TITLE: Preparing HPC Education for a Post-Moore Future

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ABSTRACT:
Though considerable progress has been made on integrating parallel and distributed computing into Computer Science curricula, many challenges still remain especially earlier in the undergraduate curriculum and later in continuing education for computing professionals. The first part of this talk will summarize experiences with HPC education in a sophomore-level course titled "Fundamentals of Parallel Programming" (COMP 322) introduced at Rice University in 2011. The learning outcomes for COMP 322 fall into three course modules -- Parallelism, Concurrency, and Distribution. We will also present experiences with a Coursera specialization that was introduced in 2017 based on COMP 322 material, but adapted into a continuing education format for computing professionals. This specialization consists of three courses, derived from the three modules in COMP 322.

In the second part of the talk, we will summarize future computing trends as we approach the end of Moore's Law, and identify pedagogic concepts that will be relevant for the post-Moore era. These "extreme heterogeneity" disruptions include new kinds of heterogenous processors and accelerators, heterogeneous memories, near/in-memory computation structures, and even non von Neumann computing elements. In our opinion, selected concepts from current pedagogy can provide a valuable starting point for creating new pedagogical materials for the post-Moore era. These concepts include task parallelism, data flow execution, and locality/distribution control as first-class primitives, which can enable strong semantic guarantees, as well as a promising foundation for post-Moore systems and also modern heterogeneous processors including CPUs, GPUs, DSPs, FPGAs, and NMPs.

BIO:
Vivek Sarkar is a Professor in the School of Computer Science, and the Stephen Fleming Chair for Telecommunications in the College of Computing at Georgia Tech. He conducts research in multiple aspects of parallel computing software including programming languages, compilers, runtime systems, and debuggers for parallel and high-performance computer systems. Prof. Sarkar currently leads the Habanero Extreme Scale Software Research Laboratory at Georgia Tech, and is co-director of the Center for Research into Novel Computing Hierarchies (CRNCH). He is also the instructor for a 3-course online specialization on Parallel, Concurrent, and Distributed Programming hosted on Coursera.

Prior to joining Georgia Tech in 2017, Prof. Sarkar was the E.D. Butcher Chair in Engineering at Rice University, where he created the Habanero Lab, served as Chair of the Department of Computer Science during 2013–2016, and created an undergraduate course on Fundamentals of Parallel Programming (COMP 322). Before joining Rice in 2007, Sarkar was Senior Manager of Programming Technologies at IBM Research. His research projects at IBM included the X10 programming language, the Jikes Research Virtual Machine for the Java language, the ASTI optimizer used in IBM's XL Fortran product compilers, and the PTRAN automatic parallelization system. Sarkar became a member of the IBM Academy of Technology in 1995 and was inducted as an ACM Fellow in 2008. He has been serving as a member of the US Department of Energy's Advanced Scientific Computing Advisory Committee (ASCAC) since 2009, and on CRA's Board of Directors since 2015.