THE USE AND MINIMIZATION OF BINARY DECISION DIAGRAMS FOR SET CONSTRAINT RESOLUTION

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ABSTRACT

Static program analysis problems frequently can be expressed in terms of the resolution of set constraints. Therefore, set constraint resolution would seem to be a natural cornerstone of a generic platform for static analysis. Classic techniques for modeling set constraints rely on graph-based representations, the implementations of which can cause the resolution algorithms to become intractable for real-life problems due to time and memory constraints. Space issues, in particular, pose a very real threat to practical analyses, as the graph sizes grow disproportionally with regard to the input problem size.

Binary Decision Diagrams (BDDs) are data structures representing boolean functions that have very low memory profiles. They eliminate substantial redundancy by internally collapsing and combining identical subfunctions. There has been a significant amount of interest in employing BDDs to compactly represent constraint sets, and the literature suggests that this is a very viable approach for static analysis platforms of the future.

We present a collection of tools for set constraint resolution that employ the freely-available BuDDy package in their representations of internal data. These tools will operate on any collection of set constraints conforming to a specific grammar and are not bound to any particular static analysis technique.

The performance of any BDD is highly dependent on certain input parameters, and we present a technique for optimizing one of those parameters—the initial variable ordering—for a given problem. We also present empirical results that demonstrate the effectiveness of this optimization and its importance in a practical BDD-based static analysis platform.