

COMPUTATIONAL TOOLS FOR NUMBER THEORISTS

Part of the PCMI 2022 summer program on *Number theory informed by computation*

Lecturer: [Andrew V. Sutherland](#)

Course assistant: [Edgar Costa](#)

Syllabus

This course will introduce you to some of the computational tools available to number theorists. My hope is that these will enrich your experience of number theory in the years ahead, and in particular, during the next three weeks when you will have the opportunity to engage with a wide range of number-theoretic topics, many of which will feature interesting examples and questions that can be explored computationally.

While this course is part of the Graduate Summer School, everyone in the PCMI 2022 summer program is welcome to participate. There are, however, some important steps you need to take ahead of time in order to get the most out of the lectures. For those planning to join the problem sessions, these steps must be completed **before the first problem session on Monday** (July 18). I highly recommend completing steps 1-5 below before the first lecture so that you can follow along with the examples I will present.

In order to learn to use a new tool, you need to actually use it (not watch me use it). To that end, we have setup a [Jupyter](#) notebook server that will allow you to run computations in any of the four computer algebra systems we will be using, [Pari/GP](#), [Magma](#), [Oscar](#), [SageMath](#), and into which you can copy code and data from the [L-functions and Modular Forms Database](#). To use the notebook server you will need a laptop or tablet you are comfortable typing on that has access to the internet and a modern browser (such as [Chrome](#), [Edge](#), [Firefox](#), [Safari](#)).

If you are a student in the Graduate Summer School who does not have access to such a device, please email drew@math.mit.edu and we will arrange a loaner (otherwise I suggest pairing up with someone).

If you are unable to travel to PCMI but would still like to participate remotely you are welcome to do so. You will not be able to watch the lectures in real time, but you will have access to all of the course content and can post questions and interact with other participants on our Zulip.

In order to sign in to our [notebook server](#) and the [Zulip](#) we will be using to answer questions and share computational tips and tricks, you need to complete the following steps:

1. If you do not already have a GitHub account, create one at <https://github.com/signup>.
2. Fill out the Google form at <https://tinyurl.com/3mdcawzs>, where you will provide your GitHub username and an email to invite to the Zulip (we will not use this email for any other purpose).
3. When you receive the invitation from GitHub to join the PCMI22 organization, click the join button and then go to <https://github.com/orgs/PCMI22/people> and make your membership public (this will give our notebook server permission to authenticate you via GitHub).
4. Verify that you can login to <https://pcmi2022.org> by clicking the "Sign in with GitHub" button.
5. When you receive the invitation to join the PCMI22 Zulip, accept the invitation and make sure you can sign in using your GitHub credentials (you do not need to create a Zulip account).

The lecture notes and problem sets for this course will all be posted on the notebook server (they rely on computational content hosted there). Links will be posted on our Zulip in the `#lectures` and `#problem sessions` streams.

Your account on our notebook server will remain available to you throughout the three week PCMI summer session, not just during the week of this course. You can easily export any notebooks you create to your own device, or transfer them to a third-party host such as [CoCalc](#).

Lecture schedule: Monday, Tuesday 2pm; Wednesday 11am; Thursday, Friday 2pm.

Problem session schedule: Monday, Tuesday 4:30pm; Thursday 9:40am and 4:30pm; Friday 4:30pm.