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riss 2010 Solver Description

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Abstract. The SAT solver riss has been developed for analyzing the resource utilization of state of the art SAT solvers. It introduces new techniques like the Slab Allocator and Prefetching.

1 The SAT Solver riss

The SAT solver riss is CDCL based. It has been implemented during a student project to analyze the memory hierarchy utilization. It uses a cache aware implementation and data structure improvements described in [9].

The 32bit C++implementation is based on HydraSAT [2], which has been submitted to the SAT Competition 2009. Since riss is a re-implemented (except conflict analysis and preprocessor) of HydraSAT, which is close to the MiniSAT 1.4 [6] implementation, the basic riss version is also comparable to MiniSAT. The components are exchangeable at runtime and can be loaded from libraries. The component system uses C++templates.

2 Data Structures

The basic data structures are taken from the Standard Template Library. Clauses are implemented according to the clause packing schema in [4] using 5 local literals. They are allocated using a Slab Allocator [3]. The watched list of the two-watched-literal schema are implemented using a vector. Removing elements from them is done lazily.

3 Solver Components

Riss implements a conflict driven decision learning search. Conflict analysis is done using the first UIP scheme. Afterwards self subsumption is applied to minimize the resulting clause (learnt clause) even further. Before the search a preprocessor, similar to the Satellite preprocessor [5], is applied.

Unit propagation treats binary clauses specially. First the assignment is applied to binary clauses and all their implications, next longer clauses are considered.

Propagating longer clauses is improved by prefetching the clause headers. Additionally, blocking literals [11] are used. Like SApperloT [7], a probing [8] step is applied, if a literal is propagated on the first level of the search tree. The obtained variable equivalence informations is not used at the moment, but found units are propagated.

Decisions are done using phase saving as it has been introduced in [10]. The phases are stored during backjumping in the search tree for all assignments that are undone. The phase information is not reset. Random decisions are made with a probability of 2%.

Scheduling restarts uses the luby schema with 32 as factor. Scheduling clause removal is done using a geometric series with base 1000 and 4/3 as increase factor. The clause removal is activity based. Clauses of size two and clauses with an activity higher than a certain threshold are kept. The activity of learnt clauses is inversely proportional to the number of tree levels that occur in this clause [1]. Learnt clauses that are added exactly before a restart are never removed.

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