# Professor helps design software for the next generation of supercomputer

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Jack Dongarra, distinguished professor of computer science at the University of Tennessee, Knoxville, is designing software that will be critical in making the next generation of supercomputers operational.

For decades, supercomputers have been tackling the world's most pressing challenges, from sequencing the human genome to predicting climate changes. But their power is limited and thus, so is our knowledge.

The next generation of supercomputers, called exascale (a quintillion floating point operations per second), holds promise for solving some of the most demanding problems in numerical modeling. But as scientists worldwide, including Dongarra, work to develop the hardware for these machines, the software to run them remains elusive.

Dongarra recently received a $1 million grant, over three years, from the U.S. Department of Energy to find a solution. Called the Parallel Runtime Scheduling and Execution Controller, or PaRSEC, his project aims to address the critical situation that is facing the supercomputing community due to the introduction of more complex supercomputer designs.

"You can't wait for the exascale computers to be delivered and then start thinking about the software and algorithms," said Dongarra. "The exascale computers are going to be dramatically different than the computers we have today. We have to have the techniques and software

to effectively use these machines on the most challenging science problems in the near future."

Today's supercomputers have processor counts in the millions. Tomorrow's exascale computers will have roughly a billion processors. In addition, the general makeup of the machines will differ dramatically through the use of multiple central processing units and hybrid systems to overcome barriers limiting today's supercomputers. These barriers include large amounts of heat and power consumption, leaking voltage and a limited bandwidth of data through the pins on a single chip.

With a goal of reaching exascale by 2020, the next generation of supercomputers promises to provide a broad range of industries, including energy, pharmaceutical and transportation, the ability to more quickly engineer superior new products that could improve a nation's competitiveness. In addition, the advancements will translate into better consumer technology.

Dongarra is also developing an algorithm to overcome a reliability problem associated with the increasing number of processors. Now, when one processor fails, the calculation may have to be repeated partially or in full. The project aims to develop software that can survive failures.

In addition to PaRSEC, Dongarra is part of an international group working to evaluate potential rewards and obstacles in designing exascale supercomputers. Workshops called Big Data and Extreme-scale Computing, hosted by the National Science Foundation, are held around the world annually. To learn more, visit www.exascale.org.

To learn more about PaRSEC, visit icl.cs.utk.edu/parsec.