Web Service Composition

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Springer

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ISBN 978-3-319-32831-7 ISBN 978-3-319-32833-1 (eBook)
DOI 10.1007/978-3-319-32833-1

Library of Congress Control Number: 2016938638

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Printed on acid-free paper

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“If I had eight hours to chop down a tree, I’d spend six hours sharpening my axe”

– Abraham Lincoln

Ein Spaziergänger geht durch einen Wald und begegnet einem Waldarbeiter, der hastig und mühselig damit beschäftigt ist, einen bereits gefällten Baumstamm in kleinere Teile zu zerssgen.

Der Spaziergänger tritt näher heran, um zu sehen, warum der Holzfäller sich so abmüht, und sagt dann: “Entschuldigen Sie, aber mir ist da etwas aufgefallen: Ihre Säge ist ja total stumpf! Wollen Sie sie nicht einmal schärfen?”

Darauf stöhnt der Waldarbeiter erschöpft auf: “Dafür habe ich keine Zeit - ich muß sägen!”

A stroller walks through a forest and meets a woodsman who is hasty and laboriously busy sawing a felled tree trunk into smaller parts.

The stroller comes closer to see why the lumberjack toils so, and then says: “Excuse me, but it occurs to me that your saw’s totally blunt. Won’t you sharpen it at least once?”

Then the forest worker groans, exhausted: "I don't have time - I must cut!"

– Various, including Prof. Lothar J. Seiwert ([01], Seite 37), Mary Walton: The Deming Management Method; (Management Books 2000 Ltd)

This book is dedicated to all of those who have been developing better sharpening tools and methods in hopes that those who are doing the actual cutting will one day use them.

Preface

Web service composition has inspired many academic conferences, workshops, and journal papers. Web service technology was initiated by and continues to be a popular technology for industry, usually under the rubric of "service-oriented architecture," which includes web service technology.

However, when one reads the many papers, one may be confused. I was. It turns out that different researchers have been attending the same meetings and using the same words, but with somewhat different semantics. There is indeed a common underlying semantics, but this was rarely explained, and so the various different approaches were rarely explicitly mentioned or, perhaps, understood. This book attempts to help researchers understand the fundamentals of web service composition in order to understand what the various approaches have in common and how they differ.

Moreover, this book attempts to do so for an undergraduate audience, though one with a basic grounding in mathematics and computer science. This book is developed from a series of lectures in the service-oriented computing course at the Karlsruhe Institute of Technology in 2012. The lectures have proven over time to be effective and are still used there.

We start with extensive definitions. It is not possible to do science without definitions. One can certainly convey how to use technologies without clear definitions, but science requires the potential for re-creation of results as well as understanding of principles. Neither is possible without agreement upon what terms of discourse mean. Lack of such definitions is responsible for many misunderstandings, including the lack of explicit recognition of the different approaches to web service composition. We begin with very basic concepts here.

This book starts from fundamental considerations of what a "service" is and builds up through the various computer-based technologies called "web services," including REST and WSDL, and examines why they would be useful. A major potential use of web services is their combination in order to achieve one or more goals. This book explains the potential for such composition and the basic problems to be solved with examples. Along the way, we show why semantics are necessary and the potential for applying semantic technologies.

The AI planning approach is discussed in detail, but other methods including model checking and Golog are described, while showing how all address the fundamental composition issues. We describe how web service composition could not only be used to solve problems unsuitable for workflows but also could replace workflows for many purposes.

The fundamental issues of composition are described, both informally and with predicate logic. We show how the fundamental approaches to composition, with quite different algorithms, solve the same basic composition problems. We finally show how such web service composition can solve problems unsuitable for ordinary workflow technologies and how workflows can be generated dynamically.

This book also describes why and how web services have failed to be used in industry. Part of the reason is failure of the industrial IT community to understand the potential for web services beyond being a set of standardized technologies for building APIs. Some large part of the problem is also that the initial technologies for building actual web services were not quite ready when they were deployed, as was seen in the Semantic Web Services Challenge [1].

Additionally, using web services per se, versus just their building technologies, requires doing extra work to identify and make explicit conditions of use, along with the common semantics that would allow services to interoperate in a real service-oriented architecture. This work has simply not been done in the usual rush to deploy systems.

But it is important. When distributed systems were first deployed, no one wanted to do the work of formally checking them. After decades of experience, industry now understands the importance of this, and commercial cloud systems are now mathematically proven correct because industry recognizes that this upfront work pays back by catching errors that would have proven costly to diagnose and repair later.

As businesses become more connected, they become effective networks of services. Eventually, business will understand that well defining these services and composing them with provably correct algorithms will be the only method that makes economic sense.

We have much to learn because these are not just distributed systems, but cooperative systems, in which services are rendered automatically and for the purposes of various owners and clients. Ensuring that these purposes are at least minimally fulfilled, especially in the face of inevitable contingencies, is not something we yet fully understand how to do.

Web service composition is a foundation technology of a large challenge we have called *Coordination Engineering* [2]. As we progress in this direction in the current century, understanding the principles of web service composition, or a very similar technology, will be increasingly important, and this book may help.

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February 2016

Acknowledgments

I am grateful to Prof. Rudi Studer for his invitation to be a guest professor at KIT in 2012 and to the following colleagues at KIT who helped tremendously with both the lecture and book preparation:

- Dr. Steffen.Stadtmueller
- Dr. Andreas Harth
- Dr. Martin Junghans

The graphics for the REST technology were all produced by Dr. Stadtmueller, and he and Dr. Harth have been very helpful in explaining this technology to me.

Dr. Marco Pistore was also very helpful in explaining the model-based planning approach and any mistake or lack of clarity here is my own. I am very thankful for his help.

I am also grateful to Prof. Michael R. Genesereth for my years in his Stanford Logic Group: his guidance, example, and granting of time to work on web services contributed positively to this book. The remaining errors are my own.

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