Mark D. Hempstead

Professor
Department of Electrical and Computer Engineering
Tufts University
Medford, MA 02155
Email: mark@ece.tufts.edu
Personal Website: https://sites.tufts.edu/tcal/people/prof-hempstead/
(Updated July 8, 2024)

Brief Description of Research Interests

Mark Hempstead is a Professor in the Department of Electrical and Computer Engineering at Tufts University. His research group, the Tufts Computer Architecture Lab, investigates methods to increase energy efficiency across the boundaries of circuits, architecture, and systems. His research has been applied to a range of platforms from embedded systems, IoT, chip multiprocessors, and high performance computing. Currently, they are exploring systems support for machine learning; design exploration of non-volatile memories; contention and memory management; thermal hotspots on chip; the security implications of the thermal-side channel; methods to automatically generate shared hardware accelerators from source code; privacy-aware databases; and quantum computer architecture or ion-trap systems. He leads an interdisciplinary effort applying engineering tools to human subject's research such as education. His group has published in several different research communities including high performance computer architecture, workload characterization, design automation, mobile-systems, embedded systems, quantum computing, and Internet-of-Things (IoT).

EDUCATION

PhD, Engineering Sciences, June 2009,
Harvard University, Cambridge MA
Academic Advisors: Prof. Gu-Yeon Wei and Prof. David Brooks (Co-Advised)
Dissertation: "Accelerator-Based Architectures for Wireless Sensor Network Applications"
Dissertation Committee: Prof. Gu-Yeon Wei, Prof. David Brooks, Prof. Margo Seltzer

S.M Engineering Sciences, June 2005
Harvard University, Cambridge MA

B.S. Computer Engineering, Summa Cum Laude, May 2003
Tufts University, Medford MA

HONORS, AWARDS AND MEMBERSHIPS

2023 ACM Senior Member
2023 IEEE Senior Member
2014 Drexel University Allen Rothwarf Award for Teaching Excellence
2014 Drexel College of Engineering Excellence in Research Award
2014 NSF CAREER Award
2012 HPCA Best Paper Nominee
2006 SRC Design Contest Winner
2002- Member Eta Kappa Nu Electrical Engineering Honor Society
2002- Member Tau Beta Pi Engineering Honor Society

Memberships: IEEE Senior Member, ACM, IEEE Computer Society, IEEE TCCA, ACM SIGARCH

WORK EXPERIENCE

Tufts University, Medford MA **Professor, Electrical and Computer Eng.** **2024 – present**
Professor, Computer Science, Secondary Appointment **2024 – present**
Promotion Approved by University Trustees February 6, 2024 and effective September 1st 2024.
Director of the Tufts Computer Architecture Lab.
Founding Director of the Tufts Masters Degree Program in Computer Engineering

Tufts University, Medford MA **Associate Professor, Electrical and Computer Eng.** **9/2015 – 8/2024**
Associate Professor, Computer Science, Secondary Appointment **9/2015 – 8/2024**

Facebook FAIR SysML, Cambridge MA and Menlo Park CA, **Research Scientist 7/2019-7/2020**
Research position while on sabbatical. Led research efforts in recommendation systems including software characterization, near-memory computing for recommendation systems and scheduling.

Drexel University, Philadelphia PA **Associate Professor** (with Tenure) **5/2015 – 8/2015**

Drexel University, Philadelphia PA **Junior Colehower Chair Assistant Professor** **1/2010 – 5/2015**
Developed a research program in power-aware computer architecture, low power circuit design, and power-aware systems. Research topics include energy-efficient microarchitecture, accelerator-based architectures, workload characterization, and power-agile computing. Re-imagined the both the undergraduate and graduate computer architecture sequences to include multi-core processing and power-aware. Winner of University wide teaching award and NSF CAREER award.

ARM Ltd., Cambridge UK	**Research Intern, PostDoc, R&D**	**7/2009 – 11/2009**
Harvard University, Cambridge MA	**Research Assistant**	**9/2003 – 6/2009**
Intel Corporation, Hudson MA	**Research Intern, VSSAD Group**	**5/2005 – 8/2005**

TEACHING EXPERIENCE

Tufts University

EE 25	Computer Organization	F'22, F'23
EE 126	Computer Engineering (Computer Architecture)	F'15, F'16, F'17, F'20, F'21, F'22, S'24
EE 156	Advanced Computer Architecture	S'16, S'18, S'19, S'21, S'22, S'23
EE 193/COMP 150	Introduction to Internet of Things	Fall 2016

At Drexel as Course Designer and Course Lead:

ECEC-414	High Performance Computing (UG)	Winter 2014, Spring 2012
ECEC-412	Modern Processor Design (UG)	Winter'15, Fall'13, Spring'13, W'12
ECEC-623	Adv. Parallel Computer Architecture (Grad)	Spring 2015, Sp'14, W'13, Sp'11
ECEC-622	Parallel Computer Architecture (Grad)	Winter 2011, Spring 2010
ECEC-621	High Performance Computer Architecture (Grad)	Winter'15, W'14, F'12, F'10, W '10
ECEC-690	Advanced Programming C/C++(Grad)	Fall 2014

At Drexel as Recitation Instructor:

ENGR-232	Dynamic Engineering Systems	Winter 2012
ECE-200	Digital Logic Design	Spring'15, Sp'14, F'13, Sp'12, F'11

Tufts University	**Lecturer**	
EE26	Digital logic systems	Spring 2009

Resident Tutor, Lowell House Harvard University – (9/2006 – 6/2009) Lived in an undergraduate residence. Responsible for the resident life of 35 undergraduates. Responsibilities also include academic advising.

FULL LENGTH PEER-REVIEWED JOURNAL, CONFERENCE PUBLICATIONS

Full Length Peer Reviewed Conference and Journal Publications	**Since 2015:**	23
(In Reverse Chronological Order)	**Total:**	36

1. Maziar Amiraski*, David Werner*, Alexander Hankin, Julien Sebot, Kaushik Vaidyanathan, Mark Hempstead. (*joint first authors), Boreas: A Cost-Effective Mitigation Method for Advanced Hotspots using Machine Learning and Hardware Telemetry; IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), April 2023.
2. Cesar Gomes, Xuesi Chen, Mark Hempstead, PInTE: Probabilistic Induction of Theft Evictions; The 2022 IEEE International Symposium on Workload Characterization (IISWC), November 2022.
3. L. Pentecost*, A. Hankin*, M. Donato, M. Hempstead, G. Y. Wei, and D. Brooks (*joint first authors), NVMExplorer: A Framework for Cross-Stack Comparisons of Embedded Non-Volatile Memory Solutions. The 28th IEEE International Symposium on High-Performance Computer Architecture (HPCA-28), April 2022.
4. Liu Ke, Udit Gupta, Mark Hempstead, Carole-Jean Wu, Hsien-Hsin Sean Lee, Xuan Zhang; Hercules: Heterogeneity-Aware Inference Serving for At-Scale Personalized Recommendation. The 28th IEEE International Symposium on High-Performance Computer Architecture (HPCA-28), April 2022.
5. Cesar Gomes, Maziar Amiraski, and Mark Hempstead; CASHT: Contention Analysis in Shared Hierarchies with Thefts. ACM Trans. Archit. Code Optim (TACO). 19, 1, Article 12 (March 2022), 27 pages. Also accepted for presentation at HiPEAC 2022.
6. Alexander Hankin*, David Werner*, Julien Sebot, Kaushik Vaidyanathan, Maziar Amiraski, Mark Hempstead. (*joint first authors); HotGauge: A Methodology for Characterizing Advanced Hotspots in Modern and Next Generation Processors. The 2021 IEEE International Symposium on Workload Characterization (IISWC), November 2021.
7. M. Lui, Y. Yetim, Ö. Özgür, Z. Zhao, S-Y Tsai, C-J Wu, M. Hempstead; Understanding Capacity-Driven Scale-Out Neural Recommendation Inference. IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), 2021. [Best Paper Nominee]
8. Parnian Mokri, Mark Hempstead; Early-stage Automated Accelerator Identification Tool for Embedded Systems with Limited Area. International Conference On Computer Aided Design (ICCAD) Nov. 2020.
9. Liu Ke, Udit Gupta, Carole-Jean Wu, Benjamin Cho, Mark Hempstead, Brandon Reagon, Xuan Zhang, David Brooks, Vikas Chandra, Utku Diril, Amin Firoozshahian, Bill Jia, Kim Hazelwood, Hsien-Hsin S. Lee, Meng Li, Bert Maher, Dheevatsa Mudigere, Maxim Naumov, Martin Schatz, Mikhail Smelyanskiy, Xiaodong Wang; RecNMP: Accelerating Personalized Recommendation with Near-Memory Processing. In Proceedings of The International Symposium on Computer Architecture (ISCA), June 2020.
10. Udit Gupta, Carole-Jean Wu, Xiaodong Wang, Maxim Naumov, Brandon Reagen, David Brooks, Bradford Cottel, Kim Hazelwood, Mark Hempstead, Bill Jia, Hsien-Hsin S. Lee, Andrey Malevich, Dheevatsa Mudigere, Mikhail Smelyanskiy, Liang Xiong, Xuan Zhang; The Architectural Implications of Facebook's DNN-based Personalized Recommendation. Proceedings of the IEEE International Symposium on High-Performance Computer Architecture (HPCA), February 2020.

11. Karthik Sangaiah, Michael Lui, Ragh Kuttappa, Baris Taskin and Mark Hempstead; SnackNoC: Processing in the Communication Layer, Proceedings of the IEEE International Symposium on High-Performance Computer Architecture (HPCA), February 2020.
12. A. Hankin, T. Shapira, K. Sangaiah, M. Lui, M. Hempstead; Evaluation of Non-Volatile Memory Based Last Level Cache Given Modern Use Case Behavior. IEEE International Symposium on Workload Characterization (IISWC). Nov 3-5, 2019.
13. Guru Prasad Srinivasa, Scott Haseley, Mark Hempstead, Geoffrey Challen; Quantifying Process Variations and Its Impacts on Smartphones. The International Symposium on Performance Analysis of Systems and Software (ISPASS), March 2019.
14. David Werner, Kyle Juretus, Ioannis Savidis and Mark Hempstead; Machine Learning on the Thermal Side-Channel: Analysis of Accelerator-rich Architectures. The 36th IEEE International Conference on Computer Design (ICCD), Oct 2018.
15. Michael Lui, Karthik Sangaiagh, Mark Hemsptead, Baris Taskin. Towards Cross-Framework Workload Analysis via Flexible Event-Driven Interfaces. The International Symposium on Performance Analysis of Systems and Software (ISPASS), April 2018.
16. K. Sangaiah, M. Lui, R. Jagtap, S. Diestelhorst, S. Nilakantan, A. More, B. Taskin, and M. Hempstead; SynchroTrace: Synchronization-aware Architecture-agnostic Traces for Light-Weight Multicore Simulation of CMP and HPC Workloads. ACM Transactions on Architecture and Code Optimization (TACO), March 2018.
17. Rizwana Begum, Guru Prasad Srinivasa, Geoffrey Challen, and Mark Hempstead; Algorithms for CPU and DRAM DVFS Under Inefficiency Constraints. The 34th IEEE International Conference on Computer Design (ICCD), Oct 2016.
18. Uncore RPD: Rapid Design Space Exploration of the Uncore via Regression Modeling. Karthik Sangaiah, Mike Liu, Siddharth Nilakantan, Baris Taskin, Mark Hempstead. In the IEEE/ACM International Conference on Computer-Aided Design (ICCAD). Oct 2015.
19. Rizwana Begum and Mark Hempstead; Power Agility Metrics: Measuring Dynamic Characteristics of Energy Proportionality. In the International Conference on Computer Design (ICCD). Oct 2015.
20. Rizwana Begum, Guru Prasad Srinivasa, Mark Hempstead and Geoffrey Challen; Energy-Performance Trade-offs on Energy-Constrained Devices with Multi-Component DVFS. In the IEEE International Symposium on Workload Characterization (IISWC), Oct 2015.
21. Siddharth Nilakantan, Karthik Sangaiah, Ankit More, Giordano Salvador, Baris Taskin, Mark Hempstead; SynchroTrace: Synchronization-aware Architecture-agnostic Traces for Light-Weight Multicore Simulation. In the IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), March. 2015.
22. Giordano Salvador, Siddharth Nilakantan, Ankit More, Baris Taskin, M. Hempstead, Effects of Non-determinism in Hardware and Software Simulation with Thread Mapping. 28th International Conference on VLSI Design and 14th International Conference on Embedded System Design 2015 (VLSID ES), Jan. 2015.
23. Siddharth Nilakantan, Scott Lerner, M. Hempstead, Baris Taskin; Can you trust your memory trace?: A comparison of memory traces from binary instrumentation and simulation. 28th International Conference on VLSI Design and 14th International Conference on Embedded System Design 2015 (VLSID ES), Jan. 2015.
24. Giordano Salvador, Siddharth Nilakantan, Ankit More, Baris Taskin, M. Hempstead; Static Thread Mapping for NoC CMPs via Binary Instrumentation Traces32nd IEEE International Conference on Computer Design 2014 (ICCD), Oct. 2014.
25. Steven Battle, and Mark Hempstead; Register Allocation and VDD-gating algorithms for Out-of-Order Architectures. International Conference on Computer Design (ICCD). Oct 2013.
26. Steven Battle, and Mark Hempstead; Characterizing the Costs and Benefits of Hardware Parallelism in Accelerator Cores. International Conference on Computer Design (ICCD). Oct 2013.

27. Siddharth Nilakantan, Mark Hempstead; Platform-independent characterization of function-level communication in workloads using Dynamic Binary Instrumentation. In 2013 IEEE International Symposium on Workload Characterization (IISWC). Sept 2013.
28. Steven Battle, Andrew Hilton, Mark Hempstead, Amir Roth. Flexible Register Management using Reference Counting. International Symposium on High Performance Computer Architecture (HPCA). Feb 2012 [Best Paper Nominee]
29. Mike Lyons, Mark Hempstead, David Brooks, Gu-Yeon Wei; The Accelerator Store Framework for High-Performance, Low-Power Accelerator-based Systems. ACM Transactions on Architecture and Code Optimization (TACO). Also Invited Presentation at HiPEAC, Paris France. January, 2012.
30. Siddharth Nilakantan, Srikanth Annangi, Nikhil Gulati, Karthik Sangaiah and Mark Hempstead; Evaluation of an Accelerator Architecture for Speckle Reducing Anisotropic Diffusion. International Conference on Compilers, Architecture, and Synthesis for Embedded Systems (CASES). Taipei, Taiwan, October 2011.
31. Mark Hempstead, Gu-Yeon Wei, and David Brooks; An Accelerator-Based Wireless Sensor Network Processor in 130 nm CMOS. IEEE Transactions on Emerging and Selected Topics in Circuits and Systems (JETCAS). Vol. 1, Num 2. June 2011.
32. Mark Hempstead, Gu-Yeon Wei and David Brooks; Architecture and Circuit Techniques for Low-Throughput, Energy-Constrained Systems Across Technology Generations. In Proceedings of the International Conference On Compilers, Architecture, And Synthesis For Embedded Systems (CASES). Seoul South Korea. October 2006.
33. Qin Wang, Mark Hempstead, and Woodward Yang; A Realistic Power Consumption Model for Wireless Sensor Network Devices, In Proceedings of the Third Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON). Reston, VA, September 2006.
34. Yingmin Li, Mark Hempstead, Patrick Mauro, David Brooks, Zhigang Hu, Kevin Skadron; Power and Thermal Effects of SRAM vs. Latch-Mux Design Styles and Clock Gating Choices. In Proceedings of the International Symposium on Low Power Electronics and Design (ISLPED'05), San Diego, CA, August 2005.
35. Mark Hempstead, Nikhil Tripathi, Patrick Mauro, Gu-Yeon Wei, and David Brooks; An Ultra Low Power System Architecture for Wireless Sensor Network Applications, In Proceedings of the 32nd International Symposium on Computer Architecture (ISCA), Madison, WI, June 2005.
36. Victor Shnayder, Mark Hempstead, Bor-rong Chen, Geoff Werner-Allen, and Matt Welsh; Simulating the Power Consumption of Large-Scale Sensor Network Applications, In Proceedings of the Second ACM Conference on Embedded Networked Sensor Systems (SenSys'04), Baltimore, MD, November 2004.

WORKSHOP AND INVITED PUBLICATIONS (PEER-REVIEWED)

Short Peer-Reviewed Conference and Workshop Publications **Since 2015:** 19
(In Reverse Chronological Order) **Total:** 28

1. Cesar Gomes, Mark Hempstead, CInC: Workload Characterization In Context of Resource Contention. Poster Paper. The IEEE International Symposium on Workload Characterization (IISWC), Oct 2023.
2. Alexander Hankin; Abdulrahman Mahmoud; Mark Hempstead; David Brooks, Gu-Yeon Wei. VelociTI: An Architecture-level Performance Modeling Framework for Trapped Ion Quantum Computers. Poster Paper. The IEEE International Symposium on Workload Characterization (IISWC), Oct 2023.
3. Parnian Mokri, Mark Hempstead; Fingerprinting Workloads for Reconfigurable Shared Accelerators, Proc. Work-In-Progress (WiP) at ACM/IEEE Design Automation Conference (DAC), June 2022
4. A. Hankin and M. Hempstead. Proposal for a Timing Model of Ion Trap Quantum Architectures, I too can Quantum! (I2Q) at ISCA 2021. Best project award winner.
5. GP Srinivasa, D Werner, M Hempstead, G Challen; Thermal-Aware Overclocking for Smartphones. Poster Paper. IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), 2021.
6. Parnian Mokri and Mark Hempstead. Improving HLS with Shared Accelerators: A Retrospective. Workshop on Languages, Tools, and Techniques for Accelerator Design (LATTE), April 2021.

7. A. Hankin, M. Amiraski, K. Sangaiah, and M. Hempstead, Toward Faster and More Efficient Training on CPUs Using STT-RAM-based Last Level Cache. 12th Annual Non-Volatile Memories Workshop (NVMW), San Diego, CA, USA, March 2021.
8. Parnian Mokri and Mark Hempstead; Early-stage Automated Identification Tool for Shared Accelerators. Poster Presentation. Field-Programmable Custom Computing Machines (FCCM2020), April 2020.
9. Cesar Gomes and Mark Hempstead; C2AFE:Capacity Curve Annotation and Feature Extraction for Shared Cache Analysis. Poster Presentation. The International Symposium on Performance Analysis of Systems and Software (ISPASS), April 2020.
10. Parnian Mokri, Maziar Amiraski, Yuelin Liu, and Mark Hempstead; Building Reconfigurable Shared Accelerators through Early-stage Automated Identification of Similar Hardware Implementations with Abstract Syntax TreesPoster Paper. In Proceedings of the 28th ACM/SIGDA International Symposium on Field-Programmable Gate Arrays, (FPGA), February 2020.
11. L. Ke, U. Gupta, C.-J. Wu, B. Cho, M. Hempstead, B. Reagan, X. Zhang, D. Brooks, V. Chandra, U. Diril, A. Firoozshahian, B. Jia, K. Hazelwood, H.-H. Sean Lee, M. Li, B. Maher, D. Mudigere, M. Naumov, M. Schatz, M. Smelyanskiy and X. Wang; RecNMP: Accelerating Personalized Recommendation with Near-Memory Processing Boston Area Architecture (BARC) Workshop, January 2020.
12. P. Mokri and M. Hempstead; Fingerprinting Coarse-Grained Reconfigurable Accelerators Using Data Movement and Structural Similarities in Applications, Boston Area Computer Architecture (BARC) Workshop, January 2018.
13. Cesar Gomes, Steven Battle, Siddarth Nilakantan, and Mark Hempstead; Cache Block Watermarking: Over-engineered and Underwhelming, In proceedings of the Workshop on Negative Outcomes, Post-mortems, and Experiences (NOPE) at MICRO, October 2017.
14. Guru Prasad Srinivasa, Rizwana Begum, Scott Haseley, Mark Hempstead, and Geoffrey Challen; Separated by Birth: Hidden Differences Between Seemingly-Identical Smartphone CPUs, In Proceedings of the 18th Workshop on Hot Topics in Mobile Computing Systems and Applications (HotMobile'17)
15. P. Mokri and M. Hempstead; ReconfASTs: Early-stage Identification of Reconfigurable Accelerators with Annotated Abstract Syntax Tree, Boston Area Architecture (BARC) Workshop, January 2017.
16. D. Werner, M. Hempstead, K. Juretus, and I. Daulagala; The Vulnerability of Specialized Architectures to Temperature Side-Channel Information Leakage, Boston Area Computer Architecture Workshop (BARC), Jan. 2016.
17. K. Sangaiah, B. Taskin, and M. Hempstead; Fast Multicore Simulation and Performance Analysis of HPC Applications with SynchroTrace, Boston Area Computer Architecture (BARC) Workshop, January 2016.
18. P. Mokri and M. Hempstead; Stockpile Of Accelerators: A Methodology To Increase Accelerators' Coverage, Boston Area Computer Architecture (BARC) Workshop, January 2016.
19. Cesar Gomes and Mark Hempstead; Combative Cache Efficacy Techniques: Analysis of cache replacement in the context of independent prefetching in last level cache. Poster. In the International Conference on Computer Design (ICCD). Oct 2015.
20. Trevor E. Carlson, Siddharth Nilakantan, M. Hempstead, Wim Heirman; Epoch Profiles: Microarchitecture-Independent Application Analysis and Microarchitectural Optimization. IEEE Computer Architecture Letters (CAL), Jan-July 2014.
21. Guru Prasad Srinivasa, Rizwana Begum, M. Hempstead, Geoffrey Challen; Prioritizing Energy Usage by Allocating Inefficiency, Appears in International Workshop on Mobile Computing Systems and Applications (HotMobile), Feb 2014.
22. A. More, S. Nilakantan, M. Hempstead, B. Taskin; Vertical Arbitration-free 3D NoCs. Proc. Work-In-Progress (WiP) at ACM/IEEE Design Automation Conference (DAC), June 2013
23. Siddharth Nilakantan, Steven Battle, and Mark Hempstead. Metrics for Early-Stage Modeling of Many-Accelerator Architectures. Computer Architecture Letters (CAL), 2012.
24. The Case for Power-Agile Computing, Geoffrey Challen, Mark Hempstead. USENIX Workshop on Hot Topics in Operating Systems (HotOS), May 2011.
25. Michael Lyons, Mark Hempstead, Gu-Yeon Wei, and David Brooks.The Accelerator Store framework for high-performance, low-power accelerator-based systems. Computer Architecture Letters (CAL) Nov 2010.

26. Mark Hempstead, Gu-Yeon Wei and David Brooks; Navigo: An early-stage model to study power-constrained architectures and specialization. ISCA Workshop on Modeling, Benchmarking, and Simulations (MoBS), June 2009.
27. Mark Hempstead, Gu-Yeon Wei and David Brooks; An accelerator-based wireless sensor network processor in 130nm CMOS. ISCA Workshop on Architectural Research Prototyping (WARP), June 2009.
28. TinyBench: The Case For A Standardized Benchmark Suite for TinyOS Based Wireless Sensor Network Devices, Mark Hempstead, David Brooks, and Matt Welsh. In Proceedings of the First IEEE Workshop on Embedded Networked Sensors (EmNets'04), Tampa FL November 2004.

INVITED PUBLICATIONS (PEER-REVIEWED)

Invited Publications **Since 2015:** 0
(In Reverse Chronological Order) **Total:** 6

1. An Accelerator-based Wireless Sensor Network Processor in 130nm CMOS," Invited paper. Mark Hempstead, Gu-Yeon Wei, and David Brooks. International Conference on Compilers, Architecture, and Synthesis for Embedded Systems (CASES-09), Grenoble, France, Oct. 2009.
2. Mark Hempstead, Gu-Yeon Wei, and David Brooks. System Design Considerations for Sensor Network Applications (Invited). International Symposium on Circuits and Systems (ISCAS). Seattle WA., May 2008. (Invited Session: Energy-Efficient Building Blocks for Ubiquitous Sensing)
3. Mark Hempstead, Michael J. Lyons, David Brooks and Gu-Yeon Wei. Survey of hardware systems for wireless sensor networks (Invited) ASP Journal of Low Power Electronics, Vol. 4., No. 1, April 2008.
4. Mark Hempstead, Gu-Yeon Wei, and David Brooks; Ultra Low Power System Architecture for Wireless Sensor Network Applications (Invited) . Nanoelectronic Devices for Defense & Security Conference (NANO-DDS). Washington D.C., June 2007.
5. Mark Hempstead, Xiaoyao Liang, Patrick Mauro, Gu-Yeon Wei, and David Brooks. Design and Implementation of An Ultra Low Power System Architecture for Wireless Sensor Network Applications (Design Contest), SRC Student Symposium – SoC design contest Phase 2, 1st place. Raleigh/Durham NC, October 2006.
6. Mark Hempstead, Xiaoyao Liang, Patrick Mauro, Gu-Yeon Wei, and David Brooks; Design and Implementation of An Ultra Low Power System Architecture for Wireless Sensor Network Applications (Design Contest), SRC Techcon – SoC design contest Phase 1, 2nd place. Portland, OR, October 2005.

PATENTS AND PENDING APPLICATIONS

Systems and methods for thermal side-channel analysis and malware detection
Mark Hempstead, David Werner, Eric Miller, Kyle Juretus, Ioannis Savadis
US Patent US11880463B2, January 2024

Computer memory module processing device with cache storage. Liu Ke, Xuan Zhang, Udit Gupta, WU Carole-Jean, Mark David Hempstead, Brandon Reagen, Hsien-hsin Sean Lee
US Patent 11,442,866, September 2022

Systems and Methods for Cache Analysis and Management. Cesar Gomes, Maziar Amiraski, and Mark Hempstead. US patent App 63/263,210, 2022.

PUBLIC SOFTWARE RELEASES

NVMExplorer: A Framework for Cross-Stack Comparisons of Embedded Non-Volatile Memory Solutions

Provides set of tools and memory models for application experts, system designers, and device experts to better understand, compare, and quantify the next generation of embedded memory solutions. Tools are available on Github and on the web, published first in HPCA 2022.
http://nvmexplorer.seas.harvard.edu/

HotGauge: A Methodology for Characterizing Advanced Hotspots in Modern and Next Generation Processors.
Opensource methodology for characterizing Hotspots in modern processors. The toolchain available on github and Zendo includes new validated processor and powermodels for 14nm, 10nm and 7nm process technology nodes. Scripts for hotspot Severity are included. The work was published at IISWC 2021.
https://sites.tufts.edu/tcal/publications/hotgauge/

PRISM Workload Characterization Tool
A flexible follow on to the Sigil Workload Characterization tool, PRSIM can be connected to a range of front-end instrumentation tools including Valgrind, Dymino Rio, and perf. This allows for the user to write a workload characterization once and then run on different tools.
Published in ISPASS 2018 and released to github March 2018.
https://github.com/VANDAL/prism

"Sigil Workload Profiling Tool for Communication Classification with Binary Instrumentation" On Git Hub with two major releases so far, 2014 and January 2015. http://dpac.ece.drexel.edu/current-research-projects/sigil/. Presented the tool at a public tutorial in conjunction with HPCA 2015, "Research Infrastructures for Accelerator-Centric Architectures" http://accelerator.eecs.harvard.edu/hpca15tutorial/

"SynchroTrace: Synchronization-aware Architecture-agnostic Traces for Light-Weight Multicore Simulation" repleased Spring 2015 in conjunction with the ISPASS 2015 presentation. Provides a tool chain and simulation methodology to collect and simulate multithreaded workloads.
https://sites.tufts.edu/tcal/research/synchrotrace/
https://github.com/VANDAL/SynchroTrace-gem5

RESEARCH FUNDING

CIRC: New: MemSysExplorer: Community Tools and Interfaces for Exploring and Evaluating Next-Generation Memory Systems. 7/1/2024 – 6/30/2027. **$1,772,466** National Science Foundation. (PI: Mark Hempstead, Co-PIs: Donato (Tufts), Wei (Harvard), Hills (Harvard), Pentecost (Amherst College)

Silicon hot spots Resulted SDC Identification & Mitigation Research. 6/1/2024, Gift. **$120,000.** Google. (PI: Mark Hempstead, Co-PI: Donato)

NSF Engineering Resource Center for Engineering Tools for Innovation and Research in Education (EnTIRE) 1/1/2021 – 12/31/2022. Tufts Springboard. **$50,000** (PI: Eric Miller, Co-PIs: Hammer and Hempstead)

"PCB Assurance using Thermal Side-Channel" 12/28/2020 – 8/31/2021. **$180,000.** Honeywell International, KCNSC, DoE.

"Planning Grant: Engineering Tools for Education Research (EnTER)" (PI: Hempstead, Co-PIs: Aeron, Hammer, Miller, Sonkusale, Thomas, Wendell) 9/1/2019 – 8/31/2021. **$100,000.** National Science Foundation.

"Convergence: RAISE: A Flexible Framework for Instrumented Learning Environments: Enhanced Learning Through Advanced Sensing, Processing, and Cognitive Technologies." (PI: Hempstead, Co-PIs: Aeron, Hammer, Miller, Sonkusale, Thomas, Wendell) 7/15/2019 – 7/31/2024. **$1,000,000.** National Science Foundation.

"Using Anomaly Detection Methods to Model and Prevent Hotspots." 5/30/2019 – 12/31/2023. **$400,000.** Intel and Google.

"Fast and Efficient Hardware Design Exploration through Memory-NoC Analysis for Multi-Core SoCs" 10/1/2014 – 9/30/2015. **$100,000.** Samsung GRO program: Next Generation Computing Ultra Low-Power Computing For Wearable IoT Devices.

"CSR: Medium: Collaborative Research: Architecture and System Support for Power-Agile Computing." 8/1/2014 – 7/31/2018. **$278,836** (Drexel Portion). National Science Foundation (NSF)

"CAREER: Combating Dark Silicon through Specialization: Communication-Aware Tiled Many-Accelerator Architectures" 2/1/2014 – 1/31/2021. **$470,000**. National Science Foundation (NSF)

"II-NEW: Testbed for High Performance Interconnects" Co-PI (PI is Baris Taskin) 10/1/2013 – 06/30/2019. **$700,000.** National Science Foundation (NSF)

"AfterBurner: Efficient Performance Scaling via Post-Retirement Processing" Subcontract. (PI is Milo Martin) 1/1/2013 – 8/31/2014. **$182,996**. University of Pennsylvania and National Science Foundation (NSF).

"Performance Estimation and Optimization of REDHAWK SDR Applications" PI. (Co-PIs Moshe Kam, Kapil Dandekar, and Jeremy Johnson) 1/1/2013 – 6/30/3015. Amount and Sponsor Confidential.

"SHF: Small: AfterBurner: Efficient Performance Scaling via Post-Retirement Processing" Co-PI (PI is Amir Roth at UPenn) 9/1/2010 – 12/31/2011. **$118,999** National Science Foundation (NSF).

PRESENTATIONS AND TALKS

5/2024	"Opportunities and Challenges: Selecting Next Generation Memory Technologies and the Threats of Thermal Hotspots" High End Computing Interagency Working Group, (NITRD) Program
6/2023	"Modeling and Mitigating On-Chip Thermal Hotspots" Intel Architecture
6/2022	"Modeling and Mitigating On-Chip Thermal Hotspots" IEEE HIR Thermal Workgroup
5/2022	"Modeling and Mitigating On-Chip Thermal Hotspots" Google
6/2019	"An Overview of the Tufts Computer Architecture Lab" Draper, Cambridge MA
5/2019	"Workload Characterization Tools For Every Need: From Architecture Agnostic Classification of Communication to Trace-based Simulation of Multi-Threaded Workloads." HPC Day
4/2019	"Workload Characterization Tools For Every Need: From Architecture Agnostic Classification of Communication and Identifying Shared Hardware Accelerators" Facebook, AI Infra Research Group
12/2016	"Combating Dark Silicon with Power-Agile Systems and Many-Accelerator Architectures", Tufts University Computer Science Colloquia

9/2015	"Combating Dark Silicon: It Takes a Village New Paradigms for Next Generation Power-Aware Computing," University at Buffalo
3/2015	"Combating Dark Silicon: It Takes a Village New Paradigms for Next Generation Power-Aware Computing," Tufts University
2/2015	"Combating Dark Silicon: It Takes a Village New Paradigms for Next Generation Power-Aware Computing," Northeastern University
10/2013	Keynote at ICCD Conference. "Combating Dark Silicon: It Takes a Village". Ashville NC.
4/2012	ISPASS FastPath Workshop Invited Speaker "Ultra-Low Power Computing with Accelerator-based Architectures"
10/2011	"Ultra-Low Power Computing with Accelerator-based Architectures", Drexel University CS Dept
4/2011	"From Sensor Networks to Accelerator-based Architectures" NCSU
11/2010	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Swarthmore College
9/2010	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Princeton University
4/2010	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Washington University, St. Louis
7/2009	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", ARM Ltd., Cambridge United Kingdom
6/2009	MOBS at ISCA, Austin Texas – "Navigo: An early-stage model to study power-constrained architectures and specialization"
6/2009	WARP at ISCA, Austin Texas – "An accelerator-based wireless sensor network processor in 130nm CMOS"
6/2009	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", University of Massachusetts Dartmouth
4/2009	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Columbia University
3/2009	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Bucknell University
1/2009	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Drexel University
10/2008	"Designing Ultra Low-Power Systems for Wireless Sensor Networks", Tufts University
5/2008	ISCAS Seattle WA – "System Design Considerations for Sensor Network Applications"
6/2007	NANO-DDS, Washington DC – "Ultra Low Power System Architecture for Wireless Sensor Network Applications"

10/2006 SRC Student Symposium, Raleigh/Durham NC – "Design and Implementation of An Ultra Low Power System Architecture for Wireless Sensor Network Applications"

10/2006 CASES, Seoul South Korea – "Architecture and Circuit Techniques for Low-Throughput, Energy-Constrained Systems Across Technology Generations"

10/2005 SRC Techcon, Portland OR – "Design and Implementation of An Ultra Low Power System Architecture for Wireless Sensor Network Applications"

6/2005 ISCA, Madison WI – "An Ultra Low Power System Architecture for Wireless Sensor Network Applications"

CURRENT STUDENTS

David Werner, PhD Candidate (Tufts ECE)
Michael Liu, PhD Candidate Drexel U. (advised by Baris Taskin at Drexel University)
Furkan Sarikaya, MS/PhD Student (Tufts ECE)
Duc Nguyen, PhD Student (Tufts ECE)

Qingwen Fu, MS Project 2023

Gabriel Sessions, Summer Undergraduate Research Student 2023

GRADUATED STUDENTS

Maziar Mehdizadeh Amiraski, PhD, May 2024, Tufts University
Parnian Mokri, PhD, May 2023, Tufts University
Cesar Gomes, PhD, Feb 2023, GEM Fellowship Winner, Tufts University
Alexander Hankin, PhD Feb 2022, Tufts University
Karthik Sangaiah, PhD Nov 2020, Drexel U. (advised by Baris Taskin), NSF GREP Fellowship
Guru Prasad, PhD, June 2019 (advised by Geoffery Challen at U. Buffalo/UIUC)
Rizwana Begum, Ph.D, June 2017. Drexel University
Steven Battle, Ph.D., June 2015. Drexel University
Siddharth Nilakantan, Ph.D., June 2015. Drexel University

Duc Nguyen, MS 2024, Tufts University (Project Advisor)
Hongyue Jin, MS 2023, Tufts University (Project Advisor)
Haiting Chan, MS 2021, Tufts University (Project Advisor)
Tomer Shapira, MS 2018, Tufts University (Project Advisor)
Alex Daniels, MS 2017, Tufts University. (Project Advisor)
Alexander Hankin, MS 2017, Tufts University. (Project Advisor)
Tara Watson, MS 2017, Tufts University. (Project Advisor)
Jason Palaszewski, M.S. Drexel University
Tianyun Zhang, M.S. Drexel University

Aleksandre "Sandro" Avaliani, Summer Undergraduate Research Student 2023
Sneha Shakya, Undergraduate Tufts Summer Scholars 2022
Ege Ozgul, Undergraduate Summer Student 2021
Hazel Leonard, Undergraduate Independent Study Student 2022-23
Xuesi "Kristen" Chen Independent Study Student 2021-22

Siqi "Jacky" Wang, Undergraduate Summer Student 2021
Daniel Ryaboshapka, Undergraduate Summer Student 2021
Haiting Chan, Undergraduate BEST Summer Student 2017
Diego Espinoza Rodriguez, Undergraduate BEST Summer Student 2017

UNIVERSITY SERVICE

2023-2026	Steering Committee Center for Engineering Education and Outreach (CEEO)
2017-	Founding Director, MS Program in Computer Engineering (Co-Chair)
2022-23	Search Committee, Computer Engineering (Member)
2022	Tufts School of Engineering OAC Committee Member
2022	Search Committee, School of Engineering Dean Search (Member)
2021	Search Committee, Computer Science Quantum Computing (Member)
2020	Search Committee, Computer Engineering (Member)
2018-2019	Search Committee Computer Engineering (Chair)
2017-2018	Search Committee Computer Engineering (Chair)
2017	Lecturer Search Committee (Chair)
2016	Tufts School of Engineering OAC Committee Member
2015	Drexel ECE Senior Design Taskforce Chair
2015-2014	Graduate Affairs Committee, ECE Department
2014	Department Chair Search Committee, Electrical and Computer Engineering
2014-2013	Distinguished Lecture Series in Computer Engineering Organizer
2013-2011	Computer Engineering Faculty Search Committee
2015-2011	ECE Senior Design Committee
2012	Computer Science Faculty Search Committee
2015-2012	Member of Academic Council and volunteer instructor for Drexel University Computing Academy (DUCA), a five week residential summer program for high school students.
2010	ECE Department Development Committee

PROFESSIONAL SERVICE AND REVIEWING ACTIVITY

Conference Organization:

1. Student Travel Grant Chair IISWC 2023
    a. Wrote an NSF Travel Grant, received 25K in travel funding, NSF Award # 2330213
2. Workshop Organizer, HotSpots Strike Back (HSSB) at ISCA 2022
3. Local Arrangements Chair, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2017
4. Registration Chair, IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), 2017
5. Technical Program Co-Chair, IEEE International Symposium on Workload Characterization (IISWC) 2016
6. Registration Chair, IEEE International Symposium on Performance Analysis of Systems and Software (ISPASS), 2015
7. Publications Chair, IEEE International Symposium on Workload Characterization (IISWC) 2014
8. Publications Chair, International Symposium on Performance Analysis of Systems and Software (ISPASS) 2014
9. Publications Chair, International Symposium on Performance Analysis of Systems and Software (ISPASS) 2013
10. Workshop Organizer, Accelerator Architectures for General-Purpose Computing: from a Hardware, System Software and Application Perspective with HPCA 2012

11. Publications Chair, International Symposium on Performance Analysis of Systems and Software (ISPASS) 2012
12. Publications Chair, International Symposium on Performance Analysis of Systems and Software (ISPASS) 2011

Conference Reviewer (Since 2010):

1. Program Committee, IEEE International Symposium on Computer Architecture (ISCA), 2024
2. Program Committee, IEEE International Symposium on Computer Architecture (ISCA), 2023
3. Program Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2023
4. External Review Committee, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2022
5. Program Committee, International Symposium on Performance Analysis of Systems and Software (ISPASS) 2022
6. Program Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2022
7. Program Committee, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2021
8. External Review Committee, IEEE International Symposium on Computer Architecture (ISCA), 2021
9. Program Committee, International Symposium on Performance Analysis of Systems and Software (ISPASS) 2021
10. External Review Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2021
11. External Review Committee, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2020
12. External Review Committee, IEEE International Symposium on Computer Architecture (ISCA), 2020
13. External Review Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2020
14. Program Committee, IEEE International Symposium on Workload Characterization (IISWC) 2019
15. External Review Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2019
16. External Review Committee, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2017
17. Technical Program Committee, 60th IEEE International Midwest Symposium on Circuits and Systems (MWSCAS) 2017
18. External Review Committee, IEEE International Symposium on Computer Architecture (ISCA), 2017
19. External Review Committee, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2016
20. External Review Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2016
21. Program Committee, IEEE International Conference on Computer Design (ICCD) 2015
22. External Review Committee, IEEE/ACM International Symposium on Microarchitecture (MICRO) 2015
23. Program Committee, International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD) 2015
24. Program Committee, IEEE International Conference on Compilers, Architectures, and Synthesis of Embedded Systems (CASES 2015).
25. Program Committee, IEEE International Conference on Networking, Architecture, and Storage, (NAS) 2015
26. External Review Committee, IEEE International Symposium on Computer Architecture (ISCA), 2015
27. External Review Committee, IEEE International Symposium on High Performance Computer Architecture (HPCA), 2015
28. Program Committee, International Conference on Compilers, Architectures and Synthesis of Embedded Systems (CASES) 2014
29. Program Committee, IEEE International Symposium on Workload Characterization (IISWC) 2013
30. Program Committee, Workshop Computer Architecture and Operating System Co-design (CAOS) 2012

Grant Proposal Panel Reviewer:

1. 2024 One NSF Panel
2. 2022 NSF Adhoc Review
3. 2018 One NSF Panel
4. 2015 One NSF Panel
5. 2014 One NSF Panel
6. 2013 One NSF Panel

Journal Reviewer (Since 2010):

1. 2022 Transactions on Components, Packaging and Manufacturing Technology
2. 2022 ACM Transactions on Architecture and Code Optimization (TACO)
3. 2020 ACM Transactions on Architecture and Code Optimization (TACO)
4. 2017 ACM Transactions on Architecture and Code Optimization (TACO)
5. 2017 IEEE Transactions on Multi-Scale Computing Systems (TMSCS)
6. 2016 ACM Transactions on Architecture and Code Optimization (TACO)
7. 2015 IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)
8. 2015 ASP Journal of Low Power Electronics (JOLPE)
9. 2014 Computer Architecture Letters (CAL)
10. 2014 ACM Transactions on Architecture and Code Optimization (TACO)
11. 2013 IEEE Transactions on Computers (ToC)
12. 2013 ACM Transactions on Architecture and Code Optimization (TACO)
13. 2013 IEEE Micro
14. 2013 Computer Architecture Letters (CAL)
15. 2012 IEEE Transactions on Computers (ToC)
16. 2012 ACM Transactions on Architecture and Code Optimization (TACO)
17. 2011 HPCA Workshop on Architectural Reliability (WRA)
18. 2011 IEEE Transactions on Computers
19. 2011 The International Journal of Computer and Telecommunications Networking (COMNET)
20. 2011 IEEE Journal on Emerging and Selected Topics in Circuits and Systems (JETCAS)
21. 2010 ACM Transactions on Architecture and Code Optimization (TACO)
22. 2010 IEEE Transactions on Wireless Communications
23. 2010 IEEE Transactions on Computers (ToC)
24. 2010 IEEE Transactions on CAD
25. 2010 ACM Transactions on Sensor Networks