Interview #2: Dr. Kazuo Yano

Enterprises of the Future Will Need Multi-purpose AIs

Dr. Kazuo Yano, Corporate Chief Engineer, Research and Development Group, Hitachi, Ltd.

AI (artificial intelligence) was formerly specialized for specific purposes. If an AI is made multi-purpose or versatile, the scope of its application immediately becomes much wider. Dr. Kazuo Yano, a researcher at the Research and Development Group, Hitachi, Ltd., envisioned a concept of a multi-purpose AI from his earliest research, with a strong intention to contribute to the world. He was able to implement the concept as an actual system, thanks to a reverse inspiration that he finally came across over many years of research. Dr. Yano says that AI cannot contribute to enterprises unless it is multi-purpose. In this interview, Dr. Yano continues to talk about his thoughts on AI.

Development of the world's first multi-purpose AI

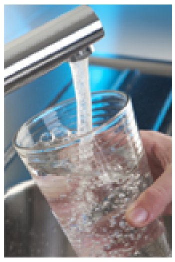
Computers began from Turing machines and eventually increased their versatility. In the early days, you had to reconnect cables every time you did a different operation. However, the von Neumann architecture included programs for such operations and thus increased versatility.

I think that AI (artificial intelligence) actually followed the same path and is now finally entering a phase for multi-purpose use. You might think that the term “AI” is a recently coined term, but AI systems have been used frequently for the last 20 years without much notice. For example, the recommendation functionality found in online stores and web searches consist of AI systems. There is also an AI for chess and an AI for *shogi*, as well as an AI for answering quizzes. All of these are AI systems specialized for specific purposes.

However, we are surrounded by many different problems every day. These problems cannot be resolved by search engines or recommendation engines. As a result, from the fairly early stages of our research into data utilization, we recognized that we needed a multi-purpose AI that could respond to many different problems. In those days, nobody was even talking about AI.

Our multi-purpose AI has resulted in immediate contributions to various businesses

I Many new technologies are developed for many specific purposes. Basically they are specialized for specific purposes. For example, mobile phones originated from phones specialized for car use. In many cases, a landmark change occurs in which the specialized technology is transformed into a multi-purpose technology. This happens when the value is recognized, when the technology is applied to a wider variety of applications, and when costs are reduced. Making a technology multi-purpose reduces costs. The cost reduction makes the market wider, which reduces costs again. In the case of car phones, they gained more versatility and eventually became smartphones.



We thus decided to focus our efforts on multi-purpose AIs from the beginning, based on our forecast that AIs would need to gain such versatility very soon. We also believed that Hitachi was in an advantageous position for developing a multi-purpose AI. Hitachi has a vast variety of connections with industries and customers all over the world, including electric utilities, manufacturers, distributors, finance companies, railway companies, transportation companies, and water supply companies. We thought that Hitachi is a company whose businesses make it a superb match for achieving a multi-purpose AI. Hitachi also has a big advantage in that it can gather data from many different businesses within itself. The resulting multi-purpose AI, called *Hitachi AI Technology/H*, was created exclusively by Hitachi with input from a wide variety of industries. This AI has already been used for 24 projects in 7 fields.

For example, by using this AI, a shop could increase its average sales per customer by 15%, a distribution warehouse could improve its productivity by 8%, a water supply plant could reduce its operating costs, and a call center could increase its success rate by more than 20%. All of these examples are actual results obtained by using Hitachi AI Technology/H.

At the same time, it is easier to deploy a multi-purpose AI system than to deploy many specialized AI systems. Companies have many issues they want to resolve. A retail store, for example, must resolve multiple issues such as determining what the appropriate order quantity is, what the hottest-selling item is, how many employees are necessary, and where items should be placed. It costs too much time and money to create a dedicated AI program specialized for each purpose. A multi-purpose AI can respond to all of these issues with the same software, which makes deployment easier.

Differing "granularities" hinder data utilization

Conventional computers are deductive. In other words, a program is used as the general principle, and if you input conditions, you can obtain more specific results or data. Achieving a multi-purpose AI requires the complete opposite way of thinking. In effect, a multi-purpose AI needs to use inductive processing to derive more general principles for increasing the desired outcome from the data used, which is the result of the specified outcome (indexes including sales amounts and productivity) under specific conditions. In the example of a distribution warehouse, it would help discover more general principles, such as how to schedule tasks and how to position the items in the warehouse, so as to increase the outcome, which is to increase productivity.

This thought itself might seem elementary. However, there were some problems that hindered the development of such an inductive computer. The largest problem was that the granularities of the outcome data and the source data were completely different.

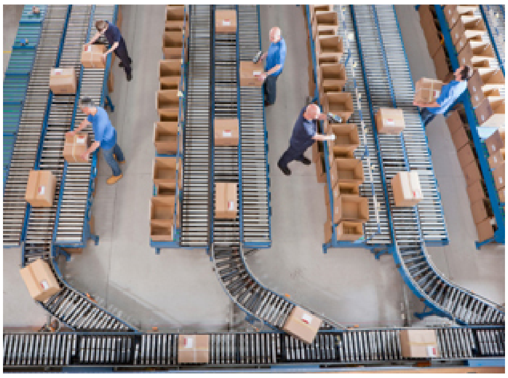
Let me explain this. For example, a desired outcome of golf is to reduce the number of shots. The number of shots is counted once per hole, therefore the total number of counts is only 18 because a round includes 18 holes. However, if you use a GPS or accelerometer, you can obtain tens of thousands of items of data per hole, in units of milliseconds. For a simple outcome, you have an enormous amount of data, in units of milliseconds. How to handle such data, which has different granularity, is a very difficult issue. Many articles explain ideas such as how to determine the correlations among large amounts of data, but it is totally impossible to investigate correlations between two data types with different granularities.

In the conventional method, humans make the hypothesis that "the more practice swings you do, the better the result." There is only one average number of practice swings per hole, and the correlation can be calculated.

However, the hypothesis made by the human does not come with any advantage of using a large amount of data. In the end, you cannot escape from the concepts devised by humans.

We thus came to the conclusion that getting humans to make the hypotheses was meaningless, and we then developed an AI system that can resolve the problem of data granularity and can generate hypotheses automatically. First, Hitachi AI Technology/H makes millions of hypotheses from enormous amounts of data. It then filters the hypotheses, checking them against past data. Then, it selects the essential factors and combines them to make hypotheses that meet the condition of achieving the target outcome.

The same AI learned how to ride on a swing and improved the efficiency of distribution warehouse operations



As an experiment, we made our multi-purpose AI system learn how to ride on a swing. We put a robot with a motor and a gyroscope, with knee joints that move, on a swing and connected the robot to the multi-purpose AI. Then, we set the desired outcome as "to increase the swinging width" but did not teach it how to ride on the swing. The AI had to decide when the robot should bend its knees. In the beginning, the robot moved randomly, and sometimes it could swing well and sometimes it couldn't. However, by chance, it bent its knees in a certain way and could swing wider. When this happened, the AI learned the results and ended up learning in the same what humans learn. Then, we allowed the AI to continue to learn. In the end, the AI created its own unique secret method of bending the knees twice in a swing. We jokingly called this method the "Double Contraction and Expansion" method.

Hitachi AI Technology/H, which learned how to ride on a swing, was also applied to a distribution warehouse. In this case, the warehouse was able to increase the efficiency of item collection by 8%. For the experiment of the swing, the outcome was set as "to increase the swinging width," while for the operations in the warehouse, the outcome was set as "to reduce the total daily operation time." Tasks in a distribution warehouse change substantially, depending on the change of seasons, changes in sales trends, and changes in sales campaigns. It is impossible for humans to make hypotheses based on such an enormous amount of changing parameters. However, the multi-purpose AI system can make hypotheses daily based on the received data, even while humans are sleeping. As a result, the AI was able to improve productivity by 8%.

Take, for example, an enterprise that has an enormous amount of data that is too large to be dealt with by humans, such as sales information and customer information. The information does not have any intent, and a human must decide that the intent is "to increase sales," which is the desired outcome. The user must then input the desired outcome into the computer. Then, from massive amounts of data (Big Data), the computer can generate hypotheses regarding “how to increase sales” and calculate the procedures for this goal. This is what “generating a program from data” means. In the beginning, we searched for a computer that was capable of performing this kind of work, but we couldn’t find any applicable machines. We had no other choice but to create the artificial intelligence software ourselves.

Additionally, it is important to understand that the same program was used for the AI for the swing and the AI for the warehouse. In other words, our AI can create hypotheses for each situation simply by modifying the outcome and the data to be input. We believe that a multi-purpose AI, which automatically creates hypotheses for diverse issues, will be helpful in a variety of business situations.

PROFILE

Dr. Kazuo Yano

Corporate Chief Engineer, Research and Development Group, Hitachi, Ltd.

Dr. Yano joined Hitachi, Ltd. in 1984. From around 2003, he has helped develop world-leading technology that can collect and utilize Big Data. His dissertations have been cited 2,500 times, and he has applied for 350 patents. He is known for the width and depth of his expertise, from artificial intelligence to nanotechnology. Currently, he is the corporate chief engineer of the Research and Development Group. His book, *Invisible Hand of Data*, was selected as one of Bookvinegar’s top 10 business book bestsellers in 2014. He has a Ph.D. in engineering and is an IEEE fellow.