

# ORIE 6328 — CONVEX ANALYSIS — Spring 2009

**Instructor:** Adrian Lewis.

**Class time:** Monday/Wednesday/Friday 11:15-12:05pm in Upson 207.

## Course outline

The simple geometric idea of convexity is fundamental in modern optimization, underpinning diverse applications ranging from control engineering to mathematical finance. A concise mathematical introduction to convexity and its computational implications, and to nonsmooth optimization, this course is based around the following two-week sections.

**Convexity:** Convex sets and separation; convex functions and their characterizations; continuity; semidefinite matrices.

**Duality:** Fenchel, conic, semidefinite, and Lagrangian duality; subgradient calculus.

**Self-concordance:** Local and global convergence of Newton's method, self-concordant functions.

**Nonsmooth minimization algorithms:** Monotone operators and the proximal point method; the augmented Lagrangian; the bundle method.

**Nonconvex optimization:** Clarke's theory: generalized gradients, regularity, tangent and normal cones.

**Variational analysis:** Ekeland's principle; error bounds and metric regularity; optimality conditions and the Karush-Kuhn-Tucker theorem.

## Course organization

**Prerequisites:** Comfort with both real analysis (at the level of Math 4130) and basic linear programming (at the level of ORIE 6300), or permission of the instructor. Some basic familiarity with MATLAB or a similar language is helpful.

**Text:** There is no required text — the course draws from a variety of sources. A good indication of many of the themes and the level is the book *Nonlinear Optimization* (A. Ruszczyński, Princeton 2006).

**Written work:** Assignments every two weeks, and a final exam.

All information about the course will appear at <http://blackboard.cornell.edu>. (Search for ORIE6328). For more information, contact Adrian Lewis: [aslewis@orie.cornell.edu](mailto:aslewis@orie.cornell.edu) <http://people.orie.cornell.edu/~aslewis>