

Mathematics and Symbolic AI

Marijn Heule, Carnegie Mellon University

Progress in symbolic AI has made it possible to determine the correctness of complex systems and answer long-standing open questions in mathematics. The crucial technology in many successes in computer-aided mathematics is satisfiability (SAT) solving. In this talk, we highlight some of these successes, including computing Schur number five, the resolution of Keller's conjecture, and solving the empty hexagon problem. The SAT solving approach can produce clever though potentially gigantic proofs. We can have confidence in the correctness of the answers because highly trustworthy systems can validate the underlying proofs regardless of their size. The final part of the talk focuses on notorious math challenges for which symbolic AI may well be suitable. In particular, we discuss applying these techniques to the Hadwiger Nelson problem (chromatic number of the plane), optimal schemes for matrix multiplication, and the Collatz conjecture.

Keywords: automated reasoning, satisfiability, proofs, formal verification