Preface

The ubiquity of the Web is enabling innovations that were thought to be beyond reach just two decades ago. The Web has now in effect become the dominant medium for all human and economic activities. The advent of Web services almost a decade ago has accelerated this trend and included such activities as e-government, e-commerce, and e-science applications. The ultimate goal of this enabling technology is the use of Web services as independent components that are automatically (i.e., without human intervention) formed and that could dissolve or persist post demand-completion.

The fast increasing number of Web services is transforming the Web from a data-oriented repository to a service-oriented repository. Web services are anticipated to form the underlying technology that will realize the envisioned "sea of services". Web services have originally been driven by standardization bodies, thus eliciting a wide acceptance in businesses and governments. The Service-Oriented Architecture (SOA) was conceived as the IT industry response to leveraging the Web as the center of all activities. This was achieved by adapting and evolving such technologies as CORBA to be Web congruous. As aforementioned, the development of Web services has so far mostly been the result of standardization bodies usually operating on a consensus basis and driven by market considerations. In this context, innovation and long-term market effects have not been the primary concerns. The standardization process has so far been very fragmented, leading to competing and potentially incompatible Web service infrastructures that lack a sound foundational framework. To maximize the benefits of this new technology, there is a need to provide a rigorous methodology for specifying, selecting, trusting, optimizing, composing, and mining Web services.

In this book, we focus on service mining. We describe a novel foundational framework that lays out a theoretical underpinning for the emerging field of service mining. We describe a disciplined and systematic framework for the efficient mining of Web services functionalities using non-functional properties, called Quality of Web Service (QoWS) parameters. The key components of this approach revolve around a novel service model that provides a formal abstraction of Web service modeling and organization. We draw inspiration from chemical processes for ser-

vice organization methodologies, and drug discovery for service mining techniques. We use this inspiration as the target application as a proof-of-concept of the proposed framework and algorithms.

We distinguish between Web service composition and Web service mining in terms of the stated *a priori* goals or lack thereof, respectively. For instance, service composition has traditionally taken a top-down approach. The top-down approach requires a user to provide a goal containing specific search criteria defining the exact service functionality the user expects. Often, the more specific the query and search criteria are, the smaller the search space and more relevant the composition results will be. The specificity of the search criteria would reflect the interest and often knowledge of the service composer about the potential composability of existing Web services. Since the composer is typically only aware of and consequently interested in some specific types of compositions, the scope of such a search is usually very narrow. The top-down approach thus works well only if the service composer clearly knows what to look for and the component Web services needed to compose such services are available. Another view, as taken by service mining, approaches service composition from the bottom-up. It aims at exploring the full potential of the service space without any *a priori* knowledge of what exactly is in it. Instead of starting the search with a specific goal, a service engineer may be interested in discovering interesting and useful service compositions as a result of the search process. For performance reasons, a general goal may be provided at the beginning to scope down the initial search space to a reasonable size. The interesting outcome of service mining is the ability to find useful and unexpected compositions. Thus, unlike the search process in the top-down approach that is strictly driven by the search criteria, the search process in the bottom-up approach is *serendipitous* in nature leading potentially to great innovations.

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