Unconstrained Optimization

- Optimality conditions
- Gradient methods; direction and stepsize choices
  - Convergence - to stationary points
  - Rate of convergence - linear, superlinear convergence
- Newton’s method and variants - affine invariance property
- Conjugate direction methods, Quasi-Newton methods, Coordinate-descent methods.
Constrained Optimization

• Optimization over a convex set, Optimality conditions and examples, Projection on a convex set.

• Feasible direction methods
  – Conditional Gradient, and Gradient Projection methods

• Lagrange Multiplier theory
  – Equality-constrained problems - regularity
  – KKT conditions - complementary slackness
  – Sufficient conditions and sensitivity analysis
  – Fritz John conditions - complementary violation; constraint qualifications
Convex Optimization

• Basic elements of convex analysis (separation theorems, operations that preserve convexity)

• Strong duality in convex optimization - linearity, Slater condition, relative interior conditions

• Conic optimization (LP, SDP, and SOCP)

• Interior Point methods - logarithmic barrier, self concordance

• Convex nonsmooth optimization
  – Subgradient methods
  – Convergence and rate of convergence analysis
  – Cutting plane methods
• First-order methods for large-scale: proximal map and proximal gradient algorithm. Relationships with earlier techniques.

• Parallel and distributed computing and optimization - totally vs partially asynchronous algorithms
Other Courses on Optimization at MIT

- 6.255: Optimization Methods
- 6.251/15.081: Linear Optimization
- 6.231: Dynamic Programming
- 6.855/15.082: Network Optimization
- 6.859/15.083: Integer Programming and Combinatorial Optimization
- 6.256: Algebraic Techniques and Semidefinite Optimization
- 6.253: Convex Analysis and Optimization
- 6.254: Game Theory with Engineering Applications