

ZENN

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I. INTRODUCTION

ZENN is based on MiniSat2.2.0[1]. The ZENN system employs Phase Shift that integrates different search methods, SAFE LBD for keeping better learnt clauses, TLBD which is a kind of LBD and two restart strategies: Luby SE Restart and LBD+CDLV Restart.

II. PHASE SHIFT

Phase Shift integrates different search methods. The solver goes through two or more phases in its search. Each phase has a limited duration and the solver changes phases when the number of restarts reaches the limit. ZENN has two phases called Luby SE Phase and LBD+CDLV Phase. Luby SE Phase uses Luby SE restart as its restart strategy and RHPolicy for determining the number of learnt clauses that will be deleted. LBD+CDLV Phase uses LBD+CDLV restart for restart strategy and RQPolicy as a method to delete learnt clauses.

A. Luby SE Phase

- 1) *Luby SE Restart*: Luby SE Restart is a restart strategy based on Luby Restart. Luby Restart use a sequence that has cycles. Luby SE Restart shortens the length of each cycle, that is, skipping the initial segments of a sequence, and let the solver search more deeply.
- 2) *RHPolicy*: The solver deletes the first half of learnt clauses at deletion time. This policy is based on MiniSat2.2 but ZENN will not delete more than half of learnt clauses like MiniSat.
- 3) *VarDecayReduction*: Set var-decay (one of parameters in Minisat) to 0.990.

B. LBD+CDLV Phase

- 1) *LBD+CDLV Restart*: LBD+CDLV restart is a dynamic restart strategy used by GlueMiniSat2.2.5[2]: if one of the following conditions is satisfied, then a restart is forced.
 - (a) an average of decision levels in the last 50 conflicts is greater than the global average.
 - (b) an average of NTLBDs (explained later) in the last 50 conflicts is greater than the global average $\times 0.8$.

- 2) *RQPolicy*: The solver deletes 3 quarters of learnt clauses at deletion time. This policy is based on GlueMiniSat2.2.5.
- 3) *VarDecayAcceleration*: Set var-decay (one of parameters in Minisat) to 0.800.

III. TLBD

True LBD, TLBD for short, is a kind of LBD[3]. TLBD is different from LBD in the manner of updating its value. TLBD ignores literals assigned at level 0.

A. NTLBD

Newest TLBD, NTLBD for short, is a kind of TLBD. NTLBD takes the latest TLBD of a learnt clause.

B. LTLBD

Lowest TLBD, LTLBD for short, is also a kind of TLBD. LTLBD takes the best NTLBD of a learnt clause so far.

C. HTLBD

Highest TLBD, HTLBD for short, is also a kind of TLBD. HTLBD takes the worst NTLBD of a learnt clause so far.

IV. SAFE LBD

Safe LBD is a criterion for freezing learnt clauses. When a learnt clause is about to be deleted, if its LTLBD is lower than SAFE LOW LBD and its HTLBD is lower than SAFE HIGH LBD, it will not be deleted but be detached and kept for possible activation in the future.

ACKNOWLEDGMENT

I wish to express my gratitude to Mr.Hasegawa, Mr.Fujita, Mr.Koshimura for valuable advices and comments.

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