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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 – CBIR 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 \( \text{target} \), and a source problem in the case base is denoted by \( \text{source} \).

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

- **Retrieval**: a problem \( \text{source} \) similar to the problem \( \text{target} \) 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 \((\text{source}, \text{Sol}(\text{source}))\), \( \text{Sol}(\text{source}) \) is adapted in order to be reused for solving the problem \( \text{target} \).

- **Memorization**: the problem \( \text{target} \) 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 Con-
ference 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 1A
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], neu-
ral 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 cogni-
tive aspects of CBR [4].

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