

IGSC 2020 Special Session

ML for Energy-Efficient System Design

Advanced computing systems have long been a fundamental driver in pioneering applications and technology. However, post-Moore's Law, this has been increasingly achieved through more complex systems such as growing heterogeneity, system size, and emerging technologies. This has made it challenging to design these systems using conventional solutions. To combat these issues, machine learning has been seen as a potential facilitator to allow intelligent systems to analyze past experiences and make better future decisions. This special session brings together two talks to discuss potential opportunities and solutions of machine learning for energy-efficient system design.

Talk 1: Self-aware Memory Management for Emerging Energy-efficient Architectures

Speaker: Nikil Dutt, Departments of Computer Science, Cognitive Sciences, and EECS, University of California, Irvine (dutt@uci.edu)

Abstract: With the advent of GPUs and application-specific accelerators in embedded platforms, data-intensive applications have exacerbated the memory performance and energy bottleneck. Memory requirements and usage patterns vary widely in emerging architectures, and resource contention manifests differently based on the instance of the architecture. Due to the fast-evolving landscape of computer hardware as well as applications, workload-specific and system-specific optimizations for energy-efficient architectures is impractical. To systematically solve this challenge, we deploy computational self-awareness principles, where intelligent systems learn from past experiences and can reason with the gained knowledge before making decisions. We discuss how self-awareness properties can be applied to design an energy-efficient memory subsystem and the different degrees of self-awareness such a system can achieve. Preliminary findings obtained by applying these principles on approximate memory systems yield energy savings of 10.5% for on-chip L1 cache. We believe this is a rich area for research and outline some future opportunities for using self-awareness in emerging energy-efficient architectures.



Speaker Biography: Nikil Dutt is a Distinguished Professor of CS, Cognitive Sciences, and EECS at the University of California, Irvine, and also a Distinguished Visiting Professor of CSE at IIT Bombay, India. He received a PhD from the University of Illinois at Urbana-Champaign (1989). His research interests are in embedded systems, EDA, computer architecture and compilers, distributed systems, healthcare IoT, and brain-inspired architectures and computing. He has received numerous best paper awards and is coauthor of 7 books. Professor Dutt has served

as EiC of ACM TODAES and AE for ACM TECS and IEEE TVLSI. He is on the steering, organizing, and program committees of several premier EDA and Embedded System Design conferences and workshops, and has

also been on the advisory boards of ACM SIGBED, ACM SIGDA, ACM TECS and IEEE ESL. He is an ACM Fellow, IEEE Fellow, and recipient of the IFIP Silver Core Award.

Talk 2: Role of Machine Learning in Multi-core System Design and Management

Speaker: Sai Manoj Pudukotai Dinakarrao, Department of Electrical and Computer Engineering, George Mason University (spudukot@gmu.edu)



Speaker Biography: Dr. Sai Manoj Pudukotai Dinakarrao received the B. Tech degree in Electronics and Communication Engineering from the Jawaharlal Nehru Technological University, Anantapur, India, in 2010, and the M. Tech degree in Information Technology (specialization: Networking and Communication) from International Institute of Information Technology Bangalore, India, in 2012, and Ph.D. degree in electrical engineering from the Nanyang Technological University, Singapore in 2015. He worked as post-doctoral researcher in TU Wien between 2015 and 2017. Dr. Pudukotai Dinakarrao research interests include hardware security, adversarial machine learning, IoT networks, deep learning in resource constrained environments, big-data processing, accelerator design, algorithms, design of self-aware many-core microprocessors, and resource management in many-core microprocessors. His work got best paper award in International Conference on Data Mining (ICDM) 2019, International Conference on Consumer Electronics (ICCE) 2020 and some of his works were nominated for best paper award in prestigious conferences such as IGSC 2020, International Conference on Computer-Aided Design (ICCAD) 2019, Design Automation and Test in Europe (DATE) 2018. His students won the Xilinx Open Hardware Contest 2017 (Student Category) and 'Best Master Thesis' Award in TU Wien, 2017. He was a recipient of 'Young Research Fellow Award' in Design Automation Conference (DAC) 2013. His research is funded by NSF and DARPA.



Session Organizer:

Ryan Gary Kim is an assistant professor in the Electrical and Computer Engineering Department at Colorado State University, Fort Collins. His current research interests include electronic design automation techniques for scalable, fully-adaptive manycore systems and domain-specific architectures.