Final Project Information

Math 282 Computational Geometry

The final project is your opportunity to learn about a topic that we didn't have the chance to cover during the semester—and to learn about many other topics from your classmates!

For your project, you will need to explore a topic, write a paper, and give a short presentation to the class. You will need to do something to make the topic your own, rather than copying information verbatim from whatever source(s) you use. This could involve producing some examples, proving theorems, implementing an algorithm, applying algorithms to data, or making a research paper understandable to your classmates.

You may complete the project individually or with a partner. If you work with a partner, then your project should be more substantial than an individual project.

Paper

Your paper must be typed in LaTeX and submitted on Moodle by start of the scheduled final exam period (Monday, May 20, 9:00am). If you need assistance with LaTeX, talk with Prof. Wright.

Assume that the audience for your paper consists of other students in this course. Write so that your classmates could read and understand your paper. Your paper should have a bibliography with at least three references. All illustrations must be of professional quality with no handwritten elements.

For some guidelines about writing a math paper, consult *How to write mathematical papers* by Bruce Berndt: https://faculty.math.illinois.edu/~berndt/writingmath.pdf.

Presentation

During the scheduled final exam period, you will give a short presentation about your project. While the presentation does not have to be as detailed or as technical as your paper, it should give your audience a clear idea of what you have done and what you have found. The length of the talk should be about 5 minutes per person.

Your talk should involve a few slides, prepared using the technology of your choice. Make sure your slides are legible, with figures clearly labeled. Slides with pictures and concise text tend to be more informative than those filled with equations. Include references in your slides as appropriate.

Ideas

Some possible topics for the final project appear below. This list is not intended to be exhaustive—feel free to come up with other ideas as well!

1. Implement a computational geometry algorithm. Discuss implementation choices that you made and difficulties that you overcame. Always acknowledge parts of code or ideas that you found elsewhere. After implementing the algorithm, demonstrate that it works.

2. Create a visual demonstration of an algorithm or proof. An interactive demonstration that allows the user to supply input or try out multiple examples would be ideal.

3. If you have experience with C++, then you could learn to use CGAL, the Computational Geometry Algorithms Library (https://www.cgal.org/). Use the algorithms supplied in CGAL to solve a problem or create a demonstration.

4. Investigate and implement image morphing:
   http://andrew.gibiansky.com/blog/image-processing/image-morphing/
5. Investigate and implement triangulated image abstraction:
   https://puckey.studio/projects/delaunay-raster
6. Go into depth with some sort of art gallery problem.
   http://cs.smith.edu/~jorourke/books/ArtGalleryTheorems/art.html
7. Investigate motion planning or collision detection algorithms. Implement an algorithm or apply existing algorithms to some real-world scenario.
8. Investigate algorithms and applications of mesh construction. Implement an algorithm or apply existing algorithms to data.
   http://persson.berkeley.edu/distmesh/persson04mesh.pdf
9. Investigate applications of Voronoi diagrams and create a demonstration:
   http://www.voronoi.com/wiki/index.php?title=Voronoi_Applications
10. Research some aspect of the Fold-and-Cut Problem: http://erikdemaine.org/foldcut/
11. Investigate an open problem! The text gives many open problems. You can produce a quality project even without solving the problem.