Numerical Analysis Project

Math 284 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):

- Homotopy methods for solving nonlinear equations
- Details of floating point numbers and round-off errors in computers
- Shur's and Gershgorin's Theorems (in numerical linear algebra)
- Pseudoinverses and/or deeper look at singular value decomposition
- B-splines, theory and applications
- Interpolation in higher dimensions
- Trig interpolation (Fourier series) or Fast Fourier Transform
- Romberg integration
- Numerical methods for partial differential equations
- Applications of any numerical method to economics, finance, physics, biology, chemistry, social sciences, etc

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 Nov 18** and email me a proposal of what you want to do (a few sentences describing your proposed project).
- Submit outline of project and sources (by email is fine) by **4pm Friday Dec 2**.
- In-class 10-minute presentations start on **Thursday Dec 8**.
- Final report due **4pm Monday Dec 19**. Emailing me your file is fine.

Report guidelines: The report should be roughly 5-7 pages double-spaced, using Word, LaTeX, R Markdown, Mathematica, or some other appropriate format. The report should include significant mathematics (theoretical or computational), but may also include less technical explanations and relevant historical or scientific background (why the method was developed, who developed it, how it's currently used, etc). MATLAB/Freemat code may be included as part of the report.

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 (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 5 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 to 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 article 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.