

Services Derivation from Business Process: A PSO-based Multi-Objective Approach

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ABSTRACT

Several approaches for services development in SOA (Service Oriented Architecture) suggest business processes as a starting point. However, there is a lack of systematic methods for services identification during business analysis. It is recognized that in service engineering, service identification plays a critical role as it lays the foundation for the later phases. Existing Service identification approaches are often prescriptive and mostly ignore automation principles, most are based on the architect's knowledge thus could result in non-optimal designs which results in complicated dependencies between services. In this paper the authors propose a top down approach to identify automatically services from business process by using several design metrics. This approach produces services from business processes as input and using an improved combinatorial particle swarm optimization algorithm with crossover of genetic algorithm. The experimentation denotes that the authors' approach achieves better results in terms of performance and convergence speed.

KEYWORDS

Business Process Modeling, Combinatorial Particle Swarm Optimization, Genetic Algorithm, Service Identification, Service Oriented Architecture

1. INTRODUCTION

Service-oriented systems are emerging as the key driver to make an enterprise wide system adaptable. Despite its popularity in practice and various services oriented frameworks and methodologies proposed by researchers, currently there is no standard process for SOA analysis and design.

In service-oriented architecture, the first phase of the SOA lifecycle is the identification of services. This phase not only determines the services that should be implemented, but also defines the logic that must encapsulate each service. Service is the basic unit in Service Oriented Computing. In methodologies design, service identification usually plays a critical role. The lifecycle of SOA delivery projects is simply composed of a series of steps that need to be completed to construct the services for a given service-oriented solution, one of the most important steps is to identify services (Thomas, 2005).

Existing identification methods can be classified into three categories based on the automation point of view: prescriptive, semi-automated, and fully-automated. Because SOA is generally used to develop large-scale software systems, using prescriptive methods may lead to lower quality of identified architectural elements. The need for an automated approach to identify services is recognized to make the service identification step more reliable.

Service identification can be presented as a multi-objective optimization problem. On the one hand, these methods have to make a compromise between different principles of SOA. On the other hand, the corresponding technical measures are not quantifiable, where the validity of decisions depends on the assessment of the architect.

In this paper, a new identification approach is proposed, which aims to resolve the above problems by supporting automation capabilities, by adopting technical metrics, and using business process as input. This method generates candidate software services using hybrid multi-objective combinatorial particle swarm optimization algorithm and genetic algorithm in order to group them into distinct services represented as clusters by analyzing dependencies between business activities and business entities.

The remaining part of the paper is organized as follows: in section 2, the most relevant work is briefly reviewed. Section 3 introduces particle swarm optimization. In section 4 we present a proposed service identification approach that uses Combinatorial Particle Swarm Optimization and GA. Section 5 provides an implementation and experiment results to demonstrate the performance of our approach. Finally, section 6 concludes the paper and outlines directions for future work.

2. RELATED WORK

The literature provides a lot of work in service identification approaches, ranging from top-down to bottom-up. In this section, we briefly review the most relevant work in service identification.

(Kazemi et al., 2011) have presented an automated method for identifying business services by adopting design metrics based on top-down decomposition of processes. This method takes a set of enterprise business processes as input and produces a set of non-dominated solutions representing appropriate business services using a multi-objective genetic algorithm.

(Azevedo et al., 2009) proposed a top-down approach for services identification from business process models, applying heuristics to define services from the semantic analysis of process elements such as business rules and business requirements, and from a syntactic analysis of process models according to its corresponding structural patterns.

(Kang et al., 2008) presented a method of service identification using ontology for product line. Primary, a Semantic relationship is derived through the mapping between feature modeling and ontology. Second, both service and service boundary are defined by semantic distance. Third, the method is proposed for feature grouping and candidate service refining service candidate which is the fittest service granularity.

(Suntae et al., 2010) introduced a service identification method based on scenario modeling and a conceptual framework to elicit possible business changes. Traceability among business requirements, business changes and the identified services are also supported by their method.

(Rana et al., 2009) have introduced a generic ontology-based framework, BPAOnto-SOA, for the derivation of software service oriented models from a given business process architecture relying on two ontologies. This framework utilizes an adapted clustering algorithm based on affinity analysis of business process functions in order to group them into services along with their associated NFRs to ensure conformance of these services with SOA principles.

(Inaganti et al., 2007) mentions some of the best practices, wherever appropriate, to point out the vagueness involved in service identification. A top-down and bottom-up technique for service identification is proposed in this methodology.

(Jamshidi et al., 2012) present a novel approach called ASIM for automatically identifying and partly specifying enterprise-level software services from business models using best the practices and principles of model-driven software development. They formulated service identification as a multi-objective optimization problem and solved it by a novel meta-heuristic optimization algorithm that derives appropriate service abstractions by using appropriate quantitative measures for granularity, coupling, cohesion, reusability, and maintainability.

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