Chapter 17
Approaches to Functional, Structural and Security
SOA Testing

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ABSTRACT

In this chapter, we provide an overview of recently proposed approaches and tools for functional and structural testing of SOA services. Typically, these two classes of approaches have been considered separately. However, since they focus on different perspectives, they are generally non-conflicting and could be used in a complementary way. Accordingly, we make an attempt at such a combination, briefly showing the approach and some preliminary results of the experimentation. The combined approach provides encouraging results from the point of view of the achievements and the degree of automation obtained. A very important concern in designing and developing web services is security. In the chapter we also discuss the security testing challenges and the currently proposed solutions.

INTRODUCTION

Traditional testing approaches are divided into two major classes: functional and structural. Functional approaches provide the ability to verify the proper behaviour of services in order to assess and validate their functionality. They treat the applications under test as black boxes, focusing on the externally visible behaviour but ignoring the internal structure. Structural approaches, also known as white-box testing, on the other hand, are a well-known valuable complement to func-
ational ones. Coverage information can provide an indication of the thoroughness of the executed test cases, and can help identify additional test cases to functional ones which exercise unexecuted paths and hence might help detect further faults.

The same division is still valid considering SOA: functional approaches are applied in SOA testing either to show the conformance to a user-provided specification, or according to their fault detection ability, assessed on fault models. In this chapter, we overview some of the existing proposals that derive functional test cases using formal specification, contracts or WSDL language.

Concerning structural testing of SOA, two different points of view can be identified: coverage measured at the level of a service composition (orchestration or choreography) and coverage of a single service. Generally, validation of service orchestrations is based on the Business Process Execution Language description considered as an extended control flow diagram. Classical techniques of structural coverage (e.g., control flow or dataflow) can be used to guide test generation or to assess test coverage so as to take into consideration the peculiarities of the Business Process Execution Language. Other proposals are instead based on formal specification of the workflows, e.g., Petri Nets and Finite State Processes used for verifying specific service properties.

Considering a service choreography, existing research focuses, among others, on service modeling, process flow modeling, violation detection of properties such as atomicity and resource constraints, and XML-based test derivation.

If, on the one side, there are several approaches for structural testing of service compositions, there are few proposals for deriving structural coverage measures of the invoked services. The reason for this is that independent web services usually provide just an interface, enough to invoke them and develop some general (black-box) tests, but insufficient for a tester to develop an adequate understanding of the integration quality between the application and independent web services. We describe an approach that addresses this deficit by “whitening” services testing through the addition of an intermediate coverage service.

In this chapter, we first provide a survey of some proposed approaches and tools for supporting SOA functional and structural testing. Then, we propose an example of application of a selected black-box approach and a selected white-box approach to a case study for comparative purposes.

In SOA services, another important aspect that must be carefully checked is security, since functional and structural testing, albeit successfully executed, do not prevent security weaknesses. Different testing strategies, usually divided into passive and active mechanisms, can be used to provide evidence in security-related issues, i.e., that an application meets its requirements in presence of hostile and malicious inputs. We will survey the most commonly-adopted methodologies and techniques such as fuzz testing, injection, and web services security extensions.

An important facet of security information management in web applications is the control of accesses. We will hence include testing methodologies exploiting the specification of access control policies by means of policy languages, such as the eXtensible Access Control Markup Language (XACML) or the Role-Based Access Control (RBAC). We will overview current proposals for access control policy testing dealing with the classification of the possible policy faults and the development of the corresponding fault model, the application of standard or ad hoc conceived test coverage criteria to measure the adequacy of a test suite, and the automated generation of test cases using (for example), change-impact analysis, random heuristics or model-based approaches.

**Functional Testing**

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