SUPERCOMPUTING: Jülich’s record-breaking computer

Supercomputers are the hidden stars among Jülich’s large-scale facilities. JUWELS and JURECA are currently among the fastest computers in the world. Their performance is even surpassed by JUPITER, which is currently being built on our campus – enormous computing power for big data and artificial intelligence (AI).

Images: Jülicher Supercomputer JUWELS, JUPITER Development system JEDI, Copyright Forschungszentrum Jülich / Sascha Kreklau

JUPITER is designed to perform a quintillion floating-point operations per second, easily outperforming 1 million state-of-the-art smartphones. Jülich’s new number one will thus help to achieve breakthroughs in AI and open new doors for research. Our two current supercomputers, JUWELS and JURECA, are already providing the computing power to address complex research issues. For example, they are used to provide insights into how potential active substances dock onto a receptor, how the climate is changing, how galaxies are formed, and how semiconductor and energy materials function. Scientists simulate all this and more on supercomputers.

"JUPITER will be the first European exascale computer. It can perform over a quintillion arithmetic operations per second with twice the accuracy, and significantly more for AI workloads. This makes it an outstanding tool for climate research or training large AI models, for example."

Benedikt von St. Vieth, Head of Division HPC, Cloud and Data Systems and Services, Jülich Supercomputing Center

A construction kit for supercomputers

Research that focuses on the grand challenges of the future cannot succeed without supercomputers. Only such systems can cope with the huge amounts of data that researchers are generating through increasingly precise measurement methods and procedures. Simulations on supercomputers make it possible to gain insights that cannot be obtained through purely experimental or theoretical approaches. The Jülich Supercomputing Centre (JSC) is also offering top-level computing time to actors outside Forschungszentrum Jülich via the Gauss Centre for Supercomputing.

At JSC, we also collaborate with national and international partners to test and develop new concepts and technologies for next-generation supercomputers. These will integrate various technologies that can be combined in different ways depending on the requirements – thanks to a dynamic modular supercomputing architecture developed at Jülich. This involves connecting digital supercomputers with quantum computers and neuromorphic systems according to the building-block principle. In this way, new types of computers will be created that can be used flexibly for different research approaches.

Not only science, but also industry, is experiencing an increasing demand for computing power. The exascale supercomputer JUPITER is a major driver of progress for Germany and Europe, which ensures technological and digital sovereignty. It will help us to develop transparent and democratic AI models, thus strengthening European competitiveness and independence.

Energy-efficient just like the brain

In all this, we also keep an eye on the energy efficiency of supercomputers. Data centres now account for just under 4 % of German electricity consumption, and this is an increasing trend. We are therefore working on efficient computer technologies to make high-performance computing sustainable for the future. And our efforts have proven successful: in May 2024, the first component of our exascale computer JUPITER took first place in the Green500 ranking of the most energy-efficient computers. In this way, the “AI revolution” can become green.

To make computers even more energy-efficient, researchers at Jülich have taken a new approach and use the human brain as their model. The brain solves certain tasks in a much more energy-efficient way than supercomputers. Neuromorphic systems, such as those we are developing at Jülich, will revolutionize computer technology.

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quintillion floating-point operations per second can be performed by Jülich’s exascale computer JUPITER – a “one” followed by 18 zeros.

200

research groups and more from Jülich, Germany, and Europe usually use the Jülich supercomputers in parallel.

1

exabyte: With JUPITER, the storage capacity at JSC increases to over 29 petabytes of flash storage, 450 petabytes of spinning disc and 700 petabytes of tape.

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