

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

Semantics Based Analysis and Synthesis of Web Services and Workflows

By

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Web service technologies provide a standard platform based on which heterogeneous software applications can be integrated over the Internet. Web service orchestration languages, such as BPEL4WS, are proposed to specify business processes as workflows whose composite tasks are web services. In many cases, it is critical to verify the correctness of a workflow before it is deployed, and it is also highly desirable that new workflows be automatically synthesized from available web services based on the business requirement.

An abstract process model is introduced to specify workflows as Web service compositions based on BPEL. The model restricts the data manipulation constructs in an abstract BPEL process. This restriction permits a full description of a protocol while hiding its computation details. A restricted abstract process can easily be converted into an abstract BPEL process or expanded into an executable process.

A logic model is presented to formally specify the semantics of web services and workflows as abstract processes. A set of inference rules are established to deduce the strongest postcondition and weakest precondition of an abstract process. We demonstrate that the rules can be used for automatic inference due to the restriction on data manipulation capabilities in an abstract process. Based on this model, an algorithm is developed to automatically annotate the semantics and verify the correctness of workflows.

An algorithm is developed to automatically synthesize a workflow given its required semantics and a task library of Web services as available components. The well-formedness of a task library is defined and the ranking assumption is introduced to simplify the synthesis procedure and guarantee its completeness. A prototype of the verification and synthesis system has been implemented and several business processes in the financial industry have been studied based on our approach. The model and the algorithm are then extended to allow business rules be specified and incorporated into the synthesis procedure.

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