

# Final Project

## Math 365, Spring 2015

In lieu of a final exam, you will present a final project on a topic of your choosing. To summarize, your project will involve

- a one page proposal due **Wednesday, April 8**.
- a 3-5 page final project write-up due **the day of your regular final**, 5PM, and
- a 10-12 minute project presentations during the last week of classes, or during our regularly scheduled final.

You may work in teams of two on your final project.

### Project Proposal

Part of your final project is a *project proposal*. This is one page write-up that includes the names of the members of your group (at most two), a description of your proposal, the numerical methods you plan to use, the primary references that you will work from, and a statement about what possible conclusions you hope to draw from your project.

Submit your one page proposal to your **final\_project** DropBox folder no later than **Wednesday, April 8**. I'll read over your proposal for approval and provide suggestions for improvement.

### Final Project

Your final project will be a 3-5 page write-up (not including code) on the results of your project. Your write-up should include equations, graphs, and a bibliography. You may typeset your project using either L<sup>A</sup>T<sub>E</sub>X(preferred!), Word or some other typesetting system that allows you to include equations, graphs and easily cite references. In addition to the typeset document, you may also include a webpage that provides supporting material such as links to internet based references, or any movies you create.

Your code can be included in an appendix or in a separate "Publish" document.

Please submit your write-up, code and optional supplementary webpage to your **final\_project** DropBox folder by **the day of your regular final, 5PM** at the latest.

Your final project will count for 20% of your final grade.

### Project presentations

During class time either the last week of class, or during our regularly scheduled final, your team will give a 10-12 minute presentation of your final project.

### Project Ideas

Here are some sample project ideas. In general, projects could come from a broad range of areas, but your project should have at its heart a mathematical idea.

#### 1. Computer graphics

- Image processing. One idea is to consider "image compression" using a SVD (singular value decomposition) approach. Singular values are like eigenvalues in that they can be used to describe the structure of a matrix, which in this case, could be a photo (JPG) or some other image you are interested in.
- Computer graphics and animation. Matlab has fairly sophisticated graphics capabilities which you can use to render 3d images.

- Fractal design. Fractals are generated using iterations in the complex plane. There are many websites devoted to describing how to create fractal images. This project should include a description of the mathematics behind the fractal as well as some kind of interactive interface to allow the user to zoom in on the fractal patterns.
- Typesetting systems (using splines). Modern typesetting systems such as TrueType Font (Apple Inc.) and Type 1 and Type 3 fonts (Adobe, Inc.) are *outline* fonts described using cubic or quadratic Bezièr curves. This project should include an investigation into the basics of Bezier curves (similar to splines) as well as some sample fonts you create in Matlab, using either known outlines or outlines that you create yourself.

## 2. Numerical methods

- Iterative methods : Investigate iterative methods for solving elliptic boundary values problems. For example, the static heat equation we solved can be solved *iteratively* using Jacobi's method or Gauss-Seidel. These methods are easy to implement, and can be very efficient when used with sparse matrices.
- Solve a transient heat equation to see the evolution of heat or diffusive processes as a function of time.
- Solve a coupled system of reaction-diffusion equations used in biological pattern formation.

## 3. Engineering and science

- Heat and mass transfer. Improve our model temperature equation by including different flame models, setting up a time dependent problem, or modifying the finite-difference approximation to allow for variable coefficient diffusion term.
- Thermodynamics or fluid dynamics
- Geophysics or geosciences

## 4. Data analysis, finance and business

- Data analysis
- Economics, financial math or business application