Ontology-based Multi-Objective Evolutionary Algorithm for Deriving Software Services from Business Process Model

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ABSTRACT

Various approaches uses business process models as starting point to derive software services. The first and the important task for developing service-oriented models is service identification. However, the majority of existing methods for service identification are developed manually because, on the one hand, they are based on the competence of the developers and, on the other hand, the business process models do not comprise sufficient knowledge to identify services automatically. The integration of Business Process Modeling (BPM), Model-Driven Development (MDD), and Ontology-based Semantic Annotation (OSA) allows the automation of the SOA (Service-Oriented Architecture) services development. Three steps are used for developing an SOA solution: service identification, service specification and finally service realization. In this paper, the authors illustrate a method called MOOSI (Multi-Objective Optimization-based Service Identification) that automatically identifies the architecturally significant elements from an annotated business process model in order to specify service model artifacts. The main goal of this work is to support the automation of the development process of service-oriented enterprise information system. The implementation results of our proposed method are discussed. This result shows that MOOSI can achieve high performance in terms of execution time and important quality in terms of modularization quality of identified services compared with other solution.

Keywords: Business Process Modeling (BPM), Genetic Algorithms-Based Clustering, Model-Driven Development (MDD), Service Identification, Service-Oriented Architecture (SOA)

INTRODUCTION

The rapid change in business environment obliges companies to evolve their information systems and their applications in order to adopt themselves with this dynamic environment. Nowadays, the enterprises are organized in networks, in which various actors can be interacting (Touzi, 2007). The competitiveness of these companies is deeply related to the capacity to structure, share and exchange knowledge with the participants in the collaborative network. This need to exchange knowledge obliges the companies to evolve their information systems.
and their applications in order to return them interoperable (Baïna, 2006). The interoperability of enterprise applications allows ensuring the exchange of functionalities and services in a transparent way. Each functionality, service, or data have a specific model. Several transformations of these models are essential to ensure interoperability between the various heterogeneous entities of the enterprise. So that these model transformations become an effective solution for establishing interoperability in a purely heterogeneous environment, it is necessary that they must be guided by a standard modeling framework. The development of an enterprise application to large scale always starts with the highest-level abstraction where they are the specification and the representation of the business in the form of business process models. These models must be projected gradually on an adapted architecture to the need for interoperability. The Model-Driven Architecture (MDA) provides the bases to support the model-driven interoperability (Baïna et al., 2006).

Currently, the more adapted paradigm to the realization of the interoperable applications is the service-oriented paradigm. Since the services encapsulate the functionalities of the applications according to enterprise business processes, the comprehension of the business process model is a precondition necessary to the automatic derivation of Service-Oriented Architecture (SOA) (Papazoglou et al., 2006). SOA is a flexible set of design principles used to quickly build applications by the assembling of a set of software services. The result of this assembly is called “composite application.” The effective achievement of this approach allows facilitating integration and interoperability of enterprise information systems that are heterogeneous and was not conceived to be interoperable. Therefore, the service-oriented approach proposes a framework to solve these problems by the development of interoperable applications starting from a high-level business process.

This article presents a systematic process for deriving service-oriented architectures from annotated business process model. This process generates candidate software services using multi-objective evolutionary algorithm that analyses dependencies between business activities in order to group them into distinct clusters. Each cluster must groups one or more closely related activities to form a future software service.

The remainder of this paper is organized as follows. In the next section, we presented an overview of the model-driven service identification process. In the section following, we illustrate our approach (MOOSI). In the section after that, we presented our prototype. The next section reviews related work in the area of service identification. Finally, we summarize our research and provide future work directions in the last section.

MODEL-DRIVEN SERVICE IDENTIFICATION PROCESS

The main idea of Service-Oriented Architecture is the restructuring of enterprise information systems into loosely coupled, independent services. These services should allow the reuse of existing implemented functionality in order to minimize the time between design and implementation when business requirements change. The key challenges in developing the service-oriented systems are the mapping of business processes models into service models. Service models play an important role during service-oriented analysis and design phases.

According to Arsanjani (2004), service-oriented modeling lifecycle has three main phases:

- **Service Identification.** This phase is about identifying the architecturally significant elements of the target solution. The output artifact of this phase is analysis-level service model.
- **Service Specification.** This phase is about describing a service: what it offers, what it requests and how it is exposed. It also describes dependencies with other services, service composition, and service messages.
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