Final Project Description

In this course you've been treated to a rather schizophrenic program of theory and code production. Both are supremely important in the real world: competent practitioners of optimization are, almost without exception, good coders and good theoreticians.

Optimization is a huge field, however, and although we've covered a range of core ideas, there is a lot of important material that didn’t make it into the course. One of the chief skills you will need if you intend to use optimization beyond this course is the capacity to teach yourself novel methods, and to talk intelligibly about such methods with your peers. Enter Final Project, stage left....

The purpose of this project is severalfold:

1. to learn a new topic in optimization
2. to give your peers some exposure to that topic
3. to get some practice coding things up, and designing appropriate numerical experiments
4. to get some practice communicating mathematics
5. to get some practice with mathematical writing

Project Overview:

In a nutshell, the final project consists of researching a topic of your choice, and then writing a paper and giving a talk about that topic. Your work needs to involve some code (that you produce) to illustrate core ideas. You can work alone, or you can work with a partner—if you work with a partner, you can submit a single paper and give a joint talk. See below for more details.

While the topic of your research can be anything you like, I propose that you choose one of two avenues of investigation. One avenue is simply to take an abstract topic that you find vaguely compelling and research how it works. The last chapter of the book has a nice annotated list of such topics, including

- compass-search method
- genetic algorithms
- simulated annealing
- conjugate gradient method

There are also plenty of topics that aren’t on the list. If you choose this route, you’ll need to some example applications, and illustrate how things work with some code.

The second avenue of investigation to consider an application that is pertinent to your major (or at the very least near and dear to your heart) and to research how optimization plays a role in this application. A few examples:

- ecology: optimal life history theory
- physics: variational principles
- economics: bioeconomic models
If you choose to proceed along this avenue, I propose that you focus on a specific model and discuss what optimization techniques can be used to solve it. Your code should illustrate these solutions.

**Due dates:**

- Friday, November 7: proposal
- Monday, December 1-Friday December 5: presentations
- Wednesday, December 10, 3pm: final paper (in hardcopy and in Dropbox.)

**Details:**

- **Proposal:** The proposal should be a neatly typeset document in which you explain what your final project will be about. At a minimum, the proposal should contain the following:
  
  - What your topic is
  - What you intend to code up
  - A plan for what plots you might want to generate for your project presentation

  If you intend to work with a partner, you can submit a single proposal together.

- **Presentation:** Presentations will be the week after Thanksgiving break. I'll randomly assign presentation slots, so the best bet is to bank on needing to go early and be pleasantly surprised if you go late. Your presentation is to be about 10 minutes long, and will be followed by questions. In your presentation, you should:
  
  - Use power point
  - Clearly frame what you’re talking about (and assume that we don’t know anything about it)
  - Illustrate the results of your coding experiments with a few choice plots, graphs, or charts.
  - Allow time for questions

- **Paper:** Your paper should be written like a section of the text. See 9.1 for an example—it’s a self-contained section of the text that includes examples. Your examples should include the results of some coding that you’ve done. You don’t need to write all the code yourself (so if you’re researching ’simulated annealing’, for example, you might find a pre-packaged simulated annealing algorithm) but you should use the code to perform experiments of your own devising. I would like the code tacked on at the end of the paper, so I can see what you’ve done.

  The paper itself will be graded for grammar, spelling, attention to detail, and scientific engagement with the topic. I will also check that you’ve made sensible use of the code and gotten things to work.

**Grades:**

- proposal 10%
- presentation 25%
- paper 65%