

Abstract

A workflow depicts how a set of tasks of any business process get executed within the associated business constraints, when it is triggered by a business event. A workflow generally cuts across various functional divisions of any organization (or a set of organizations) thus mapping all the tasks that are to be performed for achieving a given objective. Workflow Management Systems (WfMSs) deal with automating such workflows. A complete workflow process definition comprises task definitions, resource requirements, execution dependencies between tasks, temporal constraints in executing tasks, data flows across various tasks, and application mapping of tasks. Workflows can be represented in one of the many representations available, including UML diagrams, workflow graphs and Petri nets.

Workflow verification is an area of increasing concern in workflow management. It deals with verifying structural correctness of the workflows. Currently, workflow verification algorithms exist for Petri nets, workflow graphs, UML diagrams, and propositional logic representations. Of these, algorithms based on Petri nets and workflow graphs are popular. This dissertation discusses various existing algorithms for workflow verification and their limitations, and then proposes two algorithms for verifying workflow graphs, one for verifying acyclic workflow graphs, and the other one for verifying both acyclic and cyclic workflow graphs. Theoretical worst-case time complexity of the proposed algorithms are $O(E^2)$, where E is the number of the edges in the workflow graph. These algorithms are described through various illustrative business examples and toy problems.

Main contributions of this dissertation are, (a) Mahanti-Sinnakrishnan (MS) algorithm for verifying acyclic workflow graphs, (b) Mahanti-Sinnakrishnan Cyclic Workflow Verification (MSCWV) algorithm for verifying cyclic and acyclic workflow graphs, and (c) Workflow Hyperpath Generation (WHG) algorithm for generating workflow hyperpaths. A short summary of the work on these algorithms are given in the following paragraphs.

Structural conflicts that could be present in acyclic workflow graphs are deadlock and lack of synchronization. Mahanti-Sinnakrishnan algorithm for verifying acyclic workflow graphs is based on graph search techniques like AO* and Depth-First Search, thus making it simple and efficient. It could be

several advantages over the existing algorithms such as, (a) it is much simpler to comprehend visually, (b) it consumes much lesser time compared to the existing algorithm, (c) it is easier to detect any errors that could be committed during the implementation of this algorithm, (d) it is based on well known graph analysis techniques, and (e) it does not disturb the original workflow graph structure while doing the verification.

In any workflow corresponding to a business process, especially those involving hundreds of tasks, chances are there th

computing model for resource management, business activity monitoring (BAM), dynamic orchestration, and mission-critical service oriented systems.

Business processes undergo many changes due to change in regulations, business requirements, business rules, methods, technology, etc [1]. Dynamic workflows adapt to suit the business requirements from time to time using various methods, functionalities, and techniques. This dissertation presents a brief literature survey on dynamic workflows, and presents a simple application of Mahanti-Sinnakrishnan algorithm for dynamic workflows.

Keywords: Workflow Verification, Cyclic Workflow Graphs, Workflow Hyperpaths, Dynamic Workflows

References:

- [1] S. W. Sadiq, M. E. Orłowska, and W. Sadiq, "Specification and validation of process constraints for flexible workflows," *Information Systems*, vol. 30, pp. 349 - 378, 2005.