Chapter XXIV
Case Based Reasoning for Customizing Treatment Processes

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ABSTRACT

This chapter introduces a case based reasoning (CBR) system for customizing treatment processes. The CBR system enables the generating of inpatient and outpatient treatment processes and the supporting of e-services in health care networks individually customized to the patients’ needs. According to the CBR paradigm, which solves problems based on past experience, the proposed system uses old treatment processes of similar former patients and modifies them for new patients. In general, CBR is an established and well suited artificial intelligence method to support medical decision making. However, CBR systems capable of planning treatment processes by adapting old treatment processes to fit new patients are rare. The aim of this system is to increase the treatment quality of the patient by providing physicians with valuable treatment propositions and to contribute to the development of medical CBR Systems by introducing procedures enabling the generating of new treatment processes by modifying former treatment processes.

MOTIVATION

In the age of a growing flood of information on medical data and knowledge, medical decision support systems are becoming more and more important. Various artificial intelligence methods have been implemented in numerous systems to support the medical reasoning process. Among
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these methods case based reasoning (CBR) was established to support medical decision making. CBR (Amot & Placa, 1994) solves problems by using past experiences and general knowledge. Past experiences are saved in form of cases in the case base. For solving a new arising problem the CBR system searches for similar problems and attempts to adapt their solutions to fit the new problem. CBR is particularly suited for helping find solutions to medical problems (Heinisch et al., 1998, p. 1) as it resembles the physicians’ cognitive process of recalling former patients and reusing past experiences. Furthermore, the collection of patient records which represent a valuable knowledge resource can easily be integrated in a CBR system as a case base.

Medical CBR systems can be divided into different categories depending on their purpose-oriented properties and their functional properties. Purpose-oriented properties (Nilsson & Sollenborn, 2004, p. 179) describe the general aim which the system fulfills and allow the separation of medical CBR systems into diagnostic systems, classification systems, tutoring systems and planning systems. While diagnostic systems are intended to support the whole diagnostic process, classification systems focus on special diagnostic problems (e.g. image classification). Tutoring systems aim at teaching students medical knowledge based on patient records. Planning systems provide assistance by configuring medical processes (e.g. therapies) consisting of several steps. Considering the functional properties CBR systems can be classified into case-match-systems and case-adaptation-systems (Goos, 1996, p. 15). Case-match-systems only enable the retrieval of similar patient cases, whereas case-adaptation-systems also allow the adaptation of past cases to fit new patients. Most of the medical CBR systems developed in the last years are classification systems or diagnostic systems and they support case-matching only (Nilsson & Sollenborn 2004, p. 182). Moreover, the majority of these systems focus on inpatient treatment and specialize in one certain disease. Planning systems which realize the adaptation task, which support inpatient and outpatient treatment processes in health care networks and which implement disease independent algorithms are missing.

This chapter describes such a CBR system. The system proposes inpatient and outpatient treatment processes in health care networks based on the adaptation of treatment processes to new patients and can be applied to the treatment of various diseases. Besides the treatment steps to be fulfilled by the physicians, the generated propositions also contain e-services to satisfy the coordination and informational needs of the health care providers and the patients.

In order to clarify the functionality of this approach, all functions of the CBR systems are illustrated by example of heart failure treatment. Heart failure is a syndrome which is caused by cardiac disorder and which weakens the pumping capability of the heart supplying the tissue with blood and oxygen (Hoppe & Erdmann, 2004, p. 11). It is one of the most frequent and severest diseases of the industrialized countries with an approximate prevalence ranging from 0.3% to 2% and an estimated incidence of 0.1% to 0.5% (Cowie et al., 1997, p. 211). The medical treatment of the multitude of patients is important. However, in practice many patients do not obtain an adequate therapy compliant to actual guidelines (Hoppe & Erdmann, 2004, p. 15; Stödter, 2000, pp. 6, 18f). So the application of the Medical CBR system to the treatment of heart failure will hopefully contribute to the improvement of this situation.

CASE BASED REASONING FOR CUSTOMIZING TREATMENT PROCESSES

Introduction

CBR solves problems by using past experiences saved in form of cases in the case base. Each case