

Hiroyuki Miyazaki

Senior Researcher, 3rd Research Department

Table 1. Investment in Day Planning

Information and communications technology (ICT) in the area of artificial intelligence (AI); epitomized by the emergence of big data, cloud computing, and the internet of things (IoT); has developed at a dazzling speed in recent years and is having a significant impact on the societal economy. As a result, there is a strong possibility that the collection, sharing, analysis and use of information, across organizational, corporate and industrial areas, will dramatically improve the overall productivity of societal systems. However, to realize this, changes in societal systems and mechanisms are necessary.

At HRI, we intend to verify the impact of AI related ICT innovations on the economy and industry. Furthermore, we are studying measures which will enable us to respond to societal issues.

1. AI initiatives on the rise

In an image recognition competition in 2012, the University of Toronto announced that after 50 years of research it had achieved a major breakthrough using deep learning in AI. Researchers at the university had narrowed the error rate in image recognition, which had remained at around 26%, to a performance of around 16%. With the emergence of deep learning, there was a surge in interest in AI. This interest, coupled with improvements in information devices which process data, such as servers and storage systems, resulted in various initiatives.

This article will introduce some major initiatives in AI in recent years. To accelerate AI development centered on deep learning technology, companies like Apple, IBM, Microsoft, and Amazon have been moving ahead with the acquisition of venture companies and the establishment of research institutes (Table 1) as interest in the applications of AI increases (Table 2).

2. Innovation through deep learning

In image recognition, until now, people had computers solve problems by inputting algorithms and data. However,

Company	Year	Details
Amazon	2012	Acquired Kiva Systems, U.S.
Google	2013	With participation of Ray Kurzweil, acquired DNNresearch, U.S., headed by Dr. Geoffrey Hinton
	2014	Acquired DeepMind Technologies, Great Britain
Baidu	2013	Established a research institute in the Beijing, China
	2014	Established a research institute in the U.S. and appointed Andrew Ng as chief scientist
Facebook	2013	Established a research institute in the U.S. and appointed Yann LeCun as director
	2015	Established a research institute in Paris, France
Dwango	2014	Established a research institute
Recruit	2015	Established a research institute

Source: Prepared by HRI from various sources

Table 2. Applications of AI

Company	Year	Initiative
Apple	2011	Siri (voice recognition)
IBM	2011	Watson (self-learning)
	2014	Chef Watson (cooking recipes)
Microsoft	2014	Project Adam (image recognition)
		Skype Translator (translation)
Knightscope	2014	K5 (security robot)
Amazon	2014	Amazon Dash (voice recognition)
		Amazon Fresh (fresh food delivery)
		Amazon Prime Air (drone delivery)
		OAK4 (autonomous delivery robot)
	2015	Amazon Echo (voice recognition)
Google	2014	Google Chauffeur (automatic driving)
	2015	Google Translate (translation)
Facebook	2015	DeepFace (face recognition)
		Torch (open-source deep learning)

Source: Prepared by HRI from various sources

in the case of deep learning, the computer itself prepares the algorithms. Moreover, using massive amounts of image data, it learns by itself, determining those characteristics which define what a thing is, or is not. This ability to self-learn and identify characteristics without human assistance is the innovative aspect of deep learning.

When human beings recognize images, there is said to be an error rate of around 5.1%. In initial trials using deep learning in 2012, the error rate was around 16% but in 2015, Microsoft achieved a rate of 4.9% and Google, 4.8%, surpassing human accuracy.

3. Application of AI in the economy and industry

In the societal economy, where we conduct our daily activities, shortcomings associated with unreasonableness, waste, and incongruities are ever-present. As a result, people and companies often conduct their economic activities in inconvenient, inefficient, and unfair circumstances. This is due to the remaining barriers between organizations, companies and industries which fail to “connect” rationally and efficiently within the societal system as a whole. Ongoing innovations in ICT are overcoming these barriers and achieving integrated information collection, analyses and application. As a result, ICT may well dramatically enhance the overall productivity of human systems. Therefore, the analysis and optimal application of information that has been collected in real-time through IoT and shared across organizations, industries, and companies using AI, will facilitate minimization the above unreasonableness, waste and incongruities.

At HRI, we will determine what AI is now capable of achieving through deep learning, what it is likely and unlikely to be capable of achieving going forward, and we will verify its application in the economy and industry.

Image recognition is one area where AI can presently be applied (Table 3). It can also be used in security, advertising and consumer technologies. In calculation speed and memory capacity, IT devices already exceed human performance. In the future, security procedures, purchasing analyses and the autonomous operation of

machines beyond the accuracy and limits of human beings will also be possible. It is also conceivable that AI will be capable of conversation with human beings, language translation, and performing housework and nursing care. However, it is difficult to foresee deep learning, a classification technology based on the identification of characteristics, facilitating functions such as setting and solving problems, or having its own will or desires.

The following are some examples of plausible problems where the achievement of “connections” using deep learning can be expected to enhance efficiency and convenience, and bring about societal and economic benefits.

Table 3. Industrial applications that will make deep learning possible

Technology	Application	Realization Phase
Recognition	Identification of voices and sounds	In use
Multi-recognition	Identification of moving images and prediction of behavior	Under development
Robotics	Autonomous operation of machinery	Under development
Response	Comprehension of environments and emotions	To be developed
Symbol recognition	Conversation, translation and interpretation	To be developed

Source: Prepared by HRI from various sources

In the area of energy, electric power suppliers and customers will realize “connection” structures suitable in both price and service through market mechanisms. In the area of transportation, people will realize structures that can suitably “connect” public transportation, such as rail and bus, to personal methods of transportation, such as cars, at a local level. In industry and manufacturing, the manufacturing value chain will achieve structures that “connect” areas beyond industry and manufacturing. These connecting structures may well be realized through AI and ICT.

4. Corporate management based on cooperation with AI and people

The development of AI will also change corporate management. Recognition, prediction and intervention

through AI will be treated as a valuable reference information across various areas for people to base decisions on. To reap the benefits of AI, companies will need to do two things: store the necessary big data, and become conversant with AI.

Possession of big data will require collection of data across personal, organizational, corporate and industrial sectors. By the time this is achieved, ICT may be capable of maintaining the confidentiality and security of data. However, technology cannot provide answers to issues such as developing incentives for providing data and cultivating a sense of assurance regarding concerns for privacy and confirmation of data ownership.

There is also the question as to whether people will comply with AI decisions when presented. In an experiment conducted by the University of Pennsylvania, people showed a tendency to prefer human decisions over those of AI, even when the former happened to be incorrect. In other words, people remain somewhat suspicious of decisions made by AI.

For companies to own big data and make use of AI, resolution of these issues and development of management capabilities to flexibly connect human beings with big data and AI will be necessary. In this way, it will be possible to improve efficiency in areas such as AI management, resource planning, asset management, and supply chain management.

It is important to actively apply AI to society and industry with a clear understanding of what can be achieved through deep learning based AI innovation. HRI intends to continue to monitor trends in AI related ICT, and will research the associated impacts on society and industry.