**FALLDATEN: Case-Based Reasoning for the Diagnosis of Technical Devices**

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**Abstract.** We investigate the suitability of case-based reasoning supporting experts during technical diagnosis. Diagnosis is not considered as a classification task, but as a process to be guided by computer assisted experience. This corresponds to a flexible "case completion" approach. Flexibility is also needed for the expert view with predominant interest in the unexpected, unpredictable cases. Integration of further knowledge sources (domain knowledge, common knowledge) is investigated in the project. Two different approaches based on semantic nets are investigated: FALLEXPERTE-D makes use of Case Retrieval Nets (CRN) that are based on spreading activation techniques. FALLDATEN-DL employs description logics enhanced by concrete domains.

1 Introduction

Diagnosis is a task which usually needs a lot of (human) experience. Hence it is considered as a domain, where CBR can be applied with great benefits. The following reasons are listed in [15]:

- Experiences play a major role in nearly every domain.
- By using available experiences (encoded as cases) directly, the famous knowledge acquisition bottleneck is avoided to some extent.
- In some domains it seems desperate trying to encode all the knowledge in rule- or model-based form.
- The inference process is transparent for people not involved in AI research.
- Applications are easier to build, and they rapidly demonstrate ongoing results.
- Applications can evolve: As new situations are observed they may be added as new cases and the system may thus extend its scope of expertise.

In our project, diagnosis support for technical devices is investigated from the viewpoint of CBR, where documented misbehavior and solutions serve as a base (experience) for further decisions.

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2 CBR for second-level support of technical devices

2.1 Diagnosis as classification

Diagnosis is often considered as a classification problem. This view can be found e.g. in [20] where diagnosis is defined as a problem solving type where

1. the problem domain consists of two disjoint sets representing symptoms and diagnoses;
2. a problem is described by a set of symptoms;
3. the solution of a problem consists of one or more diagnoses;
4. further symptoms may be asked for to improve the result of problem solving.

This corresponds to the description of a diagnostic case as: "case = problem + solution" where the problem is given by a set (vector) of symptom values, and the solution is the diagnosis. The underlying hypothesis for the use of CBR is then expressed as: "similar symptoms ⇒ similar (same) diagnosis."

Hence the classification view to diagnosis seems to be very well related to CBR. CBR retrieval is then often considered as the task, to find the n most similar cases, and the diagnosis is computed by some voting procedure (e.g. in comparison with "n-nearest neighbor" procedures). This view is also the base for the most successful application area of CBR: Help-desks [23].

Help-Desks Help-desks are computer-based system that aid people in providing assistance over the phone. Users needing advice contact a help-desk operator. He listens to the user describing the problem, and then provides a recommendation based on his experience. Unfortunately, operators having this experiences are hard to find and expensive. The goal of a help-desk system is therefore to enable a less experienced person\(^3\) to deal with standard, frequent questions and to free the experts\(^4\) for the more complicated tasks.

Available help-desk systems fulfill this goal: Help-desk operators are normally semi-skilled workers, having only some special training on using the help-desk. They and more or less unexperienced. With this training they try to recognize certain patterns in the end users description and use these patterns as queries to the case base. Current help-desk systems normally use an attribute-value vector description and some numerical similarity function. This results in a system guiding the user in its search for the problem solution and is therefore especially suited for users that are unexperienced in the problem domain, e.g. first-level support persons such as help-desk operators.

2.2 Case Completion

If one wants to support technicians or other second-level support persons, diagnosis as classification is inappropriate for a number of reasons:

\(^3\) Also referred to as a first-level support person
\(^4\) or second-level support persons