

Towards Progress Determination in Dynamically Evolving Large Process Structures

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Abstract

Real-time business process monitoring shall enable the early detection of problems and errors, that might occur during process execution. In turn, this allows counteracting possible delays, breakdowns, or defects at an early stage and, thus, increasing the economic efficiency and efficacy of the business processes. In this context, the calculation of the progress of a dynamically evolving process structure provides the basis for advanced monitoring functions related to resource management, risk management, alarm triggering, and error warnings. This position paper discusses the fundamental challenges of determining the progress of multiple, interacting business object instances in dynamically evolving object-centric business process during run time. In particular we introduce five (sub-)research questions that need to be investigated in this context.

Keywords

object-centric business process, process monitoring, progress determination, online/real-time monitoring

1. Introduction

Business process monitoring constitutes a key element for companies to control, optimise, and evolve their business process. Moreover, it allows for an early discovery of process errors or other problems that might occur during process execution. In general, monitoring large, and dynamically evolving business process structures that allow for a high flexibility as well as dynamic changes during run time, (e.g., to dynamically add or delete business object instances and the corresponding lifecycle processes) is a challenging task [1, 2, 3]. In this context, determining the progress of large and dynamically evolving process structures is a fundamental task of any business process monitoring composing comprises a wide range of open issues for its calculation. In this paper, we discuss research questions that become relevant in the context of determining the progress in object-centric business processes with multiple, interacting business object instances and corresponding lifecycle processes. Both, the progress of the lifecycle processes of single business object types and further the progress of the overall relational process structure instance comprising a potentially large number of lifecycle processes need to be determined. In this work, we focus on the progress determination of the latter, whereas

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issues to progress determination of single lifecycle processes have already been described in [4].

The remainder of this paper is structured as follows: Section 2 gives an overview of object-centric business processes and defines the overall goal of our research on monitoring such processes. Section 3 then defines fundamental research questions to refine the problem space. Section 4 gives a synopsis of related work. Finally, Section 5 closes this paper with a summary and outlook.

2. Background

An object-centric business process consists of multiple, interacting object instances, whose behaviour is defined in terms of lifecycle processes (lifecycles for short). Each lifecycle has one start state and at least one end state as well as a number of intermediate states (cf. Figure 3). Each state can be refined by several steps that refer to update of object attributes [5]. Consequently, object-centric business process is data-driven. During run time, form sheets are generated automatically from the states of an object type. Logically, steps represent the input fields of a form sheet.

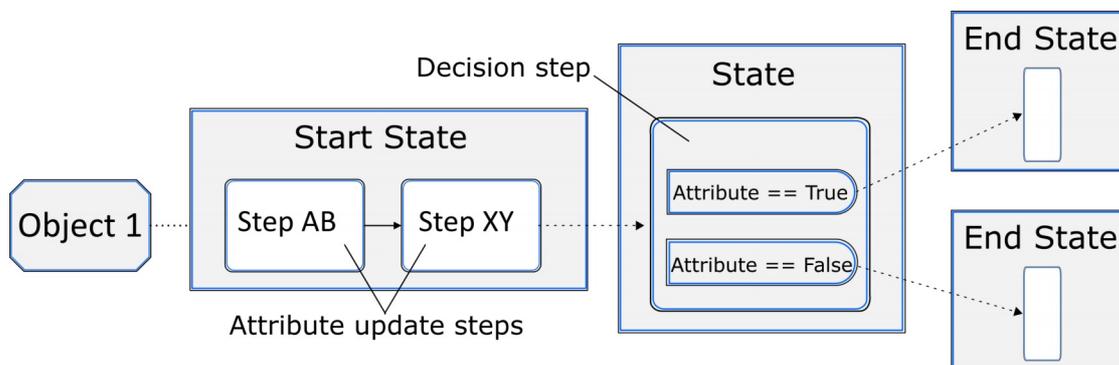


Figure 1: Structure of a simple lifecycle.

In turn, a relational process structure (RPS) (cf. Figure 2) represents the order and constraints for processing the object instances and their lifecycles, respectively, of the cardinalities between them [6]. Finally, coordination processes coordinate the execution business process (i.e., the sequence lifecycle states).

In [7], we have defined four research questions in the context of determining the progress of an object-centric business process. The aim of Research Questions 1 and 2 (RQ) was to determine the progress of a lifecycle in both a state-based view (i.e., by utilising the abstraction enabled by states) and in a step-based view, which refine the state-based view. These question were discussed in [4]. The Research Question 3 deals with determining the overall progress based on the results of Research Question 1 and 2.

- RQ 1** How can the progress of a single lifecycle process with its state-based view form be determined?
- RQ 2** How can the progress of the processing of a single state within a lifecycle process be measured?
- RQ 3** How can the progress of multiple, interacting (i.e., interrelated) lifecycles be determined?
- RQ 4** How does a coordination process affect the progress of an object-centric business process?

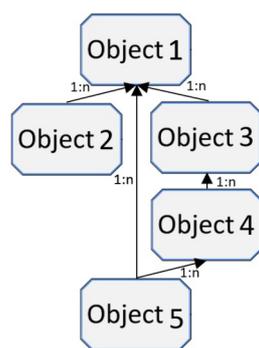


Figure 2
Simple RPS.

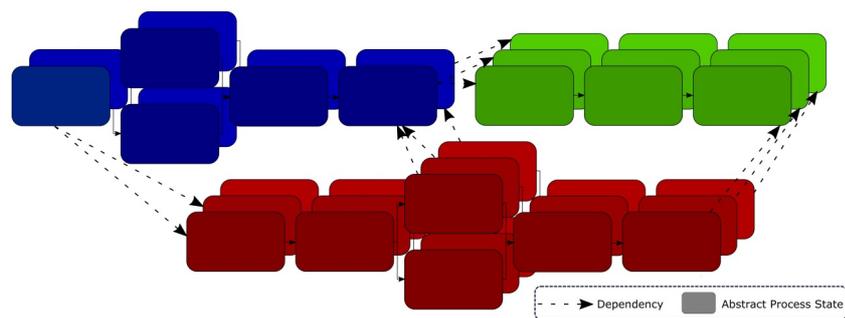


Figure 3
Simple big picture of running lifecycle instances.

Finally, Research Question 4 considered how coordination progress affects the progress determination of Research Question 3 [8].

3. Research Questions

Due to the high dynamics of relation process structures (e.g., due to varying numbers of interrelated object instances or dynamic changes) Research Question 3 is challenging to address. For example, each deletion and addition of an object instance affects the progress of the respective process structures, i.e., the overall business process. In a nutshell, to determine the progress of multiple, interacting lifecycles the following sub-research questions need to be answered:

- Sub-RQ 1** Does a generally suitable accepted understanding of progress exists?
- Sub-RQ 2** How can the progress of a single object type with multiple object instances be determined?
- Sub-RQ 3** Do characteristic patterns exist in an RPS and how can the progress of these patterns be determined individually?
- Sub-RQ 4** How can the overall progress of an RPS be determined based on the results of the previous research?

Sub-RQ 5 How should the progress of an RPS be visualised to users such that the needs of individual user groups are met?

Sub-RQ 1 is mandatory and therefore the most important one of the given questions. If there exist no generally suitable accepted understanding of progress, the following four sub-research questions can not be directly answered in a precise way. Therefore, we investigated Sub-RQ 1 in an empirical study with about 200 participants [9]. As key observation of this study, the majority of the participants gave very similar answers. For example, progress jumps within a displayed progress bar were rejected by most participants even though the overall progress of an RPS might decrease when dynamically adding object instances and their relations (i.e., constraints). From [9], it may be concluded that a general understanding of progress exists. As this central question has been answered positively, we can focus on the issues addressed by Sub-RQ 2 to Sub-RQ 5. **Sub-RQ 2** deals with the progress of a single object type, respectively, its instances and how this progress can be determined at run time taking dynamic changes into account as well. The latter include the unplanned creation of object instances as well as their deletion during run time. **Sub-RQ 3** investigates the presence of characteristic patterns in RPSs. Provided such patterns exist this sub-RQ focuses on the identification of all possible patterns and on the determination of the progress of these identified patterns individually. **Sub-RQ 4** investigates how the overall progress of the RPS can be determined based on the results from the previous sub-research questions. Finally, **Sub-RQ 5** investigates the different possibilities of visualising the progress of multiple, interacting object instances for individual user groups. In general, all approaches should be evaluated through empirical studies that focus on which is matching the human intuition of progress determination best.

4. Related Work

To the best of our knowledge there exist no works dealing with the progress of object-centric business process and its monitoring. In [10], an approach to measure the progress of activity-centric business process is presented. In [11], progress determination is based on data state transitions in activity-centric business process, improved by the use of object state transition [12]. Also, related to our work is predictive process monitoring, e.g. consider the detailed systematic literature review is presented in [13] to explore the current state of predictive process monitoring.

5. Conclusions

This paper discusses the challenges of determining the progress of RPSs, i.e., large, complex, and abstract process not being comprehensive to humans. To handle these challenges Research Question 3 "*How can the progress of multiple, interacting (i.e., interrelated) lifecycles be determined?*" (from [7]) needs to be refined. For this purpose, five sub-research questions were derived in this paper. By refining Research Question 3 we need to discuss this complex process structure in an early state.

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