SCIENTIFIC COMPUTING FOR D PHIL STUDENTS

TERM 1 - MT 2018

OUTLINE OF LECTURES

I. SPARSE MATRICES AND ITERATIVE METHODS

- I.1 View of the field
- I.2 How fast can we solve Ax=b ?
- I.3 Sparse matrices
- I.4 Conjugate gradients
- I.5 Convergence of CG
- I.6 Preconditioned CG
- I.7 Examples of preconditioners
- I.8 The definition of numerical analysis
- I.9 Overview of matrix iterations
- I.10 Lanczos iteration
- I.11 Numerical software tools and information sources

II. DENSE LINEAR ALGEBRA

- II.1 Matrices, vectors and expansions
- II.2 Orthogonal vectors and matrices
- II.3 QR factorization
- II.4 Computation of the QR factorization
- II.5 Linear least-squares
- II.6 Floating point arithmetic
- II.7 Backward error analysis
- II.8 Matrix factorizations
- II.9 SVD and low-rank compression
- II.10 Gaussian elimination as an iterative algorithm

III. OPTIMIZATION

- III.1 Newton's method for a single equation
- III.2 Newton's method for a system of equations
- III.3 Newton's method for minimizing a function of 1 variable
- III.4 Newton's method for min. a fun. of several variables
- III.5 From Newton's method to practical optimization
- III.6 NEOS and COIN-OR
- III.7 Constraints and linear programming
- III.8 Quadratic programming and Lagrange multipliers