

ISC 4220
Algorithms for Science Applications 1
Spring 2015

SYLLABUS

Instructor	Sachin Shanbhag 488, Dirac Science Library sshahbhag@fsu.edu (*)
Class	HCB 217 (Lectures: TR: 02:00 – 3:15pm) DSL 152 (Lab: W 12:15pm – 2:45pm)
TA	Nathan Crock (mathnathan@gmail.com) will lead the labs
Office Hours	(i) set up time by email (deterministic), or (ii) stop by anytime to see if I am available (stochastic)
Text	Any one of the following three books is recommended but not required. (a) Numerical Methods for Engineers S. Chapra and R. Canale, 5th edition, McGraw Hill, 2005 (b) Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms A. Greenbaum and T. Chartier, Princeton University Press, 2012 (c) Scientific Computing: An Introductory Survey M. Heath, 2nd edition, McGraw Hill, 2002
Software	Matlab (or GNU Octave). They are available on classroom computers and department computers at the fourth floor of the Dirac Science Library.
Grading	Assignments/Labs 50% (about 10 ± 1) Quizzes 50% (3 quizzes, roughly equispaced) Bonus: 5% (easy surprise tests at beginning of class)
Pre-reqs	Calculus 1 and 2

Description

“Basic computational algorithms including interpolation, approximation, integration, differentiation, and linear systems solution presented in the context of science problems. The lab component includes algorithm implementation for simple problems in the sciences and applying visualization software for interpretation of results. Prerequisite: MAS 2312. Corequisite: ISC 3222.”

Course Plan

Classes start on Jan 8 (R) and end on April 23 (R). Barring unforeseeable events, we will have 30 lectures and 12 labs. We will not have classes or labs during spring break (Mar 9–13).

A rough outline and sequence of topics is as follows:

1. *Nonlinear equations* (4)
modeling; solution of 1D nonlinear equations using closed methods such as bisection and regula falsi; Taylor series; open methods such as Newton's and secant methods.
2. *Linear Systems* (6)
solution of linear system of equations using direct and iterative methods; Gauss elimination; effect of finite precision - pivoting and scaling; LU decomposition; norms and conditioning; iterative methods such as Gauss-Siedel and successive over-relaxation.
3. *Optimization* (3)
optimization in 1D using safe-guarded methods such as golden section search and successive parabolic interpolation; 2D optimization - gradients and Hessians; steepest descent, conjugate gradient, Newton's and quasi-Newton's methods.
4. *Interpolation* (2)
polynomial interpolation - Lagrange and divided differences; Runge's phenomenon; piecewise polynomial interpolation - cubic Hermite and splines.
5. *Approximation* (2)
projection of vectors on a column space; relationship with least-squared error; normal equations; polynomial approximation and regression.
6. *Numerical integration/differentiation* (4)
Newton-Cotes - trapezoidal, Simpson's rules, error analysis; Romberg integration with successive refinement; Gauss-Legendre quadrature; integrable singularities; high-dimensional integrals and Monte Carlo integration.
7. *Ordinary differential equations* (5)
nomenclature; solution of IVPs using Euler and Taylor series expansions; higher order Runge-Kutta methods, adaptive RK; stability, implicit methods, and stiffness; BVPs using shooting method.
8. *Eigenvalues and Eigenvectors* (2)
the eigenproblem; power method and its variations; relationship to iterative methods.

Note that this course plan may be subject to small changes.

Course Policies

- Assignments are due at the beginning of the lab on the due date. You are free to discuss the labs with others, but the final submission should be unambiguously yours. Most homeworks will involve using a computer. If you cannot submit an assignment on time, due to a legitimate reason, please inform Nathan and me as soon as you can. Otherwise late submissions will be penalized.

- The “surprise tests” are mostly for diagnostic and attendance-monitoring purposes. Usually, I give full credit if a reasonable solution is attempted (no blank sheets, no random answers). Note that these tests will be administered in the first 10 minutes of class. If you attend more than 80% of the classes on time, you should not worry about these tests.
- If you think you haven’t received the credit you deserve for a homework or an exam, write up your argument, and submit for re-grading no later than 3 days after the graded assignments have been handed out.
- In general, if you score more than 90% overall you will make an A, if you score less than 60% you will fail. I don’t pre-calibrate boundaries between other grades.

University Attendance Policy

Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy

The Florida State University Academic Honor Policy outlines the University’s expectations for the integrity of students’ academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to “. . . be honest and truthful and . . . [to] strive for personal and institutional integrity at Florida State University.” (Florida State University Academic Honor Policy, found at <http://dof.fsu.edu/honorpolicy.htm>.)

Americans With Disabilities Act

Students with disabilities needing academic accommodation should:

- register with and provide documentation to the Student Disability Resource Center; and
- bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center
 874 Traditions Way
 108 Student Services Building
 Florida State University
 Tallahassee, FL 32306-4167
 (850) 644-9566 (voice)
 (850) 644-8504 (TDD)
 sdrcadmin.fsu.edu
<http://www.disabilitycenter.fsu.edu>

Free Tutoring from FSU For tutoring and writing help in any course at Florida State University, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of tutoring options - see <http://ace.fsu.edu/tutoring> or contact tutor@fsu.edu for more information. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Syllabus Change Policy

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.