Course guide
230695 - ACO - Applied Convex Optimization

Last modified: 17/06/2023

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/responsables-assignatura

Others: Consultar aquí / See here: https://telecos.upc.edu/ca/estudis/curs-actual/professorat-responsables-coordinadors/professorat-assignat-idioma

PRIOR SKILLS

Basic Algebra

TEACHING METHODOLOGY

Classroom sessions

LEARNING OBJECTIVES OF THE SUBJECT

The so-called optimization problems rise in very different fields and applications. In all of them the function to be optimize is the so-called cost or objective function and the variables that we control to carry out the optimization are many times confined, which it is called the constraints of the problem. Convex optimization arise frequently in engineering problems but often go unrecognized. This course shows that there is a substantial and useful theory for such problems. The course will give students the tools and training to recognize convex optimization problems that arise in wireless communications and networks. The basic theory of such problems is presented together with the required background to use the methods in their own research or engineering work. Finally, the course shows how the analysis of sets and convex functions are the basis of machine learning techniques.

STUDY LOAD

Type	Hours	Percentage
Hours large group	39,0	31.20
Self study	86,0	68.80

Total learning time: 125 h

CONTENTS

Introduction

Description:
Modern optimization vs classical one: Efficient solvable programmes

Full-or-part-time: 2h
Theory classes: 2h

Convex Sets and functions

Description:
Definitions and properties

Full-or-part-time: 4h 20m
Theory classes: 4h 20m

Convex programming and class of convex problems

Description:
Formulation of a convex optimization problem
Study of: LP, QP, SOCP, SDP, GP
Problem relaxation
Applications: norm minimization, filter design, low rank optimization problems (eg. Netflix, video security, image restoration)
Convex software tool programming

Full-or-part-time: 8h 40m
Theory classes: 4h 20m
Practical classes: 4h 20m

Duality

Description:
Lagrange Duality and KKT conditions
Primal-Dual decomposition
Applications: Radio resource management for satellite and wireless comm (power control, waterfilling, MIMO transceiver design), cloud computing

Full-or-part-time: 6h
Theory classes: 4h
Practical classes: 2h

Algorithms

Description:
Basic algorithms: interior point method
Simple methods for extremely large problems
Applications: compressed sensing, ML decoding and SDP relaxation, 5G beamforming
Relationship with the machine learning algorithms

Full-or-part-time: 9h
Theory classes: 9h

Multi-Objective optimization

Description:
Theory
Applications: interference networks, porftolio optimization, SVM and classification

Full-or-part-time: 9h
Theory classes: 9h

GRADING SYSTEM

Individual assessment 60%
Group assessment 40%

BIBLIOGRAPHY

Basic:
- Boyd, S.; Vandenberghe, L. Convex optimization. Cambridge: Cambridge University Press, 2004. ISBN 0521833787.
- Ehrgott, M. Multicriteria optimization [on line]. 2nd ed. Berlin, Heidelberg: Springer, 2005 [Consultation: 08/09/2021]. Available on: http://dx.doi.org/10.1007/3-540-27659-9. ISBN 3540213988.

RESOURCES

Other resources:
Class notes and problems