Introduction to Numerical Analysis - Math 104B
Summer2011
Monday to Thursday, 12:30-13:35am, Girvetz 1116

Weekly Readings

Sessions 1-6

Study: Sections 6.1, 6.2, 6.5 and 6.6.
Review: Sections 6.3 and 6.4.
Read: Section 6.7.

Objetives:

- Solving linear systems of equations: Gauss elimination.
- Pivoting.
- Matrix Factorization.
- Computational complexity: How computationally expensive are our algorithms? How do they scale with the number of equations?
- To understand how direct methods can be simplified for special types of matrices, such as tridiagonal matrices.
- To learn new forms of factorization for special matrices, in particular, the Choleskii and the LDL^T factorization for positive definite matrices.
- To develop good programming skills.

Sessions 7-12

Study: Sections 7.1, 7.2, 7.3, 7.4 and 7.5 ($\star$).
Read: Section 7.6.

Objetives:

- To learn the concept of norm for vectors and matrices. A norm allows us to define convergence in a general setting.
- Review of eigenvalues and eigenvectors.
- To learn the relation between the norm of a matrix, and its eigenvalues (in particular, the spectral radius of the matrix).

- Convergence of a sequence of matrices, and in particular, of A^n.
- The classical iterative methods for linear systems of equations: Jacobi, Gauss-Seidel, and SOR(ω).
- Computational complexity of Jacobi and Gauss-Seidel for the model problem.
- Error bounds, and the condition number of a matrix.
- The conjugate gradient method: Relation to variational problems.
- Convergence of the conjugate gradient, and preconditioning.

Sessions 13-18

Study: Sections 8.1, 8.2, 8.3, 8.4 ($\star\star$), 8.5 ($\star\star$) and 8.6 ($\star\star$).
Read: Section 8.7.

Objetives:

- To learn to pose approximation problems as Least square approximation, for the continuous and discrete case.
- To use Householder transformations to obtain the QR factorization of a matrix
- To use QR factorization to solve least square problems
- To use Gram-Schmidt procedure to obtain orthonormal bases.
- Orthogonal polynomials and Gram-Schmidt orthogonalization procedure.
- Chebyshev polynomials and its relation to minimizing the interpolation error.
- To use orthogonal polynomial to approximate continuous functions.

Sessions 19-24

Study: Sections 9.2, 9.3 and 9.4.
Review: Section 9.1.
Read: Section 9.5.

Objetives:

- To use the power method to get the dominant eigenpair of a matrix.

- Use Householder transformations to reduce a matrix to tridiagonal (symmetric case) or Hessenberg form (non symmetric case).
- Learn the QR algorithm.

⋆ Time allowing