

## Review Topics for Final Exam

1. Linear algebra
  - (a) Least squares solutions
  - (b) Vector and matrix norms, e.g.  $L^2$  and  $L^\infty$  norms
  - (c) The singular value decomposition, relative  $L^2$  condition number
  - (d) Eigenvalues and eigenvectors
    - i. Eigenvalues/vectors for real symmetric matrices
    - ii. Power method, inverse power method (with shifts)
    - iii. Jacobi's method
2. Function approximation
  - (a) Lagrange interpolation
  - (b) Approximation in the  $\infty$ -norm vs. 2-norm
  - (c) Norms of functions and inner products
  - (d) Orthogonal polynomials, Gram-Schmidt
3. Numerical integration
  - (a) Newton-Cotes formulas
  - (b) Trapezoidal rule, Simpson's rule (local error, global error for composite rules)
  - (c) Euler-Maclaurin formula
  - (d) Gaussian quadrature for polynomials
4. Initial value problems and finite differences
  - (a) Truncation (approximation) error vs. round-off error for finite differences
  - (b) Richardson extrapolation
  - (c) Local error vs. global error
  - (d) Systems of initial value problems
  - (e) Implicit vs. explicit schemes
  - (f) Absolute stability
  - (g) Stiff systems