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Using Case-Based Reasoning to Build Intelligent Systems

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1 The Basics of Case-Based Reasoning

In this talk, we first present the basics of case-based reasoning – CBR in the following – and then we show how the CBR technology can be used for building intelligent systems.

The goal of case-based reasoning is to associate a solution $\text{Sol}(P)$ with a new or target problem $P$, by reusing the solution $\text{Sol}(P')$ of a memorized problem $P'$. A CBR system takes advantage of a case base including memorized problems – or source problems – with their solutions to solve a target problem.

A case is a pair $(P, \text{Sol}(P))$, where $P$ denotes the problem statement and $\text{Sol}(P)$ the solution of $P$. The case base is a finite set of cases of the form $(P_k, \text{Sol}(P_k))$. A target problem $P$ is usually considered as a “new case”, denoted by target, and a source problem in the case base is denoted by source.

The case-based reasoning cycle relies on three main operations:

- **Retrieval**: a problem source similar to the problem target is searched in the case base. The problems memorized in the case base are considered as reference cases used to solve target problems.
- **Adaptation**: given a case retrieved in the case base, say $(\text{source}, \text{Sol(source)})$, $\text{Sol(source)}$ is adapted in order to be reused for solving the problem target.
- **Memorization**: the problem target and the (building) characteristics of the solution $\text{Sol}(\text{target})$ can be memorized as a new case to be reused in the future.

These three steps can be nested: for example, retrieval and adaptation are nested in the case-based system described in [13]; the learning step can take place within the retrieval and the adaptation steps as well, in order to learn retrieval and adaptation knowledge.

The implementation of knowledge-based systems relying on case-based reasoning gives rise to case-based reasoning systems. Given a target problem $P$, a CBR system exploits a case base and follows the preceding three-step cycle to solve $P$. The problem $P$ can be of many types, e.g. interpretation, diagnostic, configuration, planning, etc.

2 A Bibliographical Tour

The technology of CBR has been extensively studied in the past years. Important textbooks
on the subject are [18] [10] [21] [23], and [1] about industrial CBR systems.

Important researcher groups working on CBR are based in Europe, e.g. Dublin, Kaiser- slautern and Lyon. The European Conference on Case-Based Reasoning is organized every year since 1993 [24] [9] [6], and this conference becomes the International Conference on Case-Based Reasoning every two years since 1995 [22] [11].

In France, people studying CBR are members of a working group of PRC 13 (PRC IA before 1998) : see [15] for details on the research groups, and see [17] for details on the PRC 13 group.

A number of students have defended theses on many different subjects: learning in the CBR cycle [3], temporal processes and prediction [20], diagnosis and induction [2], use of CBR in optimization [8], industrial supervision [16], similarity measures [19], neural networks in CBR [14], object-based knowledge representation formalisms for building CBR systems [7] (see [5] on a related problem), case-based planning [12], ...

For terminating this short note, let us mention the publication in September 1998 of a special number on CBR of the Revue d’intelligence artificielle, where are addressed topics such as problem solving, knowledge representation, planning, supervision and cognitive aspects of CBR [4].

References


[9] J.-P. Haton, M. Keane, and M. Manago, editors. Advances in Case-Based Reasoning – Proceedings of the Second European Workshop on Case-Based Reasoning (EWCBR’94), Chantilly. Lec-


