Numerical Methods and Optimization (year 2016/17)

The course introduces some of the main techniques and methods for the solution of numerical problems. These methods often require the joint exploitation of the typical techniques of numerical analysis and of optimization algorithms. We show some of the main situations in which optimization methods are applied to solve problems of numerical analysis and some of the main situations in which the techniques of numerical analysis are essential to solve optimization problems. We also show the application of these methods to some specific problems chosen, for instance, in the following areas: regression and parameter estimation in statistics, approximation and data fitting, support vector machines, image and signal reconstruction. Furthermore, the course includes some laboratory hours during which the practical solution of some problems will be shown through the use of MATLAB.

Syllabus:

- Linear algebra and calculus background

- Unconstrained optimization and systems of equations

- Direct and iterative methods for linear systems

- Iterative methods for nonlinear systems

- Numerical methods for unconstrained optimization

- The linear least-squares problem

- Iterative methods for computing eigenvalues

- Constrained optimization and systems of equations

- Lagrangian duality

- Numerical methods for constrained optimization

- The fast Fourier transform

- Applications: regression, parameter estimation, approximation and data fitting, support vector machines, image and signal reconstruction

- Software tools for numerical and optimization problems (Matlab, in particular).

Course structure: 12 credits. Written and oral examination.