Final Project

Math 242

Use computation to investigate some mathematical topic. Your project must focus on one or more questions that can be answered (at least partially) by computation. You may work alone or with a partner.

The following list contains some ideas and links to papers that may provide inspiration for your project. However, don't be limited by this list — feel free to come up with your own idea!

- Markov chains and simulated annealing
  - Bin packing problems – paper by Rao and Iyengar
  - Investigate how adding transitions changes the steady-state distribution – paper by Diaconis and Durrett
- Sequences and more: for each of the following, there are many ways to explore, verify, and expand on ideas
  - Fibonacci polynomials – paper by Flórez, McAnally, and Mukherjee
  - Moessner's Theorem – paper by Kozen and Silva
  - Ducci Sequences – paper by Chamberland
  - Collatz Numbers – paper by Lagarias
  - Catalan Numbers – Wikipedia link
- Mathematical constants: there is plenty to investigate regarding π, e, ϕ, γ, etc. See the Wiki page on Mathematical constants or this paper on spigot algorithms.
- Wheel methods for prime sieves
- Iterated fractal systems such as Barnsley's Fern
- Integer relation algorithms such as PSLQ

Deadlines

- **Friday, May 10**: Choose your topic by this day.
- **Wednesday, May 15**: Turn in 1–2 paragraphs describing what you have accomplished, what remains to do, and what questions you have.
- **Final exam period**: Project due; presentations during the final exam period. This deadline is absolutely firm, as the professor cannot accept work after the final exam period.

Deliverables

Notebook: Turn in either a Mathematica notebook or a Google Colab notebook (turn in a PDF copy and a link to your Colab notebook).* As usual, submit code that runs, and explain what your

*If you want to use some other language, talk with the professor about an appropriate format for submitting your work.

code does. Include the items mentioned in the rubric below. Your goal should be to communicate your work to another person (e.g., another student at your level who is not in this course).

Presentation: During the final exam period, each person/group should give a short presentation explaining what they did and what they observed. Presentation length should be not more than 5 minutes per person.

Grading Rubric

Your notebook will be graded on a scale of 0 to 16 points. The following rubric gives characteristics of notebooks that will merit sample point totals. (Interpolate the following for point totals that are not divisible by 4.)

16 points. Questions and goals are clearly stated, including relevant definitions or parameters. Computations are complete; code runs and is clearly explained. Conclusions are clearly stated and backed up by sufficient computational evidence. Limitations of the methodology, extensions for future work, and conjectures are discussed. Notebook is well-formatted and easy to read.

12 points. Questions and goals are stated well, though relevant definitions or parameters may be missing. Computations are mostly complete; code runs, but explanation is weak. Conclusions are unclear or not well justified. Insufficient discussion of limitations, extensions, and conjectures.

8 points. Statement of questions or goals is unclear. Computations are incomplete; explanation is ambiguous. Code may produce errors when run. Conclusions are possibly correct, but not justified. Little or no discussion of limitations, extensions, or conjectures. Notebook is difficult to read.

4 points. Serious misunderstanding of the questions or goals. Computation is inadequate for the task at hand. Work is not clearly explained. No discussion of limitations, extensions, or conjectures. Notebook is difficult to read.

0 points. Notebook is not turned in.