Xin Zhang — Achievement 2

I have defined new problems, designed new algorithms, and conceived new applications of constrained optimization, more specifically, maximum satisfiability (MaxSAT), an optimization extension of the well-known boolean satisfiability (SAT) problem. Constraint-based approaches have emerged as a new paradigm in many areas of computer science, which is exemplified by the wide use of SAT solvers. With the rise of emerging applications such as probabilistic reasoning in machine learning, programming languages, and databases, people are increasingly solving optimization problems rather than satisfiability problems, which motivates the need for scalable MaxSAT solvers. By exploiting characteristics of MaxSAT instances generated by real-world applications, we defined the *query-guided* MaxSAT problem and the *incremental* MaxSAT problem to enable efficient solving algorithms. Query-guided MaxSAT is based on the observation that many applications only concern the assignments to certain variables of interest rather than the entire solution. Intuitively, we often only need to reason about a small fraction of the whole problem to resolve a single variable. Incremental MaxSAT is based on the observation that many applications often involve solving sequences of similar MaxSAT instances. Intuitively, we can speedup the overall solving process by reusing results across instances in the same sequence. We proposed new algorithms for both problems and empirically showed that they outperform existing algorithms in both time and memory on large MaxSAT instances comprising tens of millions of clauses generated from real-world applications in program analysis and information retrieval. Besides proposing new problems and algorithms, I also contributed new MaxSAT instances generated from my thesis work on program analysis to the MaxSAT community. Compared to existing instances, these instances are much larger and cause many existing solvers to crash when attempting to solve them. These instances have been adopted in the latest annual MaxSAT evaluation.