Statistical theory of deep learning

Course title – Intitulé du cours	Statistical theory of deep learning
Level / Semester – Niveau /semestre	M2, S2 (10/02 - 14/02 2025)
School – Composante	Ecole d'Economie de Toulouse
Teacher – Enseignant responsable	Johannes Schmidt-Hieber
Other teacher(s) – Autre(s) enseignant(s)	
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Other teacher(s) – Autre(s) enseignant(s)	
Lecture Hours – Volume Horaire CM	12h
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 :

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Course Objectives – Objectifs du cours :

Recently a lot of progress has been made regarding the theoretical understanding for deep artificial neural networks. One of the very promising directions is the statistical approach, which interprets deep learning as a statistical method and builds on existing techniques in mathematical statistics to derive theoretical error bounds and to understand phenomena such as overparametrization. The lecture surveys this field and describes future challenges.

Prerequisites – Pré requis :

The M1 MED courses in Statistics

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

Grading system – Modalités d'évaluation : Two homework assignments.

Bibliography/references – Bibliographie/références :

https://mjt.cs.illinois.edu/dlt/

https://www.cs.princeton.edu/courses/archive/fall19/cos597B/lecnotes/bookdraft.pdf

https://www.di.ens.fr/%7Efbach/ltfp_book.pdf

Session planning – Planification des séances

Lecture 1 introduction, perceptron convergence theorem, universal approximation theorem
Lecture 2 approximation rates for shallow neural networks, Barron spaces
Lecture 3 advantages of additional hidden layers
Lecture 4 deep ReLU networks
Lecture 5 optimization in machine learning
Lecture 6 benign overfitting, misclassification error for image deformation models

Distance learning – *Enseignement à distance :*