Study Guide for Midterm Exam

The Midterm Exam is in-class on Friday 26 October, 2012.

The exam is closed-book and no calculators are allowed.

Problems will be in these categories:

- apply an algorithm/method in a simple concrete case,
  E.g. Do two steps of bisection on this problem. Or: Find the interpolating polynomial through these points.
- state a theorem or definition,
  E.g. State Taylor's Theorem. (I will not ask you to prove *theorems. The two theorems your should memorize are listed below.)*
- write a short MATLAB code to state an algorithm,
  E.g. Write Newton's method as a MATLAB *code. (Write it based either on your memory/understanding of the algorithm, or from a brief description of what it does.)*
- explain/show in words, and
  E.g. Why is one of these methods better than another, when applied to this example? (Write in complete sentences.)
- derive an algorithm.
  E.g. Derive Newton's method.

Sections. From the textbook Greenbaum & Chartier, *Numerical Methods: Design, analysis, and computer implementation of algorithms*, see these sections that we covered in lecture and homework:

2.1–2.10, 4.1–4.5, 5.2–5.4, 6.1–6.2, 7.1, 7.2 (through page 141)

Also see the online notes *How to put a polynomial through points* at

`http://www.dms.uaf.edu/~bueler/polybasics.pdf`

Definitions. Please recall these definitions from memory.

- *absolute* and *relative error* (chapter 6, p. 124)
- *fixed point* and *fixed point iteration* (section 4.5)
- *absolute* and *relative condition number* (section 6.1)

Algorithms. You need to be able to recall these algorithms from memory, or re-derive them as needed.

- bisection method (section 4.1)
- Newton's method (section 4.3)
- secant method (section 4.4.3)

- three methods for constructing the interpolating polynomial (from online notes):
  - Vandermonde matrix method
  - Newton polynomial form, and its triangular matrix method
  - Lagrange's direct formula for the polynomial
- Gaussian elimination (section 7.2)
- forward substitution to solve lower triangular linear systems (section 7.2)
- back substitution to solve upper triangular linear systems (section 7.2)

Theorems. I will not ask you about the proofs. You should understand the statements of the theorems, and be able to apply them in particular cases. For those without "MEMORIZE," I will reproduce the statement on to the exam.

- Taylor's theorem with remainder (Thm 4.2.1) MEMORIZE
- Intermediate Value Theorem (Thm 4.1.1) MEMORIZE
- Newton's method converges quadratically theorem (Thm 4.3.1)
- fixed point convergence theorem (Thm 4.5.1)

Other concepts.

- Floating point arithmetic and IEEE double precision (sections 5.3 & 5.4)
- number of steps k for bisection to reduce interval size to 2δ (section 4.1, p. 78)