

Mathematics of Machine and Deep Learning Algorithms

Course title – Intitulé du cours	Mathematics of Machine and Deep Learning Algorithms – Part 1
Level / Semester – Niveau / semestre	M2 / first semester
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)	
Other teacher(s) – Autre(s) enseignant(s)	
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 : sebastien.gadat@tse-fr.eu

Office number: TSE T.586

Office Hours: by appointment

Preferred means of interaction: after lectures, by email

Course Objectives – Objectifs du cours :

Artificial Intelligence and learning have encountered a striking 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 and algorithms that are involved in machine learning for artificial intelligence problems with a specific attention to statistics and optimization.

We will address, among other, the following topics:

1. Introduction to supervised learning (classification and regression): risk bounds, logistic regression, plug-in classifiers
2. Deterministic optimization algorithms and gradient descent
3. Stochastic optimization algorithms and gradient descent Global optimization and non-convex problems
4. Introduction to Bayesian inference and sampling algorithms

Prerequisites – Pré requis :

Mathematical statistics Level M1

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 :

Written exam + project.

Bibliography/references – Bibliographie/références :

1. S. Bubeck, Convex Optimization: Algorithms and Complexity. In Foundations and Trends in Machine Learning, Vol. 8: No. 3-4, pp 231-357, 2015
2. *Boyd and Vandenberghe, Convex Optimization*, [Cambridge University Press](#)
3. Bolte, Sabach, Teboulle, "Proximal alternating linearized minimization for nonconvex and nonsmooth problems", Math. Prog. Vol 146, no 1-2, pp 59-594, 2014.
4. Duflo, Random Iterative Models, Adaptive algorithms and stochastic approximations, Springer-Verlag, New-York, Applications of Mathematics, (1997)
5. Hastie, Tibshirani, Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. (2009).

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