

# SCIENTIFIC COMPUTING FOR D. PHIL. STUDENTS

## A MATLAB-based course for graduate students in the MPLS Division

Michaelmas and Hilary Terms 2019-2020  
Prof. Nick Trefethen

Many engineers and physical scientists spend their careers solving numerical problems on the computer. The aim of this course is to provide the most useful foundation possible for PRS and D.Phil. students heading down this path. In two terms we will introduce you to many of the main techniques used today to solve linear and nonlinear systems of equations, fit data, compute eigenvalues, and solve ordinary and partial differential equations. Equally important will be to instil in you the high expectations of efficiency and accuracy that today's algorithms and machines make possible; to develop your ability to test quickly whether a computed result is correct; and to orient you toward sources of information on the latest algorithms and software in this important field.

The course meets Weeks 1-6 of Michaelmas term and Weeks 1-6 of Hilary Term.

### TERM 1: NUMERICAL (NON)LINEAR ALGEBRA.

Symmetric and nonsymmetric systems of equations, least-squares problems, eigenvalues, nonlinear systems and optimization. Sparse matrices: pre-conditioned conjugate gradients, GMRES and other Krylov subspace iterations, sparse direct methods. Applications.

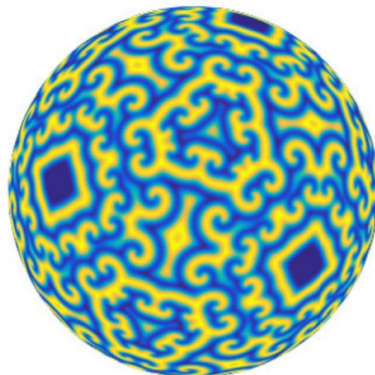
### TERM 2: DIFFERENTIAL EQUATIONS.

Algorithms and software for ODE initial-value and boundary-value problems; computational nonlinear dynamics. Finite difference and spectral methods for steady-state and time dependent partial differential equations. Applications.

There will be four MATLAB assignments each term, which participants will complete on their own computers. These will be marked each term and summarised by an overall grade to be communicated to students and their supervisors.

Lectures will include online demos and will be held in Michaelmas term Tuesdays and Thursdays 10:00-11:00 in the Maths Institute (Andrew Wiles Building) in Lecture Room 3. First lecture: Tuesday Oct. 15 at 10:00. There is no need to register in advance.

Oxford's Numerical Analysis Group is one of the pre-eminent research groups worldwide in the theory and applications of numerical methods. The lecturer is Nick Trefethen FRS, Professor of Numerical Analysis and head of this group. Trefethen is the author of the textbooks *Numerical Linear Algebra*, *Spectral Methods in MATLAB*, *Approximation Theory and Approximation Practice*, and the freely available *Exploring ODEs*, as well as the creator of Chebfun.



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