Green Computing: New Challenges and Opportunities

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ABSTRACT

As individuals and researchers approach the challenge of green computing it is natural to consider the energy consumption of computational devices and their supporting systems during their use phase (i.e., after they are deployed into service). This includes reducing energy consumption in processors, memory systems, peripheral devices, cooling systems and a host of other components that are used in deployed systems. However, for computing to be truly green, all phases of the system life-cycle, from manufacturing to disposal, must be considered. In particular there is limited awareness to the considerable fraction of the total life-cycle environmental impacts of computing systems that result from the fabrication of the integrated circuits (ICs) that are used in those devices. Studies have shown that the energy and environmental costs of IC fabrication can actually significantly outpace use-phase sustainability metrics and environmental impacts. With trends towards more exotic, thus, more environmentally unfriendly, fabrication approaches at deeply scaled nodes, life-cycle thinking for next generation computing systems that includes traditional optimization of operational energy-efficiency as well as minimizing impacts from IC fabrication is critical. In this talk I will present a new cadre of tools and methodologies to holistically evaluate energy consumption and other environmental impacts from computing. Based on these tools, I will discuss new interdisciplinary research directions and educational opportunities that emerge towards achieving more sustainable computing.

CCS Concepts/ACM Classifiers

•Social and professional topics → Sustainability; •Hardware → Impact on the environment; *VLSI design manufacturing considerations; VLSI system specification and constraints;*

Author Keywords

Sustainability; life cycle assessment (LCA); embodied energy; dark silicon; technology scaling; emerging memory; reliability; approximate computing; indifference analysis

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BIOGRAPHY

Professor Alex K Jones is a MCSI Faculty Fellow in Sustainability and Director of Computer Engineering at the University of Pittsburgh. In addition to sustainable computing, his research interests include compilers, computer architectures, electronic design automation, and reliability. He is the author of more than 140 publications in these areas. His research is funded by the U.S. National Science Foundation, DARPA, CCC, the NSF CHREC center, and industry. Dr. Jones' contributions have resulted in several awards including an ACM/SIGDA Distinguished Service Award, a seminal paper award from FCCM in addition to multiple best paper awards and nominations, a University of Pittsburgh Innovator Award, and the 2017 Carnegie Science Award. Recently, Dr. Jones led an effort in visioning for the electronic design automation community funded by the Computing Community Consortium (CCC). Dr. Jones is also actively involved in efforts to improve the scientific method for experiments in computers science and engineering, to develop methods reproducible research, and a centralized hub for computer architecture simulators, emulators, benchmarks and experiments. He serves on many journal editorial boards and conference committees including in area of sustainability, the IEEE Transactions on Sustainable Computing and the IEEE International Green and Sustainable Computing Conference. In his spare time he performs as the principal clarinetist with the Pittsburgh Philharmonic and Aeolian Winds and enjoys skiing and Tae Kwon Do.

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