A Case Retention Policy based on Detrimental Retrieval

Héctor Muñoz-Avila

Department of Computer Science
University of Maryland
College Park, MD 20742-3255
munoz@cs.umd.edu
(301) 405-2684 | FAX: 405-6707

Abstract. This paper presents a policy to retain new cases based on retrieval benefits for case-based planning (CBP). After each case-based problem solving episode, an analysis of the adaptation effort is made to evaluate the guidance provided by the retrieved cases. If the guidance is determined to be detrimental, the obtained solution is retain as a new case in the case base. Otherwise, if the retrieval is beneficial, the case base remains unchanged. We will observe that the notion of adaptable cases is not adequate to address the competence of a case base in the context of CBP. Instead, we claim that the notion of detrimental retrieval is more adequate. We compare our retain policy against two policies in the CBP literature and claim that our policy to retain cases based on the benefits is more effective. Our claim is supported by empirical validation.

1 Introduction

With the increasing use of CBR technology in real-world applications, case bases have become larger and the question of how to maintain them has become a necessary issue to address (Leake & Wilson, 1998; Watson, 1997, Chapter 8). In recent years researchers have turned their attention towards case base maintenance. Policies have been studied for reducing the size of the case base without sacrificing competence (Racine & Yang, 1997; Kitano & Shimazu, 1996; Smyth & Keane, 1998).

A complementary issue to overall policies to maintain a case base, is the policy to retain new solutions obtained from case-based planning episodes. An ideal case retention policy should add new cases in the case base only if the competence of the case base is improved. However, establishing adequate case retention policies can be very difficult; if the case retention policy is too restrictive, opportunities to increase the competence of the case base will be lost. If the case retention policy is too permissive, the case base will grow too much making overall case maintenance costly and may even loose competence. Increasing the benefits over the costs of retaining knowledge is a common problem for learning systems (Markovich & Scott, 1993). In the context of case-based planning (CBP), two case retention policies have been proposed:

K.-D. Althoff, R. Bergmann, L.K. Branting (Eds.), ICBR-99, LNAI 1650, pp. 276-287, 1999
© Springer-Verlag Berlin Heidelberg 1999
- *Eager Case Retention Policy.* This is a “default policy”; every new solution is retain as a new case in the case base. It is directly inherited from the CBR problem solving cycle (Lenz et. al. 1998; Aamodt & Plaza, 1994).
- *Case Retention Policy based on Retrieval Failures.* This is a more elaborate policy (Ihrig & Kambhampati, 1996). During the adaptation process, the retrieved cases can be either extended to a solution of the new problem or parts of the cases must be revised to obtain the solution. In the first situation, the retrieval is said to fail and the adapted solution is retain as a new case in the case base.

Intuition suggest that the Eager Case Retention Policy is too permissive and yield large case bases. The Case Retention Policy based on Retrieval Failures requires a more careful analysis. The first problem we faced to make this analysis is that no appropriate conceptual tools have been developed to analyze the competence in the context of CBR. Smyth and Keane (1998) observed that competence is reduced if adaptable cases fail to be retrieved or if non-adaptable cases are retrieved. We state that the notion of adaptable cases is not appropriate for CBP. Instead we proposed measure competence based the notions of beneficial and detrimental retrieval.

Based on the notions of beneficial and detrimental retrieval, we will observe that the Case Retention Policy based on Retrieval Failures may decrease the competence of the case bases and propose a new policy, *Case Retention Policy based on Detrimental Retrieval,* to address this flaw. We claim that our policy will result in more competent case bases. Our claim will be supported by empirical evaluation.

The next sections introduce the adaptation method used for this study, analyze the Case Retention Policy based on Retrieval Failures, introduce the Case Retention Policy based on Detrimental Retrieval, present empirical studies, discuss related work, and make some final remarks.

## 2 Adaptation by Derivational Replay

The adaptation method that we use is Derivational Replay (Veloso & Carbonell, 1993). In this method, instead of storing the solution plan $Sol$ in the case, the derivational trace followed to obtain $Sol$ is stored. The derivational trace is the sequence of planning decisions that were taken to obtain $Sol$.

The notion of derivational trace can be illustrated with an example in the logistics transportation domain (Veloso, 1994). A typical problem in the logistics transportation domain is to place the objects at different locations starting from a configuration from objects, locations and transportation means. There are different sorts of locations and means of transportation. The means of transportation have certain operational restrictions. For example, a truck can only be moved between two places located within the same city. Figure 1 illustrates a typical situation in the logistics transportation domain. In this situation there are three post offices $A$, $B$ and $C$. In $A$ there is a package $p_1$ and a truck. In $B$