Mathematics of deep learning algorithms Part 1

Course title - Intitulé du cours	Mathematics of deep learning algorithms Part 1
Level / Semester - Niveau /semestre	M2 / S1
School - Composante	Ecole d'Economie de Toulouse
Teacher - Enseignant responsable	Sébastien GADAT
Other teacher(s) - Autre(s) enseignant(s)	
Other teacher(s) - Autre(s) enseignant(s)	
Other teacher(s) - Autre(s) enseignant(s)	
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Other teacher(s) - Autre(s) enseignant(s)	
Lecture Hours - Volume Horaire CM	21
TA Hours - Volume horaire TD	
TP Hours - Volume horaire TP	0
Course Language - Langue du cours	Anglais
TA and/or TP Language - Langue des TD et/ou TP	Anglais

Teaching staff contacts - Coordonnées de l'équipe pédagogique :

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Phone number: 05 61 12 85 46

Meeting after an appointment by email

Course's Objectives - Objectifs du cours :

Deep learning has encountered a stricking success in the past recent years as an efficient method to solve supervised machine learning problems. In this course, we will emphasize on several mathematical issues involved in deep learning for artificial intelligence problems. We will address, among other, the following topics: Introduction to supervised learning (classification and regression): risk bounds, logistic regression, plug-in classifers Feed Forward neural networks and back-propagation optimization Deterministic optimization algorithms and gradient descent Stochastic optimization algorithms and gradient descent Global optimization and non-convex problems, stability of local minimizers Generative Antagonists Networks

Prerequisites - Pré requis :

Mathematical statistics Level M1

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

Laptops are accepted in the class

Grading system - Modalités d'évaluation :

Written exam + project

Bibliography/references - Bibliographie/références :

References: Bolte, Sabach, Teboulle, "Proximal alternating linearized minimization for nonconvex and nons- mooth problems", Math. Prog. Vol 146, no 1-2, pp 59-594, 2014. Lee, Simchowitz, Jordan, Recht, "Gradient descent only converges to minimizers", COLT 2016. Eldan, Shamir, "The power of depth for feedforward neural networks", 29th Annual Conference on Learning Theory, PMLR 49 :907-940, 2016. Biau, Cadre, Sangnier, Tanielian, "Some theoretical properties of GANs", Technical report, 2018. Duflo, Random Iterative Models, Adaptive algorithms and stochastic approximations, Springer-Verlag, New-York, Applications of Mathematics, (1997) Hastie, Tibshirani, Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. (2009).

Distance learning – Enseignement à distance :

En cas de nécessité, un enseignement à distance sera assuré en utilisant une séance de cours en zoom à l'horaire habituel du cours tel que renseigné dans l'emploi du temps. Nous ferons également des tds/tps à distance disponibles sur moodle.