Crash Course on Machine Learning Theory by Yacine CHITOUR

The crash course is planned for the week from **March 09** to **March 13**, 2026.

- **Title**: Crash Course on Machine Learning Theory
- **Speaker**: Yacine Chitour (L2S, University of Pairs-Saclay, France)
- **Speaker's webpage**: `https://l2s.centralesupelec.fr/u/chitour-yacine/`
- **Abstract**: In this crash course, I will present a mathematical view of modern machine learning (ML), with a particular focus on optimization, neural networks, and overparameterized models. The course begins with essential mathematical preliminaries, introducing the core concepts from linear algebra, probability, and convex analysis that underlie contemporary learning theory.

  Building on these foundations, we then study optimization methods for machine learning, including gradient-based algorithms, their convergence properties, and their role in large-scale learning problems. The course subsequently develops a theoretical understanding of neural networks, covering both structural and algorithmic aspects, and highlighting how nonlinear models can be analyzed through functional and optimization-based perspectives.

  Finally, we turn to overparameterized models, which play a central role in modern deep learning. We examine how classical notions such as generalization, implicit regularization, and optimization geometry evolve in high-dimensional and highly redundant regimes, and how these phenomena can be understood within a unified theoretical framework.

  The course emphasizes conceptual clarity, mathematical structure, and connections between optimization, statistics, and learning dynamics. It is planned for a total of 15 hours, spanning five days, and follows the progression of Learning Theory from First Principles by Francis Bach.

- **Program**:

Date	**Time**	**Topic**
Mon, March 09, 2026	9:00–10:30, 10:45–12:15	Chapter 1: Mathematical Preliminaries
Tue, March 10, 2026	9:00–10:30, 10:45–12:15	Chapter 5: Optimization for Machine Learning
Wed, March 11, 2026	9:00–10:30, 10:45–12:15	Chapter 9: Neural Networks (Part 1)
Thu, March 12, 2026	9:00–10:30, 10:45–12:15	Chapter 9: Neural Networks (Part 2)
Fri, March 13, 2026	9:00–10:30, 10:45–12:15	Chapter 12: Overparameterized Models

Table 1: Course Schedule