

# Virtual Mathcamp Sneak Peek (VMCSP): Schedule

All times are Mathcamp Standard Time (MCST) = Pacific Time (GMT -7)

## 12:00 pm: Mini-Mathcampus opens

Enter from your account on [apps.mathcamp.org](https://apps.mathcamp.org) and take a few minutes to explore.

## 12:10 pm: Welcome to VMCSP! (Lounge)

A few words of introduction

A preview of Mathcampus (this summer's virtual campus)

Learn how to post virtual signs on virtual walls (using virtual blue tape, naturally)

## 12:30 pm: Mini-Classes

### A Shady Summation ☯ (Misha, *Classroom Archimedes*)

This is a class about the sum

$$\sum_{n=1}^{\infty} \frac{\lceil \pi n \rceil}{7^n}.$$

If you ask a computer what it is, it will tell you  $\frac{3}{4}$ . (Actually, the computer will struggle to tell you what it is exactly, but it will tell you that the sum is 0.75 approximately.) Is this true, or are you a bit suspicious that a sum involving  $\pi$  will simplify to such a nice rational number?

### The Length Of Sets ☯☯ (Susan, *Classroom Bolyai*)

It's easy to measure the length of an interval — just take the difference of the end points. It's also easy to measure the length of a disjoint union of intervals — just add the lengths of the intervals together. It's harder to measure the length of sets that aren't made up of intervals. For instance the “length” of  $\mathbb{Q}$  is zero, but that result takes some work. And then there are sets where the whole notion of length or measure fails entirely. In this class, we'll introduce a classical example of a non-measurable set: the beautiful and bizarre Vitali set.

### In a real hurry to get to $\mathbb{R}$ ? ☯☯ (Mark, *Classroom Cantor*)

We'll start by constructing the natural numbers from scratch (“scratch” being a technical term for basic set theory). Then we'll use more “scratch” along with the magic compressor (a technical term for working modulo an equivalence relation; previous knowledge of compressors is not required) to construct the integers, the rational numbers, and finally the reals. (Who needs the number line? What does “line” mean, anyway?) Lots of details will be skipped, and we'll go pretty fast. Let's see whether it can be done in 30 minutes!

### A Hamming magic trick ☯ (Mira, *Classroom Descartes*)

Think of a number from 0 to 15. I'm going to ask you some Yes/No questions about it — but on one of them, you can lie! How many questions do I need in order to figure out your number? We'll show how to do this in the most efficient way possible using the Hamming code. (You can perform this as a parlor trick for your friends — it's quite impressive.) Then we'll introduce higher-dimensional Hamming codes and discuss error-correcting codes more generally. (All our digital communication runs on error-correcting codes. Without them, this Zoom call would be impossible!)

### Symmetries, Games, and Invariants ☯☯ (Tim!, *Classroom Euler*)

Proving that something is possible is easy. I don't mean to diminish anybody's accomplishments, but you want to show that a thing *can* be done, you can just do it. For example, is it possible to play Smash Mouth's All Star with a Symphony of Singamajigs? Yes — [here's the proof](#). But what if you want to show something is *impossible*? That's a more complicated story. In this class, we'll try a puzzle that has no solution. Proving that it has no solution, though, will require a detour into group theory. This class will be inquiry-based. We'll talk all together at the beginning and end, but most of the class you'll be discovering things for yourselves in groups.

### A Taste of Extremal Graph Theory ☯☯ (Mia, *Classroom Fourier*)

Say I have a graph with  $n$  vertices. How many edges does it need to have in order to guarantee that it has a triangle as a subgraph? Is half of all the possible edges enough? How about a quarter? In this mini-class, we will discover the answer together and, along the way, enter into the wonderful world of extremal graph theory.

## 1:00 pm: Passing period – take a break... or not!

### Intro to hip hop cardio (Kayla, *Classroom Iwasawa*)

Do you want to break up the passing period with a fun challenge? We will be doing last summer's favorite hip hop cardio song to transition between the class blocks. Come see who *survives* this 4 minute song!

## 1:10 pm: Mini-Activities

### Playing with paper (Maya, *Classroom Cantor*)

Make a hexaflexagon or a cute origami creation. Or bring your own project and join the crafting circle.

### Team Convergence (Mira, *Classroom Descartes*)

Come playtest a new game: a team version of the improv game Convergence. We'll start with three random "input words", then split into teams of three. Each team has a few minutes to discuss the input words and come up with a way to combine them into single output word. (For example, if the input words are "flat", "fun", and "horse", one possible output might be "chess", another might be "carousel".) In the next round, the teams get reshuffled, and each team's new input words are the output words of the three team members from the previous round. If we repeat this for several rounds, will all the teams eventually converge to the same word? I have no idea! Let's try it and see.

### Change ringing (Eric, *Classroom Euler*)

Learn to play mathematical music on (virtual) bells! Change ringing is a type of music that was invented by English church bell ringers a few hundred years ago, but because of some of the physical limitations of how church bells work, the music is really just an exploration of the rich mathematics of permutations. Normally change ringing is done using either heavy bells in a tower or with handbells, but it can be done just as easily over the internet in real time (unlike many other types of music)! No musical knowledge is required. The only skill you need is counting, and you can pick it up in less than half an hour.

### Trivia! (Mia, *Classroom Fourier*)

Answer obscure questions! Dredge up arcane knowledge! Hang out with new people! Trivia has it all. (The game will be played in teams.)

### Put a song into the Game of Four (Pesto, *Classroom Germain*)

To put a song into the Game of Four, we need to make each word be at most four "word bits" long! (Word bits? You know, like A, B, C,...) We also need to make sure we save the core of a "song". That is, we need:

- the end of one line to be the same in your ear as the end of the next line;
- the line to scan well with the tune.

Form a team, pick a song, try it out! Sing it for us all at the end (if you want).

### Fictionary (Ben, *Classroom Hypatia*)

Have you ever read a new word and come up with a wonderful guess about its meaning, only to discover that it actually meant something completely different? Fictionary gives you the chance to convince people that no, actually, your definition is the right one. We'll give you a strange and obscure word, then your teams will have a few minutes to cook up a fake definition for it. All the definitions (fake and real) will be put to a vote. Your goal is to guess the right one – and to fool everyone else into guessing yours!

## 1:40 pm: Parting words and Q & A (Lounge)

A chance to meet the architect + visual artist who is designing our campus, and ask any lingering questions for the staff.

## 2:00 pm: End of Sneak Peek

There will be an **encore presentation** of the Welcome at 3pm in the Lounge for those who couldn't join us at noon, and Mini-Mathcampus will remain open for another 24 hours. Feel free to organize your own activities/conversations in any of the classrooms and post signs in the Lounge to advertise them.