Rodric Rabbah
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Education

GEORGIA INSTITUTE OF TECHNOLOGY
Ph.D. in Computer Science, 2006

NEW YORK UNIVERSITY
Bachelor of Arts in Computer Science and Biochemistry, 1998

Professional Experience

IBM RESEARCH

Principal Research Staff Member   4/2017 – 3/2018

- Technical lead for serverless computing in the IBM cloud. Responsibilities include defining a vertical research agenda (programming model, tooling, system), as well as continuing to evolve the existing architecture, development of critical functionality, training and mentoring of developers, and engaging, supporting, and fostering an open source community around the IBM serverless techonology.

Research Staff Member   11/2006 – 4/2017

- Lead the design and implemenation of the IBM serverless computing platform, formerly OpenWhisk and now IBM Cloud Functions. Developed and lead project from initial research prototype to an offering in the IBM cloud within one year. Participated heavily in the effort to open source the technology which is now an Apache Incubator. Consulted for external customers, open-source partners, and internal adopters. Co-inventor on several patent filings.

- Co-founded and was a leading contributor to a research effort that produced a language, compiler, and runtime for high level synthesis of reconfigurable hardware. Produced several research publications, patent filings, and an open source offering of the technology.

- Developed an intial propotytpe of a streaming spreadsheet processor, and helped transfer the technology to IBM InfoSphere Streams product. Co-inventor on several patent filings and publications.

- Served as part of a 4-person volunteer team of developers, working together we replaced the IBM Research external presence system now hosting all web pages for IBM Researchers.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT)

Research Affiliate   11/2006 – 2/2007

- Developed and co-taught a 6-unit course multicore programming primer as MIT OpenCourseWare.

Research Scientist   9/2003 – 11/2006

- Made technical contributions in stream computing, including the StreamIt language, compiler and runtime. Co-authored several publications. Mentored graduate and undergraduate students, supervised Master theses, handled funding proposals and reporting.

HEWLETT-PACKARD LABORATORIES

Interned with Custom Processors and Dynamic Optimization group, Joseph Fisher   Summer 2002
Interned with Compiler and Architecture Research group, B. Ramakrishna (Bob) Rau   Summer 1999

Skills

Heavily use container technology, primarily Docker. Apache OpenWhisk built on top of open source technologies include CouchDB, Kafka, and Akka. Expert on actor programming models. Program regularly in Scala, Java, Python, and Node.js. Also can program in C/C++, Go. Also familiar with CUDA, OpenCL, VHDL/Verilog, high-level synthesis, and FPGA tooling from Xilinx and Altera.

Publications

REACTIVE AND STREAM PROCESSING

1. The Serverless Trilemma: Function Composition for Serverless Computing. Ioana Baldini, Perry Cheng, Stephen J Fink, Nick Mitchell, Vinod Muthusamy, Rodric Rabbah, Philippe Suter and Olivier Tardieu. In the proceedings of the Onward!, Vancouver, Canada, October 2017.

2. Spreadsheets for stream processing with unbounded windows and partitions. Martin Hirzel, Rodric Rabbah, Philippe Suter, Olivier Tardieu and Mandana Vaziri. In proceedings of the 10th ACM International Conference on Distributed and Event-based System (DEBS), Irvine, CA, June 2016.

3. Spreadsheets for Stream Partitions and Windows. Martin Hirzel, Rodric Rabbah, Philippe Suter, Olivier Tardieu and Mandana Vaziri. In proceedings of the Second Workshop on Software Engineering Methods in Spreadsheet, Florence, Italy, May 2015.

4. Translating imperative code to MapReduce. Cosmin Radoi, Stephen J Fink, Rodric Rabbah and Manu Sridharan. In proceedings of the ACM International Conference on Object Oriented Programming Systems Languages and Applications (OOPSLA), Portland, OR, October 2014.

5. Stream Processing with a Spreadsheet. Mandana Vaziri, Olivier Tardieu, Rodric Rabbah, Philippe Suter and Martin Hirzel. In procedings of the European Conference on Object-Oriented Programming (ECOOP), Uppsala, Sweden, July 2014.

HARDWARE SYNTHESIS

1. Growing a Software Language for Hardware Design. Joshua Auerbach, David Bacon, Perry Cheng, Stephen Fink, Rodric Rabbah and Sunil Shukla. In proceedings of the First Summit oN Advances in Programming Languages (SNAPL), Asilomar, CA, May 2015.

2. The Liquid Metal Blokus Duo Design. Erik Altman, Joshua Auerbach, David Bacon, Ioana Baldini, Perry Cheng, Stephen Fink and Rodric M. Rabbah. In proceedings of the International Conference on Field-Programmable Technology (FPT), Kyoto, Japan, December 2013.

3. The Liquid Metal IP bridge. Perry Cheng, Stephen J Fink, Rodric M Rabbah and Sunil Shukla. In proceedings of the 18th Asia and South Pacific Design Automation Conference (ASP-DAC), Yokohama, Japan, January 2013.

4. FPGA Programming for the Masses. David F. Bacon, Rodric Rabbah and Sunil Shukla. In Communications of the ACM (CACM), 56(4), April 2013.

5. The Shape of Things to Run. Josh Auerbach, Dave F Bacon, Perry Cheng, Steve Fink and Rodric Rabbah. In proceedings of the European Conference on Object-Oriented Programming (ECOOP), Montpellier, France, July 2013.

6. A compiler and runtime for heterogeneous computing. Joshua Auerbach, David Bacon, Ioana Burcea, Perry Cheng, Stephen J. Fink, Rodric Rabbah, and Sunil Shukla. In proceedings of the 49th Annual Design Automation Conference (DAC), San Francisco, CA, June 2012.

7. Compiling a high-level language for GPUs via language support for architectures and compilers. Christophe Dubach, Perry Cheng, Rodric Rabbah, David Bacon and Stephen Fink. In proceedings of the 33rd ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI), Beijing, China, June 2012.

8. Virtualization of heterogeneous machines hardware description in a synthesizable object-oriented language. Joshua Auerbach, David Bacon, Perry Cheng, Rodric Rabbah and Sunil Shukla. In proceedings of the 48th Annual Design Automation Conference (DAC), San Diego, CA, June 2011.

9. FPGA-based combined architecture for stream categorization and intrusion detection. Sunil Shukla, Rodric Rabbah, and Martin Vorbach. In proceedings of the Eight IEEE/ACM International Conference on Formal Methods and Models for Codesign (MEMOCODE), Grenoble, France, August 2010.

10. Lime: a Java-compatible and Synthesizable Language for Heterogeneous Architectures. Joshua Auerbach, David Bacon, Perry Cheng, and Rodric Rabbah. In proceedings of the ACM International Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA), Reno/Tahoe, Nevada, October 2010.

11. MacroSS: macro-SIMDization of streaming applications. Amir H Hormati, Yoonseo Choi, Mark Woh, Manjunath Kudlur, Rodric Rabbah, Trevor Mudge, Scott Mahlke. In proceedings of the Fifteenth International Symposium on Architectural Support for Programming Languages and Operating Systems (ASPLOS), Pittsburgh, PA, March 2010.

12. Flextream: Adaptive Compilation of Streaming Applications for Heterogeneous Architectures. Amir Hormati, Yoonseo Choi, Manjunath Kudlur, Rodric Rabbah, Trevor Mudge, and Scott Mahlke. In proceedings of the International Conference on Parallel Architectures and Compilation Techniques (PACT), Raleigh, NC, September 2009.

13. A Computing Origami: Folding Streams in FPGAs. Andrei Hagiescu, Weng-Fai Wong, David Bacon, and Rodric Rabbah. In proceedings of the 46th Design Automation Conference (DAC), San Fransisco, CA, July 2009.

14. Optimus: Efficient Realization of Streaming Applications on FPGAs. Amir Hormati, Manjunath Kudlur, David Bacon, Scott Mahlke, and Rodric Rabbah. In proceedings of the International Conference on Compilers, Architecture, and Synthesis for Embedded Systems (CASES), Atlanta, GA, October 2008.

15. Liquid Metal: Object-Oriented Programming Across the Hardware/Software Boundary. Shan Shan Huang, Amir Hormati, David Bacon, and Rodric Rabbah. In proceedings of the European Conference on Object-Oriented Programming (ECOOP), Paphos, Cyprus, July 2008.

STREAMIT: A LANGUAGE AND COMPILER FOR STREAMING SYSTEMS

4. A Lightweight Streaming Layer for Multicore Execution. Xin David Zhang, Qiuyuan J. Li, Rodric Rabbah, and Saman Amarasinghe. In proceedings of the Workshop on Design, Architecture and Simulation of Chip Multi-Processors (dasCMP), Chicago, IL, December 2007.

5. Beyond Gaming: Programming the PLAYSTATION3 Cell Architecture for Cost-Effective Parallel Processing. Rodric Rabbah. In proceedings of the International Conference on Hardware/Software Codesign and Synthesis (CODES+ISSS), Salzburg, Austria, September 2007.

6. MPEG-2 in a Stream Programming Language. Matthew Drake, Hank Hoffmann, Rodric Rabbah, and Saman Amarasinghe. In proceedings of the Twentieth IEEE International Parallel and Distributed Processing Symposium (IPDPS), Rhodes Island, Greece, April 2006.

7. High-Productivity Stream Programming For High-Performance Systems. Rodric Rabbah, Bill Thies, Michael Gordon, Janis Sermulins, and Saman Amarasinghe. In proceedings of the Ninth Annual Workshop on High Performance Embedded Computing (HPEC), Lexington, MA, September 2005.

8. Programming by Sketching for Bit-Streaming Programs. Armando Solar-Lezama, Rodric Rabbah, Rastislav Bodik, and Kemal Ebcioglu. In proceedings of the Conference on Programming Language Design and Implementation (PLDI), Chicago, IL, June 2005. (PLDI 2005 Best Paper)

9. Cache Aware Optimization of Stream Programs. Janis Sermulins, William Thies, Rodric Rabbah, and Saman Amarasinghe. In proceedings of the Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES), Chicago, IL, June 2005.

10. Teleport Messaging for Distributed Stream Programs. William Thies, Michal Karczmarek, Janis Sermulins, Rodric Rabbah, and Saman Amarasinghe. In proceedings of the Symposium on Principles and Practice of Parallel Programming (PPoPP), Chicago, IL, June 2005.

11. Language and Compiler Design for Streaming Applications. Saman Amarasinghe, Michael Gordon, Michal Karczmarek, Jasper Lin, David Maze, Rodric Rabbah, and William Thies. In International Journal of Parallel Programming (IJPP), Volume 33, Numbers 2-3, June 2005.

12. A Productive Programming Environment for Stream Computing. Kimberly Kuo, Rodric Rabbah, and Saman Amarasinghe. In proceedings of the Second Workshop on Productivity and Performance in High-End Computing (PPHEC), San Fransisco, CA, February 2005.

ADAPTIVE AND COOPERATIVE EXECUTION

13. How to do a Million Watchpoints: Efficient Debugging Using Dynamic Instrumentation. Qin Zhao, Rodric Rabbah, Saman Amarasinghe, Larry Rudolph, and Weng-Fai Wong. In proceedings of the International Conference on Compiler Construction (CC), Budapest, Hungary, April 2008.

14. Ubiquitous Memory Introspection. Qin Zhao, Rodric Rabbah, Saman Amarasinghe, Larry Rudolph, and Weng-Fai Wong. In proceedings of the 2007 International Symposium on Code Generation and Optimization (CGO), San Jose, CA, March 2007.

15. CEARCH: Cognition Enabled Architecture. Stephen Crago, Janice Onanian McMahon, Chris Archer, Krste Asanovic, Richard Chaung, Keith Goolsbey, Mary Hall, Christos Kozyrakis, Kunle Olukotun, Una-May O'Reilly, Rick Pancoast, Viktor Prasanna, Rodric Rabbah, Steve Ward, and Donald Yeung. In proceedings of the Tenth Annual Workshop on High Performance Embedded Computing (HPEC), Lexington, MA, September 2006.

16. Exploiting Vector Parallelism in Software Pipelined Loops. Sam Larsen, Rodric Rabbah, and Saman Amarasinghe. In proceedings of the International Symposium on Microarchitecture (MICRO), Barcelona, Spain, November 2005.

17. Dynamic Memory Optimization using Pool Allocation and Prefetching. Qin Zhao, Rodric Rabbah, and Weng-Fai Wong. In proceedings of the Workshop on Binary Instrumentation and Applications (WBIA), St. Louis, MO, September 2005.

18. Trimaran: an Infrastructure for Research in Instruction-Level Parallelism. Lakshmi Chakrapani, John Gyllenhaal, Wen-mei Hwu, Scott Mahlke, Krishna Palem, and Rodric Rabbah. In Lecture Notes in Computer Science (LNCS), Springer-Verlag, Volume 3602, Pages 32-41, August 2005.

19. Compiler Orchestrated Prefetching via Speculation and Predication. Rodric Rabbah, Hariharan Sandanagobalane, Mongkol Ekpanyapong, and Weng-Fai Wong. In proceedings of the Eleventh International Symposium on Architectural Support for Programming Languages and Operating Systems (ASPLOS), Boston, MA, October 2004.

20. Adaptive Compiler Directed Prefetching for EPIC Processors. Jinwoo Kim, Rodric Rabbah, Krishna Palem, and Weng-Fai Wong. In proceedings of the International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA), Las Vegas, NV, June 2004.

VERSABENCH: A NEW METRIC FOR BENCHMARKING FUTURE PROCESSORS

20. Versatile Tiled Processor Architectures: The Raw Approach. Rodric Rabbah, Ian Bratt, Krste Asanovic, and Anant Agarwal. In proceedings of the Eighth Annual Workshop on High Performance Embedded Computing(HPEC), Lexington, MA, September 2004.

21. Versatility and VersaBench: A New Metric and a Benchmark Suite for Flexible Architectures. Rodric Rabbah, Ian Bratt, Krste Asanovic, and Anant Agarwal. MIT Technical Memo MIT-LCS-TM-646, June 2004. (In Submission.)

MEMORY SYSTEM DESIGN AND OPTIMIZATION

22. Data Remapping for Design Space Optimization of Embedded Memory Systems. Rodric Rabbah and Krishna Palem. In ACM Transactions on Embedded Computing Systems (TECS), Volume 2, Number 2, May 2003.

23. PD-XML: Extensible Markup Language For Processor Description. Shay Seng, Krishna Palem, Rodric Rabbah, Weng-Fai Wong, Wayne Luk, and P.Y.K. Cheung. In proceedings of the IEEE International Conference on Field-Programmable Technology (ICFPT), Hong Kong, December 2002.

24. Design Space Optimization of Embedded Memory Cache Systems via a Compiler. Krishna Palem and Rodric Rabbah. In proceedings of the Sixth Annual Workshop on High Performance Embedded Computing (HPEC), Lexington, MA, September 2002.

25. Design Space Optimization of Embedded Memory Systems via Data Remapping. Krishna Palem, Rodric Rabbah, Vincent Mooney III, Pinar Korkmaz, and Kiran Puttaswamy. In proceedings of the Languages, Compilers, and Tools for Embedded Systems and Software and Compilers for Embedded Systems (LCTES-SCOPES), Berlin, Germany, June 2002.

Selected Invited Talks

Compositional Programming Models For the Serverless Cloud
The 2nd Summit oN Advances in Programming Languages (SNAPL), Asilomar, CA, May 2017

Serverless applications with Apache OpenWhisk
O'Reilly Software Architecture Conference, New York, NY, April 2017

Event-Driven Programming in the Cloud
Google Developer Group, Malta, NY, November 2016

Event-Driven Programming in the Cloud
MIT Computer Science and Artificial Intelligence Laboratory, Cambridge, MA, April 2016

Programming for Heterogeneity: GPUs, FPGAs in Modern Architectures
Keynotes on HPC Languages, Lyon, France, July 2013

Liquid Metal: Change You Can Believe In, Keynote Presentation
First International Workshop on Computing in Heterogeneous, Autonomous 'N' Goal-oriented Environments, Newport Beach, CA, March 2011

Liquid Metal: blurring the software/hardware boundary in the multicore era
Sixth Workshop on Optimizations for DSP and Embedded Systems (ODES), Boston, MA, April 2008 *and* Software Engineering for Embedded Systems Workshop at Design Automation and Test in Europe (DATE), Munich, Germany March 2008

Highly Productive Collaborations in Bit-Streaming Applications
Supercomputing, High Performance Software Challenge, Pittsburgh, PA, November 2004

The Raw Microprocessor: An Exposed Wire-Delay Architecture for ILP and Streams
Advanced Micro Devices, Boxborough, MA, October 2004

Defying the Laws of Physics: Wire Exposed Architectures and Spatially Aware Compilers
Intel Microprocessor Technology Laboratory, Santa Clara, CA, August 2004

Language, Compiler and Development Support for Stream Computing
High Productivity Programming Languages and Models Workshop, Santa Monica, CA, April 2004

Language and Compiler Design for Streaming Applications
NFS Workshop on Next Generation Systems, Santa Fe, NM, April 2004

Exploration and Optimization of High Performance Embedded Memory System
Massachusetts Institute of Technology Lincoln Laboratory, Lexington, MA, July 2002

A Compiler-Centric Approach to Optimization and Design of High Performance Memory Systems
PLDI, Birds-of-a-Feather Session: ORC as a Research Compiler Infrastructure, Berlin, Germany, June 2002

Bridging Processor and Memory Performance in ILP Processors via Data-Remapping
Hewlett-Packard Research Laboratory, Palo Alto, Ca, July 2001

Publicly Available Software and Artifacts

Shell   https://ibm.biz/serverless-shell
A programming shell for the serverless cloud.

Composer   https://ibm.biz/serverless-composition
A library for programming serverles compositions.

OpenWhisk   https://github.com/apache/incubator-openwhisk
An open plaform for serverless, event-based computing.

StreamIt	http://cag.csail.mit.edu/streamit

Language, compiler, and benchmarks for streaming systems.

Trimaran	http://www.trimaran.org

Compiler and simulator for EPIC and VLIW research.

VersaBench	http://cag.csail.mit.edu/versabench

Benchmark suite for evaluating processor performance.

Patents

Stream-enabled spreadsheet as a circuit. US Patent 9,569,418, February 2017.

Extracting stream graph structure in a computer language by pre-executing a deterministic subset. US Patent 9,454,350, September 2016.

Extraction of functional semantics and isolated dataflow from imperative object oriented languages. US Patent 9,424,010, August 2016.

Communication stack for software-hardware co-execution on heterogeneous computing systems with processors and reconfigurable logic (FPGAs). US Patent 9,329,843, May 2016.

Extracting stream graph structure in a computer language by pre-executing a deterministic subset. US Patent 9,152,399, October 2015.

Technique for compiling and running high-level programs on heterogeneous computers. US Patent 8,938,725, January 2015.

Best clock frequency search for FPGA-based design. US Patent 8,566,768, October 2013.

Customizable memory indexing functions. US Patent 7,856,529, December 2010.

Academic Honors

ECOOP distinguished paper award	July 2014
PLDI best paper award	Jun 2005
Honorable mention in Supercomputing High Performance Computing Software Challenge	Nov 2004
Recognition of seminal thesis research in the Weekly ARPA Report	Jun 2001
Founders Day Award, New York University	1998
Computer Science Prize, Courant Institute of Mathematical Sciences, New York University	1998
George Granger Brown Award in Chemistry, Department of Chemistry, New York University	1997
Elected to Phi Beta Kappa, New York University	1997
Elected to Winder's Scholar Circle, New York University	1996
Elected to Phi Lambda Upsilon, New York University	1995
Isidore Rubiner Award for Outstanding Chemical Research, New York University	1995
Dean's Honor List, New York University	1994 – 1998

Professional Activities

I have chaired the following conferences and workshops.

> International Conference on Compilers, Architectures, and Synthesis of Embedded Systems (CASES, 2012, 2013)
>
> Workshop on Software Tools for Multi-Core Systems (STMCS, 2008)

I have served on the following program committees.

> International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS, 2013)
>
> Design, Automation, and Test in Europe (DATE, 2012, 2013)
>
> IEEE International Conference on Field-Programmable Technology (FPT, 2012-2016)
>
> International Conference on Field Programmable Logic and Applications (FPL, 2012-2016)
>
> International Symposium on Code Generation and Optimization (CGO, 2008, 2012)
>
> Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES, 2011)
>
> International Conference on Compilers, Architectures, and Synthesis of Embedded Systems (CASES, 2009, 2010)
>
> International Conference on Embedded Software (EMSOFT, 2009, 2010)
>
> International Conference on High Performance Computing (HiPC, 2008)
>
> International Workshop on Cell Systems and Applications (WCSA, 2008)
>
> Fourth Annual Thomas J. Watson P=ac2 Conference (PAC2, 2008)
>
> Workshop on Parallel Execution of Sequential Programs on Multi-core Architectures (PESPMA, 2008)
>
> IBM Real-Time Innovation Awards (2007)
>
> Workshop on Programming Models for Ubiquitous Parallelism (PMUMP, 2006)
>
> Workshop on Software Tools for Multi-Core Systems (STMCS, 2006)
>
> International Conference on Parallel Processing (ICPP, 2005)

I have served as a reviewer or external review committee member for the following conferences, symposiums, and journals, covering a range of topics that spans architecture, compilers, and programming languages.

> Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)
>
> Conference on Parallel Architecture and Computation Techniques (PACT)
>
> Conference on Programming Language Design and Implementation (PLDI)
>
> Design, Automation, and Test in Europe (DATE)
>
> International Conference on Compliers, Architecture, and Synthesis for Embedded Systems (CASES)
>
> International Conference on Supercomputing (ICS)
>
> International Parallel and Distributed Processing Symposium (IPDPS)
>
> International Symposium on Code Generation and Optimization (CGO)
>
> International Symposium on Computer Architecture (ISCA)
>
> International Symposium on Hardware/Software Codesign (CODES)
>
> International Symposium on Microarchitecture (MICRO)
>
> International Systems-On-Chip Conference (SOCC)
>
> Symposium on Principles of Programming Languages (POPL)
>
> Symposium on Principles and Practice of Parallel Programming (PPoPP)
>
> The Computer Journal
>
> Transactions on Architecture and Code Optimization (TACO)
>
> Transactions in Embedded Computing Systems (TECS)

I have served as a panelist reviewer for the National Science Foundation (NSF) in 2005.