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Keynote

A Model-driven Approach for Time-energy Performance of Parallel Applications

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Traditionally, time performance is one of the key concerns in running parallel applications. However, the advent of datacenters increases the availability of systems with diverse performance-to-power ratios. These heterogeneous systems consist of hardware including high-performance processors, low-power servers, GPU accelerators, and storage and network resources with different performance. As a consequence, the very large system configuration space introduces new opportunities and complexity for users to run parallel applications efficiently.

This keynote discusses a new model-driven approach to determine time-energy efficient configurations for executing applications on heterogeneous systems. By modeling the workload service demands on cores, memory and I/O devices of a node, we obtain the energy-efficient mix of nodes that services a job while maintaining a service time deadline. We show that there is a range of "sweet spots" or Pareto-optimal configurations for executing an application within an energy budget and a given execution time deadline.

This keynote is divided into *three* main parts. First, we review the challenges that users and datacenter providers faced in achieving time and energy efficient parallel application execution. Secondly, we introduce our model-driven approach and the formulation of the mix-and-match execution time model. As an example, we discuss the application of our approach on a heterogeneous system consisting of AMD brawny nodes and ARM wimpy nodes with typical datacenter workloads including web-hosting, multimedia streaming, financial analysis, real-time speech recognition and TLS/SSL key encryption. In addition, we investigated a number of research questions including is heterogeneity better than homogeneity, are larger mixes of heterogeneous nodes better, among others. Lastly, we highlight new opportunities in modeling time-energy performance such as in cloud computing.

Biography

TEO Yong Meng is an Associate Professor of Computer Science at the National University of Singapore. He was a Visiting Professor at the Shanghai Advanced Research Institute, Chinese Academy of Science, China from 2010-2013. He received his PhD in Computer Science from the University of Manchester. Over the past twenty years, his research focused on parallel and distributed systems and applications. In the last five years, he has been focusing on the performance of parallel systems, cloud computing, and emergent properties in complex systems. A paper, co-authored with his PhD student, on time-based semantic validation won the **ACM SIGSIM Best PhD Student Paper Award** in 2009. Another paper on strategy-proof dynamic pricing of cloud computing resources won the **Best Paper Award** at the 10th International Conference on Algorithms and Architectures for Parallel Processing in 2010. He leads the Computer Systems Research Laboratory at School of Computing. He also served as Advisor (Director's Office) on Large-Scale Computing Systems, Asia-Pacific Science and Technology Centre, Sun Microsystems Inc. from 2007-2008, and External Grant Evaluator, European Research Council (Ideas Specific Program) from 2008-2013. He has received numerous external research grants including European Commission, Fujitsu Computers (Singapore) Pte Ltd, Fujitsu Laboratories Ltd (Japan), Sun Microsystems/Oracle (USA), Nvidia, and PSA Corporation (Singapore) among other institutions.

References

1. L. Ramapantulu, D. Loghin and Y.M. Teo, **An Approach for Energy Efficient Execution of Hybrid Parallel Programs**, Proceedings of 29th IEEE International Parallel & Distributed Processing Symposium, Hyderabad, India, May 25-29, 2015.
2. L. Ramapantulu, B.M. Tudor, D. Loghin, T. Vu and Y.M. Teo, **Modeling the Energy Efficiency of Heterogeneous Clusters**, Proceedings of 43rd International Conference on Parallel Processing, pp 321-330, Minneapolis, USA, Sep 9-12, 2014.
3. B.M. Tudor, **Parallelism-energy Performance Analysis of Multicore Systems**, PhD Thesis, Department of Computer Science, National University of Singapore, (advisor: Yong Meng TEO), Jan 2014.
4. B.M. Tudor and Y.M. Teo, **Towards Modelling Parallelism and Energy Performance of Multicore Systems**, Proceedings of the 26th IEEE International Parallel & Distributed Processing Symposium, PhD Forum Best Poster Award, Shanghai, China, May 21-25, 2012.