ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 2, Issue 1, January 2013

Improvement of Case-Based Reasoning Using Segmentation of Comparison Sections

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***Abstract*— Case-based reasoning is a way for problem solving that is based on the previous solved problems. This way is done using the most similarity with one of the previous cases or with extended version of previous case for adapting with the new case. The goal of this paper is the improvement of case-based reasoning using weighted segments of each value. In this way, the best similarity can be achieved. The candidate state is used directly as a solution or it can be extended to cover the new problem.**

***Index Terms*— Case-Based Reasoning, Case Retrieval, Similarity, Weighting.**

I. INTRODUCTION

Case-based reasoning is a way that uses the past experiences to solve the new problem. It is in domain of machine learning and finds the similar situation in the past and uses it in the new state. Other artificial intelligence ways use the general kowledge of problem domain or extended relation between problems and solutions, but case-based reasoning uses incremental and supporting learning[1]. When a problem is done by a solution, the state base is updated to make the incremental learning. Otherwise, the cause of fail is detected and stored to prevent the mistake in the future[2].

In Hunt model, at first, input is analyzed and the important features are detected. Then, the best adaption between the past states and the new state is determined. If a solution is exist for this problem, the constructed state is stored in the state base. Of course, there is another stage to correction of state for solving all aspects of the problem[3]. In the Leake and Kolodner model, the adapted states are analyzed based on the suitable parameters and then an appropriate solution is recommended. In the next stage, the past solution is corrected to have the best adaption to new state. Finally, new state and its solution are stored in the state base[3].

II. CASE-BASED REASONING MODEL

General model of case-based reasoning is shown in Fig.1. this model consists of four main stages[3]. In retrieve stage, similar states are retrieved. Then, the retrieved states and the new state are sent to reuse stage. In reuse stage, information and knowledge from retrieved states are used to solving the new problem.

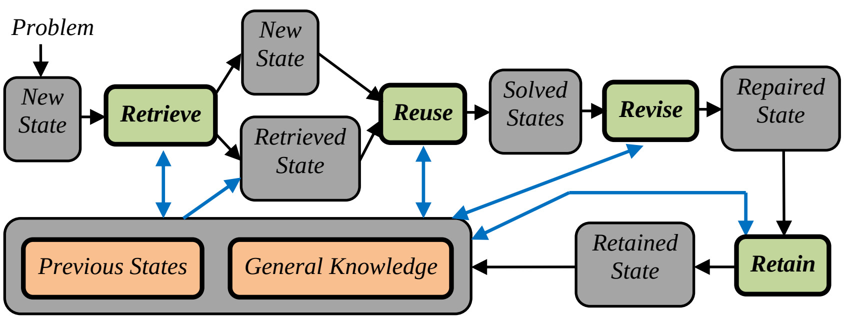

Fig.1. General model of case-based reasoning

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ISO 9001:2008 Certified
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Then, the solved problem goes to revise stage. Solved problem is revised with attention to real solution and then goes to retain stage to be stored as a learned state in state base. In most ways, real solution is asked from user or other artificial intelligence ways are used for making the initial state base[4],[5]. One of the most important stages in case-based reasoning is the retrieve stage. The way for finding the similar states has an important role in system efficiency; therefore, saving method in the state base will be very important[6].

III. Retrieving the Similar States from State Base

When a new state is accured, related features are considered and their values are saved. Then, by searching the previous stored states, states with enough similarity are selected. In this stage, values related to each feature is compared with its related value of the previous states and similarity degree is calculated[7]. This work can be done by comparing the similarity degree between similar words in each value.
For example, Fig.2 shows a new state and two previous stored states. The gray region shows the solution and the remaining region shows the problem. Also, Fig.3 shows the calculated degree of similarity between the new state and each of two previous states.

Feature	***Value***
Problem	*no access to hard disk*
Model	*Maxtor 500*
Year	*1989*
Cable	*10*
Appearance	*suitable*

a

Feature	***Value***
Problem	*no access to hard disk*
Model	*Maxtor 256*
Year	*1993*
Cable	*12*
Appearance	*suitable*
Pin State	*suitable*
Detection	*Cable Fail*
Reform	*Cable*

b

Feature	***Value***
Problem	*no access to external disk*
Model	*Digital 500*
Year	*1995*
Cable	*11*
Appearance	*improper*
Pin State	*suitable*
Detection	*Disk Fail*
Reform	*Disk Change*

c

Fig.2. a. new state b. retrieved state 1 c.retrieved state 2

Similarity is the most important concept in case-based reasoning. In best method, a special weight is dedicated to each feature based on its importance[8]. This similarity can be shown by a number between 0(no similarity) and 1(full similarity). For example, consider two sentenses "no access to hard disk" and "no access to external disk". Current methodes decides based on the number of similar words. In this example, four words in two sentenses are similar leads the similarity be equal to 0.8. Then, this number is multiplied by its importance degree. For example, in Fig.3, most important features are considered to have weith equal to 6(thick lines) and the others equal to 1. Sum of weiths is 20.

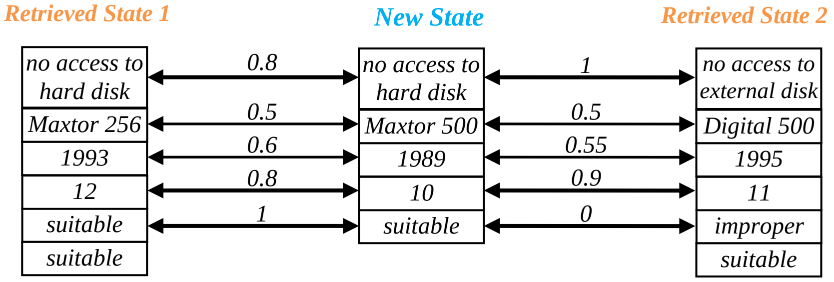

Fig.3. calculating the similarity degree

The similarity between new state and retrieval state 1 is calculated as relation (1). Also, relation (2) is about the similarity between the new state and retrieval state 2.

$$[6\times(0.8+0.8+1)+1\times(0.5+0.6)]\ /20 = 0.805 \quad (1)$$

$$[6\times(1+0.9+0)+1\times(0.5+0.55)]\ /20 = 0.622 \quad (2)$$

As calculated in relations (1) and (2), the similarity of retrieval state 1 is greater than the retrieval state 2; therefore, retrieval state 1 will be used to solve the new state. Fig.4 shows the new state and its solution that will be stored in the state base.

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Feature	Value
Problem	no access to external disk
Model	Maxtor 500
Year	1989
Cable	10
Appearance	suitable
Detection	Cable Fail
Reform	Cable

Fig.4. the new state with its solution

IV. New Method

As mentioned before, a special weight is considered for each feature of a problem, but no weight is assigned to the segments of each feature value. each feature value can be divided to segments and each segment can have a special weight. This weight specifies the importance of the related segment; therefore, the similarity degree can be calculated more precisely. For example, in the disk model feaure, the word "maxtor" can have higher importance than the word "500". In fact, it is not true that the all segments have equal percent of importance. For instance, the word "maxtor" can have 70 percent and the word "500" have the remaining 30 percent. Fig.5 shows this impact on the similarity degree. The similarity calculations are as relations (3) and (4) respectively. As it is obvious, the similarity between the new state and retrieval state 1 is greater than the previous similarity. Also, the similarity between the new state and retrieval state 2 is smaller than the previous; therefore, this method help to detect the best solution more precisely.

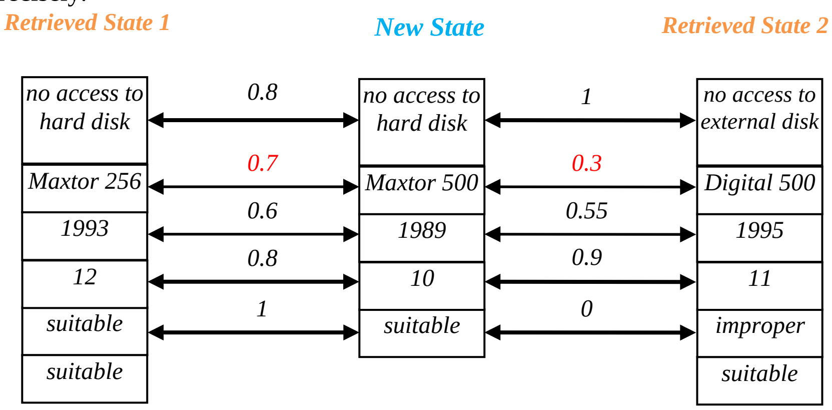

Fig.5. calculating the similarity degree

$$[6\times(0.8+0.8+1)+1\times(0.7+0.6)]\ /20 = 0.845 \quad (3)$$

$$[6\times(1+0.9+0)+1\times(0.3+0.55)]\ /20 = 0.612 \quad (4)$$

The question is that how we can valuate the portion of each segment? This work is done by anwering from the user in the special domian of khowledge. It also can be find considering the various instances of similar problems and the number of correct selected solutions.

In state base and for each feature, the most important segment is located at first and others are satisfied in terms of their importance; therefore, the candidate states are selected faster than usual. The proposed state base for saving the values related to each state is shown in Fig.6.

	State 1			. . .			**State n**		
Feature 1	First segment of value	. . .	Last segment of value	. . .	. . .	. . .	First segment of value	. . .	Last segment of value
Feature 2	First segment of value	. . .	Last segment of value	. . .	. . .	. . .	First segment of value	. . .	Last segment of value
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Feature m	First segment of value	. . .	Last segment of value	. . .	. . .	. . .	First segment of value	. . .	Last segment of value
	Solution of State 1			. . .			**Solution of State n**		

Fig.6 Proposed state base

The gray section shows the values of all features related to state 1. As shown in Fig.6, each state has some features and each feature has some words(segments). The importance of segments decrements from left to right. The number of rows is fixed and equal to maximum number of possible and visible features, whereas the number of columns is based on the number of stored states in state base. In Fig.6, the number of features and the stored states in state base are assumed to be m and n. This two dimensional array can be consedered as a three dimensional array that one dimension is related to the number of states and two other dimensions are related to features and their values. The problem solution can be stored as a special feature.

V. Conclusion

Finding the best candidate states for solving the new problem is One of the most important stages in case-based reasoning. For this, the similarity degree between important features of the new problem and the state base is calculated. the selection stage can be improved by valuation of problem features and also by valuation of the features value segments; therefore, similar states can be selected in the optimal way. Also, in state base, all featues and their value segments are in order of their importance. In future, this method can be extended to cover all aspects of the features related to all states and relationships between them. Also, the percent of importance in a feature can be considered based on the other features.

Acknowledgment

This paper is the result of the research plan "Design a hardware system for the JPEG2000 image compression algorithm". It is carried out at the department of computer engineering, Roudsar and Amlash branch, Islamic Azad University. In fact, while working in this research plan, we decided to improve the classification of bit planes based on their importance in the entropy coding stage.

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ISSN: 2319-5967
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