Thomas Gilray

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I am currently an Associate Professor in Computer Science at Washington State University, and was previously Assistant Professor at the University of Alabama at Birmingham and a Victor Basili Fellow at the University of Maryland, at College Park.

Education

University of Utah	Ph.D.	2017

Developed a unified methodology for polyvariant (*e.g.*, flow/call/arg/obj sensitive) program analysis.

I applied this framework to produce a self-reflective form of polyvariance for continuations that avoids all return-flow conflation of values (a long-standing problem for control-flow analyses), guaranteeing ideal stack precision at no cost to average or worst-case model complexity, and at in terms of human labor to implement (~ 1LOC in proposed framework). Proved that the precision is equal to an incomputable analysis with an unbounded stack and mechanically verified the proof using the Coq proof assistant. My dissertation is titled *"Introspective Polyvariance for Control-Flow Analyses"*.

University of Utah	M.S.	2012
University of Oregon	B.S.	2010

Employment

Associate Professor	Washington State University	2024 - *Present*

Working on research into scalable, tunable program analysis, program verification, logic solvers on high performance computers and clusters, and linguistic mechanisms for enforcing correctness, security/privacy, and termination properties of software; regularly teaching undergraduate and graduate-level classes in compilers and programming languages. Won an ARPA-H subaward to investigate private and secure querying for EHR systems, contracting with with Galois, inc.

Assistant Professor	U. of Alabama, Birmingham	2018 - 2024

Developed my research program in high-performance reasoning and program analysis; regularly taught undergraduate and graduate-level classes in automata theory, programming languages, and automated reasoning. Won NSF PPoSS Large, NSF PPoSS Planning, and DARPA VSPELLS grants, bringing a total of $3.12M in new research money to UAB.

Victor Basili Fellow	U. of Maryland, College Park	2016 - 2018

Joined UMD's PLUM lab with Michael W. Hicks, Jeffery Foster, and David Van Horn; worked on various collaborative projects including: soft contract verification, approximating permission-use provenance in Android, accelerating flow analyses in Datalog, and verification of faceted programs, among others. A departmental fellowship granted me great freedom to pursue long-term research.

Instructor	U. of Maryland, College Park	2017 - 2018

While at UMD, I taught a section of the Intro to Programming Languages course and developed a new Compilers course in which my students built an R^7RS Scheme Compiler from scratch.

Analysis Developer	HP, inc. (was: Fortify, inc.)	2013 - 2015
Research Assistant	U. of Utah	2011 - 2016

Teaching

(WSU) CptS 580: Advanced Programming Languages (Spring 2025)
(WSU) CptS 452: Compilers (Fall 2024)
(UAB) CS 660/760: Artificial Intelligence (Fall 2019–2021, 2023)
(UAB) CS 401/501: Programming Languages (Spring 2019–2024)
(UAB) CS 350/550: Automata and Formal Languages (Fall 2018–2023)
(UMD) CMSC 330: Intro to Programming Languages (Spring 2018)
(UMD) CMSC 430: Compilers (Fall 2017)

Service and Professional Development

ACM and SIGPLAN member; PC member, ICSE 2025; Faculty Search Committee, WSU EECS, 2024; NSF Panelist, SHF CS2 Program, 2024; NSF Panelist, PPoSS Program, 2024; External reviewer, TOPLAS 2023; Curriculum committee member 2018-2022, UAB CS Department; PC member, Dynamic Languages Symposium (DLS) 2021 co-located with SPLASH; Co-organizer, UAB HSPC 2019-2021 (High School Programming Contest); PC member, Symposium On Applied Computing (SAC) 2021; NSF Panelist, PPoSS Program, 2021; External reviewer, POPL 2020; PC chair, Scheme and Functional Programming Workshop, 2019; PC member, IEEE TCBBSI 2019; PC member, MiniKanren Workshop, 2019; Lead a student team in developing an automated grading system for UAB in 2019; External reviewer, POPL 2019; External reviewer, POPL 2018

Selected Conference Papers

1. *Datalog with First-class Facts.* **Thomas Gilray**, Arash Sahebolamri‡, Yihao Sun‡, Sowmith Kunapaneni†, Sidharth Kumar, and Kristopher Micinski. International Conference on Very Large Data Bases.
(VLDB) Sep 2025.

2. *Multi-Node Mutli-GPU Datalog.* Ahmedur Rahman Shovon†, Yihao Sun‡, **Thomas Gilray**, Sidharth Kumar, and Kristopher Micinski. International Conference on Supercomputing.
(ICS) Jun 2025.

3. *Optimizing Datalog for the GPU.* Yihao Sun‡, Ahmedur Rahman Shovon†, **Thomas Gilray**, Sidharth Kumar, and Kristopher Micinski. International Conference on Architectural Support for Programming Languages and Operating Systems.
(ASPLOS—12.7% acceptance) Mar 2025. `https://doi.org/10.1145/3669940.3707274`

4. *Column-Oriented Datalog on the GPU.* Yihao Sun‡, Sidharth Kumar, **Thomas Gilray**, and Kristopher Micinski. AAAI Conference on Artificial Intelligence.
(AAAI—23.4% acceptance) Feb 2025.

5. *Optimizing the Bruck Algorithm for Non-uniform All-to-all Communication.* Ke Fan†, **Thomas Gilray**, Valerio Pascucci, Xuan Huang, Kristopher Micinski, and Sidharth Kumar. International ACM Symposium on High-Performance Parallel and Distributed Computing.
(HPDC—19% acceptance) Jun 2022. `https://doi.org/10.1145/3502181.35314`

6. *Load-balancing Parallel Relational Algebra.* Sidharth Kumar and **Thomas Gilray**. ISC High Performance.
(ISC—31% acceptance) Jun 2020. `https://doi.org/10.1007/978-3-030-50743-5_15`
Won ISC Hans Meuer Best Paper award.

7. *Distributed Relational Algebra at Scale.* Sidharth Kumar and **Thomas Gilray**. International Conference on High Performance Computing, Data, and Analytics.
(HiPC—23% acceptance) Dec 2019. `https://doi.org/10.1109/HiPC.2019.00014`

Won HiPC Best Paper award.

8. *Size-Change Termination as a Contract.* Phúc C. Nguyễn‡, **Thomas Gilray**, Sam Tobin-Hochstadt, and David Van Horn. Programming Language Design and Implementation.
(PLDI—27% acceptance) Jun 2019. `https://doi.org/10.1145/3314221.3314643`
Invited to the Journal of Functional Programming.

9. *Soft Contract Verification for Higher-order Stateful Programs.* Phúc C. Nguyễn‡, **Thomas Gilray**, Sam Tobin-Hochstadt, and David Van Horn. Symposium on Principles of Programming Languages.
(POPL—23% acceptance) Jan 2018. `https://doi.org/10.1145/3158139`

10. *Allocation Characterizes Polyvariance.* **Thomas Gilray**, Michael D. Adams, and Matthew Might. International Conference on Functional Programming.
(ICFP—31% acceptance) Sep 2016. `https://doi.org/https://doi.org/10.1145/3022670.2951936`

11. *Pushdown Control-Flow Analysis for Free.* **Thomas Gilray**, Steven Lyde, Michael D. Adams, Matthew Might, and David Van Horn. Symposium on Principles of Programming Languages.
(POPL—23% acceptance) Jan 2016. `https://doi.org/10.1145/2837614.2837631`

12. *Dynamic Sparse-Matrix Allocation on GPUs.* James King, **Thomas Gilray**, Robert M. Kirby, and Matthew Might. ISC High Performance.
(ISC) 2016. `https://doi.org/10.1007/978-3-319-41321-1_4`
Won PRACE ISC best paper award.

Invited Talks

- Challenges in High-performance Deductive Programming. AP2S: Automated Program and Proof Synthesis. Vancouver, BC. AAAI Bridge. 2024.
- Formal Methods: Theory and Practice *(invited panel discussion).* Ljubljana, Slovenia. PLMW at ICFP 2022.
- Challenges Scaling Declarative Program Analysis. University of Illinois at Chicago. 2022.
- Declarative Program Analysis at Scale. Syracuse University. 2022.
- Contracts for Correctness (today and tomorrow). Jet, inc. 2019.
- The Best of Both Worlds: Tunable, Correct-by-design Static Analysis. University of Alabama at Birmingham. 2018.
- Static Analysis with Introspective Polyvariance. Indiana University. 2016.
- Static Analysis with Introspective Polyvariance. University of Maryland. 2016.

Contributed Talks

- Datalog with First-class Facts. London, UK. VLDB 2025.
- Load-balancing Parallel Relational Algebra. Frankfurt, Germany (remote). ISC 2020.
- Toward Parallel CFA with Datalog, MPI, and CUDA. Oxford, UK. SW 2017.
- Allocation Characterizes Polyvariance. Nara, Japan. ICFP 2016.
- Pushdown Control-Flow Analysis for Free. St. Petersburg, FL. POPL 2016.
- Partitioning 0-CFA for the GPU. Wittenberg, Germany. WFLP 2014.
- A Unified Approach to Polyvariance in Abstract Interpretations. Alexandria, VA, USA. SW 2013.
- A Survey of Polyvariance in Abstract Interpretations. Provo, UT, USA. TFP 2013.