Emerging AI technologies are powerful tools for genetic research.

Professor Satoru Miyano with supercomputer SHIROKANE

JAPAN'S NEW CENTRE OF GRAVITY FOR CLINICAL DATA SCIENCE

On a mission to mine its wealth of data for clinical insights, **THE TOKYO MEDICAL AND DENTAL UNIVERSITY** has established itself as Japan's new hub for AI-driven clinical data science.

With more than 900,000 patients treated at its hospitals each year, the Tokyo Medical and Dental University (TMDU) has amassed an enormous trove of clinical data with great potential to advance clinical knowledge and improve the quality of healthcare. However, such an extensive store of data for clinical insights can be useful only by harnessing powerful AI-enabled data science and supercomputing platforms — like those assembled under the TMDU's new Data Science Center initiative.

"Our hospitals generate huge amounts of data, but it's being only used by clinicians to treat individual patients, and not for the broader benefit of society," says the centre's director, Satoru Miyano. "The datasets are too large and complex to be analysed by humans, so we need AI to do the analysis for us. For this, we need a data platform much larger and more powerful than anything currently available for medical research in Japan. With the Data Science Center, we're building such a platform."

Established in April 2020, the Data Science Center combines state-of-the-art data infrastructure with unprecedented access to supercomputing facilities, including Japan's new supercomputer Fugaku at RIKEN's Kobe campus, which will enable deep AI-driven analyses of genomic and molecular data.

"We're also gathering and partnering with the best minds in AI from all over Japan, including Fujitsu's Artificial Intelligence Laboratories, the University of Tokyo and Keio University," says Miyano. "But we need more. We need people who can transform clinical data into knowledge, which can then be used to make healthcare more precise. So we need data scientists, statisticians and biostatisticians who want to use AI to dive deep into clinical data to generate new and powerful clinical insights."

The promise of AI

Miyano previously led the University of Tokyo's Human Genome Center and was invited to lead the Data Science Center by TMDU's outgoing president, Yasuyuki Yoshizawa.

"The new centre is a real opportunity to take our groundwork from the Human Genome Center and create a more powerful platform for clinical data science," says Miyano. "The SHIROKANE supercomputer provided by the Human Genome Center, for example, has been excellent, but it cannot compete with the petascale computing power of the new Fugaku supercomputer, which will usher in a new era of complex AI-enabled genomic analyses."

"AI-BASED GENE NETWORK ANALYSIS IS AT THE CUTTING EDGE OF GENE RESEARCH"

Genome sequencing is a routine part of diagnosis and research at TMDU, and clinicians, researchers and students have ready access to the sequencing capacity of SHIROKANE via a special arrangement with the Human Genome Center. A typical genome sequencing run on SHIROKANE takes about four hours and with forthcoming upgrades this could be slashed by more than half. However, Fugaku — now the world's fastest supercomputer — will be able to run around 4,000 sequences per day when fully optimized, opening up new opportunities for how genes are analysed.

"AI-based gene network analysis is at the cutting edge of gene research and promises to provide breakthrough clinical insights," says Miyano. "This type of analysis looks for the relationships among genes. It involves looking for correlations and similarities among tens of thousands of genes across many genomes, or even among many individual cells. This would be impossible without AI or a supercomputer like Fugaku."

Through Miyano's role as a principal investigator for a cancer research project utilizing Fugaku, the TMDU's Data Science Center is the only medical school in Japan with access to this new supercomputing resource, putting it at the forefront of the country's medical research.

"By using AI to analyse changes in gene networks, we expect to understand mechanisms like the transition of cancer from initial colonization to metastasis, where it enters the bloodstream," says Miyano. "We know that this transition occurs, but we don't know what triggers it. Research like ours using AI tools that we will develop through the Data Science Center will help unlock these mysteries."
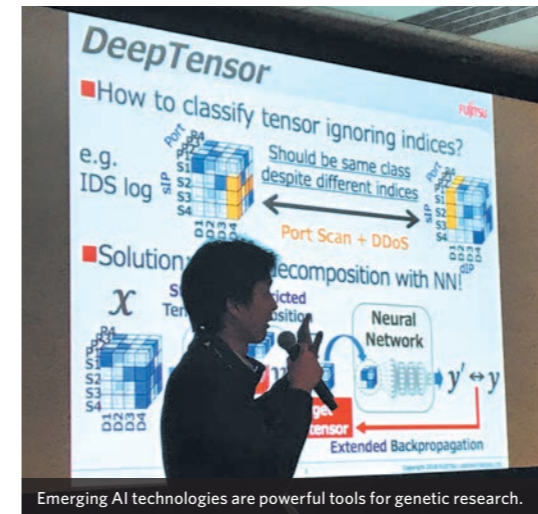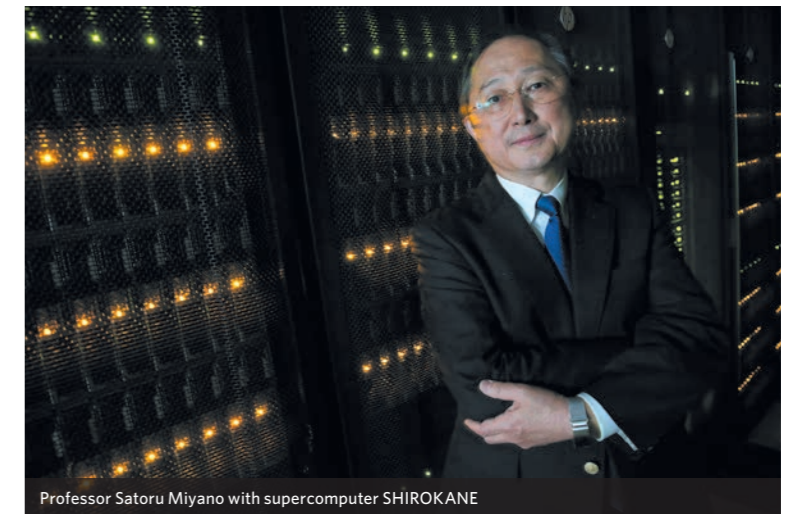
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Supercomputer Fugaku will greatly accelerate genetic analysis.

A focus on the next generation

"When I started trying to assemble experts to lead the AI programme, I found there are very few data scientists and statisticians with the right background to explore clinical data using AI," recalls Miyano. "So a major objective of the Data Science Center is AI education, to train the next generation in AI starting from a student's formative undergraduate years."

TMDU's goal is to establish a pioneering graduate school of AI education that, coupled with the Data Science Center's AI platform, will serve as a model for other medical data science centres in Japan.

"The democratization of data is vital if we are to continue to advance healthcare. In the future, particularly in Japan, there will be fewer physicians relative to patient numbers, and it will be essential to extend the concept of healthcare beyond traditional clinical practice to include data-driven precision medicine. For this, AI — and the technical expertise to use it effectively — will be indispensable. With the Data Science Center, TMDU is now leading the way in Japan as a bridge between hospitals, clinicians and companies to progress clinical data research," says Miyano. ∎

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