OPTIMIZATION TOPICS LIST
Revised April 2012

For Fall 2012 and Spring 2013 we will adopt the reading list below. The format of the exam will be to answer 4 of 6 questions drawn from material in 525, 635, 719, 720, 726, 727 and 730 (2 questions from these last three courses).

Linear Programming

- Primal simplex method
- Dual simplex method
- Duality theory
- Parametric programming and sensitivity analysis
- Degeneracy
- Linear complementarity problems
- Interior point methods

Primary references

1. D. Bertsimas and J. Tsitsiklis, *Introduction to Linear Optimization,* Athena Scientific, 1997
2. M. C. Ferris, O. L. Mangasarian & S. J. Wright: "Linear Programming with MATLAB", SIAM 2007.
3. R. J. Vanderbei, *Linear Programming: Foundations and Extensions,* Kluwer, 1996

Integer Programming/Modeling

- Integer and mixed integer models
- Existence of optimal solutions, optimality conditions
- Branch and bound methods
- Cutting plane methods
- Decomposition: Lagrangian relaxation and column generation
- Local search and other heuristics

Primary references

1. G. Nemhauser and L.A. Wolsey, *Integer and Combinatorial Optimization,* Wiley, 1988
2. L. A. Wolsey, *Integer Programming,* Wiley, 1998

Nonlinear Programming

- Optimality conditions:
  - saddlepoint
  - first-order
  - second-order

- Theorems of the alternative
- Convex sets
- Convex functions and their conjugates
- Conjugate duality and its applications
- Duality
- Unconstrained optimization theory and algorithms:
    1. line search
    2. trust-region
    3. quasi-Newton
    4. conjugate-gradient
    5. derivative-free optimization
    6. least-squares problems
- Constrained optimization theory and algorithms
    1. Optimization with bound constraints
    2. Augmented Lagrangian
    3. Sequential quadratic programming
    4. Interior-point methods
    5. Penalty functions
- Stability and sensitivity

Primary references

1. O.L. Mangasarian, *Nonlinear Programming,* SIAM, Philadelphia 1994
2. J. Nocedal and S. J. Wright, *Numerical Optimization, 2d Ed.,* Springer, 2006
3. A. Ruszczynski, *Nonlinear Optimization*, Princeton, 2005.
4. S. Boyd and L. Vandenberghe, *Convex Optimization,* Cambridge University Press, 2004. (Available for download at http://www.stanford.edu/~boyd/cvxbook/)
5. R.T. Rockafellar, *Convex Analysis,* Princeton, 1970