Interview with Hitoshi Matsubara, Professor of Future University Hakodate & President of the Japanese Society of Artificial Intelligence

# Artificial Intelligence (AI) on Verge of Making Dreams Come True

By *Japan SPOTLIGHT*

**Many kids must have dreamt about talking with humanoid robots with AI, inspired perhaps by Hollywood movies or in Japan by the popular old animation "Astro Boy" in which a humanoid robot was a good friend of humankind. This has not yet been achieved in reality, but with the recent news that AI has beaten human professional Go players, these childhood dreams may be moving closer to fulfilment.**

**Prof. Hitoshi Matsubara, president of the Japanese Society of Artificial Intelligence and a distinguished authority on AI in Japan, also has such a dream. He has organized Shogi chess matches between professional players and AI, and also had AI write a novel. For the cover story in this issue, *Japan SPOTLIGHT* interviewed him to find out what he thinks AI will be able to achieve in the future, how our society will change accordingly, and what limits AI should have.**

## What Is AI?

**JS: First of all, we need to define what AI is. How different is AI from robotics, for example?**

**Matsubara:** To tell the truth, there is no clear definition of AI even among experts. In 1956, Marvin Minski, who died in January this year, and his young fellow scientists working on subjects related to AI, got together in Dartmouth in North America to discuss the future of their work. They discussed what to call their work and finally concluded it should be called AI. They did not exactly define it but named their research area as AI. Thus we do not have any clear definition. But I guess the general consensus among ourselves is that research on achieving human intelligence by computers should be called research on AI.

*Hitoshi Matsubara, Professor of Future University Hakodate*

There is another perspective on AI called cognitive science, which is a kind of natural science. Human intelligence can be observed and measured by computers. By taking advantage of this, you can create a self-learning machine. What we call "deep learning by themselves" is not indispensable for AI, but any computer program which can behave with human intelligence would qualify as AI.

There is no clear distinction between AI and robotics. I would say that AI has a focus on intelligence, while robots focus on actions. But of course, there are many overlapping aspects between them. There are many people like myself working on both AI and robots. In terms of the computer programs used for them, we call those embedded into a computer AI, while those embedded into a robot are considered to be a part of the robot itself.

## Potential of AI

**JS: AI seems to have a wide range of impacts upon human life and economy. For example, this year the World Economic Forum highlighted AI and there emerged concerns that AI might take job opportunities from human beings. As someone who has organized games of Go and Shogi between human players and AI, and literary competitions for novels written by both human authors and AI, to what degree do you think AI could potentially do what human beings can do?**

**Matsubara:** We have had a 60-year history of AI, since the first AI experts meeting was held in 1956, as I said. During this time, we have seen three big rises in the popularity of AI. The first was in the 1950s when AI was born and the second was in the 1980s when the Japanese Ministry of International Trade and Industry launched its

fifth generation computer project. But that second rise ended in disappointment, unfortunately. The third boom is currently underway against the background of significant improvements in a computer's functions.

The key point about the quality of AI is how quickly it could respond to questions. We are now seeing a significant improvement in functional quality in this regard. For example, with AI applications embedded into a smartphone, you can rapidly find which station you would need to change at in order to reach your destination quickly. You can also use Google's search engine or Amazon's reference system: both are applications of AI.

Because of such convenient systems, the decisions we make in our daily lives increasingly depend upon AI. In another decade or two, we will be even more dependent upon AI. We would become far more intelligent with computers, because as computer intelligence makes progress, human beings will be the main beneficiaries of its merits. With the help of computers and AI, we would be able to get the information we need much more quickly than before. Though some may lament that human competency may decline due to this increasing replacement of human activity by AI, overall human beings in collaboration with computers are getting wiser and wiser.

**JS: AI can already play Go better than a professional player. With a greater capacity to learn by itself, AI could do many things much better than humans, such as selling goods in a department store. To what extent do you think it will be able to do this?**

**Matsubara:** The capacity to learn by itself would provide AI with the possibility of becoming much wiser than a human being. By learning data on human actions, a computer could reach a stage of singularity where AI could achieve better decision-making on social issues than humans can. However, whether we can leave social issues like economic policy choices upon which our destinies depend to AI would be another question. Human beings have never been caught up with by any other creations in their history, but now they are getting rather embarrassed with AI winning Go and Shogi chess games against human professionals. We will have to think about how to work with AI in the future. AI will increasingly replace human operations, at first just routine work but then gradually work that involves a decision-making process. Assuming that Go and Shogi games are complicated enough, many jobs in our economy equivalent to those games in terms of their complicatedness would be to a large extent replaced by AI.

**JS: According to Prof. Noriko Arai at the National Institute of Informatics, we could take advantage of AI in university education by enhancing students' ability to read and understand Japanese literature, assuming it would be an area least likely to be replaced by AI. You are the leader of a project using AI to write a novel. Do you think AI could gain a greater capacity to understand literature?**

**Matsubara:** Yes. Although human understanding of literature is far better than AI's at the moment, I believe there will be an AI with a greater capacity to understand literature in the future. On the question of the role of college professors, AI could do their routine stuff far better than humans, such as providing students with suitable subjects to study. But I do not think even with such AI that university professors will disappear. They should have their own work to do, but with AI we can certainly expect a significant rise of efficiency in education. AI could have a precise understanding of each student's academic abilities, even in the case of mass education where many students are learning in the same class. AI could determine what to teach depending on the outcome of short exams held frequently to gauge how much progress each individual student has made. This could be one advantage of education under AI in comparison to a human professor who cannot help but teach in accordance with the level of the average student. Teachers must discover what only a human can do in order to avoid losing their jobs. I can tell you one thing for certain: teachers in kindergartens and elementary schools must be human beings even in the future, because their mission is helping develop good personality, while university education is for producing experts. Personal development must be left only to human beings.

## Japanese Society of Artificial Intelligence

**JS: Could you briefly tell us what the Japanese Society of Artificial Intelligence, of which you are president, is currently doing? And could you tell us about your academic career and how you became interested in AI?**

**Matsubara:** Our society was founded in 1986 and we will have a 30th anniversary event this autumn. The Japanese Society of Robots was founded in 1983, so we can say it was in the 1980s that the

study of AI or robots was officially acknowledged. Our society now has 4,000 members, ranging from college students and professors to private companies' researchers. It was founded around the time I finished my PhD and started working for the National Institute of Advanced Industrial Science and Technology. I joined the society as an editorial staff member and now work as the president. So my own history of professional work experience overlaps with the history of the society.

I was born in 1959 and when I was four an animation about an android called "Astro Boy" started. My friends were charmed by the robot but I was charmed by its creator. I dreamt about becoming an engineer who could create a robot. I have been lucky to see my childhood dream come true, since I am now working on creating robots and AI. When I started my professional career as a scientist, I was well aware that AI would be my final goal.

## International Competition

**JS: It is said that Japan has an advantage in robotics as it is an optimizing technology, as in the case of automobiles in which Japanese industries are so competent. What do you think about this view?**

**Matsubara:** It is certainly true that Japan has an overwhelming advantage over other countries in this field. In particular, in the domain of humanoid robots Japanese industry has a significant competitive edge. However, as for AI corresponding to the brain of a robot, the US has never conceded its No. 1 position to any nation for 60 years. AI in Japan is behind the US by about 30 years, I guess. The Japanese are not so good at handling the philosophical aspects of AI, a concept that requires in-depth understanding of software. But Japan would now be top of the second group including European countries. The third group including South Korea or China are now rapidly catching up with Japan, and may actually catch up soon. These last couple of years, AI in Japan has fallen behind the speedy progress of US companies like Google, Facebook, Microsoft and Apple.

However, I believe that it would be possible for Japan to reduce the gap with US companies, while maintaining its top status in the second group. Since last year, Japanese industries such as automobiles or IT companies, as well as the government, have strengthened their R&D activities in AI. Competitive advantage often comes from a nation's social and political background as well. For example, even in the domain of robots, the US has a competitive advantage in the rescue robots used for emergency operations to help tackle the Fukushima nuclear power plant accident in 2011, since they use such robots for military purposes too. Japan has a competitive edge in robots, including humanoid ones, used for communication in peaceful times.

## Openness in Promoting R&D

**JS: On the question of inter-organizational collaboration which would be necessary to enhance the competitiveness of AI in Japan, will it be necessary to promote greater openness by each organization?**

**Matsubara:** Yes, that will be necessary. It is certainly true that as expertise relating to the development of AI deepens, communication and collaboration among experts in different research areas will become increasingly difficult. Experts would tend to focus on their own narrow interests and not on the overall progress of AI. In our society, there are a number of groups specializing in a certain topic and each group cannot understand what the other groups of researchers are doing. The National Institute of Industrial Science and Technology and the Institute of Physical and Chemical Research, both central institutes of science and technology in Japan, are therefore organizing a large-scale and comprehensive research project enabling all the participants to understand each other's research efforts.

**JS: What the Japanese government is today pursuing seems to be essentially promotion of open innovation. Do you think this is the right direction for AI as well?**

**Matsubara:** Yes, I think so. For example, in a recent match between Google's AlphaGo and the world Go champion Lee Sedol, the former defeated the latter. I have been involved in such projects on matches between professional human players and AI in Go and Shogi for several decades and in my experience these matches are truly a good venue for open communication and interaction among AI experts. Experts participating in these events will openly discuss the specific ideas that could be interpreted as the key to their victory. The victory of Google's AI in this light can be considered a good outcome of such open communication among experts so far, though Google has been involved in the project since only two or three years ago. Fortunately, at this moment, Google is positive about opening up to the public its basic software having achieved this victory over the world Go champion. If this happens, dissemination of such knowledge could help promote greater happiness.

**JS: What other public policy do you think will be necessary to promote AI and robots in Japan to enhance their competitiveness?**

**Matsubara:** What we learned from the Go match between AI and the champion was that the key to the success of AI will be human resources creating the programs and computing environment for AI. We will need creative engineers providing new ideas, but at the same time we will need Graphics Processing Units (GPU) for deep learning – that is, a computer for three-dimensional graphics to make a computer game appear a real match. This sort of computer works very well for deep learning and the best ones are very expensive. Google produces such a GPU itself. For this Go match, Google used

more than 100 of its best GPUs. You could learn about its algorithms for winning after reading its research papers, but Google is probably the only company that has such top-quality computers achieving such algorithms.

Therefore, I believe that our national institutes currently collaborating to found a new joint research center should have such a venue in Japan engaged in deep learning use such GPUs in common. The differences in computing environments could lead to a fatal loss of competitiveness, and this is a key question that should be addressed by public policy.

In addition, we still have a barrier between basic research and application research, which are mostly divided by the jurisdictions of various ministries. I would like the government as a whole to take the initiative in coordinating both groups of researchers and integrating them into a team engaged in research on AI beyond ministerial jurisdictions.

**JS: Given that AI could have a wide range of impacts upon our society and economy, would we need greater horizontal cooperation among different players?**

**Matsubara:** Yes, we would need cooperation from a whole range of experts, such as psychologists and brain specialists. We will need an open and flexible research community which such experts from various areas are welcome to join.

## Impact of AI on Jobs

**JS: AI will have a significant impact upon our economy. It could enhance labor productivity, and as productivity increases our economic growth rate will rise, thus leading to more job creation. Or it might replace human labor and thus job opportunities for human beings will decline. Which do you think will happen?**

**Matsubara:** I would assume that an increase in productivity thanks to AI would ensure income growth for all, in particular in Japan where the population will decline in the future. On the other hand, the jobs which human beings are expected to do will change as AI develops. Throughout human history, as science and technology has advanced, so the content of our work has changed. For example, in the old days a station clerk used to snip a ticket with scissors at a counter to let customers get on a train and another clerk would collect the tickets when the customers got off. But even now, despite ticket gates at stations being automated, there are still station clerks working there. This means the nature of a station clerk's job has changed. As AI develops, so similar changes will happen. I do not think, then, we have to worry about any loss of job opportunities. With the progress of computers, we have already seen many new jobs for programmers or system engineers created.

However, it is true that with the rapid progress of technological innovation, the knowledge that we acquired in our young days would also quickly become obsolete. You cannot earn your salary when you are 60 with the knowledge and expertise that you learned at the age of 20. The speed of innovation will be accelerated with AI and human beings may find it difficult to keep up with this rapid progress. But if you adjust well to this rapid progress, you would be able to expect a rise in salary.

However, if that does not happen, there might be an increase in income inequality between the beneficiaries of AI and the non-beneficiaries. To avoid this, we should do our best to spread the benefits of AI to as many people as possible.

## Role of Ventures in AI

**JS: You mentioned the need for collaboration among a variety of players. How about collaboration with venture businesses?**

**Matsubara:** Venture businesses are very active today in the area of AI and I guess their contribution will increase from now on, in particular in the domain of learning machines. In Japan too, many competent ventures are achieving significant performance. There are lots of big companies in Japan which could gain valuable knowledge from their existing data by using AI and they could collaborate with ventures using this knowledge for mutual benefit. Such business alliances between the big companies and new ventures have already begun and will soon increase significantly, I believe. The emergence of such ventures would be a good sign of progress in Japanese AI.

JS

*Written with the assistance of TapeRewrite Corporation.*