Math 4500/6500 Syllabus

1. Course Information

Dr. Jason Cantarella
Office: Boyd 439
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Our classroom: Boyd 221
9:05-9:55 MWF
http://www.jasoncantarella.com
"Courses", "Math 4500"

Office hours: TBA.

Book: Ward Cheney and David Kincaid, *Numerical Mathematics and Computing* (6th edition).

2. Topics Covered

Part I: Numbers and Roundoff Error

- Roundoff error. Taylor series review. (1 week)
  Initial examples. Standard forms of Taylor's theorem. O and o notation.
- Floating point representation. (1 week)
  Definition. Machine numbers. Machine epsilon. Loss of precision.

Part II: Rootfinding

- One-dimensional rootfinding without derivatives. (1 week)
  Bisection. False position method. Brent's method.
- Rootfinding with one derivative. (1 week)
  Newton-Raphson method. Convergence and stability. Systems of equations.
- Special cases. (1 week)
  Rootfinding for polynomials. Deflation. Horner's algorithm. Fixed point method.

Part III: Interpolation and Numerical Differentiation

- Polynomial Interpolation. (1 week)
  Lagrange and Newton polynomials. Calculating coefficients. Vandermonde Matrix. Chebyshev polynomial. Curve fitting.
- Spline Interpolation. (1 week)
  Cubic splines. Bezier curves. NURBS. Splines and animation.
- Interpolation Error. (1 week)
  Runge function. Choice of nodes. Error bounds.
- Numerical Differentiation. (1 week).
  Taylor's theorem estimates. Richardson Extrapolation. Numerical estimates of curvature and torsion for space curves.

Part IV: Numerical Integration

- Review of Calculus. (1 day)
  Upper and lower sums. Trapezoid rule.
- Recursive trapezoid rule and Romberg Algorithm. (1 week)
  Subdivision. Error estimates. Euler-Maclaurin Formula.
- Simpson's Rule and Adaptive Simpson's Rule. (2 days)
  Derivation of Simpson's rule. Subdivision. Newton-Cotes formulae.
- Gaussian quadrature. (1 week)
  Placement of Gauss nodes. Legendre polynomials. Integrating up to a singularity. Adams-Bashforth-Moulton formulae.
- Very high precision numerical integration. (1 week)
  Methods. PSLQ. Formula for digits of pi. Inverse symbolic calculator.
- Numerical Integration in Multiple Dimensions. (1 week)
  Quadrature rules. TRIEX. Geometric examples.

3. Grading and Policies

We plan to have two exams: at the conclusion of parts II and III. The overall course grade is computed from homework, exam, and final grades by the formula:

(1) 20% for each regular exam.
(2) 20% for the final exam.
(3) 40% for the 3 projects and homework assignments.

Homework will be due more or less weekly.

4. Academic Honesty

The University of Georgia expects every student to live up to the highest standards of academic honesty and ethics. There are severe punishments for cheating, and they are enforced **not** by your friendly neighborhood Math professor, but by stern people in suits.

5. Disclaimer

The syllabus is a general course plan, but deviations may become necessary over the course of the semester.