Course Offerings

Classes

Accessible

Number Representation

Rolfe Schmidt
What's in a name? In this course we'll question the way we write numbers and explore some other-worldly alternatives. Base 10 is only the beginning as we'll tour irrational and even complex bases, factor representations, and more. Pre-camp worksheet available here.

Card Tricks

Aaron Cho and Wendy K. Tam Cho
Come see combinatorics and number theory turn into magic with a deck of cards. Deep mathematics turns palpable for you, mystifying for your friends!

Number Theory

Burton Newman
The natural numbers 1, 2, 3, ... are some of the simplest mathematical objects one can imagine, yet simple questions about them have remained unanswered for millennia, and attempts to answer these questions have given birth to whole new fields of mathematics. In this course we will explore these questions and seek out our own!

Problem Solving and Contest Math

Matthew Cho
We prepare for math contests like MATHCOUNTS and AMC 10, and go over common topics like similar triangles, counting, independent events, and factoring. Come wrestle with some hard problems until they become easy.

Indo-European Languages

Todd Krause

Did you know English is related to German? You might've guessed, if you've seen some common words: *Vater* 'father', *Mutter* 'mother', *zwei* 'two', *Hand* 'hand'. But it's also related to Italian, to Greek, to Russian, and even to Hindi. How does that work? It's hard to see those relations just by looking, say, at newspapers in those languages today. But the farther back in time you go, the more commonalities you find.

This class will help you understand what it means for languages to be related and how the discipline of historical linguistics establishes these relationships. We will mine the history of English for clues as to how languages evolve over time. We will leap from Old English, the earliest recorded form of English, to other ancient languages that show similar patterns in both grammar and vocabulary. What other languages could we peruse and perhaps find shared traits? Latin? Ancient Greek? Gothic? (I thought that's just a way of dressing…) Sanskrit? Old Church Slavonic? Tocharian? (OK, now you're just making things up…)

Together we'll find out how, the farther back in time we go, the clearer the relations become among the members of the Indo-European family tree. Are you ready to learn a few languages?

Pre-camp worksheet available here.

Intermediate

Calculus (Just the Fun Parts)

Burton Newman

Calculus usually has a lengthy list of prerequisites, but we'll circumvent these using Desmos and Sage. Using these tools we'll discover and explore patterns that have fascinated some of the greatest mathematicians throughout history. Topics include: Derivatives, Integrals, Infinite series, Power series and Differential equations.

Prerequisites: Students should have completed Algebra 1 but must not have begun Calculus formally.

Again and Again and Again…

Burton Newman

Pick a number and add 2 (mod 5). Now add 2 again (mod 5). Now add it again and again and again… For example. If I pick 0 I get $0 \to 2 \to 4 \to 1 \to \ldots$ What happens? What if we multiply by 2 instead of add? What if we add 1 and then multiply by 2? We can build ever more complicated operations using just addition and multiplication. Do sequences always return to

where they began? Can you predict how such sequences will evolve? This course begins with elementary number theory but quickly evolves into a host of *unsolved* problems in an area of active research known as *dynamics over finite fields*.

Prerequisites: Algebra 2 and modular arithmetic. (Those familiar with finite fields will have opportunities for additional exploration.)

Statistical Simulation

Wendy K. Tam Cho

Very few real-world problems have tidy, closed-form solutions. With numerical methods and approximation theorems in hand, you won't need to let this slow you down. In this class we will learn to use R Studio to model systems and analyze their statistical properties. Because we have more time, this class can go deeper than it did in previous years.

Prerequisites: Some prior exposure to programming (e.g. 'if statements' and 'for loops').

Compartment Models in Epidemiology

Rolfe Schmidt

In this class we will learn about the basic tools epidemiologists use to model the spread of an infectious disease. Once we get the basics down, we'll explore all of the ways they are too simple, try to make them better, and see what real-world problems get in our way.

We will have optional programming activities in Scratch and TypeScript, and many of the activities can be done in the language of your choice.

Generating Functions

Chaim Goodman-Strauss

How many ways can you write 5 as a sum of odd numbers? 1+1+1+1+1, 1+1+3, 5 - looks like three. How many ways can you write 5 as a sum of different numbers? 5, 1+4, 2+3 - it's three again. Hmmm. Try it for 6. Try 7. Are they always equal? How can you prove it? In this class we'll learn how to turn counting problems into questions about polynomials and power series and unlock one of the most powerful and beautiful tools in combinatorics.

Have a look at a course preview here.

Advanced

Problem Solving and Contest Math

Matthew Cho
We prepare for more advanced math contests like AMC10/12 and AIME, and go over useful tools and common topics. Come wrestle with some hard problems until they become easy.

Quantum Computation

Tanay Mehta
Explore how quantum behavior gives us new computing primitives that appear to be fundamentally more powerful than our classical-physics based computers. This advanced class will teach you the basic elements of quantum computation. Prerequisites: Linear Algebra, probability theory, Boolean logic. Ask us, we can help you get this down before camp!

Computational Techniques in Cryptography

Rolfe Schmidt
Programming cryptographic systems is different. Speed and memory efficiency can be the difference between a nice idea and a practical tool. Poor memory management or leaky side channels can render a beautiful theoretical tool completely insecure. In this class we will get a glimpse at a few important tools for modern computational number theory and cryptography including fast multiplication, Montgomery ladders, and curve design for Elliptic Curve Cryptography.

View pre-camp worksheet here.

The Prime Number Theorem

Yo'av Rieck
In this challenging class you will learn how to prove one of the triumphs of Mathematics, the Prime Number Theorem. You will learn about the cauchy integral formula, the calculus of residues, zeta functions and more as we dive deeply into analytic number theory.

Course description and pre-camp worksheet available here.

Clubs

Polyhedron Club

Chaim Goodman-Strauss and Rolfe Schmidt
Come build with us! Check out our flyer here!

Map of Mathematics

Burton Newman
Is math 'finished' or is new math still being discovered? What mathematical fields are out there? What sort of objects do mathematicians working in those fields study? What sort of problems do they like to think about? Observing mathematicians in the wild via interviews, blogs, math overflow and articles, we'll explore mathematics as it's being done today. We'll work together to create a map of the modern mathematical landscape and learn about the objects being studied right now and the mathematicians that have devoted their lives to them.

Project Euler Club

Burton Newman
Any PE problems pique your interest? Come to the meetings to talk about your favorites or maybe the ones that stumped you. Show us your code!

NACLO Club

Soren Schmidt with Todd Krause
Come play language games with us! Every week we will dive into one or more problems from the North American Computational Linguistics Olympiad (NACLO), the International Linguistics Olympiad (IOL), or other international contests. Soren, our resident expert and United States IOL team alternate, will show you some of his favorite problems.