

# MA60053 - Computational Linear Algebra

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- Venue: NC 332
- Meeting time: Thursday 3-5, Friday 2-4.
- Doubt clearing (by appointment - N 340).
- 100 marks(mid 30 + end 50 + scribes 10 + TA 10(seminar?)).

# Possible topics to be discussed

- Error analysis.
- Matrix and vector norms: properties, condition number.
- Sensitivity analysis for solving linear system of equations
- Solving linear system of equations:
  - ▶ Direct methods.
    - ★ Gauss elimination, LU Factorization, pivoting.
    - ★ Cholesky decomposition.
    - ★ QR Factorization (Rotators and reflectors).
  - ▶ Iterative methods
    - ★ Jacobi, Gauss-Seidal, Successive over-relaxation methods, Splitting of matrices.
    - ★ Conjugate gradient method.
    - ★ Krylov subspace method, GMRES method.
    - ★ Preconditioning.
- Singular value decomposition: Geometry, least squares problems, low rank approximation problem.
- Eigenvalue problems
  - ▶ Gershgorin's theorem and its extensions, Sylvester's law of inertia, Bauer-Fike theorem, Variational Principles for Eigenvalues.
  - ▶ Power method, inverse power method, Jacobi method.
  - ▶ QR algorithm.

# References

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- Watkins, David S. Fundamentals of matrix computations. Third edition. Pure and Applied Mathematics (Hoboken). John Wiley & Sons, Inc., Hoboken, NJ, 2010. xvi+644 pp. ISBN: 978-0-470-52833-4.
- Datta, Biswa Nath Numerical linear algebra and applications. Second edition. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 2010. xxiv+530 pp. ISBN: 978-0-898716-85-6
- Ipsen, Ilse C. F. Numerical matrix analysis. Linear systems and least squares. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 2009. xiv+128 pp. ISBN: 978-0-898716-76-4
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- Demmel, James W. Applied numerical linear algebra. (English summary) Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 1997. xii+419 pp. ISBN: 0-89871-389-7
- Golub, Gene H.; Van Loan, Charles F. Matrix computations. Fourth edition. Johns Hopkins Studies in the Mathematical Sciences. Johns Hopkins University Press, Baltimore, MD, 2013. xiv+756 pp. ISBN: 978-1-4214-0794-4; 1-4214-0794-9; 978-1-4214-0859-0
- Ortega, James M. Numerical analysis. A second course. Second edition. Classics in Applied Mathematics, 3. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 1990. xiv+201 pp. ISBN: 0-89871-250-5
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