Task Acquisition with a Description Logic Reasoner

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Abstract. In many knowledge based systems the application domain is modeled in an object-centered formalism. Research in knowledge acquisition has given evidence that this approach allows one to adequately model the conceptual structures of human experts. However, when a novice user wants to describe a particular task to be solved by such a system he has to be well acquainted with the underlying domain model, and therefore is charged with the burden of making himself familiar with it. We aim at giving automated support to a user in this process, which we call task acquisition. This paper describes the TACOS system, which guides a user through an object-centered domain model and gives support to him in specifying his task. A characteristic of TACOS is that the user can enter only information that is meaningful and consistent with the domain model. In order to identify such information, TACOS exploits the ability of a description logic based knowledge representation system to reason about such models.

1 Introduction

In many areas of Computer Science and Artificial Intelligence, like Programming, Databases, and Knowledge Based Systems, formalisms for modeling an application domain share a similar view of the world. They perceive a universe as consisting of objects, which are grouped into hierarchically organized classes and linked by attributes. The classes and attributes are further specified by integrity constraints and rules that can be expressed in some fragment or variant of predicate logic.

In particular, in knowledge acquisition research, which has the goal of developing knowledge representation schemes that are capable of capturing the conceptual structures of human experts, such an object-centered approach to domain modeling has proven useful. Meanwhile, a number of tools have been built that support knowledge acquisition in this paradigm (see [5, 6]).

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As a result, at the core of many knowledge based systems there is an object-centered domain model. It might be implemented on different kinds of platforms such as object-oriented databases, knowledge representation systems based on Descriptions Logics (DLs), like LOOM [8], CLASSIC [10] and KRS [1], or even knowledge acquisition tools that allow one to execute the elicited knowledge, like KSSn [5] or EXPECT [6].

The advantage of rich domain models is that expert knowledge can be represented adequately. However, a user who wants a system to solve a particular task (e.g., booking a ticket or organizing a removal) has to know the system’s domain model well in order to specify his problem appropriately. Thus, a novice user of a knowledge based system is charged with the burden of making himself familiar with the underlying model and to figure out what kind of input is expected by the system.

In this paper we present the system TACOS (= Task ACquisition for Object-centered Systems), which utilizes its domain model to interactively acquire information from the user. This acquisition process is iterated until the system can decide whether or not the task is completely specified. In particular, TACOS guides the user through an object-centered domain model and gives support in querying it and in populating it with relevant objects.

A tool like TACOS can either function as a front-end to a knowledge based system or serve as a platform for prototyping simple such systems. Because of its support for describing objects in terms of a rich object-centered domain model it can be employed for filling and maintaining a large fact base, but also for specifying a particular task. In this paper, we concentrate on the second usage because all services of TACOS come in useful.

The rest of the paper is organized as follows. In the next section we give an overview of the system. Sections 3 to 5 describe the main building blocks, and Section 6 concludes.

2 A Bird’s Eye View of TACOS

The architecture. TACOS consists of three major components (see Figure 1): a domain modeling component, an inference component, and a user interface.

With the modeling component one sets up a model of the problem domain. A domain model consists of three parts: (1) an ontology describing the relevant classes with their attributes as well as simple integrity constraints that are to hold between them, (2) assertions introducing objects and relationships between them, and (3) a set of monotonic inference rules, by which additional relationships between objects can be derived. We also refer to ontology and assertions as the static part of a domain model and to the rules as the dynamic part. The language of the static part contains the essentials of object-centered modeling formalisms like object-oriented data models, frame systems, or DLs.

Deductions from the statements in the domain model are drawn in the inference component, which is realized by the DL based knowledge representation system KRS [1]. With the help of the inference component, the user interface