfaces (W3); Unlikely Maths (W4)

Summing Series. (, Kevin, Wednesday–Saturday)
Combinatorial sums like $\sum_{i=0}^{n} \binom{n}{i}^2$ often crop up. Some, like this one, are wonderful – there are elegant combinatorial interpretations that yield a closed-form solution, and failing that key combinatorial insight, several neat strategies exist to work your way towards an answer.

In this course, we'll develop some of these amazingly effective strategies that allow us to sum all sorts of beautiful series. And by summing some difficult series, we can (and will, if you do all the homework!) prove some famous results in mathematics, like the fact that the circumference of the unit circle is 2π! This is *not* the most sensible approach, but we'll also use our tools for more appropriate (and more difficult!) tasks, like proving the celebrated hook length formula for tableaux.

And time permitting, we might even tackle some monsters like $\sum_{i=0}^{k-1} \frac{(i+2)(i+3)(i+9)(i+10)}{(i+13)(i+14)} 2^i$. Good luck finding a combinatorial interpretation of this disaster, but we'll learn how to handle them systematically!

Homework: Recommended

Prerequisites: None.

Related to (but not required for): Generating Functions, Catalan Numbers, and Partitions (W2)

The Ham Sandwich Theorem and Friends. (, Yuval, Wednesday–Saturday)
The Ham Sandwich Theorem says that if you have a ham sandwich (consisting of two pieces of bread and a piece of ham), then you can cut it into two pieces with one knife cut in such a way that each piece gets exactly half the ham and half of each slice of bread.

This is a great theorem, but there's a problem: a ham sandwich consisting of just bread and ham is a really boring ham sandwich. What if you want your ham sandwich to have cheese, vegetables, mayonnaise, mustard, or other things? Well, you can't divide each of these equally if you only allow yourself a straight knife. But if you have a polynomial-shaped knife, you can!

[1]You can do four, actually, but that's much harder to prove.

In this class, we'll learn about the Ham Sandwich Theorem and some of its friends, and we'll even learn to cut some things that aren't sandwiches. We'll eventually get so good at cutting things that we'll be able to prove famous results, like the Szemerédi-Trotter theorem.

Homework: Recommended

Prerequisites: None.

Related to (but not required for): A (re)Introduction to Polynomials (W1); Measure and Martin's Axiom (W1); Lebesgue Measure (W3)

Turing and his Work. (🌶🌶, Sam, Wednesday–Saturday)
Were you sad to hear that Turing was not visiting Mathcamp this year? Disappointed that you couldn't hear him give a colloquium on some of his work, or that you wouldn't be able to have a conversation with him? Then come to this class, where we'll do the next best thing!

Our goal in this course will be to, as much as possible, try to understand who Turing actually was, and to learn about some of his work in AI. Day 1 will put his work into the context of his life; even though Benedict Cumberbatch is awesome, his portrayal of Alan Turing was more "Hollywood" than "accurate." After that, you guys will get a chance to drive the course: you'll be asked to read one or two of Turing's more accessible papers, and in class we'll chat about both the papers and the related mathematics (largely within the subject of computability). At a bare minimum, you'll get to read the paper where Turing gave his most complete treatment of The Imitation Game! We may also discuss Turing Machines and his algorithm for a computer to play chess. Note: "Homework Required" means that you will be asked to read one (maybe 1.5) accessible paper by Turing over the course of the week.

Free Bonuses: you'll get to read actual papers by Turing, learn from him vicariously, and feel awesome about having read an actual paper. (Unfortunately, I'm not allowed to throw in a free set of steak knives.)

Homework: Required

Prerequisites: None!

Related to (but not required for): Introduction to Complexity (W2)

Superclass (11:10–12:00, 1:10–3:00)

The Banach–Tarski Paradox. (🌶🌶🌶, Alfonso + Chris, Tuesday–Saturday)
You have heard of the Banach–Tarski paradox: take a ball, break it into a few pieces, shuffle those pieces, glue them back in a different way, and now we have two balls of the same size as the original one! Nifty trick, but how does it work? In this course you get to develop the whole mathematical theory behind this construction and prove that it actually works!

This is a superclass that meets for two class hours a day (and possibly the first hour of TAU if we need it). You will be doing most of the work: we will provide worksheets with the right definitions and questions; you will spend a big chunk of the time working, alone or in groups, sometimes with our help, on all the steps of the construction. Some of the class time will be spent on presentation and discussion of your proofs.

This course is time-consuming, but all the work (homework included) is contained in the three daily hours.

Homework: Required

Prerequisites: Basic group theory, linear algebra (matrix multiplication, and understand how a matrix represents a linear transformation).

Related to (but not required for): Measure and Martin's Axiom (W1)

Colloquia

Neural Codes. (*Mo Omar*, Tuesday)
Neurons in the brain represent external stimuli via neural codes: binary strings that encode which neurons are on/off at any given time or location. These codes often arise from stimulus-response maps, associating to each neuron a convex set where it fires. An important problem confronted by the brain is to infer properties of the regions in which a neuron fires, using only information intrinsic to the neural code. How is this construction problem approached? With some convex geometry, some algebra, and a whole lot of fun!

Finding my Place in {Teacher Educators} ∩ {Mathematicians}: Bringing a Mathematical Eye to Teacher Education. (*Nina White*, Wednesday)
When we think about mathematicians' contributions to K-12 math education, many people first think of curriculum development. But this is just the tip of the iceberg; curricula are not enacted without quality teachers and one very central role mathematicians play in improving K-12 education is educating teachers. In this colloquium I'll share why teacher education is not only important, but interesting. We'll focus on two questions that have been asked over the ages: "what mathematics do teachers need to know?" and "who should teach it?" I'll include current and historical examples of how mathematicians contribute to teacher education and describe different professional trajectories, including my own, from the world of mathematics to the world of mathematics education.

Are We Special? (*Charles Steinhardt*, Thursday)
Unlike in mathematics, in science we don't rigorously prove things according to a set of axioms, but learn from experiments and observations about the world around us. In order for this to be a fruitful approach, it is necessary to assume that our experience is somehow typical, and that we can use an experiment in a laboratory to learn about the forces responsible for, say, assembling galaxies. But bizarrely, the leading theories for the fundamental nature of our universe and of its origin seem to require that we live in a very special time and place, without any hope of testing that assertion. We'll explore the idea of what it means to be a "random" observer, what it might mean to be "special", a question that is currently the subject of a significant split in the scientific community, and what it tells us about the future of the scientific method.

Vistor Bios

Charles Steinhardt. Charles first came to Mathcamp as a student in 1996, and works on a wide variety of problems, ranging from computer science and high-energy physics to astronomy. Most recently, he has been trying to understand how the first galaxies in the universe form, a problem that has proven to be particularly intriguing because with our current understanding of physics, they seem to have formed impossibly early. Outside of astrophysics, he has played baseball for a strong Japanese amateur team, has played poker to earn a living, and is currently scheming to find a good excuse to use a chicken cannon this summer.

Matt Stamps. Matt Stamps applies ideas from geometry and topology to problems in combinatorics, mechanical engineering, and biology. This often involves studying spaces whose points correspond to more complicated objects, like graphs or robot arms or proteins... Aside from math, Matt loves to travel and write short stories in coffee shops around the world; he's visited fourteen countries outside of the US and Canada within the last three years.

Moon Duchin. Moon Duchin works in geometric topology and geometric group theory. She particularly looks at the large-scale geometric structure of groups and unusual metric spaces. One recurring theme is taming the geometric infinite by either attaching a "boundary at infinity" to a space you want to study, or else approaching it dynamically by understanding what happens after you flow or jump around in your space for a really long time. She's also actively interested in history, philosophy, and cultural studies of science.

Samin Riasat. Samin is a masters student in pure mathematics at the University of Waterloo, planning to start his PhD there this fall. He's mostly interested in number theory, the field in which he will be pursuing his PhD. He is into olympiad mathematics and is involved with the Bangladesh Mathematical Olympiad.

Mo Omar. Mo Omar is an assistant professor in the Department of Mathematics at Harvey Mudd College. His research interests lie in the interplay between algebra, combinatorics, and optimization. Mathcamp is near and dear to his heart; he was an academic coordinator and a mentor in past years and earned fame by trolling anagram games with 4-letter crustacean larvae. For fun he plays in a competitive LGBT basketball league, creates math contest problems, frequently visits a cafe in Los Angeles housing over 700 board games, promotes all things Canadian (minus Rob Ford) with emphatic pride, and screams impatiently while watching Wheel of Fortune.

Nina White. After meeting multitudes of former Mathcampers and Mathcamp staff, Nina White finally attended Mathcamp, as mentor, in 2007-2009. She returned in 2013 as Academic Coordinator. Her current position at University of Michigan is to design and teach mathematics courses for future elementary and high school teachers. She thinks daily about teaching, learning, mathematics, and how to successfully bring the three together. Her PhD focused on hyperbolic 3-manifolds, and she has a lasting love for all things geometric.

Adina Gamse. Adina first came to Mathcamp as a camper in 2005. She is now a graduate student studying topology and symplectic geometry. When not doing math(s) she can sometimes be found on the flying trapeze.

Andrew Guo. Andrew Guo was a camper in 2008, 2010–2012 and a JC in 2014. He is currently a rising senior at Stanford, where he enjoys hopping in fountains and climbing trees. His current mathematical interests are related to physics, specifically in Quantum Information Theory, but he also dabbles in General Relativity and High-Energy Physics. He will be helping to run a math tournament in Beijing, China this summer.

Yuliya Gorlina. Yuliya is a longtime Mathcamp veteran, having been a camper from 1999–2001, and a JC from 2002–2004. She received a BS in math from Caltech in 2005, and did a PhD in Math at the University of Arizona. Yuliya is currently a Business Intelligence Developer at Epic in Madison, WI.