Rethinking SAT Solving

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AIHUB JAE Intro 2022

From a theoretical and a practical perspective, SAT is a crucial problem in computer science. From a theoretical point of view, SAT is NP-complete, which means that we cannot expect to solve SAT problems efficiently, in the worst case. Problems are difficult to solve in the average case. If we chose at random an unsatisfiable SAT instance, with uniform probability, almost sure it will have a super-polynomial resolution proof. Since all SAT solvers are based on resolution, this implies a severe limitation. However, modern SAT solvers are able to solve efficiently huge industrial or real-world instances. Obviously, the reason is that these instances share some structural properties that we still do not understand completely. Unfortunately, all modern SAT solvers are based on the same techniques (learning, restarts, clause deletion,...), and in the last years, there have no been relevant advances in this direction.

In order to overcome these difficulties, we are exploring radically distinct approaches to SAT solving. On the one hand, we are getting a better understanding of the structure of industrial instances. On the other hand, we are exploring the use of distinct proof systems that overcome the limitations of resolution, such as Sherali-Adams, or even the reduction of SAT to MaxSAT and the use of MaxSAT resolutions.

The candidates for this fellowship are expected to have mathematical and theoretical computer science, as well as programming skills. They are expected to integrate into a group, work with distinct researchers, participate in the discussions (even if they do not completely understand all the objectives), be able to communicate their own ideas, and change the goals on the way,... The candidates can hold a degree in Computer Science, Artificial Intelligence, Mathematics, or Physics.