

Benjamin C. Lee

Curriculum Vitae

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benjamin.c.lee@duke.edu
Nationality: United States
Place of Birth: California

Pratt School of Engineering
Duke University
210 Hudson Hall, Box 90291
Durham, NC 27708

Interests

Computer architecture – processor and memory design, power efficiency, security.
Datacenter systems – server architecture, resource management, simulation methods.
Systems modeling – performance and power analysis, statistical machine learning.
Algorithmic economics – allocation and scheduling, multi-agent markets, game theory.
Technology policy – technology, economics, policy for environmentally sustainable IT.

Education

Harvard University

Ph.D., Computer Science, 2008
S.M., Computer Science, 2006
Minor, Statistics

University of California, Berkeley

B.S., Electrical Engineering and Computer Science, 2004
Minor, Business Administration

Experience

Duke University, Durham NC

Associate Professor, Electrical & Computer Engineering, Computer Science, 2015 – present
Assistant Professor, Electrical & Computer Engineering, Computer Science, 2010 – 2015

Stanford University, Stanford CA

NSF Computing Innovation Fellow, Electrical Engineering, 2009 – 2010

Microsoft Research, Redmond WA

Post-doctoral Researcher, Systems and Networking, 2008 – 2009

Harvard University, Cambridge MA

Graduate Researcher, Engineering and Applied Sciences, 2004 – 2008

Intel Corporation, Santa Clara CA

Intern Researcher, Microarchitecture Research, 2007

Lawrence Livermore National Laboratory, Livermore CA

Intern Researcher, Applied Scientific Computing, 2006

University of California, Berkeley CA

Undergraduate Researcher, Computer Science, 2002 – 2004

Charles M. Salter Associates, San Francisco CA

Intern Engineer, Transportation and Airport Acoustics, 2000

- Academic Honors**
- 2013 Duke University, Nortel Networks Professorship**
 - 2012 National Science Foundation, CAREER Award**
 - 2011 Google Faculty Research Award**
 - 2009 National Science Foundation, Computing Innovation Fellowship**
 - 2004 Harvard University, Engineering and Applied Sciences Fellowship**
 - 2000 National Merit Scholarship**
- Paper Awards**
- 2016 Best Paper Award, ACM Int’l Conf. Architectural Support... (ASPLOS)**
“The computational sprinting game.”
 - 2016 IEEE Micro Top Picks, Honorable Mentions**
“PoisonIvy: Safe speculation for secure memory.”
“The computational sprinting game.”
 - 2014 IEEE Micro Top Picks**
“REF: Resource elasticity fairness with sharing incentives for multiprocessors.”
 - 2011 Research Highlight, Communications of the ACM**
“Understanding sources of inefficiency in general-purpose chips.”
 - 2010 Research Highlight, Communications of the ACM**
“Phase change memory and the quest for scalability.”
 - 2009 IEEE Micro Top Picks**
“Phase change technology and the future of main memory.”
 - 2008 Best Paper Nominee, IEEE Int’l Symp. Microarchitecture (MICRO)**
“CPR: Composable performance regression for scalable multiprocessor models.”
 - 2008 ACM Doctoral Dissertation Award, Harvard University Nomination**
“Statistical inference for efficient microarchitectural analysis.”
 - 2008 Invited Participant, 38th St. Gallen Symposium**
“Corporate social responsibility and the globalization of ‘local values.’”
 - 2007 Invited Participant, 37th St. Gallen Symposium**
“Flattening the world efficiently: Digital sustainability for the twenty-first century.”
 - 2006 First Place, IEEE/ACM Supercomputing (SC) Student Research Competition**
“Statistical inference for efficient microarchitectural and application analysis.”
 - 2004 Best Paper Award, Int’l Conf. Parallel Processing (ICPP)**
“Perf. models for evaluation & auto. tuning of symm. sparse matrix-vector multiply.”
 - 2002 Best Student Paper Finalist, IEEE/ACM Supercomputing (SC)**
“Perf. opt. & bounds for sparse matrix-vector multiply.”
- Publications**
- Journals, Magazines, Books**
- Seyed Majid Zahedi, Songchun Fan, Matthew Faw, Elijah Cole, Benjamin Lee. “Computational sprinting: Architecture dynamics, and strategies.” *ACM Transactions on Computer Systems (TOCS)*, 34(4):12.1-12.26, January 2017.
 - Benjamin C. Lee. “Datacenter design and management: A computer architect’s perspec-

tive,” *Synthesis Lectures on Computer Architecture*, 11(1):1-121, February 2016.

3. Seyed Majid Zahedi, Benjamin C. Lee. “Sharing incentives and fair division for multiprocessors,” *IEEE Micro, Top Picks from the Computer Architecture Conferences*, 35(3):92-100, May/June, 2015.
4. Marisabel Guevara, Benjamin Lubin, Benjamin C. Lee. “Market mechanisms for managing datacenters with heterogeneous microarchitectures,” *ACM Transactions on Computer Systems (TOCS)*, 32(1):3.1-3.31, February 2014.
5. Rehan Hameed, Wajahat Qadeer, Megan Wachs, Omid Azizi, Alex Solomatnikov, Benjamin C. Lee, Stephen Richardson, Christos Kozyrakis, Mark Horowitz. “Understanding sources of inefficiency in general-purpose chips,” *Communications of the ACM (CACM), Research Highlight*, 54(10):85-93, October 2011.
6. Vijay Janapa Reddi, Benjamin C. Lee, Trishul Chilimbi, Kushagra Vaid. “Mobile processors for energy-efficient web search,” *ACM Transactions on Computer Systems (TOCS)*, 29(4):9.1-9.39, August 2011.
7. Ofer Shacham, Omid Azizi, Megan Wachs, Wajahat Qadeer, Zain Asgar, Kyle Kelley, Pete Stevenson, Alex Solomatnikov, Amin Firoozshahian, Benjamin C. Lee, Stephen Richardson, Mark Horowitz. “Why design must change: Rethinking digital design,” *IEEE Micro*, 30(6):9-24, November/December, 2010.
8. Benjamin C. Lee, David Brooks. “Applied inference: Case studies in microarchitectural design,” *ACM Transactions on Architecture and Code Optimization (TACO)*, 7(2):1-37, October 2010.
9. Benjamin C. Lee, Engin Ipek, Onur Mutlu, Doug Burger. “Phase change memory architecture and the quest for scalability,” *Communications of the ACM (CACM), Research Highlight*, 53(7):99-106, July 2010.
10. Benjamin C. Lee, Ping Zhou, Engin Ipek, Onur Mutlu, Jun Yang, Youtao Zhang, Bo Zhao, Doug Burger. “Phase change technology and the future of main memory,” *IEEE Micro, Top Picks from the Computer Architecture Conferences*, 30(1):131-141, January/February, 2010.
11. Benjamin C. Lee and D. Brooks. “A tutorial in spatial sampling and regression strategies for microarchitectural analysis,” *IEEE Micro, Special Issue on Hot Tutorials*, 27(3):74-93, May/June 2007.

Refereed Proceedings

12. Qiuyun Llull, Songchun Fan, Seyed Majid Zahedi, Benjamin C. Lee. “Cooper: Task colocation with cooperative games,” *Proc. 23rd IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2017.
13. Songchun Fan, Qiuyun Llull, Benjamin C. Lee. “Predicting sensory data and extending battery life for wearable devices,” *Proc. 18th Workshop on Mobile Computing Systems and Applications (HotMobile)*, February 2017.
14. Tamara Silbergleit Lehman, Andrew D. Hilton, Benjamin C. Lee. “PoisonIvy: Safe speculation for secure memory,” *Proc. 49th International Symposium on Microarchitecture (MICRO)*, October 2016.¹

¹Top Picks (Honorable Mention) from Computer Architecture Conferences, IEEE Micro.

15. Songchun Fan, Theodoros Salonidis, Benjamin C. Lee. “A framework for collaborative sensing and processing of mobile data streams: Demo,” *International Conference on Mobile Computing and Networking (MobiCom)*, October 2016.
16. Ziqiang Huang, Andrew D. Hilton, Benjamin C. Lee. “Decoupling loads for nano-instruction set computers,” *Proc. 43rd International Symposium on Computer Architecture (ISCA)*, June 2016.
17. Songchun Fan*, Seyed Majid Zahedi*, Benjamin C. Lee. “The computational sprinting game,” *Proc. 21st International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, April 2016.²
18. Songchun Fan, Benjamin C. Lee. “Evaluating asymmetric multiprocessing for mobile applications,” *Proc. International Symposium on Performance Analysis of Systems and Software (ISPASS)*, April 2016.
19. Benjamin C. Lee. “Applied statistical inference for system design and management,” *Proc. 33rd International Conference on Computer Design (ICCD)*, October 2015.
20. Qiuyun Wang, Benjamin C. Lee. “Modeling communication costs in blade servers,” *Proc. 8th Workshop on Power-Aware Computing and Systems (HotPower)*, October 2015.
21. Seyed Majid Zahedi, Benjamin C. Lee. “REF: Resource elasticity fairness with sharing incentives for multiprocessors,” *Proc. 19th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2014.³
22. Marisabel Guevara, Benjamin Lubin, Benjamin C. Lee. “Strategies for anticipating risk in heterogeneous system design,” *Proc. 20th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2014.
23. Emily Bragg, Marisabel Guevara, Benjamin C. Lee. “Understanding query complexity and its implications for energy-efficient web search,” *Proc. International Symposium on Low Power Electronics and Design (ISLPED)*, September 2013.
24. Sam Xi, Marisabel Guevara, Jared Nelson, Patrick Pensabene, Benjamin C. Lee. “Understanding the critical path in power state transition latencies,” *Proc. International Symposium on Low Power Electronics and Design (ISLPED)*, September 2013.
25. Marisabel Guevara, Benjamin Lubin, Benjamin C. Lee. “Navigating heterogeneous processors with market mechanisms,” *Proc. 19th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2013.
26. Tae Jun Ham, Bharath K. Chelepalli, Neng Xue, Benjamin C. Lee. “Disintegrated control for power-efficient and heterogeneous memory systems,” *Proc. 19th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2013.
27. Krishna T. Malladi, Ian Shaeffer, Liji Gopalakrishnan, David Lo, Benjamin C. Lee, Mark Horowitz. “Rethinking DRAM power modes for energy proportionality,” *Proc. 45th IEEE / ACM International Symposium on Microarchitecture (MICRO)*, December 2012.

² *Co-first authors; ASPLOS Best Paper; Top Picks (Honorable Mention) from Computer Architecture Conferences, IEEE Micro.

³ Top Picks from Computer Architecture Conferences, IEEE Micro.

28. Weidan Wu, Benjamin C. Lee. “Inferred models for dynamic and sparse hardware-software spaces,” *Proc. 45th IEEE / ACM International Symposium on Microarchitecture (MICRO)*, December 2012.
29. Krishna T. Malladi, Karthika Periyathambi, Frank A. Nothaft, Benjamin C. Lee, Christos Kozyrakis, Mark Horowitz. “Towards energy-proportional datacenter memory with mobile DRAMs,” *Proc. 39th ACM / IEEE International Symposium on Computer Architecture (ISCA)*, June 2012.
30. Omid Azizi, Aqeel Mahesri, Benjamin C. Lee, Sanjay J. Patel, Mark Horowitz. “Energy performance tradeoffs in processor architecture and circuit design: A marginal cost analysis,” *Proc. 37th ACM / IEEE International Symposium on Computer Architecture (ISCA)*, June 2010.
31. Rehan Hameed, Wajahat Qadeer, Megan Wachs, Omid Azizi, Alex Solomatnikov, Benjamin C. Lee, Stephen Richardson, Christos Kozyrakis, Mark Horowitz. “Understanding sources of inefficiency in general-purpose chips,” *Proc. 37th ACM / IEEE International Symposium on Computer Architecture (ISCA)*, June 2010.
32. Vijay Janapa Reddi, Benjamin C. Lee, Trishul Chilimbi, Kushagra Vaid. “Web search using mobile cores: Quantifying and mitigating the price of efficiency,” *Proc. 37th ACM / IEEE International Symposium on Computer Architecture (ISCA)*, June 2010.⁴
33. Jeremy Condit, Edmund B. Nightingale, Christopher Frost, Engin Ipek, Benjamin Lee, Doug Burger, Derrick Coetzee. “Better I/O through byte-addressable, persistent memory,” *Proc. 22nd ACM Symposium on Operating Systems Principles (SOSP)*, October 2009.
34. Xiaoyao Liang, Benjamin C. Lee, Gu-Yeon Wei, David Brooks. “Design and test strategies for microarchitectural post-fabrication tuning,” *Proc. 27th IEEE International Conference on Computer Design (ICCD)*, October 2009.⁵
35. Kristen Lovin, Benjamin C. Lee, Xiaoyao Liang, David Brooks, Gu-Yeon Wei. “Empirical performance models for 3T1D memories,” *Proc. 27th IEEE International Conference on Computer Design (ICCD)*, October 2009.⁶
36. Benjamin C. Lee, Engin Ipek, Onur Mutlu, Doug Burger. “Architecting phase change memory as a scalable DRAM alternative,” *Proc. 36th ACM / IEEE International Symposium on Computer Architecture (ISCA)*, June 2009.⁷
37. Benjamin C. Lee, Jamison Collins, Hong Wang, David Brooks. “CPR: Composable performance regression for scalable multiprocessor models,” *Proc. 41st IEEE / ACM International Symposium on Microarchitecture (MICRO)*, November 2008.⁸
38. Benjamin C. Lee. “Corporate social responsibility and the globalization of ‘local values’,” *38th St. Gallen Symposium: Global Capitalism – Local Values*, May 2008.
39. Benjamin C. Lee, David Brooks. “Efficiency trends and limits from comprehensive microarchitectural adaptivity,” *Proc. 13th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2008.

⁴ Also Microsoft Technical Report MSR-TR-2009-105, August 2009.

⁵ Also Harvard University Computer Science Technical Report TR-06-08, December 2008.

⁶ Also Harvard University Computer Science Technical Report TR-03-08, October 2008.

⁷ Top Picks from Computer Architecture Conferences, IEEE Micro; Research Highlight, Communications ACM.

⁸ Best Paper Nomination.

40. Benjamin C. Lee, David Brooks. “Roughness of microarchitectural design topologies and its implications for optimization,” *Proc. 14th IEEE International Symposium on High Performance Computer Architecture (HPCA)*, February 2008.
41. Benjamin C. Lee. “Flattening the world efficiently: Digital sustainability for the twenty-first century,” *37th St. Gallen Symposium: The Power of Natural Resources*, May 2007.
42. Benjamin C. Lee, David Brooks, Bronis de Supinski, Martin Schulz, Karan Singh, Sally McKee. “Methods of inference and learning for performance modeling of parallel applications,” *Proc. 12th ACM Symposium on Principles and Practice of Parallel Programming (PPoPP)*, March 2007.
43. Benjamin C. Lee, David Brooks. “Illustrative design space studies with microarchitectural regression models,” *Proc. 13th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2007.
44. Benjamin C. Lee, David Brooks. “Accurate and efficient regression modeling for microarchitectural performance and power prediction,” *Proc. 12th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, October 2006.
45. Benjamin C. Lee, David Brooks. “Statistically rigorous regression modeling for the microprocessor design space,” *Proc. Workshop on Modeling, Benchmarking, and Simulation (MoBS) in conjunction with ISCA-33*, June 2006.
46. Yingmin Li, Benjamin C. Lee, David Brooks, Zhigang Hu, Kevin Skadron. “Impact of thermal constraints on multi-core architectures,” *Proc. 10th Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronics Systems (ITHERM)*, May 2006.
47. Yingmin Li, Benjamin C. Lee, David Brooks, Zhigang Hu, Kevin Skadron. “CMP design space exploration subject to physical constraints,” *Proc. 12th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2006.
48. Benjamin C. Lee, David Brooks. “Effects of pipeline complexity on SMT/CMP power-performance efficiency,” *Proc. Workshop on Complexity Effective Design (WCED) in conjunction with ISCA-32*, June 2005.
49. Benjamin C. Lee, Richard Vuduc, James Demmel, Katherine Yelick. “Performance models for evaluation and automatic tuning of symmetric sparse matrix-vector multiply,” *Proc. 33rd International Conference on Parallel Processing (ICPP)*, August 2004.⁹
50. Richard Vuduc, James Demmel, Katherine Yelick, Shoaib Kamil, Rajesh Nishtala, Benjamin C. Lee. “Performance optimizations and bounds for sparse matrix-vector multiply,” *Proc. IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*, November 2002.¹⁰

Dissertations

51. Songchun Fan. “Towards energy-efficient mobile sensing: Architectures and frameworks for heterogeneous sensing and computing,” *Ph.D. Dissertation, Duke University*, September 2014.

⁹ Best Paper; Also UC Berkeley Technical Report UCB/CSD-03-1297, November 2003.

¹⁰ Best Student Paper Finalist.

52. Marisabel Guevara. “Coordinating the design and management of heterogeneous datacenter resources,” *Ph.D. Dissertation, Duke University*, April 2014.
53. Krishna Malladi. “Energy proportional memory systems,” *Ph.D. Dissertation, Stanford University*, August 2013.
54. Benjamin C. Lee. “Statistical inference for efficient microarchitectural analysis,” *Ph.D. Dissertation, Harvard University*, May 2008.¹¹

Talks

Rethinking systems management with game theory

1. Qualcomm, Raleigh, NC, March 2017.
2. ARM Research, Austin, TX, November 2016.
3. ARM Research Summit, Cambridge, UK, September 2016.
4. Microsoft Research, Redmond, WA, July 2016.

Collaborative computing for mobile sensing

5. Texas Instruments, Dallas, TX, January 2016.

Economic mechanisms for managing risk in datacenters

6. Samsung Memory Solutions Lab, Milpitas, CA, August 2015.
7. Tsinghua University, Beijing, China, July 2015.
8. Chinese Academy of Sciences, Beijing, China, July 2015.
9. North Carolina State University, March 2015.
10. University of California, Berkeley, February 2015.
11. Texas A&M University, College Station, TX, November 2014.
12. University of Illinois, Urbana-Champaign, IL, October 2014.
13. University of Massachusetts, Amherst, MA, October 2014.
14. Georgia Institute of Technology, Atlanta, GA, September, 2014.
15. Google, Mountain View, CA, July 2014.
16. Intel, Santa Clara, CA, July 2014.
17. Microsoft Research, Redmond, WA, July 2014.
18. University of Michigan, Ann Arbor, MI, April 2014
19. University of Wisconsin, Madison, WI, February 2014
20. IBM T.J. Watson Research Center, Yorktown Heights, NY, January 2014.
21. Academia Sinica, Taipei, Taiwan, January 2014.
22. National Taiwan University, Taipei, Taiwan, January 2014.

Statistical methods for hardware-software co-design

23. Oak Ridge National Laboratory, TN, November 2014.

Foundations for heterogeneous datacenter design and management

24. University of Wisconsin, Madison, WI, September 2013.
25. VMware, Palo Alto, CA, August 2013.

¹¹ Harvard University Nomination, ACM Doctoral Dissertation Award.

26. Qualcomm Research, Raleigh, NC, March 2013.
27. Ghent University, Ghent, Belgium, March 2013.
28. Chinese Academy of Sciences, Beijing, China, March 2013.
29. AMD Research, Beijing, China, March 2013.
30. Peking University, Beijing, China, March 2013.
31. Hong Kong University of Science & Technology, Hong Kong, February 2013.
32. Shanghai Jiaotong University, Shanghai, China, February 2013.
33. IBM T.J. Watson Research Center, Yorktown Heights, NY, October 2012.

Coordinated strategies for exascale computing

34. NetApp Research Triangle Park, NC, March, 2012.
35. New Faculty Lecture Series, Duke University, October, 2011.
36. IBM Research Triangle Park, NC, October, 2011.
37. University of North Carolina, Chapel Hill, September 2011.
38. Rambus, Sunnyvale, CA, August 2011.
39. IBM Austin Research Laboratory, April 2011.
40. North Carolina State University, March 2011.

Web search using mobile cores: Quantifying and mitigating the price of efficiency

41. University of California, Berkeley, August 2010.
42. Intel Corporation, Santa Clara, CA, July 2010.

Phase change memory: An architecture and systems perspective

43. Intel Corporation, Hudson, MA, August 2010.
44. Harvard University, August 2010.
45. Google, Mountain View, CA, July 2010.
46. Lawrence Livermore National Laboratory, May 2010.

Architectural inference and the pursuit of efficiency

47. Stanford Pervasive Parallelism Lab (PPL) Retreat, Santa Cruz, June 2010.
48. University of California, Los Angeles, April 2010.
49. Princeton University, March 2010.
50. University of Southern California, March 2010.
51. Duke University, March 2010.
52. Stanford University, September 2009.

Statistical inference for tractable architectural analysis

53. University of Texas at Austin, March 2009.
54. Swiss Federal Institute of Technology (ETH) Zurich, March 2009.
55. University of Rochester, March 2009.
56. Rutgers University, March 2009.
57. Northwestern University, March 2009.
58. University of Washington, Seattle, WA, March 2009.

59. AMD Research, Bellevue, WA, March 2009.
60. Microsoft Research, Redmond, WA, April 2008.
61. IBM T.J. Watson Research Center, Yorktown Heights, NY, April 2008.
62. Intel Corporation, Santa Clara, CA, June 2007.
63. Intel Corporation, Folsom, CA, June 2007.

Composable performance regression for scalable multiprocessor models

64. Intel Corporation, Santa Clara, CA, December 2007.

Regression modeling strategies for parameter space exploration

65. Lawrence Livermore National Laboratory, Livermore, CA, September 2006.

Conferences and Workshops

66. “Economic mechanisms for managing risk in datacenters,” *Workshop on Energy Secure Systems Architecture in conjunction with ISCA-41*, June 2014.
67. “Inferred models for dynamic and sparse hardware-software spaces,” *45th IEEE/ACM International Symposium on Microarchitecture (MICRO)*, December 2012.
68. “Web search using mobile cores: Quantifying and mitigating the price of efficiency,” *37th ACM International Symposium on Computer Architecture (ISCA)*, June 2010.
69. “Phase change memory: An architecture and systems perspective,” *Workshop on Emerging Memory Technologies (EMT) in conjunction with ISCA-37*, June 2010.
70. “Architecting phase change memory as a scalable DRAM alternative,” *36th ACM International Symposium on Computer Architecture (ISCA)*, June 2009.
71. “Green – Energy efficient software and principled approximation,” *Microsoft Research Techfest*, February 2009.
72. “CPR: Composable performance regression for scalable multiprocessor models,” *41st IEEE International Symposium on Microarchitecture (MICRO)*, November 2008.
73. “Efficiency trends and limits from comprehensive microarchitectural adaptivity,” *13th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2008.
74. “Roughness of microarchitectural design topologies and its implications for optimization,” *14th IEEE International Symposium on High Performance Computer Architecture (HPCA)*, February 2008.
75. “Methods of inference and learning for performance modeling of parallel applications,” *12th ACM Symposium on Principles and Practice of Parallel Programming (PPoPP)*, March 2007.
76. “Statistical inference for efficient microarchitectural analysis,” *Boston Area Architecture Workshop (BARC)*, January 2007.
77. “Illustrative design space studies with microarchitectural regression models,” *13th IEEE International Symposium on High Performance Computer Architecture (HPCA)*, February 2007.

78. “Statistical inference for efficient microarchitectural and application analysis,” *IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*, November 2006.¹²
79. “Accurate and efficient regression modeling for microarchitectural performance and power prediction,” *12th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, October 2006.
80. “Statistically rigorous regression modeling for the microprocessor design space,” *Workshop on Modeling, Benchmarking, and Simulation (MoBS) in conjunction with ISCA-33*, June 2006.
81. “Efficient design space exploration for chip multiprocessors,” *Harvard University, Industrial Partnership Annual Meeting*, October 2005.
82. “Effects of pipeline complexity on SMT/CMP power-performance efficiency,” *Workshop on Complexity Effective Design (WCED) in conjunction with ISCA-32*, June 2005.
83. “Performance models for evaluation and automatic tuning of symmetric sparse matrix-vector multiply,” *33rd International Conference on Parallel Processing (ICPP)*, August 2004.
84. “Optimizations and bounds for sparse symmetric matrix-vector multiply,” *SIAM Conference on Parallel Processing for Scientific Computing*, March 2004.
85. “Poster: Automatic performance tuning of sparse matrix kernels,” *SIAM Conference on Computational Science and Engineering*, February 2003.

Technical Panels

86. NSF Workshop on Exploiting Parallelism and Scalability, Arlington, VA, July 2015.
87. DOE Workshop on Modeling and Simulation of Exascale Systems and Applications, University of Washington, Seattle, WA, August 2012.
88. NSF Workshop on a Community Supported Computer Architecture and Design Evaluation Framework, Arlington, VA, June 2012.
89. “Architecting heterogeneous datacenters with algorithmic economics,” Informational Futures Group Meeting, Duke University, NC March 2012.
90. “Architecting a balance of power,” NSF Workshop on Cross-Layer Power Optimization and Management, University of Southern California, Los Angeles, CA, February 2012.
91. “Mega-servers vs. micro-blades,” *Workshop on Architectural Concerns in Large Data Centers (ACLD) in conjunction with ISCA-37*, June 2010.
92. “Emerging technologies,” *International Symposium on Nanoscale Architectures (NANOARCH) in conjunction with DAC-47*, July 2009.
93. “New memory technology,” *36th ACM International Symposium on Computer Architecture (ISCA)*, June 2009.

¹² First Place, ACM Student Research Competition.

Artifacts

1. Duke ActionBench: ActionBench provides mobile benchmarks for user-phone interaction. APK files can be placed in a mounted Gem5 image and installed within simulation. The repository includes benchmark source code, written in Java and Gem5 simulation scripts. (<http://people.duke.edu/~bcl15/software.html>)
2. Harvard CORE: Comprehensive Optimization via Regression Estimates (CORE) is a collection of example R scripts that construct microarchitectural performance, power regression models with correlation, association, significance analyses. (<http://people.duke.edu/~bcl15/software.html>)
3. Berkeley OSKI: The Optimized Sparse Kernel Interface is a collection of low-level C primitives that provide automatically tuned computational kernels on sparse matrix solves for use in solver libraries and applications. (<http://bebop.cs.berkeley.edu/oski/>)

Patents

1. Jeremy Condit, Edmund Nightingale, Benjamin C. Lee, Engin Ipek, Christopher Frost, Doug Burger. "Hardware and operating system support for persistent memory on a memory bus," United States Patent #US8533404. Granted September 2013.
2. Jeremy Condit, Edmund Nightingale, Benjamin C. Lee, Engin Ipek, Christopher Frost, Doug Burger. "Hardware and operating system support for persistent memory on a memory bus," United States Patent #US8219741. Granted July 2012.

Grants

1. "Gigapixel cameras for ubiquitous surveying and environmental research," Co-principal Investigator with David Brady (PI) et al., Duke University, \$50K, 2016.
2. "Coalitional game theory for co-locating software on shared hardware," Principal Investigator with Andrew Hilton (Co-PI), National Science Foundation, \$400K, 2015-2018.
3. "AWS research education grant," Principal Investigator, Amazon Web Services, \$3.5K, 2015-2016.
4. "NSF XPS workshop for exploiting parallelism and scalability," Co-principal Investigator with Wuchun Feng (PI), National Science Foundation, \$85K, 2014-2015.
5. "Multi-dimensional scheduling and resource allocation in datacenters," Co-principal Investigator with Kamesh Munagala (PI) and Sungjin Im, National Science Foundation, \$959K, 2014-2018.
6. "Allocating heterogeneous datacenter hardware to strategic agents," Principal Investigator with Vincent Conitzer (Co-PI), National Science Foundation, \$700K, 2013-2016.
7. "The center for future architectures research," Co-principal Investigator with Todd Austin (PI) et al., Semiconductor Research Corporation, Defense Advanced Research Projects Agency, \$1M to BCL of \$28M award, 2013-2017.
8. "CAREER: Foundations for heterogeneous datacenter design and deployment," Principal Investigator, National Science Foundation, \$460K, 2012-2016.
9. "Pathfinding for emerging memory technologies," Principal Investigator, Google Faculty Research Award, \$55K, 2011.

10. “Foundations for heterogeneous datacenter design and development,” Principal Investigator, Duke University Wannamaker Foundation, \$20K, 2011-2012.
11. “An application-driven approach to energy-efficient data centers,” Co-principal Investigator with Christos Kozyrakis (PI) et al., Google Focused Research Award, \$750K, 2009-2012.¹³
12. “The Computing Innovation Fellows Project: Rethinking digital design,” Fellow with Mark Horowitz (Mentor), National Science Foundation, \$280K, 2009-2010.¹⁴

**Research
Advising**

Doctoral Students

1. Ziqiang Huang, Electrical and Computer Engineering, Duke University, 2014 – .
2. Tamara Lehman, Electrical and Computer Engineering, Duke University, 2013 – .
3. Yuhao Li, Computer Science, Duke University, 2016 – .
4. Atefeh Mehrabi, Electrical and Computer Engineering, Duke University, 2016 – .
5. Bryan Prosser, Computer Science, Duke University, 2015 – .
6. Qiuyun Wang, Electrical and Computer Engineering, Duke University, 2012 – .
7. Seyed Majid Zahedi, Computer Science, Duke University, 2012 – .
8. Pengfei Zheng, Computer Science, Duke University, 2014 – .
9. Songchun Fan, Computer Science, Duke University, 2011-16.
10. Marisabel Guevara, Computer Science, Duke University, 2010-14.
11. Krishna Malladi, Electrical Engineering, Stanford University (with Horowitz), 2009-13.

Masters Students

12. Zhiyu Zhang, Computer Science, Duke University, 2016-17.
13. Henri Maxime Demoulin, Computer Science, Duke University, 2014-16.
14. Weidan Wu, Electrical and Computer Engineering, Duke University, 2010-14.
15. Xin Zhou, Electrical and Computer Engineering, Duke University, 2013-14.
16. Yifan Zhang, Electrical and Computer Engineering, Duke University, 2012-14.

Undergraduate Students

17. Matthew Faw, Electrical and Computer Engineering, Duke University, 2016 – .
18. Hunter Lee, Electrical and Computer Engineering, Duke University, 2016 – .
19. Aninda Manocha, Electrical and Computer Engineering, Duke University, 2017 – .
20. Dan Sun, Electrical and Computer Engineering, Duke University, 2017 – .
21. Brian Zhou, Electrical and Computer Engineering, Duke University, 2016 – .
22. Randall Johnson, Electrical and Computer Engineering, Duke University, 2016.
23. Rahul Swaminathan, Electrical and Computer Engineering, Duke University, 2015.
24. Stephen Hughes, Electrical and Computer Engineering, Duke University, 2015.
25. Kevin Delgado, Electrical and Computer Engineering, Duke University, 2015.
26. Michael Liou, Computer Science, Duke University, 2015.
27. Justin Wang, Computer Science, Duke University, 2015.
28. Paul Kim, Electrical and Computer Engineering, Duke University, 2014-15.
29. Justine Kim, Electrical and Computer Engineering, Duke University, 2014-15.
30. William Chang, Computer Science, Duke University, 2014.
31. Lance Co Ting Keh, Electrical and Computer Engineering, Duke University, 2014.

¹³ Funding to Stanford University. Co-PI started faculty position at Duke University.

¹⁴ Funding for 2010-2011 declined. Fellow started faculty position at Duke University.

32. Zachary Michaelov, Electrical and Computer Engineering, Duke University, 2014.
33. Nazia Tabassum, Electrical and Computer Engineering, Duke University, 2013-14.
34. Sam (Likun) Xi, Electrical and Computer Engineering, Duke University, 2012-13.
35. John Cuffney, Electrical and Computer Engineering, Duke University, 2012.
36. Taejun Ham, Electrical and Computer Engineering, Duke University, 2011-12.
37. Michael Ansel, Electrical and Computer Engineering, Duke University, 2011.

External Research Experience for Undergraduates

38. Abhimanyu Yadav, Computer Science and Engineering, IIT Kanpur, 2016.
39. Stephanie Morris, Electrical and Electronics Engineering, University of Alabama, 2013.
40. Emily Bragg, Computer Engineering, Georgia Institute of Technology, 2012.
41. Casey Mackin, Electrical and Computer Engineering, University of Arizona, 2012.

Committees

Doctoral Students

Mukesh Agrawal (advisor K. Chakrabarty), Sandeep Agrawal (advisor A. Lebeck), Qing Duan (advisor K. Chakrabarty), Rahul Ghosh (advisor K. Trivedi), Yuzhang Han (advisor S. Babu), Blake Hechtman (advisor D. Sorin), Kai Hu (advisor K. Chakrabarty), Mohamed Ibrahim (advisor K. Chakrabarty), Mayuresh Kunjir (advisor S. Babu), Adam Jacobvitz (advisor D. Sorin), Ilija Jovanov (advisor M. Pajic), Craig LaBoda (advisor C. Dwyer), Opeoluwa Matthews (advisor D. Sorin), Kesari Mishra (advisor K. Trivedi), Mohammed Mottaghi (advisor C. Dwyer), Sean Murray (advisor D. Sorin), Ralph Nathan (advisor Dan Sorin), Brandon Noia (advisor K. Chakrabarty), Jun Pang (advisor C. Dwyer), Arjun Rallapalli (advisor C. Dwyer), Animesh Srivastava (advisor L. Cox), Xin Song (advisor A. Lebeck), Zilong Tan (advisor S. Babu), Vamsidhar Thummala (advisor J. Chase), Viresh Thusu (advisor C. Dwyer), Bing Xie (advisor J. Chase), Fangming Ye (advisor K. Chakrabarty), Xiaoyan Yin (advisor K. Trivedi), Meng Zhang (advisor D. Sorin), Tong Zhou (advisor K. Chakrabarty)

Masters Students

Timothy Calloway (advisor L. Cox), Yifei Deng (advisor S. Babu), Fei Dong (advisor S. Babu), Heather Duschl (advisor C. Dwyer) Alexandru Dutu (advisor A. Lebeck), Zhiqiu Kong (advisor L. Cox), Jie Li (advisor S. Babu), Arpan Roy (advisor K. Trivedi), Benjamin Stoddard (advisor A. Machanavajjhala), Alfredo Velasco (advisor D. Sorin)

Teaching

Duke University, Durham NC

Professor, Electrical and Computer Engineering, 2010 – present

- Computer Architecture (ECE/CS 250): F15, S14, S13.
- Advanced Computer Architecture I (ECE/CS 552): F16, F12, F11
- Energy-Efficient Computer Systems (ECE/CS 590): F14, S12, F10
- Datacenter Architecture (ECE/CS 590): F13, S16

Stanford University, Stanford CA

Guest Instructor, Electrical Engineering, 2009

- Autumn 2009: Advanced Processor Architecture (EE282a).
- Autumn 2009: Digital Systems (EE108b).

Harvard University, Cambridge MA

Teaching Fellow, Engineering and Applied Sciences, 2005 – 2008

- Spring 2008: Guest lecture on power modeling, digital sustainability (CS246).
- Fall 2006: Management of innovation in science, engineering (ES139/239).
- Spring 2006: Advanced architecture, power-aware systems (CS246).

- Fall 2005: Introductory computer architecture (CS146), digital logic design (CS141).

Tutorial: Datacenter system design and management

Presenter and Co-Organizer

- 11th HiPEAC International Summer School on Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems (ACACES), July 2015.

Tutorial: Datacenter simulation methodologies

Presenter and Co-Organizer

- International Symposium on Computer Architecture (ISCA), June 2015.
- International Symposium on Microarchitecture (MICRO), December 2014.
- With Tamara S. Lehman, Qiuyun Wang, Seyed Majid Zahedi.

Tutorial: Methods of learning and inference for large design and parameter spaces

Presenter and Co-Organizer

- International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), March 2008.
- With David Brooks, Bronis de Supinski, Sally McKee, Karan Singh.

Tutorial: Inference and learning for large scale microarchitectural analysis

Presenter and Co-Organizer

- International Symposium on Computer Architecture (ISCA), June 2007.
- With David Brooks, Bronis de Supinski, Sally McKee, Karan Singh.

Service

Memberships

IEEE, Institute of Electrical and Electronics Engineers.
ACM, Association for Computing Machinery.
SIAM, Society for Industrial and Applied Mathematics.
AAAS, American Association for the Advancement of Science.

Conference General Chair

XPS 2015, Workshop on Exploiting Parallelism & Scalability.
ISPASS 2015, Int'l. Symp. Perf. Analysis of Systems & Software.

Conference Program Chair

ISPASS 2014, Int'l. Symp. Perf. Analysis of Systems & Software.

Conference Program Committees

MICRO 2017, Int'l. Symp. on Microarchitecture.
ISCA 2017, Int'l. Symp. Computer Architecture.
Top Picks 2017, IEEE Micro Top Picks.
ASPLOS 2017, Int'l. Conf. Architectural Support...
HPCA 2017, Int'l. Symposium on High-Performance Computer Architecture.
Top Picks 2016, IEEE Micro Top Picks.
DATE 2016, Design and Test in Europe Conf.
HotPower 2015, Work. on Power-Aware Computing & Systems.
MICRO 2015, Int'l. Symp. on Microarchitecture.
HPCA 2015, Int'l. Symposium on High-Performance Computer Architecture.
DATE 2015, Design and Test in Europe Conf.
HiPEAC 2015, Int'l. Conf. High-Performance Embedded Architectures and Compilers.
HotPower 2014, Work. on Power-Aware Computing & Systems.
IISWC 2014, Int'l. Symp. Workload Characterization.

SIGMETRICS 2014.
DATE 2014. Design and Test in Europe Conf.
HiPEAC 2014. Int'l. Conf. High-Performance Embedded Architectures and Compilers.
MICRO 2013, Int'l. Symp. on Microarchitecture.
HotPower 2013, Work. on Power-Aware Computing & Systems.
IISWC 2013, Int'l. Symp. Workload Characterization.
WEED 2013 (w/ ISCA), Work. on Energy-Efficient Design.
WDDD 2013 (w/ ISCA), Work. on Duplicating, Deconstructing and Debunking.
IGCC 2013, Int'l. Green Computing Conference.
ISPASS 2013, Int'l. Symp. Perf. Analysis of Systems & Software.
HiPEAC 2013, Int'l. Conf. High-Performance Embedded Architectures and Compilers.
ICCD 2012, Int'l. Conference on Computer Design.
WEED 2012 (w/ ISCA), Work. on Energy-Efficient Design.
WDDD 2012 (w/ ISCA), Work. on Duplicating, Deconstructing and Debunking.
IGCC 2012, Int'l. Green Computing Conference.
ISPASS 2012, Int'l. Symp. Perf. Analysis of Systems & Software.
IPDPS 2012, Int'l. Parallel & Distributed Processing Symposium.
HPCA 2012, Int'l. Symposium on High-Performance Computer Architecture.
ICCD 2011, Int'l. Conference on Computer Design.
MoBS 2011 (w/ ISCA), Work. on Modeling, Benchmarking, Simulation.
ICS 2011, Int'l. Conf. Supercomputing.
ICPE 2011, Int'l. Conf. Performance Engineering.
MoBS 2010, Work. Modeling, Benchmarking, Simulation.
ISPASS 2010, Int'l. Symp. Perf. Analysis of Systems & Software.
MoBS 2009 (w/ ISCA), Work. Modeling, Benchmarking, Simulation.
ISPASS 2009, Int'l Symp. Perf. Analysis of Systems & Software.

Conference Organizing Committees

MICRO 2012, Int'l. Symp. on Microarchitecture.
ISCA 2012, Int'l. Symp. on Computer Architecture.
ICS 2011, Work. on Emerging Supercomputing Technologies.
ISPASS 2011, Int'l. Symp. Perf. Analysis of Systems & Software.
WEMT 2010 (w/ ISCA), Work. Emerging Memory Technologies.
MICRO 2009, Int'l Symp. Microarchitecture.
WEMT 2009 (w/ ISCA), Work. Emerging Memory Technologies.
PACT 2009, Int'l Conf. Parallel Arch. & Compilation Techniques.

External Review Committees

ASPLOS, Int'l. Conf. Arch. Support for Prog. Lang. & Op. Sys.
HPCA, Int'l. Symp. High Performance Computer Architecture.
ISCA, Int'l. Symp. Computer Architecture.
ISLPED, Int'l. Symp. Low Power Electronics and Design.
ISPASS, Int'l. Symp. Perf. Analysis of Systems & Software.
MICRO, Int'l. Symp. on Microarchitecture.

Journal Reviews

ACM Transactions on Architecture and Code Optimization (TACO).
ACM Transactions on Embedded Computing Systems (TECS).
ACM Transactions on Design Automation of Electronic Systems (TODAES).
IEEE Transactions on Computers (TC).
IEEE Transactions on Computer Aided Design (TCAD).
IEEE Transactions on Parallel and Distributed Systems (TPDS).

IEEE Transactions on Signal Processing (TSP).
IEEE Transactions on Very Large Scale Integration Systems (TVLSI).
IEEE Computer Architecture Letters (CAL).
IEEE Micro Magazine (Micro).
Elsevier Parallel Computing.
Elsevier Sustainable Computing: Informations and Systems.
International Journal of High Performance Computer Applications.

Grant Reviews

National Science Foundation, Computer & Information Science & Engineering, 2017.
National Science Foundation, Computer & Information Science & Engineering, 2016.
Research Foundation Flanders, 2015.
National Science Foundation, Computer & Information Science & Engineering, 2014.
Department of Energy, Office of Science, Early Career Research Program, 2014.
Ministry of Education, Singapore Government, 2013.
National Science Foundation, Computer & Information Science & Engineering, 2013.
Department of Energy, Office of Science, Small Business Innovation Research, 2012.
Department of Energy, Office of Science, Small Business Innovation Research, 2011.
Research Foundation Flanders, 2011.

University Service

President's Council on Black Affairs, 2016-19.
University Judicial Board, 2016-18.
Faculty Diversity Task Force Implementation Committee, 2015-16.

Department Service

Chair, Faculty Tenure Committee, 2015-16.
Chair, Faculty Search Committee, 2015-16.
Member, Graduate Diversity Committee, 2014-16.
Member, Business Manager Search Committee, 2012.
Member, Faculty Search Committee, 2012.