

Ryan R. Newton

Curriculum Vitae

School of Informatics and Computing
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Interests

I am a computer scientist studying programming technology for data-processing, especially for deterministic data processing. My expertise is in all aspects of the programming-language implementation process, particularly for parallel and distributed languages. My previous work includes: (1) compilers for embedded architectures and GPU accelerators; (2) statically and dynamically-enforced deterministic execution of programs; and (3) low-overhead concurrent binary instrumentation, which can drive profiling and sandboxing.

Education

- Jan 2009 **Ph.D., EECS, Massachusetts Institute of Technology, Cambridge.**
Minor in computational biology. Advisors: Sam Madden & Arvind.
Thesis: "Language Design for Distributed Stream Processing"
- 2005 **S.M., EECS, Massachusetts Institute of Technology, Cambridge.**
Thesis: "Compiling Functional Reactive Macroprograms"
- 2002 **B.S., Computer Science, Indiana University, Bloomington.**

Work Experience

- 2011-present **Associate and Assistant Professor, Indiana University, Bloomington, IN.**
At IU I have built a group of Ph.D. students and postdocs, funded by four NSF grants to work on parallel functional programming and DSLs.
- 2009-2011 **Software Engineer, Intel Corporation, Hudson, MA.**
In the developer products division, I worked in the team that built and launched a prototype deterministic parallel programming framework called Intel Concurrent Collections (CnC). I also contributed to early Xeon Phi evaluation, Intel Array Building Blocks, and Intel Cilk Plus.
- 2002-2008 **Ph.D. Candidate, MIT, Cambridge, MA.**
As a graduate student I worked on problems in programming sensor networks, optimizing streaming programs, and partitioning computation in a distributed setting. Also, with collaborators, we put our DSL to use in sensor networks: for acoustic localization of wild animals, computer vision in forests, and detection of potholes with sensor-equipped taxicabs.
- Spring 2009 **Consultant, Mitsubishi Electric Research Laboratories, Cambridge, MA.**
Worked on a software framework for parallel execution of actor-based programs.
- Jun-Sep 2008 **Intern, Nokia Research, Cambridge, MA.**
Worked on prototype phone platform. Parallelized computer vision application across phone and PC using WaveScript.
- Jun-Sep 2005 **Intern, Microsoft Research, Redmond, WA.**
Framework for automatic composition of sensor network services based on logic programming.

Summer 1999, **Staff programmer**, *Schemer's Inc*, Plantation, FL.
2000 Development work on EdScheme integrated development environment.

Publications

Underlined names are students and postdocs in my research group. Please click paper titles for linked PDFs.

- POPL'18** **Towards Complete Specification and Verification with SMT**, Niki Vazou, Anish Tondwalkar, Vikraman Choudhury, Ryan G. Scott, **Ryan Newton** Philip Wadler, Ranjit Jhala, Conditionally accepted to POPL'18, .
- POPL'18** **Retrofitting Linear Types**, Jean-Philippe Bernardy, Mathieu Boespflug, **Ryan Newton** Simon Peyton Jones, Arnaud Spiwack, Conditionally accepted to POPL'18, .
- OOPSLA'17** **Low-overhead System-level Determinism with Hybrid Static/Dynamic Enforcement**, Ryan G. Scott , Omar Navarro-Leija, Joseph Devietti, **Ryan Newton**
- Haskell'17** **Adaptive Lock-Free Data Structures: A General Method for Concurrent Implementation Swapping**, Chao-Hong Chen, Vikraman Choudhury, **Ryan Newton** In the Haskell Symposium, Oxford, September 2017.
- ECOOP'17** **Compiling Tree Transforms to Operate on Packed Representations**, Michael Vollmer, Sarah Spall, Buddhika Chamith, Laith Sakka, Milind Kulkarni, Sam Tobin-Hochstadt, **Ryan Newton**
- PLDI'17** **Instruction Punning: Lightweight Instrumentation for x86-64**, Buddhika Chamith, Bo Joel Svensson, Luke Dalessandro, **Ryan Newton**.
- PPoPP'17** **SC-Haskell: Sequential Consistency in Languages that Minimize Mutable Shared Heap**, Michael Vollmer, Ryan G. Scott, Madan Musuvathi, **Ryan Newton**, To appear in the 22nd annual ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming, Austin, TX, February 2017.
- ICFP'16** **Ghostbuster: A Tool for Simplifying and Converting GADTs**, Trevor McDonell, Timothy Zakian, Matteo Cimini, **Ryan Newton** , To appear in the 21st annual ACM SIGPLAN International Conference on Functional Programming, Nara, Japan, September 2016.
- PLDI'16** **Living on the edge: Rapid-toggling probes with cross modification on x86**, Buddhika Chamith, Bo Joel Svensson, Luke Dalessandro, **Ryan Newton**, To appear in the 37th annual ACM SIGPLAN conference on Programming Language Design and Implementation , Santa Barbara, CA, June 2016 .
- JFP 1/2016** **A Language for Hierarchical Data Parallel Design-space Exploration on GPUs**, Bo Joel Svensson, Mary Sheeran, **Ryan Newton** Accepted to the Journal of Functional Programming..
- PPoPP'16** **Parallel Type-checking with Haskell using Saturating LVars and Stream Generators**, **Ryan Newton**, Ömer S. Ağacan, Sam Tobin-Hochstadt, Peter Fogg, In the 21st annual ACM SIGPLAN symposium on Principles and Practice of Parallel Programming , Barcelona, March 2016.
- LCPC'15** **Concurrent Cilk: Lazy Promotion from Tasks to Threads in C/C++**, Christopher Zakian, Timothy Zakian, Abhishek Kulkarni, Buddhika Chamith, **Ryan Newton** In the 28th annual workshop on Languages and Compilers for Parallel Computing, Raleigh, NC, September 2015.
- ICFP'15(A)** **Efficient Communication and Collection with Compact Normal Form**, Edward Yang, Giovanni Campagna, Ömer S. Ağacan, Ahmed El-Hassany, Abhishek Kulkarni, **Ryan Newton** In the International Conference on Functional Programming , Vancouver, September 2015.
- ICFP'15(B)** **Adaptive Lock-Free Maps: Purely-Functional to Scalable**, **Ryan Newton** Peter Fogg, Ali Varamesh, In the International Conference on Functional Programming , Vancouver, September 2015.

- Haskell'15 **Type-safe Runtime Code Generation: Accelerate to LLVM**, Trevor McDonell, Manuel Chakravarty, Vinod Grover, **Ryan Newton** In the Haskell Symposium, Vancouver, September 2015.
- FHPC'15(A) **Converting Data to Task-Parallelism by Rewrites**, Bo Joel Svensson, Trevor McDonell, Michael Vollmer, Eric Holk, **Ryan Newton**
- FHPC'15(B) **Meta-Programming and Auto-Tuning in the Search for High Performance GPU Code**, Michael Vollmer, Bo Joel Svensson, Eric Holk, **Ryan Newton**
- CACM 6/14 **Design Exploration through Code-generating Domain-specific Languages**, Bo Joel Svensson, Mary Sheeran, Ryan Newton, In the Communications of the ACM, June 2014, .
- OOPSLA'14
28% **Region-based memory management for GPU programming languages: Enabling rich data structures on a spartan host**, Eric Holk, **Ryan Newton**, Jeremy Siek, Andrew Lumsdaine, ACM SIGPLAN Object oriented programming systems languages and applications, *granted AEC (artifact evaluation) badge, plus Exceeds all Expectations Award for the artifact*, Portland, October 2014.
- PLDI'14
18% **Taming the Parallel Effect Zoo: Extensible Deterministic Parallelism with LVish**, Lindsey Kuper, Aaron Todd, Sam Tobin-Hochstadt, Ryan Newton, ACM SIGPLAN Programming Languages Design and Implementation, *of 287 submitted and 52 accepted papers, this is one of only 12 papers receiving the artifact evaluation (AEC) badge*, Edinburgh, June 2014.
- POPL'14
23% **Freeze After Writing: Quasi-Deterministic Parallel Programming with LVars and Handlers**, Lindsey Kuper, Aaron Turon, Neelakantan R.Krishnaswami, Ryan Newton, ACM SIGPLAN Principals of Programming Languages , San Diego, January 2014.
- WoDet'14 **Joining Forces, Toward a Unified Account of LVars and Convergent Replicated Data Types**, Lindsey Kuper, **Ryan Newton** Workshop on Determinism and Correctness in Parallel Programming, Salt Lake City, March 2014.
- WoDet'14 **Graph Algorithms in a Guaranteed-Deterministic Language**, Praveen Narayanan, **Ryan Newton** Workshop on Determinism and Correctness in Parallel Programming, Salt Lake City, March 2014.
- FHPC'13 **LVars: Lattice-based Data Structures for Deterministic Parallelism**, Lindsey Kuper, **Ryan Newton**, ACM SIGPLAN Workshop on Functional High-Performance Computing, Boston, September 2013.
- FPCDSL'13 **Embrace, Defend, Extend: A Methodology for Embedding Preexisting DSLs**, Abhishek Kulkarni, **Ryan Newton** ACM SIGPLAN Functional Programming Concepts in Domain-Specific Languages (FPCDSL), Boston, September 2013.
- PeerJ **PhyBin: binning trees by topology**, Irene Newton, **Ryan Newton** PeerJ year 2013, vol 1, page e187, <https://peerj.com/articles/187/>.
- ICFP'12
36% **A Meta-Scheduler for the Par-Monad: Composable Scheduling for the Heterogeneous Cloud**, Adam Foltzer, Abhishek Kulkarni, Rebecca Swords, Sajith Sasidharan, Eric Jiang, **Ryan Newton** In the International Conference on Functional Programming, Copenhagen, Septmeber 2012.
- FHPC'12 **Avalanche: A Fine-Grained Flow Graph Model for Irregular Applications on Distributed-Memory Systems**, Jeremiah J. Willcock, **Ryan Newton** Andrew Lumsdaine, ACM SIGPLAN Workshop on Functional High-Performance Computing, September 2012.
- DFM'11 **SCnC: Efficient Unification of Streaming with Dynamic Task Parallelism**, Dragos Sbirlea, Jun Shirako, **Ryan Newton** and Vivek Sarkar., In the Proceedings of the first workshop on Data-Flow Execution Models for Extreme Scale Computing (in conjunction with PACT 2011), Galveston Island, Texas, USA, October 2011.
- Haskell'11
39% **A Monad for Deterministic Parallelism**, Simon Marlow, **Ryan Newton** Simon Peyton Jones, In the Proceedings of the ACM SIGPLAN Haskell Symposium, Tokyo, Japan, September 2011.

- A Multi-Scale Parallel Computing Architecture for Automated Segmentation of the Brain Connectome**, Sylvain Jaume, Kathleen Knobe, Ryan R. Newton, Frank Schlimbach, Melanie Blower, R. Clay Reid, *IEEE Transactions on Biomedical Engineering*, 2011.
- FASPP'11 **Programming Future Parallel Architectures with Haskell and Intel ArBB**, Bo Joel Svensson, Ryan Newton, In the Workshop on Future Architectural Support for Parallel Programming (in conjunction with ISCA '11), San Jose, CA, June 2011.
- WoDet'11 **Deterministic Reductions in an Asynchronous Parallel Language**, Zoran Budimlic, Michael Burke, Kathleen Knobe, Ryan Newton, David Peixotto, Vivek Sarkar, Edwin Westbrook, In the Workshop on Determinism and Correctness in Parallel Programming (in conjunction with ASPLOS '11), Newport Beach, CA, March 2011.
- Stream Programming Languages**, Ryan Newton, Book Chapter, *Encyclopedia of Parallel Computing*, Springer Verlag, 2011.
- The Concurrent Collections Programming Model**, Michael G. Burke, Kathleen Knobe, Ryan Newton, Vivek Sarkar, Book Chapter, *Encyclopedia of Parallel Computing*, Springer Verlag, 2011.
- Concurrent Collections**, Zoran Budimlic, Michael Burke, Vincent Cave, Kathleen Knobe, Geoff Lowney, Ryan Newton, Jens Palsberg, David Peixotto, Vivek Sarkar, Frank Schlimbach, Sagnak Tasirlar, *SIAM PP10 Special Issue on Scientific Programming*, 2010.
- IEEE SW **A Synergetic Approach to Throughput Computing on x86-based Multicore Desktops**, Chi-Keung Luk, Ryan Newton, William Hasenplaugh, Mark Hampton, Geoff Lowney, *IEEE Software Magazine*, 2010.
- HotPar'10 **Capturing and Composing Parallel Patterns with Intel CnC**, Ryan Newton, Frank Schlimbach, Mark Hampton, Kathleen Knobe, HotPar 2010, Berkeley, California, June 2010.
- ICFP'09 **Experience Report: Embedded, Parallel Computer-Vision with a Functional DSL**, Ryan Newton, Teresa Ko, International Conference on Functional Programming, experience report, Edinburgh, Scotland, August 2009.
- NSDI'09 **Wishbone: Profile-based Partitioning for Sensornet Applications**, Ryan Newton, Sivan Toledo, Lewis Girod, Hari Balakrishnan, Samuel Madden, In *ACM SIGCOMM Networked Systems Design and Implementation*, Boston, Massachusetts, April 2009.
- Functional in the field**, Presented at *ICFP DEFUN*, Victoria, B.C., September 2008.
- LECTES'08 **Design and Evaluation of a Compiler for Embedded Stream Programs**, Ryan Newton, Lewis Girod, Michael Craig, Greg Morrisett, Samuel Madden, In *ACM SIGPLAN Languages, Compilers, and Tools for Embedded Systems*, Tucson, Arizona, June 2008.
- Mobisys'08 **The Pothole Patrol: Using a Mobile Sensor Network for Road Surface Monitoring**, Jakob Eriksson, Lewis Girod, Bret Hull, Ryan Newton, Samuel Madden, Hari Balakrishnan, In *ACM SIGMOBILE Mobisys 2008*, Breckenridge, Colorado, June 2008. (>350 citations).
- IPSN'08 **VoxNet: An Interactive, Rapidly-Deployable Acoustic Monitoring Platform**, Mike Allen, Lewis Girod, Ryan Newton, Daniel T. Blumstein, Deborah Estrin, In *ACM/IEEE International Conference on Information Processing in Sensor Networks*, SPOTS track, St. Louis, Missouri, April 2008.
- ICDE'08 **XStream: A Signal-Oriented Data Stream Management System**, Lewis Girod, Yuan Mei, Ryan Newton, Stanislav Rost, Arvind Thiagarajan, Hari Balakrishnan, Samuel Madden, In *IEEE International Conference on Data Engineering*, Cancun, Mexico, April 2008.
- IPSN'07 **The Regiment Macroprogramming System**, Ryan Newton, Greg Morrisett, Matt Welsh, In *ACM/IEEE International Conference on Information Processing in Sensor Networks*, Cambridge, MA, April 2007. (>190 citations).

- CIDR'07 **The Case for a Signal-Oriented Data Stream Management System**, Lewis Girod, Yuan Mei, Ryan Newton, Stanislav Rost, Arvind Thiagarajan, Hari Balakrishnan, Samuel Madden, In *ACM Conference on Innovative Data Systems Research*, Pacific Grove, CA, January 2007.
- IPSN'05 Building up to Macroprogramming: An Intermediate Language for Sensor Networks**, Ryan Newton, Arvind, Matt Welsh, In *ACM/IEEE International Conference on Information Processing in Sensor Networks*, Los Angeles, CA, April 2005.
- DMSN'04 **Region Streams: Functional Macroprogramming for Sensor Networks**, Ryan Newton, Matt Welsh, In *International Workshop on Data Management for Sensor Networks*, Toronto, Canada, August 2004. (>200 citations).

Technical Reports

A Lattice-Theoretical Approach to Deterministic Parallelism with Shared State, Lindsey Kuper, Ryan Newton, *IUCS Technical Report 702*, <http://www.cs.indiana.edu/cgi-bin/techreports/TRNNN.cgi?trnum=TR702>, 2012.

Intel Concurrent Collections for Haskell, Ryan Newton, Chih-Ping Chen, Simon Marlow, *CSAIL Technical Report MIT-CSAIL-TR-2011-015*, <http://dspace.mit.edu/handle/1721.1/61759>, 2011.

Amorphous Language Implementation, Ryan Newton, Jake Beal, *CSAIL Technical Report MIT-CSAIL-TR-2006-015*, <http://dspace.mit.edu/handle/1721.1/31221>, 2002.

Selected Talks

- Keynote **Haskell Taketh Away: Limiting Side Effects for Parallel Programming**, Ryan Newton, C++ Now, May 2017.
- Invited talk **Practical Statically-Checked Deterministic Parallelism**, Ryan Newton, Cambridge University and Microsoft Research colloquium, July 2016.
- PPoPP'16 **Parallel Type-checking using Saturating LVars and Stream Generators**, Ryan Newton, Presented at the symposium on Principles and Practice of Parallel Programming, Barcelona, March 2016.
- Invited talk **Practical Statically-Checked Deterministic Parallelism**, Ryan Newton, University of Michigan, February 2016.
- ICFP'15 **Adaptive Lock-Free Maps: Purely-Functional to Scalable**, Ryan Newton, In the International Conference on Functional Programming, Vancouver, September 2015.
- PLDI'14 **Taming the Parallel Effect Zoo: Extensible Deterministic Parallelism with LVish**, Ryan Newton, ACM SIGPLAN Programming Languages Design and Implementation, Edinburgh, June 2014.
- Invited talk **Big-tent Deterministic Parallelism**, Ryan Newton, University of Edinburgh, June 2014.
- Invited talk **Stream Processing for Functional Programmers**, Ryan Newton, University of Glasgow, June 2014.
- Invited talk **Big-tent Deterministic Parallelism**, Ryan Newton, University of St. Andrews, June 2014.
- Keynote, SBLP'13 **Big-tent Deterministic Parallelism**, Ryan Newton, Symposium on Programming Languages, SBLP'13, Brasilia, October 2013.
- Invited talk **Composable schedulers for heterogeneous parallel architectures**, Ryan Newton, Heriot Watt University, Scotland, September, 2012.

CnC-2011 **Panel participant, CnC workshop**, Ryan Newton, , Urbana Champaign, September 2011.

ICFP/Haskell'11 **A Monad for Deterministic Parallelism**, Ryan Newton, ACM SIGPLAN Haskell Symposium, Tokyo, September 2011.

Major Software Released (Reverse Chronological)

- **LVish**: A Haskell library for programming with generalized monotonic data structures.
- **Accelerate** Our group develops and maintains this GPU DSL in collaboration with UNSW.
- **Monad Par**: A Haskell library for strict parallel programming with fork and IVars.
- **Intel Concurrent Collections (CnC)**: Worked on the team that produced the main C++ implementation. Also implemented a Haskell version of CnC and the **CnC Spec Compiler**, a code generation tool that uses a CnC specification to generate C++ code taking advantage of declarative communication relationships described in the specification.
- **WaveScript**: Compiler and runtime/scheduler for distributed stream processing, targets many embedded platforms.
- **Regiment**: Compiler and network simulator for programming sensor networks in terms of high-level abstractions.

Research Advisees

Graduated / Completed

(Ph.D.) **Lindsey Kuper**: research scientist at Intel Labs, Santa Clara.

(M.S.) **Adam Foltzer**: researcher at Galois.

(M.S.) **Ömer S. Ağacan**: GHC developer at Well Typed

Each of the undergraduates below is a coauthor on at least one publication above:

(B.S.) **Tim Zakian**: Pursuing a Ph.D. at Oxford.

(B.S.) **Chris Zakian**: Amazon

(B.S.) **Eric Jiang**: CTO, DoubleMap (Techpoint startup of the year 2015, Inc magazine's "30 under 30")

(postdoc) **Bo Joel Svensson**: in a second postdoc at Chalmers University

(postdoc) **Trevor McDonell**: research scientist at UNSW

Current

- **2nd year Ph.D.**: Ryan Scott, Chao-Hong Chen, Vikraman Choudhury

- **3rd year Ph.D.:** Michael Vollmer
- **4th year Ph.D.:** Buddhika Chamith

Service Activities

Program Committees and Chairing:

- 2018 Program Committee, PLDI
- 2017 Organizing Committee, ICFP – 1st Artifact Evaluation Chair, establishing the practice for ICFP
- 2017 External Review Committee, PACT: Parallel Architectures and Compilation Techniques
- 2017 Program Committee, ICS: International Conference on Supercomputing
- 2017 External Review Committee, PLDI
- 2016- Glasgow Haskell Compiler (GHC) Steering Committee
- 2016 External Review Committee, ICFP
- 2015 Program Committee, SPAA
- 2014 Program Co-Chair, FHPC
- 2014 Program Committee, PEPM
- 2013 Program Committee, ICFP
- 2013 Program Chair, organizer: Haskell Implementors Workshop (HIW)
- 2012 Program Committee: PPOP, FHPC
- 2011 Program Chair: Concurrent Collections Workshop
- 2009 Program Committee, MidSens'09

NSF participation:

- 2014 NSF proposal review panel
- 2013 Area co-chair for High-level programming Models for Parallelism workshop, attended DALI workshop
- 2012 NSF proposal review panel

External Reviewer:

- 2006-present Regular reviewer for journals and conferences including: *ACM Transactions on Programming Languages (TOPLAS)*, *Programming Language Design and Implementation (PLDI)*, *European Conference on Wireless Sensor Networks (EWSN)*, *Information Processing in Sensor Networks (IPSN)*, *Conference on Embedded Networked Sensor Systems (Sensys)*, *ACM Transactions on Sensor Networks (TOSN)*, *Information Processing Letters*, *Science of Computer Programming*, and the *Communications of the ACM*,

Funding and Awards

- 2017 NSF SPX (\$800K) – fine-grained parallelism within compilers
- 2016 Mozilla Research Award (\$90K) – type safe distributed memory programming
- 2015 NSF CAREER Award (\$535K) – extending the performance and reach of LVar-based programming
- 2014 OOPSLA “Award for an Artifact that Exceeded All Expectations”

- 2013 IU Trustees Teaching Award – for the 2013/14 academic year
- 2013 NSF Award, PI XPS-1337242 (\$745K) – implementation techniques to improve data-processing programs
- NSF Award, Co-PI CNS-1320659 (\$298K) – network programming, with Martin Swamy
- 2012 NSF Award, PI CCF-1218375 (\$377K) – established the LVar model and LVish library
- 2012 Internal IU FRSP grant (\$75K) – network programming, with Martin Swamy
- 1999-2007 Exxon Scholarship. NSF and NDSEG graduate fellowships.

Teaching Experience

- 2011-2017 **Indiana:** Taught Parallelism and DSLs, GPU Compilers, Undergrad Compilers, Intro CS.
- Spring 2009 **Recitation Instructor:** MIT's Computer Systems Engineering (6.033).
- 2004-2008 **Resident Tutor, Harvard:** Individual tutoring to students in computer science. General advising to sophomores and students within my residential entryway.
- Fall 2003 **Teaching assistant, MIT:** Multithreaded Parallelism: Languages and Compilers (6.827)
- 2000,2001 **Teaching Assistant, Indiana U.:** TA for intro CS + grad/undergrad PL course
- 1998-1999, 2000 **Instructor, IMACS:** I was the instructor for classes at various age levels (2nd-12th grade). Material included basic programming, functional and object-oriented programming, implementation of programming languages, algorithmic 3D modeling, logic, and elementary set theory.

Proficiencies

Programming Languages	Haskell, Scheme, C/C++, OCaml/SML,	Operating Systems	Linux, Mac OS, various embedded (e.g. TinyOS)
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Miscellaneous

Citizenship: United States

References

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| <p>1 Simon Peyton Jones
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