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.
# Content

## Introduction

**Learning time:** 2h  
Theory classes: 2h  

**Description:**  
Modern optimization vs classical one: Efficient solvable programmes

## Convex Sets and functions

**Learning time:** 4h 20m  
Theory classes: 4h 20m  

**Description:**  
Definitions and properties

## Convex programming and class of convex problems

**Learning time:** 8h 40m  
Theory classes: 4h 20m  
Practical classes: 4h 20m  

**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

## Duality

**Learning time:** 6h  
Theory classes: 4h  
Practical classes: 2h  

**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
### 230695 - ACO - Applied Convex Optimization

<table>
<thead>
<tr>
<th>Algorithms</th>
<th>Learning time: 9h</th>
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<td>Theory classes: 9h</td>
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**Description:**
- Basic algorithms: interior point method
- Simple methods for extremely large problems
- Applications: compressed sensing, ML decoding and SDP relaxation, 5G beamforming

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<tr>
<th>Multi-Objective optimization</th>
<th>Learning time: 9h</th>
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<td>Theory classes: 9h</td>
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</table>

**Description:**
- Theory
- Applications: interference networks, portfolio optimization, SVM and classification

### Qualification system

- Individual assessment 60%
- Group assessment 40%

### Bibliography

**Basic:**

**Others resources:**
- Class notes and problems