Preface

A wide range of problems can be formalized as a set of constraints that need to be satisfied. In fact, such a model is called a constraint satisfaction problem (CSP). Another way to represent a problem is to express it as a formula in propositional logic, or, in other words, a Boolean satisfiability problem (SAT). In the quest to find efficient algorithms for solving instances of CSP and SAT specialised software has been developed. It is, however, not clear when should we choose a SAT-solver over a constraint solver (and vice versa). CSP-solvers are known for their domain-specific reasoning, whereas SAT-solvers are considered to be remarkably fast on Boolean instances. In this book we tackle these issues by investigating the connections between CSP and SAT.

In order to answer the question why SAT-solvers are so efficient on certain classes of CSP instances, we first present the various ways one can encode a CSP instance into SAT. Next, we show that with some encodings SAT-solvers simulate the effects of enforcing a form of local consistency, called k-consistency, in expected polynomial-time. Thus SAT-solvers are able to solve CSP instances of bounded-width structure efficiently in contrast to conventional constraint solvers. By considering the various ways one can encode CSP domains into SAT, we give theoretical reasons for choosing a particular SAT encoding for several important classes of CSP instances. In particular, we show that with this encoding many problem instances that can be solved in polynomial-time will still be easily solvable once they are translated into SAT. Furthermore, we show that this is not true for several other encodings.

Finally, we compare the various ways one can use a SAT-solver to solve the classical problem of the pigeonhole principle. We perform both theoretical and empirical comparison of the various encodings. We conclude that none of the known encodings for the classical representation of the problem will result in an efficiently solvable SAT instance. Thus in this case constraint solvers are a much better choice.

http://www.springer.com/978-3-319-21809-0

Bridging Constraint Satisfaction and Boolean Satisfiability

Petke, J.

2015, XI, 113 p. 19 illus., Hardcover
ISBN: 978-3-319-21809-0