Towards a Formal Framework to Compare Protocol Interpretations and Task Specifications

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Abstract. In this paper we discuss a formal framework that can be used to relate and compare different possible interpretations and formal task specifications of a given (verbal) expert protocol. Notions are defined that can be used to describe the differences and relations between these task specifications. The framework is used to structure the analysis of an example protocol dealing with an office assignment task. We give examples of different task specifications based on alternative interpretations of this protocol.

1 Introduction

It is well-recognized that a subject performing protocol analysis is making his or her own interpretation of the protocol [1, 3, 8, 13]. Therefore the model or task specification resulting from a protocol analysis is essentially subjective and may be biased by the mental background of the one who was doing the analysis. During the modelling process various (often unconscious) choices are made. To be able to compare different task specifications that are made on the basis of one given protocol (e.g. by different persons) it would be helpful to have an overview or taxonomy of the types of choices that are possible in principle. Such an overview can be thought of as a kind of map (i.e., a picture or graph) of all possibilities in the search space of interpretations and task specifications. By positioning interpretations and task specifications on such a map and defining different branching points, the process of adopting one of the interpretations and creating one of the task specifications can be made more concrete and visible.

In practice a complete map as discussed is not always needed and feasible; in general such a complete map may be infinite. One depends on the possible interpretations and task specifications that one is able to identify. Therefore in practice only a partial map will be considered. And even if this happens to be a complete map (which is very unlikely), it will not be easy to conclude that one has been exhaustive. But also a partial map might increase one’s insight in the task behind the protocol and its possible specifications.

From a theoretical viewpoint one may give an abstract definitional framework, independent of the question whether in practice one is able to consider a complete map, or only a partial map. To design such a framework in a well-defined manner it will be helpful if the task specifications that are considered are well-defined, i.e., can be given in a formal format [9]. A possible approach to formal task specifications is offered by the formal specification framework DESIRE (framework for DEsign and Specification of Interacting REasoning modules; see [7, 10]). We have this type of formalisation in mind, but since
the description we will give in this paper is at a more abstract level, other approaches may fit in as well. What is important though is that a task specification takes into account both static and dynamic aspects of the task. The behaviour of the task (the order of the steps in the problem solving process) should be determined completely by the specification: given such a specification it should be possible to create unambiguously a related reasoning trace.

In order to illustrate the abstract definitional framework we give possible different interpretations of a sample protocol, provided by Marc Linster as a test problem in the Sisyphus project. Originally, participants of this international project were asked to provide a model of the problem solving process reported in the protocol (for the solutions, see [11, 12]). When building our model (fully discussed in [5]) we identified a lot of possible choices for the interpretation of the protocol. The analysis of the given protocol raised most of the issues which will be discussed in an abstract way in this paper.

In Section 2 we give the content of a formal framework that can be used to compare formal protocol interpretations and formal task specifications and define the basis notions underlying this framework. In Section 3 the example protocol is presented. Section 4 gives an overview according to our framework of different protocol interpretations and task specifications that can be made for the example protocol. Finally, in section 5 we draw some conclusions about our approach.

2 The Content of the Framework

We assume that the protocol to be interpreted states the problem to be solved and gives an account of the solution process. The latter is given in the form of steps taken by the expert, with some explanations. However, the explanations usually do not fully reflect all details of the problem solving process. Very likely not everything that was taking place in the expert's head was registered. On the other hand, some irrelevant statements may also have been included, which the expert did not really use. Our aim with interpreting a protocol is to reconstruct the expert's model for problem solving.

Of course, usually there is a pragmatic aim too, namely to build a system which is capable to replace an expert's problem solving activity. The idea is to build a system based on the expert's problem solving model. Although we assume this model may be present in the expert's head, it is not directly available to us. The only thing we can do is to use information available in the protocol (or several sample protocols) and make an interpretation of it. This protocol interpretation can be used as a basis for a task specification that specifies an executable problem solving model for the task that may or may not be the same as the expert's model. Notice that we require that a task specification determines unambiguously the dynamic aspects of the task behaviour (the order of the process steps). This is an important difference with a protocol interpretation: this is related to the given protocol only and a complete specification of the process is not required. For shortness, sometimes we will use the word "model" to refer to either a protocol interpretation, or to a task specification.

2.1 Basic Elements of the Framework

Usually, the reasoning process as expressed in a protocol is underspecified. It gives only fragments of the real expert's problem solving model, and maybe even these fragments are not expressed sincerely. Therefore several interpretations can be given for one single protocol. If a task specification has been created then some of its parts may relate to parts of the given protocol. But often not all parts of the protocol are covered. Some protocol fragments may contain irrelevant information or may be found so unclear that one is not able to determine whether they are relevant and what they should mean. Conversely, and