

Optimization for deep learning

Course title – Intitulé du cours	Optimization for deep learning
Level / Semester – Niveau / semestre	M2 / first semester
School – Composante	Ecole d'Economie de Toulouse
Teacher – Enseignant responsable	Jérôme Bolte
Other teacher(s) – Autre(s) enseignant(s)	
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Other teacher(s) – Autre(s) enseignant(s)	
Lecture Hours – Volume Horaire CM	18
TA Hours – Volume horaire TD	
TP Hours – Volume horaire TP	
Course Language – Langue du cours	English / Anglais
TA and/or TP Language – Langue des TD et/ou TP	English / Anglais

Teaching staff contacts – Coordonnées de l'équipe pédagogique :

Email : jbolte@ut-capitole.fr

Office number: TSE T.588

Office Hours: by appointment

Preferred means of interaction: after lectures, by email

Course Objectives – Objectifs du cours :

This course is thought to provide a quick glance at deep learning through the angle of optimization. After a short historical introduction to AI along the “neuronal” perspective, we will study the case of the perceptron, we will then introduce deep learning as a multilayer perceptron. We will show its superiority in terms of expressivity.

In a second stage we shall review the basic learning method: the gradient method. We shall emphasize intuition and elementary but fundamental results. The lecture will be concluded by considerations on backpropagation and reshuffled gradient methods.

The object of this mathematical course is to give intuition and insights on Deep Learning through theory.

Prerequisites – Pré requis :

Basic notions of differential calculus and analysis: continuity, sequence, compactness, normed vector spaces, gradients, Hessians.

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

Students are expected to attend and actively participate in all lectures. Personal computers allowed.

Grading system – Modalités d'évaluation :

To be discussed - the objectives of the course are to provide intuitions and understand a few theoretical results.

Bibliography/references – Bibliographie/références :

Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT press.

Higham, C. F., & Higham, D. J. (2019). Deep learning: An introduction for applied mathematicians. *Siam review*, 61(4), 860-891.

Beck, A. (2017). *First-order methods in optimization*. Society for Industrial and Applied Mathematics.

Session planning – Planification des séances :

All the details concerning the different sessions will be given during the first lecture.

Distance learning – Enseignement à distance :

Distance learning can be provided when necessary by implementing, for example:

- Interactive virtual classrooms
- Remote (online) tutorials (classes)
- Email support