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PRESS RELEASE

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BlueMeme Inc.

BlueMeme and Kyoto University conduct joint research on genome analysis using quantum computers

Quantum computation is applied for genome analysis, which is formerly carried out on classical computers

BlueMeme Inc. and Masao Nagasaki, Professor at the Centre for the Promotion of Interdisciplinary Education and Research, Kyoto University, have been conducting joint research on the social implementation of 'genome informatics analysis with quantum computers' since April 2022.

Quantum computers[i] are fundamentally different from classical computers in their principle of operation. The implementation of algorithms using quantum computers is expected to solve various problems in society by overcoming the computational limits of classical computers. Examples include identifying the most efficient delivery routes in the logistics industry and enabling the rapid discovery of potential new medicines in the pharmaceutical industry.

Genome informatics, on the other hand, is a field that applies information science techniques to solve issues in genome science. For example, in the case of human genomics, information obtained from approximately 3 billion base pairs of DNA[ii] is processed and analyzed on computers (currently classical computers) using various algorithms to discover insights that can lead to medical advances, such as identifying genetic factors in disease. BlueMeme, in collaboration with Professor Masao Nagasaki, aims to find new insights by applying quantum computing to the field of genomics and expanding the scale and speed of computation.

Background and purpose of the joint research
BlueMeme aims to transform enterprise system development through the use of the latest technologies, and focuses on 'quantum computers' as the next generation of computing power for industrial systems in the digital labor era.

Corporate DX is business transformation using data and computing technologies. Therefore, the quality and type of services achieved through DX will be highly dependent on the capabilities of classical computer. The emergence of quantum computers is expected to provide a strong boost to DX in companies, however, the current social implementation of quantum computation is limited to only a few areas, such as logistics, finance and chemistry, and there are many potential areas where quantum computation has not yet been implemented.

As quantum computers with 'error correction[iii]' are expected to significantly improve the performance of industrial systems in the future, BlueMeme believes it is important to research the potential use of quantum computers in areas where implementation research has not yet progressed.

BlueMeme targets genome analysis in the life science field, which aims to solve problems related to disease, food and the environment. The human genome consists of a sequence of approximately 3 billion base pairs, and is subject to computational analysis due to its digital data-like nature. Since the revolution in sequencing equipment in the 2000s, genomic data has been growing rapidly at a rate exceeding Moore's Law[iv]. It is therefore believed that new technologies such as quantum computers will be required in addition to large-scale classical computers to solve these challenges. However, only a few test implementations have been carried out using quantum computation, partly because the quantum computing platforms are still in their early stages of development.

The analysis performance of quantum computers is expected to improve significantly in the near future. This will enable the acquisition of innovative academic findings in research fields and the provision of personalized medical care in clinical practice. With a view to such a future society, BlueMeme will actively replace existing computational tasks in genome analysis algorithms where quantum computers are expected to be utilized and verify their performance.

i：A computer that uses the physical laws of quantum mechanics to process information. Quantum bits, the information processing unit of a quantum computer, can express superimposed information of 'both 0s and 1s', unlike bits, which express information in terms of '0s or 1s'.
ii：The macromolecules that constitute the genetic information of life, consisting of four types of base: A (adenine), T (thymine), G (guanine) and C (cytosine).
iii：The function of correcting errors that occur during computer operations. Existing quantum computers do not have this function.
iv：A rule of thumb for semiconductor performance that states that "the integration density of semiconductor circuits doubles in one and a half to two years." Proposed by Gordon Moore, founder of Intel Corporation, USA.

Description of the joint research
BlueMeme and Professor Masao Nagasaki collaborate to explore how quantum computers can be applied to genome analysis, tackling specific problems in genome analysis in two computational tasks (quantum AI and combinatorial optimization calculations) where quantum computers are expected to be particularly effective.

(i) Quantum AI technology.
AI technologies, including machine learning and deep learning, enable computers to automatically extract patterns from large amounts of data, such as images and character sequences. Quantum AI refers to the AI models built on quantum computers, which have been previously developed on classical computers, and is gaining attention as a cutting-edge field of research. Quantum AI is expected to improve the prediction performance of models in classification tasks.

(ii) Combinatorial optimization calculations
Combinatorial optimization is a calculation that "obtains an optimum solution that satisfies the conditions from a large number of combinations". For example, in the 'travelling salesman problem', the calculation is to find the shortest route for a truck to return to its starting point after visiting delivery destinations. While it is difficult for classical computers to solve a huge number of combinatorial problems, it is expected that the 'quantum superposition' nature of quantum computers will enable such calculations to be solved efficiently.

Masanori Matsuoka, CEO BlueMeme
The development of software for quantum computers is a key challenge for the future of the IT industry. Instead of waiting for quantum computer hardware to mature, there is value in exploring breakthroughs with what is currently available. We are grateful for the opportunity to collaborate with Kyoto University and will continue to focus on the development of quantum computer applications. We believe that the results will be used not only in life sciences, but also in all other fields.

Masao Nagasaki, Professor Kyoto University
Since the explosion of deep learning technology, the technology has been already used daily for analyses in genome science. In the future, the same will happen to quantum computing technology. In particular, 10,000 whole human genome sequencing data can be generated just from one sequencer. Additionally, the sequencing cost is a few hundred dollars per person. Now the technology is ready as a public infrastructure. In other words, genome science needs high-performance computing with appropriate computational algorithms. One of the demanding solutions is quantum computing; together with it, implementing proper quantum algorithms is a crucial element.

About BlueMeme Inc.
BlueMeme was the first company in Japan to introduce OutSystems, a low-code development platform in 2012, and has been at the forefront of the Japanese low-code development market. BlueMeme utilizes its own development methodology, “AGILE-DX”, which combines low-code technology with agile methods. With the aim of contributing to the international competitiveness of Japanese companies, BlueMeme supports the in-house system development and DX of its customers through unique entrusted development, consulting and training. BlueMeme, company code “4069.T”, has been listed on the Tokyo Stock Exchange since 2021.
https://www.bluememe.jp/

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*Note that this is a joint release and may be distributed in duplicate.
*This release will have no impact on the forecast of results for the year ending 31 March 2023.

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