LSU CCT Receives Half Million NSF Grant for GPU Cluster

Multi-core CPUs are the processors of choice in all modern computing platforms. However, GPUs (graphics processing unit) are becoming cost-effective, and have proven themselves to be very powerful general-purpose processors in their own right. The interest in using GPUs for scientific and engineering applications has been accelerating at a ferocious rate over the last few years, and today GPUs can now be found in many of the world's fastest machines on the Top500 supercomputer list.

Honggao Liu, deputy director of the LSU Center for Computation & Technology (CCT), recently received $539,999 from the National Science Foundation (NSF) for "Shelob," a project for computer science research, education, training, and development for Louisiana. Shelob will be a GPU cluster—a system composed of multiple server nodes—commonly called a Beowulf cluster, but each node will include GPUs to add additional processing power. The Shelob cluster will include at least 24 compute nodes, one head/control node, and 100 terabytes of scratch disk storage. The nodes will communicate with each other over an FDR (Fourteen Data Rate) InfiniBand network fabric at a data rate of 56Gb/s. Each node will have at least 64GB of memory, dual 8-core Intel Sandy Bridge processors, and three next-generation NVIDIA "Kepler" GPUs. The Shelob cluster will be used primarily to develop a large set of open source GPU-enhanced research applications.

Over the last decade, science and engineering disciplines have undergone a profound transformation and now require serious cyberinfrastructure (computers, networks, and other support) to make major advances. During this time, Louisiana has made great strides modernizing its educational and research facilities through comprehensive investments in cyberinfrastructure. The Louisiana Optical Network Initiative (LONI) and the LA-SiGMA (Louisiana Alliance for Simulation-Guided Materials Applications) project are products of this statewide investment. High Performance Computing (HPC), the heart of advanced cyberinfrastructure, has evolved drastically since the launch of the LONI initiative.

"The purchase of a Kepler GPU-accelerated cluster will allow the state to take the next step in supercomputing and produce a workforce ready for the new generation of parallel supercomputers. The cluster will be the centerpiece of an effort to transform computational sciences education and research throughout Louisiana," said Liu.

"The payoff from this project will be significant. Hundreds of researchers throughout Louisiana will use the Shelob cluster to develop a new generation of codes. These codes need to be ready for the next generation of GPU-accelerated national leadership supercomputers which will come on-line over the next couple of years. To use these new supercomputers, researchers will need to write GPU-enhanced massively parallel codes. The Shelob cluster will be used to train a new generation of researchers to program using CUDA, OpenCL, and the PGI Accelerator compiler. Even a new programming tool, the Pluto compiler, is being prepared for this new breed of supercomputer."

"We propose to transform computer and computational science research and education throughout Louisiana by graduating our users from the current massively parallel paradigm to a GPU-enabled parallel paradigm."

The Shelob project incorporates training and education at all levels, from a Beowulf Boot Camp for high school students to more than 20 annual CCT workshops and computational science distance learning courses for students. It will also be used in the CCT Research Experience for Undergraduates (REU) and the LA-SiGMA Research Experience for Teachers (RET) programs.

The Shelob project team, led by Liu, will use the Shelob cluster to advance GPU- enabled open source software. Team members include esteemed investigators from large multi-institutional projects, including Cactus, Pluto, STE||AR and LA-SiGMA. They include from LSU: Mark Jarrell, principal investigator for the LONI Institute, LA-SiGMA, professor of physics and CCT; Hartmut Kaiser, team lead of the CCT STEllAR group, adjunct assistant professor of computer science; Steven Brandt, team lead of the CCT Cactus Computational Framework, adjunct professor of computer science; and J. (Ram) Ramanujam, professor of electrical and computing engineering and CCT. Other senior personnel from LSU include Q. Jim Chen, Peter Diener, Randall Hall, David Koppelman, Xin Li, Frank Loeffler, James Lupo, Juana Moreno, Ravi Paruchuri, Jian Tao, Bhupender Thakur, and Mayank Tyagi.

"Together, this team will enable new discovery on the next generation of supercomputers," said Liu.

For more information about the LSU Center for Computation & Technology, visit www.cct.lsu.edu.

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