Conceptual Modelling of new knowledge Reconfiguration based on the common node connection from a different memory

JeongYon Shim
Division of General Studies, Computer Science,Kangnam University
San 6-2, Kugal-ri, Kihung-up, YongIn Shi, KyeongKi Do,Korea
Tele : +82 31 2803 736 Email:mariashim@kangnam.ac.kr

***Abstract*— Human being has his own different knowledge frame and comprehends the things based on his knowledge. As the more intelligent computer aided services are required, the importance of personalization increases. For this reason, it is necessary to construct individual oriented memory which is a base of intelligent system.**

Accordingly, we proposed Conceptual modelling of new knowledge reconfiguration based on the common node connection from a different memory. The well formed structure of knowledge frame with special synonym list was designed for the efficient knowledge reconfiguration, and using this structure Knowledge retrieval mechanism was made to perform extracting the associated data.We applied this mechanism to the supposed virtual knowledge frame and tested.

I. Introduction

Human being has personal own knowledge in the memory and comprehends the things from the personal own point of view. When a new knowledge comes in, the knowledge frame reacts on this new invader. In the case of conflicting with the existing knowledge frame, the structure of frame is reconstructed according to the importance of coming new knowledge. This reconfiguration function is an indispensable element for efficient memory management. It is also an very important function for preventing the redundancy and inconsistency problem of DataBase .

Many studies for solving redundancy and inconsistency problem have been made for many years in Database Researching area. But it is limited to standardizing the inconsistent concepts or terminologies[3,7].

Accordingly, in this paper we propose Memory reconfiguration mechanism based on the personal frame for the efficient knowledge frame management. In this mechanism, an incoming inconsistent knowledge is reconfigured from the common node in the existing knowledge frame.

II. The memory structure for the reconfiguration mechanism

For the efficient knowledge management, well formed structure and mechanism for memory reconfiguration are necessary. Accordingly the memory structure for reconfiguration was proposed in this section. The proposed structure consists of knowledge reconfiguration and knowledge retrieval process as shown in figure 1.

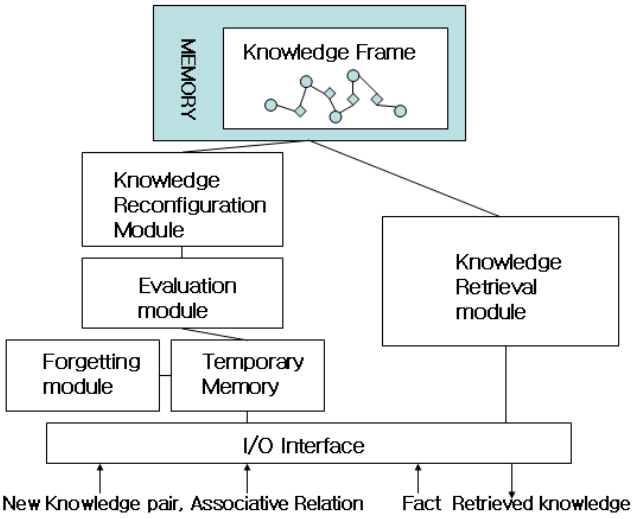

Fig. 1. Memory reconfiguration mechanism

The process of knowledge reconfiguration is as follows: the incoming new knowledge and its associative relation into I/O interface are stored in Temporary memory and propagated to Evaluation module for evaluation. After evaluating process,the knowledge that was not selected is aborted and moved to the forgetting pool of which Forgetting mechanism is described in the paper[5]. Otherwise the selected knowledge is passed to knowledge frame and change its structure by reconfiguration mechanism. The updated knowledge frame is used as one of source for knowledge retrieval.

Another module which takes part in the important function is Knowledge retrieval module. It has the process of extracting the associative knowledge in the frame.

III. Memory reconfiguration and knowledge retrieval mechanism

A. Knowledge frame in the memory

The structure of knowledge frame has a logical form of Mind Map according to their associative relations as shown in figure 2 and figure 3,.

Knowledge frame consists of knowledge nodes and associative relation. Knowledge node has one keyword representing

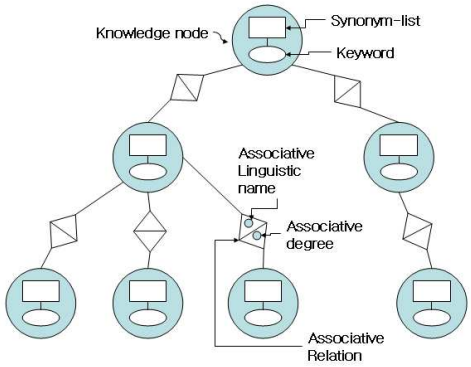

Fig. 2. Knowledge frame in the memory

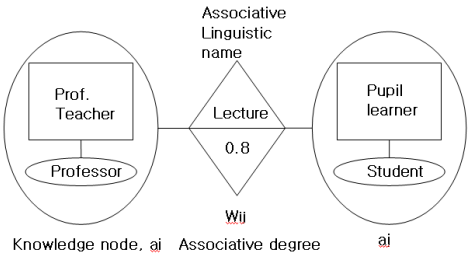

Fig. 3. Knowledge nodes and their associative relation

the name of the knowledge and Synonym list.Generally, one concept can be represented as several synonymous names. For example, the concept of 'professor' is represented as synonym, 'prof','teacher' and etc.. For good generalization, the process for synonym should be considered. For this reason, we designed the synonym list and made it searched during knowledge reconfiguration and retrieval mechanism. Associative relation includes its associative linguistic relation name and associative degree, W_{ij}.

$$W_{ij} = P(a_i|a_j) \tag{1}$$

Table 1. shows Knowledge frame table which is used for knowledge reconfiguration and retrieval mechanism. The names in the title bar denote the abbreviated form of $S-list$:$synonym-list$, Rel:associative relation name and deg:associative degree.

TABLE I
KNOWLEDGE FRAME TABLE

Code	keyword	$S-list$	Rel	deg	node1	node2
Root	null	null	null	0.0	Root	a1
a_1	professor	$prof-teacher$	lecture	0.8	a_1	a_2
:	:	:	:	:	:	:

B. Memory Reconfiguration mechanism

As described in the previous section, memory Reconfiguration is a necessary function for maintaining the accurate and substantial knowledge frame. The incoming new knowledge and its associative relation should be estimated in Evaluation module for confidence. In Evaluation module, Confidence factor,C_i is calculated using Importance factor, I_i, and frequency degree,F_i. Knowledge Reconfiguration module decides if it make this incoming new knowledge take part in the reconfiguration process with Confidence factor.

$$F_i = \frac{1}{1+e^{-n}} \tag{2}$$

Where n denotes frequency of access. Confidence factor is calculated by equation 3.

$$C_i = \frac{I_i + F_i}{2} \tag{3}$$

Memory Reconfiguration

Memory reconfiguration mechanism starts to search the common nodes in the existing frame when a new knowledge frame comes in. If the common node is found, reconfiguring process centering around common node is made as shown in figure 4.

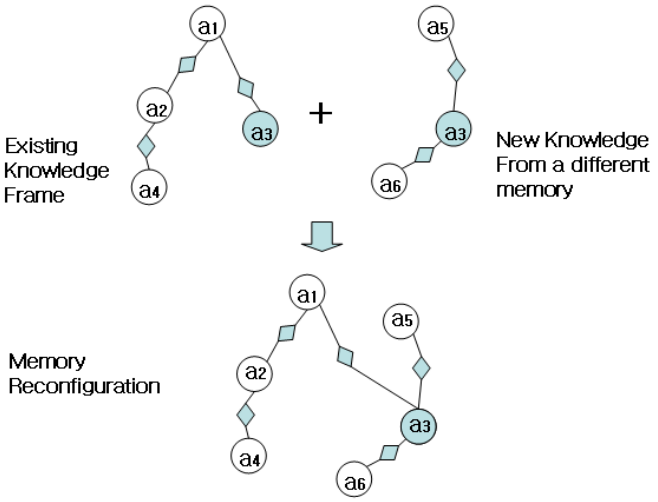

Fig. 4. Knowledge reconfiguration

However, there are several cases for reconfiguration during searching the correspondent nodes and relation in the existing knowledge frame. Accordingly, five cases are considered as follows. Figure 5 shows the initial state.

Case 1 :(a_i = a_{newi}**,** a_j=a_{newj}**,** R_{ij}=R_{newij} **)**

In this case the weight of associative relation is adjusted by the equation because all the three terms are correspondent.

$$K = W_{ij} + W_{newij}$$

$$W_{ij} = \frac{1}{1+e^{-K}}$$

Case 2 :(a_i = a_{newi}**,** a_j=a_{newj}**,** $R_{ij} \neq$**R**$_{newij}$ **)**

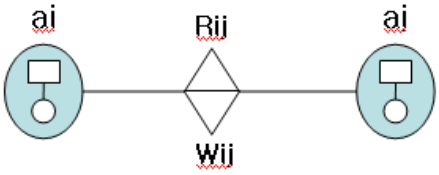

Fig. 5. Initial state

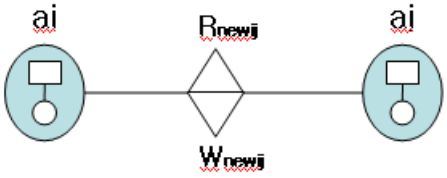

Fig. 6. Reconfiguration of case 1

The new associative relation link is created.

Case 3 :(a_i = a_{newi}**,** a_j ≠**a**$_{newj}$**,** R_{ij} ≠**R**$_{newij}$ **)**

The new associative relation link and knowledge node are created.

Case 4 :(a_i = a_{newi}**,** a_j ≠**a**$_{newj}$**,** R_{ij} = R_{newij} **)**

In this case adjusting process is required because there is a conflict between the existing frame and incoming new knowledge frame. If the strength of associative relation between the existing nodes is greater than the strength of new one,the new frame is aborted. Otherwise, the links of the existing frame are deleted , new link is created and the new strength substitutes for the old one.

Case 5 :(a_i ≠**a**$_{newi}$**,** a_j ≠**a**$_{newj}$**,** R_{ij} ≠**R**$_{newij}$ **)**

A new link is connected to the root node because there is no correspondent frame to the new frame in the existing memory.

When the new knowledge and associative relation selected in evaluation testing are propagated into the knowledge frame, Knowledge reconfiguration mechanism starts according to the following Algorithm 1.

Algorithm 1 : Knowledge Reconfiguration algorithm

(I/O interface)

Step 1 Input the new knowledge, associative degree and the importance of the knowledge I_i.

(Temporary memory)

Step 2 Store on Temporary memory.

(Evaluation Module)

Step 3 Calculate confidence degree.

$$F_i = \frac{1}{1+e^{-n}}$$

$$C_i = \frac{I_i + F_i}{2}$$

Step 4 If$(C_i \geq \epsilon)\&(t \geq T)$

Then goto Forgetting module

Else goto Knowledge Reconfiguration module.

Forgetting module :

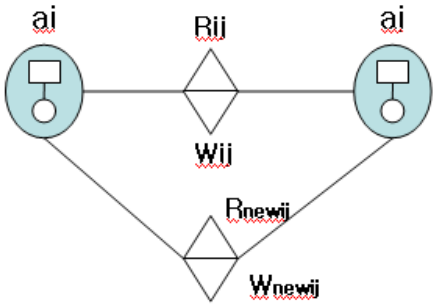

Fig. 7. Reconfiguration of case 2

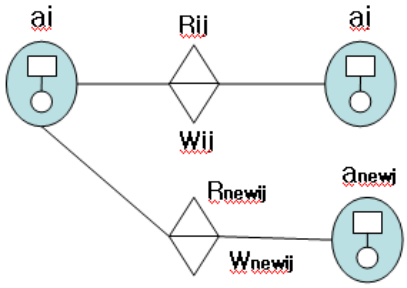

Fig. 8. Reconfiguration of Case 3

Move the input knowledge to the forgetting pool and remove it.

Knowledge Reconfiguration module :

Step 4-1 :

Search the representative name in the knowledge node and synonym list.

Step 4-2 :

Case 1(a_i = a_{newi}, a_j=a_{newj}, R_{ij}=R_{newij})

Adjust the associative relation degree

$$K = W_{ij} + W_{newij}$$

$$W_{ij} = \frac{1}{1+e^{-K}}$$

Case 2(a_i = a_{newi}, a_j=a_{newj}, R_{ij} ≠R$_{newij}$)

Create the new associative relation

Case 3(a_i = a_{newi}, a_j ≠a$_{newj}$, R_{ij} ≠R$_{newij}$)

Create the new link and node

Case 4(a_i = a_{newi}, a_j ≠a$_{newj}$, R_{ij} = R_{newij})

the state of confliction

if W_{ij} ≥W$_{newij}$

Then Abort the new knowledge pair

Else Delete the existing link and create the new link.

Case 5(a_i ≠a$_{newi}$, a_j ≠a$_{newj}$, R_{ij} ≠R$_{newij}$)

Create the associative relation and node connected to Root

Step 5:if knowledge pair = t

Then goto Step 6

Else goto Step 1

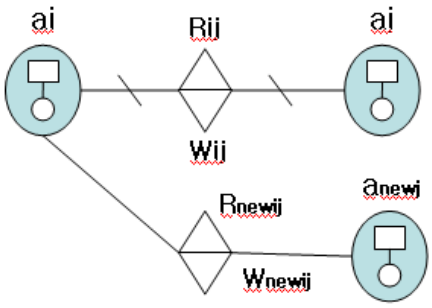

Fig. 9. Reconfiguration of Case 4

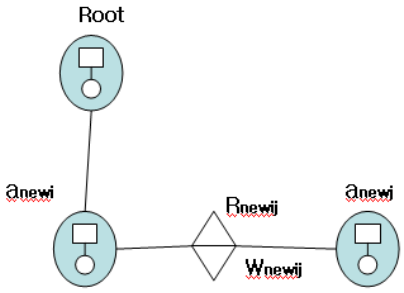

Fig. 10. Reconfiguration of Case 5

Step 6:STOP.

C. Knowledge Retrieval

Knowledge Retrieval module takes part in the function of data extraction. When the fact comes into I/O interface Knowledge Retrieval module searches corresponding keyword in the knowledge frame and synonym list. If it is found,associative knowledge nodes connected to the keyword are extracted. In this mechanism, extracted associative level can be adjusted according to the given threshold. Given the following table, Knowledge Retrieval module extracts the related tuple from the found keyword in line with the numbering sequence in the table.

TABLE II

KNOWLEDGE RETRIEVAL IN KNOWLEDGE FRAME TABLE

Code	keyword	$S-list$	Rel	deg	node1	node2
Root	null	null	null	0.0	Root	a_1
(1)a_1	professor	$prof-teacher$	lecture	0.8	a_1	a_2
(2)a_2	student	$pupil$	study	0.6	a_2	a_5
a_3	..	..	..	..	a_3	a_7
a_4	..	..	..	..	a_4	a_3
(3)a_5	Computer	$CS-Eng..$	self	0.0	a_5	null
:	:	:	:	:	:	:
a_n	...	...	...	...	a_n	null

After knowledge retrieval mechanism, the full inferential path is obtained as follows:

[a_1 : Professor (prof, teacher)] - lecture (0.8)- [a_2 : Student(pupil)] - study (0.6) - [a_5 :Computer (CS, Engineering)]

Suppose that we set the value of threshold as 0.7, the retrieved path in this level is :

[a_1 :Professor (prof, teacher)] - lecture (0.8) - [a_2 :Student (pupil)]

It means that this Knowledge retrieval mechanism can adjust the extracting level.

IV. EXPERIMENTS

We tested with the supposed virtual knowledge frame. Figure 11 shows the existing knowledge frame and figure 12 represents the incoming new knowledge frame. The knowledge frame table of existing one is listed in figure 13. After Knowledge reconfiguration mechanism is performed centering around common node as shown in figure 14, the contents of that frame are changed as following figure 15. Figure 16 represents the retrieved knowledge starting from the keyword.

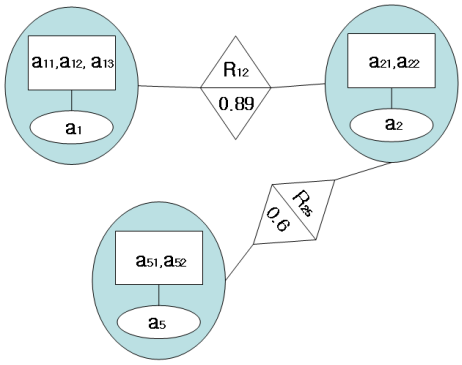

Fig. 11. The existing knowledge frame

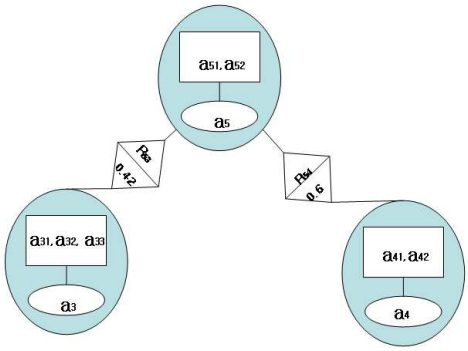

Fig. 12. New knowledge frame from a different memory

V. CONCLUSION

We proposed Conceptual model of new knowledge reconfiguration based on the common node connection from a different memory. For the efficient knowledge reconfiguration, the well formed structure of knowledge frame with special synonym list

```
----------------------------------
 1: List
 2: Knowledge Reconfiguration
 3: Knowledge Retrieval
 4: End
----------------------------------
    Select the Key (1/2/3/4)?  1

 ... List

 Code  Keyword   S-list        Rel   deg   node1  node2
-------------------------------------------------------
 Root    null       null       null  0.00  Root   a1
 a1       a1    a11-a12-a13    R12   0.89  a1     a2
 a2       a2    a21-a22        R25   0.60  a2     a5
 a5       a5    a51-a52        R55   0.00  a5     null
-------------------------------------------------------
```

Fig. 13. The list of existing knowledge frame

```
... Knowledge  Reconfiguration
Input(keyword/node2/Rel/deg/Importance)? a5 a3 R53 0.42 0.8
...evaluation
threshold(default=0.5)? 0.5
a5  found
a3  not found
R53 not found
I=0.80 F=0.68 Ci=0.74  Selected

...Knowledge Frame was reconfigured.
----------------------------------
 1: List
 2: Knowledge Reconfiguration
 3: Knowledge Retrieval
 4: End
----------------------------------
    Select the Key (1/2/3/4)?  2

... Knowledge  Reconfiguration
Input(keyword/node2/Rel/deg/Importance)? a5 a4 R54 0.6 0.9
...evaluation
threshold(default=0.5)? 0.5
a5  found
a4  not found
R54 not found
I=0.90 F=0.80 Ci=0.85  Selected
...Knowledge Frame was reconfigured.
```

Fig. 14. Knowledge reconfiguration

was designed. Knowledge retrieval mechanism is performed using this designed structure.

As a result of testing, we could find that it can reform the knowledge frame and extract the related data using this structure easily. It could solve redundancy and inconsistency problem. This mechanism can be applied to construct personal memory structure and personal preference can be calculated by strength of associative relations. Personal preference is a very important information for providing service considering personal characteristics in many areas of E-commerce system,Database management and etc..

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[4] Jeong-Yon Shim, Chong-Sun Hwang Data Extraction from Associative Matrix based on Selective learning system *IJCNN'99, Washongton D.C.*


```
 ... List

 Code  Keyword   S-list        Rel   deg   node1  node2
-------------------------------------------------------
 Root    null       null       null  0.00  Root   a1
 a1       a1    a11-a12-a13    R12   0.89  a1     a2
 a2       a2    a21-a22        R25   0.60  a2     a5
 a5       a5    a51-a52        R53   0.42  a5     a3
 a3       a3    a31-a32-a33    R33   0.00  a3     null
 a5       a5    a51-a52        R54   0.60  a5     a4
 a4       a4    a41-a42        R44   0.00  a4     null
-------------------------------------------------------
```

Fig. 15. The list after reconfiguration

```
----------------------------------
 1: List
 2: Knowledge Reconfiguration
 3: Knowledge Retrieval
 4: End
----------------------------------
    Select the Key (1/2/3/4)?  3

...Knowledge Retrieval
Input keyword? a1
...a1 was found
...Inferential path
...[a1]-R12(0.89)-[a2]-R25(0.60)-[a5]-R53(0.42)-[a3]
...Inferential path
...[a1]-R12(0.89)-[a2]-R25(0.60)-[a5]-R54(0.60)-[a4]
```

Fig. 16. Knowledge retrieval

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