Midterm Study Guide

1. Basic ideas:

   - order of convergence
   - asymptotic error constant

2. Rootfinding:

   (a) Basic ideas:

      - multiplicity of roots

   (b) Bisection method, False position, Newton's method, Secant method:

      - formulation of the algorithm
      - be able to compute a few iterations
      - requirements for convergence
      - order of convergence

   (c) Fixed point method in general:

      - requirements for existence of a fixed point
      - requirements for convergence
      - order of convergence
      - be able to compute a few iterations

   (d) Acceleration of convergence (Aitken's method):

      - application of an Aitken's method

3. Systems of equations:

   (a) Gaussian elimination

      - row operations
      - no pivoting, partial pivoting, scaled partial pivoting
      - formulation of the algorithm
      - application of the algorithm to a 2×2 or 3×3 matrix.

   (b) LU decomposition

      - via Gaussian elimination and via direct factorization

- using LU factorization for solving systems
- special matrices (diagonally dominant, positive definite, tridiagonal)
- Cholesky decomposition
- be able to find an LU decomposition of 2×2 or 3×3 matrix.

(c) Iterative methods

- iteration matrix and requirements for convergence
- be able to write the iteration matrix and compute a few iterations for the Jacobi method, Gauss-Seidel method, and SOR.

(d) Newton's method

- formulation the method
- be able to compute a few iterations

4. Eigenvalues and Eigenvectors:

(a) Gershgorin's theorem

- be able to localize eigenvalues of a given matrix

(b) Power method, Inverse power method

- what method to use for the eigenvalue which has largest modulus/has smallest modulus/is closest to a given number
- general matrices vs symmetric matrices
- formulation of the method
- be able to compute a few iterations