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.

This will be a group project, completed in groups of two or three students.

Timeline

- **January 19:** Complete the Project Planning Survey. This will ask for possible topics and who you do (or don't) want to work with.
- **January 20:** Project topics and groups finalized.
- **January 23-27**: Afternoon class time will be devoted to final projects. Discuss progress and questions with the professor.
- **January 28, 10:30am:** Projects due. Group presentations about what you studied and discovered.

Paper

Your paper should explain what you have learned or discovered as part of your final project. 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 must be typed (with proper Mathematical typesetting) and submitted on Moodle by start of the scheduled final exam period (Saturday, January 28, 10:30am).

Your paper should have a bibliography with at least three references. All illustrations must be of professional quality with no handwritten elements.

A typical length for the paper is 2000 words for a two-author paper, or 3000 words for a three-author paper. However, the length of the paper may be less if your project involves writing a substantial amount of code. Furthermore, the quality of the paper is more important then the length of the paper.

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 3–4 minutes per person.

Your presentation 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. Research and 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. Study data structures used for storing geometric objects such as graphs, surfaces, or polyhedra. Implement a demonstration. One possible starting place is http://www.sccg.sk/~samuelcik/dgs/geom_structures.pdf.
4. Investigate and implement image morphing. One possible starting place is http://andrew.gibiansky.com/blog/image-processing/image-morphing/.
5. Investigate and implement triangulated image abstraction. One possible starting place is https://puckey.studio/projects/delaunay-raster.
6. Go into depth with some sort of art gallery problem. Joseph O'Rourke has a book on this topic: 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. One possible starting place is http://persson.berkeley.edu/distmesh/persson04mesh.pdf.
9. Investigate applications of Voronoi diagrams and create a demonstration. One possible starting place is http://www.voronoi.com/wiki/index.php?title=Voronoi_Applications.
10. Research some aspect of the Fold-and-Cut Problem. Erik Demaine's website is a good place to start: 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.