

A Static Analysis Technique to Detect Unsatisfiable Conditions in Ontology-based Workflows

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Abstract: Static analysis techniques for consistency checking of workflows allow to avoid runtime errors. This is in particular crucial for long running workflows where errors, detected late, can cause high costs. We consider workflows in which the processed data has semantic metadata in terms of a given domain ontology, like e.g. for medical trials. Such semantic metadata is not only crucial to allow data integration, but can also help to improve data quality. In our work we show that it can be utilized in static analysis techniques to detect data inconsistencies in the workflow definition at design time of the workflow. We divide data inconsistencies into two categories:

1. *Data-dependent Control Flow Inconsistencies* cause e.g. undesired abortion of workflow executions or non-reachable tasks due to unsatisfiable conditions.
2. *Semantic Data Inconsistencies* causing data collected during workflow execution to be inconsistent with the knowledge of the underlying domain that we assume to be given by a domain ontology.

Here, we focus on detecting Data-dependent Control Flow Inconsistencies. It is important to eliminate this kind of inconsistencies in workflows to guarantee reliable workflow executions. In particular, we focus on detecting unsatisfiable conditions, a data inconsistency which can lead to non-reachable tasks in workflows.

The class of workflows we consider consists of human processable tasks, comprising forms that users have to fill in at execution time. We have already presented a language called SWOD for this class of workflows elsewhere¹, emphasizing especially a formally defined data perspective based on an existing domain ontology. Furthermore, we have sketched a static analysis technique utilizing description logic and its reasoning services to check both categories of data inconsistencies, but have in particular focused on checking semantic data inconsistencies.

The contribution of this paper is to augment our previous work by describing in detail the semantics of SWOD focusing on semantics of conditions and a static analysis technique to detect unsatisfiable conditions in SWOD workflow descriptions. The described technique is the base to detect other kinds of data-dependent control flow inconsistencies. We discuss soundness and completeness of the technique.

Integrated with existing algorithms for checking structural consistency, the technique described here can have the capability to guarantee soundness of complex workflows.

¹G. Weiler, A. Poetzsch-Heffter, and S. Kiefer. Consistency Checking for Workflows with an Ontology-based Data Perspective. In 20th International Conference on Database and Expert Systems Applications, 2009.