

## Selected Topics in Nonsmooth Optimization

Course title – Intitulé du cours	Selected topics on nonsmooth optimization
Level / Semester – Niveau /semestre	M2, in September 2024
School – Composante	Ecole d'Economie de Toulouse
Teacher – Enseignant responsable	Guoyin Li
Other teacher(s) – Autre(s) enseignant(s)	
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Lecture Hours – Volume Horaire CM	10 h (Lectures)
TA Hours – Volume horaire TD	
TP Hours – Volume horaire TP	
Course Language – Langue du cours	English
TA and/or TP Language – Langue des TD et/ou TP	

### **Teaching staff contacts – Coordonnées de l'équipe pédagogique :**

[g.li@unsw.edu.au](mailto:g.li@unsw.edu.au)

### **Course Objectives – Objectifs du cours :**

The topic of the course will be “Selected topics on nonsmooth optimization”, and it will be divided in 4 units. The first three unit are the classic ones, providing a primer on the field. The last unit is focused on some recent development on nonsmooth optimization.

- I.- Nonsmooth optimization-- Brief introduction and motivation examples (1.5 h)
- II.- A prime on nonsmooth analysis (1.5 h)
- III.- Basic methods for solving nonsmooth optimization (4h)
- IV.- Recent development on nonsmooth optimization: selective topics (3 h)

At the end of the course, the student is expected to be able to:

- Recognize and formulate basic nonsmooth optimization problems
- Identify and apply basic methods to solve standard nonsmooth optimization problems
- Understand basic convergence analysis for some commonly used nonsmooth optimization methods

### **Prerequisites – Pré requis :**

An M1 level course on optimization. The students are expected to be familiar with linear programming, Karush-Kuhn-Tucker first-order optimality conditions, and basic convex optimization.

## **Practical information about the sessions – Modalités pratiques de gestion du cours :**

**Grading system – Modalités d'évaluation :** Defense of a project.

## **Bibliography/references – Bibliographie/références :**

## **Session planning – Planification des séances**

The detail of the units is as follows:

I.- Nonsmooth optimization-- Brief introduction and motivation examples (1.5 h)

- Introduction on Nonsmooth Optimization problems
- Motivation and Examples

II.- Basic tools for nonsmooth optimization (1.5 h)

- Preliminaries on Nonsmooth Analysis
- Proximal operators and basic calculus

III.- Basic methods for solving nonsmooth optimization (4 h)

- Gradient descent methods
- Proximal gradient methods and its variants
- Inertia/accelerated proximal gradient methods
- A gentle introduction to alternative direction method of multiplier (ADMM) – if time is permitted.

IV.- Some recent developments on nonsmooth optimization: selective topics (3 h)

- Nonsmooth fractional optimization
- The Kurdyka-Łojasiewicz inequality
- Projection free methods

## **Distance learning – Enseignement à distance :**

*Distance learning can be provided when necessary by implementing:*

- *Interactive virtual classrooms*
- *Recorded lectures (videos)*
- *MCQ tests and other online exercises / assignments*
- *Remote (online) tutorials (classes)*
- *Chatrooms*

*En cas de nécessité, un enseignement à distance sera assuré en mobilisant:*

- *Classe en ligne interactive*

- *Vidéo enregistrée de la présentation du matériel pédagogique*
- *QCM et exercices en ligne*
- *TP/TD à distance*
- *Forum...*