Spring semester 2021/22

Mathematical programming[1] is a part of mathematics dealing with the theory and methods of solving problems directly related to practical real-life questions. Typically, such problems have the form

Find the minimum of a given function $f : A \to \mathbb{R}$.

Depending on the nature of the set A and the function in question, various mathematical techniques can be applied to design an algorithmic procedure leading to the solution.

The present lecture will focus on linear programming (in which A is a polyhedron in an Euclidean space and f is a linear function) and discrete programming (where the set A is finite but so big that it is practically impossible to compare all the values $f(x)$).

Outline

1. Introduction: optimization problems and methods.
2. The simplex algorithm (the theory and a concrete implementation).
3. Duality theory.
4. Examples of integer programming problems and methods.
5. Basic network problems (including the minimal spanning tree, the shortest path algorithms, the transportation problem).
6. Network flows problems.
7. The knapsack problem.

Basic references

(a) D. Bertsimas, J. Tsitsiklis, *Introduction to linear optimalization*, Athena Scientific (1997).

(b) G. Sheithauer, *Introduction to cutting and packing optimization*, Springer (2018).

(c) D. Bertsimas, *Introduction to Mathematical Programming*, lecture notes available at MitOpenCourseWare

(d) M. Uetz, *Discrete optimization*, course available at his webpage.

[1] not to be confused with computer programming