Summer School in Numerical Mathematics

Numerical Analysis, Image Processing and Surface Computing

Numerical Analysis is the study of algorithms for solving the problems of continuous science. By "algorithm" we mean a sequence of calculations, typically performed on a computer. This is a broad and exciting subject. This course will introduce (or review, depending on your background) some basic areas of numerical analysis. We will then explore, computationally, several application areas which intersect with cutting-edge Oxford Mathematics research.

Topics and Schedule

- Week 2:
  - Monday–Wednesday: background material in Numerical Analysis, Finite differences and interpolation. Quadrature. Interpolation in barycentric form. Numerical solution of differential equations (ODEs and PDEs). Software considerations.
  - Wednesday: Midterm.
  - Thursday: no lectures.
  - Friday: Image processing.
- Week 3: no lectures.
- Week 4: Image processing and computing on curved surfaces, project work.

Lecturers

- Prof. Colin Macdonald, Associate Professor in Numerical Methodologies, Tutorial Fellow at Oriel College, University of Oxford.
- Dr Martin Robinson, Postdoctoral Research Fellow, Mathematical Institute, University of Oxford.
- Mr Yujia Chen, DPhil Student, Mathematical Institute, University of Oxford.

Text Books

None required, but for additional reading:

- LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations, SIAM 2007.
- Süli and Mayers, An Introduction to Numerical Analysis, CUP 2003.

And other references, papers and lecture notes to be added during the course.

Website

There may be various material online. Start looking here:

- people.maths.ox.ac.uk/macdonald/CBL
- github.com/cbm755/summer-school

Midterm

There will be a midterm exam on Wednesday 13 August.

Projects and Presentations

Students will present the results of one or more projects towards the end of the course. Likely Thursday 28th August. More details on projects to follow.

Computations and Software

The projects and lectures will involve computation and programming.

Matlab: we recommend Matlab if you already have it.

Octave: alternatively, you can use GNU Octave which is Free/Open Source Software. Octave is included in the package managers for most popular GNU/Linux distributions.

Octave for Windows/Mac: consult wiki.octave.org/Octave_for_Microsoft_Windows. As of August 2014, we recommend the "3.8 MXE" build at mxeoctave.osuv.de. Consult their website for Mac OS X installations.

Tablets/phones: one possibility is to use Octave within cloud.sagemath.com. There are also Android apps for Octave and Matlab.

Other software

Python: The Python packages SciPy and NumPy are another possibility (although we will focus on Matlab/Octave for this course). Most of the things we're doing could be easily done in Python as well.

Revision control: like many research groups, we use *Git* for revision control. This is a very useful skill to learn for graduate school or for almost any career involving software. On Windows/Mac you might try the GUI "SourceTree". We may use this software during the course.

LaTeX: you might consider using the Beamer class for your presentation. Also a necessary skill for graduate school.