

Simplicity Rather Than Knowledge

William Bricken

I've spent over 20 years implementing algorithms for Boolean minimization, with particular application to area optimization of large semiconductor circuits. This exploration has included almost all published algorithms, dozens of conventional and exotic data structures, over two dozen programming languages and styles, and almost every level of implementation, from reconfigurable silicon through customized instruction sets, conventional programming languages, and very high-level languages such as Mathematica.

The huge, randomly generated CNF formulae used to study SAT phase transition have attracted many creative approaches (such as variants of unit propagation, differential equations, probabilistic moments, component connectivity, cutting planes, and so on). However, I've learned one thing about the nature of Boolean minimization that seems obvious now. No matter how clever an algorithm is, no matter how extensively the structure of a problem is analyzed, no matter how much adaptive learning and lemma caching is used, the most successful approach to the general Boolean minimization problem is to use the simplest possible algorithm—brute force applied to lexicographically sorted formulae and implemented in reconfigurable silicon.

The lessons learned? For the general case, complexity cannot be finessed by any degree of cleverness. Native silicon is faster than any symbolic optimization. Simplicity rather than knowledge is the key.

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