Advanced Convex Optimization
Yuri Nesterov (UC Louvain)
Invited course in the Optimization Master Program of Paris-Saclay
https://webens.math.u-psud.fr/-optimization-

Venue : Ecole Polytechnique, Amphi Lagarrigue
Dates : January 20-22, 2016 20: 10h-12h,14h-16h, 21: 10h-12h, 14h-16h, 22: 10h-12h.

The course is open to all interested persons and mainly targets M2 and PhD students and researchers from academics or R&D. It is funded by PGMO *(EDF & FMJH)*.

Abstract

In this course, we address a wide spectrum of questions related to theoretical justification of optimization algorithms and complexity of optimization problems. We start from deriving the lower complexity bounds for different classes of Black-Box convex optimization problems and providing them with optimal methods. Our second topic is the second-order schemes with global complexity guarantees. After that, we discuss different approaches of Structural Optimization, which lead to significant acceleration of Black-Box minimization methods. The first of these topics is the theory of self-concordant functions and polynomial-time interior-point methods. For large-scale optimization, we describe the smoothing technique. Finally, we present new subgradient methods with sublinear iteration cost, which can be applied for solving huge-scale optimization problems.

Detailed program

Lecture 1. Complexity of Black-Box Optimization
- Difficult problems
- Lower complexity bounds for Convex Optimization
- Optimal methods

Lecture 2. Second order methods. Systems of nonlinear equations
- Globally convergent second-order schemes
- Cubic regularization for Newton Method
- Modified Gauss-Newton method

Lecture 3: Structural Optimization: Interior-point methods
- self-concordant functions
- self-concordant barriers
- application examples.

Lecture 4. Structural Optimization: Smoothing Technique
- explicit model of objective function
- smoothing
- application examples

Lecture 5. Huge-scale optimization
- sparsity in optimization problems
- coordinate-descent schemes
- gradient methods with sublinear cost of iteration