

MATH 135A

Introduction to Numerical Analysis I

Course Description

Introduces basic numerical techniques for computing solutions of problems in science and engineering, as well as computational implementation of such techniques using MATLAB and Python. Topics include floating point computation, error analysis, numerical methods for solutions of linear and nonlinear scalar systems of equations, and numerical interpolation.

Prerequisites

CS 010A with a grade of C- or better, may be taken concurrently; MATH 031 with a grade of C- or better, may be taken concurrently; or equivalent; or consent of instructor.

Textbook

Numerical Mathematics and Computing (7th edition, 2013) by E. Ward Cheney and David R. Kincaid

Suggested Lecture Schedule

Week #	Textbook Section(s)	Topic(s)
1	1.1, 1.2, 1.3, 1.4	Brief introduction to scientific computing, rounding and chopping, accuracy and precision, basics of algorithms, nested multiplication, Taylor series, floating-point representation, loss of significance Lab – Introduction to MATLAB/Python interface, workspace, create variables, numbers and precision, custom data types, Error messages, testing/debugging, reading exceptions, examples with loss of precision
2	2.1	Naive Gaussian elimination and the algorithm Lab – Loops in MATLAB/Python, implement the naive Gaussian elimination
3	2.2	Gaussian elimination with scaled partial pivoting Lab – Matrices operation, indexing, vectorization, implement the modified Gaussian elimination algorithm
4	2.3, 3.1	Tridiagonal and banded systems, introduction to nonlinear equations Lab – Matrices operation to construct tridiagonal and banded systems
5	3.1, 3.2	Introduction to bisection method, Newton’s method Lab – Implement the bisection and Newton’s method using MATLAB

6	3.3	Introduction to the secant method and convergence analysis Lab – Implement the secant method and experiment with convergence of root-finding methods
7	4.1	Introduction to polynomial interpolation Lab – Function definitions, implementation of the polynomial interpolation
8	4.1	Introduction to Lagrange and Newton form of interpolation Lab – Implementation of the Lagrange form
9	4.2	Interpolation errors and review Lab – Error analysis of interpolation methods
10	6.1, 6.2	1st and 2nd degree spline functions, natural cubic splines Lab – Use spline functions to interpolate data