A tentative outline for cs406

Term 1 of 2016/17, Tue Thu 11:00-12:30pm

Uri Ascher

1. Introduction
   (a) Types of problems, and what we concentrate on
   (b) Basics: convexity, gradient and Hessian, Taylor expansions, linearity, optimality
2. Unconstrained optimization
   (a) Necessary and sufficient conditions
   (b) Basic methods: gradient descent and Newton
   (c) Line search and trust region
   (d) Quasi-Newton: secant; BFGS
   (e) Derivative-free optimization; Nelder-Mead
   (f) Linear and nonlinear least squares; Truncated SVD; Gauss-Newton
   (g) Case study: Kalman filter
3. Constrained optimization
   (a) Necessary and sufficient conditions; KKT; duality
   (b) Linear programming: simplex
   (c) Linear programming: primal-dual; interior point
   (d) Augmented Lagrangian; proximal method and ADMM
   (e) Case study: sparse solution to unconstrained equations via ℓ_1
   (f) Convex quadratic programming
   (g) Sequential quadratic programming
4. Very large problems (time permitting)
   (a) Preconditioned conjugate gradient method
   (b) Krylov subspace methods
   (c) Inexact Newton applications
   (d) Limited memory BFGS
   (e) Large scale least squares and saddle point