PCOPM: A Probabilistic CBR Framework for Obesity Prescription Management

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Abstract. Obesity has become one of the most prevalent health problems around the world. Many obesity therapy cases need efficient management in order to be shared and utilized. Prescription management has been proved to be successful strategy in obesity management. Since a case usually contains incomplete information, this article examines probabilistic case-based reasoning (CBR) by integrating Bayesian networks (BN) with CBR and proposes a probabilistic CBR framework for obesity prescription management (PCOPM) to assist health professionals to share their experiences of obesity exercise prescription online. The PCOPM ties together CBR and BN into a unified framework that includes both obesity experience and intelligent embodiment of decision making for obesity management. The proposed approach will facilitate the research and development of intelligent web-based obesity management.

Keywords: Case-based reasoning (CBR), Bayesian network (BN), Ontology, Obesity management.

1 Introduction

Obesity is an increasing health problem in the world because of its strong associations with hypertension, insulin resistance, type 2 diabetes, cardiovascular diseases [1]. More and more obese people hope to lose their weight through exercises [2]. However, they do not know what to do and how to do. Health professionals such as exercise doctors and personal trainers are responsible for developing different programs for different obesity patients or clients. An exercise prescription for an obese patient depends on his/her health status, sex, age, physical fitness, metabolic abnormality, individual exercise interests and different responses to different exercise types [3]. A professional designer should integrate all of these into an obesity prescription that can be followed and adjusted as needed [4].

Normally, an exercise doctor identifies predisposed factors based on the observed symptoms to produce initial impressions (hypotheses established, or suspicion) [5, 6]; then the doctor sets up a series of examination in order to find evidence; finally, the
doctor makes its final diagnosis and issues an obesity prescription. In practice, a successful prescription depends on the experience of a doctor. Besides acquiring experience by the individual's practice, a doctor usually consults colleagues or domain experts to make diagnosis decision, which is a kind of experience sharing. Unfortunately, this kind of experience sharing is slow and inefficient. Different specialists of exercise prescription have their own experiences in the practice of exercise prescription for obesity management. Consequently, how to share experiences is very important to optimize the exercise prescription for an obese person.

In addition to the problems addressed above, any case is incomplete, that is, many factors should be investigated, but only some of them are available due to cost, devices and other limitations. A doctor has to make decision based on the existing incomplete current case and the previous cases [7].

Case-based reasoning (CBR) has been applied in the diagnosis field for years [8, 9]. CBR solves new problems by adopting solutions that were used to solve old similar problems [10]. The similarity of problems lies in that they have similar feature structures and similar feature values. However, it is very common in obesity diagnosis that the solution might not be the same even that the problems of obesity are similar. Generally speaking, similar problems have likely similar solutions in the obesity diagnosis and treatment.

In recent years, Bayesian networks (BNs) have been increasingly used in a wide range of applications including bioinformatics, speech recognition, to name a few [2, 11]. BNs come from multidisciplinary ideas of artificial intelligence, decision analysis and probability communities [3]. A BN offers a stable structure and inference mechanism for addressing the obesity problems. Approximate reasoning can be performed by BN such as MCMC [12]. Probability makes it easy to combine decision with utility theory. However, it lacks of operability in the obesity diagnosis domain since a case usually contains incomplete information. For example, some hidden nodes in the BNs never have data.

This article addresses the above-mentioned issues by examining probabilistic case-based reasoning. It then proposes a probabilistic CBR framework for obesity prescription management: PCOPM. The PCOPM ties together CBR and BNs into a unified framework that includes both obesity experience and intelligent embodiment of decision making for obesity management. The remainder of this article is organized as follows: Section 2 examines the probabilistic case-based reasoning (CBR). Section 3 proposes PCOPM, a Probabilistic CBR Framework for Obesity Prescription Management. Section 4 ends this article with some conclusions and the future work.

2 Probabilistic Case Based Reasoning

Case-based reasoning (CBR) is a paradigm that solves new problems by adopting solutions that were used to solve old similar problems [10]. It is described as a cyclical process including RETRIEVE, REUSE, REVISE, and RETAIN [13]: RETRIEVE the most similar case(s); REUSE the case(s) to attempt to solve the problem; REVISE the proposed solution if necessary, and RETAIN the new solution as a part of a new case. In obesity management, the knowledge of doctors is a mixture of biological and medical knowledge, clinical guide and experiences from cases. So there is a growing interest in applying CBR to medical diagnosis systems [9].