

Overview

1. Introduction (Lecture 1 + Introductory slides)
 - What is an optimization problem?
 - Examples of optimization problems.
2. Unconstrained optimization and iterative algorithms (Lectures 2-6)
 - Unconstrained optimization
 - Convex functions
 - Gradient descent (steepest descent, step length, linear least squares)
 - Convergence of iterative methods
 - Convergence of gradient descent
 - Newton's method
 - Machine learning / supervised learning
3. Linear Programming Theory (Lectures 7-13)
 - Convex sets
 - Linear programming duality: a first glance
 - Polyhedra
 - Farkas' Lemma
 - Linear programming duality
 - A first algorithm
 - Optimality condition for linear programming
 - Newton's method and idea of interior point methods
 - Path following and the central path
4. Non-linear convex optimization (Lectures 14-18)
 - Quadratic programming and portfolio optimization
 - Lagrangian duality
 - KKT conditions
 - Logarithmic barrier and central path
 - Linear support vector machines
5. Semidefinite programming
 - Semidefinite programming as generalization of LP
 - Relaxation of the MaxCut problem

Questions and Answers

Q: Which lectures are relevant for the test?

A: Weeks 1-12 (lectures 1-20).

Q: What do we have to know from the lectures?

A: The following *will not* be asked, though the statements should be known:

- Python code will not be part of the test;
- Proofs in Section 4.3 on the convergence of gradient descent. What needs to be remembered from this section is that gradient descent has *linear* convergence (implied by the last Theorem in that section).
- Proof of Theorem 5.6 (quadratic convergence of Newton's method), though the statement should be known.
- Section 5.2 (Quasinewton methods)
- Proof of Lemma 7.8.
- Proof of Corollary 9.3.
- Section 13.2
- Proof of Theorem 15.1
- Proof of Theorem 16.2
- Description of barrier algorithm at end of Lecture 17
- Derivation of separation margin in Lecture 18
- Proof of Theorem 19.4

As a rule of thumb, it is beneficial for the understanding to know the proof ideas, though precise reconstruction of proofs will not be asked.

Q: Which problems are relevant?

A: Problem that use Python or require cutting a shape out of paper will not be relevant to the test. More precisely, the following problems will not feature:

- Part B problems.
- Problem 2.1(c) (the derivation).

- Problem 2.3
- Problem 3.2