The Future of Ultrascale Computing Under Study

Some two hundred scientists from more than 40 countries are researching what the next generation of ultrascale computing systems will be like. The study is being carried out under the auspices of NESUS, one of the largest European research networks of this type coordinated by Universidad Carlos III de Madrid (UC3M).

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The project began a few months ago with 29 European countries, but at present consists of 39 European countries and six countries from other continents. / uc3m.

Ultrascale systems combine the advantages of distributed and parallel computing systems. The former is a type of computing in which many tasks are executed at the same time coordinately to solve one problem, based on the principle that a big problem can be divided into many smaller ones that are simultaneously solved. The latter system, in both grid and cloud computing, uses a large number of computers organized into clusters in a distributed infrastructure, and can execute millions of tasks at the same time usually working on independent problems and big data.

The scientific objective of NESUS is to study the challenges presented by the next generation of ultrascale computing systems. These systems, which will be characterized by their large size and great complexity, present significant challenges, from their construction to their exploitation and use. “We try to analyze all the challenges there are and see how they can be studied holistically and integrated, to be able to provide a more sustainable system,” noted Jesús Carretero, full professor in the UC3M Department of Computer Science and coordinator of the European Union’s important COST Action.

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The goal in scalable and sustainable technology is for us to have large parallel supercomputers, now termed “exascale” computers, and to have large data centers with hundreds of thousands of computers coordinating with distributed memory systems by the year 2020. “Ultimately, the idea is to have both architectures converge to solve problems in what we call ultrascale,” said Carretero. The applications of these systems and the benefits they can yield for society are enormous, according to the researchers, who note that this type of computing will help conduct studies about genomics, new materials, simulations of fluid dynamics used for atmospheric analysis and weather forecasts, and even the human brain and its behavior.

Large systems, important challenges

The challenges that this type of computing poses affect aspects such as scalability, the programming models used, resilience to failures, energy management, the handling of large volume of data, etc. “We try to find the way that all solutions that are proposed can be transmitted to user

applications with the minimum possible redesign and reprogramming effort," Carretero remarked.

The project started last March and the researchers have already held two important meetings: one for work groups in Madrid in July and another in Oporto (Portugal) at the end of August, attended by representatives of the research groups that participate as well as Project Officers from the EU's H2020 program. By reducing duplication of work and providing a more comprehensive vision of all the researchers, this COST Action hopes to increase the value of these groups at the European level, promoting European leadership in this area of knowledge, as well as enhancing its impact on science, the economy and society.

This Action, which concludes in 2018, aims to produce a catalogue of open source applications that are being developed by the scientists and which will serve to demonstrate new ultrascale systems and take on their main challenges. In this way, anyone will be able to use these applications to test them in their systems and demonstrate their level of sustainability.

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