

Review questions for the final exam

Review Session: March 16th, Wednesday at 9am-9:50am during lecture.

The final is on **March 18th, 11:30am-2:30pm at MS 6229**. The final is cumulative, but the focus is on the later sections.

Exam coverage:

§1.1, 1.2, 2.1-2.4, 3.1, 3.2, and 8.3

§4.1-4.4, 4.7, 6.1, 6.2, 6.5, 6.6 (after midterm sections)

1. Derive two-point and three-point formulas for numerical differentiation. What are their respective truncation errors? Give examples where you use these formulas to approximate derivative of some functions. Find error bounds and actual errors. Can you derive formulas for higher derivatives?
2. How do you accelerate convergence of low-order Newton-Cotes formulas using Richardson's extrapolation. Give examples.
3. Derive the basic numerical quadrature formulas: trapezoidal and Simpson's rule. What are the truncation errors for both? Give examples using these formulas and calculate actual errors and error bounds. What are the composite trapezoidal and Simpson's rule? What are their respective truncation error?
4. How is Gaussian quadrature different from the Newton-Cotes formulas? Given the roots, coefficients, and the Legendre polynomials, how do you approximate definite integrals? Give examples.
5. How is LU decomposition equivalent to Gaussian elimination? Explain and give an example.
6. What is partial pivoting? scaled partial pivoting? When or why are they executed? Comment on the instability of Gaussian elimination (in the case of without pivot and in general).
7. What are some of the special types of matrices in which Gaussian elimination without pivoting yields stable unique solutions? Please give at least 3 examples.
8. Given a matrix A , can you find its Cholesky factor? Give an example.