On three thinking forms: abstract, imagination and intuition based on fuzzy models

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Abstract

In this paper, based on an analysis of knowledge management fuzzy model, the judgment thinking process is discussed. Then, the fuzzy models of three thinking forms based on intelligent information processing are established. There are fuzzy logic inference model of abstract thinking, fuzzy pattern recognition model of imagination thinking Fuzzy state equation model of intuitive thinking.

Keywords: knowledge management, intelligent information processing, fuzzy model

1. Introduction

Knowledge management is a systemization, a process that drives management and uses group knowledge, and includes knowledge foundation, knowledge issuance and sharing together [1]. Generally, a knowledge management system is composed of knowledge gaining, generating system, knowledge issuance, and sharing system. Both knowledge gaining and generating system mainly use the knowledge gaining relevant knowledge and experiences or supplies with a definite knowledge environment to create relevant knowledge. Moreover they document it and save it for the later use. Knowledge issuance system mainly uses computer network technology, data storage technology management and issues relevant knowledge. Knowledge sharing system mainly uses group apparatus and workflow system to reach knowledge sharing. In this paper, based on an analysis of knowledge management fuzzy model, the judgment thinking process is discussed. Then, the fuzzy models of three thinking forms based on intelligent information processing are set up.

2. Knowledge Management-Based Fuzzy Models

Because most knowledge management processes are human's thinking activity processes, in fact they are typical intelligent information processing. The related information in this process mostly is fuzzy intelligent information except little precise information. Consequently, in the model base system of knowledge management-based enterprise strategic decision support system we should start with the human brain thinking process and establish corresponding intelligent information processing fuzzy model base in light of fuzzy information processing means. We might similarly describe and simulate human intelligent activity by a series of fuzzy model, which should improve knowledge management-based enterprise strategic decision standard.

Now in knowledge management people study thinking activity process deep. With human brain become multi-structured, complicated and high-class thinking organ, human's thinking capability and thinking form improve accordingly. Thinking form includes not only abstract thinking and imagination thinking but also intuitive thinking. Each thinking activity process usually follows several thinking forms to effect alternately and synthetically early or late.

The typical thinking activity process could be regarded as an intelligent information processing, besides, it could be divided into four specific process: (1) information processing via recognition process; (2) information transmission via communication process; (3) information storage via memory process; and (4) information usage via decision process. Such process could regarded as some input information, some output information by processing. That is, employing great system control modeling idea, looking on the human brain as black box, we emphasize to study the relation of thinking process input and output, represent the external behavior, function and result. Then we should establish the index system of input and output information, study the fuzzy information quantitative processing method, finally establishes the corresponding integrated fuzzy model.

Generally speaking, the arranged thinking activity process could be divided to the types of judgment, expression, storage and decision according to the thinking target.

2.1. Judgment Thinking Process

The object of judgment thinking process is some objective states of affairs its terminal is judgment. However, such thinking process also could be divided to some specific types, three thinking links are confirmed.

Question------Inference------Judgment

Here, the first question is the suggested question, including initial simple judgment, or by directly proposed, or by collection. Moreover including the related condition and elementary matter, we should arrange these factors. Inference itself is a great deal of front-to-back joined complicated links as well as single link. We should employ different thinking inference forms according to specific problem. The conclusion of inference is the judgment that the target desires, but this judgment should be integrated harmonious result of several thinking forms.

2.2. Decision Thinking Process

Decision thinking process is the thinking process with some actions for object, also could be divided to some specific patterns, for instance:

(1) Selecting

The main thinking frame is the following links' combination:

Collection------Comparison------Corresponding------Decision------Examination

Such collection should be various input forms. Input information represents the possible combination of two or more actions. Then we should compare these several possibilities, specially taking the long-range or current interest as the standard, or we could select other standards to compare. Finally we should take steps according to the selective results, and select the feedback information to proof in the practical action.

(2) Feedback

The main frame form is:

Determination------Gathering------Correct------Proving

On some condition people might not think the object factor and measure over before the action. So in the beginning people should make decision in a hurry. Then they start to gather the information and improve the action in practice.

3. Three Thinking Forms Based on Fuzzy Models

People have the perfect thinking organization, could use their own knowledge flexibly to solve the problem with different thinking forms. Commonly human conscious purposeful thinking forms include: (1) abstract thinking; (2) imagination thinking; (3) intuitive thinking. We should use various methods to establish corresponding fuzzy model in terms of different characteristics of three thinking forms. Knowledge management is a systemization, a process that drives management and uses group knowledge, and includes knowledge foundation, knowledge issuance and sharing together [1]. Generally, knowledge management system is composed of knowledge gaining and generating system and knowledge issuance & sharing system. Knowledge gaining and generating system mainly uses the knowledge gaining relevant knowledge and experiences or supplies with a definite knowledge environment to create relevant knowledge, moreover document it and save it for the later use. Knowledge issuance system mainly uses computer network technology and data storage technology management and issues relevant knowledge. Knowledge sharing system mainly uses group apparatus and workflow system to reach knowledge sharing.

3.1. Fuzzy Logic Inference Model of Abstract Thinking

Abstract thinking also is called logic thinking. It bases sensibility understand, reflects nature of a thing correctly or incorrectly, and reveal thing's internal relation of thinking forms by concept, judgment and inference. In practical abstract thinking people apply the fuzzy concept and fuzzy inference more, so we could employ fuzzy logic method to establish the corresponding fuzzy inference model [2].

Generally speaking, consider the case with two-input, one-output fuzzy system:

Input: x equals A' and y equals B'

R_1: if we impose x equals A_1 and y equals B_1, then z equals C_1;

Also R_2: if we impose x equals A_2 and y equals B_2, then z equals C_2;

⋮

Also R_n: if we impose x *equals* A_n and y equals B_n, then z equals C_n.

Output: z equals C'.

Where *x*, *y* and *z* might represent the variables of the state and control of system, A_i, B_i and C_i respectively is the value of *x*, *y and z*.
Define the inclusion relation R_i of the fuzzy control regulation "if we impose *x equals* A_i and *y* equals B_i, then *z* equals C_i":

$R_i = (A_i \text{ and } B_i)\text{--- } C_i$ (1)

Namely $\mu_{R_i} = \mu_{(A_i and B_i \to C_i)}(x, y, z)$

$= [\mu_{A_i}(x) and \mu_{B_i}(y)] \to \mu_{C_i}(z)$ (2)

Consider a series of fuzzy control regulation, now we should have the overview of fuzzy inclusion relation:

$$R = \bigcup_{i=1}^{n} R_i \quad (3)$$

Finally, we should get

$$C = (A' \text{ and } B') \circ R \quad (4)$$

Which gives that

$$\mu_{(A' and B')}(x, y) = \mu_{A'}(x) \wedge \mu_{B'}(y)$$

Or

$$\mu_{(A' and B')}(x, y) = \mu_{A'}(x)\mu_{B'}(y)$$

Where "$\circ$" is a synthetic operational character, we usually employ maximum-minimum synthesis method. For example, when we choose the pension pattern, the fuzzy control regulation can express different choice project of pension pattern which according to different condition on two states. So we can educe correspond choice project of pension pattern, by such fuzzy ratiocination operation method.

In the complicated case, sometimes we should solve the complicated fuzzy inclusion statement; here we might not describe the detail.

3.2. Fuzzy Pattern Recognition Model of Imagination Thinking

Imagination thinking (including experience thinking) mostly uses typical means to generalize, and people might think depending on imaginative makings and experience pattern. Therefore, we could use pattern recognition idea to establish fuzzy pattern recognition model [2].

In this article we study the following model: Let U be the entire of recognition object, be a group, the object u in the group U are represented by some limited parameter values, each parameter presents some characteristic of u. So that, the object U goes with the random vector $P(u_{1,\ldots},u_m)$, which u_i (i=1,2,…,m) relative to the value of the characteristic, thus P(u) is called the pattern of U. The task of pattern recognition is to classify each object to the same type, and that commonly is a fuzzy set. We assume that there exist a series of fuzzy set $A_1,\ldots, A_n$, when a recognition method is employed by the object u, there results the subordinated extent $\mu_{A_j}(u)(j = 1,2,\cdots,n)$, which indicates the degree that object u is subordinate to the type A_j. In a general way, the recognition method usually isn't described clearly, so the method is undefined. Now the pattern recognition should change an undefined method to a definite method. Firstly we might cognition the object, after that we should cognition the pattern.

In principle, the recognition job of fuzzy pattern as following three steps:

(1) Feature extraction
We might extract and cognition a number of related feature, furthermore measure the actual data of each feature, finally change u to the pattern:

$$P(u) = (u_1,\ldots,u_m) \quad (5)$$

(2) Membership function building
We might build a definite method to result the membership function $\underset{\sim}{\mu}_{A_j}(j = 1,2,\cdots,n)$. Where u is the subordinated extent of A_j, $\underset{\sim}{\mu}_{A_j}(u)$ depends on the feature $u_1,\ldots,u_m$.

(3) Recognition decision
We should adjudge u to a certain type according to some allocating principle. The common allocating principle as follows:
(A) Maximum principal
If there exists $j_0 \in (1,2,\cdots,n)$, it satisfies $\underset{\sim}{\mu}_{A_{j_0}}(u) = \max[\underset{\sim}{\mu}_{A1}(u),\cdots,\underset{\sim}{\mu}_{An}(u)]$, then we might consider u be relatively subject to A_{j_0}, adjudge u be subject to the type of A_{j_0}.
(B) Horizontal principal
Suppose a range $\lambda \in [0,1]$, that is $a \overset{\Delta}{=} [\mu_{A_1}(u),\cdots,\mu_{A_n}(u)]$. If $a < \lambda$, we should consider "refuse recognition" decision, then search the problem and analyze again; If $a \geq \lambda$, we should consider the recognition feasible. If there exists $\mu_{A_{j_1}}(u),\cdots,\mu_{A_{j_k}}(u) \geq \lambda$, we should consider u be subject to $A_{j_1} \cup \ldots \cup A_{j_k}$.

In the common use, we might combine these two principles.

$a < \lambda$, We apply "Refuse recognition " decision; when $a \geq \lambda$, we can apply the maximum principle.

3.3. Fuzzy State Equation Model of Intuitive Thinking

Intuitive thinking is also called inspirational thinking, main body intuition leading thinking form. Intuition is the interoperable result of dominant consciousness and sub-consciousness. Its basic features are paroxysmal, accidental, creative, fuzzy, and ordinary, and paroxysmal, fuzzy are outstanding.

Intuitive paroxysmal indicates its surprise from the time way; and its unconsciousness from the effect way. But this correlates to the inference of sub-consciousness. The inference result is an information-jumping phenomenon. Intuitive fuzzy mostly performs on the input and output information of intuitive thinking. If we want to simulate intuitive thinking, we should establish the L-R fuzzy data-based fuzzy state equation model of intuitive thinking [3-5].

Considering the random time fuzzy system with the time variability, we should get its state equation:

$$\underset{\sim}{x}(k+1) = A(k)\underset{\sim}{x}(k) + B(k)\underset{\sim}{u}(k) \qquad (6)$$

$$\underset{\sim}{y}(k) = C(k)\underset{\sim}{x}(k) \qquad (7)$$

As a result, we might modify equation (6), (7) in terms of component:

$$\underset{\sim}{x}_i(k+1) = \sum_{s=1}^{n} a_{is}(k)\underset{\sim}{x}_s(k) + \sum_{l=1}^{r} b_{il}(k)\underset{\sim}{u}_l(k) \qquad (8)$$

$$i = 1, 2, \cdots, n$$

$$\underset{\sim}{y}_j(k) = \sum_{i=1}^{n} c_{ji}(k)\underset{\sim}{x}_i \qquad j = 1, 2, \cdots, m \qquad (9)$$

If we substitute equality (8) for (9) over and over, when initial status $\underset{\sim}{x}(0)$ is known, we should carry out the proper collation, then we might have[6]

$$\underset{\sim}{y}_j(k) = \sum_{s=1}^{n} \alpha_s^j(k)\underset{\sim}{x}_s(0) + \sum_{l=1}^{r}\sum_{p=1}^{d} \beta_{lp}^j(k)\underset{\sim}{u}_l(k-p) + \underset{\sim}{e}_j(k)$$

$$j = 1, 2, \ldots, m \quad (10)$$

For example, when we carry out the specific intuitive thinking analysis, if there For example, when we carry out the specific intuitive thinking analysis, if there exist some mutational characteristic, we can employ above fuzzy status equation model to represent according to testing fuzzy data. Then we should get thinking output information and work out the qualitative and quantitative forecast result.

4. Conclusion

As mentioned above, based on an analysis of knowledge management fuzzy model, the judgment thinking process is discussed. Then, the fuzzy models of three thinking forms based on intelligent information processing are established. There are fuzzy logic inference model of abstract thinking, fuzzy pattern recognition model of imagination thinking, Fuzzy state equation model of intuitive thinking.

Then, usually several thinking forms effect alternately and synthetically early or late in the actual thinking process. Therefore, fuzzy integrated judgment model should be established on the basis of three thinking forms and different fuzzy models by fuzzy large-scale system modeling technique.

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