Curriculum Vitae

Clark Barrett

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Research Interests

Automated reasoning; satisfiability modulo theories (SMT); formal methods; formal verification; verification of smart contracts; verification of neural networks; AI safety; security; hardware design productivity and verification.

Education

Ph.D.: Stanford University, 2003, Computer Science. Advisor: David L. Dill.
Thesis Title: *Checking Validity of Quantifier-Free Formulas in Combinations of First-Order Theories.*

M.S.: Stanford University, 1998, Computer Science. Advisor: David L. Dill.

B.S.: Brigham Young University, 1995, Electrical and Computer Engineering (with Honors), Computer Science, and Mathematics. Summa Cum Laude with University Honors. Minors: Physics, Music.

Appointments

Professor (Research), Computer Science, Stanford University, Sept. 2021 to present.
Associate Professor (Research), Computer Science, Stanford University, Sept. 2016 to Aug. 2021.
Visiting Scientist, Google, Mountain View, CA, Jan. 2015 to July 2017.
Visiting Associate Professor, Stanford University, Sept. 2013 to Aug. 2016.
Associate Professor, Computer Science, Courant Institute, NYU, Sept. 2008 to Aug. 2016
Assistant Professor, Computer Science, Courant Institute, NYU, Sept. 2002 to 2008.

Research Group

Ph.D. Students: Caleb Donovick, Haoze Wu, Alex Ozdemir, Ying Sheng, Scott Viteri, Amalee Wilson, Hanna Lachnitt, Rachel Cleaveland, Samuel Akinwande, Abdalrhman Mohamed,

Graduated Ph.D. Students:

- *Makai Mann*, "Augmenting Transition Systems for Scalable Symbolic Model Checking," Computer Science, Stanford University, 2021.
- *Andres Nötzli*, "Towards Better Simplifications in SMT Solvers with Applications in String Solving," Computer Science, Stanford University, 2021.
- *Kshitij Bansal*, "Decision Procedures for Finite Sets with Cardinality, and Local Theories Extensions," Computer Science, New York University, 2016.
- *Wei Wang*, "Partition Memory Models for Program Analysis," Computer Science, New York University, 2016.
- *Liana Hadarean*, "An Efficient and Trustworthy Theory Solver for Bit-vectors in Satisfiability Modulo Theories," Computer Science, New York University, 2014.

- *Tim King*, "Effective Algorithms for the Satisfiability of Quantifier-Free Formulas Over Linear Real and Integer Arithmetic," Computer Science, New York University, 2014.
- *Dejan Jovanović*, "SMT Beyond DPLL(T): A New Approach to Theory Solvers and Theory Combination," Computer Science, New York University, 2012.
- *Igor Chikanian*, "Automatic Deduction for Theories of Algebraic Data Types," Computer Science, New York University, 2011.
- *Chris Conway*, "Tools and Techniques for the Sound Verification of Low-Level Code," Computer Science, New York University, 2011.
- *Yeting Ge*, "Solving Quantified First Order Formulas in Satisfiability Modulo Theories," Computer Science, New York University, 2010.
- *Ying Hu*, "Translation Validation of Loop Optimizations," Computer Science, New York University, 2005.

Postdocs and Research Scientists:

- *Pei Huang*, Postdoc, 2022 - present.
- *Min Wu*, Postdoc, 2022 - present.
- *Aina Niemetz*, Postdoc, 2017 - 2019; Research Scientist, 2019 - present.
- *Mathias Preiner*, Postdoc, 2017 - 2019; Research Scientist, 2019 - present.
- *Nestan Tsiskaridze*, Research Scientist, 2020 - present.
- *Florian Lonsing*, Research Scientist, 2019 - 2022.
- *Aleksandar Zeljić*, Postdoc, 2018 - 2022.
- *Gereon Kremer*, Postdoc, 2020 - 2022.
- *Yoni Zohar*, Postdoc, 2018 - 2021.
- *Ahmed Irfan*, Postdoc, 2019 - 2021.
- *Cristian Mattarei*, Postdoc, 2016 - 2018.
- *Guy Katz*, Postdoc, 2016 - 2018.
- *Morgan Deters*, Postdoc, 2008-2013; Senior Research Scientist, 2013-2015.
- *Dejan Jovanović*, Postdoc, 2012-2013.

Visiting Scholars:

- *Teruhiro Tagomori*, NRI Secure, 2020-present.
- *Stéphane Demri*, CNRS, 2012-2014.

Awards and Honors

Personal

Best SCP Tool Paper, International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), 2022.
CAV Award, 2021.
Test of Time Award, Conference on Logic in Computer Science (LICS), 2021.
Honorable Mention Paper, Conference on Formal Methods in Computer-Aided Design (FMCAD), 2020.
Best Paper, International Joint Conference on Automated Reasoning (IJCAR), 2020.
Distinguished Artifact Award, International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), 2018.

Best Short Paper, Symposium on SDN Research, 2018.
Best Paper, Conference on Formal Methods in Computer-Aided Design (FMCAD), 2016.
Best Paper, International Test Conference (ITC), 2015.
ACM Distinguished Scientist, December 2014.
Haifa Verification Conference Award, October 2010.
Member, IFIP Working Group 2.3 (Programming Methodology), elected March, 2010.
IBM Software Quality Innovation Award, November 2008.
National Science Foundation CAREER award, 2007-2012.
Nominated for Miller Research Fellowship (declined), 2002.
Best Paper, Design Automation Conference (DAC), 1998.
National Science Foundation Graduate Fellowship (declined).
National Defense Science and Engineering Graduate Fellowship, 1995-1999.
Karl G. Maeser Graduate Fellowship, 1995.
Co-valedictorian, Brigham Young University, 1995.

Systems

SMT-COMP 2022: winner in 15 of 20 competition-wide categoreis (cvc5);
SMT-COMP 2021: winner in 17 of 20 competition-wide categoreis (cvc5);
SMT-COMP 2020: winner in 6 of 8 competition-wide categories (CVC4);
HWMCC 2019: winner (Cosa2)
SMT-COMP 2019: winner of 13 first place trophies (of 18 possible) (CVC4);
SyGuS-COMP 2019: winner, general, PBE-BV, PBE-Strings, Inv tracks (CVC4)
SMT-COMP 2018: winner, main track (CVC4);
SyGuS-COMP 2018: winner, general, PBE-BV, PBE-Strings, and CLIA (tied) tracks (CVC4)
SMT-COMP 2017: winner, main track (CVC4);
SyGuS-COMP 2017: winner, linear-integer-arithmetic track and strings track (CVC4)
SMT-COMP 2016: winner, main track (CVC4);
SyGuS-COMP 2016: winner, linear-integer-arithmetic track (CVC4)
CASC 2015: winner, TFN division (CVC4);
SMT-COMP 2015: winner, main track (CVC4);
SyGuS-COMP 2015: winner, general track and linear-integer-arithmetic track (CVC4);
SV-COMP 2015: bronze medal, MemorySafety division (Cascade);
CASC 2014: winner, TFA division (CVC4);
SMT-COMP 2014: winner, ALIA, AUFLIA, AUFLIRA, LIA, LRA, QF_AUFBV, QF_LRA, QF_NRA, UF, UFLIA divisions (CVC4);
SMT-COMP 2012: winner, QF_UFLRA division (CVC4);
SMT-COMP 2007: winner, AUFLIRA division (CVC3);
SMT-COMP 2006: winner, AUFLIRA division (CVC3);

Systems Under Development

cvc5: An open-source SMT solver. Available at
`http://cvc5.github.io`.

Pono: An SMT-based model checker. Available at
`https://github.com/upscale-project/pono`.

Smt-switch: A solver-agnostic API for SMT solving. Available at
`https://github.com/stanford-centaur/smt-switch`.

Marabou: An open-source verifier for neural networks. Available at
`https://github.com/NeuralNetworkVerification/Marabou`.

Previously Developed Systems

CVC4: An open-source SMT solver. Available at
`http://cvc4.stanford.edu/`.

Cosa2: An open-source SMT-based model checker. Available at
`https://github.com/upscale-project/cosa2`.

CoSA: An open-source hardware model-checker. Available at
https://github.com/cristian-mattarei/CoSA

SMT Solvers: Stanford Validity Checker (SVC), Cooperating Validity Checker (CVC), CVC Lite, CVC3

Cascade: A program verification platform. Available at
`http://cvc4.cs.stanford.edu/cascade/`.

TVOC: A Translation Validator for Optimizing Compilers. Available at
`http://cs.nyu.edu/acsys/tv`.

Teaching

New York University

Computer Systems Organization, Fall 2012, Spring 2013.
Class web page available at `http://cs.nyu.edu/web/Academic/Courses/archive.html`.

Logic and Verification, Spring 2003, Spring 2004.
2003 class web page available at `http://www.cs.nyu.edu/~barrett/courses/spr03/index.html`. 2004 class web page available at `http://cs.nyu.edu/courses/spring04/G22.3033-003/index.htm`.

Logic in Computer Science, Fall 2003, Fall 2004, Fall 2007, Fall 2008, Fall 2009.
Class web pages available at `http://cs.nyu.edu/web/Academic/Courses/archive.html`.

Programming Languages, Fall 2008, Spring 2012.
Class web pages available at `http://cs.nyu.edu/web/Academic/Courses/archive.html`.

Software Engineering, Spring 2005, Spring 2006, Spring 2007, Spring 2008.
Class web pages available at `http://cs.nyu.edu/web/Academic/Courses/archive.html`.

Topics in Automated Deduction, Spring 2007, Spring 2009.
Class web pages available at `http://cs.nyu.edu/web/Academic/Courses/archive.html`.

Stanford University

Introduction to Automated Reasoning (CS 257), Fall 2022, Helped design course. Instructors: Caroline Trippel and Haoze Wu.

Advanced Computer Organization: Processor Architecture (EE 482), Teaching assistant, Spring 1997. Instructor: Kunle Olukotun.

Discrete Structures, Accelerated (CS 103X), Teaching assistant, Spring 2000, Winter 2001. Instructors: David Dill and John Mitchell.

Techniques for Program Analysis and Verification (CS 357), Co-instructor, Fall 2013, Fall 2015. Other instructors: Alex Aiken and David Dill.

Professional Activities

Steering Committee

FMCAD: Conference on Formal Methods in Computer-Aided Design, 2019-present.

SMT: International Workshop on Satisfiability Modulo Theories, 2009-2012, 2014-2018.

Program/Event Chair

Formal Verification of Machine Learning, Workshop at ICML, co-organizer, 2022.

FMCAD: International Conference on Formal Methods in Computer-Aided Design, co-chair, 2019.

VNN: AAAI Spring Symposium on Verification of Neural Networks, co-chair, 2019.

NASA Formal Methods Symposium, co-chair, 2017.

SAT/SMT Summer School, organizer, 2014; chair, 2015.

SMT-COMP: Satisfiability Modulo Theories Competition, co-chair, 2005, 2006, 2007, 2008, 2009, 2010.

Amir Pnueli Memorial Symposium, chair, 2010.

SMT: International Workshop on Satisfiability Modulo Theories, co-chair, 2008.

Program Committees

CADE: Conference on Automated Deduction, 2017, 2019.

CAV: International Conference on Computer Aided Verification, 2006, 2008, 2009, 2016, 2018, 2021.

CPP: Conference on Certified Programs and Proofs, 2017.

DIFTS: Workshop on Design and Implementation of Formal Tools and Systems, 2011.

FMCAD: International Conference on Formal Methods In Computer-Aided Design, 2006, 2020.

FoMLAS: Workshop on Formal Methods for ML-Enabled Autonomous Systems, 2019, 2020, 2021, 2022, 2023.

FroCoS: International Symposium on Frontiers of Combining Systems, 2005, 2011, 2013, 2015.

IJCAR: International Joint Conference on Automated Reasoning, 2018.

MEMOCODE: International Conference on Formal Methods and Models for Codesign, 2009.

NFM: NASA Formal Methods Symposium, 2016.

PAAR: Workshop on Practical Aspects of Automated Reasoning, 2012, 2014.

PDPAR: Workshop on Pragmatics of Decision Procedures in Automated Reasoning, 2003, 2004, 2005, 2006.

PXTP: Workshop on Proof eXchange for Theorem Proving, 2011.

SAT: International Conference on Theory and Applications of Satisfiability Testing, 2005.

SIGDA: Ph.D. Forum at the Design Automation Conference, 2004, 2005.

SMT: International Workshop on Satisfiability Modulo Theories, 2007, 2008, 2009, 2010, 2011, 2012, 2020.

SYNT: Workshop on Synthesis, 2021.

TPHOLs: International Conference on Theorem Proving and Higher Order Logics, 2004, 2005.

VMCAI: International Conference on Verification, Model Checking and Abstract Interpretation, 2008.

VSTTE: Workshop on Verified Software: Theories, Tools and Experiments, 2012.

WING: Workshop on Invariant Generation, 2012.

Referee

Conference/Workshop papers: CADE, CAV, DAC, EMSOFT, FMCAD, FroCoS, FSTTCS, IJCAR, LPAR, MEMOCODE, PAAR, PDPAR, POPL, SMT, TACAS, STACS, TPHOLs, VMCAI.

Journal papers: *ACM Computing Surveys*, *ACM Transactions on Computational Logic*, *AI Communications*, *Artificial Intelligence Journal*, *Communications of the ACM*, *Formal Aspects of Computing*, *Information and Computation*, *IEEE Transactions on Computer-Aided Design*, *Journal of Formal Methods in System Design*, *Journal of Automated Reasoning*, *Journal of the ACM*, *Journal on Satisfiability, Boolean Modeling and Computation*, *Journal of Symbolic Computation*, *Journal of Zhejiang University-Science A*, *Logical Methods in Computer Science*, *Theoretical Computer Science*.

Departmental Service (Stanford)

Awards committee, 2018-2021.
Gates space committee, 2017-2023.
Lecturer search committee, 2018-2019.
Masters program student advisor, 2016-2023.
PhD admissions, 2016-2018.
Strategic research initiatives committee (head), 2018-2023.

Departmental Service (NYU)

Appointments Committee, 2008-2009.
Coordinator for departmental spring showcase, 2007, 2008.
Department chair search committee, 2005-2006, 2008.
Director of Undergraduate Studies, 2009-2010.
Fellowship committee (PhD student admission and oversight committee), 2004-2008.
Graduate curriculum committee, 2006-2009.
Teaching load committee, 2006-2007.
Teaching assignments committee, 2009-2014.
Undergraduate curriculum committee, 2004-2010.
Undergraduate mentor, 2003-2008.

Other Activities

Participant at NSF workshops and panels.

One of three coordinators of the SMT-LIB initiative (see `http://www.smtlib.org`). Responsible for collecting and maintaining the library of benchmarks; chair of the SMT-LIB working group on model generation; contributor to many other aspects of the initiative.

Industry Experience

Consulting: Reservoir Labs Inc., Calypto Design Systems, MIT Lincoln Laboratory, Mentor Graphics (formerly 0-in Design Automation).

Amazon, 2023 - present. Amazon Scholar (Robert Jones, host). Consulting on uses and applications of automated reasoning tools.

Facebook Novi, 2018 - 2022. Consultant for Move Prover team (smart contract verification tool).

Google, 2015 - 2017, Visiting Scientist (Domagoj Babic, host). Using SMT to find security vulnerabilities.

Intel, 1996, Summer Intern under Carl Seger. Prototyping and development of an early version of *Forte*, a formal verification tool suite.

Microsoft Research, 1993, Summer Intern under Charles Simonyi. Programmer on "Intentional Programming" project.

Publications

Conference Publications

(1) Matan Ostrovsky, Clark Barrett, and Guy Katz. An abstraction-refinement approach to verifying convolutional neural networks. In Ahmed Bouajjani, Lukáš Holík, and Zhilin Wu, editors, *Proceedings of the* 20^{th} *International Symposium on Automated Technology for Verification and Analysis (ATVA '22)*, volume 13505 of *Lecture Notes in Computer Science*, pages 391–396. Springer International Publishing, October 2022.

(2) Ross Daly, Caleb Donovick, Jackson Melchert, Rajsekhar Setaluri, Nestan Tsiskaridze, Priyanka Raina, Clark Barrett, and Pat Hanrahan. Synthesizing instruction selection rewrite rules from RTL using SMT. In Alberto Griggio and Neha Rungta, editors, *Proceedings of the* 22^{nd} *International Conference on Formal Methods In Computer-Aided Design (FMCAD '22)*, pages 139–150. TU Wien Academic Press, October 2022.

(3) Andres Nötzli, Haniel Barbosa, Aina Niemetz, Mathias Preiner, Andrew Reynolds, Clark Barrett, and Cesare Tinelli. Reconstructing fine-grained proofs of rewrites using a domain-specific language. In Alberto Griggio and Neha Rungta, editors, *Proceedings of the* 22^{nd} *International Conference on Formal Methods In Computer-Aided Design (FMCAD '22)*, pages 65–74. TU Wien Academic Press, October 2022.

(4) Abhishek Nair, Saranyu Chattopadhyay, Haoze Wu, Alex Ozdemir, and Clark Barrett. Proof-stitch: Proof combination for divide-and-conquer SAT solvers. In Alberto Griggio and Neha Rungta, editors, *Proceedings of the* 22^{nd} *International Conference on Formal Methods In Computer-Aided Design (FMCAD '22)*, pages 84–88. TU Wien Academic Press, October 2022.

(5) Tom Zelazny, Haoze Wu, Clark Barrett, and Guy Katz. On optimizing back-substitution methods for neural network verification. In Alberto Griggio and Neha Rungta, editors, *Proceedings of the* 22^{nd} *International Conference on Formal Methods In Computer-Aided Design (FMCAD '22)*, pages 17–26. TU Wien Academic Press, October 2022.

(6) Omri Isac, Clark Barrett, Min Zhang, and Guy Katz. Neural network verification with proof production. In Alberto Griggio and Neha Rungta, editors, *Proceedings of the* 22^{nd} *International Conference on Formal Methods In Computer-Aided Design (FMCAD '22)*, pages 38–48. TU Wien Academic Press, October 2022.

(7) Ying Sheng, Andres Nötzli, Andrew Reynolds, Yoni Zohar, David Dill, Wolfgang Grieskamp, Junkil Park, Shaz Qadeer, Clark Barrett, and Cesare Tinelli. Reasoning about vectors using an smt theory of sequences. In Jasmin Blanchette, Laura Kovács, and Dirk Pattinson, editors, *Proceedings of the* 11^{th} *International Joint Conference on Automated Reasoning (IJCAR '22)*, volume 13385 of *Lecture Notes in Computer Science*, pages 125–143. Springer Nature, August 2022.

(8) Gereon Kremer, Andrew Reynolds, Clark Barrett, and Cesare Tinelli. Cooperating techniques for solving nonlinear real arithmetic in the cvc5 smt solver (system description). In Jasmin Blanchette, Laura Kovács, and Dirk Pattinson, editors, *Proceedings of the* 11^{th} *International Joint Conference on Automated Reasoning (IJCAR '22)*, volume 13385 of *Lecture Notes in Computer Science*, pages 95–105. Springer Nature, August 2022.

(9) Haniel Barbosa, Andrew Reynolds, Gereon Kremer, Hanna Lachnitt, Aina Niemetz, Andres Nötzli, Alex Ozdemir, Mathias Preiner, Arjun Viswanathan, Scott Viteri, Yoni Zohar, Cesare Tinelli, and Clark Barrett. Flexible proof production in an industrial-strength smt solver. In Jasmin Blanchette, Laura Kovács, and Dirk Pattinson, editors, *Proceedings of the* 11^{th} *International Joint Conference on Automated Reasoning (IJCAR '22)*, volume 13385 of *Lecture Notes in Computer Science*, pages 15–35. Springer Nature, August 2022.

(10) Andres Nötzli, Andrew Reynolds, Haniel Barbosa, Clark Barrett, and Cesare Tinelli. Even faster conflicts and lazier reductions for string solvers. In Sharon Shoham and Yakir Vizel, editors, *Proceedings of the* 34^{th} *International Conference on Computer Aided Verification (CAV '22)*, volume 13372 of *Lecture Notes in Computer Science*, pages 205–226. Springer, August 2022.

(11) Aina Niemetz, Mathias Preiner, and Clark Barrett. Murxla: A modular and highly extensible api fuzzer for smt solvers. In Sharon Shoham and Yakir Vizel, editors, *Proceedings of the* 34^{th} *International Conference on Computer Aided Verification (CAV '22)*, volume 13372 of *Lecture Notes in Computer Science*, pages 92–106. Springer, August 2022.

(12) Haniel Barbosa, Clark W. Barrett, Martin Brain, Gereon Kremer, Hanna Lachnitt, Makai Mann, Abdalrhman Mohamed, Mudathir Mohamed, Aina Niemetz, Andres Nötzli, Alex Ozdemir, Mathias Preiner, Andrew Reynolds, Ying Sheng, Cesare Tinelli, and Yoni Zohar. cvc5: A versatile and industrial-strength SMT solver. In Dana Fisman and Grigore Rosu, editors, *Proceedings of the* 28^{th} *International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS '22)*, volume 13243 of *Lecture Notes in Computer Science*, pages 415–442. Springer, apr 2022. *Best SCP Tool Paper Award.*

(13) Haoze Wu, Aleksandar Zeljić, Guy Katz, and Clark Barrett. Efficient neural network analysis with sum-of-infeasibilities. In Dana Fisman and Grigore Rosu, editors, Proceedings of the 28^{th} International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS '22)*, volume 13243 of* Lecture Notes in Computer Science*, pages 143–163. Springer, April 2022.*

(14) Yoni Zohar, Ahmed Irfan, Makai Mann, Aina Niemetz, Andres Nötzli, Mathias Preiner, Andrew Reynolds, Clark Barrett, and Cesare Tinelli. Bit-precise reasoning via int-blasting. In Bernd Finkbeiner and Thomas Wies, editors, Proceedings of the 23^{rd} International Conference on Verification, Model Checking, and Abstract Interpretion (VMCAI '22)*, volume 13182 of* Lecture Notes in Computer Science*, pages 496–518. Springer, January 2022.*

(15) Nestan Tsiskaridze, Maxwell Strange, Makai Mann, Kavya Sreedhar, Qiaoyi Liu, Mark Horowitz, and Clark Barrett. Automating system configuration. In Ruzica Piskac and Michael W. Whalen, editors, Proceedings of the 21^{st} International Conference on Formal Methods In Computer-Aided Design (FMCAD '21)*, pages 102–111. TU Wien Academic Press, October 2021.*

(16) Saranyu Chattopadhyay, Florian Lonsing, Luca Piccolboni, Deepraj Soni, Peng Wei, Xiaofan Zhang, Yuan Zhou, Luca Carloni, Deming Chen, Jason Cong, Ramesh Karri, Zhiru Zhang, Caroline Trippel, Clark Barrett, and Subhasish Mitra. Scaling up hardware accelerator verification using A-QED with functional decomposition. In Ruzica Piskac and Michael W. Whalen, editors, Proceedings of the 21^{st} International Conference on Formal Methods In Computer-Aided Design (FMCAD '21)*, pages 42–52. TU Wien Academic Press, October 2021.*

(17) Alex Ozdemir, Haoze Wu, and Clark Barrett. SAT solving in the serverless cloud. In Ruzica Piskac and Michael W. Whalen, editors, Proceedings of the 21^{st} International Conference on Formal Methods In Computer-Aided Design (FMCAD '21)*, pages 241–245. TU Wien Academic Press, October 2021.*

(18) Colin Paterson, Haoze Wu, John Grese, Radu Calinescu, Corina S. Păsăreanu, and Clark Barrett. Deepcert: Verification of contextually relevant robustness for neural network image classifiers. In Ibrahim Habli, Mark Sujan, and Friedemann Bitsch, editors, Computer Safety, Reliability, and Security (SAFECOMP '21)*, volume 12852 of* Lecture Notes in Computer Science*, pages 3–17. Springer International Publishing, September 2021.*

(19) Makai Mann, Ahmed Irfan, Florian Lonsing, Yahan Yang, Hongce Zhang, Kristopher Brown, Aarti Gupta, and Clark Barrett. Pono: A flexible and extensible SMT-based model checker. In Rustan Leino and Alexandra Silva, editors, Proceedings of the 33^{rd} International Conference on Computer Aided Verification (CAV '21)*, volume 12760 of* Lecture Notes in Computer Science*, pages 461–474. Springer International Publishing, July 2021.*

(20) Ying Sheng, Yoni Zohar, Christophe Ringeissen, Andrew Reynolds, Clark Barrett, and Cesare Tinelli. Politeness and stable infiniteness: Stronger together. In André Platzer and Geoff Sutcliffe, editors, Proceedings of the 28^{th} International Conference on Automated Deduction (CADE '21)*, volume 12699 of* Lecture Notes in Artificial Intelligence*, pages 148–165. Springer, July 2021.*

(21) Makai Mann, Amalee Wilson, Yoni Zohar, Lindsey Stuntz, Ahmed Irfan, Kristopher Brown, Caleb Donovick, Allison Guman, Cesare Tinelli, and Clark Barrett. Smt-switch: A solver-agnostic C++

API for SMT solving. In Chu-Min Li and Felip Manyà, editors, Proceedings of the 24^{th} International Conference on Theory and Applications of Satisfiability Testing (SAT '21)*, volume 12831 of* Lecture Notes in Computer Science*, pages 377–386. Springer, July 2021. Barcelona, Spain.*

(22) Makai Mann, Ahmed Irfan, Alberto Griggio, Oded Padon, and Clark Barrett. Counterexample-guided prophecy for model checking modulo the theory of arrays. In Jan Friso Groote and Kim Guldstrand Larsen, editors, Proceedings of the 27^{th} International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS '21)*, volume 12651 of* Lecture Notes in Computer Science*, pages 113–132. Springer, March 2021.*

(23) Aina Niemetz, Mathias Preiner, Andrew Reynolds, Clark Barrett, and Cesare Tinelli. Syntax-guided quantifier instantiation. In Jan Friso Groote and Kim Guldstrand Larsen, editors, Proceedings of the 27^{th} International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS '21)*, volume 12652 of* Lecture Notes in Computer Science*, pages 145–163. Springer, March 2021.*

(24) Guy Amir, Haoze Wu, Clark Barrett, and Guy Katz. An SMT-based approach for verifying binarized neural networks. In Jan Friso Groote and Kim Guldstrand Larsen, editors, Proceedings of the 27^{th} International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS '21)*, volume 12652 of* Lecture Notes in Computer Science*, pages 203–222. Springer, March 2021.*

(25) Ahmed Irfan, Kyle D. Julian, Haoze Wu, Clark Barrett, Mykel J. Kochenderfer, Baoluo Meng, and James Lopez. Towards verification of neural networks for small unmanned aircraft collision avoidance. In Proceedings of the 39^{th} Digital Avionics Systems Conference (DASC '20)*, October 2020.*

(26) Yuval Jacoby, Clark Barrett, and Guy Katz. Verifying recurrent neural networks using invariant inference. In Dang Van Hung and Oleg Sokolsky, editors, Proceedings of the 18^{th} International Symposium on Automated Technology for Verification and Analysis (ATVA '20)*, volume 12302 of* Lecture Notes in Computer Science*, pages 57–74. Springer International Publishing, October 2020.*

(27) Haoze Wu, Alex Ozdemir, Aleksandar Zeljić, Kyle Julian, Ahmed Irfan, Divya Gopinath, Sadjad Fouladi, Guy Katz, Corina Pasareanu, and Clark Barrett. Parallelization techniques for verifying neural networks. In Alexander Ivrii and Ofer Strichman, editors, Proceedings of the 20^{th} International Conference on Formal Methods In Computer-Aided Design (FMCAD '20)*, pages 128–137. TU Wien Academic Press, September 2020.*

(28) Florian Lonsing, Subhasish Mitra, and Clark Barrett. A theoretical framework for symbolic quick error detection. In Alexander Ivrii and Ofer Strichman, editors, Proceedings of the 20^{th} International Conference on Formal Methods In Computer-Aided Design (FMCAD '20)*, pages 26–35. TU Wien Academic Press, September 2020.*

(29) Lenny Truong, Steven Herbst, Rajsekhar Setaluri, Makai Mann, Ross Daly, Keyi Zhang, Caleb Donovick, Daniel Stanley, Mark Horowitz, Clark Barrett, and Pat Hanrahan. fault: A python embedded domain-specific language for metaprogramming portable hardware verification components. In Shuvendu K. Lahiri and Chao Wang, editors, Proceedings of the 32^{nd} International Conference on Computer Aided Verification (CAV '20)*, volume 12224 of* Lecture Notes in Computer Science*, pages 403–414. Springer International Publishing, July 2020.*

(30) Jingyi Emma Zhong, Kevin Cheang, Shaz Qadeer, Wolfgang Grieskamp, Sam Blackshear, Junkil Park, Yoni Zohar, Clark Barrett, and David L. Dill. The move prover. In Shuvendu K. Lahiri and Chao Wang, editors, Proceedings of the 32^{nd} International Conference on Computer Aided Verification (CAV '20)*, volume 12224 of* Lecture Notes in Computer Science*, pages 137–150. Springer International Publishing, July 2020.*

(31) R. Bahr, C. Barrett, N. Bhagdikar, A. Carsello, R. Daly, C. Donovick, D. Durst, K. Fatahalian, K. Feng, P. Hanrahan, T. Hofstee, M. Horowitz, D. Huff, F. Kjolstad, T. Kong, Q. Liu, M. Mann, J. Melchert, A. Nayak, A. Niemetz, G. Nyengele, P. Raina, S. Richardson, R. Setaluri, J. Setter, K. Sreedhar, M. Strange, J. Thomas, C. Torng, L. Truong, N. Tsiskaridze, and K. Zhang. Creating

an agile hardware design flow. In Proceedings of the 57^{th} Design Automation Conference (DAC '20). *Association for Computing Machinery, July 2020.*

(32) Eshan Singh, Florian Lonsing, Saranyu Chattopadhyay, Max Strange, Peng Wei, Xiaofan Zhang, Yuan Zhao, Jason Cong, Deming Chen, Zhiru Zhang, Priyankja Raina, Clark Barrett, and Subhasish Mitra. A-QED verification of hardware accelerators. In Proceedings of the 57^{th} Design Automation Conference (DAC '20). *Association for Computing Machinery, July 2020.*

(33) Ying Sheng, Yoni Zohar, Christophe Ringeissen, Jane Lange, Pascal Fontaine, and Clark Barrett. Politeness for the theory of algebraic datatypes. In Nicolas Peltier and Viorica Sofronie-Stokkermans, editors, Proceedings of the 10^{th} International Joint Conference on Automated Reasoning (IJCAR '20), *volume 12166 of* Lecture Notes in Computer Science, *pages 238–255. Springer International Publishing, July 2020.* Best paper award.

(34) Sumathi Gokulanathan, Alexander Feldsher, Adi Malca, Clark Barrett, and Guy Katz. Simplifying neural networks using formal verification. In Ritchie Lee, Susmit Jha, and Anastasia Mavridou, editors, NASA Formal Methods: 12th International Symposium, (NFM '20), *Lecture Notes in Computer Science, pages 85–93. Springer, May 2020. Moffet Field, California.*

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(118) Andrew Reynolds, Viktor Kuncak, Cesare Tinelli, Clark Barrett, and Morgan Deters. Refutation-based synthesis in SMT. *Formal Methods in System Design*, 55(2):73–102, December 2019.

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(120) Eshan Singh, David Lin, Clark Barrett, and Subhasish Mitra. Logic bug detection and localization using symbolic quick error detection. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, 2018.

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(131) Lenore Zuck, Amir Pnueli, Benjamin Goldberg, Clark Barrett, Yi Fang, and Ying Hu. Translation and run-time validation of loop transformations. *Formal Methods in System Design*, 27(3):335–360, November 2005.

(132) Carl-Johan H. Seger, Robert B. Jones, John W. O'Leary, Tom Melham, Mark D. Aagaard, Clark Barrett, and Don Syme. An industrially effective environment for formal hardware verification. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, 24(9):1381–1405, September 2005.

Refereed Workshop Publications

(133) Makai Mann, Amalee Wilson, Cesare Tinelli, and Clark Barrett. Smt-switch: A solver-agnostic c++ API for SMT solving (extended abstract). In *Proceedings of the* 18^{th} *International Workshop on Satisfiability Modulo Theories (SMT '20)*, July 2020.

(134) Burak Ekici, Arjun Viswanathan, Yoni Zohar, Clark Barrett, and Cesare Tinelli. Verifying bit-vector invertibility conditions in coq (extended abstract). In Giselle Reis and Haniel Barbosa, editors, *Proceedings of the Sixth Workshop on Proof eXchange for Theorem Proving (PxTP '19)*, volume 301 of *Electronic Proceedings in Theoretical Computer Science*, pages 18–26, August 2019. Natal, Brazil.

(135) Yafim Kazak, Clark Barrett, Guy Katz, and Michael Schapira. Verifying deep-rl-driven systems. In *Proceedings of the 2019 Workshop on Network Meets AI & ML (NetAI '19)*, pages 83–89. Association for Computing Machinery, August 2019. Beijing, China.

(136) Andrew Reynolds, Haniel Barbosa, Aina Niemetz, Andres Nötzli, Mathias Preiner, Clark Barrett, and Cesare Tinelli. Rewrites for SMT solvers using syntax-guided enumeration. In *Proceedings of the* 16^{th} *International Workshop on Satisfiability Modulo Theories (SMT '18)*, July 2018. Oxford, United Kingdom.

(137) Guy Katz, Clark Barrett, David L. Dill, Kyle Julian, and Mykel J. Kochenderfer. Towards proving the adversarial robustness of deep neural networks. In Lukas Bulwahn, Maryam Kamali, and Sven Linker, editors, *Proceedings of the First Workshop on Formal Verification of Autonomous Vehicles (FVAV '17)*, volume 257 of *Electronic Proceedings in Theoretical Computer Science*, pages 19–26, September 2017. Turin, Italy.

(138) Tim King and Clark Barrett. Exploring and categorizing error spaces using BMC and SMT. In *Proceedings of the* 9^{th} *International Workshop on Satisfiability Modulo Theories (SMT '11)*, July 2011. Snowbird, Utah.

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(143) Sean McLaughlin, Clark Barrett, and Yeting Ge. Cooperating theorem provers: A case study combining HOL-Light and CVC Lite. In Alessandro Armando and Alessandro Cimatti, editors, *Proceedings of the* 3^{rd} *Workshop on Pragmatics of Decision Procedures in Automated Reasoning (PDPAR '05)*, volume 144(2) of *Electronic Notes in Theoretical Computer Science*, pages 43–51. Elsevier, January 2006. Edinburgh, Scotland.

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(146) Sergey Berezin, Clark Barrett, Igor Shikanian, Marsha Chechik, Arie Gurfinkel, and David L. Dill. A practical approach to partial functions in CVC Lite. In Wolfgang Ahrendt, Peter Baumgartner, Hans de Nivelle, Silvio Ranise, and Cesare Tinelli, editors, *Selected Papers from the Workshops on Disproving and the Second International Workshop on Pragmatics of Decision Procedures (PDPAR '04)*, volume 125(3) of *Electronic Notes in Theoretical Computer Science*, pages 13–23. Elsevier, July 2005. Cork, Ireland.

(147) Clark Barrett and Jacob Donham. Combining SAT methods with non-clausal decision heuristics. In Wolfgang Ahrendt, Peter Baumgartner, Hans de Nivelle, Silvio Ranise, and Cesare Tinelli, editors, *Selected Papers from the Workshops on Disproving and the Second International Workshop on Pragmatics of Decision Procedures (PDPAR '04)*, volume 125(3) of *Electronic Notes in Theoretical Computer Science*, pages 3–12. Elsevier, July 2005. Cork, Ireland.

(148) Clark Barrett and Sergey Berezin. A proof-producing boolean search engine. In *Proceedings of the* 1^{st} *International Workshop on Pragmatics of Decision Procedures in Automated Reasoning (PDPAR '03)*, July 2003. Miami, Florida.

(149) Clark Barrett, Benjamin Goldberg, and Lenore Zuck. Run-time validation of speculative optimizations using CVC. In Oleg Sokolsky and Mahesh Viswanathan, editors, *Proceedings of the* 3^{rd} *International Workshop on Run-time Verification (RV '03)*, volume 89(2) of *Electronic Notes in Theoretical Computer Science*, pages 89–107. Elsevier, October 2003. Boulder, Colorado.

(150) Clark W. Barrett, David L. Dill, and Aaron Stump. A generalization of Shostak's method for combining decision procedures. In Alessandro Armando, editor, *Proceedings of the* 4^{th} *International Workshop on Frontiers of Combining Systems (FroCoS '02)*, volume 2309 of *Lecture Notes in Artificial Intelligence*, pages 132–146. Springer-Verlag, April 2002. Santa Margherita Ligure, Italy.

(151) Aaron Stump, Clark W. Barrett, and David L. Dill. Producing proofs from an arithmetic decision procedure in elliptical LF. In Frank Pfenning, editor, *Proceedings of the* 3^{rd} *International Workshop on Logical Frameworks and Meta-Languages (LFM '02)*, volume 70(2) of *Electronic Notes in Theoretical Computer Science*, pages 29–41. Elsevier, July 2002. Copenhagen, Denmark.

Technical Reports

(152) Karthik Ganesan, Florian Lonsing, Srinivasa Shashank Nuthakki, Eshan Singh, Mohammad Rahmani Fadiheh, Wolfgang Kunz, Dominik Stoffel, Clark Barrett, and Subhasish Mitra. Effective pre-silicon verification of processor cores by breaking the bounds of symbolic quick error detection. Technical report, 2021.

(153) Christopher A. Strong, Haoze Wu, Aleksandar Zeljić, Kyle D. Julian, Guy Katz, Clark Barrett, and Mykel J. Kochenderfer. Global optimization of objective functions represented by ReLU networks. Technical report, 2020.

(154) Sam Blackshear, David L. Dill, Shaz Qadeer, Clark W. Barrett, John C. Mitchell, Oded Padon, and Yoni Zohar. Resources: A safe language abstraction for money. Technical report, 2020.

(155) Lindsey Kuper, Guy Katz, Justin Gottschlich, Kyle Julian, Clark Barrett, and Mykel Kochenderfer. Toward scalable verification for safety-critical deep networks. Technical report, 2018.

(156) Nicholas Carlini, Guy Katz, Clark Barrett, and David L. Dill. Provably minimally-distorted adversarial examples. Technical report, 2018.

(157) Clark Barrett, Daniel Kroening, and Thomas Melham. Problem solving for the 21st century: Efficient solvers for satisfiability modulo theories. Technical Report 3, London Mathematical Society and Smith Institute for Industrial Mathematics and System Engineering, June 2014. Knowledge Transfer Report.

(158) Dejan Jovanović and Clark Barrett. Sharing is caring: Combination of theories. Technical Report TR2011-940, Depatrment of Computer Science, New York University, October 2011.

(159) Clark Barrett, Morgan Deters, Albert Oliveras, and Aaron Stump. Design and results of the 4^{th} annual satisfiability modulo theories competition (SMT-COMP 2008). Technical Report TR2010-931, Depatrment of Computer Science, New York University, July 2010.

(160) Dejan Jovanović and Clark Barrett. Polite theories revisited. Technical Report TR2010-922, Depatrment of Computer Science, New York University, January 2010.

(161) Christopher L. Conway, Dennis Dams, Kedar S. Namjoshi, and Clark Barrett. Points-to analysis, conditional soundness, and proving the absence of errors. Technical Report TR2008-910, Depatrment of Computer Science, New York University, March 2008.

(162) Clark Barrett, Robert Nieuwenhuis, Albert Oliveras, and Cesare Tinelli. Splitting on demand in SAT Modulo Theories. Technical Report 06-05, Department of Computer Science, University of Iowa, August 2006.

(163) Clark Barrett, Igor Shikanian, and Cesare Tinelli. An abstract decision procedure for satisfiability in the theory of recursive data types. Technical Report TR2005-878, Department of Computer Science, New York University, November 2005.

Ph.D. Thesis

(164) Clark W. Barrett. *Checking Validity of Quantifier-Free Formulas in Combinations of First-Order Theories*. PhD thesis, Stanford University, January 2003. Stanford, California.

Book Reviews

(165) Clark Barrett. "Decision Procedures:An Algorithmic Point of View," by Daniel Kroening and Ofer Strichman, Springer-Verlag, 2008. *Journal of Automated Reasoning*, 51(4):453–456, December 2013.

Patents

(166) Subhasish Mitra, Clark Barrett, David Lin, and Eshan Singh. Post-silicon validation and debug using symbolic quick error detection, January 2020. Patent No. 10528448.

Selected Talks

"On the Surprising Usefulness of Proofs," Stanford Center for Automated Reasoning Annual Meeting, July 13, 2022.

"Toward Certified Robustness Against Real-World Distribution Shifts," Stanford Center for AI Safety Annual Meeting, July 12, 2022.

"Domain-Specific Reasoning with Satisfiability Modulo Theories," Invited Keynote, 24^{th} International Symposium on Formal Methods (FM '21), November 22, 2021.

"Efficient Neural Network Analysis with Sum-of-Infeasibilities," Stanford Center for AI Safety Retreat, September 14, 2021.

"Towards Rigorous Verification for Safe Artificial Intelligence," Invited Keynote, International Workshop on Machine Learning Systems Engineering, December 1, 2020.

"Parallelization Techniques for Verifying Neural Networks," Stanford Center for AI Safety Retreat, August 10, 2020.

"Domain-Specific Reasoning with Satisfiability Modulo Theories," Invited Keynote, 10^{th} International Joint Conference on Automated Reasoning (IJCAR '20), July 4, 2020.

"Towards Verification of Deep Neural Networks," IFIP Working Group 2.3, Los Altos, CA, October 31, 2019.

"Challenges and Opportunities in Formal Methods," Formal Methods at Scale (invitation-only NSA/DoD meeting), SRI, Menlo Park, CA, October 9, 2019.

"Upscale: Scaling up Verification for Open Source Hardware," Defense Advanced Research Projects Agency Electronics Resurgence Initiative Summit, Detroit, MI, July 16, 2019.

"Verification of Deep Neural Networks with SMT," Online Briefing for the Aerospace Vehicle Systems Institute Working Group on Machine Learning, November 13, 2018.

"Formal Methods for AI Safety," GE Edge & Controls Symposium, GE Global Research Center, Niskayuna, NY, September 27, 2018.

"Verification of Deep Neural Networks with SMT," Apple Computer Town Hall, Cupertino, CA, August 20, 2018.

"Breaking Barriers in Formal Hardware Verification," Defense Advanced Research Projects Agency Electronics Resurgence Initiative Summit, San Francisco, CA, July 24, 2018.

"Verification of Deep Neural Networks with SMT," Tutorial at the Design Automation Conference (DAC), San Francisco, CA, June 27, 2018.

"Towards Formally Verified Deep Neural Networks," High Confidence Software and Systems Conference, Annapolis, MD, May 7, 2018.

"Formal Methods for Safe Autonomy," Workshop on The Road to Safe Autonomy, Stanford, CA, April 18, 2018.

"Towards Verification of Deep Neural Networks," NeurIPS Workshop on Machine Learning and Computer Security, Los Angeles, CA, December 8, 2017.

"Dramatic Improvements in Pre-silicon and Post-silicon Validation of Digital Systems with Quick Error Detection and Formal Methods," USC Computer Engineering Seminar, Los Angeles, CA, September 21, 2017.

"20 Years of Decision Procedures," Dill@60 Workshop, Heidelberg, Germany, July 24, 2017.

"Formal Verification of Deep Neural Networks," SystemX Workshop, Stanford, CA, April 12, 2017.

"Automatic Discovery and Localization of Tough Bugs in Large SoCs using Formal-Enhanced Quick Error Detection," DREAM Seminar, Berkeley, CA, March 6, 2017.

"Reluplex: An Efficient SMT Solver for Verifying Deep Neural Networks," Google Brain Seminar, Mountain View, CA, February 24, 2017.

"Electrical Bug Localization with Quick Error Detection Enhanced by Formal Methods," SystemX Conference, Stanford, CA, November 15, 2016.

"Satisfiability Modulo Theories," Sixth Summer School on Formal Techniques, Menlo College, Menlo Park, CA, May 23, 2016.

"Satisfiability Modulo Theories," SRI, Menlo Park, CA, November 10, 2015; Stanford University, Stanford, CA, November 11, 2015.

"The Satisfiability Revolution and the Rise of SMT," Google, New York, NY, December 9, 2014; Samsung Research America, San Jose, CA, October 7, 2014; NASA Ames, Moffett Field, CA, August 14, 2015; UC Davis, Davis, CA, May 29, 2014.

"Satisfiability Modulo Theories," Ed Clarke Symposium, Carnegie Mellon University, Pittsburg, PA, September 19, 2014.

"Proofs in Satisfiability Modulo Theories," with Pascal Fontaine and Leonardo de Moura, All about Proofs, Proofs for All, Vienna, Austria, July 18, 2014.

"SMT: Where do we go from here?" 12^{th} International Workshop on Satisfiability Modulo Theories, Vienna, Austria, July 17, 2014.

"Lazy and Eager Approaches to Solving Bit-vectors," SRC GRC CADTS Verification Review, Austin, TX, April 15, 2014.

"The Satisfiability Revolution and the Rise of SMT," ExCape Webinar, March 3, 2014, online at `https://excape.cis.upenn.edu/news-events.html`.

"Lazy Bit-Vector Solving using Subtheories," SRC GRC CADTS Verification Review, Berkeley, CA, April 10, 2013.

"Bit-Precise Reasoning in Systems Analysis and Verification," Yale University, New Haven, CT, February 14, 2013.

"The Satisfiability Revolution and the Rise of the Ingenious Machine," Stanford University, Stanford, CA, January 10, 2013.

"Scalable and Accurate SMT-based Model Checking of Data Flow Systems," AFOSR Annual Review, Washington, DC, November 27, 2012.

"Beyond DPLL(T): A New Model-Based Approach to Search in SMT and its Application to Solving Nonlinear Arithmetic," Carnegie Mellon University, Pittsburgh, PA, October 5, 2012.

"From SAT to SMT: Successes and Challenges," Harvard University, Cambridge, MA, August 19, 2012.

"New Insights on the Nelson-Oppen Method," Northeastern University, Boston, MA, August 13, 2012.

"Beyond DPLL(T): A New Boolean Search Framework for Model-Based Theory Reasoning," IFIP Working Group 2.3, Seattle, WA, July 18, 2012.

"Efficient SMT Solving for Bit-vectors and Arrays," SRC GRC CADTS Verification Review, Boulder, CO, April 11, 2012.

"Scalable and Accurate SMT-based Model Checking of Data Flow Systems," AFOSR Annual Review, Arlington, VA, October 26, 2011.

"From SVC to CVC4: 15 Years of Decision Procedures," SMT Summer School, MIT, Cambridge, MA, June 13, 2011.

"An Abstract Decision Procedure for a Theory of Bit-Vectors," SRC GRC CADTS Verification Review, Santa Barbara, CA, April 6, 2011.

"Tools and Techniques for the Sound Verification of Low-Level Code," MIT, Cambridge, MA, March 31, 2011.

"Sharing is Caring: An Efficient New Theory Combination Method," SRC GRC CADTS Verification Review, Austin, Texas, April 13, 2010.

"New Insights on the Nelson-Oppen Method," IFIP Working Group 2.3, Lachen, Switzerland, March 2, 2010.

"An Introduction to Satisfiability Modulo Theories," Tutorial (with Sanjit Seshia) at the International Conference on Computer-Aided Design (ICCAD), San Jose, CA, November 2, 2009.

"From SAT to SMT: Successes and Challenges," Keynote address at the Eighth International Workshop On The ACL2 Theorem Prover and Its Applications, Northeastern University, Boston, MA, May 12, 2009.

"Improving Bit-Vector Reasoning in Satisfiability Modulo Theories," SRC GRC CADTS Verification Review, Raleigh, NC, April 15, 2009.

"Satisfiability Modulo Theories: Successes and Challenges," NSF Workshop on Symbolic Computation for Constraint Satisfaction, Arlington, VA, November 14, 2008.

"Satisfiability Modulo Theories," MIT, Cambridge, MA, September 25, 2008.

"SAT Solvers: Theory and Practice," and "SMT Solvers: Theory and Practice," invited lectures at the Summer School on Verification Technology, Systems & Applications, Max-Planck-Institut für Informatik, Saarbrücken, Germany, September 15-19, 2008.

"SAT and SMT Solvers: Theory and Practice," MIT Lincoln Laboratory, Lincoln, MA, September 5, 2008.

"Bit-Precise Reasoning Using Satisfiability Modulo Theories," IFIP Working Group 2.3, Cambridge, UK, July 23, 2008.

"Satisfiability Modulo Theories," IBM T. J. Watson Research Center, Hawthorne, New York, May 19, 2008.

"Satisfiability Modulo Theories," UT Austin, April 18, 2008.

"Satisfiability Modulo Theories," IFIP Working Group 2.3, Santa Fe, NM, October 11, 2007.

"Satisfiability Modulo Theories in Practice," CMU, Pittsburgh, PA, April 16, 2007.

"An Abstract Decision Procedure for Satisfiability in the Theory of Recursive Data Types," Microsoft Research, Redmond, Washington, November 6, 2006.

"Satisfiability Modulo Theories," Reservoir Labs, New York, New York, October 20, 2006.

"Formal Software Verification," Cooper Union, New York, New York, October 19, 2006.

"CASCADE: C Assertion Checker and Deductive Engine," IBM T. J. Watson Research Center, Hawthorne, New York, August 31, 2006.

"Compiler Validation with Automated Decision Procedures," University of Iowa, Iowa City, Iowa, November 11, 2005.

"DPLL(T) with Generalized Theory Propagation," Workshop on Deduction and Applications, Schloß DagStuhl, October 28, 2005.

"Satisfiability Modulo Theories," Princeton University, Princeton, New Jersey, October 5, 2005.

"Theory and Practice of Decision Procedures for Combinations of Theories," invited tutorial presented with Cesare Tinelli at the 17^{th} International Conference on Computer Aided Verification (CAV '05), Edinburgh, Scotland, July 6, 2005.

"Compiler Validation using Automated Decision Procedures," Microsoft Research, Redmond, Washington, December 16, 2004.

"Compiler Validation with Automated Decision Procedures," Reservoir Labs Technical Presentation, Reservoir Labs, New York, New York, November 29, 2004; Bioinformatics Lab Talk, New York University, New York, New York, November 24, 2004; Computer Science Invited Lecture Series, Pace University, New York, New York, October 26, 2004.

"CVC Lite: Selected Stories from the Trenches," Combination of Decision Procedures Summer School, SRI International, Menlo Park, California, August 11, 2004.

"Using Proofs for Fast and Reliable Boolean Reasoning in CVC Lite," Intel Formal Verification Symposium, Hillsboro, Oregon, June 11, 2004.

"The Common Roots of Mathematics and Computing," Faculty Resource Network, New York University, New York, New York, June 8, 2004.

"Formal Software Verification," Pace University, New York, New York, March 22, 2004.

"Applying Automated Decision Procedures: Using CVC Lite in Compiler Validation," Computer Science Colloquium, Washington University, St. Louis, Missouri, September 12, 2003.

"Efficiently Combining Boolean and First-Order Reasoning," Max Planck Institut für Informatik, Saarbrücken, Germany, June 10, 2003.

"The Nelson-Oppen Method for Combining Decision Procedures," Max Planck Institut für Informatik, Saarbrücken, Germany, June 5, 2003.

"Checking Validity of Quantifier-Free Formulas in Combinations of First-Order Theories," Rice University, April 2002; University of Pisa, April 2002; California Institute of Technology, March 2002; Northrop Grumman, March 2002; NEC Laboratories, March 2002; New York University, March 2002; University of Utah, March 2002; Columbia University, March 2002; Brigham Young University, February 2002.

"A Framework for Cooperating Decision Procedures," Intel Strategic CAD Laboratories, Hillsboro, Oregon, May 2000.

"A Unified Framework for Cooperating Decision Procedures," Brigham Young University Computer Science Colloquium, Provo, Utah, March 2000.

"Bit-Vector Decision Procedures in the Stanford Validity Checker," SRI International, Menlo Park, California, May 1998.