Matthew Hertz

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EDUCATION

◇ **Ph.D. in Computer Science**, UNIVERSITY OF MASSACHUSETTS AMHERST
September 2006
Thesis Title: *Quantifying and Improving Garbage Collection Performance*
Advisor: Emery Berger

◇ **M.S. in Computer Science**, UNIVERSITY OF MASSACHUSETTS AMHERST
May 2001
Master's Project: *Error-Free Garbage Collection Traces: How to Cheat and Not Get Caught*
Advisors: J. Eliot B. Moss and Kathryn S. McKinley

◇ **B.A. in Computer Science**, CARLETON COLLEGE
June 1997

ACADEMIC EXPERIENCE

◇ **Teaching Associate Professor** *Sept. 2016 - present*
UNIVERSITY AT BUFFALO Buffalo, NY
I recently joined the faculty of the Computer Science and Engineering department at the University of Buffalo. While at the University, I have taught the second semester programming course, both the undergraduate and masters software engineering courses, and an Internet-themed seminar for new transfer and first year students. I have chaired or co-chaired Lecturer search committees and also serve on the departmental committee overseeing the undergraduate curricula. Finally, I am a member of the team responsible for replacing the first-year programming sequence with an entirely approach starting in the Fall 2018 semester. Our new model was developed with the goals of improving student diversity and increasing student retention rates, while preserving the high levels of student achievement we currently see.

◇ **Associate Professor** *Sept. 2011 - May 2016*
◇ **Assistant Professor** *Sept. 2005 - Aug. 2011*
CANISIUS COLLEGE Buffalo, NY
I developed several research projects, most including undergraduate researchers, and served on several school-wide committees. I also taught several courses and labs each semester. During this time, I revamped the curricula of the upper-level software engineering course and sophomore programming courses to increase the focus on testing, debugging, and other practical issues. I also reorganized the introductory course for non-majors so that it presented the material in a more logical progression for the students. My revised curriculum was then used by every instructor in all sections of this course. I developed 3 entirely new courses: CSC299 (Advanced Computer Practicum) focused on the skills needed for programming contests by developing student's ability to analyze problems, utilize data structures in workable algorithms, and implement and debug programs; CSC313 (Advanced Programming Topics) taught important topics not covered in other courses, especially design patterns and code optimizations; CSC400 (Cryptography) was jointly developed with a colleague from the Math department to provide an interdisciplinary look at secret codes. I also oversaw numerous student research projects and honors theses.

◇ **Visiting Assistant Professor**, Computer Science Department *August 2006*
UNIVERSITY OF ROCHESTER Rochester, NY
As part of this appointment, I continued research examining the composite and emergent patterns in large scale program behavior, including program locality, reference affinity, and program phases In particular, I examined the impact that memory management has on program performance and how these can be offset and improved.

◇ **Research Assistant**, PLASMA Lab *June 2004 - August 2005*
UNIVERSITY OF MASSACHUSETTS AMHERST Amherst, MA
My thesis compares the performance of automatic and explicit memory management to find and improve those areas where garbage collection suffers most. For this, I developed a system that uses *accurate object lifetime traces* to compare memory management performance on unaltered garbage-collected applications. Using this *oracular memory manager*, I find that when memory is plentiful, the performance of garbage collection and explicit memory management is comparable. When memory is limited, however, paging causes garbage collection to run orders-of-magnitude slower than explicit memory managers. I find that this poor paging performance is due to existing garbage collectors repeatedly touch evicted pages. My thesis presents the *bookmarking collector* which uses summary information about evicted pages to limit or even eliminate page faults. The bookmarking collector's performance matches state-of-the-art garbage collectors when memory is plentiful and runs orders-of-magnitude faster when paging.

◇ **Research Assistant**, ALI Lab — *Sept. 1999 - June 2004*
UNIVERSITY OF MASSACHUSETTS AMHERST — Amherst, MA
My Master's project used a simulator I helped redesign, *gc-sim*, to show that commonly used "granulated" object lifetime traces cause significant distortions in simulator results. To enable the continued use of these traces, I developed the asymptotically optimal *Merlin algorithm*. The Merlin algorithm which can improve trace generation by a factor of 817 over past approaches. Initially implemented with GCTk, the garbage collection toolkit I helped design and develop, my implementation of Merlin is now included within the *Jikes RVM* as part of the *MMTk* CVS tree.

◇ **Instructor**, CMPSCI 187 (Intro. to Data Structures) — *Sept. 2000 - Jan. 2001*
UNIVERSITY OF MASSACHUSETTS AMHERST — Amherst, MA
I was the sole instructor responsible for my section of this course. I designed the homework, midterm, and final, prepared lectures and discussion sections, held office hours, and co-managed the teaching assistant and grader.

◇ **Instructor**, CMPSCI 197C (Intro. to C++) — *Jan. 2000*
UNIVERSITY OF MASSACHUSETTS AMHERST — Amherst, MA
I was the instructor responsible for all facets of this optional 1 month course. This class provides undergraduates with an understanding of the C++ language.

INDUSTRIAL EXPERIENCE

◇ **Graduate Student Intern**, Java Technologies Group — *May 2002 - Aug. 2002*
SUN MICROSYSTEMS — Burlington, MA
During my internship, I implemented a whole-heap garbage collector with which I measured the cost of the existing write barriers within the HotSpot JVM. I compared the cost of these write barriers with a new, filtering write barrier I implemented. Based upon these results, I implemented and analyzed the efficiency of a new static analysis that removes unneeded write barriers.

◇ **Software Engineer**, Device Driver and Firmware Development — *Jan. 1999 - July 1999*
VIA, INC. — Northfield, MN
As the lead firmware developer, I was responsible for creating the device driver for the new "highly reflective" touchscreen display. I rewrote our smart-battery charger's firmware to enable using it with the latest generation of batteries. I also updated the company's wearable computer BIOS to be APM compliant.

◇ **Software Engineer**, Software Research Division — *Jan. 1998 - Jan. 1999*
VIA, INC. — Northfield, MN
I served as the designer and team-leader of a project creating a programming language, compiler, and runtime system enabling program creation and customization on wearable computers via touchscreen input and voice commands. The system also featured immediate program distribution via wireless networking. Using a library I developed, I also led a project working with the US Navy to operate an existing class 3 IETM seamlessly on a tablet-like touchscreen.

◇ **Analyst**, Continuous Improvement Team — *June 1997 - Jan. 1998*
ANDERSEN CONSULTING — Minneapolis, MN
During this time I researched, designed, and helped select a defect tracking tool. I was also a member of the team which implemented a software review process and served on several code review teams.

ADMINISTRATIVE EXPERIENCE

◇ **Director, Office of Research and Institutional Effectiveness** — *Sept. 2012 - July 2016*
CANISIUS COLLEGE — Buffalo, NY
I directed the office responsible for the school's data analytics and measuring and helping improve institutional effectiveness. This includes providing institutional data requested by governmental, non-profit, and commercial agencies; responding to internal requests for data analyses; and providing reports and analyses that guide the college's data-driven decision-making process. I directed the design of an institution-wide assessment collection system, worked with offices across campus to ensure accurate data records, developed a data warehouse and automated many data reports, and created programs projecting enrollments and financial aid budgets, meeting accreditor requirements for assuring the validity of teacher education assessments, and reporting academic departments' performance metrics.

◇ **Computer Science Department Chair** — *May 2011 - Sept. 2012*
CANISIUS COLLEGE — Buffalo, NY
During the year in which I served as Chair, I oversaw the process by which the department's space in the new Science Building was allocated. I then organized moving the department from our prior space into this new building. During this time, I was also responsible for managing budgets, scheduling classes and instructors, organizing student assessments, and working with new and transferring students.

GRANTS & AWARDS

- ◇ **CSE Department Best Teaching Faculty Award** 2017
- ◇ **NSF Grant CSR-0834323** Sept. 2008 - Sept. 2011
- ◇ **CASCON (IBM Center for Advanced Studies Conference) Best Demo Award** CASCON 2009
- ◇ **School of Arts & Sciences Summer Research Fellowship** Summer 2008
- ◇ **Canisius College Summer Teaching Incentive** Summer 2007
- ◇ **ACM International Collegiate Programming Contest** Honorable Mention (1997), 17th (1996)

BOOKS

- ◇ **Hertz, M.** 2007. *Quantifying and Improving the Performance of Garbage Collection*. VDM Verlag, Saarbrücken, Germany.

REFEREED JOURNAL PUBLICATIONS

- ◇ BLACKBURN, S. M., **Hertz, M.**, MCKINLEY, K. S., MOSS, J. E. B., AND YANG, T. 2007. Profile-based pretenuring. *Transactions on Programming Languages And Systems (TOPLAS) 29*, 1 (Jan.), 2.
- ◇ **Hertz, M.**, BLACKBURN, S. M., MOSS, J. E. B., MCKINLEY, K. S., AND STEFANOVIĆ, D. 2006. Generating object lifetime traces with Merlin. *Transactions on Programming Languages And Systems (TOPLAS) 28*, 3 (May), 476–516.

REFEREED CONFERENCE PUBLICATIONS

- ◇ **Hertz, M.** AND FORD, S. 2013. Investigating factors of student learning in introductory courses. In *Proceeding of the 44th ACM Technical Symposium on Computer Science Education (SIGCSE 2013)* (Denver, CO, March 2013), pp. 195–200. *Acceptance Rate: 38%, Impact: Unknown%*.
- ◇ **Hertz, M.** AND JUMP, M. 2013. Trace-based teaching in early programming courses. In *Proceeding of the 44th ACM Technical Symposium on Computer Science Education (SIGCSE 2013)* (Denver, CO, March 2013), pp. 561–566. *Acceptance Rate: 38%, Impact: Unknown%*.
- ◇ **Hertz, M.**, KANE, S., KEUDEL, E., BAI, T., DING, C., GU, X., AND BARD, J. E. 2011. Waste not, want not: Resource-based garbage collection in a shared environment. In *Proceedings of the 2011 ACM SIGPLAN International Symposium on Memory Management (ISMM 2011)* (San Jose, CA, June 2011), pp. 65–76. *Acceptance Rate: 54%, Impact: Top 9.58%*.
- ◇ **Hertz, M.** 2010. What do 'CS1' and 'CS2' mean? investigating differences in early courses. In *Proceedings of the 41st SIGCSE Technical Symposium on Computer Science Education (SIGCSE 2010)* (Milwaukee, WI, March 2010), pp. 199–203. *Acceptance Rate: 34%, Impact: Unknown*.
- ◇ ZHANG, C., KELSEY, K., SHEN, X., DING, C., **Hertz, M.**, AND OGIHARA, M. 2006. Program-level adaptive memory management. In *Proceedings of the 2006 ACM SIGPLAN Internal Symposium on Memory Management (ISMM 2006)*, ACM SIGPLAN Notices (Ottawa, ON, Canada, June 2006), pp. 174–183. *Acceptance Rate: 38%, Impact: Top 9.58%*.
- ◇ **Hertz, M.** AND BERGER, E. D. 2005. The performance of automatic vs. explicit memory management. In *Proceedings of the 2005 ACM SIGPLAN Conference on Object-Oriented Programming Systems, Languages & Applications (OOPSLA 2005)*, Volume 40(11) of *ACM SIGPLAN Notices* (San Diego, CA, Oct. 2005), pp. 313–326. *Acceptance Rate: 18%, Impact: Top 2.29%*.
- ◇ **Hertz, M.**, FENG, Y., AND BERGER, E. D. 2005. Garbage collection without paging. In *Proceedings of the 2005 ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2005)*, Volume 40(7) of *ACM SIGPLAN Notices* (Chicago, IL, June 2005), pp. 143–153. *Acceptance Rate: 21%, Impact: Top 0.24%*.
- ◇ YANG, T., **Hertz, M.**, BERGER, E. D., KAPLAN, S. F., AND MOSS, J. E. B. 2004. Automatic heap sizing: Taking real memory into account. In *Proceedings of the 2004 ACM SIGPLAN Internal Symposium on Memory Management (ISMM 2004)*, ACM SIGPLAN Notices (Vancouver, BC, Canada, Nov. 2004). *Acceptance Rate: 35%, Impact: Top 9.58%*.
- ◇ HIRZEL, M., DIWAN, A., AND **Hertz, M.** 2003. Connectivity-based garbage collection. In *Proceedings of the 2003 ACM SIGPLAN Conference on Object-Oriented Programming Systems, Languages & Applications (OOPSLA 2003)*, Volume 38(11) of *ACM SIGPLAN Notices* (Anaheim, CA, Oct. 2003), pp. 359–373. *Acceptance Rate: 18%, Impact: Top 2.29%*.
- ◇ **Hertz, M.**, IMMERMAN, N., AND MOSS, J. E. B. 2002. Framework for analyzing garbage collection. In R. BAEZA-YATES, U. MONTANARI, AND N. SANTORO Eds., *Foundations of Information Technology in the Era of Network and Mobile Computing: IFIP 17th World Computer Congress - TC1 Stream (TCS 2002)*, Volume 223 of *IFIP Conference Proceedings* (Montreal, Canada, 2002), pp. 230–241. *Acceptance Rate: 38%, Impact: Top 62.73%*.

- ◇ **Hertz, M.**, BLACKBURN, S. M., MOSS, J. E. B., MCKINLEY, K. S., AND STEFANOVIĆ, D. 2002. Error free garbage collection traces: How to cheat and not get caught. In *Proceedings of the International Conference on Measurement and Modeling of Computer Systems*, Volume 30(1) of *ACM SIGMETRICS Performance Evaluation Review* (Marina Del Rey, CA, June 2002), pp. 140–151. *Acceptance Rate: 13%, Impact: Top 8.02%*.
- ◇ STEFANOVIĆ, D., **Hertz, M.**, BLACKBURN, S. M., MCKINLEY, K. S., AND MOSS, J. E. B. 2002. Older-first garbage collection in practice: Evaluation in a Java virtual machine. In *Proceedings of the Workshop on Memory System Performance (MSP 2002) and the International Symposium on Memory Management (ISMM 2002)*, Volume 38(2) of *ACM SIGPLAN Notices* (Berlin, Germany, Feb. 2002), pp. 25–36. *Acceptance Rate: 71%, Impact: Top 9.58%*.
- ◇ BLACKBURN, S. M., SINGHAI, S., **Hertz, M.**, MCKINLEY, K. S., AND MOSS, J. E. B. 2001. Pretenuring for Java. In *Proceedings of the 2001 ACM SIGPLAN Conference on Object-Oriented Programming Systems, Languages & Applications (OOPSLA 2001)*, Volume 36(11) of *ACM SIGPLAN Notices* (Tampa, FL, Oct. 2001), pp. 342–352. *Acceptance Rate: 19%, Impact: Top 2.29%*.

DEMOS & POSTERS

- ◇ HOVEMEYER, D., **Hertz, M.**, DENNY, P., SPACCO, J., PAPANCEA, A., STAMPER, J., AND RIVERS, K. 2013. Cloudcoder: Building a community for creating, assigning, evaluating and sharing programming exercises. In *Proceeding of the 44th ACM Technical Symposium on Computer Science Education (SIGCSE 2013)* (Denver, CO, March 2013), pp. 742–742. Poster Presentation w/ Published Abstract.
- ◇ **Hertz, M.** AND FORD, S. 2012. When do students learn? investigating factors in introductory courses. Faculty Poster at CCSCNE 2012.
- ◇ BARD, J., KANE, S., KEUDEL, E., BAI, T., GU, X., **Hertz, M.**, AND DING, C. 2009. Waste not, want not: Adaptive memory sharing in multi-core environments. Demo at CASCON 2009 Technology Showcase.

OTHER PRESENTATIONS AND INVITED TALKS

- ◇ "Monte Carlo-Based Enrollment Projections", 5th Joint Conference of the Upstate Chapters of American Statistical Association, Buffalo, NY, Apr. 2016.
- ◇ "'Little Assignments' on Big Data", Western New York CS Teachers Association Fall Conference, Buffalo, NY, Oct. 2013
- ◇ "Assessing the Assessment: Practice What You Preach", The 2011 Assessment Institute, Indianapolis, IN, Nov. 2011
- ◇ "Garbage Collection on Modern Hardware", Canisius College School of Arts & Sciences Faculty Colloquium, Buffalo, NY, Nov. 2009
- ◇ "Cooperative Memory Management for Multi-core Systems", 8th Workshop on Compiler-Driven Performance (CDP09), Toronto, ON, Canada, Nov. 2009
- ◇ "Poor Richard's Memory Manager", Univ. of Delaware, Newark, DE, Aug. 2009
- ◇ "Garbage Collection Without Paging", Nokia S60 Runtime Platform Group, Helsinki, Finland, Aug. 2008
- ◇ "Using Graphs for Dynamic Memory Management", Canisius College Summer REU Program, Buffalo, NY, July 2007
- ◇ "Quantifying and Improving Garbage Collection Performance", Univ. of Rochester, Rochester, NY, Oct. 2005
- ◇ "Cooperative User- and Kernel-Level Memory Management", DaCapo ITR Grant Meeting, Lafayette, IN, Aug. 2004
- ◇ "Hippocratic Garbage Collection", New England Programming Language and System Symposium Series (NEPLS 12), Burlington, VT, June, 2004
- ◇ "VM-Aware Garbage Collection", DaCapo ITR Grant Meeting, Albuquerque, NM, Aug. 2003
- ◇ "Pretenuring For Java", DaCapo ITR Grant Meeting, Albuquerque, NM, Aug. 2003
- ◇ "Merlin GC Trace Generation", DaCapo ITR Grant Meeting, Austin, TX, Jan. 2002
- ◇ "Cheating Safely: The Effects of Trace Granularity on Simulator Fidelity", DaCapo ITR Grant Meeting, Amherst, MA, Feb. 2001

STUDENTS SUPERVISED

- ◇ Anthony Secondo
- ◇ Ryan Carey
- ◇ Alec Curto
- ◇ Stephen Kane
- ◇ Elizabeth Keudel
- ◇ Jonathan Bard
- ◇ Katelyn Bilz
- ◇ Benjamin Lafko
- ◇ Anthony Secondo
- ◇ Jacob Slack
- ◇ Kimberly Stockwell
- ◇ Matthew Spencer
- ◇ Matthew Gracie, independent study supervisor
- ◇ Damon McKernan, independent study supervisor

THESIS COMMITTEES

- ◇ Sean Wagner, primary reader for honors thesis
- ◇ Stephen Kane, primary reader for honors thesis
- ◇ Sarah Mullin, 2nd reader for honors thesis
- ◇ Jeffery Rathbun, 2nd reader for honors thesis
- ◇ Kris Venstermanns (University of Ghent), member Ph.D. committee
- ◇ Kirk Kelsey (University of Rochester), member Ph.D. committee
- ◇ Xiaoming Gu (University of Rochester), member Ph.D. committee

PROFESSIONAL ACTIVITIES

- ◇ External Department Review Committee Member: Spring 2015 (SUNY Oswego)
- ◇ Middle States Accreditation Visiting Team Member: Spring 2014
- ◇ Publicity Chair for: CCSCNE 2013, CCSCNE 2012, CCSCNE 2011
- ◇ External Review Committee Member for: SIGCSE 2012, ASPLOS 2012, ISMM 2010
- ◇ Program Committee Member for: MSPC 2014, TIMERS 2008
- ◇ Reviewer for: CCSCNE 2014, SIGCSE 2012, CCSCNE 2012, CCSCE 2011, SIGCSE 2011, IEEE Transactions on Computers, CCSCE 2010, ITiCSE 2010, SIGCSE 2010, ACM Transactions on Programming Languages and Systems (TOPLAS), CCSCNE 2010, CCSCNE 2009, FIE 2009, SIGCSE 2009, CCSCE 2009, SIGCSE 2008, PLDI 2008, FIE 2008, SIGCSE 2008, SIGCSE 2007, ACM Transactions on Architecture and Compiler Optimizations (TACO), MSPC 2006, PLDI 2006, ITI 2004, WOSP 2004, OOPSLA 2004, PLDI 2004, ISMM 2004, OOPSLA 2003
- ◇ Member of the ACM SIGPLAN Education Board

University Service

- ◇ Member of Financial Aid Planning Committee — Sept. 2012 - July 2016
- ◇ Member of Vice President for Academic Affairs Cabinet — Sept. 2012 - July 2016
- ◇ Advisor to Strategic Planning Committee — Sept. 2012 - July 2016
- ◇ Advisor to College-Wide Budget Committee — Sept. 2012 - July 2016
- ◇ Member of Academic Programming Board — Sept. 2013 - July 2016
- ◇ Member of College-Level Assessment Committee — Sept. 2013 - July 2016
- ◇ Member of Middle States Self-Study Steering Committee — 2012 - 2014
- ◇ Computer Programming Teams Coach — Jan. 2007 - May 2013
- ◇ Computer Club Advisor — Sept. 2006 - May 2013
- ◇ Member of College of Arts and Sciences Outcomes Assessment Advisory Committee — June 2008 - Sept. 2012
- ◇ Member of Canisius College Online Education Committee — June 2007 - June 2009

Community Service

- ◇ Speaker for Buffalo - Niagara Chapter of the March of Dimes — 2007 - *present*
- ◇ Ambassador Family for the Buffalo - Niagara Chapter of the March of Dimes — 2014; 2009

Software

- ◇ **AoV** Along with students from my Fall 2014 Software Engineering course, I developed, designed, and implemented a tool used by the Canisius College School of Education and Human Services to evaluate the validity of their assessment instruments. This code allows for program directors to describe their assessment instruments and then have outside reviewers assesses these instruments along a number of important aspects. The results of these evaluations are saved as a PDF and made available to accreditors. This tool is in use at Canisius College to document compliance with CAEP requirements and being considered for adoption by other institutions.
- ◇ **Merlin** I developed, designed, and implemented a GC trace generation tool using the Merlin algorithm. My code has been incorporated into MMTk and is now included as part of MMTk and IBM's widely used, open-source Jikes RVM. "Merlin traces" have been used for a number of publications, and has been incorporated into research projects in at least 10 different institutions.
- ◇ **GCTk** I collaborated on the design and implementation of GCTk, an open, easily-modifiable infrastructure in which to build high performance garbage collectors. Running in the IBM's Jikes RVM, a Java in Java virtual machine, GCTk made it possible to compare algorithms in an apples-to-apples setting and led to the development of MMTk.