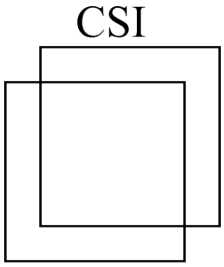
CHARLES UNIVERSITY



Mgr. Martin Koutecký, Ph.D.
Charles University
Computer Science Institute
Malostranské nám. 25, 3rd floor, room #326
118 00 Praha 1, Czech Republic
Telephone: +420 774 853 316
Email: koutecky@iuuk.mff.cuni.cz

Review of the Bachelor Thesis of Vít Kološ

The thesis considers a practical problem faced by kitchen designers: creating a kitchen layout is a job with some (though not all) clear inputs, constraints, and objectives, it is quite time consuming for both the designer and the client, and it is usually iterative (the client initially doesn't quite know what they want). Taken together, this is a problem ripe for automation using a combinatorial optimization paradigm – creating a mathematical model of the problem, considering the corresponding computational problem, formulating it as some kind of mathematical program, and applying existing solvers. This is what the thesis has done, and in my view, quite successfully so.

The student has been in regular contact with industry representatives who have continuously provided input and feedback. Based on this, he has arrived at a kitchen layout model which abstracts a lot of the geometry by dividing a kitchen into "parts", which are essentially just segments to be partitioned, with some parts belonging in one "group" (most notably a lower and an upper part of the same wall) for the purposes of alignment and placement constraints. The main task is assigning fixtures to particular places in kitchen parts.

Some fixtures have a fixed-width (e.g., an oven), some a variable width (e.g., a custom-made cabinet). This means that the problem has both a constraint satisfaction *and* a geometric element. For this reason, the student has compared the performance of formulating the problem as a Mixed Integer Linear Program (MILP), which would presumably be more efficient if the geometric element is dominant, as well as a Constraint Satisfaction Problem (CSP), which emphasizes the constrained structure.

I am brushing over many aspects of the model (what are all the constraints and objectives) that make it quite complex. Also, formulating it as an MILP or a CSP requires significant care and attention to detail.

The bottom line of the experimental evaluation is that the most efficient is the (free) CP-SAT solver, which is from the CSP family; however, it also uses the simplex algorithm internally, so perhaps it is able to also exploit the geometry of the problem somehow. The second most efficient was the (commercial) Gurobi solver. Both of these methods solve the model instances well below the initially set 2 minute threshold considered as "practically bearable". In this sense, I consider the thesis a great success.

The student has also developed a Web UI to interact with the solver.

The thesis is written clearly and well. It is a joy to read, and the results are presented in a comprehensible and convincing manner.

I suggest the grade of "1" without hesitation.