

Benjamin C. Lee

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Nationality: United States
Place of Birth: California

School of Engineering and Applied Science
University of Pennsylvania
Levine 276, 220 South 33rd Street
Philadelphia, PA 19104

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

Academic Experience

University of Pennsylvania, Philadelphia PA
Co-Director, NSF Expedition in Computing, Carbon Connect, 2024-.
Associate Chair, Electrical & Systems Engineering, 2024-.
Professor, Electrical & Systems Engineering, Computer & Information Science, 2020-.

Duke University, Durham NC
Co-Director, NSF IUCRC, Alternative Sustainable and Intelligent Computing, 2018-20
Associate Professor, Electrical & Computer Engineering, Computer Science, 2015-20
Assistant Professor, Electrical & Computer Engineering, Computer Science, 2010-15

Stanford University, Stanford CA
NSF Computing Innovation Fellow, Electrical Engineering, 2009-10

Harvard University, Cambridge MA
Graduate Researcher, Engineering and Applied Sciences, 2004-08

University of California, Berkeley CA
Undergraduate Researcher, Computer Science, 2002-04

Industrial Experience

Google, Remote
Visiting Researcher, Global Infrastructure Group, 2024-.

Meta AI, Boston MA
Visiting Researcher, Fundamental AI Research, 2021-23

Microsoft Research, Redmond WA
Post-doctoral Researcher, Systems and Networking, 2008-09

Intel Corporation, Santa Clara CA

Intern Researcher, Microarchitecture Research, 2007

Lawrence Livermore National Laboratory, Livermore CA

Intern Researcher, Applied Scientific Computing, 2006

**Academic
Honors**

IEEE Fellow, 2024

ACM Distinguished Scientist, 2019

IEEE Senior Member, 2019

Dean's Award for Excellence in Mentoring Nominee, Duke University, 2018

Celebrating Mentors Honoree, Duke University, 2018

Hall of Fame, Int'l Symp. High-Perf. Computer Architecture (HPCA), 2018

Nortel Networks Assistant Professorship, Duke University, 2013-15

CAREER Award, National Science Foundation, 2012

Faculty Research Award, Google, 2011

Computing Innovation Fellowship, National Science Foundation, 2009

Engineering and Applied Sciences Fellowship, Harvard University, 2004

National Merit Scholarship, 2000

**Publication
Awards**

IEEE Micro Top Picks select, annually, significant papers in computer architecture based on novelty, potential for long-term impact. CACM Research Highlights select outstanding, broadly relevant articles from full spectrum of computer science research.

Distinguished Reviewer, 2024

Int'l Conf. Architectural Support... (ASPLOS)

Honorable Mention, IEEE Micro Top Picks, 2024

Carbon Explorer: A holistic framework for designing carbon aware datacenters

Selected for ISCA@50 25-Year Retrospective, 2023

Understanding sources of inefficiency in general-purpose chips

Persistent Impact Prize, Non-volatile Memory Workshop (NVMW), 2022

Architecting phase change memory as a scalable DRAM alternative

Persistent Impact Prize, Non-volatile Memory Workshop (NVMW), 2020

Better I/O through byte-addressable, persistent memory

Best Paper Nominee, Workshop on Machine Learning for CAD (MLCAD), 2020

F-LEMMA: Fast learning-based energy management for multi/many-core processors

Research Highlight, Communications of the ACM, 2019

The computational sprinting game

Best Paper, Int'l Symp. High-Perf. Computer Architecture (HPCA), 2018

Amdahl's Law in the datacenter era: A market for fair processor allocation

Best Paper, Int'l Symp. Perf. Analysis Systems & Software (ISPASS), 2018

MAPS: Understanding metadata access patterns in secure memory

Outstanding PhD dissertation award, Duke Electrical & Computer Engineering, 2017

Microeconomic models for managing shared datacenters

Invited Paper, ACM Transactions on Computer Systems, 2017

The computational sprinting game

Best Paper, Int'l Conf. Architectural Support... (ASPLOS), 2016

The computational sprinting game

Honorable Mention, IEEE Micro Top Picks, 2016

The computational sprinting game

Honorable Mention, IEEE Micro Top Picks, 2016

PoisonIvy: Safe speculation for secure memory

Invited Paper, ACM Operating Systems Review, 2015

Modeling communication costs in blade servers

IEEE Micro Top Picks, 2014

REF: Resource elasticity fairness with sharing incentives for multiprocessors

Invited Paper, ACM Transactions on Computer Systems, 2011

Mobile processors for energy-efficient web search

Research Highlight, Communications of the ACM, 2011

Understanding sources of inefficiency in general-purpose chips

Research Highlight, Communications of the ACM, 2010

Architecting phase change memory as a scalable DRAM alternative

IEEE Micro Top Picks, 2009

Architecting phase change memory as a scalable DRAM alternative

Best Paper Nominee, Int'l Symp. Microarchitecture (MICRO), 2008

CPR: Composable performance regression for scalable multiprocessor models

Harvard University Nominee, ACM Doctoral Dissertation Award, 2008

Statistical inference for efficient microarchitectural analysis

Invited Participant, 38th St. Gallen Symposium, 2008

Corporate social responsibility and the globalization of 'local values'

Invited Participant, 37th St. Gallen Symposium, 2007

Flattening the world efficiently: Digital sustainability for the twenty-first century

First Place, Supercomputing (SC) Student Research Competition, 2006

Statistical inference for efficient microarchitectural and application analysis

Best Paper, Int'l Conf. Parallel Processing (ICPP), 2004

Performance models for evaluation and automatic tuning of symmetric sparse matrix-vector multiply

Best Student Paper Finalist, Supercomputing (SC), 2002

Performance optimization and bounds for sparse matrix-vector multiply

Publications**Journals, Magazines, Books**

1. Rehan Hameed, Wajahat Qadeer, Megan Wachs, Omid Azizi, Alex Solomatnikov, Benjamin C. Lee, Stephen Richardson, Christos Kozyrakis, and Mark Horowitz. “Retrospective: Understanding sources of inefficiency in general-purpose chips,” *ISCA@50 25-Year Retrospective: 1996-2020*, June, 2023.
2. An Zou, Karthik Garimella, Benjamin Lee, Christopher Gill and Xuan Zhang. “F-LEMMA: Fast learning-based energy management for multi-/many-core processors,” *IEEE Transactions on Computed-Aided Design of Integrated Circuits and Systems (TCAD)*, 42(2):616-629, May 2022.
3. Yuhao Li and Benjamin Lee. “Phronesis: Efficient performance modeling for high-dimensional configuration tuning,” *ACM Transactions on Architecture and Code Optimization (TACO)*, 19(4), September 2022.
4. Atefeh Mehrabi, Aninda Manocha, Benjamin C. Lee, Daniel J. Sorin. “Bayesian optimization for efficient accelerator synthesis,” *ACM Transactions on Architecture and Code Optimization (TACO)*, 18(1):4:1-4:25, December 2020.
5. Seyed Majid Zahedi, Benjamin C. Lee. “A win for game theory in the data center,” *IEEE Spectrum*, April 2020.
6. Yuhao Li, Dan Sun, Benjamin C. Lee. “Dynamic colocation policies with reinforcement learning,” *ACM Transactions on Architecture and Code Optimization (TACO)*, 17(1):1:1-1:25, March 2020.
7. Songchun Fan*, Seyed Majid Zahedi*, Benjamin C. Lee. “Distributed strategies for computational sprints,” *Communications of the ACM (CACM), Research Highlight*, 62(2):98-106, February 2019. *Equal Contributions.
8. Rupert Freeman*, Seyed Majid Zahedi*, Vincent Conitzer, Benjamin C. Lee. “Dynamic proportional sharing: A game-theoretic approach.” *Proc. of the ACM on Measurement and Analysis of Computing Systems (POMACS)*, 2(1):3:1–3:36, June 2018. *Equal Contributions.
9. Pengfei Zheng and Benjamin C. Lee “Hound: Causal learning for datacenter-scale straggler diagnosis.” *Proc. of the ACM on Measurement and Analysis of Computing Systems (POMACS)*, 2(1):17:1–17:36, June 2018.
10. Seyed Majid Zahedi, Songchun Fan, Benjamin C. Lee. “Managing heterogeneous datacenters with tokens.” *ACM Transactions on Architecture and Code Optimization (TACO)*, 15(2):18:1–18:23, June 2018.
11. 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.
12. Benjamin C. Lee. “Datacenter design and management: A computer architect’s perspective,” *Synthesis Lectures on Computer Architecture*, 11(1):1-121, February 2016.
13. 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.

14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.
20. 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.
21. 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

22. Haiyang Huang, Newsha Ardalani, Anna Sun, Liu Ke, Shruti Bonsale, Anjali Sridhar, Hsien-Hsin Lee, Carole-Jean Wu, Benjamin C. Lee. "Toward efficient inference for mixture of experts" *Conference on Neural Information Processing Systems (NeurIPS)*, 2024.
23. Jiali Xing, Benjamin C. Lee. "Datacenter demand response for carbon mitigation: From concept to practicality." *Proc. International Conference on Green and Sustainable Computing (IGSC)*, October 2024.
24. Benjamin C. Lee, David Brooks, Arthur van Benthem, Udit Gupta, Gage Hills, Vincent Liu, Linh Thi Xuan Phan, Benjamin Pierce, Christopher Stewart, Emma Strubell, Gu-Yeon Wei, Adam Wierman, Yuan Yao, Minlan Yu. "Carbon Connect: An ecosystem for sustainable computing." *arXiv:2405.13858 [cs.DC]*, August 2024.
25. Leo Han, Jash Kakadi, Benjamin C. Lee, Udit Gupta. "Towards game-theoretic approaches to attributing carbon in cloud data centers." *Proc. Workshop on Sustainable Computer Systems (HotCarbon)*, July 2024.

26. Jiaxun Cui, Xiaomeng Yang*, Geunbae Lee*, Mulong Luo*, Peter Stone, Hsien-Hsin Lee, Benjamin Lee, G. Edward Suh, Wenjie Xiong**, Yuandong Tian**. “MACTA: A multi-agent reinforcement learning approach for cache timing attacks and detection.” *Proc. International Conference on Learning Representations (ICLR)*, May 2023. *Equal 2nd Authors, **Equal Advisors.
27. Yuhao Li, Abhishek Gupta, Alex Yang, Peinan Chen, Benjamin Lee, Joey Pinto, Arun Kejariwal and Max Balandat. “HHVM performance optimization for large scale web services.” *Proc. International Conference on Performance Engineering (ICPE)*, April 2023.
28. Bilge Acun, Benjamin Lee, Fiodar Kazhamiaka, Kiwan Maeng, Udit Gupta, Manoj Chakkaravarthy, David Brooks, Carole-Jean Wu. “Carbon Explorer: A holistic framework for designing carbon aware datacenters.” *Proc. International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2023.¹
29. Carole-Jean Wu, Ramya Raghavendra, Udit Gupta, Bilge Acun, Newsha Ardalani, Kiwan Maeng, Gloria Chang, Fiona Aga Behram, James Huang, Charles Bai, Michael Gschwind, Anurag Gupta, Myle Ott, Anastasia Melnikov, Salvatore Candido, David Brooks, Geeta Chauhan, Benjamin Lee, Hsien-Hsin S. Lee, Bugra Akyildiz, Maximilian Balandat, Joe Spisak, Ravi Jain, Mike Rabbat, Kim Hazelwood. “Sustainable AI: Environmental implications, challenges, and opportunities.” *Proc. of Machine Learning and Systems (MLSys)*, August 2022.
30. Bilge Acun, Benjamin C. Lee, Fiodar Kazhamiaka, Aditya Sundarrajan, Manoj Chakkaravarthy, Kiwan Maeng, David Brooks, Carole-Jean Wu. “Carbon dependencies in datacenter design and management.” *Proc. Workshop on Sustainable Computer Systems Design and Implementation (HotCarbon)*, July 2022.
31. Atefeh Mehrabi, Daniel J. Sorin, Benjamin C. Lee. “Spatiotemporal strategies for long-term FPGA resource management.” *Proc. International Symposium on Performance Analysis of Systems and Software (ISPASS)*, May 2022.
32. Jiali Xing, Max Demoulin, Konstantinos Kallas, Benjamin C. Lee. “Charon: A framework for microservice overload control.” *Proc. Workshop on Hot Topics in Networks (HotNets)*, November 2021.
33. Atefeh Mehrabi, Donghyuk Lee, Niladrish Chatterjee, Daniel J. Sorin, Benjamin C. Lee, Mike O’Connor. “Learning sparse matrix row permutations for efficient SpMM on GPU architectures.” *Proc. International Symposium on Performance Analysis of Systems and Software (ISPASS)*, March 2021.
34. An Zou, Karthik Garimella, Benjamin Lee, Christopher Gill and Xuan Zhang. “F-LEMMA: Fast Learning-based Energy Management for Multi/Many-core Processors.” *Proc. Workshop on Machine Learning for Computer Aided Design (MLCAD)*, November 2020.²
35. Atefeh Mehrabi, Aninda Manocha, Benjamin C. Lee, Daniel J. Sorin. “Prospector: Synthesizing efficient accelerators via statistical learning.” *Proc. Design Automation and Test in Europe (DATE)*, March 2020.
36. Ziqiang Huang, Jose Joao, Alejandro Rico, Andrew D. Hilton, Benjamin C. Lee. “DynaSprint: Microarchitectural sprints with dynamic utility and thermal management.” *Proc. International Symposium on Microarchitecture (MICRO)*, October 2019.

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

² Best Paper Nominee.

37. Songchun Fan, Theodoros Salonidis, Benjamin Lee. “Swing: Swarm computing for mobile sensing,” *Proc. International Conference on Distributed Computing Systems (ICDCS)*, July 2018.
38. Rupert Freeman*, Seyed Majid Zahedi*, Vincent Conitzer, Benjamin C. Lee. “Dynamic proportional sharing: A game-theoretic approach,” *Proc. International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS)*, June 2018. *Equal Contributions.
39. Pengfei Zheng and Benjamin C. Lee “Hound: Causal learning for datacenter-scale straggler diagnosis,” *Proc. International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS)*, June 2018.
40. Tamara Lehman, Andrew Hilton, Benjamin C. Lee. “MAPS: Understanding metadata access patterns in secure memory,” *Proc. International Symposium on Performance Analysis of Systems and Software (ISPASS)*, April 2018.³
41. Seyed Majid Zahedi*, Qiuyun Llull*, Benjamin C. Lee. “Amdahl’s Law in the datacenter era: A market for fair processor allocation,” *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2018.⁴ *Equal Contributions.
42. Qiuyun Llull, Songchun Fan, Seyed Majid Zahedi, Benjamin C. Lee. “Cooper: Task colocation with cooperative games,” *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2017.
43. Songchun Fan, Qiuyun Llull, Benjamin C. Lee. “Predicting sensory data and extending battery life for wearable devices,” *Proc. Workshop on Mobile Computing Systems and Applications (HotMobile)*, February 2017.
44. Tamara Silbergleit Lehman, Andrew D. Hilton, Benjamin C. Lee. “PoisonIvy: Safe speculation for secure memory,” *Proc. International Symposium on Microarchitecture (MICRO)*, October 2016.⁵
45. Songchun Fan, Theodoros Salonidis, Benjamin C. Lee. “A framework for collaborative sensing and processing of mobile data streams: Demo,” *Proc. International Conference on Mobile Computing and Networking (MobiCom)*, October 2016.
46. Ziqiang Huang, Andrew D. Hilton, Benjamin C. Lee. “Decoupling loads for nano-instruction set computers,” *Proc. International Symposium on Computer Architecture (ISCA)*, June 2016.
47. Songchun Fan*, Seyed Majid Zahedi*, Benjamin C. Lee. “The computational sprinting game,” *Proc. International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, April 2016.⁶ *Equal Contributions.
48. Songchun Fan, Benjamin C. Lee. “Evaluating asymmetric multiprocessing for mobile applications,” *Proc. International Symposium on Performance Analysis of Systems and Software (ISPASS)*, April 2016.

³ Best Paper Award.

⁴ Best Paper Award.

⁵ Top Picks (Honorable Mention) from Computer Architecture Conferences, IEEE Micro.

⁶ Best Paper Award; Top Picks (Honorable Mention) from Computer Architecture Conferences, IEEE Micro; Research Highlight, Communications ACM.

49. Benjamin C. Lee. "Applied statistical inference for system design and management," *Proc. International Conference on Computer Design (ICCD)*, October 2015.
50. Qiuyun Wang, Benjamin C. Lee. "Modeling communication costs in blade servers," *Proc. Workshop on Power-Aware Computing and Systems (HotPower) in conjunction with SOS-25*, October 2015.
51. Seyed Majid Zahedi, Benjamin C. Lee. "REF: Resource elasticity fairness with sharing incentives for multiprocessors," *Proc. International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2014.⁷
52. Marisabel Guevara, Benjamin Lubin, Benjamin C. Lee. "Strategies for anticipating risk in heterogeneous system design," *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2014.
53. 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.
54. 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.
55. Marisabel Guevara, Benjamin Lubin, Benjamin C. Lee. "Navigating heterogeneous processors with market mechanisms," *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2013.
56. Tae Jun Ham, Bharath K. Chelepalli, Neng Xue, Benjamin C. Lee. "Disintegrated control for power-efficient and heterogeneous memory systems," *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2013.
57. Krishna T. Malladi, Ian Shaeffer, Liji Gopalakrishnan, David Lo, Benjamin C. Lee, Mark Horowitz. "Rethinking DRAM power modes for energy proportionality," *Proc. International Symposium on Microarchitecture (MICRO)*, December 2012.
58. Weidan Wu, Benjamin C. Lee. "Inferred models for dynamic and sparse hardware-software spaces," *Proc. International Symposium on Microarchitecture (MICRO)*, December 2012.
59. Krishna T. Malladi, Karthika Periyathambi, Frank A. Nothaft, Benjamin C. Lee, Christos Kozyrakis, Mark Horowitz. "Towards energy-proportional datacenter memory with mobile DRAMs," *Proc. International Symposium on Computer Architecture (ISCA)*, June 2012.
60. 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. International Symposium on Computer Architecture (ISCA)*, June 2010.
61. 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. International Symposium on Computer Architecture (ISCA)*, June 2010.
62. Vijay Janapa Reddi, Benjamin C. Lee, Trishul Chilimbi, Kushagra Vaid. "Web search using mobile cores: Quantifying and mitigating the price of efficiency," *Proc. International*

⁷ Top Picks from Computer Architecture Conferences, IEEE Micro.

Symposium on Computer Architecture (ISCA), June 2010.⁸

63. Jeremy Condit, Edmund B. Nightingale, Christopher Frost, Engin Ipek, Benjamin Lee, Doug Burger, Derrick Coetzee. “Better I/O through byte-addressable, persistent memory,” *Proc. Symposium on Operating Systems Principles (SOSP)*, October 2009.⁹
64. Xiaoyao Liang, Benjamin C. Lee, Gu-Yeon Wei, David Brooks. “Design and test strategies for microarchitectural post-fabrication tuning,” *Proc. International Conference on Computer Design (ICCD)*, October 2009.¹⁰
65. Kristen Lovin, Benjamin C. Lee, Xiaoyao Liang, David Brooks, Gu-Yeon Wei. “Empirical performance models for 3T1D memories,” *Proc. International Conference on Computer Design (ICCD)*, October 2009.¹¹
66. Benjamin C. Lee, Engin Ipek, Onur Mutlu, Doug Burger. “Architecting phase change memory as a scalable DRAM alternative,” *Proc. International Symposium on Computer Architecture (ISCA)*, June 2009.¹²
67. Benjamin C. Lee, Jamison Collins, Hong Wang, David Brooks. “CPR: Composable performance regression for scalable multiprocessor models,” *Proc. International Symposium on Microarchitecture (MICRO)*, November 2008.¹³
68. Benjamin C. Lee. “Corporate social responsibility and the globalization of ‘local values,’” *St. Gallen Symposium: Global Capitalism – Local Values*, May 2008.
69. Benjamin C. Lee, David Brooks. “Efficiency trends and limits from comprehensive microarchitectural adaptivity,” *Proc. International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2008.
70. Benjamin C. Lee, David Brooks. “Roughness of microarchitectural design topologies and its implications for optimization,” *Proc. International Symposium on High Performance Computer Architecture (HPCA)*, February 2008.
71. Benjamin C. Lee. “Flattening the world efficiently: Digital sustainability for the twenty-first century,” *St. Gallen Symposium: The Power of Natural Resources*, May 2007.
72. 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. Symposium on Principles and Practice of Parallel Programming (PPoPP)*, March 2007.
73. Benjamin C. Lee, David Brooks. “Illustrative design space studies with microarchitectural regression models,” *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2007.
74. Benjamin C. Lee, David Brooks. “Accurate and efficient regression modeling for microarchitectural performance and power prediction,” *Proc. International Conference on Archi-*

⁸ Also Microsoft Technical Report MSR-TR-2009-105, August 2009.

⁹ Persistent Impact Prize, Non-volatile Memories Workshop (NVMW) 2020

¹⁰ Also Harvard University Computer Science Technical Report TR-06-08, December 2008.

¹¹ Also Harvard University Computer Science Technical Report TR-03-08, October 2008.

¹² Persistent Impact Prize, Non-volatile Memories Workshop (NVMW); Top Picks from Computer Architecture Conferences, IEEE Micro; Research Highlight, Communications ACM.

¹³ Best Paper Nomination.

tectural Support for Programming Languages and Operating Systems (ASPLOS), October 2006.

75. 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.
76. Yingmin Li, Benjamin C. Lee, David Brooks, Zhigang Hu, Kevin Skadron. “Impact of thermal constraints on multi-core architectures,” *Proc. Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronics Systems (ITHERM)*, May 2006.
77. Yingmin Li, Benjamin C. Lee, David Brooks, Zhigang Hu, Kevin Skadron. “CMP design space exploration subject to physical constraints,” *Proc. International Symposium on High-Performance Computer Architecture (HPCA)*, February 2006.
78. 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.
79. Benjamin C. Lee, Richard Vuduc, James Demmel, Katherine Yelick. “Performance models for evaluation and automatic tuning of symmetric sparse matrix-vector multiply,” *Proc. International Conference on Parallel Processing (ICPP)*, August 2004.¹⁴
80. Richard Vuduc, James Demmel, Katherine Yelick, Shoaib Kamil, Rajesh Nishtala, Benjamin C. Lee. “Performance optimizations and bounds for sparse matrix-vector multiply,” *Proc. International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*, November 2002.¹⁵

Dissertations

81. Benjamin C. Lee. “Statistical inference for efficient microarchitectural analysis,” *Ph.D. Dissertation, Harvard University*, May 2008.¹⁶

Preprints and Technical Reports

82. Jiali Xing, David Fischer, Nitya Labh, Ryan Piersma, Benjamin C. Lee, Yu Amy Xia, Tuhin Sahai, Vahid Tarokh. “Talaria: A Framework for Simulation of Permissioned Blockchains for Logistics and Beyond,” *arXiv, 2103.02260 [cs.CR]*, March 2021.

Invited Seminars

2024. Princeton University; Columbia University; University of Pennsylvania.

2023. NASDAQ TradeTalks; Architecture 2.0 Workshop; University of Pennsylvania, Kleinman Center for Energy Policy; S&P Global Podcast; Princeton University; Microsoft Azure.

2022. The Pennsylvania State University; Lockheed Martin Advanced Technologies Lab; Samsung Memory Solutions Lab; Penn Wharton China Center; NSF Workshop on Redefining the Future of Computer Architecture from First Principles.

2021. Facebook AI Research.

2020. University of Pennsylvania.

¹⁴ Best Paper; Also UC Berkeley Technical Report UCB/CSD-03-1297, November 2003.

¹⁵ Best Student Paper Finalist.

¹⁶ Harvard University Nomination, ACM Doctoral Dissertation Award.

2019. Arm Research Summit Austin; AMD Research; NVIDIA Research; University of Pennsylvania.

2018. Yale University; Princeton University; Arm Research Summit Cambridge (UK); California Institute of Technology.

2017. Princeton University; Carnegie Mellon University; Massachusetts Institute of Technology; Qualcomm Research Raleigh.

2016. Arm Research Austin; Arm Research Summit Cambridge (UK); Microsoft Research Redmond; Texas Instruments Dallas.

2015. NSF Workshop on Exploiting Parallelism and Scalability; Samsung Memory Solutions Lab Milpitas; Tsinghua University; Chinese Academy of Sciences Beijing; North Carolina State University; University of California, Berkeley.

2014. Texas A&M University; University of Illinois Urbana-Champaign; University of Massachusetts Amherst; Georgia Institute of Technology; Google Mountain View; Intel Santa Clara; Microsoft Research Redmond; University of Michigan Ann Arbor; University of Wisconsin Madison; IBM T.J. Watson Research Center; Academia Sinica Taipei; National Taiwan University Taipei; Oak Ridge National Laboratory.

2013. University of Wisconsin Madison; VMware Palo Alto; Qualcomm Research Raleigh; Ghent University; Chinese Academy of Sciences Beijing; AMD Research Beijing; Peking University Beijing; Hong Kong University of Science & Technology; Shanghai Jiaotong University; IBM T.J. Watson Research Center, 2012

2012. DOE Workshop on Modeling and Simulation of Exascale Systems and Applications; NSF Workshop on a Community Supported Computer Architecture and Design Evaluation Framework; NSF Workshop on Cross-Layer Power Optimization and Management; NetApp Research Triangle Park.

2011. New Faculty Lecture Series, Duke University; IBM Research Triangle Park; University of North Carolina, Chapel Hill; Rambus Sunnyvale; IBM Austin Research Laboratory; Princeton University; North Carolina State University.

2010. University of California, Berkeley; Intel Corporation Santa Clara; Intel Corporation Hudson; Harvard University; Google, Mountain View; Lawrence Livermore National Laboratory; Stanford Pervasive Parallelism Lab (PPL) Retreat; University of California, Los Angeles; Princeton University; University of Southern California; Duke University.

2009. Stanford University; University of Texas at Austin; Swiss Federal Institute of Technology (ETH) Zurich; University of Rochester; Rutgers University; Northwestern University; University of Washington, Seattle; AMD Research Bellevue.

2008. Microsoft Research Redmond; IBM T.J. Watson Research Center.

2007. Intel Corporation Santa Clara; Intel Corporation Folsom; Intel Corporation Santa Clara.

2006. Lawrence Livermore National Laboratory.

Meeting Presentations

1. "Design for sustainable computing." *International Green and Sustainable Computing Conference*, November 3, 2024.
2. "AI and the environment: Sustaining the common good." *Markkula Center for Applied Ethics, Santa Clara University*, November 1, 2024.

3. "AI for sustainable datacenters." *PRECISE Industry Day*, October 4, 2024.
4. "Implications of artificial intelligence-related data center electricity use and emissions." *National Academies*, November 12-13, 2024.
5. "Sustainable computing for sustainability." *National Science Foundation*, August 16, 2024.
6. "DynaSprint: Microarchitectural sprints with dynamic utility and thermal management," *International Symposium on Microarchitecture (MICRO)*, October 2019.
7. "Economic mechanisms for managing risk in datacenters," *Workshop on Energy Secure Systems Architecture in conjunction with ISCA-41*, June 2014.
8. "Inferred models for dynamic and sparse hardware-software spaces," *45th IEEE/ACM International Symposium on Microarchitecture (MICRO)*, December 2012.
9. "Web search using mobile cores: Quantifying and mitigating the price of efficiency," *37th ACM International Symposium on Computer Architecture (ISCA)*, June 2010.
10. "Phase change memory: An architecture and systems perspective," *Workshop on Emerging Memory Technologies (EMT) in conjunction with ISCA-37*, June 2010.
11. "Mega-servers vs. micro-blades," *Workshop on Architectural Concerns in Large Data Centers (ACLD) in conjunction with ISCA-37*, June 2010.
12. "Emerging technologies," *International Symposium on Nanoscale Architectures (NANOARCH) in conjunction with DAC-47*, July 2009.
13. "Architecting phase change memory as a scalable DRAM alternative," *36th ACM International Symposium on Computer Architecture (ISCA)*, June 2009.
14. "Green – Energy efficient software and principled approximation," *Microsoft Research Techfest*, February 2009.
15. "CPR: Composable performance regression for scalable multiprocessor models," *41st IEEE International Symposium on Microarchitecture (MICRO)*, November 2008.
16. "Efficiency trends and limits from comprehensive microarchitectural adaptivity," *13th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, March 2008.
17. "Roughness of microarchitectural design topologies and its implications for optimization," *14th IEEE International Symposium on High Performance Computer Architecture (HPCA)*, February 2008.
18. "Methods of inference and learning for performance modeling of parallel applications," *12th ACM Symposium on Principles and Practice of Parallel Programming (PPoPP)*, March 2007.
19. "Statistical inference for efficient microarchitectural analysis," *Boston Area Architecture Workshop (BARC)*, January 2007.
20. "Illustrative design space studies with microarchitectural regression models," *13th IEEE International Symposium on High Performance Computer Architecture (HPCA)*, February 2007.

21. “Statistical inference for efficient microarchitectural and application analysis,” *IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*, November 2006.¹⁷
22. “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.
23. “Statistically rigorous regression modeling for the microprocessor design space,” *Workshop on Modeling, Benchmarking, and Simulation (MoBS) in conjunction with ISCA-33*, June 2006.
24. “Efficient design space exploration for chip multiprocessors,” *Harvard University, Industrial Partnership Annual Meeting*, October 2005.
25. “Effects of pipeline complexity on SMT/CMP power-performance efficiency,” *Workshop on Complexity Effective Design (WCED) in conjunction with ISCA-32*, June 2005.
26. “Performance models for evaluation and automatic tuning of symmetric sparse matrix-vector multiply,” *33rd International Conference on Parallel Processing (ICPP)*, August 2004.
27. “Optimizations and bounds for sparse symmetric matrix-vector multiply,” *SIAM Conference on Parallel Processing for Scientific Computing*, March 2004.
28. “Poster: Automatic performance tuning of sparse matrix kernels,” *SIAM Conference on Computational Science and Engineering*, February 2003.

Popular Press

1. Brianna Monsanto. “Microsoft is building wooden data centers to slash carbon emissions.” *IT Brew*, November 18, 2024.
2. “Microsoft’s nuclear deal could spark new market for AI power.” *PYMNTS*, September 25, 2024.
3. Kleinman Center for Energy Policy. ““Why AI consumes so much energy and what might be done about it.” *Energy Policy Now Podcast*, September 24, 2024.
4. Megan Crouse. “Sending one email with ChatGPT is the equivalent of consuming one bottle of water.” *Tech Republic*, September 20, 2024.
5. Sascha Brodsky. “AI agents evolve rapidly, challenging human oversight.” *IBM Blog*, August 13, 2024.
6. Joe McKendrick. “Artificial expectations? Time to get real about AI.” *Forbes*, July 23, 2024.
7. Jennifer Lee. “Global tech outage: South Jersey Boy Scout troop stuck overseas due to airline impact of outage.” *Fox29 Philadelphia*, July 21, 2024.
8. Allison Parshall. “What do Google’s AI answers cost the environment?” *Scientific American*, June 11, 2024.
9. Lucas Mearian. “AI chip shortages continue, but there may be an end in sight.” *Computer World*, May 7, 2024.

¹⁷ First Place, ACM Student Research Competition.

10. Sascha Brodsky. "Nscale offers AMD AI chips-as-a-service in green data center'." *Network World*, May 3, 2024.
11. Charlie Sorrel. "Apple's new on-device model is the future of AI." *Lifewire*, April 26, 2024.
12. Megan Crouse. "AI Sustainability: How Microsoft, Google Cloud, IBM and Dell are Working on Reducing AI's Climate Harms." *Tech Republic*, April 22, 2024.
13. Sarah Huffman. "Penn professor on gen AI's rapacious use of energy: 'One of the defining challenges of my career'" *Technical.ly*, April 22, 2024
14. Laura Bratton and Britney Nguyen. "Google and Intel are challenging Nvidia's AI chip dominance It won't be easy." *Quartz*, April 11, 2024.
15. John Mello. "Google joins Amazon, Microsoft with new Arm-based data center CPU, Axion." *Tech News World*, April 10, 2024.
16. Lucas Mearian. "Intel unveils its AI roadmap, chips to rival NVIDIA." *Computerworld*, April 9, 2024.
17. Mike De Socio. "Here's what the solar eclipse will do to all our solar panels." *CNET*, April 5, 2024.
18. Cat Clifford. "AI teeters between climate boom and energy burden." *Cipher*, March 20, 2024.
19. "Nvidia earnings expected to show domination of AI chip market." *PYMNTS*, February 21, 2024.
20. Ines Ferre. "Inflation: Why your electricity costs keep going up." *Yahoo Finance*, February 18, 2024.
21. Sascha Bordsky. "AI could devastate the environment, but help is on the way." *Tech Times*, February 7, 2024.
22. Jill Malandrino. "The state of the semiconductor chips market," *Nasdaq TradeTalks*, February 1, 2024.
23. Issie Lapowsky. "Inside AI's giant land grab." *Business Insider*, December 21, 2023.
24. Siddharth Garg et al. "Architecture 2.0 Workshop: How machine learning will redefine computer architecture and systems." *Computer Architecture Today*, December 20, 2023.
25. Molly Falanagan. "AI and environmental challenges." *Environmental Innovations Initiative*, November 30, 2023.
26. Paul Gillin. "Who will win the battle for AI in the cloud? Maybe everyone." *Silicon Angle*, November 24, 2023.
27. Sarah Wells. "Should data centers be kept cool – or warm?" *IEEE Spectrum*, November 16, 2023.
28. Cosmo Sanderson. "Will rampant AI's 'insatiable' thirst for power leave green energy trailing in its wake?" *Recharge News*, November 3, 2023.
29. S&P Global. "Artificial intelligence and cryptocurrency guzzle electricity, but can they also support the grid?" *Energy Evolution Podcast*, September 15, 2023.

30. Delger Erdenesanaa. "A.I. Could Soon Need as Much Electricity as an Entire Country," *The New York Times*, October 10, 2023.
31. Ines Ferre. "Energy consumption 'to dramatically increase' because of AI," *Yahoo Finance*, October 1, 2023.
32. Robert McMillan. "Data centers eye second raid on your cellphone," *Wired*, March 2013.
33. Rachel Courtland. "The battle between ARM and Intel gets real," *IEEE Spectrum*, May 2012.
34. John Hennessy and David Patterson. "Warehouse-scale computers to exploit request-level and data-level parallelism," *Computer Architecture: A Quantitative Approach*, 5th edition, pp. 471–475, 2012.
35. Charles Moore. "Power efficiency as the #1 design constraint," *Communications of the ACM (CACM), Technical Perspective*, 54(10):84, October 2011.
36. Mary Jane Irwin. "Technology scaling redirects main memories," *Communications of the ACM (CACM), Technical Perspective*, 53(7):98, July 2010.
37. "Microsoft paper proves Atom servers can succeed," PCMag.com. 23 April 2010.
38. James Hamilton. "Web search using small cores," Perspectives Blog, 27 September 2009.
39. "Energy-efficiency work reaps rewards," Microsoft Research News. 10 August 2009.
40. "Optimizing software to take advantage of PCM," Numonyx Software Article, July 2009.

Artifacts

1. Duke Hound: Statistical machine learning for diagnosing performance stragglers from datacenter traces. Analysis is implemented atop Spark for distributed computation. Analysis is demonstrated for production Google datacenter and Lenovo experimental system. (<https://www.seas.upenn.edu/~leebcc/software.html>)
2. 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. (<https://www.seas.upenn.edu/~leebcc/software.html>)
3. 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. (<https://www.seas.upenn.edu/~leebcc/software.html>)
4. 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. "Carbon Connect: An ecosystem for sustainable computing," Co-Director and Penn Principal Investigator with Harvard University (Lead), National Science Foundation Expedition, \$4.2M of \$12M to Penn, 2024-2029.
2. "Game theoretic electronic warfare," Principal Investigator, Lockheed Martin Corporation, \$125K, 2021-2022.
3. "Automated rapid certification of software (ARCOS)," Duke Principal Investigator with Johns Hopkins University, Applied Physics Laboratory (Prime), Defense Advanced Research Projects Agency, \$150K, 2020-2021.
4. "Statistical machine learning for systems management," Principal Investigator, Lenovo Research via NSF IUCRC, \$250K, 2019-21.
5. "Disaggregated data centers for energy efficiency," Principal Investigator, Samsung Research, \$100K, 2021.
6. "Center for alternative sustainable and intelligent computing (ASIC)," Co-Director with Yiran Chen (Director) and Hai Li, National Science Foundation IUCRC, \$750K, 2018-2023.
7. "Defense logistics agency (DLA)," Sr. Personnel with Vahid Tarokh (Duke PI) and with Raytheon Technologies (Prime), Defense Advanced Research Projects Agency, \$200K, 2020.
8. "Server architectures for distributed shared memory," Principal Investigator, Samsung Research via NSF IUCRC, \$50K, 2020.
9. "Dynamic power allocation and efficient system-on-chip scaling," Principal Investigator, Semiconductor Research Corporation, \$210K, 2018-2020.
10. "Coalitional game theory for co-locating software on shared hardware," Principal Investigator with Andrew Hilton (Co-PI), National Science Foundation, \$400K, 2015-2020.
11. "Multi-dimensional scheduling and resource allocation in datacenters," Co-Principal Investigator with Kamesh Munagala (PI) and Sungjin Im, National Science Foundation, \$959K, 2014-2020.
12. "Allocating heterogeneous datacenter hardware to strategic agents," Principal Investigator with Vincent Conitzer (Co-PI), National Science Foundation, \$700K, 2013-2019.
13. "Gigapixel cameras for ubiquitous surveying and environmental research," Co-Principal Investigator with David Brady (PI) et al., Duke University, \$50K, 2016.
14. "AWS research education grant," Principal Investigator, Amazon Web Services, \$3.5K, 2015-2016.
15. "NSF XPS workshop for exploiting parallelism and scalability," Co-Principal Investigator with Wuchun Feng (PI), National Science Foundation, \$85K, 2014-2015.

16. “The center for future architectures research,” Duke Principal Investigator with University of Michigan (Prime), Semiconductor Research Corporation and Defense Advanced Research Projects Agency, \$1M of \$28M to BCL, 2013-2017.
17. “CAREER: Foundations for heterogeneous datacenter design and deployment,” Principal Investigator, National Science Foundation, \$460K, 2012-2016.
18. “Pathfinding for emerging memory technologies,” Principal Investigator, Google Faculty Research Award, \$55K, 2011.
19. “Foundations for heterogeneous datacenter design and development,” Principal Investigator, Duke University Wannamaker Foundation, \$20K, 2011-2012.
20. “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.
21. “The Computing Innovation Fellows Project: Rethinking digital design,” Fellow with Mark Horowitz (Mentor), National Science Foundation, \$280K, 2009-2010.

**Research Advising
Doctoral**

Current

1. Akis Giannoukos, Computer and Information Science, 2022-.
2. Haiyang Huang, Computer Science (with Rudin), 2019-.
3. Jiali Xing, Computer and Information Science, 2020-.
4. William Meng, Electrical and Systems Engineering, 2022.
5. Ziqi Meng, Electrical and Systems Engineering, 2022-.

Alumni

6. Yuhao Li, Computer Science, 2022.
Machine learning for efficient and robust datacenter performance management
Software Engineer, Meta
7. Atefeh Mehrabi, Electrical and Computer Engineering (with Sorin), 2022
Design and management strategies for hardware accelerators
Computer Engineer, Microsoft
8. Pengfei Zheng, Computer Science, 2020
Artificial intelligence for understanding large and complex datacenters
Computing Innovation Fellow, University of Wisconsin, Madison
9. Ziqiang Huang, Electrical and Computer Engineering, 2019
Coordinating software and hardware design for performance under power constraints
Assistant Research Professor, University of Waterloo
10. Tamara Lehman, Electrical and Computer Engineering, 2019
Design strategies for efficient and secure memory
Assistant Professor, University of Colorado, Boulder
11. Seyed Majid Zahedi, Computer Science, 2018
Managing shared resources in the data center era: Computer architecture meets game theory
Assistant Professor, University of Waterloo
12. Qiuyun Wang, Electrical and Computer Engineering, 2017
Microeconomic models for managing shared datacenters
Software Engineer, Google

13. Songchun Fan, Computer Science, 2016
Towards energy-efficient mobile sensing: Architectures and frameworks for heterogeneous sensing and computing
Software Engineer, Google
14. Marisabel Guevara, Computer Science, 2014
Coordinating the design and management of heterogeneous datacenter resources
Software Engineer, Google

**Research Advising
Masters**

Alumni

1. Shuyue Wang, Computer and Information Science, 2024.
2. Dan Sun, Electrical and Computer Engineering, 2021.
3. Yunxing Zhang, Computer and Information Science, 2021.
4. Ankita Nayak, Electrical and Computer Engineering, 2019
Member of Technical Staff, Draper
5. Bryan Prosser, Computer Science, 2019.
6. Keerthana Jetty, Electrical and Computer Engineering, 2017.
Silicon Design Engineer, Microsoft
7. Zhiyu Zhang, Computer Science, 2016-17.
Software Engineer, Google
8. Henri Maxime Demoulin, Computer Science, 2014-16.
PhD Student, University of Pennsylvania
9. Weidan Wu, Electrical and Computer Engineering, 2014.
Software Engineer, Google
10. Xin Zhou, Electrical and Computer Engineering, 2014.
Software Engineer, Amazon Web Services
11. Yifan Zhang, Electrical and Computer Engineering, 2014.
Software Engineer, Cisco

**Research Advising
Undergraduate**

Current

1. Amanda Guan, Arts and Sciences, 2024-.
2. Atharv Awasthi, Computer Science, 2024-.
3. Khush Gupta, Computer and Information Science, 2024-.
4. Jash Kakadia, Computer and Information Science, 2024-.
5. Erica Wang, Computer and Information Science, 2023-.
6. Tianyi Wu, Computer and Information Science, 2022-.

University of Pennsylvania, Independent Study

7. Paul Loh, Computer and Information Science, 2023.
8. Justin Qiu, Computer and Information Science, 2023.
9. Nathaniel Hoaglund, Computer and Information Science, 2022.
10. Kevin Li, Computer and Information Science, 2021-22.
Associate, Citadel
11. Connor Anton, Systems Science and Engineering, 2020-21.

Duke University, Thesis with Departmental Distinction

12. Calvin Ma, Computer Science, 2018-20.
Time series analysis for straggler prediction
Technology Analyst, Goldman Sachs
13. Jacob Chasan, Computer Science and Economics, 2019.
Re-defining resource allocation in computing systems
Investment Banking Analyst, Goldman Sachs
14. Rahul Swaminathan, Electrical and Computer Engineering, 2016.
Yarn application statistics: Collecting, aggregating and visualizing big data metrics
Software Engineer, Appian
15. Paul Kim, Electrical and Computer Engineering, 2015.
Resource elasticity fairness in scale
Research Assistant, University of Chicago, Booth School of Business
16. Tae Jun Ham, Electrical and Computer Engineering, 2012.
Designing scalable heterogeneous memory for high-performance computing
PhD Student, Princeton University

Duke University, Independent Study

17. Ryan Piersma, Electrical and Computer Engineering, 2018-20.
PhD Student, Columbia University
18. Jerry Wang, Electrical and Computer Engineering, 2020.
19. Elizabeth Bartusiak, Computer Science, 2019-20.
20. Anshu Dwibhashi, Electrical and Computer Engineering, 2019-20.
21. Brian Nieves, Computer Science, 2018-19.
22. Vishnu Gottiparthi, Electrical and Computer Engineering, 2017-18.
23. David Tran, Computer Science, 2018.
24. Harry Xie, Computer Science, 2018.
25. Aninda Manocha, Electrical and Computer Engineering, 2017-18.
PhD Student, Princeton University
26. Dan Sun, Electrical and Computer Engineering, 2017-18.
PhD Student, Duke University
27. Hunter Lee, Electrical and Computer Engineering, 2016-17.
28. Elijah Cole, Electrical and Computer Engineering, 2016-17.
PhD Student, California Institute of Technology
29. Matthew Faw, Electrical and Computer Engineering, 2016-17.
PhD Student, University of Texas, Austin
30. Brian Zhou, Electrical and Computer Engineering, 2016-17.
31. Randall Johnson, Electrical and Computer Engineering, 2016.
Software Consultant, Red Hat
32. Stephen Hughes, Electrical and Computer Engineering, 2015.
33. Kevin Delgado, Electrical and Computer Engineering, 2015.
34. Michael Liou, Computer Science, 2015.
35. Justin Wang, Computer Science, 2015.
36. Justine Kim, Electrical and Computer Engineering, 2014-15.
PhD Student, Seoul National University
37. William Chang, Computer Science, 2014.

38. Lance Co Ting Keh, Electrical and Computer Engineering, 2014.
Software Engineer, Box
39. Zachary Michaelov, Electrical and Computer Engineering, 2014.
Software Engineer, TellApart
40. Nazia Tabassum, Electrical and Computer Engineering, 2013-14.
PhD Student, University of Virginia
41. Sam (Likun) Xi, Electrical and Computer Engineering, 2012-13.
PhD Student, Harvard University
42. John Cuffney, Electrical and Computer Engineering, 2012.
Software Engineer, Google
43. Michael Ansel, Electrical and Computer Engineering, 2011.
Systems Architect, NetApp

External Research Experience

44. Cecily Chase, Applied Mathematics, Brown University, 2018.
45. Abhimanyu Yadav, Computer Science and Engineering, IIT Kanpur, 2016.
MS Student, Columbia University
46. Stephanie Morris, Electrical and Electronics Engineering, University of Alabama, 2013.
47. Emily Bragg, Computer Engineering, Georgia Institute of Technology, 2012.
PhD Student, University of Texas, Austin
48. Casey Mackin, Electrical and Computer Engineering, University of Arizona, 2012.
PhD Student, University of California, Berkeley

Thesis Committees

Doctoral Students (University of Pennsylvania)

Heena Nagda (advisor B. Loo), Kelly Shiptoski (advisor J. Devietti), Liangcheng Yu (advisor V. Liu), Haoran Zhang (advisor V. Liu and S. Angel)

Doctoral Students (Duke University)

Mukesh Agrawal (advisor K. Chakrabarty), Sandeep Agrawal (advisor A. Lebeck), Fan Chen (advisor Y. Chen), Qing Duan (advisor K. Chakrabarty), Mahmoud Elfar (advisor M. Pajic), Rana Elnaggar (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), Vuk Lesi (advisor M. Pajic), Jiachen Mao (advisor Y. Chen), Opeoluwa Matthews (advisor D. Sorin), Kesari Mishra (advisor K. Trivedi), Mohammed Mottaghi (advisor C. Dwyer), Sean Murray (advisor D. Sorin), Ralph Nathan (advisor D. Sorin), Kent Nixon (advisor Y. Chen), Brandon Noia (advisor K. Chakrabarty), Jun Pang (advisor C. Dwyer), Wubin Pang (advisor D. Brady), Arjun Rallapalli (advisor C. Dwyer), Animesh Srivastava (advisor L. Cox), Chang Song (advisor H. Li), 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), Bonan Yan (advisor H. Li), Fangming Ye (advisor K. Chakrabarty), Xiaoyan Yin (advisor K. Trivedi), Meng Zhang (advisor D. Sorin), Xiangyu Zhang (advisor A. Lebeck), Tong Zhou (advisor K. Chakrabarty)

Masters Students (Duke University)

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

University of Pennsylvania, Philadelphia, PA

Professor, Electrical and Systems Engineering, 2020–.

- Introduction to Computer Systems (CIS 2400): S22, F23.
- Advanced Topics in Computer Architecture (CIS 6010): S23, F24.
- Datacenter Architecture (ESE 6650): F22, S24.
- Data Science for Cloud Computing (ESE 6800): S21.

Duke University, Durham NC

Professor, Electrical and Computer Engineering, 2010–20.

- Computer Architecture (ECE/CS 250): F19, F18, S18, F15, S14, S13.
- Advanced Computer Architecture I (ECE/CS 552): F17, F16, F12, F11
- Energy-Efficient Computer Systems (ECE/CS 590): F14, S12, F10
- Datacenter Architecture (ECE/CS 590): S20, S16, F13

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

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

Professional 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.

Journal Editorial Board

Associate Editor, Communications of the ACM, 2019–.

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).

Steering/Executive Committees

ASPLOS 2025–, Int’l Conf. Arch. Support for Prog. Lang. & Op. Sys.
TCuArch 2022–, Technical Committee on Microprogramming and Microarchitecture.
ISPASS 2017-22, Int’l Symp. Perf. Analysis of Systems & Software.

Conference General Chair

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

Conference Program Chair

ASPLOS 2026, Int’l Conf. Arch. Support for Prog. Lang. & Op. Sys.
ISPASS 2014, Int’l Symp. Perf. Analysis of Systems & Software.

Conference Program Committees

Int’l Symp. Computer Architecture (ISCA), 2017-18, ’19, ’21-24.
Int’l Symp. High Performance Computer Architecture (HPCA), 2012, ’15, ’18-19, ’21-22.
Int’l Symp. on Microarchitecture (MICRO), 2013, ’15, ’17, ’20-22.
Int’l Conf. Arch. Support for Prog. Lang. & Op. Sys. (ASPLOS), 2017, ’20, ’23-25.
USENIX Hot Carbon Workshop, 2023.
IEEE Micro Top Picks, 2016-19.
Design Automation and Test Europe (DATE), 2014-16.
Int’l Conf. Measurement & Modeling Comp. Sys. (SIGMETRICS), 2014.
Work. Power-Aware Computing & Systems (HotPower), 2013-14.
Int’l Conf. High Perf. Embedded Arch. & Compilers, 2013-14.
Int’l Symp. Perf. Analysis of Systems & Software (ISPASS), 2009-10, 2012-13.
Int’l Symp. Workload Characterization (IISWC), 2013-14.
Int’l Conf. Computer Design (ICCD), 2011-12
Int’l Parallel & Distributed Processing Symposium (IPDPS), 2012.
Int’l Conf. Supercomputing (ICS), 2011.

Conference Organizing Committees

Int’l Conf. Arch. Support for Prog. Lang. & Op. Sys. (ASPLOS), 2025.
Int’l Symp. Microarchitecture (MICRO), PhD Forum, 2023-24.
Int’l Symp. Microarchitecture (MICRO), 2012
Int’l Symp. Computer Architecture (ISCA), 2012
Work. Emerging Supercomputing Technologies (ICS), 2011
Int’l Symp. Perf. Analysis of Systems & Software (ISPASS), 2011
Int’l Symp. Microarchitecture (MICRO), 2010
Int’l Conf. Parallel Arch. & Compilation Techniques (PACT), 2010

External Review Committees

Int’l Conf. Arch. Support for Prog. Lang. & Op. Sys. (ASPLOS).

Int'l Symp. High Performance Computer Architecture (HPCA).
Int'l Symp. Computer Architecture (ISCA).
Int'l Symp. Low Power Electronics and Design (ISLPED).
Int'l Symp. Perf. Analysis of Systems & Software (ISPASS).
Int'l Symp. on Microarchitecture (MICRO).

Grant Reviews

Ministry of Education, Singapore Government, 2024.
National Science Foundation, Computer & Information Science & Engineering, 2022.
National Science Foundation, Computer & Information Science & Engineering, 2020.
Università della Svizzera Italiana, 2019.
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.

Academic Service

University of Pennsylvania

Associate Chair, Electrical and Systems Engineering, 2024-.
Faculty Panelist, University Disciplinary Hearings, 2024-.
Penn Environmental Sustainability Advisory Committee, 2024-.
SEAS Faculty Council (Chair), 2023-24.
SEAS Faculty Council, 2022-25.
ESE Faculty Search Committee, 2020-23.

University Service, Duke University

Provost's Academic Programs Committee (Vice-Chair), 2019-20.
Provost's Academic Programs Committee, 2017-19.
President's Council on Black Affairs, 2016-19.
University Judicial Board, 2016-18.
Faculty Diversity Task Force Implementation Committee, 2015-16.

Department Service, Duke University

Faculty Search Committee, 2019-20.
Faculty Search Committee (Chair), 2017-19.
Faculty Tenure Committee 2017-19.
Computer Engineering Curricular Group (Lead), 2017-18.
Faculty Tenure Committee (Chair), 2015-16.
Faculty Search Committee (Chair), 2015-16.
Graduate Diversity Committee, 2014-16.
Business Manager Search Committee, 2012.
Faculty Search Committee, 2012.