Workshop on Sustainable and Performant Computing

7. March 2024
1300-1600
Room ITV-454, IT-bygget, Gløshaugen

Organizer: Magnus Jahre, IDI
Organized in collaboration with the IE faculty's strategic research areas on Energy Efficient Computing Systems (EECS)

1300-1330	**Invited talk: Performant and Sustainable Hardware for ML and ML for Design** *Professor Lizy Kurian John, University of Texas at Austin, USA* **Abstract:** The emerging machine learning (ML) applications put exploding demands on hardware systems, and it is important to deliver high throughput, low latency and low energy consumption, in order to sustain the thriving development of cognitive systems and applications. Designing performant and sustainable circuits and systems to enable, support, and harness the power of machine intelligence is important to keep the present momentum of intelligent systems is important. In this talk, I will describe some of our research on providing efficient hardware infrastructure for ML. In addition to designing systems for ML, we also conduct research on using ML in designing and evaluating systems. In this talk I'll describe a few examples on using ML for pre-silicon performance evaluation during design of computer systems.
1330-1340	Break
1340-1410	**Invited talk: High Performance CPU Front-End Server Microarchitecture** *Dr. Gilles Pokam, Intel, USA* **Abstract:** The compute demands of the future data center will increase, driven primarily by user and data growth and increased software complexity. These changes are already causing the industry to rethink the architecture of next-generation servers by optimizing the server CPU to meet the demands of data center applications. In this talk, I will describe the strain that these data center applications place on a processor core's instruction delivery mechanisms and discuss new avenues to address this problem in front-end caching.
1410-1420	Break
1420-1450	**Invited talk: Sustainable Computer Systems** *Professor Lieven Eeckhout, Ghent University, Belgium* **Abstract:** Sustainability and climate change is a major challenge for our generation. In this talk I will argue that sustainable development requires a holistic approach and involves multi-perspective thinking. Applied to

	computing, sustainable development means that we need to consider the entire environmental impact of computing, including raw material extraction, component manufacturing, product assembly, transportation, use, repair/maintenance, and end-of-life processing (disassembly and recycling/reuse). Analyzing current trends reveals that the embodied footprint is, or will soon be, more significant compared to the operational footprint. I will present a simple, yet insightful, first-order model to assess and reason about the sustainability of computer systems in light of the inherent data uncertainty. Applying the model to a variety of case studies illustrates what computer architects and engineers can and should do to better understand the sustainability impact of computing, and to design sustainable computer systems.
1450-1500	Break
1500-1530	**Invited talk: Ultra Low Energy Computation Methods for Implantable Cardiac Devices** *Professor Eugene B. John, University of Texas at San Antonio, USA* **Abstract:** The next generation implantable cardiac devices are expected to evolve into smart connected devices, in sync with the ubiquitous trend of smart appliances. However, the path to future smart cardiac devices has major challenges that must be addressed. The nature of the application inherently makes the cardiac devices extremely resource constrained with mission critical functional specifications that must be met. Power consumption and functional reliability are the primary factors that govern the design of a cardiac device's system architecture. Although existing low-power design techniques are efficient and are regularly utilized in modern cardiac devices to meet those goals, they fall short when it comes to solving the computational challenges anticipated in a smart and connected cardiac device. Our research aims to develop ultra-low energy computation methods and design methodologies that can enable future cardiac devices to become a reality. By analyzing the existing and the anticipated new computational workloads of a smart cardiac device, innovative and scalable power-saving design techniques are presented.

Speaker bios

Lizy Kurian John is Truchard Foundation Chair in Engineering at the University of Texas at Austin. She received her Ph. D in Computer Engineering from the Pennsylvania State University. Her research interests include workload characterization, performance evaluation, memory systems, reconfigurable architectures, and high-performance architectures for emerging workloads. She is the recipient of many awards including Joe J. King Professional Engineering Achievement Award (2023), The Pennsylvania State University Outstanding Engineering Alumnus Award (2011), the NSF CAREER award, UT Austin Engineering Foundation Faculty Award, Halliburton, Brown and Root Engineering Foundation Young Faculty Award, University of Texas Alumni Association (Texas Exes) Teaching Award, etc. She has coauthored books on Digital Systems Design using VHDL (Cengage Publishers, 2007, 2017), a book on Digital Systems Design using Verilog (Cengage Publishers, 2014) and has edited 4 books including a book on Computer Performance Evaluation and Benchmarking. She served as the Editor-in-Chief of IEEE Micro from 2019-2023. She holds 16 US patents and is an IEEE Fellow, ACM Fellow and Fellow of the National Academy of Inventors (NAI).

Dr. Gilles Pokam is a Senior Principal Engineer at Intel. Prior to joining Intel, Gilles was a postdoctoral researcher at UCSD and a researcher at the IBM T.J. Watson Research Center in NY. His research focuses on microarchitecture and its interactions with system software and security. Dr. Pokam is currently leading efforts to develop next-generation CPU microarchitectures to improve the performance, energy efficiency, and security of emerging data center workloads. Dr. Gilles Pokam holds a Ph.D. in Computer Science from INRIA (France). He holds more than 30 patents and has authored more than 50 papers at leading conferences on microarchitecture and system software. Gilles is a two-time recipient of the IEEE Top Pick Award, which recognizes the year's most significant publications with the greatest impact on the industry. Gilles' research was also selected in 2023 for inclusion in the ISCA@50 25-year Retrospective as one of the most notable ISCA papers of the past 25 years. Gilles is a member of the MICRO Hall of Fame.

Lieven Eeckhout (PhD 2002) is a Senior Full Professor at Ghent University, Belgium. His research interests include computer architecture and the hardware/software interface, with specific emphasis on performance evaluation and modeling, dynamic resource management, CPU/GPU microarchitecture, and sustainability. He is the recipient of the 2017 ACM SIGARCH Maurice Wilkes Award and the 2017 OOPSLA Most Influential Paper Award, and he was elevated to IEEE Fellow in 2018 and ACM Fellow in 2021. He served as Program Chair for ISCA 2020, HPCA 2015, CGO 2013 and ISPASS 2009; Editor-in-Chief for IEEE Micro (2015-2018); and technical program committee member for 50+ computer architecture conferences. He is the recipient of five European Research Council (ERC) grants, including a Starting Grant, an Advanced Grant and three Proof-of-Concept Grants.

Eugene B. John received his Ph.D. in Electrical Engineering from Pennsylvania State University. He is currently a Professor in the Department of Electrical and Computer Engineering at the University of Texas at San Antonio. His research interests include, Energy Efficient Computing, Ultra-Low Energy Computing for Implantable Cardiac Devices, Hardware Architectures for Machine Learning and Artificial Intelligence, Computer Architecture, Computer Performance

Analysis, Power-Aware and Secure Systems, and Low Power Integrated Circuits and Systems. He has over 160 publications and seven U.S. patents. He was inducted into the National Academy of Inventors (NAI) in 2022. He is a recipient of the University of Texas System Regents' Outstanding Teaching Award. He served as an Associate Editor for IEEE Transactions on Sustainable Computing (2019-2023) and is currently serving as an Associate Editor for the ACM Computing Surveys.