



Academic Research

Sparking new scientific possibilities

Shanghai Jiao Tong University

Helping researchers deepen their understanding of life on Earth and the universe with a high-performance computing cluster based on Lenovo ThinkSystem servers and Lenovo Neptune™ liquid cooling technology.

Lenovo

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The background

Practice is key to learning; studying and the pursuit of knowledge is inseparable from practice. The rapid development of high-performance computing (HPC), artificial intelligence (AI), 5G, and other technologies in recent years has ushered in explosive data growth—and exciting new breakthroughs.

SJTU has cultivated a reputation as a leading center of scientific research and technological innovation. For over a decade, the university has led the country in both the number of research projects and the amount of funding supported by the National Natural Science Foundation of China. It also holds the top position in research and conference paper output among China's academic institutions.



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The challenge

From shining new light on dark matter and the farthest reaches of the universe to exploring the genetic bases of metabolic traits of the Chinese population, researchers at SJTU drive important progress in dozens of fields. To keep advancing scientific knowledge and make groundbreaking discoveries, these teams rely on HPC more than ever.

In complex research projects in physics, cosmology, or life sciences, ever-increasing compute performance is needed to push boundaries and gain new insights. To support groundbreaking scientific research and innovation, HPC resources that enable researchers to process large data sets and perform complex calculations efficiently are vital.

Why **Lenovo**?

HPC at SJTU received a major boost in April 2021. To mark the university's 125th anniversary, Lenovo Chairman and CEO, Mr. Yang Yuanqing, who is also an SJTU alumnus, made a personal donation of RMB 100 million (US\$15.7 million) to build a cutting-edge HPC center. You can read more about this [here](#).

The new facility at SJTU, known as the “Yang Yuanqing Scientific Computing Center”, was officially opened in December 2021. At the heart of the new center is an HPC cluster called “Siyuan-1”, built with Lenovo's most advanced HPC technologies.

At the unveiling of the Yang Yuanqing Scientific Computing Center, Lenovo also announced a new strategic cooperation agreement with SJTU. Over the next three years, Lenovo will allocate RMB 200 million (US\$31.4 million) to help the university advance scientific research, nurture new talent, and incubate innovative technologies.



World-class HPC system

The Siyuan-1 supercomputer is based on Lenovo ThinkSystem SD650 and ThinkSystem SD650-N V2 servers, featuring Lenovo Neptune™ liquid cooling technology. Each server is equipped with 3rd Gen Intel Xeon Scalable processors, giving Siyuan-1 a total of 60,032 compute cores. The supercomputer also features 92 NVIDIA A100 Tensor Core GPUs, which bring a big performance boost for highly parallelized AI and HPC workloads.

Siyuan-1 also makes use of Lenovo Distributed Storage System for IBM Spectrum Scale (DSS-G) arrays, which offer a total storage capacity of up to 10 PB. The Lenovo storage, compute nodes, and functional nodes are all connected with Mellanox InfiniBand HDR 200Gb/s networking fabric.

Siyuan-1 is the very first HPC cluster in China to use Lenovo's 5th generation Neptune liquid cooling technology, which removes heat from the CPUs, memory, IO, local storage, and voltage regulators using a copper-based water loop. Siyuan-1's water-cooled servers can support more than 52.5kW of power in a single cabinet, while their power density is 6.5 times that of air-cooled servers. This allows for extremely high computational density in a small footprint: Siyuan-1 is made up of just 14 server cabinets and covers an area of less than 11 square meters.

Hardware

Lenovo ThinkSystem SD650 V2
Lenovo ThinkSystem SD650-N V2
Lenovo Distributed Storage Solution for IBM Spectrum Scale (DSS-G)
3rd Gen Intel Xeon Scalable processors
NVIDIA A100 Tensor Core GPUs
Mellanox InfiniBand HDR 200Gb/s

Software

IBM Spectrum Scale
SLURM Workload Manager

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Results

With a theoretical computing peak of close to 6 PFLOPS, Siyuan-1 is ranked 132 in the global TOP500 November 2021 list of supercomputers.¹ It is ranked 12 in the Chinese TOP100 during the same period, and first for computing power. It gives the university's researchers access to exceptionally high-performing compute resources, allowing them to run larger and more complex workloads than ever before and cut time-to-insight.

The Siyuan-1 cluster has enabled SJTU to compete with the world's top universities in terms of computing power, and is helping advance cutting-edge research in various scientific fields. For example, research into the structure of neutrinos and the aerodynamic characteristics of aircraft. Siyuan-1's 60,032 CPU cores allow researchers to submit tens of thousands of parallel computing tasks at once. Not only does this reduce workload queues, it also reduces the time taken to standardize data, helping to increase efficiency.

- ✓ 6 PFLOPS theoretical calculation peak
- ✓ Up to 95% faster data analysis
- ✓ 40% energy savings
- ✓ 10% carbon emissions offset

¹ Source: [TOP500 November 2021](#)

Green, low-carbon HPC

Not only does the Lenovo platform provide world-class compute performance, it significantly reduces energy costs and carbon emissions. Compared to traditional air-cooled systems, Lenovo's Neptune liquid-cooling technology can reduce energy costs by over 40%. The system can also collect extra heat to serve other facilities in the HPC center, such as water heaters in kitchens, dehumidification systems in the building's basement, and temperature control systems in other labs, further improving energy efficiency. Another benefit of Lenovo Neptune liquid cooling technology is the ability to maintain a dense footprint—Siyuan-1 covers an area of just 300m².

What's more, Siyuan-1's waste heat recovery system is expected to achieve a carbon offset of around 10%, reducing carbon dioxide emissions by approximately 950 tons a year. It means that as SJTU continues to advance groundbreaking research with HPC, it won't just improve our understanding of the planet, it will help protect it too.



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Supported by Lenovo technology, we can provide our research community with the computing performance and capacity they need to drive demanding workloads and advance crucial scientific work.”

Wen Minhua

Director, Computing Division, Network and Information Center, Shanghai Jiao Tong University

How do you advance scientific knowledge?

Empowering scientists to tackle more complex questions and uncover fresh insights faster with Lenovo technology.

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