CCT Colloquium Series

Performance Analysis and Optimization of Large-scale Scientific Applications on Cluster Systems with CMPs

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Department Head and Royce E. Wisenbaker Professorship II

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Abstract:
The current trend in high performance computing systems is shifting towards cluster systems with CMPs (chip multiprocessors). Further, the CMPs are usually configured hierarchically (e.g., multiple CMPs compose a multi-chip module and multiple multi-chip modules compose a node) to compose a node of the parallel system. A major challenge to be addressed is efficient use of such cluster systems for large-scale scientific applications. In particular, such systems have significant sharing of node resources, which can cause performance inefficiencies. In this talk, we quantify the performance gap resulting from using different number of processors per node for application execution; this information is used to provide a baseline for the amount of optimization needed when using all processors per node. We conduct detailed performance analysis to identify how applications can be modified to efficiently utilize all processors per node. We focus on three scientific applications: a 3D particle-in-cell application Gyrokinetic Toroidal Code (GTC) in magnetic fusion, a Lattice Boltzmann Method for simulating fluid dynamics (LBM), and an advanced Eulerian gyrokinetic-Maxwell equation solver for simulating microturbulent transport in plasma (GYRO).

Speaker's Bio:
Valerie E. Taylor earned her B.S. in Electrical and Computer Engineering and M.S. in Computer Engineering from Purdue University in 1985 and 1986, respectively, and a Ph.D. in Electrical Engineering and Computer Science from the University of California, Berkeley, in 1991. From 1991-2002, Dr. Taylor was a member of the faculty in the Electrical and Computer Engineering Department at Northwestern University. Dr. Taylor joined the faculty at Texas A&M University as Head of the Dwight Look College of Engineering's Department of Computer Science in January of 2003, and is, also currently a holder of the Royce E. Wisenbaker Professorship II. Her research interests are in the area of high performance computing, with particular emphasis on the performance of parallel and distributed applications and mesh partitioning for distributed systems. She has authored or co-authored over 90 papers in these areas. Dr. Taylor has received numerous awards for distinguished research and leadership, including the 2002 IEEE Harriet B. Rigas Award for woman with significant contributions in engineering education, the 2002 Outstanding Young Engineering Alumni from the University of California at Berkeley, the 2002 Nico Habermann Award for increasing the diversity in computing, and the 2005 Tapia Achievement Award for Scientific Scholarship, Civic Science, and Diversifying Computing. Dr. Taylor is a member of ACM and Senior Member of IEEE-CS.

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