Interactive Systems and Sources of Uncertainties

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INTRODUCTION

Today’s e-commerce environment requires that interactive systems exhibit abilities such as autonomy, adaptive and collaborative behavior, and inferential capability. Such abilities are based on the knowledge about users and their tasks to be performed (Raisinghani, Klassen and Schkade, 2001). To adapt users’ input and tasks an interactive system must be able to establish a set of assumptions about users’ profiles and task characteristics, which is often referred as user models. However, to develop a user model an interactive system needs to analyze users’ input and recognize the tasks and the ultimate goals users trying to achieve, which may involve a great deal of uncertainties.

Uncertainty refers to a set of values about a piece of assumption that cannot be determined during a dialog session. In fact, the problem of uncertainty in reasoning processes is a complex and difficult one. Information available for user model construction and reasoning is often uncertain, incomplete, and even vague. The propagation of such data through an inference model is also difficult to predict and control. Therefore, the capacity of dealing with uncertainty is crucial to the success of any knowledge management system.

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Currently, a vigorous debate is in progress concerning how best to represent and process uncertainties in knowledge based systems. This debate carries great importance because it is not only related to the construction of knowledge based system but also focuses on human thinking in which most decisions are made under conditions of uncertainty. This chapter presents and discusses uncertainties in the context of user modeling in interactive systems. Some elementary distinctions between different kinds of uncertainties are introduced. The purpose is to provide an analytical overview and perspective concerning how and where uncertainties arise and the major methods that have been proposed to cope with them.

Sources of Uncertainties

The user model based interactive systems face the problems of uncertainty in the reference rule, the facts, and representation languages. There is no widely accepted definition about the presence of uncertainty in user modeling. However, the nature of uncertainty in a user model can be investigated through its origin. Uncertainty can arise from a variety of sources. Several authors have emphasized the need for differentiating among the types and sources of uncertainty. Some of the major sources are as follows:

1. The imprecise and incomplete information obtained from the user’s input. This type of source is related to the reliability of information, which involves the following aspects:
   - Uncertain or imprecise information exists in the factual knowledge (Dutta, 2005). The contents of a user model involve uncertain factors. For instance, the system might want to assert "It is not likely that this user is a novice programmer." This kind of assertion might be treated as a piece of knowledge. But it is uncertain and seems difficult to find a numerical description for the uncertainty in this statement (i.e., no appropriate sample space in which to give this statement statistical meaning, if a statistical method is considered for capturing the uncertainty).
   - The default information often brings uncertain factors to inference processes (Reiter, 1980). For example, the stereotype system carries extensive default assumptions about a user. Some assump-