CLASS DESCRIPTIONS — WEEK 4, MATHCAMP 2009

Contents

9:00 AM Classes

Representation Theory of Finite Groups. ($\frac{1}{2}$; Mark; week 1 of 1)

It turns out that you can learn a lot about a group by studying homomorphisms from it to groups of linear transformations (if you prefer, groups of matrices). Such a homomorphism is called a *representation* of the group; representations of groups have been widely used in areas ranging from quantum chemistry and the physics of elementary particles to the famous classification of all finite simple groups. For example, Burnside, who was one of the pioneers in this area together with Frobenius and Schur, used representation theory to show that the order of every finite simple group that is not cyclic must have at least three distinct prime factors. (The smallest example of such a group, the alternating group A_5, is important in understanding the unsolvability of quintic equations by radicals.) We won't get that far, but you should definitely get to see some unexpected, beautiful, and important facts about finite groups, along with proofs of most if not all of them.

Prerequisites: Group Theory and Linear Algebra, no fear of abstraction

Homework: Recommended

Olympiad Problem Solving. (; Alison; week 1 of 1)

This is a class for students who want to train for olympiad competitions such as USAMO, or who just like doing olympiad probems for fun. This week's topics are classical geometry (Tues-Wed) and combinatorics (Thurs-Sat).

Prerequisites: Problem solving experience

Homework: Required

Related to: Olympiad Problem Solving (Week 1), Olympiad Problem Solving (Week 2)

Sums of Squares and Pell's Equation. (; JR; week 1 of 1)

We will be studying two famous (and related) questions in number theory. The first question asks: if a positive integer n is given, can we write n as the sum of two squares? This question has a very nice solution, which was found by Fermat in 1640. The second questions is: If d is a fixed positive integer, then what are the integer solutions to the equation $x^2 - dy^2 = 1$? The equation $x^2 - dy^2 = 1$ is known as Pell's equation, and also dates back several hundred years.

Although both of the questions involve only the integers, it turns out that the best way to understand these problem is to consider larger sets of numbers. When looking for integers that can be written as the sum of two squares, we will examine complex number of the form $a + bi$, where a and b are integers. When studying Pell's equation, it is natural to consider real numbers of the form $a + b\sqrt{d}$, where again a and b are integers.

In this class, you will learn a little bit of ring theory (sets like $\{a + bi : a, b \in \mathbb{Z}\}$ and $\{a + b\sqrt{d} : a, b \in \mathbb{Z}\}$ are called 'number rings'). We will use this machinery to solve these two wonderful problems.

Prerequisites: Familiarity with arithmetic mod p, and familiarity with the complex numbers

Homework: Recommended

Category Theory. (; *Anti*; week 1 of 1)

> "Good mathematicians see analogies. Great mathematicians see analogies between analogies." – Stefan Banach

If you've learned about sets, you may have learned about functions and Cartesian products of sets. If you've learned about groups or rings, you may have learned about group and ring homomorphisms and direct products. If you've learned about topological spaces, you may have learned about continuous maps and product topologies. And if you've learned about two or three of these things, you might have started to notice some analogies.

Category theory is a language for describing these sorts of analogies. It's a framework which suggests fruitful questions to ask about new fields of of mathematics. And it's a tool for saving work by proving theorems once in general language, instead of many times in different language. In this class we'll study categories, functors, limits and colimits, and maybe even adjunctions; homework will be working out details in your favorite examples. Hopefully by the end of the week you'll understand what John Baez meant when he said "every sufficiently good analogy is yearning to become a functor."

Prerequisites: Some exposure to at least two of the following: groups, rings, fields, modules, vector spaces, topological spaces, metric spaces, manifolds, partial orders, or other abstract structures

Homework: Recommended

10:00 AM Classes

Boolean Algebras. (; Waffle; week 1 of 1)

You may have learned about "Boolean algebra" in a computer science class. In that setting, Boolean algebra is the behavior of 0 (false) and 1 (true) under logical operations like "and", "or", and "not". It's really not that interesting, since there's not very much you can say about this.

The mathematical notion of a Boolean algebra, on the other hand, is a vast and very interesting generalization of this. A Boolean algebra is an abstract collection of "truth values" on which we have operations called "and", "or", and "not" which obey the usual rules of logic. You can think of an element of a Boolean algebra as representing a degree of certainty or probability in the truth of something about which you have incomplete knowledge. For example, if you're thinking of an integer n and I don't know what n is, the statement "n is odd" is neither true nor false from my perspective—it's somewhere in between.

The fundamental theorem on Boolean algebras says that any Boolean algebra can be represented on a collection of "possible worlds" called *ultrafilters.* An ultrafilter is a world in which everything is either true or false. The reason that not everything is either true or false in the Boolean algebra is that we don't know which world we're in. For instance, in the example given above, there is a world in which $n = 0$, a world in which $n = 1$, and so on. In some of these worlds n is odd and in others n is even. The theorem then says that we can identify every element of the Boolean algebra with the set of worlds in which it is actually true (so we identify "n is odd" with the set of worlds in which n actually is odd).

What does all this have to do with topology? It turns out that lots of interesting examples of Boolean algebras come from topological spaces. In fact, the set of ultrafilters of any Boolean algebra naturally forms a topological space, and Boolean algebras are really the same thing as certain special topological spaces (totally disconnected compact Hausdorff spaces). We'll learn a little category theory to figure out what we mean by "the same thing" and then do some topology to prove this.

Prerequisites: Pointset Topology; some experience with abstract algebra is also recommended

Homework: Recommended

Related to: Pointset Topology

The 27 lines on a cubic surface. (; *Dave Savitt*; Tuesday-Wednesday)

The cubic Fermat surface F_3 is the surface in 3-space whose equation is $x^3+y^3+z^3 = 1$. If you allow yourself to consider F_3 as a *complex surface* – that is, if you consider its complex solutions, and not just its real solutions – then it's not hard to see that this surface contains 27 different lines. Here's how to write them down. Let ζ and ζ' be cube roots of 1. Then the lines are $\begin{cases} (t, -\zeta t, \zeta') \\ (t, \zeta', -\zeta t) \\ (\zeta', t, -\zeta t) \end{cases}$. Since there are three choices for each of ζ and ζ' and three different families of lines, we've written down a total of 27 lines.

The amazing fact is that *every* cubic surface contains *exactly* 27 lines, if you count them correctly; that is, no matter what cubic polynomial in three variables you write down, its solution set will always contain 27 lines. In this class, we'll prove this theorem.

Prerequisites: Linear algebra, especially determinants

Homework: None

Combinatorial Game Theory. (; *Alfonso Gracia-Saz*; Thursday-Saturday)
We have a plate with blueberries, blackberries, and raspberries. We take turns eating them. In your turn, you may eat as many berries as you want, at least one, but they all have to be of the same type. Then it is my turn. Unless you are Abi, the goal is not to eat a lot of berries: the winner is the person who eats the last one. Will you beat me?

The above is an example of an impartial combinatorial game. There are tons where it came from, and you probably have encountered some. To solve them all, there are basically only two weapons that you need to learn. I propose you two paths to enlightment.

If you are patient, my little grasshopper, come to the class. I will motivate the two weapons and I will guide you all to discover them. The beauty of this topic is as much in the final results as it is in the journey, and I do not want to deprive you of the pleasure of discovering it slowly. We will also attack many examples, from easy ones to actual open problems. The colloquium on Friday will then be just one of the four meetings that this course has.

If you prefer a crash course, on the other hand, you can attend the colloquium only. It will be a self contained lecture, and you will still learn the two weapons. I should warn you, however, that it will spoil the journey.

Prerequisites: None

Homework: Optional

Geometry and Transformations. (; Nina; week 3 of 3)
The third week of this course will cover [1] hyperbolic surfaces and some spherical geometry.

Feel free to jump in starting Friday for a smattering of spherical soliloquies .

Friday: Isometries of the 2– Sphere: quaternions, RP^3, and $SO(3)$.
Saturday: Surfaces of positive curvature.

Prerequisites: To enter Friday: Linear Algebra

Homework: Required until Friday

[1] pun intended ⌣̈

Shock Waves and Traffic Flows. (; Mike; week 1 of 1)

What happens if you slam your brakes on a crowded freeway? The car behind you slows down, which causes the car behind that one to slow down, and so on. Even after you get back up to speed the congestion can linger for much longer, and may even propagate backward or forwards.

This class will be an introductory look at a particular class of PDE (Partial Differential Equations) which we can use to model the way viscous fluids propagate, spreading out and forming shocks. While we're at it we may as well assume that cars and people form a viscous fluid, which works out reasonably well on the whole . . . assuming your highway has only one lane.

Prerequisites: Calculus, partial derivatives

Homework: Optional

Related to: Fourier Analysis

11:00 AM Classes

Algebraic Topology. (; *Megumi Harada*; week 1 of 1)

Topologists are mathematicians who study qualitative questions about geometrical structures. For example: we do not ask: "How big is it?" but rather, "Does it have any holes in it? Is it all connected together, or can it be separated into parts?" Put another way, topology can be thought of as a study of shapes that arises when we use a particularly flexible notion of an "equivalence" of two objects, i.e. we say that two shapes are equivalent ("homeomorphic") if one can be continuously deformed into the other. As a quick example, a sphere is homeomorphic to a cube, as you can probably visualize pretty quickly. Because there are very many continuous deformations, it is quite hard to prove that two shapes are not equivalent in this sense. For example, it may seem obvious that a sphere (here we mean the surface of a ball, not the solid ball) cannot be continuously deformed into a torus (here we mean the surface of a normal, single-holed Dunkin' Donuts doughnut), since they are fundamentally different shapesone has a hole and the other does not! However, it is not easy to turn this intuition into a rigorous argument.

Algebraic topology is, as the name suggests, a marriage of algebra and topology. The way we will see this in action in this class is by the use of the fundamental group of a topological space. In particular, we'll see how group-theoretic ideas, married with a bit of topology, can prove that indeed, the sphere is not equivalent to the torus. Time permitting, we'll also see some unexpected applications of these ideas, like Brouwer's theorem (in dimension 2) which states that any continuous map of a 2-dimensional disc to itself must have at least one fixed point.

Prerequisites: Group theory, some familiarity with notions from calculus (e.g. continuity of a function)

Homework: Highly recommended

Factoring. (; David; week 1 of 1)

Suppose you want to factor $10^{64} + 1$. Or you want to factor $x^{300} + 88x^{60} + 1$. How would you do it?

Well, the first thing to note is that you should use a computer. But even with a computer, these problems are hard enough that a brute force approach will get you nowhere (well, you may be able to factor the polynomial). We need to be more clever.

In this class we'll discuss algorithms for solving these two problems: integer factorization and factorization of polynomials. Specifically, I'll describe the Multiple Polynomial Quadratic Sieve, which is the second fastest known factoring algorithm for general integers, and the Cantor-Zassenhaus algorithm for factoring polynomials over $\mathbb{Z}/p\mathbb{Z}$.

Don't be scared by my classes in the first three weeks: this one will be easier. In particular, we'll spend the first day learning about the linear algebra and quotient rings that we'll be using for the rest of the week. If you already know a lot of algebra, feel free to skip the first day.

Prerequisites: Enough linear algebra to know what a basis is, how to translate between linear maps and matrices, arithmetic with polynomials over $\mathbb{Z}/p\mathbb{Z}$, Euclidean algorithm for gcds of integers (I'll explain how it generalizes to polynomials)

Homework: Optional

Trail Mix. (& ; Mark; week 1 of 1)

Would you like a snack and a break from your hard-core mathematical adventure? Try one or more of these classes, which are one-time offerings without homework (but if you're intrigued by things that come up, we can definitely talk more during TAU or some other time).

- *Perfect Numbers* (, Tuesday)

  Do you love 6 and 28? The ancient Greeks did, because each of these numbers is the sum of its own (positive) divisors, not counting itself. Such integers are called *perfect*, and while a lot is known about them, other things are not: Are there infinitely many? Are there any odd ones? Come hear about what is known, and about what perfect numbers have to do with an ongoing search for large primes of a particular form, the so-called Mersenne primes - a search which has largely been carried out, with considerable success, by a large network of "volunteer" computers.

  Prerequisites: None

- *The Pruefer Correspondence* ($\frac{1}{2}$, Wednesday)

  Suppose you have n points around a circle, with every pair of points connected by a line segment. (If you like, you have the complete graph K_n .) Now you're going to erase some of those line segments so you end up with a tree, that is, so that you can still get from each point to each other point along the remaining line segments, but in only one way. How many different trees can you end up with? The answer is surprisingly neat, and we'll go through a combinatorial proof that is particularly cool.

  Prerequisites: None

- *Continued Fractions* (, Thursday)

  If you start writing down the numbers

$$1,\ 1+\frac{1}{1},\ 1+\frac{1}{1+\frac{1}{1}},\ 1+\frac{1}{1+\frac{1}{1+\frac{1}{1}}},\ \ldots,$$

  what happens if you decide not to stop, that is, to continue? What numbers can be represented by "continued fractions" similar to this one, and by more general ones? What do such things have to do with Pell's equation $x^2 - Dy^2 = 1$? We'll try to answer some, and maybe all, of these questions.

  Prerequisites: None

- *Integration by Parts and the Wallis Product* (, Friday)

  Integration by parts is one of only two truly general techniques for finding antiderivatives (the other is integration by substitution). In this class you'll see (or review) this method, and two of its applications: How to extend the factorial function, so that there is actually something like the "factorial of 1/2 " (although the generally used terminology is a bit different), and how to derive the famous product formula

$$\frac{\pi}{2} = \frac{2}{1}\cdot\frac{2}{3}\cdot\frac{4}{3}\cdot\frac{4}{5}\cdot\frac{6}{5}\cdot\frac{6}{7}\cdots$$

  which was first stated by John Wallis in 1655.

  Prerequisites: Basic single-variable calculus

- *The Chinese Remainder Theorem.* ($\frac{1}{2}$, Saturday)

  Suppose one celestial phenomenon happens every seventy years, including last year, and another one happens every forty-one years, including next year, and a third one happens every fifty-nine years, including this year. Will they ever happen in the same year, and if so, when will that be? The Chinese Remainder Theorem can help answer questions like this, and the theorem is quite helpful throughout elementary number theory. If you haven't seen it and you like number theory, do consider taking this class.

  Prerequisites: Modular arithmetic will probably be enough, although a bit of number theory experience beyond that might help.

1:10 PM Classes

Topics in Topology. (; Shoe; week 1 of 1)

Join us as we move beyond the basics of the first two weeks to some more advanced and more interesting topics. We will begin by defining infinite product spaces, including a detailed study of $\mathbb{R}^\infty$ and its properties. We will see if $\mathbb{R}^\infty$ is a metric space (according to our normal metric, the diagonal of a cube of side length 1 has length $\sqrt{n}$ in $\mathbb{R}^n$, but we don't want the unit cube in $\mathbb{R}^\infty$ to be unbounded.... can we resolve this?). We will study topological manifolds (that is, spaces which locally look like $\mathbb{R}^n$). One question we will answer is: can any manifold be imbedded in $\mathbb{R}^n$ for some n? (The Klein bottle cannot be imbedded in $\mathbb{R}^4$ but it can be imbedded in $\mathbb{R}^4$). We will probably have time to explore other fun theorems, such as a topological proof of the infinitude of primes.

This class will not be any harder than the Point-Set topology class of 2 weeks ago, its just that now we have more tools at our disposal, so we can do more!

Prerequisites: Point-Set topology, or previous knowledge (definitions, the subspace, product space, and quotient space topologies, connectedness and compactness)

Homework: Required/Recommended

Related to: Algebraic Topology

Fourier Analysis. (; Mike; week 1 of 1)

As if your analysis weren't furry enough already ...

Fourier analysis is the decomposition of functions into waves, or more generally the use of symmetry to study functions and other objects. We do this because it's pretty and powerful, and because we want to talk on the telephone to call our parents. Fourier transforms are the basis for some spectacular pure mathematics, and at the heart of numerous applications.

This subject is approachable from the perspectives of real analysis and linear algebra, and we will need to combine both viewpoints to achieve a satisfactory theory. We will cover Fourier transforms in several contexts, with a possible foray into Hilbert space.

Prerequisites: Calculus, Real Analysis, Linear Algebra, there will be i's, it might help to know what a group is

Homework: Optional

Related to: Real Analysis, Measure and Integration, Shock Waves and Traffic Flows, Linear Algebra, Inner Products

Half-Marathons

Computer Science and Proofs. (; *Dan Zaharopol*; week 1 of 1)

Suppose you have a logical formula, like $(x_1 \wedge \neg x_2) \wedge (x_2 \vee \neg x_3) \vee (x_3 \wedge (\neg x_2 \vee \neg x_1))$. A proof that this formula can be satisfied might be an assignment of "true" and "false" values to the variables x_i such that the formula evaluates to true.

Using this simple kind of idea, the P vs. NP problem turns into a deep question about the relative difficulty of checking that a proof is correct vs. coming up with the proof in the first place, and that's the topic of my digestif. This class is going to be a huge expansion on those ideas, building on a rich interplay between questions about what you can do with computers and questions about what kinds of proofs are satisfactory for different kinds of problems, and how much of a proof you even need to look at to verify its correctness.

We're going to begin by looking at the halting problem, a problem which no computer can solve, and use it to prove Godel's incompleteness theorem. Afterwards, we'll investigate different notions of proof and the associated computational complexity of problems that might be done with these proofs. One result will tell us that you don't need to look at a whole proof to be reasonably certain that it's correct; another result will tell us about how one prover might convince a less powerful verifier of the truth of certain statements. This will yield rich results on questions about how long computers need to solve different kinds of problems, giving us insight into the nature of computation as well as of proof.

Prerequisites: None, though for those of you who took "Computability and Complexity" last year, some of the early material may be familiar to you (we will quickly get to new stuff)

Homework: In-class

LP and Network Flows. (; Mathieu; week 1 of 1)

Many optimization problems, both abstract and concrete, can be formulated as network flow problems, which ask how much fluid can flow through a network of pipes with given capacities, or as linear programs (LP), which ask how to maximize a linear function of several variables subject to linear constraints. In this half-marathon, we'll explore how to solve these formulations efficiently, and see that there is a very nice theory of duality behind them.

Prerequisites: Linear Algebra

Homework: In-class

Martin's Axiom and the Continuum Hypothesis. (; Susan; week 1 of 1)

You may have heard that the Continuum Hypothesis is "independent" of set theory. That is to say, no contradiction arises from either the Continuum Hypothesis or its negation being added to set theory. But how would you go about proving that you *can't* get a contradiction? In this class we'll see how Martin's Axiom, an extra set-theoretic axiom, can be used to construct objects which cannot be constructed in standard set theory. Then we'll use what we've learned from working with Martin's Axiom to prove the independence of the Continuum Hypothesis.

Prerequisites: Set Theory in week 2 required, week 3 recommended. You must be familiar with ordinals, cardinals, and cardinal arithmetic. Familiarity with model theoretic definitions will be extremely helpful.

Homework: In-class

Related to: Set Theory, Infinite Trees

Colloquia

Visualizing Geometry: The Shape of Space in Higher Dimensions. (*Megumi Harada*, Tuesday)

From the ancient civilizations to modern times, human minds have consistently pondered the question: what is the shape of the universe in which we live? The answers given, as is well known, have been different during different stages of scientific inquiry. However, one feature which many of the theories have in common is (at least partially) their visual nature. As visual creatures, it is perhaps natural for us to wish to "see", or at least to imagine in some visible manner, the shape of space. This presents a conundrum: it is in fact quite difficult to "see", and hence to theorize about, shapes of space (or space-time) in higher (say, three or more) dimensions, since in most of our day-to-day experience, we are limited to two-dimensional representations of three-dimensional objects. In this sense, our everyday, quotidian techniques of visualization are inherently limited to small dimensions, whereas an understanding of the physical universe requires us to be able to "see" shapes in higher dimensions.The mathematician gets around these difficulties by undergoing a visualization training regime, in which, by using certain techniques in one- and two-dimensional situations, she may then gradually develop an intuition and an ability to sufficiently generalize these techniques allowing her to then visualize, in a concrete way, "shapes" in these higher dimensions. In this talk, I will briefly motivate the careful study of such spaces, introduce the ideas in the first steps of such a training regime, invite the audience to play some visual games, and – time permitting – briefly outline some of the mathematical techniques which both construct (and help visualize) higher-dimensional spaces, such as: gluing, direct products, fiber products, connect sum, and stereographic projection.

Quaternion Algebras. (*Dave Savitt*, Wednesday)

On October 16, 1843, while taking a walk along the Royal Canal in Dublin, William Rowan Hamilton realized that he could extend the arithmetic of the complex numbers to create an algebraic structure on four-dimensional Euclidean space: $\mathbb{H} = \{x + iy + jz + kw \,:\, x, y, z, w \in \mathbb{R}\}$ with $i^2 = j^2 = -1$ and $k = ij = -ji$. Hamilton's key idea was that the multiplication would have to be non-commutative: ij is not equal to ji.

Our questions: can we generalize Hamilton's construction to make other algebraic structures on four-dimensional spaces? If yes, then how many? Along the way to answering these questions, number theory will enter the picture in surprising ways.

Mathematics to DIE For: The Battle Between Counting and Matching. (*Jennifer Quinn*, Thursday)

Positive sums count. Alternating sums match. So which is "easier" to consider mathematically? From the analysis of infinite series, we know that if a positive sum converges, then its alternating sum must also converge but the converse is not true. From linear algebra, we know that the permanent of an $n \times n$ matrix is usually hard to calculate, whereas its alternating sum, the determinant, can be computed efficiently and it has many nice theoretical properties.

In this talk, we will investigate a variety of positive and alternating sums involving binomial coefficients, Fibonacci numbers, and other beautiful combinatorial quantities. How are the terms in each sum concretely interpreted? What is being counted? What is being matched? Do alternating sums always give simpler results? You decide.

Combinatorial Game Theory. (*Alfonso Gracia-Saz*, Friday)
For details on this colloquium see the blurb for Alfonso's class. This colloquium will not require attending the rest of the class.

Digestif

Calculus Without Calculus. (*Brenda Fine*, Saturday)
If you've ever taken a calculus class, you've almost certainly seen certain types of problems. Without a doubt, you've learned how to find the equations of tangents to curves. In all likelihood, you've learned how to maximize an area with a given shape and perimeter, and minimize the perimeter of a region of given shape and area. You've probably also seen the ol' "swim-and-run" problem of finding the route that minimizes the amount of time it takes to swim to the shore, and then run to a certain place on land. As it turns out, all of these problems - and more - can be solved without evaluating a single limit or derivative. In this brief course, we'll exploit the geometric properties of diagrams, and we'll explore some powerful inequalities that let us solve optimization problems swiftly and elegantly. Come to Calculus Without Calculus, and learn the math your calculus teacher doesn't want you to know. Previous knowledge of calculus isn't necessary, and in fact, those who have taken a calculus class before may find themselves distressed to learn just how much calculus they've used unnecessarily in the past.

Visitor Bios

Alfonso Gracia-Saz. (University of Toronto)
Alfonso Gracia-Saz has been involved with Mathcamp since 2004. Originally from Spain, he received his PhD from the University of California at Berkeley and spent one year at Keio University in Japan. He studies mathematical physics, differential geometry, higher-order algebra, and he counts both mathematicians and physicists among his collaborators. Outside of math, he loves folk dancing – contra and square dancing in particular – and is fascinated by the amount of mathematics (geometry, abstract algebra, topology, and even category theory) that can be found in the patterns.

Anti (Mike) Shulman. (University of Chicago)
In his quest to experience Mathcamp from all possible angles, this will be Anti's first year as a Visitor (he has previously been a camper, a JC, a mentor, and an AC). He acquired his current Mathcamp name (short for "Anti-mike") in 2003 after a Mike-off with the current mentor Mike. He is currently a postdoc at the University of Chicago studying category theory, but also enjoys reading and talking about topology, geometry, set theory, logic, physics, and computer science.

Brenda Fine. (Citizen of the World)

Brenda Fine studied pure math at the University of Waterloo. A glutton for punishment, she then signed up for a few more years of the same at UBC, eventually completing a thesis on tropical geometry. When she applied for a faculty position at BCIT, the department head thought that there was a typo in her CV, and that Brenda had actually studied *topical* geometry. Although Brenda cannot assure you that this bio is free of typos, she assures you that she did indeed study *tropical* geometry, with an R. As a matter of fact, if you Google "topical geometry," Google asks "Did you mean: *tropical* geometry?," which you probably did, whether you knew it or not, even though, at the time of this writing, "topical geometry" (whatever the hell that is) returns 743,000 hits. Brenda is unduly sensitive about this confusion.

Despite this misunderstanding, Brenda successfully landed the position at BCIT and has been teaching a potpourri of courses there for the last year. She also creates wheel-thrown pottery, and spends an inordinate amount of time in Irish pubs.

Dave Savitt. (University of Arizona)

Originally from Vancouver, Canada, David Savitt was the first-ever counselor at Mathcamp, and this year he will be working at his twelfth Mathcamp. David received his PhD at Harvard University in 2001 (where his work focused on an extension of the results which led to the proof of Fermat's Last Theorem) and did his postdoctoral research at McGill University (Montreal) and Institute des Hautes Etudes Scientifiques (Paris).

Jennifer Quinn. (University of Washington)

Jennifer Quinn earned her BA, MS, and PhD from Williams College, the University of Illinois at Chicago, and the University of Wisconsin, respectively. She recently joined the faculty at the University of Washington, Tacoma where she is a Professor of Interdisciplinary Arts & Sciences working to build a mathematics curriculum on the expanding campus. Prior to joining UWT, she served as Executive Director of the Association for Women in Mathematics and before that, spent more than a decade as a faculty member at Occidental College in Los Angeles. An award winning teacher, author, and scholar, Jenny thinks that beautiful proofs are as much art as science. Simplicity, elegance, and transparency should be the driving principles. Simply understanding mathematical truth is not sufficient. Instead, strive to put mathematics into a concrete framework where truth becomes apparent and ideas quickly generalize. Jenny will guide an exploration of mathematical truths by the basic combinatorial techniques of counting and matching.

Megumi Harada. (McMaster University)

Megumi Harada works on symplectic geometry, which provides a mathematical framework for classical physics and also ties in to quantum physics, combinatorics, and graph theory. Megumi loves to draw pictures and to get people excited about math. In 2005, she was the only mathematician among the 10 finalists in a televised competition for "Ontario's Best Lecturer" (billed as "reality TV with a high IQ"). She has also appeared regularly on TV Ontario's More 2 Life program to discuss mathematics in everyday life.