

## **M9 : An Introduction to Nonlinear Optimization**

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The optimization of a nonlinear function, possibly subject to linear and/or nonlinear constraints, is a basic tool for a large group of applications and a fundamental requirement in many control theory applications. This course will give students the necessary background on the theory and the main algorithmic approaches useful for the optimization of nonlinear functions. Some knowledge on linear programming and duality might prove useful, even if not strictly necessary. The course will cover the following topics:

- Optimality conditions for differentiable optimization problems; KKT conditions
- Lagrangean duality
- Local optimization methods for smooth unconstrained optimization: gradient methods, Newton and Quasi-Newton methods, trust-region approaches
- Local optimization methods for constrained optimization over convex sets; gradient -projection based methods, lagrangean methods, barrier and interior point algorithms, penalty and augmented lagrangean methods
- Introduction to nonconvex (global) optimization: theory, deterministic and stochastic techniques



Fabio Schoen, born in 1954, obtained a Laurea degree in Mathematics from the University of Milano; he was research fellow at CNR (National Research Council), then Associate Professor at Milano State University and since 2001 he is full professor of Operations Research at the Faculty of Engineering of the University of Florence (Italy). His main research interests deal with algorithms for the optimization of nonconvex problems (global optimization); in this field he developed stochastic computational techniques for the approximation of the global minimum in problems characterized by a large number of variables and a huge number of local optima. Problems of this kind frequently arise in many applications, like, e.g., in molecular conformation problems. His teaching activity spans most of the classical fields of operations research, from linear, combinatorial and nonlinear optimization to methods and models for production planning and for the optimization of transport networks. More information can be found on the web page

<http://alanine.dsi.unifi.it/users/schoen>