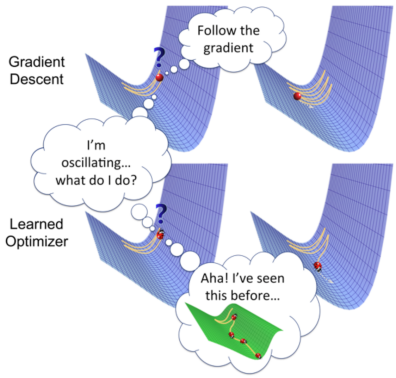
Math/DATA 496T Section 2 Optimization for Data Science and AI



Spring 2026

MWF 10:00-10.50

Instructors: Rossana Capuani, Deborah J Hughes Hallett and Laurent Vincent Pagnier

Course Overview This course bridges mathematical theory and computational practice in optimization. Beginning with multivariable calculus and gradient-based analysis, students will learn how to formulate, analyze, and solve optimization problems. The course culminates with modern data science applications, linking optimization to regression, support vector machines, and neural networks.

During this course the students will learn

- **Foundations in Multivariable Calculus:** functions of several variables, gradients, directional derivatives, and the geometry of level sets.
- **Unconstrained and Constrained Optimization:** first- and second-order optimality conditions, Taylor approximations, Lagrange multipliers, and KKT systems.
- **Linear Programming (LP):** modeling, feasible regions, simplex intuition, and duality. Applications to resource allocation and portfolio problems.
- **Numerical Methods and Algorithms:** gradient descent, Newton's method, stochastic updates, and proximal ideas for regularization.
- **Applications in Data Science:** least squares, logistic regression, SVMs, LASSO, and neural networks as optimization problems.

Prerequisites: Math 129, Math 313. Prior Python experience is helpful but not required.

Why Take This Course?

- Build a strong foundation connecting **calculus, linear algebra, and decision making.**
- Understand the mathematics driving **machine learning and data-driven modeling.**
- Gain **hands-on coding experience** solving optimization problems.