Four CDCL Solvers Based On Learnt Clause Management And Restarts

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***Abstract*—this description introduce four CDCL solvers: Relaxed_LCFTP, Relaxed_LCFTP_V2, Relaxed_LCFTP_V3 and Relaxed_LCMCBDL_BLB, which are entering to the SAT Competition 2021.**

I. INTRODUCTION

This description presents four improved solvers based on Relaxed_LCMDCBDL_newTech (First SAT solver in SAT Competition 2020). The main improvements we made are involved the following two aspects: firstly, we changed the bumping evaluation method of learnt clauses; secondly, we adjusted the luby restart policy based on the variation tendency of the backtrack level during the solving process.

II. TWO IMPROVEMENTS

A. Learnt clause feedback to propation

In 2015, Chanseok Oh added a mid-tier of learnt clause database in COMiniSatPS, it quickly have become the dominant clause management strategy in recent SAT Race. The reason why this strategy so efficient is clearly clarified in the paper [1]. However, we tried to figure out the inner reason about it. And we found another decisive factor push this strategy to its solving limits of performance. The factor we observed that really matters in this principle is the feedback of learnt clause, which connects the whole solver components and guides the future search of algorithm. As such, the quality of learnt clause is the cornerstone of the solver [2]. From this respects, we guess the feedback of learnt clause have something with its quality. And we traced the call of learnt clause in the whole solver running except the conflict analyzing, which was the dominant strategy in recent year. Consequently, we found the important call of learnt clause in Boolean constrain propagation. In this process, with the assignment of literals, the algorithm search the related clauses and literals [3]. It would be high quality if a learnt clause is used repeatedly in propagation. Based on this , we tried to change the method of bumping activities, which directly represents the quality of learnt clauses.

Additionally, thanks to the professor Cai, and his excellent solver, Relaxed_LCMDCBDL_newTech, our details of this new strategy are implied in Relaxed_LCFTP. And the other version, Relaxed_LCFTP_V2 and his friend Relaxed_LCFTP_V3, are the parameter adjusting versions with our personal experiment.

B. Backtracking level-based optimization method for restarts

Relaxed_LCMDBDL_BLB used a restart policy based on the variation tendency of the backtracking level. The original intention of this improvement was whether there is a certain attribute does not change during the solving process when SAT solvers equipped with the same branch heuristics, preprocessing, and learning clause management but with different restart policies. We extracted the backtracking levels of the solution process and observe their properties in different restart policies, and found that the trend of the backtracking levels in the same instance was broadly similar. On the other hand, we configured the luby restart policy for Minisat to observe the performance of the UNSAT and SAT instance backtracking levels. We found an upward trend in the backtracking levels in SAT instances, and the trend is made more pronounced by gradually increasing the luby interval. And it is shown by experiments that the strategy of gradually increasing the luby interval is faster than the original version for SAT instances. Therefore, we use the same method to calculate the backtracking level as we used to calculate lbd, using the backtracking level as another threshold parameter for the restart.

REFERENCES

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