System Description of Pathcount

Kosuke Oguri[1], Kenji Hashimoto[2], and Masahiko Sakai[1]
[1]Nagoya University
[2]Kagawa University
team/solvers: Naps+GPMC

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2024 version

The differences from the 2023 version described below is that

- Fitting single-threaded regulation.
- Added a function to count paths for directed graphs.

2023 version

Pathcount adopts the following steps as its basic framework.

- Preprocessor: converts a given undirected graph to a directed one by replacing each edge with two directed ones. Moreover, it eliminates unnecessary vertices when provided path terminals.
- Constraint generator: produces Pseudo-Boolean constraints of a path in a graph. It generates degree constraints and cycle detection constraints. CNF generator: converts constraints into CNF form by a Pesudo-Boolean constraint solver NaPS [1].
- Model counter: calculates the number of paths by a path counter, a variant of projection model counting solver GPMC [2].

The main differences between GPMC and the path counter are removing time-consuming preprocessing and the split component facility. It adopts a new variable choice strategy: choosing a consecutive path variable. If given no path terminals, it counts all paths for each vertex as a starting terminal.

We introduce hierarchical path counting for graphs shaped with satellite cities. More precisely, it first enumerates all (outer) paths in the graph obtained by collapsing all internal vertices in each town. It also counts the possible paths consistent with the enumerated one for each city. It admits the multiplication of the counts for the outer path.

References

[1] Masahiko Sakai and Hidetomo Nabeshima, Construction of an ROBDD for a PB-constraint in band form and related techniques for PB-solvers, IEICE Transaction on Information and Systems, Vol. E98-D, No. 6, pp. 1121-1127, Jun 2015. https://www.trs.css.i.nagoya-u.ac.jp/projects/NaPS/

[2] Ryosuke Suzuki, Kenji Hashimoto, and Masahiko Sakai, Improvement of Projected Model-Counting Solver with Component Decomposition Using SAT Solving in Components, JSAI Technical Report, SIG-FPAI-103-B506, pp. 31-36, Mar 2017 (in Japanese). https://www.trs.css.i.nagoya-u.ac.jp/projects/PMC/