Z3++ in SMT-COMP 2025

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1 Introduction

Z3++ is a derived solver based on Z3 [4], and it has participated in the SMT-COMP since 2022 [1]. This year, Z3++ participates in the incremental track of QF_NIA. The usage is to run "./smtcomp_run_incremental" command in the uploaded archive [3].

We modify the Z3 solver (version 4.8.13) by adopting the local search procedure as a new tactic. The local search procedure is based on the LocalSMT solver [2, 3, 5], a local search solver dedicated to SMT on arithmetic theories. Specifically, when the original tactics fail to solve the new query in incremental mode, we shall utilize the historical solution generated during previous "(check-sat)" queries. The historical solutions can be applied to generate an initial solution for the local search procedure, while the search information in the local search procedure can be applied to guide the decision heuristic for later queries in the CDCL(T) algorithm [6]. Overall, the search information can be shared between the CDCL(T) procedure and the local search procedure, so as to boost both search procedures. The detailed description about the deep combination can be found in this paper [7].

We consider that the local search algorithm is specifically suitable for incremental SMT queries, since after a minor modification to the previous formula, a new solution may be found by simply modifying a few variables, and local search can effectively utilize the previous solution.

References

1. Cai, S., Li, B., Zhan, B., Zhang, X., Zhao, M.: Z3++ at smt-comp 2023
2. Cai, S., Li, B., Zhang, X.: Local search for smt on linear integer arithmetic. In: International Conference on Computer Aided Verification. pp. 227–248. Springer (2022)
3. Cai, S., Li, B., Zhang, X.: Local search for satisfiability modulo integer arithmetic theories. ACM Transactions on Computational Logic **24**(4), 1–26 (2023)

[3] https://zenodo.org/records/15470563/files/new.zip

4. De Moura, L., Bjørner, N.: Z3: An efficient smt solver. In: International conference on Tools and Algorithms for the Construction and Analysis of Systems. pp. 337–340. Springer (2008)
5. Li, B., Cai, S.: Local search for smt on linear and multilinear real arithmetic. In: FMCAD 2023. pp. 168–177. TU Wien Academic Press (2023)
6. Nieuwenhuis, R., Oliveras, A., Tinelli, C.: Solving sat and sat modulo theories: From an abstract davis–putnam–logemann–loveland procedure to dpll (t). Journal of the ACM (JACM) **53**(6), 937–977 (2006)
7. Zhang, X., Li, B., Cai, S.: Deep combination of cdcl (t) and local search for satisfiability modulo non-linear integer arithmetic theory. In: Proceedings of the IEEE/ACM 46th International Conference on Software Engineering. pp. 1–13 (2024)