Review of Bachelor Thesis

Faculty of Mathematics and Physics, Charles University

Kitchen Layout Generation as an Optimization Problem

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Overall Evaluation

Excellent work! The paper is written very clearly, with few to no typos. Explanations are well-motivated, and the visuals are effective and polished. It is particularly impressive that the thesis is accompanied by a working web application capable of performing the computations described.

The thesis provides a good overview and a clear contextualization of the problem within the existing literature.

The modeling component is comprehensive, with many constraints carefully crafted to accurately reflect the application. The comparison of different formulations and solvers adds strong academic value, both in the modeling formulations and the computational experiments.

This is excellent work for a bachelor's thesis, and I recommend a grade of 1 (best).

Minimal Additions Needed:

Here are two minor comments that I suggest to be addressed for the final version.

- It is important to provide detailed information about the hardware and software environments used for computational testing. Please specify the versions of solvers used—e.g., Gurobi, HiGHS, CP-SAT, etc. Please also specify details about the computer that was used for the computations.
- Please also state if the runtime measurement reported includes the model compilation (by Pyomo or Minizinc) or if it is just the time spent in the solver.

Comments

Here are some minor comments that could improve the thesis (or provide extensions to the work), but are not needed for acceptance of the thesis.

- **Table 6.1:** Consider using bold formatting to highlight the best results in each row or column to make the table easier to read at a glance.

- **Computational Environment:** When presenting the computational experiemnts, clarify what it means for an instance to be "solved." Specifically, what optimality gap (e.g., from Gurobi) is reported?
- **Objective Function and Prioritization:** The thesis should provide more detail on how the different priorities were handled in the objective function. Did you consider a multi-objective or goal-oriented framework? It would be helpful to include a summary table showing how each priority performed in the final solution.
- **Exploring Trade-offs:** As a feature enhancement, consider extending the web application to solve the model multiple times with varying weights on the objectives, thereby generating a set of 3–5 diverse layout options for comparison.
- **Primal-Dual Plot:** Include a plot comparing a representative instance showing the evolution of the primal and dual bounds for both the Gurobi MILP solver and CP-SAT. This would provide insights into how quickly good feasible solutions are found and how solver time is spent tightening bounds.
- **Formulation Improvement:** The MILP model could potentially be strengthened by adding constraints involving triples of features (instead of just pairs), which might improve both model accuracy and solver performance.
- **Section on Integer Variables:** You mention that MiniZinc only supports integer widths. Did you also test the Gurobi model with integer width variables? This may yield different runtime behaviors.
- **Multi-objective Visualization:** It would be informative to include a radar (spider) chart showing how the final solutions perform across the various prioritized objectives.

1. Random Thoughts

From an Industrial and Systems Engineering (ISE) perspective, it would be interesting to simulate workflows within the generated kitchen layouts to analyze efficiency and movement patterns. This could provide an additional layer of validation or refinement to the model-generated designs. This would include some modeling using Simio for instance or SymPy.

Alternatively, your optimization models could include in the objective some distance minization of things that are used in sequence frequently.