Informatics is the Forefront of Philosophy†

Makoto Nagao

Introduction

The Intention of This Book

The computer was born on the occasion of the World War II. It was considered to be a machine that not only performed calculations but also had the ability to simulate the human brain. If we could express what the human brain is doing in the form of an algorithm, it could be realized on a computer. The possibility began to be considered by many computer scientists in the latter half of 1950s, and has led to today's artificial intelligence after many twists and turns. In this way, the position of the informatics is spreading in which it tries to clarify the working of the human brain from the computer side as a model.

Meanwhile, the work of the human brain has been a concern from the ancient Greek era and has been debated in the field known as philosophy until today. Various things have been considered in that long history, but unfortunately, it was only discussed in the world of thinking, probably because there was no such thing as today's computer as a tool that could be used for research. For this reason, the concepts, verbal expressions, and discussions there have always been ambiguous and misunderstood. It was argued that the meaning of what Plato said was this or that, and it can be said that progress in the world of philosophy was slow.

However, what many of the wise have discussed from ancient Greece over 2,500 years can be a reference for what is done in today's informatics and artificial intelligence research. In addition, if it is possible to clarify how this long history of philosophy is linked to the study of brain models (artificial intelligence) that uses the powerful research tool, computer, there is a great benefit for both philosophy and informatics.

Of course, there is a limit to elucidating the working of the human brain by means of computer. The activities of the human brain are clearly done at the biological level, and its thorough elucidation must be done neurophysiologically. However, it will take a considerable amount of time until this approach allows us to clearly understand the working of the human brain, and we cannot wait until the findings obtained from it are returned to the society. Thus, it is probable that there is a great meaning in connecting to many societal applications by modeling the working of the human brain at the conceptual level, that is, the level of computer

† This is a post-edited translation that uses the results of machine translation to the maximum possible extent.

and informatics.

While discussions in philosophy so far have been conducted at the conceptual level, efforts have been made to make arguments more accurate by the analytical philosophy developed in the United States, and today they have a powerful tool for the argument called computer. As a result, the fact that the philosophical argument can be refined empirically will have a great impact on the future philosophy. There is nothing more to ask for if this book presents a starting point for that.

However, in informatics and artificial intelligence research, it is a concrete memory representation and algorithm representation on the computer, so how to connect the world of concept and the world of algorithms becomes a big issue. The former is very ambiguous, while the latter is a world of 1 or 0 which does not allow ambiguity. However, since attempts to fill this large gap are being made aggressively in the latter, smooth connections between the philosophical world and the informatics world should be realized in the near future. At any rate, we have entered the time of having discussions of philosophical topics formerly discussed at the level of vague concepts by performing concrete simulations on computers and demonstrating the validity of the model. In that sense, informatics is at the forefront of philosophy.

In this book, Part I introduces roughly the topics in the history of philosophy so far that are related to today's informatics within the scope of my understanding (although there is a possibility of misunderstanding). Then it will discuss how it is being realized in today's informatics. Unfortunately, however, since what is developed in informatics are not inspired by what is discussed in philosophy but are what the researchers involved in informatics thought on their own. Because of this, there is a considerable gap between the two. Rather, there are many cases where it is necessary for informatics to accept many ideas from the world of philosophy—the study of the humanity—and to be careful not to cause problems when the achievements of informatics are used in society. For example, the issue of how virtual world technology affects human psychology is an issue that cannot be concluded easily, but it will have to be done better with the help of psychology and cognitive sciences that follow the flow of philosophy.

In Part II of this book, I will give a personal view on some of the issues currently handled by informatics of what can be said when thinking philosophically, how they can be incorporated into models of informatics, and what will be the direction to go from now on. In addition to thinking about the future of informatics and artificial intelligence, we will also consider the way of being of human beings.

Philosophy has traditionally distinguished the mind and body and discussed the working of

the mind exclusively. It lasted from the era of Plato and Aristotle, to the era of Kant and Hegel. Descartes wrote "Passions of the Soul" and carefully examined the relationship between the working of the mind and the body, but he is widely known for claiming that it is important to think logically, on the assumption that the working of the mind is unique to humans. If we liken this idea to a computer, it can be considered that the body corresponds to computer hardware, and the mental activity corresponds to software and programs. Computers can work in any way by programs and probably can simulate the working of human spirit. In particular, it is important in recent years that programs capable of automatically changing computers according to various data and environments are developed. We could possibly say that, with the computer's ability to change itself voluntarily, in other words by having the automatic learning function, the computer has gained infinite possibilities. This is commonly referred to as artificial intelligence, and I would like to discuss its possibilities and limitations at the end of this book.

The following is a summary of what we are going to discuss in this book.

(1) Informatics treats information activities in the human brain as a model

(2) The book discusses what and how ancient philosophers argued, and how it can be helpful in the development of informatics

(3) A representative example that simulates the human brain is artificial intelligence, and the book will consider the human-like functions that it should have and its possibilities for the future

Part I

History of Western Philosophy and Informatics

1. Beginning of Western philosophy

1.1 Socrates and Plato

The beginning of Western philosophy is in ancient Greece, as everyone says. Around 500 BC, many people had questions about what the basis was of what constitutes the world, and many made various proposals. The idea that fire, water, air, etc. are the basic units was proposed. Why did this idea come up? The world and the universe are constantly changing. They are constantly changing as flowers bloom and trees grow and wither, and there may be something that never changes among them. There are basic elements that make up this universe, which are combined to make everything we see, which then may continue to change while they are being recombined. So, there should be something invariant as the basis that make up such changing phenomena. This is where philosophy started.

Meanwhile, there was Socrates (BC 470/469-399), who thought about ways in which a human being should be and about who thinks about such things, looking at humans who compose a society and act with various desires. He is the person that left the famous word "Know yourself" and died immensely in a trial in Athens. Plato (BC 428/427-348/347) was strongly influenced by Socrates's thinking and discussed philosophy more deeply and systematically, and he philosophically established psychology, political science, and state theory. A large number of people gathered at the academic institution Akademeia that Plato opened to fulfill and deepen the academic system. Aristotle (BC 384-322) entered there shortly after Plato's death and organized various things from another point of view. Western classical philosophy was thus created by the three giants, Socrates, Plato and Aristotle, and became the source of the current stream of Western philosophy. There were three major issues that were taken up: what is the root of everything, what is existence, and what is human being and self?

Socrates argued that the eternal truth, good, and beauty were the true knowledge. He spoke of the importance of being aware of how we are ignorant for not knowing those things and of having a yearning for absolute knowledge, arguing that we should realize how ignorant we actually are. Socrates talked to people, especially young people, to have them think about this and made an effort to make others awakened through the dialogue. The importance of

dialogue started here.

Plato, who was greatly influenced by Socrates's way of thinking, advocated the concept of *idea* regarding the everlasting truth and existence. For example, in terms of flowers, there are various flowers such as rose and cherry blossoms. Recognizing them as "flowers" is the *idea* (abstract existence) of flowers in the brain, and in the real world it appears as a rose or as a blooming cherry blossom. In this way, the reality is always changing in various ways, so the essence of the flower—the one that is unchanged with the flower—should exist separately, and that is the *idea* (concept) of the flower. Then, he thought that the universality of the *idea* should be linked to the concept of "good" in the mind of the people, when thinking of what the universality was secured by. In this way, Plato started from *idea* and developed the idea that it should be universal and for that purpose, thought that it must be secured by the good that should exist in people's mind, and from that point of view, he discussed the issue of virtues and stated what a nation should be like. And he developed the famous thought that "the nation should be ruled by philosophers."

1.2 Aristotle

Aristotle admired Plato's thought and entered Plato's Akademeia to explore philosophy, but he came to have an idea opposite to that of Plato's. Then, Aristotle made achievements in a much wider range of fields than Plato had done. First of all, since the way of inquiry of knowledge that had been done prior should be done in a clearer way, he established logic as a procedure for this. He first clarified the concept of category. They were categories such as entity, quantity, quality, relationship, place, time, location, active, and passive. He made one conceptual system such that at the most basic parts that each individual has a name and there is a concept of the kind as a bundle of them. These are all central issues in today's informatics. Next, he clarified the concept of proposition. A proposition is a basic sentence expression consisting of a subject and a predicate and has true or false value. He established the methodology where every proposition obeys the contradiction law ("A and not A" is not possible) and then clarified the form of inference called three-stage reasoning to obtain correct knowledge by performing various inferences. That is, he established the starting point of the study of logic we have today. Aristotle's logic was arranged using symbols in the middle of the 19th century by G. Boule (1815-1864). This symbolic logic became the basis of today's computers.

Aristotle thought that a collection of individuals makes up the universe, and that they are materials (called *materia*) and the forms made using them, that is, what is called *eidos*. He

captured the world thinking that the material forms the possibility of being made, and that an object is made by adding objective and force.

What should be noted here is that words that can be subjects or predicates in propositions, such as a dog is a general word as in "dogs bark" and "what barks is a dog," but in the case of a dog named Pochi, it must be a subject such that it can be said that "Pochi is a dog" but not "a dog is Pochi." From this, he focused on the concept of individual. In other words, Aristotle centered on individuals and thought of the form in which there is an abstract concept of dog as the name of their set. This is the opposite of Plato's idea that a real individual comes out as a concrete example from *idea* (concept). When observing the individual, he also paid attention to the nature of what comes to the predicate part, such as what kind of property and quantity this has and what kind of relationship it has with others.

From this point of view, Aristotle created the study system of zoology by observing animals in detail. From the same point of view, he studied botanical science and meteorology, and from the logical point of view, he widely studied in natural sciences including physics and astronomy. On the other hand, he examined what an entity is, assuming that an individual who is the subject but not a predicate is the basis of existence. And from the idea that it is the expression of energy in this universe in which the world is filled with living individuals and that is what God has given, he considered the ethics that they should have. He discussed the virtues and happiness as the manifestation of human life as well as their relationship with the state and politics. Aristotle can thus be said to have laid the foundation for all studies from humanities and sociology to natural sciences. Therefore, learning means philosophy, and all learning was part of philosophy. He was an all-rounder who had learned humanities and scientific in a well-balanced manner and had thoughts on religion as well, and he was a typical example of a good old-age scholar.

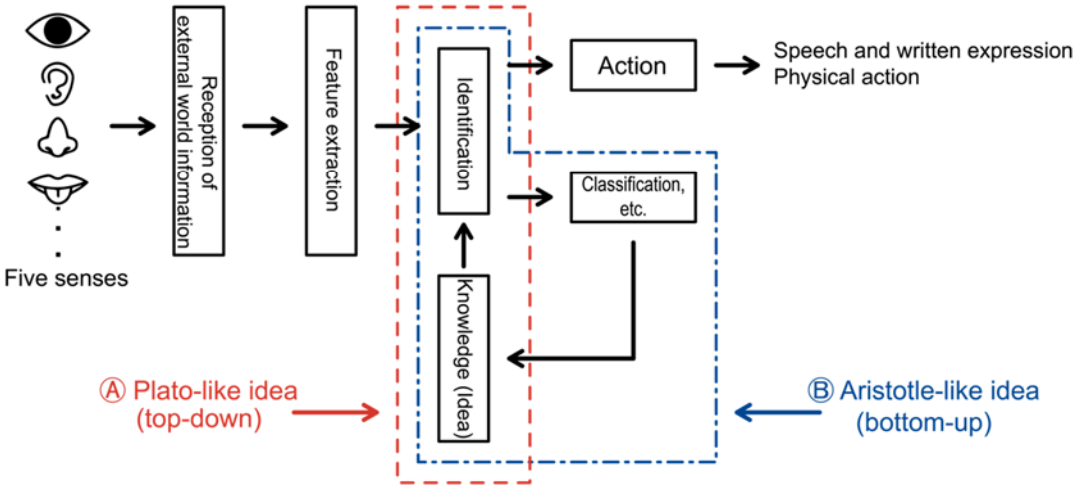
1.3 Ancient Greek Philosophy and Informatics

Let us consider the relationship between the ancient Greek studies briefed above and the modern informatics. It has already been mentioned that symbolic logic, which is the basis of mathematics and computers, originated in Aristotle's logic. What we are going to discuss here is the relationship between the objects present in the world and the artificial intelligence system that recognizes them, stores them as knowledge, and uses them. Today's system of external world recognition can be shown as in Figure 1. In this figure, the idea of Plato corresponds to the part enclosed as A. That is, it is assumed that an object model (*idea*) is present in the brain, and the object is recognized by identifying which model the external

object is closest to. In other words, there is information corresponding to an *idea*, and the *idea* in which the object in the outside world is most similar to is searched out from memory (knowledge) in the brain. That is fine, but I encounter the problem that I cannot put it into a computer if I do not know how Plato's *idea* exists in my head. In other words, what is the structure of knowledge like? The simplest of the structure would be Aristotle's concept of character and *materia*. Today, this is a more diverse and detailed description of information, and these constitute a complex network system. The basis is the so-called ontology and the network of related networks. (See II-4)

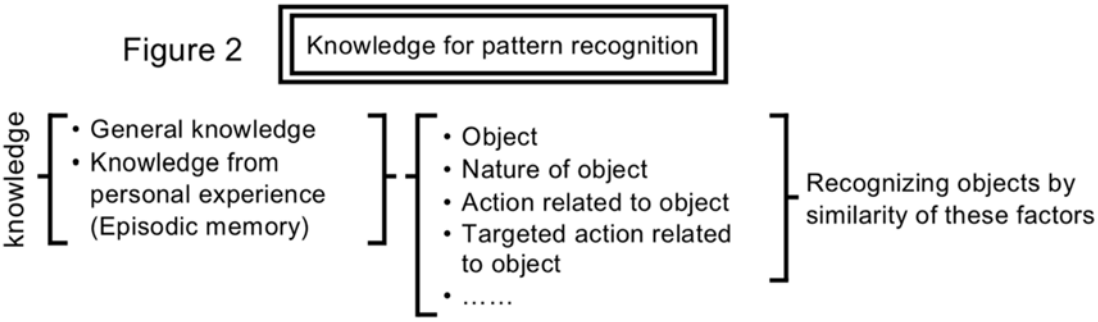
The Aristotle-like idea in Figure 1 are shown in the function of the portion enclosed as B and the system of knowledge in Figure 2. It is considered that each of many objects in the outside world observed and analyzed in the form of a combination of various features is divided into groups by techniques such as clustering, and each corresponds to one concept. In other words, by looking at real objects in detail, we create a collection of many objects with the same or similar properties and give it a concept.

Figure 1 Brain system model for pattern recognition



Plato's and Aristotle's philosophy was a kind of study of knowledge, and the focus was the relationship between the existence of the real world and the *idea*. Human beings do not have the *idea* of what exists in the world when they are born (although some philosophers argued they do). How are *ideas* formed in the brain as children grow up, how are new concepts created as civilization develops, and what is the process like? It could be a philosophical task to clarify them, but such considerations have not been made much and are missing in the philosophy so far. I look forward to the future studies of psychology and education.

Figure 2



In today's informatics, such things are considered as follows. One way is to perform clustering by focusing on the characteristics of a large number of individuals, repeating collecting similar individuals to distinguish them from large grouping to detailed groups by classifying them in detail, and then to create a conceptual system of tree structure, that is, an ontology. In recent years, more precise grouping has been performed by analyzing not only visual characteristics but also the DNA possessed by the targets. Another way is to assign a new concept when an object that has properties not possessed by previously known objects is discovered, being mindful that an object has various properties (including structural differences). It is probably one way of learning to clarify the process of making knowledge more abundant in this way.

An even more difficult question is, what kind of structure the knowledge is as a whole? In particular, it is important today to pay attention to what kind of relationship exists between the concepts. In other words, when a tree structure of knowledge is classified and created, it is important to find out about some kind of relationship between concepts on different branches and to assign a link between them. That means to focus on so-called associative connections. Things like this have not been discussed much in the conventional philosophy, and it is still halfway through in today's informatics. In any case, the subject of recognition and knowledge is a fundamental subject not only in philosophy but also in informatics.

What has been described above is the mutual comparison between the thinking and analysis related to the workings of the human brain and the creation of systems in informatics, and one of the issues that was much discussed in the philosophy at that time but did not garner interests in informatics is the consideration on the question of what is good for human beings and society. Both Plato and Aristotle considered these brain functions in depth. They discussed what happiness is to human beings, what is good, how it is to society and the state, and how it must be. On the other hand, what is created by informatics is one of the driving forces that brings convenience and creates wealth and develop civilization for society, nation or the world, but it has not been considered at all whether it contributes to bringing people towards good and to bringing happiness to the whole world.

In today's network society, various criminal acts are carried out, and many things that impede the development of healthy humanity have come to be carried out. To prevent them, is it enough to give moral education, or is it necessary to take any measures on the information system, and to what extent should that be?; it is necessary to seriously consider from an informatics point of view. This is a big issue for us in the future. It is a matter of whether it is possible to analyze concepts such as good and ethics more deeply and thoroughly so that it can function in checking the world of programs.

2. Western Middle Ages, religious age

2.1 God's world rule

The ancient Greek philosophy represented by Plato and Aristotle was transmitted by two schools of Plato's Akademeia and Aristotle's Lyqueion, but it disappeared in the mid-4th century due to the emergence and spread of Christianity. The idea introduced by Jesus was maintained by the disciples in the form of a Christian bible, and in the 4th century, it was finally positioned as the national religion of the Roman Empire. There were many gods in the ancient Greek era (polytheism), but a clear monotheism was established by the New Testament, which was created based on the behavior of Jesus Christ. In most cases of polytheism, people were afraid of natural phenomena that were beyond human knowledge, and as this is the work of God, it was centered on begging not to make the gods angry, and fearing and honoring the gods. In the case of a monotheism like Christianity or Islam, believers received a kind of revelation in their mind and soul and believed in God in an attitude of giving themselves to God. Especially in the case of Christianity, God was almighty, and because the world and the universe were created by God, it was firmly believed that everything was true. It became a religion in which the human beings were created by God and were allowed to live through the covenant with God, and the religion ruled the spiritual world of the medieval Europe for about a thousand years.

So what is this kind of god like? Should God create a good world? Why is there sin in the world? Is Jesus a god or an evangelist God sent to the human world? Such philosophical arguments became active, and this became the central subject of the philosophy of the medieval Christian world. Augustine (354-430), the greatest theologian and philosopher of the Middle Ages, showed the thinking that, God is eternal and what God shows is eternal truth, so knowledge can become a truth only if it is supported by faith. This was the central

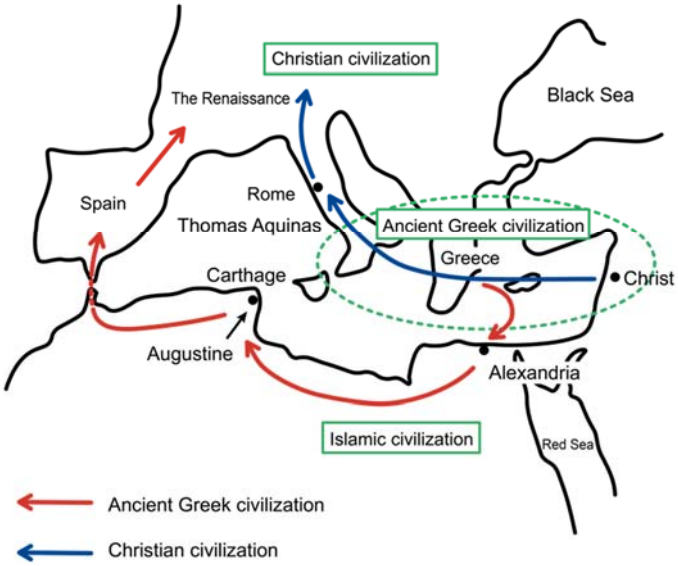
position of Christian theology until Thomas Aquinas (around 1225-1274), the greatest philosopher and theologian of Schola philosophy, appeared in the 13th century. Augustine's thought was based on Plato's idea, but Thomas Aquinas ties Aristotle's philosophy to the foundation of faith, and said that the individual believes in Christianity because he receives revelation from God in the soul, and the existence of God was proved out of that. In addition, he said that the world created by God is composed of hierarchy of various categories according to Aristotle's concept of *materia* and *eidos*. In any case, the universe is a god-made one, and the view of the universe that the celestial body is rotating around the earth is firmly engraved in Christianity, based on which Galileo Galilei (1564-1642) was interrogated as heresy.

There is an eschatology in western Christian society. This has been discussed in various ways by many people from the Old Testament era to the recent years. Buddhism has the idea of reincarnation, and it is an idea that if it dies, it will be reborn as something else. While this is cyclic, in the monotheistic West the history flows in one direction, and by coming to an end, it will hopefully go to the kingdom of God. But those who were not called by God fall into purgatory or hell. Those fall into purgatory may rise to heaven, but those who fall into hell will suffer forever. "Divine Comedy" by Dante (1265-1321) is a narrative written in a concrete form, and the medieval way of thinking is clearly expressed. The eschatology is the idea that the whole world will come to an end, and the judgment of God will be there. This may seem like an unthinkable idea from the standpoint of natural science, but given the global-scale pollution, air pollution, energy problems, global resource exhaustion and the population explosion brought by the civilization that has developed rapidly from the 18th century to today, the end for humanity may come in the next three hundred years or five hundred years.

2.2 Contribution by the Islamic World

During that time, the philosophy created in ancient Greece was rather translated into Arabic by scholars who gathered at the Alexandria Library and protected, and research was conducted not only on theology but also on mathematics and natural sciences. The word algorithm comes from this Arabic math. In the Islamic world that dominated the Mediterranean, Plato and Aristotle's philosophy was more refined and systematically organized. In particular, natural scientific aspects and logic in Aristotle's philosophy were examined in depth. Especially among them, what is universal was deeply discussed in relation to the concept of God. In addition, the theory of celestial movement was established from Plato's thinking centered on the sun, the world map was made, and the progress and the culmination of medicine were made. However, these were all made in a manner consistent with Christianity, and were linked

Figure 3 Propagation of ancient Greek civilization



to the worship of the power of God.

The achievements of Greek studies and the studies developed in the Islamic world, were transferred to Europe where the Renaissance was about to begin (Figure 3), through Spain which had been ruled by Muslims for 800 years and finally escaped the domination in 1492, as many ancient Greek documents including Plato and Aristotle were translated into Latin along with the study of the Islamic world.

2.3 Tradition of civilization and translation

The basic idea of this era was that God created the world, and the idea contrary to this was strongly denied and excluded, but in the meantime, people created many things and concepts that God did not create. There must have been a number of contradictions to the writings of the Bible, and it is the point of wonders why it did not become a subject of doubt and why it was not considered a problem. In particular, it is strange that philosophy at that time ignored the existence of human ability (power of creation) to create things that God did not think of.

One of the significance of the Western Middle Ages from the perspective of an informatics point is as follows. The enormous knowledge introduced by ancient Greece was translated from Greek into Arabic in the Hellenistic period and brought to the Arab world, then it was organized as an academic system, and more knowledge was added. In its early days, systems of knowledge of Plato and Aristotle were organized, and humanities and social studies were

developed. In the second half, mathematics, medicine, alchemy, etc. were developed. Then, as the power of the European continent became stronger in the 13th and 14th centuries, the study of ancient Greece was transmitted to entire Europe along with the study of the Hellenistic period by being translated from Arabic to Latin.

This flow shows that translation of books and knowledge has great power to change history. Another well-known example is one where Luther (1483-1546) created and published a German translation of the Bible. Until then, the Bible could be read only in Latin, and the general public could only know and understand the content of Christianity from the preaching of church pastors. However, a German translation was given, and printed a lot by Gutenberg's printing technique (circa 1452), and a society where even the common people can read the Bible directly was realized. As it became possible to know and believe in the teachings of Christ without the help of a pastor, the European society had a Renaissance, which afterward triggered the overturn of the European society, which was ruled by a powerful royal right. It is said that a great cause of the fall of the Berlin Wall was that the information on the West had been transmitted to the East steadily. Today, translations are gradually being implemented by machine translation rather than manually. In particular, portable speech translators have become available between 20 and 30 languages. The time must come for people around the world to communicate freely through machine translation, and it will bring about another major historical change. This is a major contribution of informatics.

3. In modern times, what kind of age was modern?

3.1 Escape from God's Bondage

The Middle Ages were ruled by Christianity. In other words, what is written in the Bible is correct, the other way of thinking is the evil way. In the thousand years during the Middle Ages, controversies have been made endlessly not only on what is written in the Bible, but also on what is God and what the content in the Bible means. They were justified in the Roman pope, and the faith of the people was expanded. The argument on "proof of the existence of God" is interesting in those arguments. Although there were arguments from several perspectives, this was based on the desire to prove that God exists by human reason. An easy-to-understand explanation for us in the present age is that it is impossible for anyone but God to be able to design the natural world and the universe as such harmonious. It possibly can be said that Aristotle's clarified logic and triple logics were used to prove the existence of God,

so logics and causal thinking were established widely in the West, forming a foundation for strong thinking in modern times.

In the presence of such a strong Christian theology, Copernicus (1473-1543), who observed the wonder of the universe ruled by God, had a concept of heliocentric theory and summarized it in around 1510. However, it is said that he did not publish it until just before his death due to the fear of being heresy. The telescope was invented in 1608, and many people, including Galileo, observed the universe in detail. Galileo demonstrated heliocentric theory to replace the geocentric theory, and this became gradually recognized in society. People began to notice that the more they looked at nature, the more things were against what was written in the Bible. In such a trend, for example, in the world of painting, a perspective that began to be known from the Middle Ages was put in place, a number of paintings that remain today were produced, the human spirit was exposed, and the Renaissance blossomed.

What is important to us is Descartes (1596-1650). Descartes thoroughly considered what is true and reached the basic position of "I think, therefore I am." Starting from there, he was convinced that the truth exists in what he gained by clearly observing things, and that made him affirm the real world. In other words, he distinguished the objective world from the mental world and considered the importance of creating an objective academic system for the former. From this point of view, Descartes created analytical geometry on a system called Cartesian coordinate system today and also made great achievements in mathematical natural sciences. Descartes also made great achievements in the mental world. It is in his book "The Passions of the Soul." While thinking separately about the objective world and the mental world, he recognized that the mind and the body interact with each other, and there is a dimension of mind-body unity. It is interesting how we can incorporate these things into future robots. Not only Descartes but also Galileo had a religious mind, but they feared that they would be punished by the Holy See because what they believed to be true conflicted with Christian theology.

Pascal (1623-1662) showed his genius from a young age and made many contributions in the natural sciences. He wrote a conic curve theory, made the world's first computer for his father's work, and publicly conducted experiments on the existence of a vacuum. He found the principle of Pascal, and the unit of atmospheric pressure today is called Pascal. However, in the second half of his short life, he entered the world of faith in God and left sentences that spelled out the importance of faith, which were summarized after his death as "Pansee (Thoughts)" that is famous today. This greatly influenced the analysis of human spirit, existentialism, in recent years. Faith is essential to become a human being who develops mental concentration and does not get lost.

3.2 British empirical philosophy

Locke (1632-1704) was a British philosopher and political thinker, and was also the founder of the so-called British empirical philosophy, which put experience as a basis in thinking. Saying that all the idea of human beings was derived entirely from experience, he denied the (European) continental idea of the innate idea. His idea of forming knowledge from comparison of ideas is also important in modern knowledge-processing technology. The next great person to appear in England is Newton (1642-1727), as is widely known. He was a mathematician, physicist, and astronomer, who established the system of mechanics and became the founder of modern science. He made three inventions of light spectrum, universal gravitation, and calculus. "Principia" and "Optics" are such achievements, which would have a great influence on future generations. It can be said that it is an achievement that brings the idea of Descartes to a specific form.

Hume (1711-1776) needs to be mentioned as another great master of the British empirical philosophy. The causality law that "A causes B to occur" had been a universal idea since Aristotle's logic, but Hume probed it radically. Hume said that the causality law was not definite, but B simply occurred after A, and there was an empirical fact that A and B always coexist, so it was not possible to clearly explain what necessity there was. He said that it was only a subjective conviction supported by empirical relationships such as similarity, identity, space-time relationship, degree of quantity or number and nature, converse, cause and effect. It is a kind of skepticism, and it is necessary to think that the causality in the study other than theoretical physics, especially the causality in the construction of the knowledge system of informatics, is such a thing. His moral theory should also be noted. His words that "reason is a slave of passion" should be noted in the future construction of the brain model. (II-5)

3.3 Continental transcendental philosophy

In contrast to British empirical philosophies, the philosophy of the European continent was dominated by the Platonic transcendental philosophy. Freed from the idea of the universe created by God by Descartes, the foundation of the idea of modern science was established in which humans objectively observed the universe and the world, and assembled things from there. Leibniz (1646-1716) is a philosopher who was active in all disciplines of the continent in the same period as Newton and made achievements in the fields of natural sciences, mathematics, law, theology, linguistics and history. There was a controversy who was first to

discover calculus, Newton or him. He was a universal scholar who is said to have made formalization of logic and concepts of binary systems. He introduced the notion of universality and harmony as a concept common to these various studies and tried to explain the formation of the universe with this concept.

Continental philosophy produced the philosophical giant Kant (1724-1804). Kant is said to have been the founder of the idealism philosophy (Platonic position), and he challenged the question of what people can know. He thought that it would be necessary to go beyond the concept of empiricism in order to recognize a causal relationship that is truly valid, so to speak, scientifically true, not a causal relationship as Hume says. This is Kant's position of transcendental idealism. Such certainty exists as an a priori recognition in the world of mathematics and logic, but in the other regions of universes and worlds, he believed that this must be verified from a synthetic and generative position, not from an analytical one. In other words, he acknowledged a priori that there is a cause for all changes, and thought that it would be possible to objectively explain the world by this. But admitting a priori is what human beings do, and we do not know if the facts of the world really are. Therefore, Kant says that he admits a priori and the conclusions that are unfolded from it are the "truths" that can be obtained in humans, and that they do not know whether that is the case or not (Figure 4). This corresponds to the incompleteness theorem that Godel (1906-1978) clarified in 1931 (in short, there is something that cannot be proved in an axiom system), and more intuitively speaking, it is a way of thinking that we cannot avoid the existence of mysterious things that cannot be proved. It may be that there is a limit to human thinking. In Physics they seem to be exploring whether there are new powers in addition to the four powers known today, and if it is discovered the world will expand again.

Kant also examined the relationship between human free will and actions and moral law. He thought that practical reason based on practical and empirical recognition would take

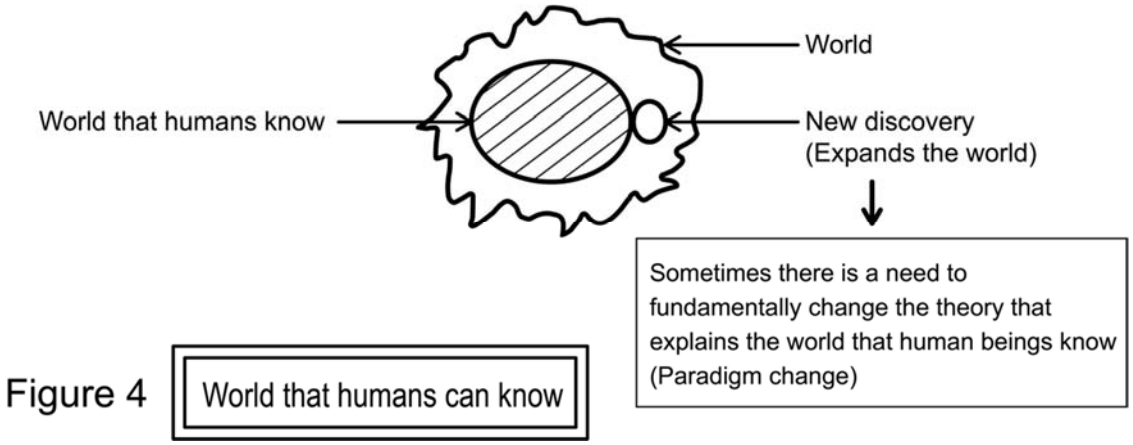


Figure 4

wrote "The Critique of Practical Reason." This free will problem is an important issue when precedence, rather than various ideas derived theoretically, that is, theoretical reason, and considering artificial intelligence in the future.

3.4 Hegel's dialectics

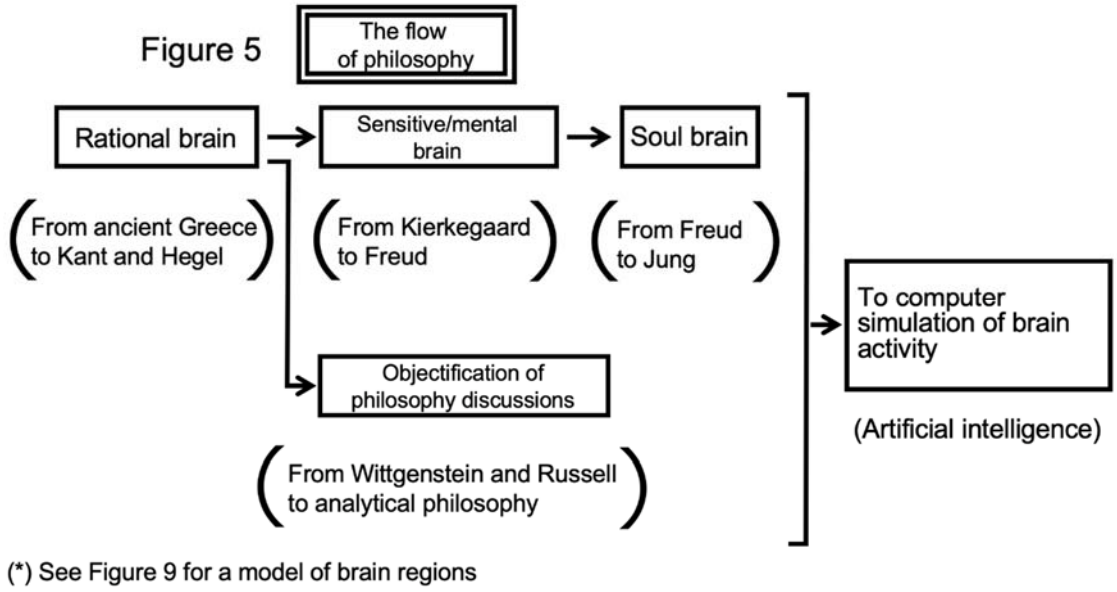
Hegel (1770-1831), who took over Kant, introduced a time axis, an axis for the concept of historical flow, which resulted in the famous dialectic. When human consciousness recognizes something in the external world, at first it is the recognition of its shape and others. Then it is understood in the concept of the abstract world one step higher, namely in the world of abstract names such as books and desks. In the next stage, we consider where in the system of knowledge we have so far we position it, the meaning of the object, and use it as knowledge. However, knowledge and values differ from person to person. It is natural that this differs depending on the difference in the process of experience accumulated so far, and differences and contradictions arise there. This contradictory thing becomes a kind of confrontation, but it is integrated into a new idea, a new world, which is one level higher. In other words, the basic idea is that, by the repetition that the world of contradictory things is integrated into the new world, it develops historically toward the consistent ideal world without conflict. The idea, usually called "thesis, antithesis, synthesis," existed before Hegel, but was considered in more detail by Hegel, and was considered to be the basis of all movement and formation. The ultimate is the world of Hegel's absolute spirit. This is also true in the development of history. That should be the end of history that Francis Fukuyama said in recent years (although this was not the case). This is called dialectic logic. In natural sciences, when a phenomenon that cannot be explained by the results of science and technology up until then is recognized, an effort is made to construct a new theory that can explain this new phenomenon, including the results and knowledge up to that time. This is another dialectical effort. Though an end of history would probably not come to natural science. Thus, it is believed that the continental idealism philosophy of Europe has been put to an end by Hegel. In other words, the theory in the abstract world about what human thought was completed in a sense.

4. Philosophy that leads to the present age

4.1 Human return

However, it cannot be considered here that the history of philosophy was completed. In these philosophies up to Kant and Hegel, the fundamental problem of the philosophies "what is a human being who thinks, what I am as the individual who thinks" may have been forgotten, or each living human being is the existence embracing the contradiction and worries how it should live, and Kierkegaard (1813-1855) considered how to do with this. He faced the problem of an ego that could not be solved by the philosophical system of Kant and Hegel that tried interpreting the world rationally. From here the big task of the human mind becomes the central task of the philosophy, and it led to phenomenology by Husserl (1859-1938), Heidegger (1889-1976), also led to psychology by Freud (1856-1939) and Jung (1875-1961), and has evolved into today's psychology and cognitive science. The outcome of these studies has become an issue that must be taken into consideration in the future, such as in informatics and robotics (see Figure 5).

It may be said that the western philosophy before that was implicitly under the influence of Christianity even after Descartes, but this was totally rejected by Nietzsche (1844-1900). He completely denied not only Christianity but also restraints of concepts by Socrates and Plato, and insisted to return to the world of the original human soul. "God is dead," he cried. Human beings are not bound by the gods and philosophies that humans have made, but they have more powerful human bodies and spirits and should be able to live freely. Many things about Nietzsche tended to be considered nihilistic claims against pre-existing gods and philosophies, but it may be better to think that in fact they are not, that they frankly accept each life, and it is themselves, from there they are not bound by anything and should live firmly as good human beings. The ultimate of such a way of life is a superman what Nietzsche called. This may be thought to be due to the knowledge in human brain activity, the work of the soul that is further below the activity of the mind, etc., and this should be a topic to be taken up in the future of psychology and cognitive science. That human beings live is the work of the will, in particular the idea that humans have free will is predominant. This is particularly the case in comparison with the recent development of robots, where the discussion of the problem of comparison between human and robot has attracted much attention from the viewpoint of whether robots can have (free) will. The issue of aesthetics is one of the same nature. It is a question of whether the genius sense for music such as Mozart is human-only or whether a robot can



reach such a genius situation. They are also related to the issue of soul Nietzsche has considered, and will be discussed in the last chapter of Part II (see II-10). This problem cannot be ignored in informatics, as it is a key concept for making future robots truly human.

4.2 Review of recognition process

With Kant and Hegel, an idealistic worldview reached an area of perfection in a sense, and Kierkegaard made it a central task of philosophies to understand what is a human being and a self. Then they returned to the discussion on what kind of process was used for recognition. We can say it is a study to detail the recognition process that Aristotle et al shortly worked on. This is a concept called phenomenology started by Husserl, and it is a question of how to connect external phenomena to acceptance judgment. When there is a phenomenon, it should not be an a priori interpretation (that is, judgment by prejudice). Empty the mind and recall every possible interpretation of the phenomenon, and the most reasonable interpretation should be taken. For example, when you see something long and narrow that snakes, it may be a snake if it's in the field, or it's an eel if it's in the water. It is necessary to think the external condition of what environment it is in.

When the outside world is photographed on the retina, it is necessary to look at it with an empty mind, not to judge it immediately based on your own current interest (this is referred to as an *epoche* or suspension of judgment). That is one feature of Husserl's phenomenology. This would correspond to "pure experience" in "Study of Good" by Nishida Kitaro (1870-

1945). The information itself at the time of purely accepting the outside world before the judgment is "real." From an engineering point of view, it is the one at a stage where the outside world is reflected on a photoelectric conversion semiconductor chip of tens of millions of pixels through the lens of the camera. From that point on, you will come to a judgment of what is reflected from your past experience, knowledge, and the situation of the site. Next, Husserl introduced the factor of the work of consciousness (see Figure 6). In other words,

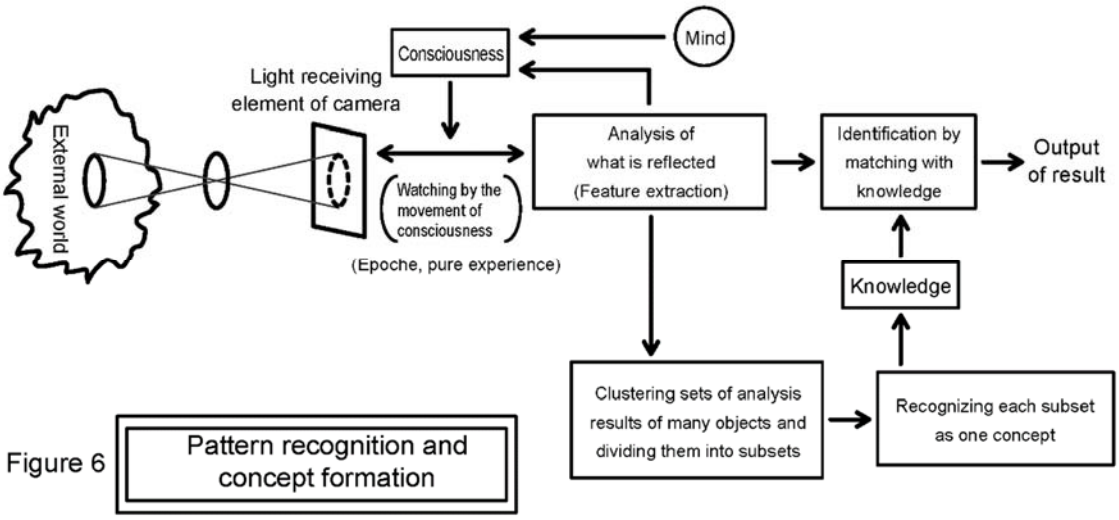


Figure 6 Pattern recognition and concept formation

though it is visible, it has to be a matter of where the consciousness of the person who is watching it is. It depends on the awareness of the scene (environment) that is the premise of judgment, and it is safe to say that you cannot actually see the target part that you are not interested even though you see it. When we happened to see a person, we often look at their faces but don't pay attention to what they wear.

In this way, Husserl thought that recognition was achieved by the intentionality of the mind as to how the awareness of the object works. Even if the object is not completely visible, partial information can be used to determine that the object is OO. And if you can estimate the hidden part that was not in your field of view or if others make the same judgment, you will be sure of your own recognition. This is known as Gestalt psychology and was published in the 1910s. Whereas the previous recognition process was based on the idea that the shape of an object is made up of a combination of elements, the entire shape of an object has a meaning as a single entity, which should be considered to be more than just a combination of elements (see Figure 7). It is because that, while people are always trying to grasp the whole, they recognize the detailed components, and there is a case even if they recognize all the elements, they do not necessarily correctly recognize the object as an object with one meaning. It can be said to be of the Platonian position to consider the whole, and the idea of the recognition until then was of the Aristotle position.

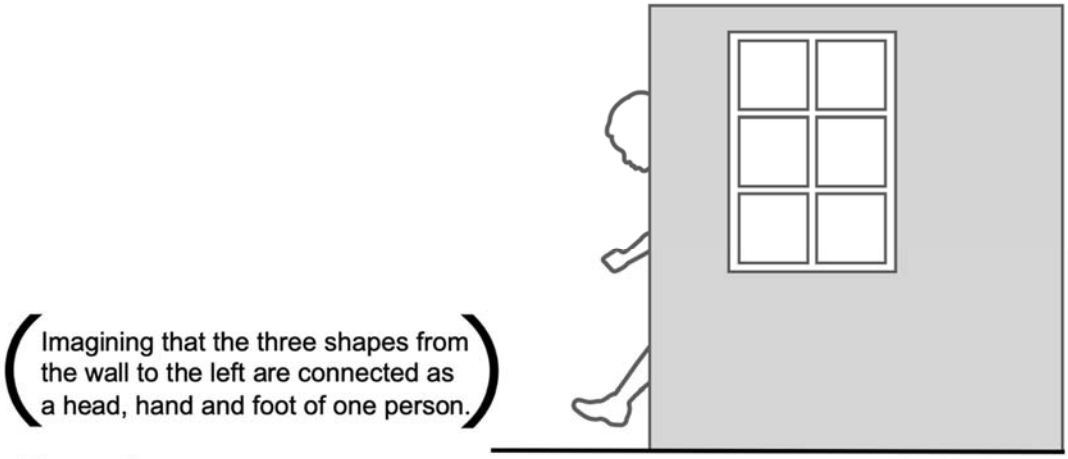
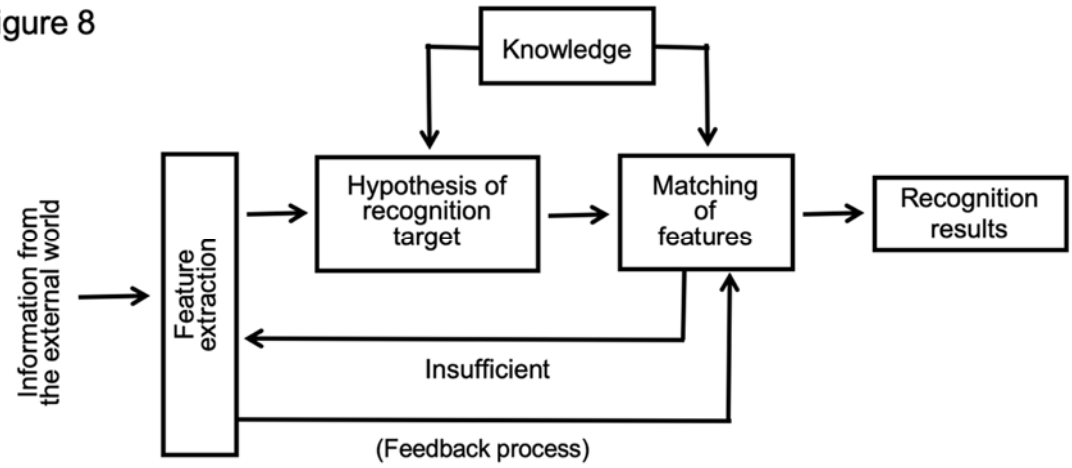


Figure 7

However, in the case of trying to recognize a large and complex object, or in the case of an object that is partially concealed, the whole image is assumed and the sub-elements are examined, and conversely, the whole image is confirmed by detecting sub-elements assuming the whole based on sub-elements. It may be what human beings are doing to raise the certainty of recognized object by repeating the top-down and bottom-up methods like this by trial and error (Figure 8). In addition, it is necessary to think about how this process involves knowledge.

To this Husserl's recognition model, Merleau-Ponty (1908-1961) added the importance of physical sense and considered. Judgment in the human brain depends on the synthesis of the five senses, but Merleau-Ponty analyzed the importance of the senses that the body accepts, the memory of the movement, and the experience. The senses of the body are transmitted to the brain and the consciousness, and from that there is a loop in which the body moves in a more appropriate manner by feedback instructions. When reaching to get things, the eyes act to take appropriate actions, but constant feedback commands are working to reach out and grab something. Without it, we cannot grasp things in motion. It can be said that this is characterized in that it is a world where we are not conscious in detail. In the recognition in informatics, the task of what to recognize is given in advance, but if this is not the case, we do not know by what factors Husserl's consciousness and interest appear instantaneously in the relevant local area of the brain. Elucidating this mechanism will be a major issue when creating humanoid robots. When something unexpected appears in the field of vision suddenly, if it cannot be aware of it and judge what it is likely to be by analyzing it, it cannot work sufficiently when tracking a criminal with a surveillance camera.

Figure 8



4.3 The world of language and meaning that begins with Saussure

Languages have been studied from ancient Greek times through the Middle Ages to the present. The mainstream has been a study such that European languages are derived from Sanskrit as a parent language, and grouping many languages by similarity, which was research that relied mainly on pronunciation and spelling similarities. This is generally referred to as diachronic linguistics (linguistics whose main axis is the passage of time). Saussure (1857-1913), on the other hand, was the first to pay particular attention to what structure one language has. It is synchronic linguistics (mainly limited to the languages of the age of the present age), but in the case of Saussure, it is often called structural linguistics.

Regarding words, for the first time, Saussure clearly separated their letter representations (labels such as word names) and the objects (or concepts or meanings) they point to. And he described that we often referred to the same thing with different names, and the connection between the expression of words and the object was not inevitable. In other words, he showed a new way of thinking that a name has arbitrariness and what the meaning of a language is. For example, the meaning cannot be determined without considering the entire surrounding situation. Another important thing is that differences in words are brought about by differences. In other words, he clarified that the way to divide the world appeared in the words. For example, Japanese people distinguish a rainbow into seven colors and have words such as red, yellow, but some ethnic groups distinguish them into three colors. Furthermore, although father and dad point to the same object, for example (Saussure did not say this), the former is an expression in a neutral position, while the latter is an expression with the meaning of familiarity and respect. It should be noted that different expressions for the same object always

contain some different meanings. Such a way of thinking would form an academic field called semiotics later, and it will lead to the task of constructing a knowledge system in the future informatics, and it is an important way of thinking in machine translation.

In addition, a language composed of promises shared by society such as vocabulary and grammar was called a langue, and a sentence spoken by an individual based on that was called a parole. The ability of such speech is called *langage*. And, it was said that a langue was to be studied. Furthermore, what Saussure has made clear is that the meaning of the words is not fixed, but different depending on the situation, and this raises a big question that the philosophy established by the words is a solid structure. At this point, the flow of philosophical research changed greatly, and it was recognized that it was important to investigate what a language is and what a meaning is, and philosophical research changed in that direction. This is said to be the linguistic turn of philosophy.

Wittgenstein (1889-1951) was the person who made the trigger, and he thought deeply about what the meaning of words is. Then, in the later years, he concluded that "the meaning of words is the use of the language" as a summary of his research. This means that understanding a language means that you can use that language freely. (From our point of view today, these words are tautology, which is natural but its meaning is deep). It says that the use of language is not simply an ability to create sentences according to its grammar, but it is necessary that the sentences and utterances are consistent with the context in which they are uttered and the surrounding situation. He also referred to the dialogue between people as a language game. As a result, Wittgenstein was convinced that he explicated the limits of what could be said, what could be explained and what could not be explained. This is to unambiguously clarify the limits of knowledge, and to clarify the limits of the world. So he wrote, "A man must be silent about something he can't tell." This way of thinking had a great influence on the philosophy that followed. Frege and Russell also came to recognize that language is what describes the world, and is a central task of philosophy. It leads to language processing and knowledge expression by computers today. The author proposed an example-based machine translation method in the 1980's, which became used in many parts of the world. It was not as ambiguous as a language grammar, but a method of translating based on an analogical idea using concrete examples of the use of the language that Wittgenstein said. And it defined that what shows what a word means is to collect and show every usage of that word.

4.4 The world of symbolic logic

Aristotle's logic is called propositional logic. A basic proposition is treated as one undivided unit, and the interrelation between propositions is considered as a problem. The proposition "Socrates is human" should automatically lead to "There is Socrates as one of human beings," but such a thing was not treated as a problem. Frege (1848-1925) got a step closer to these things and made logical descriptions possible. To that end, he entered into details about the structure of the proposition, and introduced a symbol indicating existence and a symbol indicating that a whole set has a certain property, such as Socrates in the set of human beings. The former is denoted by $\exists$ in the existential quantization quantifier, and the latter is denoted by $\forall$ in the universal quantization quantifier. When an individual x has a property P, it is expressed as P(x). Also, when two individuals x and y are in a certain relationship R, they are expressed as R(x, y), and when they represent a relationship between three individuals, they are expressed as S(x, y, z), etc. A logical system that introduces such quantization quantifiers and relational expressions is called predicate logic.

Predicate logic can perform richer content description than propositional logic. For example, denying that "all individuals x in the set have the property of F" means that at least one individual x does not have the property of F. Then, it can be written that

$$\sim [\forall x F(x)] = \exists x [\sim F(x)]$$

is valid. The combination of propositional logic and predicate logic is called symbolic logic. The system of predicate logic was later reorganized into the form of lambda calculus, and it was further used as an attractive computer language for informatics, such as LISP and prolog, to prove theorem by computers, etc.

Frege then made an effort to find out the basics of mathematics, but he also gave a deep insight into the meaning of linguistic expressions and their significance. As one of them, by the famous sentence "the Venus in the morning is the Venus in the evening," distinction was made such that the same object (both refer to Venus) is accepted as the meaning but its significance is different, and he made an opportunity to linguistic philosophy.

Russell (1872-1970) followed and wrote the famous *Prinpicia*, showing that many parts of mathematics can be rewritten by symbolic logic. Some of them were used as examples of computer theorem proving in the first symposium on artificial intelligence held in Dartmouth in 1958, and it was shown that many examples in *Prinpicia* could be proved mechanically. It can be said that this was a monumental event in artificial intelligence research.

The philosophy based on Russell's logic was later taken over by the members of the Vienna Circle, but many of them moved to the United States due to the Nazi oppression. With the

Wittgenstein's logic positivism philosophy and the efforts of Carnap (1891-1970) who moved to the United States and Quine (1908-2000) that followed, it blossomed as an American-centered analysis philosophy. Many topics about the treatment of meaning in languages that are still discussed even today are probably based on them. In was the effort to make philosophical arguments instead of using vague words, but using explicit means such as symbolic logic (see Figure 5). One of them is many-valued logic and modal logic as a direction in which predicate logic is further developed, but unfortunately it ended without sufficient results being obtained. Quantum computers are becoming a topic today, and the idea of quantum logic used there may somehow help these new logics.

What I would like to expect from symbolic logic and programming languages based on it is whether it is possible to use such forms and programs to describe the system of knowledge described later. In that case, the focus is on the extent to which the world can be described by setting the function expression P appearing in the predicate logic with respect to the whole of the knowledge and by representing the relationship between them. Detailed discussions and efforts in this direction have hardly been made in the philosophy so far, but in informatics we will need to consider thoroughly such practical points beyond philosophy.

4.5 Pragmatics, semiotics, generative grammar

Linguistic philosophy has developed from predicate logic to modal logic, but it has not been possible to express the richness of linguistic expression exhaustively, and proceeded to the study of linguistic expression itself. For example, in addition to the features possessed by questions and imperative sentences, speech acts were also considered. It even analyzes, for example, that if the person at the dining table tells the next person "Is it salt?," he expects to pass it to him, and this is called pragmatics. It is a study of everyday linguistics centering on Austin (1911-1960). Such ways of thinking and the results of linguistic philosophy are important in the construction of a computer-based dialogue system in the future.

Semiotics is an idea that extends the meaning of words to the area of social activity and culture. It is a position, as well as clarifying the meaning of a certain word, to spread consideration to the graphic content and the cultural content that spreads in the background. For example, when referring to the "five-storied pagoda," it not only refers to the temple tower in Japanese Buddhism, but it also translates into what is connected to the heavens, or the expression of a Buddhist outlook on the universe. We will even discuss the associative area that extends to Japanese culture, such that the Tokyo Sky Tree is built with the concept of a central pillar of the five-storied pagoda or recalling Rohan Koda's famous short stories. The

knowledge and dictionaries necessary for the future dialogue system in computers will have to be considered up to this point.

Levi-Strauss (1908-2009) brought this idea to anthropology. He found that there was something in common between different ethnic groups in relatives and marital relationships. For example, the fact that incest is abstinence is widely present in all ethnic groups. A position to clarify the underlying structure not only in folklore but also in many fields this way is what is called structuralism. And, through the conversion of the structure, we are also interested in the extent to which similar structures exist. The structure of the language is SOV in Japanese and SVO in English, and by connecting between them by conversion, translation is realized. Introducing and organizing this concept among many languages is necessary for future multi-language machine translation.

As a later development of linguistics, the concept of generative grammar created by Chomsky (1928-) is also important for those involved in informatics. While the language has been the subject of structural analysis since Saussure, Chomsky has studied language from the viewpoint of sentence generation: what is the mechanism by which humans speak. In other words, it was a completely new idea in that it tried to clarify the research position of elucidation of language ability in human brain. This is also a very important idea for informatics. Structural thinking has since been introduced into biology, economics, music and psychology. From the perspective of informatics, for example, in a dialogue system between human and computer, it will be a challenge from now on to investigate whether there is a common structure among languages and ethnic groups about the progress of dialogue and design the system from that perspective.

4.6 Psychological approach

If philosophy is to elucidate the workings of human brains, we cannot ignore the finding of 'unconsciousness' by Freud (1856-1939) who emerged in the 20th century. Human brain activity is mainly in the cerebral cortex, making inferences based on memory and linking it to speech. However, there are many parts of the memory which are suppressed by the cerebrum's certain functions and are not exposed, and they are transformed and mixed with other memories and appear as a dream. In addition, with the aging, the normal functioning of the brain weakens, and sometimes memory of the young age accumulated in deep layers of memory may appear on the surface. The existence of such an unconscious world has manifested itself in human behavior in various ways. He paved the way for the existence and treatment of psychotic phenomena that come from the suppression of the unconscious world.

Jung (1875-1961), who learned from Freud, elucidated the situation of the complex and led the phenomenon of unconsciousness in the individual to the concept of unconsciousness in the collective world (ethnic people). For example, he suggested that the ideal female image for men was shared by the ethnic group, which would lead to ethnic myths and so on. Such an unconscious world is considered to be deeper than the unconscious layer in brain that Freud revealed, and Jung thought that it would be transmitted genetically to the ethnic group. In this way, Jung thought that a hierarchy exists in the work of the brain; the part of the cerebral cortex where the ego makes clear logical reasoning, the part of the mind that controls it in a sense unconsciously, and under that the collective unconscious congenital to the ethnic group that the individual is not aware at all, that is to say, the ethnic group's basis of energy for survival as a living being that may be called a soul. Such hierarchy of functions and their interrelationships that brains should have (see II-5) will be helpful for the ideal state of the robot brain model to be created. In that sense, further development of research on psychology and cognitive science is desired.

4.7 From analytical philosophy to the age of informatics modeling

The history from the birth of the philosophy to today stated above is from the surface layer to the deep layer of the human brain, that is, from the layer of the logical reasoning function of the cerebral cortex, to the part of sensitivity and the working of the mind, and to the part of the work of the soul. It can be seen that the philosophical interest has historically shifted in the direction of the depth of the brain activity (see Figure 9). It can be said that the work of the top layer is a world where Plato and Aristotle started along with Kant and Hegel discussed, and the second layer is from Kierkegaard to Freud, Saussure, Wittgenstein, Levi-Strauss, etc., and there was Jung about the deep problems of the mind as well as many people in the contemporary French philosophy who approached serious problems of the modern society through the problems of the mind and soul when human beings are put in a unique environment or extreme situation. On the other hand, what is named as analytical philosophy, which tried to advance the philosophy by recognizing the importance of making philosophical arguments using clearer analytical methods and symbolic logic methods rather than discussing with vague tools of words as in the past, was active centering on the United States, but this too has not achieved sufficient results. Given this, it is probably the challenge from now for how far informatics can solve philosophical problems by means of powerful simulation (see Figure 5).

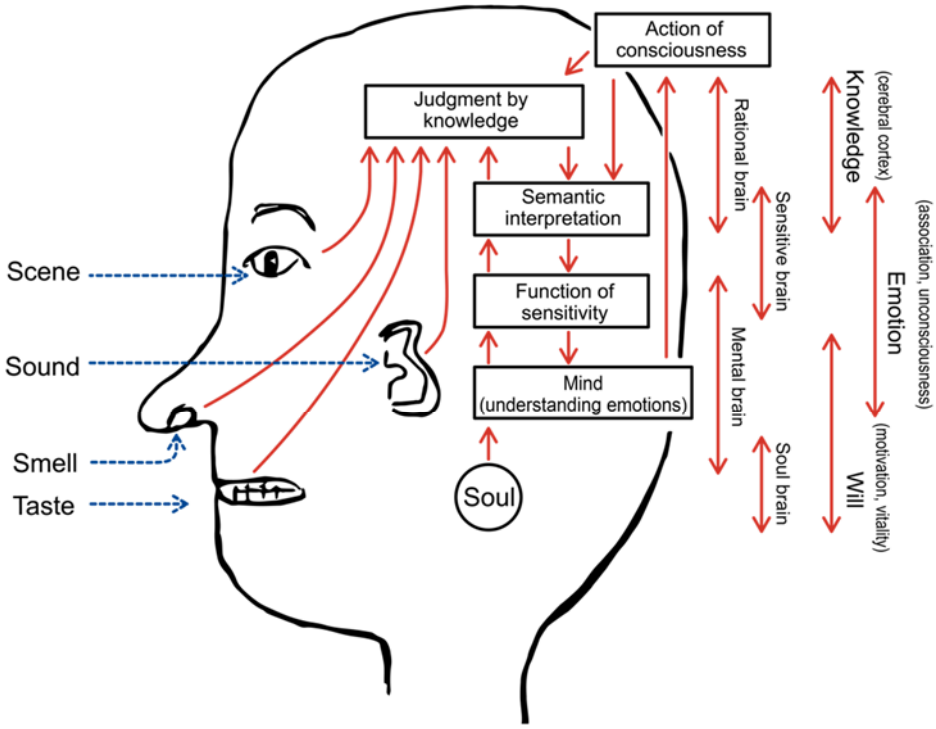


Figure 9 Hierarchy of human brain

So what direction will we go from now on? It is not easy to discuss the world of souls at a specific academic level. One approach may be to rethink from the standpoint of the present of what philosophy is originally aimed at. If we think of what human beings are, it would be a discussion on the fact that the times of the present day are such confused and ethnic conflict is happening everywhere, and why the soul, which is the driving force of life and survival of human beings as a living thing, is combative, and if there is no possibility of coexistence or co-prosperity. In other words, it is a direction to investigate the way of being a human as a group and the way of society, from the way of being a single person. It can mean that we will have to go to a place where we will need to think about this thing called religion again. Because it is necessary to keep the mind and soul clean.

To start with, the beginning of philosophy is the understanding of the whole universe, and the idea of natural sciences occupied a large portion in the philosophy. As we have today's study using tools capable of performing something close to the function of human brain such as computer and artificial intelligence, that is, informatics, another direction would be to advance by the fusion of philosophy and informatics, or at least the work of cerebral cortex and a considerable part of the work of mind in a concrete form or by experimental science. As the term "experimental philosophy" already exists, such a direction may not be an absurd dream. If this document is the first step in that direction, I have nothing more to ask.

Furthermore, it will be necessary to consider how to see the rapidly developing field of biology due to the DNA discovery, especially the life sciences where artificial life is about to be created.

Part II

Philosophical Consideration on the Major Issues in Informatics

1. About pattern recognition

First, we will consider the process of pattern recognition in ordinary engineering, which is not general recognition but takes in information from the outside world, collates it with the target concept (this is called a pattern) held internally, and recognizes it. Information from the outside world is sensed and captured by human senses. Human beings often accept and judge information from the outside world simultaneously with their eyes and ears, but in engineering they make decisions in separate systems, and it is a future task to process information from all five senses in an integrated manner and use them for judgment.

External information is captured by a sensor into a computer, from which various features are extracted. In the case of digital cameras, it begins with capturing an external scene two-dimensionally with a photoelectric conversion element of millions of pixels. From the information acquired in this way, the characteristics such as form, surface, and color are extracted in the next step, but the way of processing differs depending on the intention of what they want to recognize. Merleau-Ponti and Nishida Kitaro say that it is important to look at the state of accepting the outside world information just before the intention works, without any assumptions. Nishida referred to this as pure experience, and Merleau-Ponti referred to it as *Epoche* (suspension of judgment) (see Figure 6). In other words, it emphasizes the importance of emptying one's mind and seeing. Merleau-Ponti said that in this state, the work of the consciousness of watching works. Even if they are visible, they will not be able to recognize the object unless they see it. He said that the recognition will be realized only when their consciousness is working. Also, in the case of a large scene that does not enter into one view, the intention must work in the direction of moving the gaze, but it makes some hypotheses about the object in the brain. If this cannot be done, the gaze will move at random and a search will be made so that possible objects can be assumed.

The following steps will be taken to realize this on a computer. First, we mobilize all the knowledge that the computer has and compare it with the input information, put every possibility on the basis of judgment, and take out the one that meets the conditions. At this time, it is unlikely that perfect agreement will be found, but the most similar ones will be picked up, and in the selection, feedback to look at the object repeatedly based on the intention and purpose is forced to work. If you look at a dog or a cat, you can judge it by the distinction of detailed features, but if you are a cat lover, you may first think it is a cat and if it is not after looking closely at it you will think it may be a dog. It is also difficult to guess what the intention of the subject is, such as whether it is going to jump on you. In the case of

human pattern recognition, in addition to the work of the viewer's awareness and intention, the estimation of the intention of the subject's action is also performed, but the realization of this in a mechanical pattern recognition system is difficult at present. This part is largely due to human instincts and is the most difficult part for computers. However, the intention of human beings also depends on the surrounding circumstances and the circumstances until then, and it is a philosophical question whether it can be called human will. When you land a robot on a planet outside the solar system that you don't know, you will encounter situations where you cannot predict what judgment to make and what action to take if you do not know what scene you will encounter. It would be interesting to think about what kind of recognition strategy the robot takes autonomously at that time.

Pattern recognition means that it can be recognized only when there is information (knowledge) on the object to be viewed, and it is based on the top-down idea by Plato that recognition can be possible only when there is an idea. So how do we get the *idea* and concept of this pattern? Known patterns and concepts can be acquired by parents or teachers teaching children, but what about acquiring patterns and concepts about new things? That would be done by Aristotle's bottom-up approach.

As shown in I-4.2, models of computer recognition can only be written as shown in Figure 1 at present. As shown in this figure, it will be understood from the informatics point of view that both the Platonic and the Aristotle-like positions are necessary. In the current pattern recognition, recognition is carried out exclusively from the Plato position. However, in the era of Big Data from this point on, it will be from the Aristotle's position, such that Big Data is automatically analyzed by methods such as clustering to create new conceptual objects, or reorganizing the knowledge system from a new perspective to create a new efficient recognition system. For that purpose, it is necessary to specifically and comprehensively algorithmize what is shown in A and B of Fig. 1. For objects that cannot be distinguished by such methods, it is necessary to bring in new observation methods to expand the dimension of observation or to make more precise observation. However, what kind of nature or movement to focus on is related to ethnic culture and is not easy. It is an issue that we do not even know can be solved by analyzing big data.

Now let us consider pattern recognition in general. I described the idea of Gestalt in I-4.2. It is a position that one form is composed of several parts and makes a form with one meaning (Gestalt), which is a reasonable idea. What makes a part is called a feature, and when gestalts are formed by feature extraction and their structural combination, the question arises whether each part is not a gestalt. A triangle has three corners, and the corners are connected by a straight line, but the corners and straight lines are reasonable gestalts, and each one has meaning. Therefore, patterns may be considered to be built up into more complex patterns by combinations of basic patterns. If you think that way, you can think of the way of recognition that it decides whether it belongs to the same kind based on the sameness and similarity of the structure, such as in what kind of arrangement relation and the structure the element pattern is connected and piled up.

Therefore, it is considered to be a big task to clarify what kind of similarity is possible, and the kinds of similarity as a basis of distinction to classify and explain the world. I will list the candidates.

- Similarity of five senses information
- Similarity of feature shape
- Structural similarity
- Topology isomorphism
- Similarity of temporal change
- Semantic similarity .....

Let us consider the concept of being similar in more detail. This is something opposite to what is not similar, to clarify the boundary of the distinction between a certain concept and another concept, and it is a relativization of the concept, so to speak. For example, how to distinguish between rainy and cloudy. Given the meaning of the words, a plausible semantic explanation of each of the close two words is also necessary, but rather, the problem is how to distinguish the semantic differences between the two words and their boundaries. Although Japanese culture has intermediate expressions such as fog and haze between rain and cloudy, there may be cultural spheres that do not have such expressions. Since it is almost impossible to make the distinction in a semantic description, it can only be shown as the meaning of the distinction by indicating as many sentences in which such words are used as possible. Readers would imagine the boundary of the distinction from these sentences. This is the idea of the example-based translation method for machine translation (EBMT) that I proposed in 1990. What is interesting is how these gestalts and meanings are stored in the human cerebral cortex, but this will remain a challenge that will not be known for years to come.

2. To understand the language

A new view of language was invented by Saussure. It is the construction of the study to see the structure that one language has, not the historical linguistic research up to then, that is, the viewpoint of how the smallest unit of language combines and forms sentences. Languages are roughly divided into spoken language and written language, and regarding the former, R. Jacobson (1896-1982) achieved a great result. Regarding the latter, in the age of computer, various achievements have been obtained about the structure of written sentences. Many people think that sentences must be written according to grammar, but it is not at all that the grammar of the language is shown concretely and correctly. It is only shown in a vague manner to the extent that Japanese is a SOV-type language in which the predicate comes last, while English and the like are SVO-type languages. It is valid in

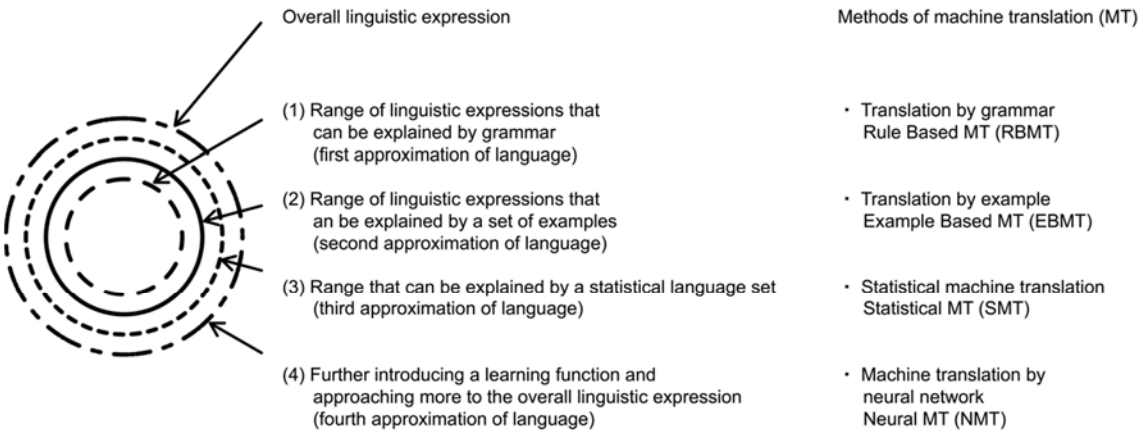


Figure 10 Means of explaining language and machine translation using these means

normative sentences that the subject precedes the predicate and the predicate supports the subject, but not necessarily in real sentences. Since computers deal with real sentences, it is necessary to create grammatical rules that can be used even in such cases, but that is very difficult. When we say what a grammar is, we can just say that it is a word-to-word connection that holds in many cases (Figure 10).

Therefore, the question is whether we can create an algorithm to translate, by examining a large set of sentences in one language and what words and words occur in what kind of relationship and in what frequency, and analyzing the sentences by the computer based on that.In the early stages of research and development of machine translation, a large amount of language data could not be used, then sentences were analyzed according to grammatical rules that humans had in mind, and the sentence structures were converted according to the grammars of other languages. This is rule-based translation (RBMT). However, it got stuck because it is difficult to create a grammar system that can explain all linguistic expressions, and it is difficult to convert the grammatical structure of one language to the grammatical structure of another language with high reliability.

A more difficult problem is that one word is ambiguous and it must be translated into several meanings in another language. For example, the word “high” corresponds to high, tall, expensive, famous, etc. in English, but it will be selected with reference to the example such as mountain is high, he is tall, price is expensive, and he is famous. Since the meaning of one word is determined by the relationship with nearby words, phrases, etc., the word dictionary needs to have many examples to indicate that different usages have different meanings. Alternatively, it is desirable to create a dictionary of phrases (a series of words), not a word dictionary, so as to avoid the diversity of language meanings. However, if a word dictionary contains 10,000 words, it will be several millions of headline phrases as a two-word phrase dictionary, and a three-word dictionary cannot be created manually. However, it can be fully realized with today’s computers.

Figure 11 **Meaning of words**

(1)It is self-contradictory to explain the meaning of words using words

(2)Define the meaning of a word by illustrating it with a complete set of expressions that include the word (translation by example)

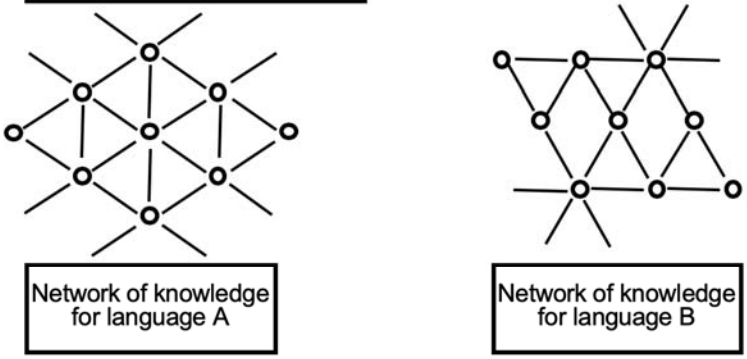
(3)Define the meaning of a word by creating hundreds of sememes and combining them

(It is impossible for humans to achieve this. Would it be possible if a vast set of sentences is processed and learned?)

(Is this how neural machine translation (NMT) works?)

One way of defining the meaning of the word (Figure 11) is to examine the relationship between the words minutely. According to this method, the entire words form a huge and complex network (Figure 12). This network is, so to speak, a representation of the culture behind the language, and languages and cultures whose word network topology is similar are considered to be similar. Taking the words (concepts) in the network, there is something unique in connection with other words (that is the meaning of the words), and the network topology of the words in two languages can correspond beautifully. If we extend it, if there is a portion where the local structure is identical in the network topologies of the two languages, the words or phrases of the two languages there are considered to be

Figure 12 **Network of knowledge**



(1) The network structures of A and B have the same patterns → A and B share similar cultures

(2) The network structures of A and B have the same patterns in some parts → The corresponding words, or sentences, in those parts express the same thing

corresponding, and you will be able to make unique correspondences between words in two language. Thus, a bilingual dictionary between words in two languages can be automatically created. The same is true for the structure of the sentence. That is a possibility of deciding a parallel translation when the structure of a sentence and the whole network structure of the words used there are almost same in the two languages. Such a method will play a major role in the automatic generation of machine translation systems going forward. This network topology is also the basis for supporting the meaning of words. The word names given to each node there will be arbitrary, which is consistent with Saussure's assertion.

As Wittgenstein stated that "the meaning of the word is its usage" as to what the other meaning is, the dictionary should have as many sentences as possible showing the usage besides the entry words and the semantic description. Although the meaning descriptions in the ordinary dictionary show only the typical word usage, it is necessary to list all those expressions in order to handle other subtle meaning expressions. Today, there are more than 100 million sentences in a computer, and collecting and showing all usages of one word by analyzing them is to show the meaning of the word. For machine translation, giving an unclear abstract semantic description in an ordinary dictionary is hardly useful, and it is necessary to create a dictionary in which every example of one word is associated with the corresponding possible expressions of other languages. It is called an example dictionary. It is necessary to recognize that is the meaning of words. In an ordinary dictionary, the definition of the meaning of the word ultimately falls in the tautology (synonymous repetition), but such a contradiction can be avoided in the dictionary by this method. It is a definition of meaning that can be realized only in the computer age. The American analytical philosopher Quine (1908-2000) had an idea close to this.

In machine translation of a language, it is considered that the meaning of each word of one language is expressed in the form as described here, and the corresponding expression in the target language to be translated for the usage of each word needs to be given. However, there are cases where the corresponding expression cannot be determined within the expression range shown as the usage of the original language. As such, it may not be possible to determine the meaning of the words appearing there by only a part of the sentence, and the translation expression may not be determined well. So it was attempted to input a sentence unit of a language and its translation into the computer and use it. This is the way thinking in an example translation. However, at that time it was difficult to collect a large number of bilingual data, so it was not possible to achieve substantial results. Today, however, bilingual data is being accumulated in millions and tens of millions, and these can be used to make the deep learning functions work to organize these example data and make them easy to use. It has become possible to translate at a translation rate of 90% or more except for literary sentences such as poems and novels (see Figure 10). The task from now on will be how to grasp the context, how to express it and apply it to the interpretation of the following expression.

3. Nature of dialogue

It is difficult to define what it means to understand words. Therefore, we cannot but use a method to estimate whether we understand correctly depending on whether we can respond properly when we receive words and sentences. Many Japanese people are not good at English. Even if you speak grammatically correct English, it is often not understood well by the other person. However, even speaking broken English that is not correct in grammar, some people can tell what they want to say and get an appropriate response. What exactly does this mean? That would mean that speech is mostly understood by the situation. The situation here is based on whether appropriate knowledge, the scene and the time transition etc. are taken into consideration, and if the information which is short but key can be transmitted even by the expression of a single word, communication is sufficiently established. This means that appropriate and strong inferences can be made between the key information and the situation, and the question is whether such a program can be successfully created. Dialogue between human and robot is a big issue going forward.

What is person-to-person dialogue like? When two people discuss a topic, not only is the knowledge structure in the brains of the two people equal in the rational brain (see Figure 9), but same in the sensitive brain and the mental brain, or it may be considered as an effort to recognize what kind of knowledge structure difference exists in the human reason brain of the two and to fill in the gaps with each other. Here, it is necessary to first understand the content of the other person's utterance. Analyze the speech using your general knowledge. Based on the result, the other party's intention is inferred, and from that, some kind of inference is made to produce a response. Another factor in establishing a dialogue is how much knowledge and information you have about the other party in the dialogue. It is necessary to deal with the other party while putting the situation of the other party as knowledge in your episodic memory (see II-4 and Figure 2) through the dialogue. Therefore, in addition to general knowledge, it is necessary to learn and acquire knowledge about the other party of the dialogue, the scene of the dialogue and the societal situation at that time. Therefore, it is difficult to create a good dialogue system.

Considering that dialogue is usually performed with voice, there is a problem of how to recognize the intention and emotion of the speaker included in the speech. Analyses of such information contained in accents and intonations are not yet sufficient. It should be noted that this is often a major factor in determining the direction of subsequent inferences and responses.

The problem is what direction to infer after the other party's intention is understood. If you are not interested at all, just return a "yes" response. However, if the other person's words are completely different from your own knowledge or if they are the opposite of what you are thinking, a response will be "That would be different" or "No, I think that's OO." What kind of reply to make to the other

party's speech depends not only on your own knowledge but also your state of mind for the other party at that time. You do not want to talk to this person, you are sharply denied your position, you see people you have never met before; there are so many cases. A good dialogue is a work of getting in touch with each other, and elucidation of this part is a very interesting field going forward.

4. About knowledge

Knowledge is the product of the human brain formed from what exists in this universe, and it is the meta things that are created from it; that is to say, the abstract concepts, and the interrelations among them. Simply speaking it refers to all the information in the brain of human beings. The problem is, first of all, what kind of thing the knowledge is and what kind of structure the whole is, how new knowledge is created, how it is accepted, and where it is placed in the system of knowledge. As for knowledge, it has been a major task in philosophy since Plato and Aristotle until today. Plato showed the thought that if the existence of something is true, it should be immutable, and that what in the real world is constantly changing, while the concept (*idea*) of itself is immutable and true in a true meaning. Aristotle took the approach of forming an abstract concept from examination of objects in the real world in detail and stated that some (objects) could be described by material and form. It may be considered to correspond to the current description of the name of the object and the nature of it (feature extraction in pattern recognition). The representative method of describing the system of knowledge in today's informatics is as follows.

(a) Name of object
(b) The nature of the object,
(c) Interaction with other objects

Then it becomes a problem here what kind of thing and how many is specified as a kind of nature and the relation between them, but even the standard has not been fixed. As properties, for example, color, shape, size, image quality of surface,
Moreover, as correlations, there are things such as superior-subordinate relation, partial-whole relation, purpose relation, causal inheritance relation, relation by association, but there is nothing that is standardized. A variety of ontology systems are relatively easy attempts on them. In any case, the whole body of knowledge can be considered to constitute one vast network. It looks like a tree-like structure if you emphasize superior-subordinate relations, and it will look like a kind of mesh if you pay attention to partial-whole relations and causal inheritance relations. These may be considered to form a three-dimensional structure. When new information comes in, if registering it as knowledge

into the knowledge network, it will be placed by making related links near the related knowledge on the network. It is necessary to guarantee intersubjectivity (see II-6) for the information just coming in to be knowledge. It is also necessary to consider how to check it.

Besides creating an encyclopedic knowledge structure that is general and socially common, there are knowledge and information specific to individuals. This is a memory of what an individual experiences, and is called episodic memory. Depending on how much such knowledge is known to others, the contents of the dialogue will change in various ways. For example, without knowing that the other party is married, you cannot say, “How is your wife?”

In this way, knowledge can be general knowledge common to society or individual empirical knowledge belonging to individuals, and it is important to know in what kind of structure they are in the mind, but at the moment that is not known at all. It would be possible make it on a computer by force, but we would have to put hope on how to analyze and organize big data about knowledge. And it needs to be considered from the perspective of how to use knowledge.

The knowledge includes not only those in the form of concepts or symbols, but also those such as images, landscapes, sounds, music, tastes, senses of touch, or memories, and in what structure these are stored, taken out and used is a problem from now on.

With regard to the use of such knowledge networks, it is considered more important to have the following functions as compared to the conventional use of databases. When a certain thing is recalled, automatically making the activity high on the node on the knowledge network corresponding to that and the range of the link or node connected to that, and by making the neural functions in the area related to the recall much higher than those of unrelated networks, making it is possible to extract and infer knowledge efficiently so that appropriate knowledge and information can be extracted. Because the system of knowledge is huge, it is thought that this kind of thing is done even in the human head. I would like to wait for the day when it can be elucidated in psychology, cognitive science and brain science as to how such things are in the human brain.

5. About knowledge

Based on what is described above, a computer model of the brain structure as shown in Figure 9 may be assumed. The top layer of the brain is the part of deduction and reasoning performed in the cerebral cortex, and it can be said that it is responsible for most rational brain functions. Let’s call this part the rational brain. You can think that most of the linguistic functions are also performed here. Most of the sensuous interpretation of the information given by the sense organs is thought to be performed in the lower part of this rational brain. Let’s call this part the sensitive brain. What supports the rational brain and the sensitive brain on the back side is called the mind, and I think that it is a

mental brain that controls emotions. The state of the other's mind is inferred, and the state of the mind (this is ruled by the soul assumed to be further deep) governs the deduction and inference direction in the cerebral cortex. Depending on the degree of friendly feelings to the other party, you may respond in a positive direction, or not or in a completely neutral position. In situations where the physiological functions of the human brain are not yet well understood, it would be inevitable to think of such a rough computer model and put it into the robot's brain for useful action.

It is probably the function of consciousness that it constantly travels through the brain consisting of such layered structure, and issues commands to the place to respond or respond in response to external stimuli. More strictly speaking, consciousness is considered to be an act of recognizing what you are doing through the action of feedback confirming that you have worked on a certain place in the brain. In terms of computers, this is equivalent to the task of finding out whether a large number of complex processing programs are working smoothly, checking information from the outside, and detecting viruses. If this conscious activity is not working in a normal way, it will lead to situations such as schizophrenia and neurosis. It can be understood that concentrating the mind takes the work of the brain in a deeper direction by concentrating the range in the brain where the consciousness circulates to the relevant place. For this purpose, the program of consciousness is given strong energy from the soul, which is the source of the brain, to control the scope of work.

Consciousness naturally has the property of running around randomly. What controls it is the energy that comes out of the dimension of the soul, but if it breaks, the consciousness becomes disorderly. It is often said that a kaleidoscope of memories since childhood are flashed back at the moment when people are dying, and that may be a phenomenon that occurs because the energy of consciousness runs out and loses control and consciousness spreads throughout the brain.

It is assumed that what has such a big influence on the working of the mind is the part called the soul that supports the foundation of human existence. The activity in this part fills the body with vitality, making the mind positive and activating the person's thoughts and actions. If you are suffering from a serious illness and your soul's activity is extremely depressed, you cannot make a positive reaction regardless of what you were told bright things, and the mind's direction works negatively. Although Freud's unconscious world may be a work of the mind, it is important to consider a model that it is governed by the degree of vitality of human beings, which may be termed souls.

These four layers may be thought to be corresponding to what is known as "knowledge, emotion, mind," but memory is related to this in various ways. Also in memory, general knowledge is strongly related to layer 1, and experience-based memory (episodic memory) is related to layers 1 and 2. The mind is related to the level of souls in the layer 3 and layer 4, and it may be related to how to activate the entire memory.

We can say that, memories that remain even after years are gradually transferred from the upper layer to the deep layer and remain, but as they get older and lose their upper memory, they come up

again to the upper layer (or as there is nothing in the upper layer, the deep layer is directly exposed to consciousness).It is a phenomenon that the memory in childhood comes back as you get older. The brain is always working, but the workings of the brain mentioned here must be under the control of consciousness. In the case of a computer, it is an interesting task in what form of a program to make it.

6. Model the world

Many philosophers, including Kant, do not know what the true figure of the universe is, the world is said to be a range of knowledge obtained through the action of human recognition. Plato and others are in the position that the world that can be deducted from a few sure things is the world for human beings. On the other hand, empiric people take the position that the observable world shows the limits of the world we can know. It is understandable if we follow the history of science (see Figure 4) that the world is expanding due to advances in the types and performance of observation devices.

The world we know has so much different content that it is difficult for humans to grasp everything as knowledge in either deductive or inductive positions. However, in the age of computers with almost unlimited memory capacity that never forgets, in an era where efforts are made to collect all the information that occur in society and space in the name of big data, aside from whether the word inductive is appropriate or not, it may be safe to assume that an attempt has been made to grasp the whole of the universe by putting all the phenomena and objects in the space-time world into memory and performing various analyses and inferences. And if this is properly available, things that are not possible with human brain activity may be possible with computers.

But philosophers will say that the true form of the universe is not understood by humans. It is because the way of defining the true form is not good. Isn't it better to rethink the definition of what is right and what is true? Science focuses on analyzing objects. On the other hand, engineering takes a much wider position than scientific verification, whether the findings and laws obtained through analysis can be relied upon and whether it is possible to expand the world by using them. In other words, the engineering process of creating things tries to broaden the understanding of the world and the universe and to contribute to a deeper understanding of the true image of the world. If it is possible to make something as expected by carrying out an engineering process based on the hypothesis that combining such facts in this way will make new things like this, it would be a powerful way to create new things that God did not even know by taking the idea "Almighty God created all the things" one step further. It is strange that such a method of understanding the world by demonstration with synthesis has not been taken up in philosophy so far. It should have been a mistake that God did not realize that it would be horrible if giving human brains the function of reasoning and learning. It may

be the same thing that we have given artificial intelligence a learning function.

If there is a phenomenon that cannot be explained by such a method of understanding, it will return to understanding by classical analysis again, a world of new laws will be discovered, and a paradigm change (see II-11) will be made. However, in this case as well, it is probably the correct attitude to think that the new phenomenon world and the way of its understanding have been added, rather than the knowledge acquired so far being totally denied. Appearance of the world of quantum mechanics does not mean that the world of classical physics has been totally denied. So, it can be said that the era of philosophical recognition of the world up to Kant is completely over. Just to add in the honor of Kant, the issue of human spirit is something that cannot be touched at all in the model of the informatics position described here, and it is a big issue given to us what to do with it with informatics in the future.

The fact that things are understood or the existence of a certain thing is understood is accepted socially by the fact that as many people in human society as possible understand in common. In philosophy this is called intersubjectivity. It is a subjective act that each person understands and approves, but it is said to be intersubjective when what is understood or approved is shared by others. If this applies to all members of society, it will be objective. Since mathematics and physics are contents that people in the whole world agree with, it can be said that this is an objective fact and a true thing. However, as a more powerful means of confirmation of the truth, if we predict that "if this process is taken, it will result as such" as described here, and if we experiment and confirm that it is true, it may be better to think that securing the credibility of the content and process is a more positive objectivity and confirmation of factuality. It may be called hypothesis test understanding / agreement.

In the future network society, information will spread to the world in an instant. At that time, it is a big problem how to secure the credibility of the information. Moreover, even if the information is highly reliable, there is a problem as to whether the credibility (that is, correctness) is guaranteed. These two problems will become serious in the international community in which information will be increasingly flooded. It may be possible to respond to this to a certain extent technically, but it may be said that it is a big philosophical task how to see such situations and how to deal with it ideologically.

Virtual reality creates three dimensional space that does not exist in reality by using computer graphics technology. It is a technology that gives a sense of reality to human five senses such as sight, hearing, touch, etc., and simulates as if you were in it. When a person enters such a space, what kind of judgment and action does the person take? If you feel that it is the real world when you live in such a space for many days, and reach the end of your life without knowing that there is a rich real world outside of it, that would be too sad. Similarly, if the real world in which we live were actually a virtual world, there would be no such a foolish being as foolish as we are today. People in the Middle Ages believed that heaven is the ideal land and hoped to live there.

7. Strict logic and about reasoning

With recent hearing aids, you can change the intensity of each range as you like. The world of the sounds of people who do not properly tune it and hear may be different from the world of the sounds of normal people. The same is true for the recognition of colors in the eye. Why is it guaranteed that the sound and the scenery of each healthy person are the same in the first place? It is interesting not to doubt that people live in the same world and feel and judge same, which may be different for each person.

Human intellectual activity is performed in the cerebral cortex. There, various thoughts are made by the functions of knowledge and reasoning that are stored, judgments are made, and the results are linked to action. To what extent are these functions correct and precise? Yesterday's Mr. A and today's Mr. A are not the same, even though he wears the same kimono, such that he has no brilliance in his eyes. However, we do not doubt that it is the same person. It is because we ignore small differences. Even in the reasoning process in the brain, for example, even if it is judged that it is a cherry tree because of the shape of a leaf, it is thought to be judged as it is highly likely to be similar in the range of one's own knowledge despite other possibilities. Thus, all activities in the brain are not performed in a strict manner as in a computer, and they contain ambiguity, which is more like an estimation that it should be almost like this. For example, even if you command to correctly tell this information to the other party, when it is relayed to a few people one after another, the information given first is often received with considerable distortion. In this way, what human beings are doing is inaccurate more or less. It is because the work of judging the same in the human brain is actually inaccurate (ambiguous). Fuzzy theory is proposed in 1965 as a model to handle such ambiguity. Fuzzy sets and fuzzy inferences were introduced, and the results were used for system control and speech recognition, but not widely developed.

If artificial intelligence is to simulate the function of the human brain, it will realize a process involving such ambiguity, but the computer is not good at doing the ambiguity on the contrary and devoted to be precise. So it can be said that humans are inferior to computers. By taking vague responses or actions, however, it has the advantage of not hurting human emotions and being able to act with voluntary judgment even when ordered. If you are required to be too precise, you will have to ask for others with specifications of all the conditions, which cannot be done and society may not work. Therefore, it is necessary to create a computer that can receive and understand the vague instructions and opinions of human beings and accept the meaning of important parts correctly, but this is a difficult problem. Humans are ambiguous in all cases and often make mistakes with the inaccuracy, so it may be said that humans are worse. As society gets more complicated and computers are used in everything, people have to be strict, but this is a heavy burden. It will be necessary to come

up with a way in which even the ambiguous way will not result in mistakes. Or by changing the way of thinking, it may be good to think and realize that we cannot reach the ultimate truth no matter how much effort we put and the truth exists in the ambiguity. It may be better to think that human brain work is triggered by an analogy with what it remembers, and that it makes analogical reasoning.

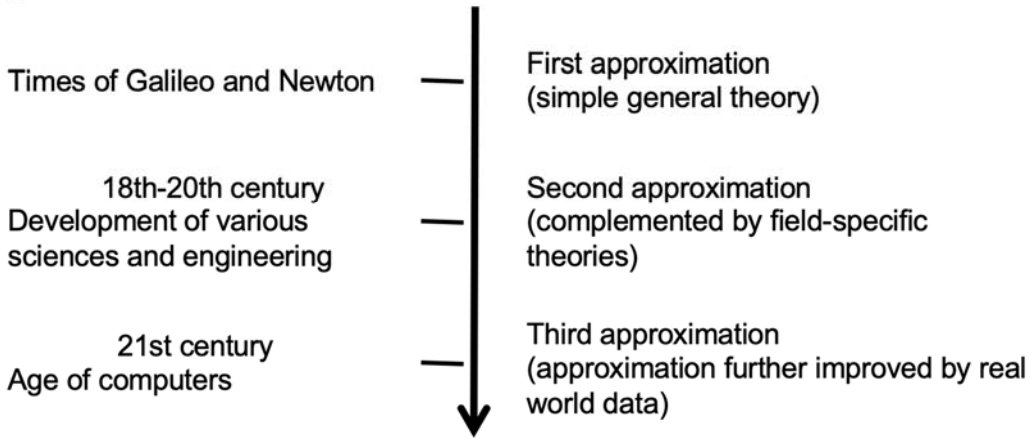
The impossibility of translation has been argued for for a long time. They say it is impossible to translate sentences of a certain language, especially sentences of novels and poetry. Machine translation that makes an international contribution, which is a major accomplishment of research in informatics, is criticized as if to say it cannot be trusted. Then, do they have a good understanding of their native language's novel and poetry? Is there a fundamental gap between the depth of comprehension and completeness (if any), and the comprehension of what has been translated? Isn't that a matter of degree? It depends on the background knowledge and experience that the person has, and even people who have the same native language may have differences in understanding, and in some cases they may only be able to understand only superficially. Human understanding cannot avoid being ambiguous even with sentences of logical definition.

It is thought that every language has the power to describe in any detail in both coverage and depth, so even if it is not possible to translate one poem in another language with the same number of words, it will be possible to reach the same level of understanding as the native's understanding of the poem by explaining the content and background of the poem using many words. As stated in I-2.3, wisdom from ancient times is transmitted to the present global world by translation, and has built up today's global culture and civilization. It is interesting that some essence and valuable knowledge is transmitted even if being ambiguous. It is good from this point of view that there has been an endless debate on what Hegel's thought is.

8. With the age of big data

In recent years, it is said that the age of big data has come, with the claim that data is important and the hidden information that can be read from data is valuable. How should we understand this phenomenon? Modern science is said to originate in Galileo and Descartes, and the study of mechanics was systematized by Newton. As a result, not only the movement of celestial bodies but also engineering such as civil engineering and architecture developed, and Napoleon (1769-1821) made a polytechnic school in Paris and promoted the development of engineering. However, Newtonian mechanics corresponds to the primary approximation learning that supports such fields, that is, the trunk in the case of trees. There are various special phenomena in each field in addition to that, and to explain them, it is necessary to add a field-specific theory. For example, in the field of mechanics, disciplines have been branched and refined by adding laws on friction and air resistance. This can be

Figure 13



called the age of the second approximation. Thus, many scientific and technological fields have been developed until recently. However, we cannot fully explain the phenomena of the earth sciences, such as earthquakes, typhoons, and plate tectonics.

In humanities-related studies, in modern economics the first approximation theory has been developed by Marshall and Keynes, but it has not yet reached the point where economic phenomena can be well explained. As the next step, the second approximation study is being developed with behavioral economics etc. Also in linguistics, linguistic analysis centering on grammar, estimation of human language ability from a language generation position have been developed, but they are all studies of first or second approximations about language. In computer-based language translation, grammar-based models and systems were created in the early days of research. But it was insufficient and then first-aid corrections were made for various unusual expressions, and the whole has become a mass of know-how that is completely unforeseeable.

In order to break through this situation, it was considered to be better to gather concrete examples of past translations that humans have made and translate according to them, and the method of example-led translation was suggested for the first time in 1980.That is, it is a program system in which data corresponding to the original text and the translated text in the translations are collected, an example dictionary is created, and a given sentence is translated following this. But at that time there were few computer networks, and it was not possible to gather such data on a computer to create an example dictionary, so this idea remained ideal. However, in the 1990's, example data began to be accumulated gradually, and the system of this thinking began to be developed here and there as being better than systems based on grammar. Then, probabilistic and statistical ideas were introduced there and it became an age of statistical translation. Then a learning function was introduced to this, which became a neural translation system, and a dramatic improvement in quality was achieved (Figure 10). In these cases, the number of parallel examples collected and used for learning amounts to millions to

billions, and it is possible to cope with expressions that appear only infrequently, and achieve a translation that can be read smoothly, which has become a practical system.

As described above, when it is not possible to find a rule for better handling the phenomenon in the target field, it is better to refer to real data, and so to speak as a third-order approximation method, it has penetrated society to raise the degree of approximation by collecting a large amount of data in the field and using them successfully (Figure 13). It is thought to be a reason to say it is the age of big data. The idea of using the data of phenomena directly in this way may be said to originate from example translation. It is a last resort for the super-complex phenomena area where the law cannot be built. It can be said to be the time to handle the last end leaves after the extension from stem to branch (second approximation). As for the application, there are a large number of cases for consumer departments of banks and companies, and relatively simple cases of courts (such as judgments on traffic punishment sentences), and how to effectively use them is being discussed.

9. About learning

Although the brain is the most important thing for humans and the most advanced human function is the learning function of the brain, it was slightly described by Aristotle and not argued at all in philosophy thereafter. This is strange. There have been two extreme debates that human brains were totally blank when they were born and that they had genetic knowledge as they were born, but today such debates would not make sense. If there is genetic inheritance, it may be that there may be some difference in the way the neural network is stretched and the degree of its activation, and the way memory is made.Even in recent years, someone said that learning is to recognize something in oneself and is not something that can be told in words, but it seems to be about the nature of learning and not a process of the brain becoming smarter by learning.

Autopoiesis is a concept related to learning. This is thought by Chilean biologist H.R. Maturana (1928-?) and F. J. Varela (1946-2001) in the early 1970s; when seeing a living body as a system theory, the living body is considered to be “an existence that creates itself,” and it is considered to be a completely closed system. But is there such a completely closed system in the real world? When thinking about learning, there is always some kind of interaction with the outside world, learning is performed through the stimulus information, then it leads to the growth. For example, an artificial intelligence system is a system that has a function of self-organization that takes in information from the outside world, forms its own system in its own way, that is, in a subjective form, and updates it. It may be said to be closed in a sense. It can be said that it is a system that learns from outside and learns voluntarily inside and becomes smarter.

Humans have the learning ability to learn from cases and get smarter. There have been various

studies on making computers have learning functions since artificial intelligence research started, but it was not possible to create good learning models. However, a method called deep learning has recently been developed, and a learning method comparable to human beings has been created, and it has shown its power in games such as Shogi and Go. This not only imitates the cases of Shogi and Go performed by humans, but also refers to such cases as a way of finding new powerful moves by playing tens millions or hundreds of millions of times between computers. It has come to the level of the game ability that cannot be reached by humans at all. Such a thing seems to be applicable to various other tasks to make a powerful artificial intelligence system, but in order to do so, things equivalent of a rule in a game will have to be clarified. For example, when thinking about artificial intelligence that makes stock trading successful, if it can be even approximately arranged in the form of rules what factors cause the stock price to go up and down and how it affects the stock price, stock trading will be a world of game.

Therefore, it would be nice if the rules that would be in the problem domain could be clarified, but there is no explicit rule for most of the issues in society. Therefore, the issue is how to extract what look like the implicit rules. It is a very interesting subject whether artificial intelligence can voluntarily extract it from big data using a learning function instead of human beings thinking and extracting it. For example, when deep learning is applied to machine translation of a language, what is considered to be the meaning of the word is created into a semantic space of several hundred dimensions in parametric form, and it appears that translation is performed via this. It is imagined that the semantic space for covering a large number of parallel examples is made in this way. It is imagined that perhaps meaning and style may be captured in this way in the human brain. In this way, artificial intelligence may be able to voluntarily exert more power than humans on various issues. Recent artificial intelligence is said to become smarter without learning data. However, it is a case where there are clear rules like Go and Shogi, and at the level where there are something like rules, learned data is still indispensable. Actual human beings can only find something that is likely to be a rule that may be valid just to a part of a task (language grammar is a typical example!), but if you give artificial intelligence the rule-finding method of many people, it will learn the rule-finding method generalized about from there, and then it may be able to automatically detect implicit rules in new fields. There is a possibility that it may really surpass human beings.

How the philosophy should think about such a learning situation can be a serious problem. It is necessary to think about the influence on society by machines learning more than human beings, rather than what learning is. Along with the future of robots in one narrow specialized field, it is necessary to think about the possibility of robots that can learn strongly in all fields like humans.

10. About artificial intelligence

It is well known that the term artificial intelligence was created in 1958 by a group of researchers interested in these things. Simply put, it can be said to realize the works of human brains on a computer. The part of the human brain's rational work, that is, the work of the cerebral cortex, can be performed on a logical and mathematical basis, which achieved great results. However, with respect to the lower levels of brain activity, that is, the work of the world where "heart" such as sensitivity and emotion is strongly related, it is not possible to create a clear theoretical system, and the main means are to conduct what human beings are doing with methods like a simulation, the level of imitation. Therefore, at this level, a method of collecting a large number of cases, finding the most appropriate one among them, and performing the same thing is effective. Example-Based Machine Translation (EBMT) was the first attempt. The problem is to find the most appropriate example. Today's big data utilization is a necessary technology to scrutinize subtleties that are hard to be in theory. In these cases, it is central to collect case examples of all phenomena patiently and use them as a teacher.

We discussed the problem of rule detection from big data at the end of the previous chapter, but something similar can be said about knowledge. Since artificial intelligence can store knowledge and information from around the world, and it can be transmitted to artificial intelligence of the next era, its knowledge and information will become increasingly large and refined. It is far beyond the knowledge and information possessed by individual people or individual societies. And since it infers while reorganizing knowledge with the learning ability of artificial intelligence, it will go beyond human ability in this aspect as well. The human brain is clearly limited, things are forgotten, and considering that the reasoning ability is not as deep as the artificial intelligence, the human brain cannot beat the artificial intelligence at the level of working of the cerebral cortex.

If there is anything that human beings can beat artificial intelligence, it will be in the mind that supports brain activity and in the work of the level of the soul below it. It would be that, through the work of the mind, human beings are supposed to have love for parents, children and others inherent in living things, instinctual standards for things such as good and evil, and a sense of beauty. If you see a little child hungry, you will try to give only one piece of bread you have even if you are hungry. People have such human love. Kant calls this the moral law, but we will have to question whether such instinct can be given to a robot. It could be a horrible reality that all future wars will take place with the help of robots, so in order not to do so, robots must always be embedded with the moral law of human love.

There is a philosophical task that humans have free will (or the ability to decide the purpose on the fly), but robots may not be able to have free will. However, if we examine in detail what human free will is, we are deciding any of various possible choices while wondering in light of the selection

criteria of oneself, which may not be free will. This decision process while wondering would not be something that only humans can do. The selection criteria owned by each human are based on a small number of value criteria that are much narrower than the selection criteria that artificial intelligence would have, and this is what we gain from experience and varies from person to person. Moreover, because it can be inconsistent, it cannot help becoming a decision with less confidence than artificial intelligence decisions that have reliable value standards. Isn't this just expressed by the word free will? The world is super complex and it is almost impossible to grasp the whole, and that is the same for both artificial intelligence and human beings. However, considering that artificial intelligence can have more amount of more accurate knowledge and information than human beings, human beings will have no chance to win.

Let me explain it a little more concretely. In Shogi, the rules are clear, the next move is the act of selecting one of the limited possibilities, and they choose the one that seems to be the most advantageous in a phase of the next few steps. It is a limited world. So what about humans working on a general task? For humans, the number of choices for making decisions about a task is enormous. But it is not endless. And they would choose the most advantageous option for themselves on the spot or in the near future, but in any case it is finite even if huge. If we think this way, we may think that the next move choice in Shogi and human decision-making are essentially the same. The criteria for being the most advantageous can be set in various ways both for Shogi and human beings, but they do not differ much in a sense of choice in the finite world. Because the space of choice is so large as to be imagined by a single human being, you may just think that the choice there is done as if you do it freely. There is no doubt that modern or future computers will be able to make an appropriate choice in such a huge selection space, so again here humans are not likely to beat artificial intelligence.

It may be the instinctive desire for survival as a living thing that humans have a purpose, but if artificial intelligence does not inherently have such a desire, that is another matter. That means that if you give artificial intelligence a clear goal, it can go beyond humans. For example, if you give artificial intelligence the goal of winning humans (anything), what kind of thing will it try to win humans? If you think in this way, it may not be necessary to seriously discuss free will. It may be a waste of effort. But rethinking, if free will is to determine the most favorable selection criteria, this will determine the person's life, which will lead to the idea of Plato and Aristotle about the good, and in that sense, we should recognize the value in the ancient Greek philosophy.

It should be noted that, on the other hand, various serious problems related to big data are emerging. For example, personal information and every action of the individual such as personal spending habits, hobbies, close friends, are tracked by a computer and incorporated into big data. Then, once the data has been captured and stored, it will be stored for a long time, but there may be personal records that one person wants to forget or want people to forget. Therefore, it is actually claimed that the right to demand deletion of personal data should be established.

If human beings have a chance to win, ironically saying, it may be that human beings make much more wrong judgments, hurt others, confuse the world, but still struggle to seek for ideals. This is expressed by the beautiful words of respect for diversity. The only comfort lies in the fact that it was humans that have created artificial intelligence with the ability to surpass human beings, and as long as artificial intelligence also learn and grow based on what human beings do, it will advance while making mistakes similar to human beings do and in that sense they are similar. And it may be fortunate for humans that artificial intelligence has a limitation that they cannot automatically create the artificial intelligence as hardware rather than software, that is, artificial intelligence as a robot. That is because artificial intelligence cannot have the self-proliferation instinct possessed by genes. If biological artificial intelligence is created and it has an instinctive self-proliferation function, the situation will change. The way genes seek other genes and encourage them to grow is truly mysterious, but terrifying.

11. Science philosophy and information philosophy

As already mentioned, there were many people in the modern era who were philosophers and also mathematicians and natural scientists, like Descartes, Pascal and Leibniz, but in the 19th century persons specialized only in natural sciences appeared and they came to be called a scientist. For example, Ernst Mach (1838-1916) and Henri Poincare (1854-1912) were researchers in the transition period, and they were the people of the early natural science that also considered philosophy. In the 20th century, research on the methodology of science began to be conducted deeply, positivist science theory became widespread, and the conclusion obtained by the scientific method came to be believed to be absolute.

But against this kind of excessive (?) scientific theory, some people argued that science does not necessarily have such objectivity and rationality. What is famous is the idea of a paradigm change. Until Galileo, geocentric theory was believed, but by conducting astronomical observation in detail, contradictions were discovered and heliocentric theory came to be thought correct. Then the universe was explained without contradiction by Newton's law of universal gravitation. In addition, as the atomic structure becomes clearer, it becomes impossible to explain with Newtonian mechanics and quantum mechanics was introduced. Then contradictory facts for one theory were discovered, or the phenomena that cannot be explained by the theory was found, which then led to the necessity to consider a new scientific framework. And they tried to guarantee the correctness of the scientific framework in the approach that one scientific framework cannot be realized if one contradictory case is found. Popper (1902-1994) referred to this as falsifiability. It was expressed as a paradigm change that the theory and the way of thinking up to then replaces a completely new way of thinking.

It is generally believed in science that things can be explained by causality (lawlike) and that it is

guaranteed that anyone can reproduce the same thing. However, it cannot be dependable as it is discovered that it may not always be guaranteed in all cases, such as chaotic phenomena. The chaos phenomenon is that even if it starts from almost the same situation, it will become a completely different situation if it goes to some extent, and the causality may not always be guaranteed. Informatics is scientific research on information, but it cannot be said that information phenomena do not have such chaotic phenomena. It is better to think that there is no guarantee that it will not become chaos unless it is modeled very carefully, especially with regard to the prediction of how complicated social phenomena will evolve.

The philosophy of science has a history that since Popper's paradigm theory, the way of thinking and methods of biology and life science has been completely changed by the discovery of DNA. However, after that, it may be considered that there is no major change that can be called a paradigm change in natural sciences. Philosophy has been discussed in a more precise form through analytical philosophy. As a result, the thought that philosophy has been the study that supports the foundation of all studies since ancient times collapsed, and a deep thought is required for each individual study. In addition, we are in the age of examining how to deal with human and social difficulties that each study has. Although this is natural, we cannot help feeling a sense of loneliness.

The science as a target of philosophy of science is very diverse, and it is difficult to have philosophical discussions common to all disciplines today. It is becoming an age when it is considered by field, such as "philosophy in medicine," "philosophy in humanities," and "philosophy in social sciences." Among them, it is necessary to consider what kind of problems "philosophy in informatics" has, what kind of things are being discussed now, and what should be discussed in the future. Let's raise some things that can be considered other than the issues discussed in Part II of this book.

• What is information?
• What role should information play in personality formation?
• Is the information's mechanism that generates value and wealth acceptable to society?
• Right to hide (protect, erase) information, duty to disclose
• Information system vulnerability and information crime
• Possibilities and problems of artificial intelligence

Closing

As shown in Figure 5 in the first part of this book, we see the flow of philosophy to this day that discussion has been deepened from the one centered on the workings of the cerebral cortex towards the workings of the mind and soul, there was a direction from the rough and abstract level of discussion to the one as specific and as precise as possible, and what is discussed became possible to be simulated

as an algorithm since the concrete tools such as computers become available, which has led to an informatics position today. In this way, it has been stated that it is the informatics, or artificial intelligence that is a powerful part in it, that fairly succeeds to the analytical philosophy. Then, in Part II, I stated how the main philosophical tasks from now on are treated as informatics tasks and what kind of difficult issues exist there. However, current informatics has a problem in that it is only interested in creating new software and systems and effective use in society.

The main task in the scope of the conventional philosophy is what is recognition, what is meaning, what is knowledge, or what is the mind or soul, and all in all, what is human. However, it can be considered that they are shown in a more concrete and more computable form than in the past, as described in this book. Therefore, one of the directions of the future philosophy is to advance the approach further specifically described in this book, and to link the relationship between informatics and neuroscience at an empirical level. But this can no longer be called a philosophy. The other direction would be what has been debated from ancient Greece; that is, an effort to establish a forum for global agreement to obtain consensus on what is good, what is justice, what is happiness, keeping the mind sound, eliminating conflicts in the world, and measures for it.

As the use of information penetrates every corner of the society, it causes various crimes and starts to upset the society. It may be because a solid philosophical backing for information and its use in society is lacking, and the ethical and moral aspects shown out of there are totally ignored. When I was a child, my mother often said, “Do not do anything bad just because no one is watching. The god of heaven can see everything,” but today we are in a situation where computers and network systems that cover the world see everything instead of God, and what is worse, there is a structure where it is used by the company that operates the system. From such a point of view, it will be necessary to encourage contemporary French ideas and the social theory of Habermas (1929-) and Luhmann (1927-1998) in Germany to be discussed in such directions, or to treat discussions on the equality of the public sphere and society or mutual understanding by communication such as a theory of justice by Rawls of the United States (1921-2002) in the direction of constructing ideal things with security in the modern age with extremely developed information networks. Otherwise, we can not but say that the age of traditional philosophy has reached its end.

The pursuit of science is endless, and the question “what is it and why?” will continue forever. The quest is made from the moon to Mars, Mercury, even beyond the galactic system, and there is a desperate desire for humanity to reach there. Despite the fact that many people die of hunger on the earth. Human beings fight with each other and spend time for wars. Can’t human beings realize enlightenment or control desire? I think it will be necessary, not only to discuss issues of good and ethics within the scope of the rational brain but also to make efforts to focus on the ideas of Buddha, thoughts of absence of zen, morality and religion, then deepen the discussion useful for the future information society, and link them to the practice. It would be necessary to carefully consider what

Pascal's way of life was. In any case, it is necessary to make efforts to find new philosophical problems from the contents like this book, which is an extension of analytical philosophy.

(Note) The research on information became active, and the word "information science" was made and got spread. The word "science" has been used in various disciplines such as human science or educational science, as it is an attractive word that implies the preciseness and makes you believe it to be true. It is considered to mean the study to research with methodological things such as scientific analysis and clarification of causality. However, can we establish a solid methodology under this name to better explain the complex, contradictory real world? The question should arise whether science is almighty. Is there a true reality in what cannot be explained by scientific methods or where there is a hole in the network of scientific methods (Big data shows it)? Isn't it a small part of the world that can be explained by scientific methods, the whole study, or the whole object that human beings are interested in, is a broader one and that must be expressed by the word "-ics or -ologies" (study) rather than "science." I have been thinking like this for a long time. Therefore, when it was decided that Kyoto University put together a united school to handle information, many teachers insisted that it be called the Graduate School of Information Science, but the author who was the organizer of the opinion persuaded them that it is better to call informatics. As a result, Kyoto University named it Graduate School of Informatics. This word has been gradually accepted by society since then. "Informatics" in this book has such a history and meaning.

Supplement to “Informatics is the Forefront of Philosophy”

Makoto Nagao (May 7, 2019)

(1) A new framework of semiotics

• The utterance content is hieroglyphed and it is further symbolized and then human utterances are written as sentences. As a result, what a human thinks and the work of mind have all come to be expressed as sentences. From there, each unit of sentence expression is cut out as a word, the world of what it means is created, the relationship between the words is discussed, and the academic fields of linguistics and semiotics are created.

• The Iwanami Information Science Encyclopedia that I wrote could be regarded as a semiotic system that expresses the whole information field (In the commentary of this encyclopedia, I described ontology, thesaurus, words’ relationships in details). In this way, we can see that semiotics and knowledge systems are in a close relationship. While semiotics examines the structure of the system of concepts and the possible appearance of the system, the knowledge system can be viewed as its concrete practice.

• In general, one concept cannot be expressed sufficiently with words alone. As a complement to that, it is necessary to relate to the scene when expressing it and the work of the mind. Therefore, for the semiotic system, it is necessary to construct a descriptive system in which not only words but also drawings, pictures, videos, sounds, etc. are connected.

• Semiology and linguistics are different. Linguistics is a study focusing on grammatical relationships, on top of semiology. The complex network of the various properties of concepts, the empirical knowledge when the concepts are specifically used, and the relationships among the concepts thus created is the system of semiology. This system covers (should cover) not only characters but also images, videos, music, sounds, etc., so its concrete form can be expressed well only in digital media.

• It is modern semiotics that the system of knowledge has spread from the text and its surroundings to the world of sounds and images. When the words spoken by the soul are art (see (4)), the new semiotics should be an elucidation of the words spoken by the soul. In other words, it is not necessary nowadays to consider semiotics in the world that extends from the language world to the entire human sense world.

• The most primitive example of such a world’s concrete manifestation would be manga. Manga is a world of media mix that pictorially depicts delicate worlds that cannot be easily expressed in words, such as minds and emotions, together with words, and in a sense it may represent the first step in the inevitable direction for better communication.

(2) Memory problem

• It is necessary to think about memory before discussing the issue of consciousness. As is well known, there is a distinction between short-term memory and long-term memory. For example, when a word is uttered and heard, the stimulus is transmitted from neuron to neuron in the brain, and its trace is left. This is considered to be short-term memory. In the brains of young people, there are clear traces of their transmission pathways, but in older people, the intensity of the transmission pulses diminishes or the transmission is not carried out by a single neuronal pathway but rather in a bundle of quite neurons. The bundle is becoming thinner due to aging and the activity of the pathway decreases immediately, so memory cannot be kept for a long time and are soon forgotten.

• It is thought that the trace of short-term memory are fixed chemically in a few days, or are transferred to the deep part of the brain and fixed chemically. While sleeping, the brain cleans up the waste and does various things, and elucidation of this work will be the most important.

• The clear part of the causality of the information (memory fragment or unit information) at that time is stored almost as it is, but the part that connects the unit information is relatively weak, so the link disappears quickly. As a result, the long-term storage of the series of information is stored separately for each unit information in a non-causal form. As a result, if these are taken out as dreams, they may be broken apart for each unit information and recalled synthesized at random and in random order without causality.

• When information is transferred to long-term storage, it is broken into unit information, so time information is lost there. That is probably the reason that time seldom clearly appears in a dream.

(3) Problem of consciousness

• Floyd may have thought of consciousness-pre-consciousness-non-consciousness, as if these were all areas of memory (?), but consciousness is a stimulating action in the brain; a memory area to which the stimulus does not reach directly is an unconscious area, and it is not that there exists an area of unconsciousness.

• When considering the problem of consciousness, it is better to consider the function of a computer software system. The computer runs various programs concurrently. It is a program called an operating system (OS) that manages these movements, which receives external or internal stimuli (interrupt signals) and issues commands to related programs. And it always manages that the whole computer works well, in the form of checking that the program receiving the command responds correctly and works.

• The working of consciousness in the brain may be a working of a neural network that does almost the same as the working of the computer management system (consciousness program).When the brain receives a stimulus from the outside (inside), the consciousness program activates the appropriate part of the brain according to the stimulus and checks that it works well. The actual work (action) is

performed not a consciousness program, but by the part of the neuron network involved in the work. Consciousness programs are constantly running around in the brain, and they also check for internal stimuli (for example, a signal that the desired work is completed).

• That the consciousness program confirms that this kind of brain work is being performed may mean being aware of. That is, it is an operation in which the consciousness program itself confirms that the consciousness program works normally.

• Feedback checks are conducted on all human activities. However, for example, in the situation of walking while being distracted by something, the walking action is performed unconsciously. Only when you miss your step, consciousness goes to that.

• In the case of a dream, feedback of consciousness may not be performed clearly. Because the work of the consciousness program falls to the lowest level when you go to sleep, the consciousness receives a weak stimulus by commands from the body during sleep, and the consciousness issues commands in the brain at random to some extent. If this occasionally reaches the unconscious area, some fragments of memory from the unconscious memory area appear under the control of consciousness. This is a situation where it is left without feedback checking whether the fragment of memory works normally because the level of consciousness is low (let us call it a state of semi-consciousness). In this case, it is thought that a situation occurs in which there is no logic or story between them, since there is no check of consciousness and various memory fragments appear randomly. This may be a dream phenomenon.

• Thus, consciousness is a guard tower that always looks at all of the functions of the brain. It would be better to think that the program function that moves the muscles or understands the words coming from the ear under this guard tower is the whole operation of the brain. Reflexive movements are situations in which an input stimulus is delivered to a local operating program before it is delivered to a consciousness program.

• The ego may be to check that the whole program of brain activity under supervision by the consciousness program is different from that of others, and that the consciousness program confirms (becomes aware of) it. Super-ego is an unconscious world that cannot be checked by the ego-check program, and this may be a folk-common brain world physically and mentally.

• It may be said that the mind is some work in the brain part of the emotional work that has received emotion stimulation from the soul and the phenomenon where it affects the rational brain and the work is inferred from the expression (word) from the rational brain.

• When a person falls down in an accident, they are said to be conscious / not conscious, but even if there is a physical response, it is judged that they are not conscious if the verbal response is not a reasonable one. If the verbal response is not valid, it may be considered to be in a state of semi-consciousness, as it is a situation where conscious feedback checks are not performed successfully.

• It is said that people often remembers everything randomly from childhood to death at the moment

of human death like a kaleidoscope. Isn't it a phenomenon that, the control of the brain functions, which are managed by the action of clear consciousness out of the energy coming from the soul, gets out of control by the loss of energy from the soul, and the memory of the suppressed unconscious area is released then those memories come out randomly at the same time in the world of semi-consciousness?

(4) Brain model and work

• A model relating to the workings of the brain is shown on page 48 in "Informatics is at the Forefront of Philosophy," and it is divided into three parts: rational brain, mental brain, and soul brain.

• The rational brain is the part where the logical work is central, and the tool that exposes the work to the outside (words) are languages.

• The mental brain is the part where the mind works. It is greatly influenced by the activities of the soul and influences the work of the rational brain. The means of expressing the work of this part to the outside is art (music, painting, etc.). In other words, the words spoken by the mind and soul are music and painting. Therefore, if you appreciate art, you cannot understand art unless it is received by the mind and soul, and communication at this level does not make sense.

• The soul brain is a part of the motive force as human beings, its expression is a cry, and the degree of its vitality makes the mind work positively or negatively.

• With a baby at the time of birth, the work of the soul brain is central, but afterward the work of the mental brain grows up. At this stage, humans, like other animals, are most sensitive to the risk of survival, and the functions of the rational brain gradually emerge thereafter.

• If we think that the drawing of a cave such as by Cro-Magnon man is an expression of human language at the stage of brain development where the function of the rational brain (language) was not enough, it would be at the level of mind or soul I will. How about thinking that, it is the trace of information communication to inform co-workers where there are animals or the number of them (many, less) by drawing a realistic animal picture or poorly drawing a human, since they have not reached to the formation of symbols (or words) pointing to external objects (animals).If you think so, there may be a possibility that information such as which direction and distance (close or far) from the cave is drawn in some form.

• Isn't it difficult to think that people at that time draw beautiful pictures with artistic awareness. We just feel that way, but it may be more natural to think that it was depicted as a means of information transmission at the level of the mind in the age without language.