UE Efficient methods in optimization

Level
Baccalaureate +5

ECTS
3 credits

Component
UFR IM2AG (informatique, mathématiques et mathématiques appliquées)

Semester
Automne

- **Teaching language(s):** English
- **Open to exchange students:** Yes
- **Code d'export Apogée:** GBX9AM87

Presentation

Description

The subject of this half-semester course are more advanced methods in convex optimization. It consists of 6 lectures, 2 x 1,5 hours each, and can be seen as continuation of the course “Non-smooth methods in convex optimization”.

This course deals with:

Evaluation : A two-hours written exam (E1) in December. For those who do not pass there will be another two-hours exam (E2) in session 2 in spring.

Objectives

- Topic 1: convex analysis
- Topic 2: convex programming
- Basic notions: vector space, affine space, metric, topology, symmetry groups, linear and affine hulls, interior and closure, boundary, relative interior

- Convex sets: definition, invariance properties, polyhedral sets and polytopes, simplices, convex hull, inner and outer description, algebraic properties, separation, supporting hyperplanes, extreme and exposed points, recession cone, Carathéodory number, convex cones, conic hull
- Convex functions: level sets, support functions, sub-gradients, quasi-convex functions, self-concordant functions
- Duality: dual vector space, conic duality, polar set, Legendre transform
- Optimization problems: classification, convex programs, constraints, objective, feasibility, optimality, boundedness, duality
- Linear programming: Farkas lemma, alternative, duality, simplex method
- Algorithms: 1-dimensional minimization, Ellipsoid method, gradient descent methods, 2nd order methods
- Conic programming: barriers, Hessian metric, duality, interior-point methods, universal barriers, homogeneous cones, symmetric cones, semi-definite programming
- Relaxations: rank 1 relaxations for quadratically constrained quadratic programs, Nesterovs #/2 theorem, S-lemma, Dines theorem Polynomial optimization: matrix-valued polynomials in one variable, Toeplitz and Hankel matrices, moments, SOS relaxations

Course parts

Lectures	Lectures (CM)	36h

Recommended prerequisites

Linear algebra: matrices, vector spaces, linear functions

Analysis: differentiability, gradients, convergence, continuity

Knowledge check

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Period : Semester 9

Useful info

Contacts

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Campus

- Grenoble - University campus