Study Guide for Midterm Exam

The Midterm Exam is in-class on Friday 28 October, 2011.

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 .... No calculator needed!
- apply an error theorem to a particular case,
  *e.g. Find n so that equally-space trapezoid rule on this integral has this accuracy. Except for "*MEMORIZE*" below, I will state the error theorem as part of the problem.*
- state a theorem or definition,
  I will not ask you to prove *theorems. Applies to all definitions but only theorems with "*MEMORIZE*" below.*
- write a short pseudocode or a MATLAB/OCTAVE code to state an algorithm,
  Do this based only 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 theorem or method is better than another, when applied to this example? Write in complete sentences.
- derive an algorithm.
  e.g. Derive Newton's method. or *Derive the formula for the linear interpolating polynomial.*

Sections. From the textbook J. Epperson, *An Introduction to Numerical Methods and Analysis*, see these sections that we covered in lecture and homework: 1.1, 1.3, 1.5, 2.1, 2.4, 2.5, 3.1, 3.2, 3.3, 3.5, 3.6, 3.7. Also, see the online notes *How to put a polynomial through points*.

Definitions. Generally you need to be able to recall these definitions from memory.

- absolute and relative error (p. 15)
- order of convergence for sequences (p. 110)

Algorithms ("how to" aspects). Generally you need to be able to recall these algorithms from memory, or rederive them as needed.

- Horner's rule (Alg. 2.1 on p. 40)
- linear interpolation (p. 58)
- trapezoid rule (p. 64)
- bisection (Alg. 3.1 on p. 89 and/or Alg. 3.2 on p. 91)
- Newton's method (equation (3.7) on p. 96)

Theorems (mostly "how good" aspects). I don't care about the proofs, but about the statements of the theorems, and whether you can apply them in particular cases. Those without "MEMORIZE" I will reproduce on to the exam.

- Taylor's Theorem with Remainder (pp. 2–3) MEMORIZE
- Intermediate Value Theorem (p. 10) MEMORIZE
- Mean Value Theorem (p. 9)
- Linear Interpolation Error Theorem (p. 60)
- Trapezoid Rule Error Theorems (p. 66)
  - for a single subinterval, and
  - for a uniform grid
- Bisection Convergence and Error Theorem (p. 89)
- Newton Error Formula Theorem (pp. 108–109)
- Theorem 3.3 (Newton Convergence Theorem) (p. 114)

Other concepts.

- Floating point arithmetic (as described on pp. 21–23)