

The lab on primes

Our text contains many questions concerning the distribution of primes and how one might attempt to generate primes via formulas. There are lots of fascinating patterns to observe, but for the most part, proving that these patterns hold will be too difficult. We're going to do this lab so that you get a feel for the *questions* in this part of number theory.

The assignment

Since we can't prove our conjectures in this lab, we're not going to write papers. Instead you will pair up with a partner to prepare a short (5-8 minutes) oral presentation for the class. Your job is to explain what you investigated using examples to illustrate your computations and support any conjectures that you may have formulated.

You must use a computer (either LaTeX or Powerpoint) to generate slides for your presentation. As a rule of thumb, if your presentation runs n minutes, you should have no more than $\lceil \frac{n}{2} \rceil$ slides. (This does not count "overlays." If you display an example "line-by-line" then I'll only count the final view as a slide.)

The goal of this assignment is two-fold. First, I want you to have fun exploring properties of primes. The other goal is for you to think carefully about how you would display mathematics in an oral presentation.

Topics

Computer programs for this lab are in the "Primes" folder on ella. I have divided the questions in the lab into 7 possible presentation topics. You are welcome to explore more than one question, but since your presentation will be very short, it will probably be best to focus on just one of the topics below in the presentation.

- (1) Explain how the Sieve of Eratosthenese works with a demonstration.
- (2) Explain (step-by-step, using examples) how the programs `prime_check` and `list_primes` work. (Show us what is happening as the programs perform their loops.)
- (3) Do Exercises 7 and 8 regarding Mersenne primes, and explain your findings. Use `mersenne_check`.
- (4) Do Exercises 9 and 10 regarding Euler primes, and explain your findings. Use `euler_check`.
- (5) Do Exercises 11 and 12 (more on formulas for primes), and explain your findings. Modify `euler_check` by replacing $m^2 + m + 41$ by the suggested polynomials.
- (6) Do Exercises 13-15 on primes mod 4, and present your findings. Use `primes_mod4`.
- (7) Do Exercises 17-20 on the distribution of primes, and present your findings. Use `count_primes_interval`.

Preparing slides

There is a sample slide presentation in our lab course directory. You can see the LaTeX files as well as the finished products. Keep the following questions in mind as you work.

- (1) How much information can your audience absorb at once?
- (2) Is there enough empty space on your slides? Empty space can help to highlight an important formula or computation.
- (3) Are you using too many slides? If the slides go by too quickly, the material won't sink in.
- (4) Is there enough information on the slides so that any numbers and formulas that appear have context? Don't just jump into listing a bunch of numbers, be sure to set up your examples carefully.
- (5) Is the type big enough to see from a distance? **Never** use a LaTeX "article" in slides. Use special slide-preparation packages to prepare slides.
- (6) Are the colors visible from a distance? Be especially careful of the colors yellow and light green as they can be very difficult to see.