Towards Next-generation AI that Learns from Biological Evolution

Future of Hitachi AI – Aiming for Rapid Advances through Collaborative Research into Versatile Intelligence with Kyoto University

Hitachi is currently in the process of commercializing Hitachi AI Technology/H, which automates optimization and decision-making in various ways through the utilization of large volumes of data, thereby contributing to improvement in outcomes for corporations. Meanwhile, anticipating rapidly changing times, Hitachi has also begun research and development of next-generation AI that "learns from life" and evolves to face successive challenges. The Hitachi Kyoto University Laboratory, a new joint research division for collaborative creation with Kyoto University, aims to deliver new type of AI which continually evolves by learning for itself through "learning from biological evolution."

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AI Developed by Hitachi to Increase Efficiency and Improve Productivity

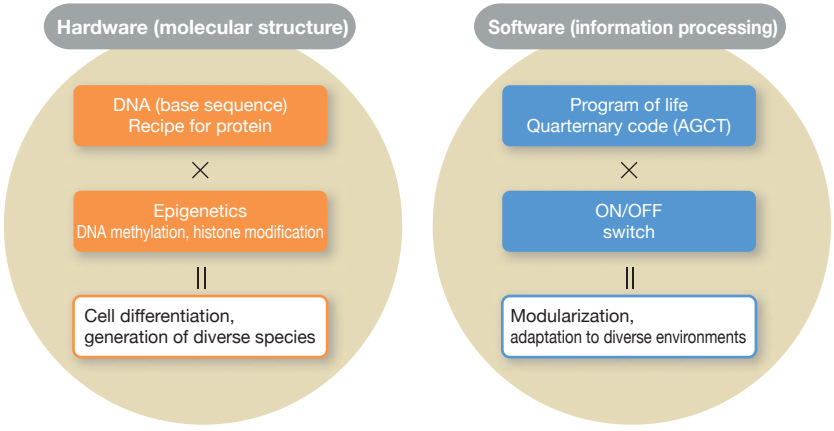
Describe the positioning and purpose of artificial intelligence (AI) in research and development

Tanizaki In the future, connecting data about people and things with the Internet of Things (IoT), analyzing the big data thus gathered and translating this into improvements in efficiency will be essential to solve society's problems. To achieve this through collaborative creation with customers, Hitachi launched the IoT platform Lumada in May 2016. AI will play an important role on the data analysis side of this initiative.

One type of AI is Hitachi's proprietary Hitachi AI Technology/H (abbreviated as AT/H below). AT/H achieves the target outcome (higher purpose) in a wide range of applications including day-to-day operations, facilities and systems, without the need for customization. A key feature of AT/H is that it can be applied in a wide range of fields and it has already contributed to improving productivity, reducing operating costs and reducing power consumption in 14 fields.

Moriwaki The context for our research into AT/H is that, faced with a rapidly changing world business environment and increasing uncertainty, corporations are having to increase the efficiency and speed of their business operations and adopt a disruptive business model. This cannot be achieved simply by analyzing and visualizing gathered data. Measures that contribute more directly to the target outcome are required. In other words, corporations need to find the optimal solution for achieving the target outcome in a vast amount of data. We, therefore, concluded that, instead of conventional recognition-type AI, discovery-type AI

AI that learns from life



DNA: deoxyribonucleic acid, AGCT: adenine, guanine, cytosine and thymine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focusing on a huge amount of combinations of data was needed. With AT/H, we aimed for AI that supports people as a social platform rather than AI that replaces people.

Mine In the world of AI, deep learning has been in the spotlight recently, and an area where deep learning excels is pattern recognition such as image recognition, speech recognition. Hitachi has experience of handling many types of image data and other data in the sphere of operational technology (OT) for social infrastructure systems, and has drawn on its specialist knowledge and knowhow in the application of AT/H.

Tanizaki This is precisely where Hitachi's strength lies: Hitachi uses a loop consisting of repeated proof-of-concept testing in actual business to detect issues and resolution of any newly detected issues to speed up research and development.

Possibilities for New AI that Learns from Life

Hitachi has also begun research into next-generation AI, right? Tell us about the Hitachi Kyoto University Laboratory initiative.

Tanizaki Last year, the Hitachi Research and Development Group established three centers for promoting collaborative creation with customers. One of these is the Center for Exploratory Research which promotes open innovation with universities. In all, around 30 Hitachi researchers from the Center for Exploratory Research are working at Kyoto University, the University of Tokyo and Hokkaido University. At the Hitachi Kyoto University Laboratory, participating researchers contemplate future societal challenges on the theme "exploration of basics and theory based on an understanding of humanity and culture," aiming to deliver innovation to help achieve both a resolution of those challenges and economic development.

Mine One of the themes of the research is the exploration of next-generation AI. With values and patterns of behavior changing dramatically as a result of the widespread use of information technologies and globalization, we are required to respond rapidly to successive challenges. The type of AI Hitachi focused on as AI to help us to do this is AI inspired by "biological evolution", in other words "AI that learns from life," the next-generation AI that solves problems by adapting to fit new circumstances, evolving like a living thing. Eight researchers from Hitachi joined Kyoto University and began discussions with professors specializing in the field of biology.

Tanizaki There are two sides to this research. Besides developing more sophisticated AI that learns from life, we are also examining how to use AI through investigation into the fundamental problems of human social activity in the light of knowledge obtained through cutting-edge research done by Kyoto University in the past such as primate research.

Moriwaki Previous AI research has focused on the ability of humans as higher organisms to use language, in other words, the sharing of explicit knowledge. However, the type of knowledge required in the future is non-verbalized tacit knowledge that is beyond human recognition. AI that learns from life is an attempt to get closer to utilizing such tacit knowledge and holds much promise as the new direction for AI.

Translating the Mechanisms behind the Creativity of Life into Language of Artificial Intelligence

Describe how you approach research into AI that learns from life.

Mine The area we are focusing on is not the brain of living things but their DNA, or deoxyribonucleic acid. Living things have survived changes in their environment through 4 billion years of evolution and this intelligence is written into their DNA. DNA consists of only four different nucleic acids: adenine (A), guanine (G) cytosine (C) and thymine (T) and DNA is the recipe for making body proteins, so to speak. By combining the protein made according to this recipe with external mechanisms that switch the synthesis of proteins within cells on and off, living things have evolved into many different species through the differentiation of simple cells into cells with specific functions.

We approach this as hardware. We regard the mechanisms of growth and evolution of living things as a world of chemistry, in other words, hardware consisting of molecular structures and chemical reactions that make up living things. Alternatively we can also approach this as a world of information processing or as software. In other words, DNA is a program written in a base-four code—a quaternary code of AGCT, and a system that combines the functions of this program with an on/off switch can be regarded as a biological system that will adapt to a constantly changing external environment. Our aim is to translate the mechanisms behind the diversity and creativity of life itself into the language of information processing in order to realize a new type of AI.

Hitachi has done collaborative research with universities in the past. How is this research different?

Mine In past collaborations, Hitachi usually set a clear timeframe for the creation of products and services and collaborated with outside researchers to develop the technology necessary to achieve this. This collaboration is different in the sense that Hitachi is focusing on thinking about the future, a much larger societal challenge. By actually working at Kyoto University, Hitachi's researchers are able to hold more in-depth, serious discussions and this is also different from previous collaborations. Through in-depth discussions with researchers not only in the field of biology but in a wide range of other academic fields such as engineering, sociology and ethics, Hitachi's researchers intend to conduct a more far-reaching, in-depth exploration of the challenges facing future society, including the future relationship between people and AI.

Tanizaki Hitachi The University of Tokyo Laboratory aims to develop a vision for a Super Smart Society (Society 5.0) advocated in the "5th Science and Technology Basic Plan." Meanwhile, the Hitachi Hokkaido University Laboratory is focusing on exploration of social challenges and proof-of-concept testing using the regional characteristics of Hokkaido. Through collaboration with various partners including universities, Hitachi aims to achieve social innovation originated in Japan, including developing a vision, proving social value in research and development, and forming an ecosystem in anticipation of commercialization.