

# Psychological Jump in Vague Knowledge

Mikio Nakatsuyama

Department of Industrial Design, Akita Municipal Junior College of Art and Craft  
12-3 Araya-Okawamachi, Akita 010-16 JAPAN  
Tel: +81-188-88-8139 Fax: +81-188-88-8109 E-mail: nakatsu@amcac.ac.jp

## Abstracts

This paper deals with the decision in vague knowledge. One method is a classic theory, that is to say, constraints and goals in the vague knowledge. Another method is the fuzzy catastrophe. If there exist two fuzzy variables, there may be a discontinuity which plays an important role in decision.

**Keywords:** Approximate reasoning, decision, catastrophe, vague knowledge

## 1. Introduction

Creative ideas are believed to be independent on past known ideas. From the viewpoint of the art, the artistic ideas also seem to happens at random. When an artist wish to draw lines on a paper, he ought to determine the position, length, thickness and color of the first line. After having drawn a line, the impression of the image of the paper and in this circumstance he must determine the same parameters of the second line again. We show another example of the circumstance change by an action and the next action is subjected to the effect of the first action. Of course the third action is subjected to the effect of the first and second action and so on. A man is supposed to take his lunch in a large

shopping center where lots of restaurants stand. He choose a restaurant by considering his appetite, but he dose not agree their prices. Then he choose another restaurant by considering his payment, but the menus does not satisfy his require. And another reason he choose the third restaurant and finally he choose even the first restaurant.

This scheme bears a close resemblance to the heuristic research that works in a determined and known space. On the contrary, this scheme works in the vague circumstance and the decision-rule space may change every time when an action is done. We outline this scheme.

Another scheme based on the fuzzy catastrophe. Some applications of the catastrophe theory are valid only when

they are described in a special class of ordinary differential equations. So variables are able to be differentiated at least. Human decision is performed in a human brain and variables transmitted in the nerves are not analog quantities, but seem to be discrete digits. Can anyone differentiate the discrete digits? Fortunately most physical phenomena are not analog one and can be described by some differential equations. Even the digital computers can calculate the differential equation and some approximate calculation is used. Therefore we can simulate the decision by using fuzzy catastrophe.

## 2. Decision-rule Space in vague knowledge

Let  $\text{intu}(\text{Level}, \{\text{Already Selected and Determined Nodes}\})$  be a random function

that denotes the following node at the level  $\text{Level} + 1$ . Let  $\text{sat}(\text{Node}(\text{Level}))$  be a satisfaction function that represents the grade of satisfaction at each level. At the root node, the first decision is done.

$$\text{Node}① = \text{intu}(0,0) \quad (1)$$

$$\begin{aligned} \text{Node}② &= \text{intu}(1, \{\text{Node}①\}) \\ \text{If } \text{sat}(\text{Node}①) &> \text{Th}(1) \end{aligned} \quad (2)$$

where  $\text{Th}(1)$  is a threshold value at the level 1.

$$\begin{aligned} \text{Node}③ &= \text{intu}(2, \{\text{Node}①, \text{Node}②\}) \\ \text{If } \text{sat}(\text{Node}②) &> \text{Th}(2) \end{aligned} \quad (3)$$

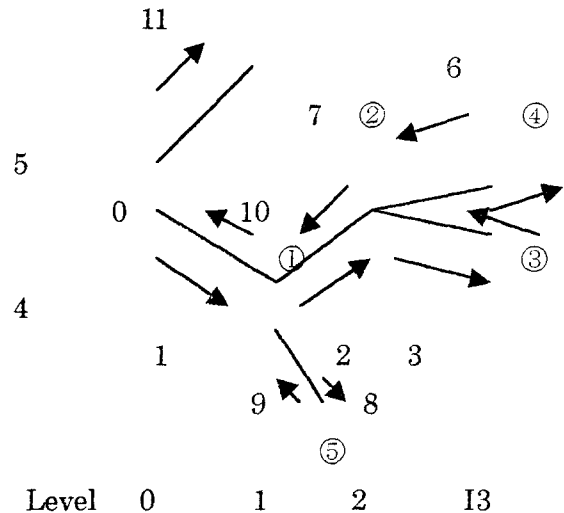


Fig.1 The decision-rule space

If  $\text{sat}(\text{Node}③) < \text{Th}(3)$ , then  $\text{Node}④$  will be tested. And if  $\text{sat}(\text{Node}④) < \text{Th}(4)$ , then  $\text{Node}⑤$  will be tested and so on. This scheme is different from the heuristic research, because the functions  $\text{intu}$  and  $\text{sat}$  are not calculated before the calculation of a previous node. We define the functions as follows. [1]

$$\text{sat}(n) = a_n \wedge b_n \wedge c_n \wedge \dots \wedge x_n \quad (4)$$

where  $a_n, b_n, c_n, \dots$  and  $x_n$  are the estimated values.

$$\text{int}(n, \{\text{Nodes}\}) = \text{random}(M) \quad (5)$$

$M$  is a definite number. The random function  $\text{random}(M)$  is not uniform one

and the value of  $T_h$  is determined subjectively.

### 3. Fuzzy Catastrophe [4]

Human decision is performed in his brain. All the information which flow through neurons is not analogous, but seem to be discrete and ambiguous. The discrete numbers are dealt with computers and are easily differentiated in them. Of course it is only an approximate calculation which explains clearly the physical phenomena in the world. The fact encourages us that the human decision rely on the fuzzy catastrophe. If the two variables are related to a decision, they are easily represented by fuzzy variables  $X$  and  $Y$  of which values are converted into the values between 0 and 1. Two quantities are represented by  $x$  and  $y$ . Let the third quantity be  $z$ . The term  $z$  is calculated by some ordinary differential equations of which variables are  $x$  and  $y$ . Strictly speaking, the ordinary differential equations are substituted by fuzzy differential equations. The definition of the fuzzy differential equations may not be difficult, but can not be calculated easily. For example, the most simple differentiation is shown as follows.

$$\Delta w / \Delta t = (w_1 - w_2) \text{ divided by } (t_1 - t_2) \quad (6)$$

Of course, the values  $(w_1 - w_2)$  and  $(t_1 - t_2)$  have vague values and the value  $(w_1 - w_2)$  divided by  $(t_1 - t_2)$  is more vague value. Then the fuzzy differential equations must have no effective value. So we use the ordinary differential equations for the first approximation. Fig. 2 shows an example of the fuzzy catastrophe. A term  $x$  represents the parameter of the economy and the other term  $y$  represents the parameter of the appetite. The third term  $z$  means the number of Michel stars or the grade of the restaurant.

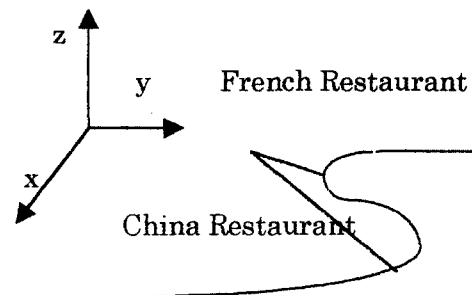


Fig. 2 The fuzzy catastrophe

### 4. Realization of catastrophe

It is very difficult to show the catastrophe in a human brain by using the neural net or so. We suppose that the neural net containing the feedback loop might represent the catastrophe. Therefore we express the catastrophe

only in quality more than quality.

## 5. Conclusion

We describe about the psychological jump in the vague knowledge that resembles to the heuristic research, but is not deterministic. We'll try to elaborate the mathematical expression of the psychological jump in the vague knowledge and apply to the image recognition in the future. [2][3] Another method is the fuzzy catastrophe. Three variables are represented as fuzzy variables. Of course we can not use the fuzzy variables themselves, so we suppose that the fuzzy variable has the value between 0.0 and 1.0. The fuzzy catastrophe may express a part of the decision mechanism in brain. Some decision in AI use the probability of perception in vague knowledge. [5] Our method resembles the dynamic belief network in AI. We believe that our method is more realistic.

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