TITLE: Programming Constructs for Exascale Systems and their Implementation Challenges

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ABSTRACT:

Exascale systems pose new critical challenges for programmability due to their concurrency, energy efficiency and resiliency requirements.  In this talk, we summarize lessons learned in the design and implementation of new parallel programming constructs in the Habanero Multicore Software research project (http://habanero.rice.edu).  These constructs have the potential to offer significant improvements in programmability for future high-end systems, but only if their implementation challenges can be surmounted.  At the intra-node level, the constructs offer a revolutionary approach to simplifying the programming of manycore processors with heterogeneous devices, thereby rendering current heterogeneous and hybrid programming models obsolete.  At the inter-node level, these constructs can be implemented using alternate approaches, including an evolutionary MPI-based approach, a bridging PGAS-based approach, and new revolutionary approaches to integrating communication with asynchronous parallelism. We expect the granularity of communication to decrease, and the integration with fine-grained asynchronous parallel computations to increase, as we span this spectrum of approaches for communication substrates from evolutionary to revolutionary.  Finally, we discuss experiences gained with a compiler transformation framework for analyzing and optimizing fine-grained asynchronous task-parallel programs.

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