

# 27th International Conference on Theory and Applications of Satisfiability Testing

SAT 2024, August 21–24, 2024, Pune, India

Edited by

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## ■ Preface

This volume contains (extended) abstracts of invited talks and full papers presented at the 27<sup>th</sup> International Conference on Theory and Applications of Satisfiability Testing (SAT 2024). SAT 2024 was held from August 21–24, 2024, in the Sahyadri Park facility of Tata Consultancy Services in Pune, India. This was the first time that the conference was held in India, and it was jointly organized by Indian Institute of Technology Bombay and Tata Consultancy Services.

The International Conference on Theory and Applications of Satisfiability Testing (SAT) is the topmost annual meeting focused on all aspects of the propositional satisfiability problem, broadly construed. In addition to propositional satisfiability in its classical form, the scope of the conference also includes Boolean optimization problems like MaxSAT and Pseudo-Boolean (PB) constraint solving, Quantified Boolean Formulas (QBF), Satisfiability Modulo Theories (SMT), Model Counting, and Constraint Programming (CP) for problems with clear connections to Boolean-level reasoning.

The call for papers for SAT 2024 welcomed original contributions addressing different aspects of SAT, interpreted in a broad sense. This included theoretical advances such as exact algorithms, proof complexity, and other complexity issues, practical search algorithms, knowledge compilation, implementation-level details of SAT solvers and SAT-based systems, problem encodings and reformulations, applications including both novel application domains and improvements to existing approaches, as well as case studies and reports on findings based on rigorous experimentation. Both regular (long) papers and short papers were welcomed for submission, with the latter format also including tool papers.

A total of 70 submissions, with authors distributed across 25 countries, were received by the submission deadline. Of these, 52 were regular papers, 4 were short papers, and 14 were tool papers. Each submission was reviewed by at least 3 (4 in most cases) Program Committee members and external expert reviewers identified by the Program Committee. Authors of submitted papers were provided an opportunity to respond to initial reviews and to specific queries posed by reviewers during an author response period that spanned 5 days. Subsequent to this, there was extensive discussion among Program Committee members for finalizing the list of accepted papers. Eventually, 24 papers were unconditionally accepted, and an additional 4 papers were accepted subject to the condition that the authors addressed specific comments of reviewers, and the revised version went through a fresh round of review. Authors of conditionally accepted papers were given 2 weeks to revise their papers. Each revised paper was again reviewed by two of the reviewers who had originally reviewed the paper. The 4 conditionally accepted papers were eventually accepted after the reviewers satisfied themselves that all reviewers' comments were attended to adequately in the revised versions of the papers. Overall, a total of 28 papers were finally accepted for SAT 2024, with 23 of these being regular papers, 4 being tool papers, and 1 being a short paper.

In addition to the presentation of accepted papers, the technical program of SAT 2024 also included three invited talks by eminent researchers in the area. Martina Seidl (Institute for Formal Models and Verification at Johannes Kepler University, Austria), Cesare Tinelli (The University of Iowa, USA), and Moshe Y. Vardi (Rice University, USA) delivered invited talks on important and contemporary topics of significant interest to the community. Abstracts or extended abstracts of their talks are included as part of this volume.



In recognition of outstanding and impactful contributions in areas of relevance to the conference, four awards were presented at SAT 2024. The Program Committee deliberated and gave suggestions for the choice of the Best Paper and the Best Student Paper, the latter for a paper whose lead author was a student when the work was done. The Award Committee, consisting of Nikolaj Bjørner, Shaowei Cai, Daniel Le Berre, and Jakob Nordström, carefully considered these suggestions to arrive at the final award recommendations. Accordingly, the **Best Paper Award** of SAT 2024 was conferred on “The Strength of the Dominance Rule” by Leszek Aleksander Kołodziejczyk and Neil Thapen “*for the use of theoretical tools from mathematical logic to answer a question of considerable applied interest regarding the strength of different methods for proof logging.*” The **Best Student Paper Award** of SAT 2024 was conferred on “Speeding-up Pseudo-Boolean Propagation” by Robert Nieuwenhuis, Albert Oliveras, Enric Rodríguez Carbonell, and Rui Zhao (student author) “*for the principled approach used for measuring the impact of implementation choices for Pseudo-Boolean propagation.*”

The three runner-ups for the above awards are: “Optimal Layout Synthesis for Deep Quantum Circuits on NISQ Processors with 100+ Qubits” by Irfansha Shaik and Jaco van de Pol, “Quantum Circuit Mapping Based on Incremental and Parallel SAT Solving” by Jiong Yang, Yaroslav A. Kharkov, Yunong Shi, Marijn Heule, and Bruno Dutertre, and “eSLIM: Circuit Minimization with SAT Based Local Improvement” by Franz-Xaver Reichl, Friedrich Slivovsky, and Stefan Szeider.

This year, the SAT Association also established a new award called the ***Fahiem Bacchus PhD Award in Satisfiability***. This award distinguishes one outstanding PhD thesis from the past two years in the field of satisfiability, broadly construed. The award is named after Fahiem Bacchus, who made significant contributions to the theory and practice of SAT, to the SAT community, and to the SAT Association. In response to the call for nominations, the committee for selecting the Fahiem Bacchus Award received a number of strong applications.

The inaugural Fahiem Bacchus Award was conferred at SAT 2024 on Dominik Schreiber for his PhD thesis “Scalable SAT Solving and its Applications”, defended at the Karlsruhe Institute of Technology (KIT) in 2023.

The two runner-ups for the award are: Stephan Gocht (Lund University, thesis title: “Certifying Correctness for Combinatorial Algorithms by Using Pseudo-Boolean Reasoning”) and André Schidler (Technische Universität Wien, thesis title: “Scalability for SAT-based Combinatorial Problem Solving”).

The ***SAT Test-of-Time Award*** is an award instituted by the SAT Association that is given annually to a selected paper from around 20 years back with a large impact on SAT and beyond. The SAT 2024 Test-of-Time Award was conferred on the paper “Combining Component Caching and Clause Learning for Effective Model Counting”, which appeared in the proceedings of SAT 2004 and was authored by Tian Sang, Fahiem Bacchus, Paul Beame, Henry A. Kautz, and Toniann Pitassi.

The week of SAT 2024 also included a pre-conference instructional school and three workshops that were held at the same venue as the main conference. The 9<sup>th</sup> edition of the *Indian SAT+SMT School*, organized by Supratik Chakraborty, Priyanka Golia, Ashutosh Gupta, Saurabh Joshi, Kumar Madhukar, and Kuldeep S. Meel, was held during August 18–19, 2024. Subsequently, the following three workshops were concurrently held on August 20, 2024.

- *Pragmatics of SAT*, organized by Katalin Fazekas and Alexey Ignatiev
- *International Workshop on Quantified Boolean Formulas and Beyond*, organized by Hubie Chen, Friedrich Slivovsky, and Martina Seidl
- *Workshop on Counting, Sampling and Synthesis*, organized by Paulius Dilkas and Priyanka Golia



The results of four major competitions, as listed below, were also announced during the technical program of SAT 2024.

- *SAT Competition 2024*, organized by Marijn Heule, Markus Iser, Matti Järvisalo, and Martin Suda
- *Pseudo-Boolean Competition 2024*, organized by Olivier Roussel
- *Model Counting Competition 2024*, organized by Johannes Fichte, Markus Hecher, and Arijit Shaw
- *MaxSAT Evaluation 2024*, organized by Matti Järvisalo, Jeremias Berg, Ruben Martins, Tobias Paxian, and Andreas Niskanen

We are thankful to all individuals, institutions, and organizations who contributed to making SAT 2024 a success. We thank all authors for submitting their work to SAT 2024, and also thank all instructional school, workshop, and conference participants for actively participating in the technical sessions. Our deepest thanks go to all Program Committee members and external expert reviewers for carefully reading the submissions, providing constructive comments, and for participating in extensive discussions that helped in selecting the strongest papers for the technical program of the conference. A special thanks to the Award Committee for working on a very tight schedule to arrive at the Best Paper and Best Student Paper decisions, and also for recommending runner-ups for these awards. We are thankful to the three invited speakers for accepting our invitation and enlightening the audience with their insights and perspectives. Our thanks to the organizers of all the school, workshops, and competitions that were affiliated to SAT 2024. A special thanks to Daniela Kaufmann and Alexey Ignatiev for serving as Workshops Chair of SAT 2024.

We are thankful to R. Venkatesh, who served as General Chair of SAT 2024, and to the entire local organizing committee that worked tirelessly under the leadership of Ravindra Metta to make the conference a success. We wish to thank Finance Chair Hrishikesh Karmarkar, Sponsorship Chair Kumar Madhukar, Publicity Chair Abhisekh Sankaran, Advisory Chair Kuldeep S. Meel, and Webmasters Weichieh Wang and Anand Yeolekar for their crucial roles in various aspects of organization of the conference. Our special thanks go to Indian Institute of Technology Bombay and Tata Consultancy Services for helping us negotiate mandatory clearance procedures for SAT 2024. We thank the SAT Association for its invaluable guidance and support at all steps of organizing the conference. Thanks are also due to the EasyChair conference management system for facilitating the submission, review, and selection of papers, and to the editorial and publishing staff at LIPIcs for their help and guidance in compiling this volume.

Finally, we wish to thank all sponsors and supporters of SAT 2024, whose generous financial support made it possible to organize the conference smoothly. We gratefully acknowledge the enormous support, both financial and logistical, provided by Tata Consultancy Services. In addition, sponsorship was provided by Amazon Web Services, Cadence Design Systems, Synopsys, Advanced Micro Devices, Google, and Microsoft. We are grateful to Dr. Anand Deshpande for his support, advice, and encouragement. Generous support for international student travel grants was provided by the journal of Artificial Intelligence (AIJ), while similar support for travel and registration of Indian students was provided by the ACM India Council and the Association for Logic in India. The ACM India Council and the Indian Association for Research in Computing Science provided invaluable support at all stages of organizing the conference. Our sincere thanks to all these organizations for their role in making SAT 2024 a success.

August 2024

Supratik Chakraborty  
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