

Liana Hadarean

Education

- 2009–present **PhD**, *New York University*, New York, NY.
PhD Candidate in Computer Science advised by Clark Barrett.
September 2014 (expected graduation)
- 2005–2009 **BA**, *Colgate University*, Hamilton, NY.
Double Major in Computer Science and Art & Art History
summa cum laude

Research Interests

Satisfiability modulo theories (SMT), Boolean satisfiability (SAT), automated reasoning, decision procedures, model checking, and formal verification of hardware and software.

Publications

Conferences&Journals

- [1] Liana Hadarean, Kshitij Bansal, Dejan Jovanovic, Clark Barrett, and Cesare Tinelli. A tale of two solvers: Eager and lazy approaches to bit-vectors. In *26th International Conference on Computer Aided Verification (CAV'14), Vienna, Austria (in submission)*, 2014.
- [2] Liana Hadarean, Tim King, Kedar S. Namjoshi, Oswaldo Olivo, V.N. Venkatakrisnan, and Lenore D. Zuck. The construction of a self-certifying compiler. In *26th International Conference on Computer Aided Verification (CAV'14), Vienna, Austria (in submission)*, 2014.
- [3] Aaron Stump, Duckki Oe, Andrew Reynolds, Liana Hadarean, and Cesare Tinelli. SMT proof checking using a logical framework. *Formal Methods in System Design*, 42(1):91–118, 2013.
- [4] Vijay Saraswat, David Cunningham, Liana Hadarean, Louis Mandel, Avraham Shinnar, Olivier Tardieu, et al. Constrained types—future directions. In *CP-18th International Conference on Principles and Practice of Constraint Programming-2012*, 2012.
- [5] Clark Barrett, Christopher Conway, Morgan Deters, Liana Hadarean, Dejan Jovanovic, Tim King, Andrew Reynolds, and Cesare Tinelli. CVC4. In *23rd International Conference on Computer Aided Verification (CAV'11), Snowbird, Utah*, 2011.

Refereed Workshops

- [6] Liana Hadarean, Kshitij Bansal, Dejan Jovanovic, Clark Barrett, and Cesare Tinelli. A bit lazy: A lazy DPLL(T)-style bit-vector solver. In *Semiconductor Research Corporation (SRC) Techcon*, 2013.

- [7] Andrew Reynolds, Cesare Tinelli, and Liana Hadarean. Certified interpolant generation for EUF. In S. Lahiri and S. Seshia, editors, *Proceedings of the 9th International Workshop on Satisfiability Modulo Theories (Snowbird, USA)*, 2011.
- [8] Andrew Reynolds, Liana Hadarean, Cesare Tinelli, Yeting Ge, Aaron Stump, and Clark Barrett. Comparing proof systems for linear real arithmetic with LFSC. In A. Gupta and D. Kroening, editors, *Proceedings of the 8th International Workshop on Satisfiability Modulo Theories (Edinburgh, England)*, 2010.

Projects

2009-present

CVC4.

CVC4, the latest in the Cooperating Validity Checker family of tools, is an automated theorem prover for Satisfiability Modulo first-order Theories. As part of the development team for CVC4, I have been involved in implementing different core aspects of the system. My biggest contribution is implementing and designing the bit-vector decision procedures. Specifically, I developed a decision procedure based on lazy bit-blasting and word-level inprocessing techniques. The procedure relies on several algebraic sub-solvers, complete for certain fragments of the theory, to avoid expensive SAT reasoning. Additionally I implemented an eager bit-blasting version of the decision procedure. I also implemented the prototype for the the lemmas on demand based decision procedure for the theory of arrays and I was one of the early developers of the CVC4 proof module that produces externally checkable refutation proofs.

Work Experience

Summer 2013

LLVM Self-certifying Compiler, *University of Illinois at Chicago*, Chicago, IL, Research Intern.

Research on developing a self-certifying compiler that emits an externally checkable “witness” for each transformation. The witness establishes a simulation relation between the source and the optimized program transition relations, and it can be checked by using an external SMT solver. I implemented witness generators for several optimizations in the the LLVM compiler framework, as well as helped encode the semantics of LLVM instructions in SMT. (Mentor: Lenore D. Zuck)

Summer 2012

Constrained Type Inference with SMT, *IBM TJ Watson Research*, Hawthorne, NY, Research Intern.

Research on developing and integrating support for rich constraint types in the programming language X10. X10 is a research language developed at IBM Research that focuses on productivity and performance on a large scale. Rewrote the constraint solving part of the X10 compiler to integrate it with SMT solvers to type check richly typed programs. The constraints were generated as part of the X10 type inference algorithm over constraint types. (Mentor: Avraham Shinnar)

Summer 2011

SMT for Hardware Model Checking, *Synopsys*, Hillsboro, OR, Research Intern.

Research on integrating SMT technologies with the existing hardware bounded model checking infrastructure. Translated from the internal word-level representation into SMT-lib format using efficient encodings in the combination of the quantifier-free theories of bitvectors and arrays. Provided experimental evaluation of SMT solvers compared to the SAT based approach on hard industrial verification problems. (Mentor: Per Bjesse)

Summer Schools

- Summer 2011 **Summer School Marktoberdorf**, *Bayrischzell*, Germany.
Attended two-week summer course on the topic *Tools for Analysis and Verification of Software Safety and Security*. The summer school offered in-depth lectures and tutorials on the latest advancements in model checking and probabilistic model checking, SAT solvers, interactive theorem proving, extended static checking, separation logic and formal security proofs among other topics.

Talks

- September 2013 A Witnessing Compiler: A Proof of Concept, *4th International Conference on Runtime Verification, INRIA Rennes, France*
- September 2013 A Bit Lazy: A Lazy Bit-vector DPLL(T)-style Solver, *Semiconductor Research Corporation (SRC) Techcon, Austin, TX*
- April 2010 Comparing Proof Systems for Linear Real Arithmetic with LFSC, *8th International Workshop on Satisfiability Modulo Theories (SMT), Edinburgh, UK*
- April 2010 Converting CVC3 proofs to LFSC for QF_LRA, *6th Northeastern Verification Meeting, New York University, NY*

Teaching Experience

- Spring 2012 **Section Leader**, *New York University*, MSc level Programming Languages class.
- Fall 2011 Running the recitation consisting of a one hour weekly lecture, holding office hours, grading and proctoring. The course covered the following programming languages: Scheme, ML, Java, Ada, C/C++ and Prolog.

Scholarships and Awards

- 2013 NYU Dean's Dissertation Fellowship
- 2009–present NYU McCracken Fellowship
- 2008 Sisson Mathematics Prize, Colgate University
- 2006–2008 Charles A. Dana Scholar, Colgate University

Professional Activities

Reviewing for FMCAD 2011, SMT 2012, SMT 2013 and CAV 2014.