Development of a support system for associating main dish desired to be eaten using the anteater program

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Abstract

The anteater program is a method to acquire similar knowledge to experts, for example animal classification etc. This program acquires knowledge itself and can be also applied to other areas. And, this program does not have a built-in database. In this paper, an improved anteater program is proposed to narrow down main dishes potentially desired to be eaten as an association support system. The subjects firstly registered some dishes (main dishes) in the system as a process, which they had eaten before, and the impressions for each dish were recorded at the same time. Some questions were created to narrow down the dishes potentially desired to be eaten based on these impressions. As the subjects answered a series of questions, they could associate the dishes that they might potentially desire to eat, and this process continues until the name of the dish is finally concluded in the system. This system is a learning system. When the concluded dish name is not the dish the subject desires to eat, new questions are added for a binary tree so the subject can reach the name of the desired dish.

Key words

associative memory, anteater program, learning system, decision support, expert system

1. Introduction

In recent years, human higher-order thinking processes have been studied in the field of cognitive science. Scientific discoveries and creative thought processes are particularly studied. And, computer systems and class programs including bridging with learning science and information systems science, have been developed to support learning and ideas in the areas of discovery and creativity (Maehigashi and Miwa, 2015; Matsumuro and Miwa, 2016; Yokoyama and Miwa, 2021, Akai et al., 2022; Shimojo et al., 2022). The mental burden on people is great in today's complex and diverse society. There is so much to worry about, and so much knowledge, methods, customs and other information that we have to remember. Therefore, there is confusion and difficulty in making decisions and narrowing down memories. This paper aims to build a system that draws out human potential-consciousness and supports the decision-making system. There is a research report with similar contents to this paper. The title is, "Artificial intelligence: Travel destination decision supporting system using anteater program" (Nara, 2002). The content of the paper is similar to this paper in that it attempts to extract potential knowledge. However, a conclusion cannot be reached each time until reaching the leaves (ends) of the decision tree in the process. On the other hand, the system proposed in this paper emphasizes associative memory and a result can be obtained even if the treatment does not necessarily reach the leaves. In other words, the difference is that the subject is reminded of the dish that they desire to eat during the process.

People often wonder what to eat for lunch, and eventually, they choose the menu that they often eat. It would be useful if a system could learn what a subject desired to eat depending on the situation and narrow down the choice. The anteater program is introduced below (Kimura and Oyabu, 1989) and then a main dish association support system is proposed.

The final goal of this research is to build a system that can be used when a user cannot maintain composure. The following may be considered as the cases in which the user is unable to maintain composure: making specialized knowledge or precise judgment, and people who need to think calmly are experiencing fatigue and irritation due to personal matters (for example, disagreements between family members).

2. Introduction of the anteater program

The anteater program acquires rules, and also modifies them. A set of rules (knowledge base) is expressed as a binary tree as shown in Figure 1, and each rule is in the form of 'IF condition THEN conclusion'. The functions of the anteater program are explained according to Figure 1. First, 'Does it have wings?' is asked. If the answer is 'NO' then the route reaches '?'. Each time the anteater program reaches a '?,' it asks for the animal's name and further questions to identify it the next time. For example, assuming that the animal is a sheep, the following question is 'Does it have hair?'. The next question is 'Do sheep have hair?'. If the user indicates 'YES' or 'NO' as the answer, the program is complete. As a result, Figure 1 is transformed into the tree structure of Figure 2. The anteater

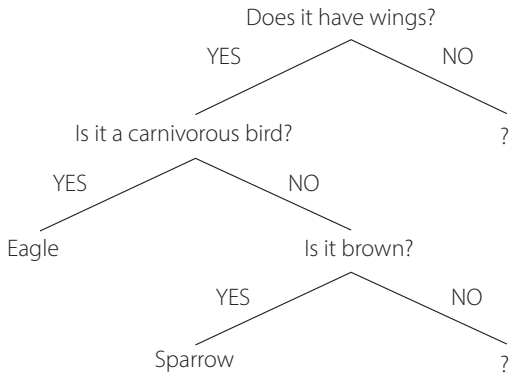

Figure 1: Tree structure knowledge base (1)

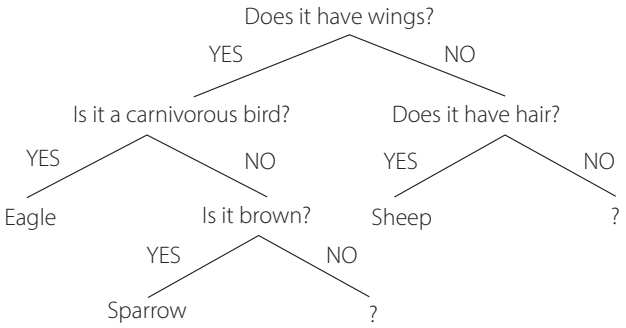

Figure 2: Tree structure knowledge base (2)

program can obtain additional information and arrive at the desired answer in this way.

It is also possible that the answer is wrong. In this program, the system may learn more, namely the case where the answer is wrong. In this case, the real answer and discrimination question are indicated and incorporated into the tree structure. For example, the program searches the tree structure and reaches 'sparrow' which it has already learned. At this time, if the true answer is 'wren,' the program's answer is 'NO' to the question 'Is that a sparrow?'. As in the previous process, the program teaches the true answers to 'sparrow' and 'wren' with 'YES' or 'NO.' Figure 2 is improved to Figure 3 as a result.

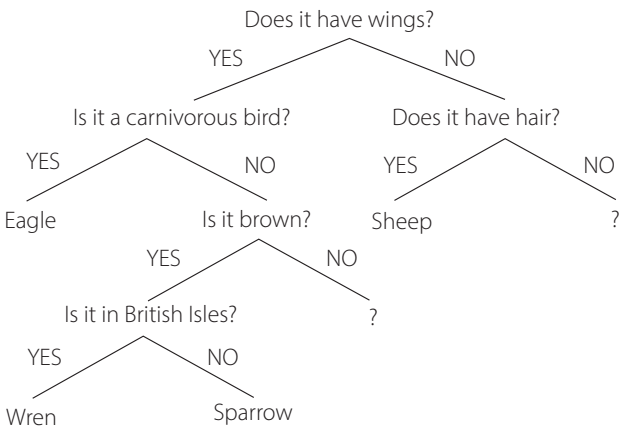

Figure 3: Tree structure knowledge base (3)

3. Proposal of associative support system for main dish selection

An associative support system for main dish selection is proposed using an anteater program in this section. First, the flowchart of the associative support system for main dish selection is shown in Figure 4. In addition, the execution example of how to add main dishes to this system is shown in Figure 5. The effectiveness of main dish association support is increased when a certain number of dishes are added. A part of the decision tree (tree-structured knowledge base) that is created is indicated in Figure 6. This system sometimes includes contradictory knowledge because it acquires the knowledge from multiple users. The knowledge targeted by this system is common to all users and other knowledge is acquired by individual users. The latter knowledge is used to improve association accuracy. For example, *ramen* noodles are included in both 'light dishes' and 'rich dishes.' This system collects impressions of the dishes which the user has eaten in the past, and supports the narrowing down of the main dishes based on the result. Therefore, if users enter into the system the impressions of the dishes they have eaten, the utilization efficiency of this system will increase. This system uses associative memory to extract dishes that the user desires to eat from the user's implicit memory. A demonstration experiment is shown in the next section.

4. Verification test

4.1 Experiment

The users provided this system with the names of dishes they have eaten, their impressions before and impressions after eating, and questions to differentiate between multiple dishes. Finally, a decision tree is created to perform the associative support. This makes the associative support system available for use. When using this system, it is possible to check the correct answer rate for whether or not the name of the dish is the one that the user potentially wants to eat.

4.2 Result

The experiment was conducted with 8 subjects. The results of the trial application are shown in Table 1. The first correct answer rate was when all subjects answered correctly. This is thought to be because many subjects had a clear idea for the dishes they wanted to eat on a daily basis. In addition, for those who have few dishes they would like to eat, it is thought that there may be cases where it becomes difficult to narrow down the dishes that they potentially want to eat, and resulting in failure. This case occurs when this system is used continuously. However, the effectiveness of this system is acknowledged since there are cases where the answer is correct.

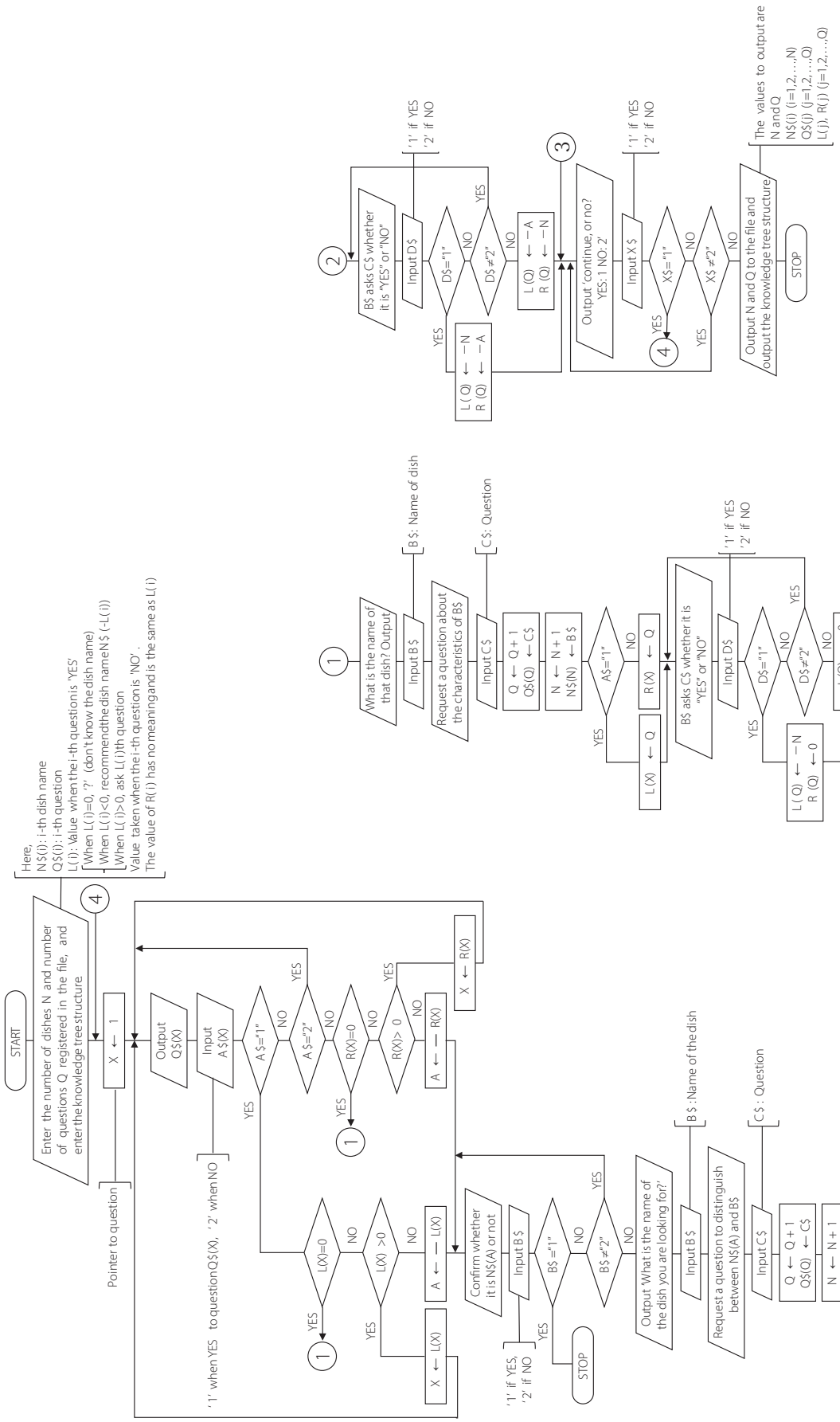

Figure 4: Flowchart of main dish association support system

Answer the following questions.
Is it a commonly known dish? YES: 1, NO: 2
YES
Don't understand. What is the name of that dish?
? Curry rice
Please ask questions regarding the characteristics of curry rice.
? Is it a spicy food?
Is curry rice spicy? YES: 1, NO: 2
YES
Continue asking questions? YES: 1, NO: 2
YES
Please answer the following questions.
Is it a commonly known dish? YES: 1, NO: 2
YES
? Is it a spicy food? YES: 1, NO: 2
YES
Is that dish curry rice? YES: 1, NO: 2
NO
I give up. What is the name of the dish you are thinking of?
? *Mabo tofu*
Please ask the question to differentiate between curry rice and *mabo tofu*.
? Is it a *tofu* dish?
Is *mabo tofu* a *tofu* dish? YES: 1, NO: 2
YES
Do you want to continue asking questions? YES: 1, NO: 2

Figure 5: Example of adding main dishes

Is it a chilly day today? —(Yes)---Do you want some hot food?—(Yes)----Do you like hot pot dishes?…
—(No)----Do you want to try popular dishes?…
—(No)---Did anything good happen today?—(Yes)----How about some *sushi*?…
—(No)----Do you want to eat nostalgic food?…

Figure 6: Excerpt from the decision tree used in this system

5. Points from subjects

The problems and impressions pointed out by the subjects are shown in Tables 2 and 3 respectively. First, the problems are pointed out. Subjects mistakenly thought it was something they actually needed to eat. Therefore, Problems (issues) (2), (3), . . . , (8) in Table 2 were pointed out. There was no need to actually eat the food in this experiment.

The subjects can try to associate dishes they potentially want to eat and see if they can finally point out the name of the dish by using this system in an interactive manner. There is no problem even if the foods the subjects desire to eat change depending on the season. What is important is whether the system can identify the dishes that the subjects potentially want to eat. Therefore Problem (1) can be excluded.

Regarding Problem (9), it has been pointed out that the

Table 1 Experimental accuracy rate

Subject	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Correct answer rate (%)
A	○	×	○	×	○	○	×	×	○	○	60
B	○	○	×	○	○	×	×	○	×	×	50
C	○	○	○	○	×	○	×	○	○	○	80
D	○	×	×	×	○	×	×	×	×	○	30
E	○	○	×	×	×	○	○	×			50
F	○	×	×	×	○	×	×	○			38
G	○	○	×	×	×	○					50
H	○	×	×	×	○						40

Note: ○ = Correct, × = Failure.

Table 2: Problems

(1) The desired dishes change depending on the season.
(2) Don't want to choose it because it's the same as what I ate yesterday (duplication).
(3) Don't choose it because it's expensive (cost).
(4) Can't choose because can't go shopping for ingredients (no storage).
(5) The restaurant was closed on the day (business holiday).
(6) Does not take into account the time and effort required to make it (time and effort).
(7) Don't want to go far to a restaurant.
(8) Can't eat while on a diet.
(9) Interaction with the system takes too long.
(10) Sometimes there are redundant questions.
(11) The series of the created questions are not necessarily logically ordered.
(12) Too many choices: Users have to answer more than 25 questions, which can be frustrating.
(13) Bias towards specific cooking styles: Many questions are about specific cooking styles and ingredients, so it is not possible to cover the preferences and eating habits of any user.
(14) Conflicting answers: As a user answers a series of questions, he/she may give contradictory answers.

Table 3: Impressions

(1) There may be cases where the subject cannot choose because he/she does not have enough money.
(2) There may be cases where he/she cannot choose due to lack of ingredients.
(3) There may be cases where he/she cannot choose due to closure.
(4) He/she may not be able to choose the option that takes time (cooking time and/or travel distance).
(5) There may be restrictions on ingredients to maintain health.
(6) The decision trees should be periodically reviewed and simplified to avoid redundancy and inappropriate questions.
(7) Flexible customization: The ability to customize questions based on user preferences and eating habits is appealing.
(8) Interesting experience: This decision tree was an interesting experience for users.
(9) Increased insight: Users have the opportunity to think more deeply about their own food preferences.

dialogue could be effective and the series of questions could be kept shorter if the system was a human. Regarding Problem (10), when separating dish groups, the characteristics of previously used dishes may be asked because multiple subjects are adopted. The knowledge base (decision tree) for cooking is not created originally until the concept of whole dishes are prepared. A decision tree is created by adding each dish specified one by one by the subject. Moreover, the questions are created so that it can be understood that the decision tree has different characteristics so as not to overlap with already registered dishes. Therefore, the structure of the decision tree is determined by the dishes specified by the subjects. Problem (12) is the same as Problem (9). Problem (13) is important, but there is currently no solution. Problem (14) often occurs due to Problem (11). Regarding impressions, many were related to constraints on food selection ((1), (2), . . . , (5) in Table 3). In addition, (6) is an important point for improving this system. Impressions (7), (8), and (9) indicate that this system has high applicability.

6. Conclusion

In this paper, the anteater program was firstly applied to register the names of dishes that users had eaten, and a decision tree that added the images and characteristics of the dishes was created. Once the names of the dishes have been entered, it becomes possible for the user to interact with the system to find dishes that the user might potentially want to try, which is an important function of this system. Unfortunately, the accuracy rate is currently only about 50.75%. Future research results are expected to improve the accuracy rate.

There are three possible applications for the anteater program. First, the classification of trademarks handled by the Japan Patent Office is considered as an example of its direct application. The second application is to narrow down what a user is looking for using personal preferences, learning, and associations. And, a third application would be to apply to travel agency systems to grasp group trends based on customer wishes, etc. The system proposed in this paper can be

said to have both the second and third applications.

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