

FOR IMMEDIATE RELEASE

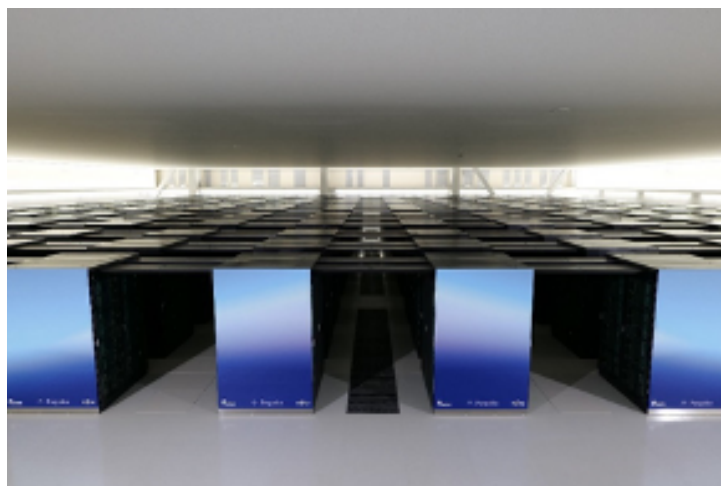
Supercomputer "Fugaku" Achieves World No. 1 in Graph500

11th Consecutive Top Ranking, Demonstrating High Big Data Processing Capability

IRVINE, California – Jun 10, 2025 – Fixstars Corporation (TSE Prime: 3687, US Headquarters: Irvine, CA), a leading company in performance engineering technology, today announced that a joint research group including Fixstars Corporation, along with RIKEN, Tokyo Tech, Nippon Telegraph and Telephone Corporation, and Fujitsu Limited, has achieved the world's No. 1 ranking in the BFS (Breadth-First Search) division of Graph500, an international supercomputer performance ranking for large-scale graph analysis, using the supercomputer "Fugaku". This marks the 11th consecutive top ranking for "Fugaku", with a Graph500 score of approximately 204 TeraTEPS.

This ranking was announced by the Graph500 Committee in conjunction with ISC2025, an international conference on HPC (High Performance Computing) currently being held at the Congress Center Hamburg in Germany.

The performance of large-scale graph analysis is a critical indicator for analyzing big data that requires processing of large and complex data. The joint research group will continue to develop large-scale graph processing technology using "Fugaku".



Supercomputer "Fugaku"

Joint Research Group

RIKEN Center for Computational Science Operations Technology Division, Advanced Operations Technology Unit

Keiji Yamamoto, Unit Leader
Masahiro Nakao, Engineer

Tokyo Tech Institute of Innovative Research, Digital Twin Research Unit

Katsuki Fujisawa, Professor
Keiichiro Yamamura, Specially Appointed Assistant Professor

Fixstars Corporation

Koji Ueno, Fellow
Ryo Takagi, Director
Masaki Ohno, Lead Engineer
Yuto Inoue, Senior Engineer
Atsuya Shibata, Senior Engineer
Kosuke Suzuki, Senior Engineer
Kiraku Minami, Senior Engineer
Tetsuro Sakamoto, Engineer

Nippon Telegraph and Telephone Corporation, Computer & Data Science Laboratories

Hiroyuki Takahashi, Senior Research Scientist
Kazuki Oikawa, Senior Research Scientist
Junya Arai, Senior Research Scientist
Arashi Ogata, Researcher
Ryoto Imanishi, Researcher

1. "Fugaku" Measurement Results

The joint research group used 152,064 nodes (approximately 95.7% of the total) of "Fugaku" to solve a Breadth-First Search problem on an ultra-large graph consisting of approximately 8.8 trillion vertices and 140.7 trillion edges in an average of 0.69 seconds. The Graph500 score is 204.068 TeraTEPS. In the measurement, the joint research group successfully processed a graph of unprecedented scale for the Graph500 ranking by employing memory-saving technology they developed. In general, larger problems allow for more efficient parallel processing, so the memory-saving technology also yielded good results in terms of performance. Furthermore, to suppress performance fluctuations due to random numbers, the group introduced a search for random seed values that yield good performance.

<Related Link>

Graph500 Ranking

<https://graph500.org>

2. About Graph500

Complex phenomena in the real world are often expressed as large-scale graphs (representing relationships between data using vertices and edges), requiring high-speed graph analysis by computers. For example, in social networking services (SNS), graph analysis is used to analyze relational data such as "who is connected to whom". Furthermore, in initiatives toward Society 5.0, the development of new businesses that create new value is being promoted by converting large amounts of data acquired through technologies such as IoT (Internet of Things) into graphs and processing them at high speed on computers. These efforts aim to achieve both the creation of new industries and the reduction of waste emissions, and are expected to contribute significantly to the promotion of Sustainable Development Goals (SDGs), particularly Goal 9 (Industry, Innovation, and Infrastructure) and Goal 11 (Sustainable Cities and Communities). "Graph500" is a competition that measures the performance of graph analysis, which has such diverse applicability.

"Graph500" began in 2010 with the BFS division, and currently, rankings for each of the three divisions—BFS, SSSP (Single-Source Shortest Path), and Green (power efficiency of BFS)—are updated twice a year. While the BFS and Green divisions handle graphs where the edge lengths between vertices are the same, the SSSP division deals with graphs where the edge lengths between vertices differ, and rankings are based on the number of processed elements per unit time (1 second).

Since "Graph500" handles large-scale graphs, graph data must be distributed across multiple nodes, and in systems with large networks like "Fugaku," optimizing communication performance is also crucial. The joint research group is developing software that can analyze large-scale graphs at high speed on supercomputers. As a result of their efforts to date, by highly combining the following advanced software technologies (1) to (6), they have successfully developed world-leading graph search software capable of handling the increasing scale and complexity of real data expected in the future.

- (1) Efficient partitioning and compression of graph data among multiple nodes
- (2) Algorithm for reducing redundant graph searches
- (3) Preprocessing that removes unnecessary vertices without affecting BFS results
- (4) Optimization of communication performance in supercomputer large-scale networks
- (5) Automatic tuning of parameters that control the behavior of search algorithms
- (6) Seed value search to mitigate performance fluctuations due to random numbers

Achieving the No. 1 ranking in the BFS division of "Graph500" demonstrates that "Fugaku" exhibits high performance not only in regular computations commonly used in scientific and technical calculations but also in graph analysis, which is mostly composed of irregular computations, showcasing "Fugaku"'s excellent versatility in supporting a wide range of

applications. It also demonstrates the high technical capabilities of the joint research group that developed software capable of maximizing hardware performance. The joint research group is currently continuing to investigate reducing the load of subsequent calculations through preprocessing and data compression, and will accelerate performance improvements based on the data obtained from measurements.

<Related Link>

RIKEN Center for Computational Science

<https://www.r-ccs.riken.jp/jp/>

GitHub repository for the program developed in this research

<https://github.com/RIKEN-RCCS/Graph500-BFS/>

Note 1)

This research utilizes the following results (algorithms and programs):

- 1: JST CREST "Creation of System Software Technologies for Post-Peta-scale High Performance Computing (Research Supervisor: Mitsuhsa Sato)" research topic "Ultra-large Graph Optimization Infrastructure in Post-Peta-scale Systems (Principal Investigator: Katsuki Fujisawa, Site Representative: Toyotaro Suzumura)"
- 2: JST CREST "Creation and Systematization of Next-Generation Fundamental Technologies for Integrated Utilization of Big Data (Research Supervisor: Yuichi Kirekawa)" research topic "EBD: Extreme Big Data Fundamental Technologies for Next-Generation Yottabyte Processing (Principal Investigator: Satoshi Matsuoka)"
3. Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research "Development of High-Performance Graph Library with Automatic Performance Tuning Function (Principal Investigator: Masahiro Nakao, Co-Investigators: Katsuki Fujisawa, Yuetsu Kodama)"
- 4: GitHub repository for large-scale graph analysis program
<https://github.com/suzumura/graph500/>

References:

Junya Arai, Masahiro Nakao, Yuto Inoue, Kanto Teranishi, Koji Ueno, Keiichiro Yamamura, Mitsuhsa Sato, and Katsuki Fujisawa, "Doubling Graph Traversal Efficiency to 198 TeraTEPS on the Supercomputer Fugaku," in SC24: International Conference for High Performance Computing, Networking, Storage and Analysis, November 2024.

Masahiro Nakao, Koji Ueno, Katsuki Fujisawa, Yuetsu Kodama, and Mitsuhsa Sato, "Performance of the Supercomputer Fugaku for Breadth-First Search in Graph500 Benchmark," in High Performance Computing: 36th International Conference, ISC High Performance 2021, June 2021, pp. 372-390.

Koji Ueno, Toyotaro Suzumura, Naoya Maruyama, Katsuki Fujisawa, Satoshi Matsuoka, "Efficient Breadth-First Search on Massively Parallel and Distributed-Memory Machines," Data Science and Engineering, vol. 2, no. 1, pp. 22-35, March 2017.

Koji Ueno, Toyotaro Suzumura, Naoya Maruyama, Katsuki Fujisawa, Satoshi Matsuoka. "Extreme Scale Breadth-First Search on Supercomputers". in 2016 IEEE International Conference on Big Data (Big Data), December 2016, pp. 1040-1047.

3. Supplementary Explanation

[1] Breadth-First Search (BFS) is an algorithm that traverses all vertices in a graph in order of their distance from the starting vertex. It is suitable for finding the shortest path from the starting vertex to each vertex when all edge lengths are equal.

[2] Supercomputer "Fugaku" (ふがく)

The successor to the supercomputer "K". Its purpose is to contribute to Japan's growth and produce world-leading results in solving social and scientific problems in the 2020s. It began shared use in March 2021 as a world-class supercomputer with comprehensive capabilities in power performance, computational performance, user convenience and ease of use, creation of groundbreaking results, and acceleration functions for big data and AI.

Currently, "Fugaku" is being utilized as an indispensable HPC infrastructure for realizing Society 5.0, which Japan aims for.

[3] TeraTEPS (Tera-Traversed Edges Per Second)

TEPS is an acronym for Traversed Edges Per Second and represents the execution speed score of the "Graph500" benchmark. In the "Graph500" benchmark, the vertices of a given graph and the edges connecting them are processed. The speed of a computer in "Graph500" is defined as the number of edges processed per second. Tera in TeraTEPS represents 10^{12} , and TeraTEPS is the value obtained by dividing the number of edges processed per second by 10^{12} . The harmonic mean of 64 trials is used to calculate the TeraTEPS value. TEPS stands for Traversed Edges Per Second.

[4] Node

The smallest unit of computing resource in a supercomputer where an operating system can run. In the case of "Fugaku," it consists of one CPU (Central Processing Unit) and 32 GiB (gibibytes) of memory.

[5] Random seed value

A numerical value used to initialize a pseudo-random number generator (a program that creates a sequence of numbers that appear random). Using the same value will always generate the same pseudo-random number sequence.

[6] Society 5.0

This refers to a new society following the hunting society (Society 1.0), agrarian society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0). It was first advocated in Japan's 5th Science and Technology Basic Plan as the vision of the future society that Japan aims to achieve. It aims to realize a new society that balances economic development and the resolution of social issues by incorporating new technologies that affect the nature of society, such as IoT, robots, AI (artificial intelligence), and big data, into all industries and social life.

[7] Sustainable Development Goals (SDGs)

International goals outlined in the "2030 Agenda for Sustainable Development" adopted at the UN Summit in September 2015, covering the period from 2016 to 2030. It consists of 17 goals and 169 targets for realizing a sustainable world, and is universal, applicable not only to developing countries but also to developed countries themselves, with Japan actively working towards them (partially adapted and reproduced from the Ministry of Foreign Affairs website).

###

About Fixstars Corporation

Fixstars is a technology company dedicated to accelerating AI inference and training through advanced software optimization solutions. It supports innovation in healthcare, manufacturing, finance, mobility, and other industries. For more information, visit: <https://www.fixstars.com/>

Media Contact

Public Relations, Fixstars Corporation

Email: press@fixstars.com

Tel: +81-3-6420-0751