10 fastest supercomputers in the world 2024

The top 10 most powerful supercomputers in the world today have just been announced, of which 5 supercomputers are located in the US, two in China, and the rest belong to Japan, Finland and Italy. This list is extracted from the Top500 Supercomputer Ranking.

The Top500 supercomputing project is announced twice a year, online or at the International Supercomputing Conference and the ACM/IEEE Supercomputing Conference in late May or early June and November.

This project was carried out by famous experts such as Jack Dongarra of the University of Tennessee; Knoxville, Erich Strohmaier and Horst Simon of the US Energy Research Scientific Computing Center; Hans Meuer of the University of Mannheim. and annually since 1993.

What is a supercomputer?

Supercomputers or supercomputers are High Performance Computers (HPC) - high performance computers, with outstanding computing capabilities, far beyond what you can think. They "plow" hard at universities, laboratories and other large, important facilities around the world.

Supercomputers play an important role in the field of computational science, and are used for a variety of complex computational tasks in many fields, including quantum mechanics, weather forecasting, and research. climate research, oil and gas exploration, molecular modeling (calculating the structures and properties of chemical compounds, biological macromolecules, polymers, crystals), and physical simulations (such as simulate the early moments of the universe, the aerodynamics of aircraft, spacecraft, the explosion of nuclear weapons, nuclear fusion). Throughout their history, supercomputers have proven important in the field of cryptanalysis.

How is the speed of a supercomputer measured?

Supercomputer speed is measured in FLOPS (floating-point operations per second) instead of MIPS (million instructions per second). As of 2015, there are supercomputers that can perform up to 10 quadrillion FLOPS, measured in P(eta) FLOPS. The majority of today's supercomputers run Linux-based operating systems.

The speed of the supercomputers on this list is also calculated in petaflops, one petaflop is equivalent to 10^15 (10 million billion) calculations/second, please multiply slowly.

10 supercomputers in the world

1. Frontier, USA

Frontier was built in 2022 by American multinational information technology company Hewlett Packard Enterprise, in collaboration with subsidiary Cray. This is the world's first exascale supercomputer, which means it can calculate at least 10^18 calculations per second.

Frontier has a total of 8,730,112 cores and achieved 1.1 EFLOPS (or exaflops) in Linpack benchmark tests. It is based on the latest HPE Cray EX235a architecture and uses a combination of 64-core 2GHz 3rd generation CPU 7A53s and AMD's MI250X GPU.

Frontier is also the most efficient supercomputer in the world, with an energy efficiency rating of 52.23 gigaflops/watt. Each of its 74 computing cabinets weighs about 3.63 tons and the entire system has a total cost of up to 600 million USD.

2. Fugaku, Japan

Speed: 442,010 petaflops, peak performance 537,212 petaflops

Built by Fujitsu, Fugaku is installed at the RIKEN Center for Computer Science (R-CCS) in Kobe, Japan. With the additional hardware, the system achieved a new world record with a result of 442 petaflops on HPL, 3 times more than the second system on the list.

RIKEN's director, Satoshi Matsuoka, said that 'it was finally possible to use the entire machine instead of just a small part of it'.

Since the June competition, his team has been able to tweak the code for maximum performance. 'I don't think we can improve much more,' Matsuoka said.

3. Aurora

This is one of the youngest supercomputers on the list that can become the most powerful in the future.

The Aurora supercomputer has a capacity of: 585 petaFLOPS (0.59 exaFLOPS), located at Argonne National Laboratory - Illinois, USA (ALCF). This is the second exascale supercomputer built.

Aurora is the result of cooperation between Intel and HPE, first operating in June 2023. This supercomputer integrates scientific tools and analysis, performs modeling, simulation and runs artificial intelligence (AI).

ALCF representatives said that Aurora has the potential to reach 2 exaFLOPS of computing power, double that of Frontier. Its power can create accurate models in many fields, including climate prediction, materials science, energy storage and fusion reactions.

Central to Aurora is fusion.

4. Eagle

Instead of being located in a laboratory, Eagle is located in an entire data center system that operates Microsoft's Azure cloud server service, allowing anyone to access it through the Microsoft Azure cloud platform.

The Eagle supercomputer has a capacity of 561 petaFLOPS (0.56 exaFLOPS), first operating in August 2023.

Microsoft's supercomputer is equipped with an Intel Xeon Platinum 8480C 48-core Sapphire Rapids architecture CPU, an Nvidia H100 Hopper architecture GPU, an Nvidia Infiniband NDR data bridge, a total of 1.1 million processing cores.

5. LUMI, Finland

LUMI (Large Unified Modern Infrastructure) was built by HPE in 2022 and located in Finland, becoming the fastest supercomputer in Europe. LUMI has a total of 1,110,144 cores and clocks at 151.9 PFLOPS.

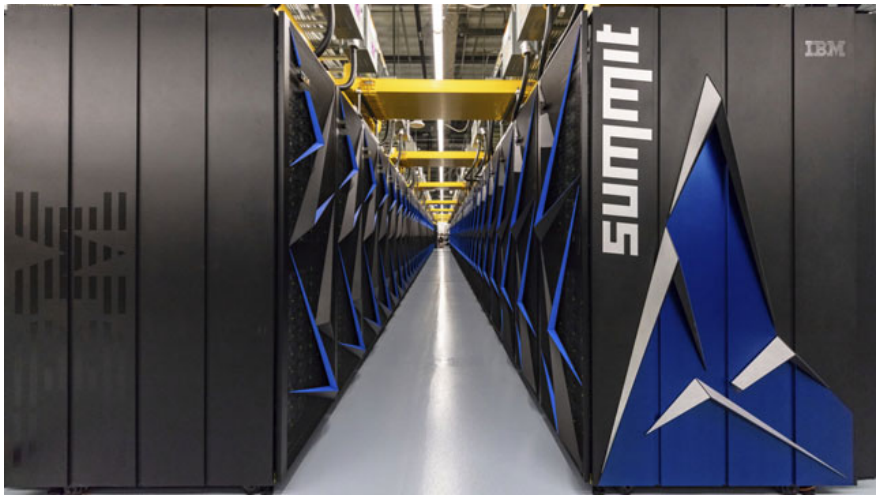
LUMI runs on the same processor as Frontier and has an energy efficiency rating of 51.63 gigaflops/watt, making it the second most efficient supercomputer in the world.

6. Leonardo (Italy)

The Leonardo supercomputer uses Intel's Xeon Platinum 8358 32C chip and Nvidia's A100 and HDR100 processors, achieving 238.7 petaflops of computing power. The supercomputer is located in Bologna city, operating from November 2022. The cost of building Italy's supercomputer is 240 million USD. Intel and Nvidia are responsible for the software that runs the machine.

7. Summit, USA

Speed: 148,600 petaflops, peak performance 200,795 petaflops



Headquartered at Oak Ridge National Laboratory (ORNL) in Tennessee, Summit was built by IBM and is the fastest system in the US. Launched in 2018, it has a performance of 148.8 petaflops, with 2,282,544 IBM Power9 cores and 2,090,880 Nvidia Volta GV100 cores and has 4,356 nodes, each node containing two 22-core Power9 CPUs and 6 NVIDIA Tesla V100 GPUs.

Recently, two teams working on Summit won the prestigious Gordon Bell Prize for excellence in high-performance computing, often referred to as the 'Nobel Prize of supercomputing'.

8. Sierra, USA

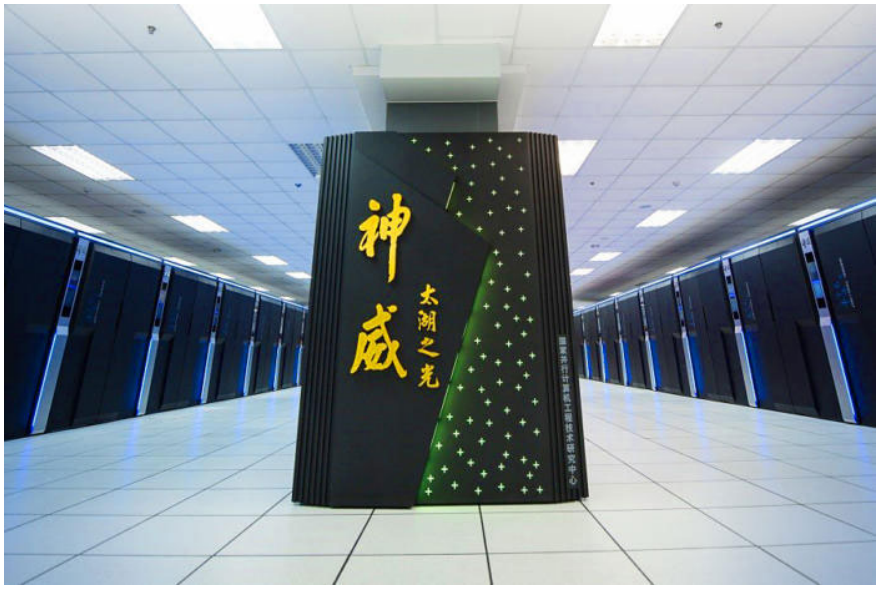
Speed: 94,640 petaflops, peak performance 125,712 petaflops

A system at Lawrence Livermore National Laboratory (LLNL) in California, Sierra has an HPL index of 94.6 petaflops. With each of the 4320 nodes equipped with 2 Power9 CPUs and 4 NVIDIA Tesla V100 GPUs, it has a similar architecture to that of Summit.

Sierra also entered the 15th position on the Green500 list of the world's most energy-efficient supercomputers.

9. Sunway TaihuLight, China

Speed: 93,015 petaflops, peak performance 125,436 petaflops.



Installed at China's National Supercomputing Center in Wuxi city, Sunway TaihuLight previously held the No. 1 position for two years (2016 and 2017). However, its rankings have dropped since then. It was ranked third last year and this year has dropped to fourth.

Built by China's National Research Center for Parallel Computing Technology & Engineering (NRCPC), Sunway TaihuLight achieved 93 petaflops on the HPL benchmark. It is exclusively powered by Sunway SW26010 processor.

10. Perlmutter, USA

Speed: 64.6 Pflop/s, peak performance 89.795 petaflops.

This is the only new supercomputer in the top 10 list this time. Perlmutter is based on the HPE Cray Shasta platform, using both AMD EPYC nodes and Nvidia's 1536 accelerated A100 nodes.