Building Petri Nets from Empirical Data

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Abstract

Workflow management promises a new solution to an age-old problem: control-ling, monitoring, optimizing and supporting business processes. What is new about workflow management is the explicit representation of the business process logic which allows for computerized support. Workflow nets, a subclass of Petri Nets, are known as attractive models for analysing complex business processes. On the one hand, Petri nets can be used as a design language for the specification of complex workflows. On the other hand, Petri net theory provides for powerful analysis techniques which can be used to verify the correctness of workflow procedures. This article proposes a method whose main advantage consists in automatical discovering of workflow nets form process logs. The results indicate that this method is able to discover processes whose underlying models are acyclic and sound workflow nets, involving parallel, conditional and sequential constructs.

In former times, information systems were designed to support the execution of individual tasks. Todays information systems need to support the business processes at hand. It no longer suffices to focus on just the tasks. The information system also needs to control, monitor and support the logistical aspects of a business process. In other words, the information system also has to manage the flow of work through the organization. Many organizations with complex business processes have identified the need for concepts, techniques, and tools to support the management of workflows. Based on this need the term workflow management was born (cf. [1], [2]).

The main purpose of a workflow management system (WfMS) is the support of the definition, execution, registration and control of *processes*. In this article we propose a Petri Net approach for these problems[3]. There are several reasons for choosing Petri Nets for workflow modelling:

- *formal semantics*
  A workflow process specified in terms of a Petri net has a clear and precise definition, because the semantics of the classical Petri net and several enhancements (color, time, hierarchy) have been defined formally.

- *graphical nature*
  Petri nets are a graphical language. As a result, Petri nets are intuitive and easy to learn. The graphical nature also supports the communication with end-users.

- *expressiveness*
  Petri nets support all the primitives needed to model a workflow process. All the routing constructs present in todays workflow management systems can be modelled. Moreover, the fact that states are represented explicitly, allows for the modelling of milestones and implicit choices.

- *properties*
  In the last three decades many people have investigated the basic properties of Petri nets. The

firm mathematical foundation allows for the reasoning about these properties. As a result, there is a lot of common knowledge, in the form of books and articles, about this modelling technique.

- *analysis*
  Petri nets are marked by the availability of many analysis techniques. Clearly, this is a great asset in favor of the use of Petri nets for workflow modelling. These techniques can be used to prove properties (safety properties, invariance properties, deadlock, etc.) and to calculate performance measures (response times, waiting times, occupation rates, etc.). In this way it is possible to evaluate alternative workflows using standard Petri-net-based analysis tools.

- *vendor independent*
  Petri nets provide a tool-independent framework for modelling and analyzing processes. Petri nets are not based on a software package of a specific vendor and do not cease to exist if a new version is released or when one vendor takes over another vendor.

However the process of workflow design takes a long time and the resulting models are often incomplete and unrealistic. We think that Petri Nets could be a framework for automatization of the WfMS. In this paper we present a method for discovery of a business process, given a workflow log ("a history" which contains information about how events took place). For the events that cannot be automatically ordered, a preordering notion is introduced. This helps refining the coverage graph for most of the situations that can appear.

This far, the algorithm can deal with acyclic graphs only. We intend to extend our research for the cyclic case, because in most of the real situations we must face cyclic workflows. Also unbalanced graphs can raise problematic cases, so this direction must be investigated.

References

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