

# Optimization Project

Math 294 Prof. Leise

**Goal:** To delve deeply into a topic of interest by finding and studying an article or part of a book on that topic and then writing a report, which should include some mathematical analysis and/or numerical computations.

The project report and presentation forms 20% of your course grade, and, more importantly, is your opportunity to learn about something of interest to you that involves some aspect of numerical analysis. Feel free to propose a topic that is completely different from anything we have discussed, but also feel free to choose a project that delves deeply into a topic that we did examine.

**Topic suggestions** (you are not limited to these; an internet search will yield many topics):

- Deeper look at underlying theory for existence and/or uniqueness for a particular type of optimization problem
- Simplex method for LP
- Fourier's method for LP and its dual (<http://www.jstor.org/stable/pdf/2322281.pdf>)
- Marginal and sensitivity analysis of LP ([http://www-personal.umich.edu/~murty/books/opti\\_model/junior-5.pdf](http://www-personal.umich.edu/~murty/books/opti_model/junior-5.pdf))
- Numerical methods for a particular type of optimization problem (e.g., chapter 12)
- Applications covered by the textbook (chapters 13-16): supervised learning statistical methods, portfolio optimization, optimized control of systems, etc.
- Other applications of optimization to economics, finance, physics, biology, chemistry, social sciences, etc., from other books or articles

Feel free to talk to me at any point about finding sources and what material should be included in the final report.

## **Timeline:**

- Choose a topic by **4pm Friday April 7** and email me a proposal of what you want to do (a few sentences describing your proposed project topic).
- Submit outline of project and sources (by email is fine) by **4pm Friday April 21**.
- In-class brief presentations start on **Tuesday April 25**.
- Final report due **4pm Monday May 8**. Emailing me your file is fine.

**Report guidelines:** The report should be at least 6 pages double-spaced, using Word, LaTeX, R Markdown, Mathematica, or some other appropriate format. The report should include significant mathematics (theoretical or computational), and may also include less technical explanations and relevant historical or scientific background: how a problem arose, why a method was developed, who was involved in the development of the ideas, historical evolution of ideas, etc.

**Sources:** You should use at least two sources of information, which may include your textbook, other books, and scholarly articles. You should not rely on a website as a main source of information in most cases (since websites often contain incorrect information), but searching the web may be helpful initially as an idea-generator of interesting topics and for basic information. Searching JSTOR and MathSciNet may also be helpful, in addition to a general Five College library search (start looking for books and articles early in case you need to ask for an interlibrary loan or order an article to be delivered).

Your report should list **all sources** used in researching and writing your report. You may use any standard style to cite them, for example:

Baker, G.L., and Gollub, J.P. *Chaotic Dynamics: An Introduction*, Cambridge University Press, Cambridge, 1990.

Li, T.-y., and Yorke, J., "Period Three Implies Chaos." *American Mathematical Monthly* **82** (1975), 985-992.

There are two purposes in citing your sources: first, to give credit to those who did the work and published it, and second, to enable readers to find these articles or books if they want to read further about that topic.

When you refer to a source of information in the text of your report, cite that source using a standard style, as in the following examples:

One author: How fireflies oscillate in synchrony can be explained using a relatively simple nonlinear system (Strogatz, 1994).

Two authors: Tyson and Novak (2001) discovered a bifurcation that explains the cell cycle.

More than two authors: Tyson et al. (2004) found that something interesting occurred.

If you copy a figure, cite the source in the caption.