# 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<br><br>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<br><br>Lab – Loops in MATLAB/Python, implement the naive Gaussian elimination |
| 3 | 2.2 | Gaussian elimination with scaled partial pivoting<br><br>Lab – Matrices operation, indexing, vectorization, implement the modified Gaussian elimination algorithm |
| 4 | 2.3, 3.1 | Tridiagonal and banded systems, introduction to nonlinear equations<br><br>Lab – Matrices operation to construct tridiagonal and banded systems |
| 5 | 3.1, 3.2 | Introduction to bisection method, Newton's method<br><br>Lab – Implement the bisection and Newton's method using MATLAB |

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