Mark Batty

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Education

Ph.D. Computer Science, University of Cambridge, graduated January 2015.

Diploma in Computer Science, Passed with Distinction, University of Cambridge, 2007.

MMath Masters in Mathematics, University of Nottingham, 2005.

Employment

Lecturer, University of Kent, March 2015 onwards.

Research Associate, University of Cambridge, September 2014 – March 2015.

Research Intern, Nvidia, Redmond, WA, USA, June 2014 – September 2014.
I defined the memory model of the next generation of Nvidia GPUs.

Research Assistant, University of Cambridge, January 2014 – June 2014.

Research Associate, Fraser Research, Princeton, NJ, USA, October 2007 – October 2008.
I took a clean-slate, global-scale network design from the concept stage to a working prototype.

Research Vision

Computer systems are an impressive feat of human coordination. The constituent parts are complex, but are made to work together by establishing interfaces with prose specifications. Modern multi-core systems introduce additional subtlety by exposing relaxed-memory concurrency, whose careful use is essential to performance, yet exceedingly difficult to get right. Prose specifications are untestable, inherently ambiguous, and in many cases have been shown to contain major errors.

I develop rigorous mathematical specifications, testing tools, and verification techniques for real-world concurrent systems, focusing on established interfaces (e.g. C, C++ and, OpenCL) and concrete testable artefacts (e.g. x86, Power, ARM CPUs, and Nvidia, AMD GPUs). My goal is to offer an alternative to the prevailing culture in computer system engineering — replacing ambiguous, incomplete, and incorrect prose specifications with mathematics, enabling testing over specifications, and proving highly subtle parts of the system correct against the observable behaviour of modern hardware.

Research

Refereed Conference Papers

Papers where I was the lead author are marked with ★.

★ Overhauling SC atomics in C11 and OpenCL. M. Batty, A. Donaldson, J. Wickerson. In Proc. ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL) , 2016. *13 pages.*

Remote-Scope Promotion: Clarified, Rectified, and Verified. J. Wickerson, M. Batty, B. Beckmann, A. Donaldson. In Proc. ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), *part of* SPLASH, 2015. *17 pages.*

★ The Problem of Programming Language Concurrency Semantics. M. Batty, K. Memarian, K. Nienhuis, J. Pichon, P. Sewell. In Proc. 24th European Symposium on Programming (ESOP), 2015. *25 pages.*

GPU concurrency: weak behaviours and programming assumptions. J. Alglave, M. Batty, A. Donaldson, G. Gopalakrishnan, J. Ketema, D. Poetzl, T. Sorensen, J. Wickerson. In Proc. 20th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), ACM 2015. *15 pages.*

★ Library Abstraction for C/C++ Concurrency. M. Batty, M. Dodds, A. Gotsman. In Proc. 40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL), 2013. *14 pages.*

Synchronising C/C++ and POWER. S. Sarkar, K. Memarian, S. Owens, M. Batty, P. Sewell, L. Maranget, J. Alglave, and D. Williams. In Proc. 33rd ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI), 2012. *10 pages.*

Clarifying and Compiling C/C++ Concurrency: from C++0x to POWER. M. Batty, K. Memarian, S. Owens, S. Sarkar, and P. Sewell. In Proc. 39th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL), 2012. *12 pages.*

★ Mathematizing C++ Concurrency. M. Batty, S. Owens, S. Sarkar, P. Sewell, and T. Weber. In Proc. 38th ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL), 2011. *12 pages.*

Nitpicking C++ Concurrency. J. C. Blanchette, T. Weber, M. Batty, S. Owens, and S. Sarkar. In Proc. 13th International ACM SIGPLAN Symposium on Principles and Practice of Declarative Programming (PPDP), 2011. *11 pages.*

Workshop Papers

Relaxed Memory Models Must Be Rigorous. F. Zappa Nardelli, P. Sewell, J. Ševčík, S. Sarkar, S. Owens, L. Maranget, M. Batty, and J. Alglave. In Proc. Exploiting Concurrency Efficiently and Correctly – $(EC)^2$, 2009.

C++ Standard Committee Papers

D4136 C Concurrency Challenges. M. Batty, K. Memarian, K. Nienhuis, J. Pichon, P. Sewell. August 18, 2014.

N3196: Omnibus Memory Model and Atomics Paper. P. McKenney, M. Batty, C. Nelson, H. Boehm, A. Williams, S. Owens, S. Sarkar, P. Sewell, T. Weber, M.Wong, L. Crowl, B. Kosnik. November 11, 2010.

N3132: Mathematizing C++ Concurrency: The Post-Rapperswil Model. M. Batty, S. Owens, S. Sarkar, P. Sewell, T. Weber. August 23, 2010.

N3125: Omnibus Memory Model and Atomics Paper. P. McKenney, M. Batty, C. Nelson, H. Boehm, A. Williams, S. Owens, S. Sarkar, P. Sewell, T. Weber, M.Wong, L. Crowl. August 22, 2010.

N3136: Coherence Requirements Detailed. M.Wong, B. Kosnik, M. Batty. August 20, 2010.

N3074: Updates to C++ Memory Model Based on Formalization. P. McKenney, M. Batty, C. Nelson, N.M. Maclaren, H. Boehm, A. Williams, P. Dimov, L. Crowl. March 11, 2010.

N3045: Updates to C++ Memory Model Based on Formalization. P. McKenney, M. Batty, C. Nelson, N.M. Maclaren, H. Boehm, A. Williams, P. Dimov, L. Crowl. February 15, 2010.

N3057: Explicit Initializers for Atomics. P. McKenney, M. Batty, C. Nelson, N.M. Maclaren, H. Boehm, A. Williams, P. Dimov, L. Crowl. March 11, 2009.

N2955: Comments on the C++ Memory Model Following a Partial Formalization Attempt. M. Batty. September 28, 2009.

C Standard Committee Papers

Defect Reports: #401, #402, #403, #404, #405, #406, #407, #408. M. Batty. February, 2012.

N1584: Some Discrepancies with the C++11 Memory Model. M. Batty. October 14, 2011.

Grants

Author of CGrail: unified, optimisable and formally-specified C concurrency, *Lloyds Register Foundation supported Royal Academy of Engineering Research Fellowship*, 5 years, £465k, started January 2016.

Author of Heterogeneous memory model study, *Global Communications Headquarters Small Grant*, £19,600, funded December 2015.

Coauthor of REMS: Rigorous Engineering for Mainstream Systems, P. Sewell et. al., *EPSRC Programme Grant*, £465k, Funded 2012.

Prizes

The Association of Computing Machinery Special Interest Group on Programming Languages (ACM SIGPLAN) John C. Reynolds Doctoral Dissertation Award, 2015.

The Council of Professors and Heads of Computing and British Computing Society (CPHC/BCS) Distinguished Dissertation Award, 2015.

Conference and Seminar Presentations

University of York, York, October 2015.

Max Planck Instiut Informatik, Saarbrücken, July 2015.

University of Utah, Salt Lake City, September 2014.

ISO/IEC JTC1/SC22/WG21 SG1: C++ concurrency subgroup, Redmond, September 2014.

NVIDIA Corporation, Redmond, August 2014.

York Concurrency Workshop, University of York, April 2014.

Programming Languages and Systems Group Seminar, University of Kent, Canterbury, November 2013.

Henzinger Group Seminar, IST, Vienna, October, 2013.

ISO/IEC JTC1/SC22/WG5 – The Fortran Standards Committee, Delft, The Netherlands, June 2013

Workshop on Verified Concurrent Programs, Microsoft Research, Cambridge, June, 2013.

Coverity R&D Seminar, San Francisco, April 2013

40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL), Rome, January, 2013.

Programming, Logic, and Semantics group Seminar, IT University of Copenhagen, November, 2012.

Oxford Concurrency Workshop, Department of Computer Science, University of Oxford, July, 2012.

Yak, Cambridge University, December, 2011.

Departmental seminar, Technische Universität Dresden (TUD), February, 2011.

38th ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL), Austin USA, January, 2011.

Multi-Core Memory Models and Concurrency Theory, Schloss Dagstuhl - Leibniz Center for Informatics, January, 2011.

Institut National de Recherche en Informatique et en Automatique (INRIA), Paris Rocquencourt, November, 2010.

Teaching

University of Kent

CO890: Concurrency and Parallelism (MSc), Lecturer on GPUs and formal methods.

International

Semantics and Tools for Low-level Concurrent Programming, ENS Lyon, Winter School (7.5 hours), January 2013.

Advanced Topics in Programming, Harvard University, Guest Lecture, November 2011.

University of Cambridge

Hoare Logic, Guest Lecture, October 2014.

Multicore Semantics and Programming (MPhil ACS), Lecturer on C/C++11, 2011, 2012, 2013, 2014.

Multicore Programming (MPhil ACS), Lecturer on C/C++11, 2010.

Semantics of Programming Languages (undergraduate), Supervisions, 2009, 2010, 2011.

Further Java (undergraduate), Demonstrations, 2010, 2011.

Foundations of Computer Science (undergraduate), Demonstrations, 2010, 2011.

Programming in Java (undergraduate), Demonstrations, 2009, 2010.

Advising

Boyu Fang (MPhil ACS) The OpenMP memory model, 2014-2015.

Reinoud Elhorst (MPhil ACS) Lowering C11 Atomics for ARM in LLVM, 2013.

Simon Beaumont (Part II undergraduate) Efficient Parallel Route-Planning Methods, 2011-2012.

Danish Zeb (MPhil ACS) Relaxed Memory Models, Isabelle/HOL and SMT, 2010.

Robin Message (undergraduate intern, Fraser Research) 2008.

Simon Hay (undergraduate intern, Fraser Research) 2008.

Professional Activities

ERC member of 37th annual ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI), June 2016.

Organiser of The Kent Concurrency Workshop, Kent, June 2016.

Organiser of The South of England Regional Programming Language Seminar (S-REPLS), Kent, April 2016.

PC member of Tiny Transactions on Computer Science Volume 4 (Tiny ToCS), March 2016.

Panel member for Programming Language Mentoring Workshop (PLMW), January 2016.

Reviewer for 21st ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP), October 2015.

Reviewer for ACM Transactions on Architecture and Code Optimization (TACO), October 2015.

Member of the Khronos Group, joined November 2014.

Committee member of the British Standards Institute, joined September 2014.

Reviewer for 26th International Conference on Computer Aided Verification (CAV), 2014.

Reviewer for ACM SIGPLAN Object-Oriented Programming, Systems, Languages & Applications (OOPSLA), 2013.

Reviewer for 40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL), 2013.

Reviewer for 23rd International Conference on Computer Aided Verification (CAV), 2011.

Adviser to ISO IEC JTC1/SC22/WG14 – The C Standards Committee, attending meetings at:

Washington DC, USA, October 2011.

Adviser to ISO IEC JTC1/SC22/WG21 – The C++ Standards Committee, attending meetings at:

Redmond, WA, USA, September 2014.

Madrid, Spain, March 2011.

Batavia, IL, USA, November 2010.

Rapperswil, Switzerland, August 2010.