A Design of Reticular Activating System based on P/N Type Matching Selection

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Abstract

As the information circumstance is getting more complicated, the requirements for implementing the efficient intelligent system adopting human brain functions is getting high. We focus on the function of Reticular Activating System which takes charge of information selection. In this paper we designed P/N Type Matching Selection in Reticular Activating System for the efficient memory retention and retrieval. Type definition and P/N Type matching selection mechanism are specially implemented for flexible memory structure. This mechanism was applied to virtual memory and tested.

1 Introduction

On the other side, as computer technology develop very rapidly, the virtual circumstance of information including internet environment is getting more complex. This information world transcending the concept of time and space shows complex features of huge real world. And it has enormous data like a flood. The problem is a fact that we are facing more complex environment than the past because real world we have lived and the virtual world developed by computer technology are overlapping each other more and more. Under these circumstance, it requires the development of more efficient intelligent system which can select important data appropriate for the special purpose and make a decision autonomously. For implementing efficient intelligent system in this complex environment, adopting human brain mechanism it should have such a function of Type matching information selecting, learning, efficient configuring the memory and information retrieving.

Accordingly, in this paper we design Reticular Activating System which has the function of selecting the data, learning, structuring the memory and knowledge retrieving. Especially five types reflecting its own nature are defined and Type matching selecting mechanism by P/N signal is proposed. we applied this system to a virtual memory and tested a variation of experimental results according to the matching types.

2 Reticular Activating System

2.1 The structure of Reticular Activating System

In this section Reticular Activating System which can select and store the information was designed. As shown in Fig.1, this system has a hierarchical structure and it consists of Knowledge acquisition, Selection and Storing to Memory. In this process, an important thing is that human being accepts the matching data with his own type and preference easily and the thinking structure is constructed by personal preference. It is guessed that personal preference is made of his nature and the adaptive pressure for surviving from the external circumstance. Because of this characteristics, the living things have continued evolving to the most adaptable structure for surviving in the complex world.
Second, Reticular Activating layer has a knowledge net which consists of nodes and their associative relations. The nodes in knowledge net are connected to the nodes of Associative layer vertically. The importance value is assigned to the connection weight of this vertical relation. Selection module performs selecting process with these values of associative relations and vertical relations using the criteria given by Meta Knowledge.

Third, Storing to Memory consists of two part of Knowledge Reconfiguration and storing the values for NN. In Reconfiguration, the selected nodes and relations are reconfigured and stored in memory. The knowledge net is performed by attaching nodes centering around common node. After reconfiguration the centering node is connected to index which is used in searching process. In the case of polysemy, the common node is connected by On/Off switching to multiple knowledge net. The another part of memory is storing the values for NN. In this system stores the values of category, parameters and weight matrix. These stored values are used for perception, inference and knowledge retrieval.

Reticular Activating System performs the functions of Learning, Selection, memory reconfiguration and Knowledge retrieval as these three parts collaborates on a work interactively.

3 P/N Type Matching Selection

In this section Type matching selection mechanism choosing the matching knowledge according to Type Matching Rule is proposed and reconfiguration mechanism is also designed.

3.1 Type definition

Everything has its own characteristics. In this study, we define its own characteristic as a Type.

**Definition 1 : Type**

Type is defined as own characteristic which presents nature of particular things. An object has one of five types, i.e. M, F, E, K and S.

There exists Attracting relation or Rejecting relation between two types. If one type meets Attracting relation, two types are associated and their relational strength increases. On the contrary, if it meets Rejecting relation, expelling strength works on two types and their strength decreases.

**Definition 2 : Type Matching**

Type Matching is defined as the status that represents matching degree between two types.

**Definition 3: Attracting Relation**

Attracting Relation is defined as the status that one type is helping the other type. \( A \oplus \gg B \) means that type A helps type B.

**Definition 4: Rejecting Relation**

Rejecting Relation is defined as the status that one type is rejecting the other type. \( A \ominus \gg B \) means that type A rejects type B.

The following table1 and table2 shows Type Matching rule of Attracting relation and Rejecting relation. This rule is designed that one type have two Attracting types and two Rejecting types.

<table>
<thead>
<tr>
<th>Attracting Relation</th>
<th>M \oplus \gg F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F \oplus \gg E</td>
</tr>
<tr>
<td></td>
<td>E \oplus \gg K</td>
</tr>
<tr>
<td></td>
<td>K \oplus \gg S</td>
</tr>
<tr>
<td></td>
<td>S \oplus \gg M</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rejecting Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>M \ominus \gg E</td>
</tr>
<tr>
<td>E \ominus \gg S</td>
</tr>
<tr>
<td>S \ominus \gg F</td>
</tr>
<tr>
<td>F \ominus \gg K</td>
</tr>
<tr>
<td>K \ominus \gg M</td>
</tr>
</tbody>
</table>
3.2 Type Matching Selection mechanism

Type Matching Selection System was designed as following Figure 2. If P/N switch turns on, the activating degree of selecting type is set. According to P/N signal, Type Selection Module selects matching knowledge with that type from Master Knowledge net in Reticular layer. Then Knowledge Reconfiguration module reconstructs new knowledge net with selected knowledge in the previous step.

P/N switching controls the signal for activating status. P/N switching has two status of P and N. P signal represents 'Active' status and N signal represents 'Inactive' status. If P/N switching is set on the status of 'P', 'Affecting relation' works stronger than 'Being affected relation'. Conversely, if it is 'N' status, 'Being affected relation' is stronger than 'Affecting relation'.

For example, Suppose that the type of one object is B and type B is related to two Type Matching Rules i.e. A \( \oplus \gg B \), B \( \oplus \gg C \). In this rule A is 'affecting relation' to B and C is 'being affected relation' by B. That is, on the signal of 'P' a B-type-object accepts C type knowledge stronger than A type knowledge. On the signal of 'N', a B-type-object accepts stronger A type knowledge than C type knowledge.

3.3 Knowledge Reconfiguration

As shown in Figure 3, the basic structure of knowledge net is described in the graph. A knowledge node contains its own type, \( T_i \) and internal strength, \( I_i \). One knowledge node is connected to the other knowledge node with Relational strength, \( S_{ij} \).

The graphic representation of knowledge net is translated to associative knowledge list of table 3. New knowledge net is constructed by the following Knowledge reconfiguration algorithm.

Algorithm 1 : Knowledge Reconfiguration algorithm

STEP 1: Get the type of Object, \( T_i \).
*Initialization

Table 3: Associative knowledge list

<table>
<thead>
<tr>
<th>Type</th>
<th>I_s</th>
<th>R_s</th>
<th>K - n</th>
</tr>
</thead>
<tbody>
<tr>
<td>( K_i )</td>
<td>( T_i )</td>
<td>( I_i )</td>
<td>( S_{ij} )</td>
</tr>
<tr>
<td>( K_j )</td>
<td>( T_j )</td>
<td>( I_j )</td>
<td>( S_{jk} )</td>
</tr>
</tbody>
</table>

STEP 2: Look up Attracting Rule Table
Search Affecting Type, \( H_p \)
Search Being affected Type, \( H_N \)

STEP 3: Look up Rejecting Rule table
Search Affecting Type, \( R_p \)
Search Being affected Type, \( R_N \)

REPEAT

STEP 4: Input the knowledge node from Master Knowledge net
Get the type of Knowledge node, \( T_k \).

STEP 5: If P-switching:
    case \( T_k \) == \( T_i \)
    \( I_k = 1.0 \)
    case \( T_k \) == \( H_p \)
    \( I_k = 0.8 \)
    case \( T_k \) == \( H_N \)
    \( I_k = 0.5 \)

STEP 6: If N-switching:
    case \( T_k \) == \( T_i \)
    \( I_k = 1.0 \)
    case \( T_k \) == \( H_N \)
    \( I_k = 0.8 \)
    case \( T_k \) == \( H_P \)
    \( I_k = 0.5 \)

*Knowledge Reconfiguration

STEP 7: Add the input knowledge node to New knowledge net.
UNTIL (knowledge node of master knowledge net == Null)

STEP 8: Output New reconfigured Knowledge net

STEP 9: Stop.

4 Experiments

P/N Switching selection mechanism is applied to virtual memory. The knowledge net shown in Figure 4 was used for testing P/N Switching selection process and Knowledge configuration.

Fig. 4 Master Knowledge Net

Fig. 5 New Reconfigured Knowledge Net: P/N Switching = P

Table 4 shows translated Associative Knowledge List that represents master knowledge net. Suppose that the type of object is F, New reconfigured knowledge net is as Figure 5. New net was configured by extracted Type Matching Rules which are M ⊕ ≫ F and F ⊕ ≫ E.

Table 4. Associative Knowledge list

<table>
<thead>
<tr>
<th>P/N Switching : P</th>
</tr>
</thead>
</table>

Table 5. Associative Knowledge list of New Reconfigured Knowledge net

Enter the type of Object : F

Fig. 6 Associative Knowledge list of New Reconfigured Knowledge net

Figure 6 described the testing result of P/N Masking. It shows Associative knowledge list of reconfigured knowledge net according to P/N switching signal. For the type of object, F, a piece of type matching knowledge was selected and new knowledge net was reconfigured. As a result, it was found that New knowledge net controlled by P/N Type matching selection was successfully made. This new knowledge net containing type information can be used for efficient data retrieving.

5 Conclusion

In this paper, we propose Reticular Activating system which has functions of selective reaction, learning and inference. This system consists of
Knowledge acquisition, selection, storing and retrieving part. Reticular Activating layer is connected to Meta knowledge in the high level of this system and takes part in Data Selection. Type definition and P/N Type matching selection mechanism in Reticular Activating System were specially designed. We applied this system to the virtual memory and tested P/N Type Matching selection mechanism.

As a result of testing, we could find that new knowledge net was successfully made by P/N Type matching selection. It is expected that Reticular Activating system, the concept of its P/N Type matching selection can contribute to implement flexible associative memory and efficient retrieval mechanism.

References


