Class Clusters

Algebra

These classes are about algebraic structures, which are roughly speaking different types of sets where one can do different types of operations, and the ways they interact with each other. In doing so, they touch on many beautiful topics: symmetries, the Euclidean plane, integers, and many, many other types of math.

- Introduction to linear algebra (Narmada, W1)
- Introduction to group theory (Eric, W1)
- What are your numbers worth? (Eric, W2)
- Polygons, friezes, and snakes — oh my! (Kayla, W2)
- Introduction to ring theory (Kevin, W2)
- Representation theory of the symmetric groups (Raj, W2)
- Wedderburn's Theorem (Mark, W2)
- Linear algebra through knots (Raj, W3)
- Solving equations with origami (Eric, W3)
- Problem solving: olympiad inequalities (Ian, W3)
- How to count rings (Kevin, W3)
- Coxeter groups (Kayla, W3)
- Outer life of inner automorphisms (Steve, W4)
- Vhat are your vectors vorth? (Travis, W4)
- Polynomial Methods (Narmada, W4)
- Finite fields (Aaron Landesman, W4)

Analysis

Analysis is all about limits: describing what happens to functions when you make very very very very small changes to the inputs. In these classes, you'll think about limits in all sorts of contexts: real numbers, complex numbers, higher dimensions, and applications to other areas of math.

- Khinchin's constant and the ergodic theorem (Ben, W1)
- Fourier series (Jonathan Tannenhauser, W1)
- Metric spaces (Krishan, W1)
- Multivariable calculus crash course (Mark, W1)
- Discreet calculus (shh!) (Travis, W1)
- Epsilons and deltas (Ben & Charlotte, W2)
- Green's Theorem (Mark, W2)
- Mechanics of fluid flow (Neeraja, W2)
- Calculus of variations (Ben and Steve, W3)
- Functions of a complex variable (Mark, W3 + W4)
- A very chill intro to measure theory + dimension (Charlotte, W3)
- Why do we need measure theory? (Tanya, W3)
- Non-standard analysis (Krishan, W3)
- Perron trees (Charlotte, W4)
- aspacefillingcurve (Charlotte, W4)

Combinatorics

Combinatorics is the art of counting. This could mean something like counting the number of objects that satisfy a certain property, or studying the strategies in a finite game.

- Hlod onto yoru ahts! (Tim!, W1)
- Discreet calculus (shh!) (Travis, W1)
- Erdős's distinct distance problem (Neeraja, W1)
- Beyond inclusion/exclusion (John Mackey, W2)
- Polygons, friezes, and snakes — oh my! (Kayla, W2)
- Packing permutation patterns (Misha, W2)
- Representation theory of the symmetric groups (Raj, W2)
- Introduction to graph theory (Tim!, W2)

- First, choose randomly (Travis, W2)
- How to build a donut (Kayla, W3)
- Graph colorings (Mia, W3)
- Guess Who? (Tim!, W3)
- The sum-product conjecture (Neeraja, W3)
- Coxeter groups (Kayla, W3)
- Generating functions, Catalan numbers, and partitions (Mark, W3)
- Latin squares (Zoe Wellner, W3)
- Kuratowski's game (Ian, W4)
- Vhat are your vectors vorth? (Travis, W4)
- How to rob your friends (Arya, W4)
- How to rob your friends 2: non-transitive dice boogaloo (Eric, W4)
- Matroids and the chromatic polynomial (Raj, W4)
- Polynomial Methods (Narmada, W4)

Computer Science

These classes are all about the mathematical study of computers and algorithms. Which problems can be solved quickly by a computer? Which ones can't be solved at all? How can computers be used to draw conclusions about large amounts of data?

- Inspecting gadgets (Della, W1)
- Information Theory (Mira Bernstein, W1)
- Hlod onto yoru ahts! (Tim!, W1)
- Introduction to cryptography (Ian, W2)
- Randomized vs deterministic computation (Tanya, W2)
- Introduction to graph theory (Tim!, W2)
- Guess Who? (Tim!, W3)

Geometry

In these classes you'll think about shapes: how to slide them around, cut them up, and measure their lengths and angles. The classes you'll see in this theme range from familiar objects in the plane to much wilder shapes, where even just visualizing them is a challenge by itself.

- Cubic curves (Mark, W1)
- Geometry, under construction (Arya, W1)
- Problem solving: geometry galore (Ian, W1)
- Problem solving: triangle geometry (Zach Abel, W2)
- Parabolic curves (Misha, W2)
- Polytopes (Susan, W2 + W3)
- Solving equations with origami (Eric, W3)
- Coxeter groups (Kayla, W3)
- Vhat are your vectors vorth? or, part of the part of combinatorics and discrete geometry that ve can do easily vith linear algebra (Travis, W4)
- Intersections of algebraic plane curves (Nic Ford, W4)

Logic/Set Theory

What is a set? What constitutes a valid mathematical proof? Which axioms should we use? These classes are all about using the tools of mathematics to study the foundations of mathematics itself.

- Reverse mathematics (Steve, W1)
- Infinite arithmetic (Susan, W1)
- Introduction to model theory (Krishan, W2)
- Gödel's incompleteness theorems (Steve, W2)
- Infinite Ramsey Theory (Susan, W2)
- Consistency of arithmetic (Della, W3)
- Logic puzzles (Misha, W3)

Number Theory

How well do you know the whole numbers, $1, 2, 3, \ldots$? Do you want to get to know them a whole lot better? These classes will help you to learn about the integers and many of their friends, using whatever tools we can get our hands on.

- Introduction to number theory (Mia, W1)
- The transcendence of many numbers (including π and e) (Dave Savitt, W1)
- Bhargava's cube (Kevin, W1)
- What are your numbers worth? (Eric, W2)
- Introduction to cryptography (Ian, W2)
- The Wythoff array (Della, W2)
- Elliptic curves (Ruthi Hortsch, W2)
- Solving equations with origami (Eric, W3)
- All Aboard the Möbius (Narmada, W3)
- Music: the number theory of sound (J-Lo, W3)

Probability/Statistics

How likely is an uncertain event to occur? What's the chance of getting struck by lightning, or dealing a winnable Solitaire game? These classes will answer many questions of this flavor, although probably not these specific questions.

- Hlod onto yoru ahts! (Tim!, W1)
- Information Theory (Mira Bernstein, W1)
- Is it possible to gamble successfully? (Tanya, W1)
- Introduction to cryptography (Ian, W2)
- First, choose randomly (Travis, W2)
- Guess Who? (Tim!, W3)
- How to rob your friends 2: non-transitive dice boogaloo (Eric, W4)
- Gaussian magic (Tanya, W4)
- Markov chain Monte Carlo (Moon Duchin, W4)

Problem Solving

These classes will be all about solving problems! :)

- Problem solving: geometry galore (Ian, W1)
- Problem solving: triangle geometry (Zach Abel, W2)
- Problem solving: olympiad inequalities (Ian, W3)
- Problem solving: induction (Misha, W4)

Topology

In these classes you'll think about shapes: how they curve, bend, and stretch. These courses can be classified as "topology," as they involve studying properties of shapes that don't change when you deform them continuously.

- Homotopy groups of spheres (Kevin, W1)
- Metric spaces (Krishan, W1)
- Knot invariants (Raj, W1)
- Take it to the limit (Arya, W2)
- How to build a donut (Kayla, W3)
- Borsuk–Ulam theorem (Arya, W3)
- Coxeter groups (Kayla, W3)
- Kuratowski's game (Ian, W4)
- Braid groups (Arya & Kevin, W4)