

# Course Syllabus

Computational Mathematics Laboratory Course

Master Programme in Computer Science (WIF), University of Pisa  
Academic Year 2013–2014

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**Version** Last update: 2014-02-03.

**Info** Taught in the summer semester 2014; 4 hours/week; nominal (non-binding) length: 48 teaching hours. 6 ECTS credits. The course is for the master degree in computer science, although students from other programs are welcome.

**Timetable** Wednesday 9-11 and Friday 11-13 (*changed* with respect to the time originally planned, be careful!)

**Aim** Presenting several techniques and applications of numerical mathematics and applied linear algebra, with a hand-on approach, practical experimentation on a computer with Matlab, and a few proofs (but not too many).

**Detailed program** This is the first year I teach this course; I do not have a very clear idea of how long each topic will take, so this program is only approximate and may change during the course. In the first lectures, students will be asked whether they have preferences or special interests on some of the topics.

- Introduction to the programming language used (Matlab/Octave).
- Curve drawing and interpolation algorithms: splines, Bézier curves. Image warping/rotation/scaling.
- Fast Fourier Transform and other trigonometric transforms. Applications to polynomial computations, signal filtering (sounds and images), JPEG compression.
- Krylov subspace algorithms: large-scale linear systems, eigenvalue problems and matrix functions.
- Singular Value Decomposition: image compression, data clustering, face reconstruction.
- Markov chains and nonnegative matrix computations: web ranking problems, queuing models, population dynamics.

**Reference texts** Unfortunately, there is no textbook that follows closely the course topics. We will make use of the following books for some of the items in the program:

- *Applied Numerical Analysis*, 7th edition, Gerald and Wheatley.
- *Deblurring Images: Matrices, Spectra, and Filtering*, Hansen, Nagy and O’Leary.

**Prerequisites** Nothing special: a basic course in numerical analysis, and some generic programming experience. These are usually both included in a Computer Science B.Sc. course.

**Course language** This course belongs to a master program following an internationalization project of the University of Pisa. All the written teaching material will be in English. The lectures will be in English unless everybody in the room is a fluent Italian speaker.

**Course webpage** Course-related material, such as an up-to-date version of this syllabus, can be found at <http://www.di.unipi.it/~fpoloni/dida/lmc14/index.html>. Other electronic media such as a mailing list may be set up to communicate with the students.

**Office hours** Will be agreed between the students and the teacher.

**Exam dates** Will be agreed between the students and the teacher. The general policies of the university apply.

**Evaluation** 1/3 of your grade will come from the exercises and programming experiences performed together during the class. Students who do not attend the lectures will have the opportunity of submitting these exercises remotely (no penalization). 2/3 of your grade will come from an oral exam. Exceptionally motivated students with special interest on one topic can take an additional programming project.

**Student ethics** When it comes to cheating in the exams, the teacher is stricter than the median of professors in Pisa. Do not expect to get away without consequences if caught cheating.

For any other question, contact the teacher.