

Machine learning techniques to identify hard constraints in linear programs

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Contacts

This Master's thesis is supervised by Prof. Louis Wehenkel (L.Wehenkel@ulg.ac.be) with the help of Alejandro Marcos Alvarez (amarcos@ulg.ac.be). Do not hesitate to contact us for further information. Students are encouraged to propose new subjects according to their affinities and to their wishes.

Profile

Students in Electrical Engineering or Computer Engineering.

Description of the proposed Master's thesis

Constrained linear problems are encountered very often in practice. Although there exist methods that are able to solve such problems very quickly, the increasing size of the problems, both in terms of variables and in terms of constraints, is a limitation to the efficiency of traditional methods.

Traditional methods, such as the simplex algorithm, usually consider the entire set of constraints to compute the solution to the problem. However, in many cases, some constraints are useless for the determination of the solution.

In Figure 1, the red constraints are useless since they do not delimit the feasibility region. Moreover, due to the sense of the optimization problem (minimization), the constraints C3 and C4 are not restrictive for the solution. On the other hand, the constraints C1 and C2 are hard since they need to be satisfied and since they are restrictive for the solution.

Discovering the useless and hard constraints is a key to solve problems more rapidly.

Optimization already has some tricks in order to detect some of the useless constraints. This step is known as 'presolve'. However, only heuristics are used within presolve and those heuristics may not identify all the useless and hard constraints.

Goal: The goal of this Master's thesis is to find out to what extent machine learning techniques can be used to find the hard and useless constraints in linear problems.

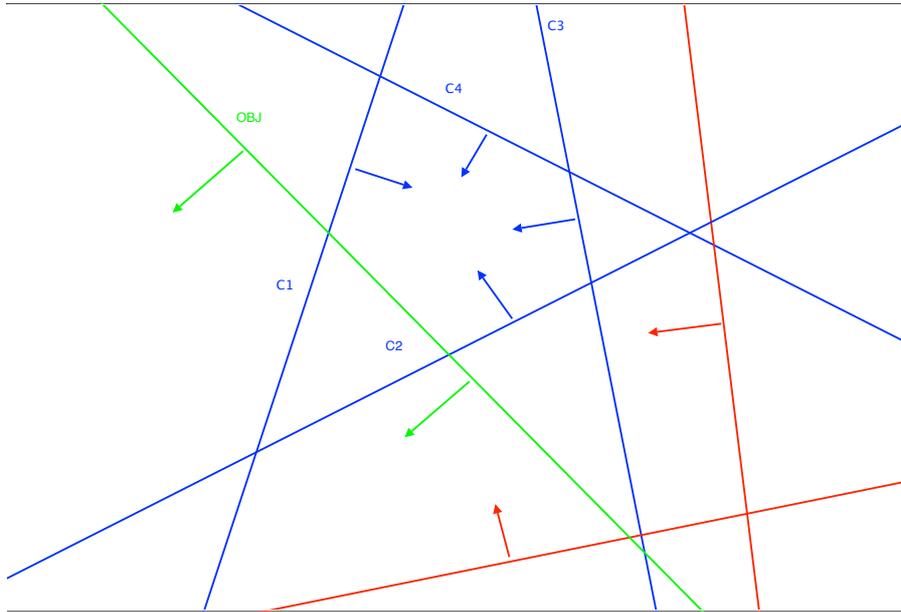


Figure 1: Example of linear optimization problem with useless constraints

References

- [1] ED Andersen and KD Andersen, *Presolving in linear programming*. Mathematical Programming, 1995.