The Coming Era of Mathematical Capitalism

–How the Power of Mathematics Changes Our Future–

<Summary>

March 26, 2019

Industry-Academia Round-Table Discussion to Encourage Human Resources in the Fields of Science and Mathematics to Play Important Roles in Industry

International society is now considered to be facing the advancement of the “fourth industrial revolution,” a new trend in which dramatic dissemination of IT equipment and the implementation of AIs, big data, IoT and other advanced technologies in society not only causes a digital revolution, of which people are aware in every social situation, but also stimulates businesses to cultivate new markets of innovative digital products, services and systems.

We believe that we have identified the top three science priorities in order for Japan to lead the fourth industrial revolution and to even go beyond its limits: mathematics, mathematics, and mathematics!

Let’s look at an example of AIs that have accelerated the fourth industrial revolution.

The arrival of deep learning technology worked as one of the triggers of the current, so-called “third AI boom.” Deep learning technology is a new algorithm for mechanical learning, and mathematics lie at the core of the algorithm.

As AI technologies are developing, more and more businesses need human resources with knowledge or ability in mathematics and this situation will motivate more businesses and societies to directly make use of such human resources. For example, human resources with ability in mathematics can highly execute such knowledge not only in data analyses, but also in modeling or simulating. In particular, in the field of collaboration and cooperation between AIs and people, knowledge of mathematics is strongly indispensable for businesses to further enhance the reliability of control of AIs, data to be learned, and estimated results. Moreover, if businesses intend to create groundbreaking innovation in AI per se, human resources with sophisticated knowledge of modern mathematics will be decisively significant for such businesses.

Looking at the field of deep learning that has made a huge impact on society, businesses have already started a race of developing AIs that will exceed the limits of current performance. Development of more sophisticated AIs requires human resources with a higher knowledge of mathematics.

It is not too much to say that “winners in the field of mathematics are winners in the fourth industrial revolution.”

Furthermore, as the end of the Moore's law era is coming into sight, businesses have been advancing a race of the development of computing technologies using new principles, such as quantum computers. In this trend, human resources who may manipulate such technologies should be those who have higher knowledge of mathematics and are able to make full use of the knowledge.

The fact that mathematics is an essential element for digital technologies is not the only reason why businesses facing the fourth industrial revolution require human resources with mathematical ability.

Businesses facing the fourth industrial revolution are strongly required more than ever to abstract and generalize specific challenges, take an overview of the challenges, and solve them in a comprehensive manner. Mathematics is the exact approach that businesses should take to abstract and generalize such challenges.

In addition, mathematics is the foundation of many science technologies in a variety of fields. Life science, nanotechnology, environmental science, materials science, physics, chemistry, financial engineering, economics and sociology are all such examples. Mathematical progress is expected to bring about development of these fields as well as permit businesses to conduct cross-sectoral, interdisciplinary research and development through finding common challenges among different fields by placing mathematics at the core.

Some experts point out that the majority of current mathematical approaches that have been applied to industries and societies are based solely on 19th-century mathematics. This means that the field of mathematics after the beginning of the 20th century is a broad, undeveloped frontier area, which no one has ever cultivated. If businesses hope to create breakthrough innovations, they must cultivate this frontier. In this context, businesses seem to not have any more time to wait for starting investment in mathematics-based research and development and fostering human resources with mathematical ability.

As described above, the ongoing advancement of the fourth industrial revolution tolls the arrival of the era of so-called “mathematical capitalism,” i.e., an economy in which mathematics brings about sources of national wealth.

Mathematical capitalism, a new economic system emerging after a period of about 2,500 years since Pythagoras stated, “All is number,” seems to most glaringly represent this statement.

What management or social system is suitable to the era of mathematical capitalism, a time in which industries foster human resources expertized in the fields of science and mathematics to bring out their higher ability of mathematics and connect it to innovation? Such management or social system is expected to be a novel one, different from conventional systems. Despite this expectation, all countries and companies are still working to find specific solutions to this question. If any country or company uncovers an optimal solution to the question ahead of other countries and companies, it will be the winner in the era of mathematical capitalism.

Accordingly, Japan has sufficient potential to become such a winner.

As Japanese industrial players are becoming aware of the fact that they are facing the approach of an era where higher knowledge of mathematics determines companies’ competitiveness backed by the arrival of the third AI boom, an increasing number of Japanese companies have been engaging in proactive recruiting of human resources expertized in the fields of science and mathematics. The academic sector as well is about to start proactive efforts for supplying such human resources to mathematics-based projects under industry-academia collaboration or to industrial players, as seen in an academic trend in creating a faculty of data science. Japan should expand this trend and further consolidate it.

In addition, the level of mathematical ability in Japan is as high as in other countries and Japan is rich in young human resources with outstanding mathematical ability. To foster such human resources and provide them with opportunities to play leading roles in the future, the industry, academia and government sectors of Japan should closely collaborate and cooperate, further develop the field of mathematics in Japan and strongly advance the development of the field of science by integrating the field of mathematics and other fields.