Chapter

Humanistic Next-Generation Artificial Intelligence Capable of Association

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Abstract

The third artificial intelligence (AI) boom focused on the "handling of large amounts of data" and "automated learning." One may think that AI can do anything because it is capable of automated learning, but there are still many problems that AI must tackle. The "necessity of a large amount of data" is and will become an even more significant problem. Obtaining an accurate solution from small amounts of data requires imagination and the detection of trends from a small number of phenomena. One approach is to add artificial data. For example, data can be created by intentionally including noise, and the variation may be expanded by a crossover. Different data can be generated by association or inference. Needless to say, these are artificial data and are not correct cases. "Humanistic AI" must be implemented by devising a scheme to allow accurate learning from small amounts of data. I think that the days when robots are considered enemies are transient and robots will soon be recognized as good partners that support humans instead of being rivals.

Keywords: artificial intelligence, humanistic AI, association, inference

1. Introduction

The third artificial intelligence (AI) boom focused on the "handling of large amounts of data" and "automated learning." Collecting and learning information expressed in various forms in a variety of fields can lead to the automated detection of knowledge and rules. One may think that AI can do anything because it is capable of automated learning, but there are still many problems that AI must tackle. The "necessity of a large amount of data" is and will become an even more significant problem.

Large amounts of data are indispensable to statistic processing. In other words, problems where data cannot be collected cannot be solved. One view is that "problems where the collection of data is difficult are not big problems anyway, and therefore, can be ignored." Is this really acceptable? Ignoring a problem because the amount of data is small separates problems into those that can and those that cannot be processed using AI. Stretching in this direction leads to the formation of gaps, which then leads to discrimination and information gaps. Therefore, although an effective use of information technology should be accessible to the weak, a totally opposite scenario may occur.

2. Problems in Japan

The population of Japan is approximately 120 million, which is about one tenth of that of all of the Western countries combined or that of China. As a consequence, the amount of data that a large country can collect in 1 month takes around a year to collect in Japan. Therefore, Japan cannot win against large countries, as the performance of AI is currently governed by the amount of collected data.

Therefore, AI developed abroad will be imported and used. This is sufficient to some extent from a macroscopic point of view. However, Japan is a very unique group as compared to large countries, a fact that is often overlooked because Japan is highly ranked, for instance, in terms of economy. Many aspects of the Japanese culture are peculiar; hence, there will be some unreasonableness if AI developed abroad is used as-is. From a microscopic point of view, Japanese people have to put up with some issues in their lives.

For example, a translation service that a large company provides for free mistranslated "Sakaisuji Line," which is a subway line in Osaka, as "Muscular Line," and "Sakaisuji" as "thigh muscle." This is a big problem for people living in Japan, and international sightseeing visitors will be bewildered (**Figure 1**) [1].

This type of mistake can be easily detected and resolved by Japanese people. In contrast, for companies providing services globally, a small mistake in a specific region in a single country might not be an issue. Indeed, this mistranslation must not have been viewed as a problem that needed to be addressed, because no correction was made for a long time after this problem was reported. Thinking from a global macroscopic viewpoint naturally emphasizes covering more countries, regions, and languages. However, minority groups must clearly understand this issue: systems are not always created and provided with sufficient consideration to minority groups.

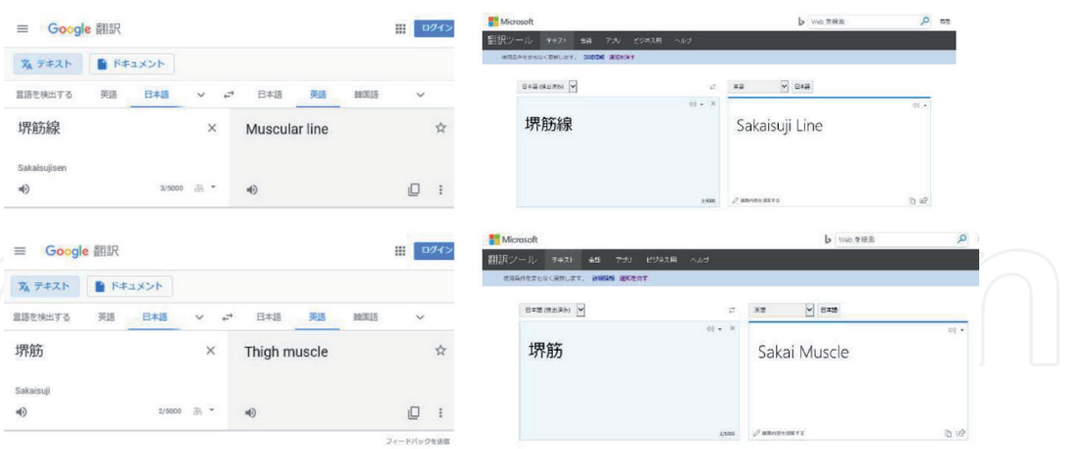


Figure 1.
Example of a translation service.

3. Limits of statistical processing

Having more data is not always better. For example, consider someone who loves "tomatoes" very much and eats tomatoes every day. A favorite friend's birthday is approaching, and he wants to give this friend a present. After consultation with various acquaintances, the recommendation was to "give my favorite thing as a present." He therefore decided to give "tomatoes" as the birthday present because "I love 'tomatoes' so much; I eat them every day." Is this a good idea?

Of course not. Giving "tomatoes" as a birthday present clearly contradicts common sense. However, "giving my favorite thing as a present to others" is not a wrong idea. Had the person loved "cakes" instead of "tomatoes," then giving "cakes" as a birthday present to his favorite friend would have been a very successful result. Then, what is the difference between "tomatoes" and "cakes"? These are both food! Distinguishing these just by using statistical processing is very difficult. In contrast, the "tomatoes" lover might be very happy when very rare, top-grade tomatoes are given to him as a birthday present.

As is evident from this example, schemes that do not simply analyze large amounts of data but instead analyze high-quality data or give solutions with good precision will be indispensable.

Many data can be collected if the target is large. One resolution when a large amount of data cannot be collected is to increase the denominator by increasing the target domain. A considerable amount of data can be collected in this case, but a large amount of irrelevant data will also be collected. In contrast, purging unnecessary data that become the noise leads to the narrowing of the target domain. Characteristic data can be collected by focusing on a certain domain, but this results in the problem of how to collect large amounts of data in the limited domain.

The issue of quantity and quality is basically a trade-off relationship. Collecting large amounts of data is necessary to cover various cases and to judge the importance of certain things by investigating the frequency. Therefore, the shortcut to obtaining high-quality data is to secure the variation and sufficient data for determining the relative importance.

4. Mechanism to derive the solution from less data

Obtaining an accurate solution from small amounts of data requires imagination and the detection of trends from a small number of phenomena. One approach is to add artificial data. For example, data can be created by intentionally including noise, and the variation may be expanded by a crossover. Different data can be generated by association or inference. Needless to say, these are artificial data and are not correct cases. However, if an environment where very delicate simulations are possible can be obtained, artificial data that are not true, but very close, may be created.

We humans can, without actually experiencing everything, imagine and think by reading books or listening to others' experiences. Simulated experience is valuable. I think that computers can also respond to simulated data. However, computers are not as imaginative as humans. Common sense is necessary when imagining things. The timing, circumstances, and situation must be taken into account. Moreover, judgments must consider the position of the counterpart, human relations, the atmosphere, and the underlying background.

However, current computers are not capable of this task, which is understandable because computers live in a world of "0"s and "1"s and things are considered and handled as symbols. AI that can support humans and can be active as partners need a mechanism that has common sense and can understand and share human feelings.

5. Implementation of humanistic AI

I founded the Artificial Intelligence Engineering Research Center at Doshisha University in 2018, and I am now its Director. Many professors who focus on various AI-related research work at this research center and are conducting research on AI from diverse viewpoints. I am particularly interested in the "implementation of humanistic AI" [2].

"Humanistic" has two aspects: one is "common knowledge," which is "what everyone knows," and the other is "common sense," which is "conscience and sound consideration and judgment." "What everyone knows" can be statistically processed because it can be found explicitly in dictionaries or is what many people agree upon. However, "conscience and sound consideration and judgment" is very tricky. It depends on ethics, morals, manners, virtues, and cultures; thus, the "correct" answer is vague, and judgments can vary from person to person. However, there can be some guidelines such as "this is not good" or "this is impossible" (**Table 1**).

Examples of expressions that the Japanese use casually are "the size of 20 Koshien Stadiums" and "input single-byte alphanumeric characters in this field." These expressions are not strange to the Japanese but are difficult to understand for people outside of Japan. A person unfamiliar with the size of the "Koshien Stadium" cannot relate to what the term "the size of 20 Koshien Stadiums" means. "Single-byte alphanumeric characters" are different from "double-byte" characters, and this expression does not make sense to Westerners who do not use double-byte characters that appear in languages such as Japanese and Chinese. Another example is the following conversation of a married couple: "Help with housework when you are off from work!" "I'm ceaselessly driving a truck, so please let me rest on those rare days off!" The assumption that "the wife is doing the housework, and the truck driver is the husband" is a very outdated common sense in the current world of gender equality.

"Conscience and sound consideration and judgment" therefore changes with, for example, the timing, circumstances, sex, age group, region, position, and/or era. Trying to learn this automatically results in a lack of data. The population of Japan is already small, and classifying data by sex, age group, or region further reduces the amount of data. However, "humanistic AI" must be implemented under these circumstances by devising a scheme to allow accurate learning from small amounts of data (**Figure 2**).

	Common knowledge	**Common sense**
Meaning	What everyone knows	Conscience and sound Consideration and judgment
Definition	Found explicitly in dictionaries	The "correct" answer is vague
Judgments of people	Many people agree upon	Judgments can vary from person to person

Table 1.
"Humanistic" has two aspects.

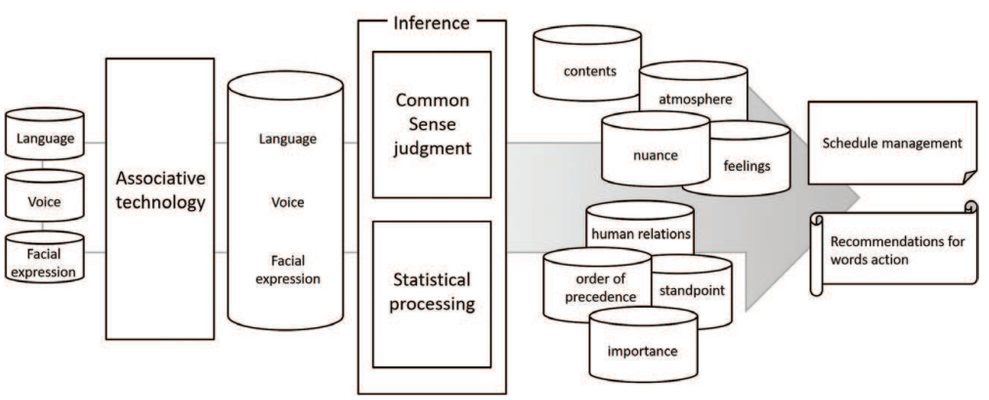


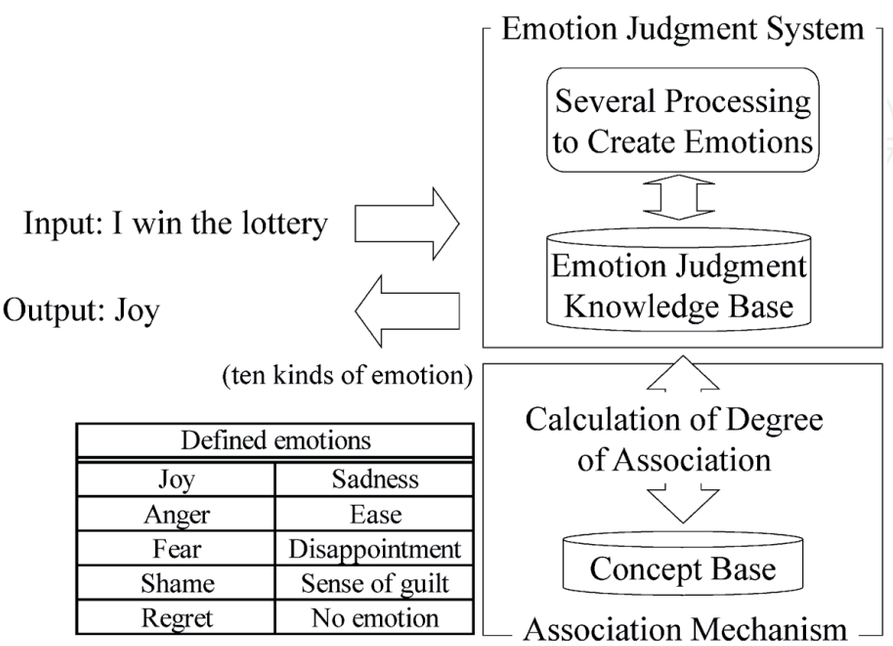
Figure 2.
Example of "humanistic AI."

6. Estimation of emotions from language

My specialty is AI with an emphasis on natural language processing. In particular, I have continued to study emotions ever since I started research. With the widespread use of smartphones, speech input is gaining popularity again. New search methods by the use of Siri in iPhones and smart speakers have been proposed, and these are becoming accepted. Further advances in technology and the day when everyone can freely use sophisticated computers are being anticipated. One solution is to use the means of communication between humans as the means to use computers. When robots that can coexist and live together with humans are developed, the ability of robots to understand humans, judge human emotions, and sympathize with humans should be a very important element. Therefore, I focused on reading the emotions of the counterpart from the contents of one's speech and proposed a method to judge the speaker's emotions by analyzing the contents of the speech (**Figure 3**) [3–5].

Emotions were judged on the basis of a knowledge database where emotions were defined for 406 combinations of 203 objective word categories and two verb and normal and nominal adjective word categories, or for 8024 combinations of 34 objective word categories; 59 verb and normal and nominal adjective word categories; active or passive voice (two categories); and positive or negative form (two categories). When categorizing objective words and verb and normal and nominal adjective words, the ambiguity is judged from the relationships between words (**Figure 4**). To effectively use this knowledge database where a small amount of knowledge is registered to judge processing and emotions, I developed a proprietary "concept base" that automatically interprets limited knowledge broadly to respond to diverse expressions [6–9] (**Figure 5**). One result showed that this proposed method is capable of reproducing 74.2% of the emotion judgment ability.

The "concept base" has been developed for over 20 years by my research group. "Word2vec," which has gained considerable popularity recently, is a dictionary built on a similar concept [10]. Word2vec appeared recently; thus, my feeling is that "the times have finally caught up with our ideas." Word2vec is a method that expresses the meaning of a word using multiple numbers on the basis of the hypothesis that "the meaning of a word can be characterized using words that collocate with



Defined emotions	
Joy	Sadness
Anger	Ease
Fear	Disappointment
Shame	Sense of guilt
Regret	No emotion

Figure 3.
Outline of the emotion judgment system.

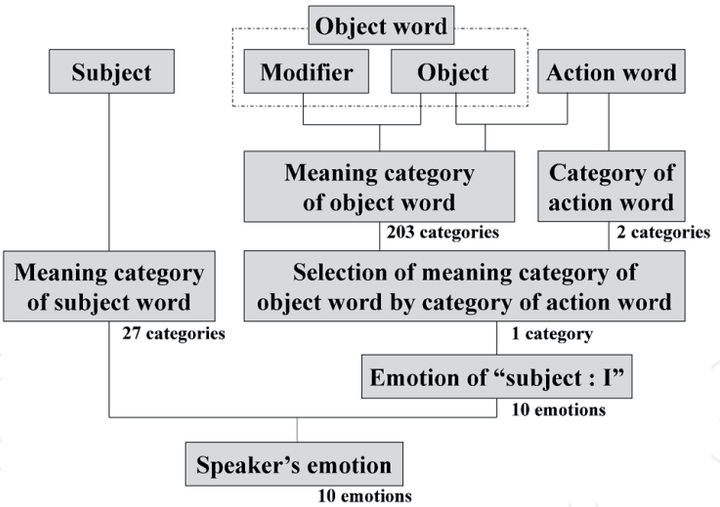


Figure 4.
Flow of emotion judgment system.

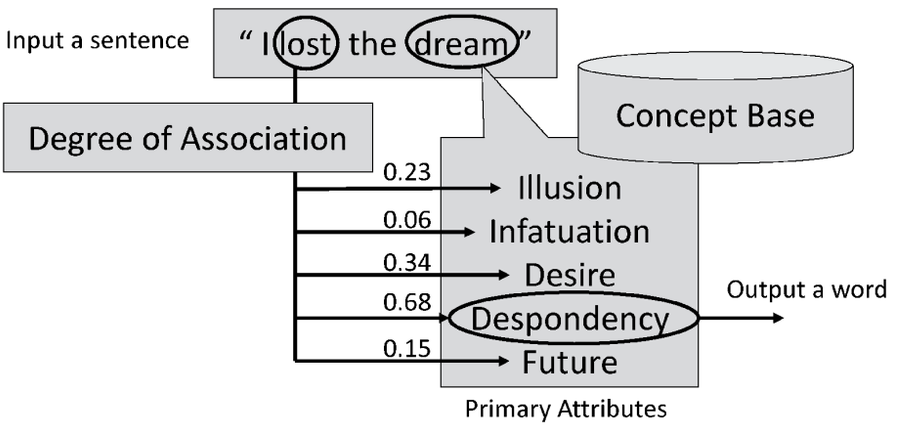


Figure 5.
Technique of automatically interpreting limited knowledge broadly to respond to diverse expressions.

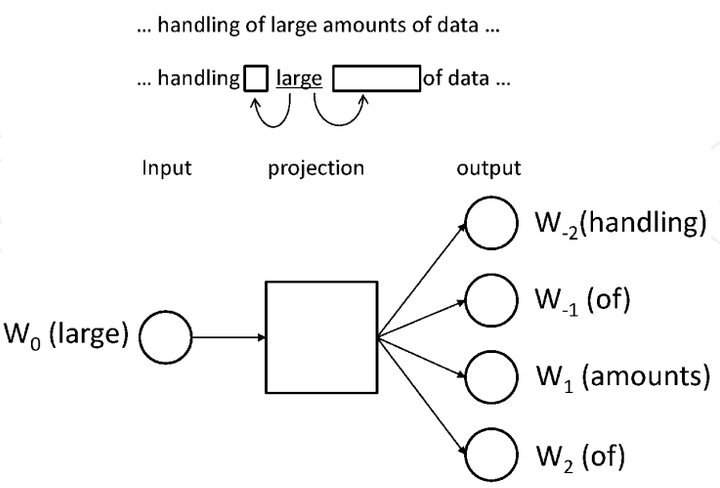


Figure 6.
Image of Skipgram in Word2vec.

it." In other words, a word is expressed using a vector in an arbitrary dimension. Expressing the meaning with multiple numbers requires learning from large amounts of data. One method is "Skipgram" that learns words close to a given word (**Figure 6**), and another is "CBoW," which learns words that often appear when a certain number of words exist (**Figure 7**).

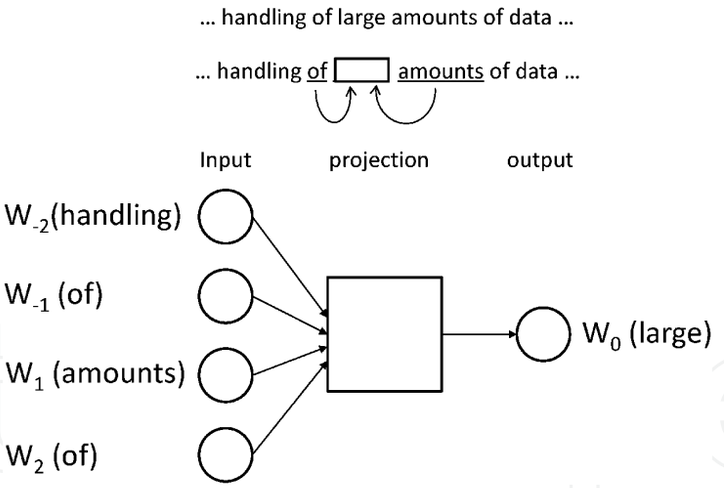


Figure 7.
Image of CBoW in Word2vec.

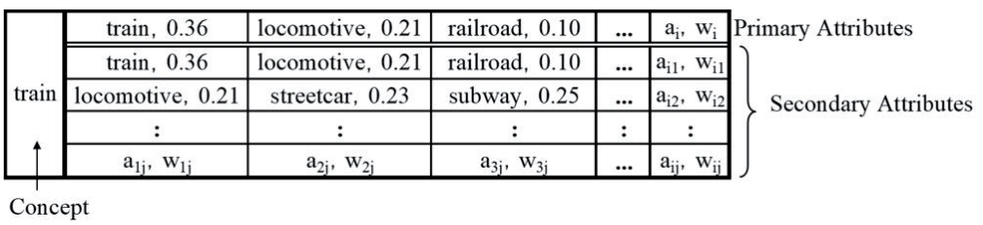


Figure 8.
Example of concept base.

	Concept base	Word2vec
Accuracy	89.9%	78.4%

Table 2.
Result of accuracy comparison between concept base and Word2vec.

Word2vec needs to arbitrarily specify a finite number of dimensions. Therefore, the meaning of words must be compressed, and the expressions are slightly forced. In contrast, the concept base expresses the meaning of words with multiple words, which is different from Word2vec. This setup allows the expression of a word with multiple, or, in theory, an infinite number of words. Therefore, all the concepts of a word pictured in a human brain can be expressed (**Figure 8**). Indeed, our concept base captures the meaning of words more precisely than that captured in Word2vec (**Table 2**) [11].

7. Conclusions

The implementation of "humanistic AI" may lead to humans falling in love with a robot instead of a real human. A robot may know more about you than other humans, will do what you want to be done, will not complain, and can have a good conversation. Therefore, the chances of falling in love with a robot are considerably high.

I think that the days when robots are considered enemies are transient and robots will soon be recognized as good partners that support humans instead of being rivals. When such a time comes, what will humans do and what should humans do? Research on AI forces me to think about humans instead of just on technology. After all, the role model of a robot is none other than us humans. I wish for an evolution to a world where humans can be humans.

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