Testing in Service Oriented Architectures with dynamic binding: A mapping study

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1 Summary

This article aims at identifying the state of the art in the research on testing Service Oriented Architectures (SOA) with dynamic binding. Testing SOA presents new challenges to researchers because some traditional testing techniques need to be suitably adapted due to the unique features of this new paradigm, for example, the dynamic behavior that allows discovering, selecting and binding a service at runtime. Testing this dynamic binding is one of the most challenging tasks in SOA because the final bound services cannot be known until the moment of the invocations. Hence, there have been a number of recent studies that aim at improving the quality of the dynamic binding using testing approaches.

The objective of this review is to search, analyze and synthesize the different approaches that have been previously proposed. Thus, following the guidelines proposed by Prof. Barbara Kitchenham we have performed a mapping study, which is a particular form of systematic literature review (SLR) that contributes to identify and categorise the available research on a specific topic.

The mapping study has been carried out following a protocol we have developed to guide the search, selection and synthesis of the studies. This protocol includes a set of research questions and a three-phased strategy that allows searching in a broad number of journals and conferences/workshops proceedings. With the aim of selecting the most relevant studies, we have devised study selection criteria that allow deciding whether a study is finally included or excluded in the set of primary studies. Before applying these criteria, we found 392 papers. Removing the duplicates and excluding such papers that do not pass the different criteria, a set of 33 primary studies were finally selected.

As a result of this review, the objectives of the different approaches are grouped into two categories: studies that aim to detect faults in the service oriented application (19 studies) or studies that make a decision about the service to be invoked based on the test results (14 studies). The proposed testing approaches focus more on non-functional characteristics rather than on functional.

Regarding the applied testing techniques, the results of this review show that, currently, two thirds of the studies apply monitoring approaches to improve the dynamic binding. These approaches check properties of the executing system in order to perform an adaptive action (for example, rebind to another service) when a

A. Ruíz, L. Iribarne (Eds.): JISBD'2012, pp. 383-384, ISBN:978-84-15487-28-9.
Jornadas SISTEDES'2012, Almería 17-19 sept. 2012, Universidad de Almería.

deviation from the expected behaviour is detected. In addition, a third of studies generates and executes test cases with the aim of detecting problems or gathering data to make a decision about the binding.

Although there are different stakeholders that participate in the testing process (provider, registry, client and even a third party), it is the client who plays the most active role with 24 of the 33 studies proposing that the client takes part in the tests. The registry and a broker also represent stakeholders that are often proposed to take part in the tests. However, only four studies suggested that the service providers should participate in the dynamic binding testing process.

During the review we have identified four points in time when the execution of tests may improve the dynamic binding of the services. Service execution is the most frequently recommended point in time to perform tests using monitoring techniques. The points in time before the publication of the services in a registry, during the time they are published and just before their binding are also considered as suitable times to test services.

Regarding the technologies that are used in the primary studies, the description of the atomic services and service compositions that represent the system under test is almost always specified using WSDL for the former and BPEL for the latter, although there are a reduced number of examples that use semantic technologies such as OWL-S or SAWSDL. In such studies where a registry is in charge of storing the services, the UDDI standard is the only mentioned specification. However, in the context of testing SOA with dynamic binding, there is no standard language for representing the terms agreed in an SLA.

The validation methods used in the primary studies have several limitations. Firstly, almost a third of these studies do not present any type of validation of the proposed approach. In addition, the most frequently used validation method is evaluation, with very few studies performing a rigorous analysis of their results and only two studies applying the approach to a real scenario. Most of the examples used in the studies were designed ad hoc and in only one case the example has been extracted from a standard specification.

Reference

1. Palacios, M., García-Fanjul, J., Tuya, J. Testing in Service Oriented Architectures with dynamic binding; a mapping study. Information and Software Technology, 53 (3), 171-189 (2011) http://dx.doi.org/10.1016/j.infsof.2010.11.014

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* This work was partially funded by the Department of Science and Innovation (Spain) and ERDF funds within the National Program for Research, Development and Innovation, Projects Test4SOA (TIN2007-67843-C06-01) and Test4DBS (TIN2010-20057 -C03-01) and FICYT (Government of the Principality of Asturias) Grant BP09-075.

Automated Metamorphic Testing on the Analysis of Feature Models *

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1 Summary

Software Product Line (SPL) engineering is a reuse strategy to develop families of related systems. From common assets, different software products are assembled reducing production costs and time–to–market. Products in SPLs are defined in terms of features. A *feature* is an increment in product functionality. *Feature models* are widely used to represent all the valid combinations of features (i.e. products) of an SPL in a single model in terms of features and relations among them. The automated analysis of feature models deals with the computer–aided extraction of information from feature models. Typical operations of analysis allow determining whether a feature model is void (i.e. it represents no products), whether it contains errors (e.g. features that cannot be part of any product) or what is the number of products of the SPL represented by the model. Catalogues with up to 30 analysis operations on feature models and multiple analysis solutions have been reported.

Feature model analysis tools deal with complex data structures and algorithms. This makes the implementation of analyses far from trivial and easily leads to errors increasing development time and reducing reliability of analysis solutions. Gaining confidence in the absence of faults in these tools is especially relevant since the information extracted from feature models is used all along the SPL development process to support both marketing and technical decisions. Thus, the lack of specific testing mechanisms in this context appears as a major obstacle for engineers when trying to assess the functionality and quality of their programs.

In [1], we gave a first step to address the problem of functional testing on the analyses of feature models. In particular, we presented a set of manually designed test cases, the so-called FaMa Test Suite (FaMa TeS), to validate the implementation of the analyses on feature models. Although effective, we found several limitations in our manual approach that motivated this work. First, evaluation results with artificial and real faults showed room for improvement in terms of efficacy. Second, the manual design of new test cases relied on the ability of

* This work has been partially supported by the European Commission (FEDER) and Spanish Government under CICYT project SETI (TIN2009-07366), and by the Andalusian Government under ISABEL(TIC-2533) and THEOS (TIC-5906) projects.

A. Ruíz, L. Iribarne (Eds.): JISBD'2012, pp. 385-386, ISBN:978-84-15487-28-9.
Jornadas SISTEDES'2012, Almería 17-19 sept. 2012, Universidad de Almería.