

Anytime Algorithms for MaxSAT and Beyond

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Abstract—Given a propositional formula F in Conjunctive Normal Form (CNF), a SAT solver decides whether it is satisfiable or not. It is often required to find a solution to a satisfiable CNF formula F , which optimizes a given Pseudo-Boolean objective function Ψ , that is, to extend SAT to optimization.

MaxSAT is a widely used extension of SAT to optimization. A MaxSAT solver can be applied to optimize a Pseudo-Boolean objective function Ψ , given a CNF formula F , whenever Ψ is a linear function.

MaxSAT has a diverse plethora of applications, including applications in computer-aided design, artificial intelligence, planning, scheduling and bioinformatics. A variety of approaches to MaxSAT have been developed over the last two decades. In this tutorial, we focus on anytime MaxSAT algorithms, where an anytime algorithm is expected to find better and better solutions, the longer it keeps running. The anytime property is crucial in industrial applications, since it allows the user to: 1) get an approximate solution even for very difficult instances, and 2) trade quality for performance by regulating the timeout.

Anytime MaxSAT solvers have been evaluated at yearly MaxSAT Evaluations since 2011 in the so-called incomplete tracks. We trace the evolution of anytime MaxSAT algorithms over the last decade and lay out the algorithms, applied by the winners of MaxSAT Evaluation 2020.

Furthermore, we touch upon anytime algorithms for optimization problems beyond MaxSAT, such as bit-vector optimization and the problem of optimizing an arbitrary not-necessarily-linear function, given a CNF formula.

Finally, we discuss challenges and future work.