UWrMaxSat Entering the MaxSAT Evaluation 2024

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***Abstract*—UWrMaxSat is a complete solver for partial weighted MaxSAT instances and pseudo-Boolean ones. It can be also characterized as an anytime solver, since it outputs the best known solution, whenever its run is interrupted. It needs a SAT solver as an oracle and can be used with a few modern solvers, from which COMiniSatPS by Chanseok Oh (2016) has been selected as a default one. Several solving strategies have been implemented in it (selected by parameters) but the default one is an UNSAT-based core-guided OLL procedure, where a sorter-based encoding is applied to translate cardinality constraints into CNF. If this strategy is not successful for a selected time, it is changed to a SAT/UNSAT-based binary search. For relatively small instances, beside the MaxSAT solver, the SCIP mixed-integer-programming solver is used as an independent advanced tool with its, quite different, solving techniques. This paper describes new elements in UWrMaxSat version 1.6, which is submitted to the MaxSAT Evaluation 2024. They include (1) a closer integration with SCIP solver for mixed integer programming, and (2) an implementation of the general Boolean multi-level optimization in the SAT/UNSAT strategy.**

***Index Terms*—MaxSAT-solver, UWrMaxSat, COMiniSatPS, SCIP, sorter-based encoding, core-guided, complete solver**

I. Description

It is the fifth time when UWrMaxSat is participating in MaxSAT Evaluation (MSE). Its description can be found in the series of publications [6], [7], [9], [10] and a more complete presentation in [8]. See there for the main features added to the solver in previous years.

The new version is denoted by 1.6 and contains two new extensions. Firstly, the cooperation with SCIP solver [2] is more involved, especially when both solvers has to run in the same thread (as it is required by the competition rules). Secondly, the GBMO (that is, general Boolean multi-level optimization, see [5]) splitting points are now also used in the UNSAT/SAT binary-search solving phase.

The results of recent MSE competitions showed that extending the standard set of MaxSAT techniques with the mixed-integer programming (MIP) methods implemented in a MIP solver can increase the number of solved instances. The SCIP optimizing suite was chosen as an extension of UWrMaxSat in its version 1.4. In the standard configuration both solvers run in separate threads and the first which solves the instance is a winner and reports its result. CNF clauses are preprocessed by COMiniSatPS SAT solver before they are converted into Boolean linear inequations for SCIP. Earlier, the MaxPre preprocessor [4] can further reduce the numbers of variables/clauses in an instance and it can be easily switch on by an option of UWrMaxSat. In the single thread, the SCIP is run first for a predefined number of second and if it is not successful, UWrMaxSat tries to solve the instance. In such a case, the partial results of SCIP were discarded.

In the present version of UWrMaxSat, the start of SCIP solver can be delayed for a certain number of seconds and UWrMaxSat tries to solve an instance in meantime. If it is unsuccessful, its lower and upper bounds on the weight of an optimal solution are given as an additional input to SCIP. When the latter timeouts, its lower/upper bounds and the best solution are compared with the previous results of UWrMaxSat and can improve them. Then the solving process of the MaxSAT solver is continued. In addition, if the relative gap between the bound of SCIP is less than 10 percent, the time assigned to SCIP is extended and it resumes its computation.

Finding GBMO splitting points is computationally expensive, therefore UWrMaxSat tries to find some of them within limited resources. When found, they were previously used only in the process of stratification [1]. Now, the SAT/UNSAT binary search is done independently in each region between consecutive splitting points. In this way, encodings of goal linear functions are less costly.

Finally, it is the first time when the MaxPre is switched on in the solver submitted to the unweighted exact track with the time limit of 60s for its techniques. Generally, preprocessing is an important part of an system for solving MaxSAT problems. An interesting question is whether an output of the SCIP preprocessing can be effectively used by a MaxSAT solver.

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