

# A Framework of Counseling System for Student Guardianship using Case Based Reasoning (CBR) Inference

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**Abstract.** Case Based Reasoning (CBR) based systems are systems that use case-based inference methods, in this case identical to previous experiences used to predict solutions to some new problems. In this study, the framework of the CBR-based counseling system was developed, which is expected to support and represent the guardian's lecturers to face students in counseling, where students can receive solutions of all kinds of problems encountered in this study. Within this framework, counseling data will be processed into the basis of knowledge, whether it be a problem or a solution into the counseling system. Using a CBR based algorithm, the data will be training data to be able to provide a solution to the next incoming problem.

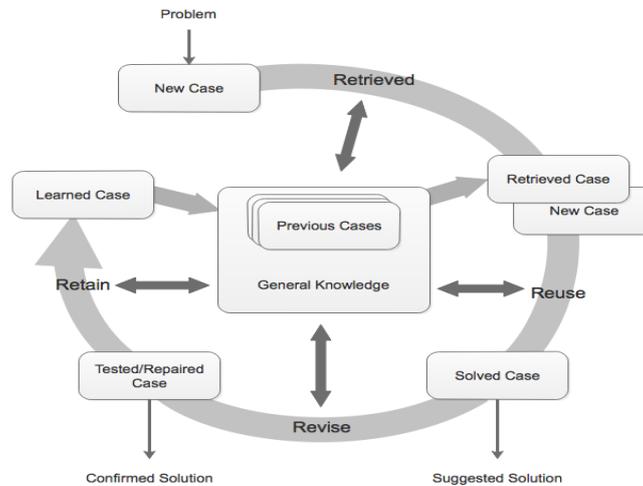
## 1. Introduction

The definition of CBR was created by Riesbeck and Schank [1]: “A case-based reasoned solves problems by using or adapting solutions to old problems.” while the methodology for CBR was describes by Peter Checkland [2] as a “set of principles which guide action”. What are they? The first of these is a desire by the problem solver to solve a problem by explicitly trying to reuse a solution from a similar past problem.

Thus, a CBR must retrieve cases from a case-library and in some way assess the similarity of cases in the library to the current problem description. Second, a CBR system should attempt to reuse the solution suggested by a retrieved case, either with or without revision. Finally, a CBR system should seek to increase its knowledge by retaining new cases. The subsequent sections will show how four different applications use this set of principles, defined as CBR, to solve real-world problems [3]. CBR is a problem-solving methodology that aims at reusing previously solved and memorized problem situations, called cases. A case is a concrete problem-solving experience. One of the main assets of CBR is its eagerness to learn.

Learning in CBR can be as simple as memorizing a new case or can entail refining the memory organization or meta-learning schemes [4]. CBR working cycle can be described best in terms of four processing stages (R4 model) as shown in Figure 1 [5]: (a) RETRIEVE the most similar case(s). (b) REUSE the case(s) to attempt to solve the current problem. (c) REVISE the proposed solution if necessary. (d) RETAIN the new solution as a part of a new case. Other paragraphs are indented.





**Figure 1.** CBR life cycle.

From model R4, then developed model R5 by Gavin and Zhaohao [6]. They propose an additional feature by adding the REPARTITION feature.

## 2. Discussion

Currently, there have been many papers discussing the implementation of CBR in various fields, such as medicine [7][8][9], education [10], and many research and technology fields. For this paper, we will discuss how to build a counseling system using CBR method. Student counseling is usually done by students who want to share with lecturers about the various academic problems they by meet face to face on campus. It was conducted between the lecturers who were appointed as guardian lecturers to the students under their guardianship. Things students usually consult are formal matters of lectures or about family issues that lie behind the academic difficulties they face.

Official matters such as consultations on what courses are appropriate for them to take in the next semester, how much credit they can take, about the final project, the fees to be paid, the procedures administrative or academic to pass and so forth. Things that are informal or semi-official e.g. previously problematic courses should be faced in what way, about the conflict between the student and his lecturer, about his financial difficulties in financing the study, how to study which is effective, how the strategy of dealing with a lecture.

### 2.1. Concept of CBR algorithm for counseling expert system

From the concepts that have been made by Munirah and Aslan [8], has constructed and described algorithms for counseling systems based on CBR. The Expert System based CBR implies that the knowledge base of the expert system is a set of cases, cases taken from CBR, and the inferencing machine is the CBR method. In the implementation, the case in question is a card that has a general structure as follows:

- Section Questions asked by students (next called as Head)
- Section Questions asked by the expert system and answered by the student (next called as Body)
- Section Solutions that answer student questions (next called as Tail).

Furthermore, related to how the CBR process in the basis of cards can be explained by the following steps:

Step 1. All the cards in the system form clusters called clusters of cards.

Step 2. Each card may only join one cluster.

Step 3. Each card in the same cluster will have the same set of parameters, the contents or answers of those parameters may be different.

Step 4. Each card in the same cluster has different or equal solutions.

Step 5. Each cluster has a cluster keyword.

Step 6. Cluster keyword = the combined number of keywords from card heads joined in the cluster.

Step 7. If there is a new card, the new card selects the closest cluster as its cluster.

Step 8. The proximity of a cluster with a new card, measured by a metric formulated as follows:

$$\Delta(X, A) = \frac{1}{\Delta key\_word(X, A) + 1} \quad (1)$$

Where:  $\Delta key\_word(X, A)$  = the number of cluster X keywords that are the same as the A card keyword

Step 9. The formation of a new cluster is determined by setting a threshold of distance between any clusters with a new incoming card. The assignment of a threshold is set based on assumptions, which can be corrected as the system goes where users can estimate better accuracy.

- Example of threshold setting:

A new card A forms a new cluster, if and only if for all X cluster on the system is filled with  $d(X, A) > 1/5$ .

- Example of threshold use:

Suppose in the system there are two clusters, namely cluster X and cluster Y, then there is a new card A that enters the system. And threshold is set equal to 1/5. For example:

$$\Delta key\_word(X, A) = 4$$

$$\Delta key\_word(Y, A) = 3$$

Then the cluster proximity is obtained:

$$d(X, A) = 1/4$$

$$d(Y, A) = 1/3$$

Then the result is:

$$d(X, A) > 1/5 \text{ and } d(Y, A) > 1/5$$

Means, card A forms a new cluster different from the cluster X and cluster Y, call it for example cluster Z, where  $A \in Z$ .

Step 10. When a new card, entered into a cluster, then automatically the new card has the same parameters with all cards in the cluster. Then the new card is returned to the user to manually fill those parameters.

Step 11. When a new card has been filled in its parameters, the new card is returned to its original cluster, to find a solution that matches the card.

Step 12. The determination of the card solution is done by creating a metric that measures the distance between the new card and the other cards in the same cluster.

Step 13. Metrics that measure between cards in the same cluster are defined as follows:

Suppose that card B and card C are in cluster X, and there is a new card A that is returned to cluster X after parameter A is filled by the student.

The similarity between card A to card B is expressed by a metric formulated as follows:

$$J(A, B) = \frac{1}{\Delta parameter\ of\ (A, B)} \quad (2)$$

Where:  $\Delta parameter\ of\ A, B$  = the number of answers with the same parameters between A and B

For Example:

$\Delta parameter\ of\ (A, B) = 5$  (there are 5 answers with the same parameters between A and B), then the similarity is:  $J(A, B) = 1/5$ , while  $\Delta parameter\ of\ (A, C) = 6$  (there are 6 answers to the same parameters between A and C), so the similarity is:  $J(A, C) = 1/6$

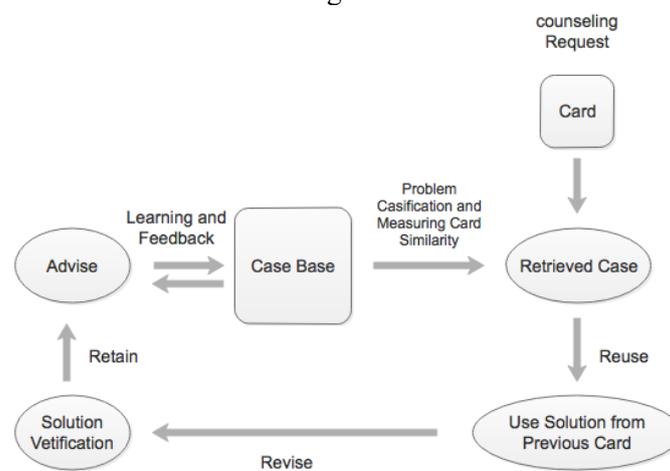
Conclusion:

A is closer to C then to B, so solution A = solution C

Step 14. Related to how a new solution is formed, a threshold is created for the  $J(A, B)$  metric that determines when a new solution is formed. Suppose the threshold is set to  $1/5$ , this means: If for every Y card is any in the X cluster, and the new card A, where  $J(A, Y) < 1/5$ , then there is no solution matching one of the cards in cluster X, so card A forms a new solution. New solutions are provided by an expert or expert related to the field in question on card A, then stored (adapted) back into cluster X for next use.

## 2.2. Framework for the counseling expert system

Based on the concept that has been described above, all the work steps in the above algorithm are depicted in the framework scheme as shown in Figure 2.



**Figure 2.** The framework for the counseling expert system.

## 3. Conclusions

From the results of this study, can be concluded:

- Construction of counseling expert system can be a solution to facilitate student counseling system and make it easier for guardian lecturers to handle more students in their guardianship even though they cannot meet face to face.
- CBR inference method is implemented by formulating metrics based on matching words on student questions, and it is hoped that the use of these metrics into the system can flexibly provide solutions to student problems.
- This scheme is a framework of counseling system based on an expert system with CBR inference method.

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