

A Probabilistic Approach to Service Selection with Conditional Contracts and Usage Patterns

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1 Abstract

A Service Oriented Architecture (SOA) lays the ground for loose coupling of interoperable services. In a SOA, there are service providers, that offer services under certain conditions, and service users, that need services that fulfill certain criteria. Service contracts provide the necessary basis for the interaction between the two of them, by describing the functional and non-functional properties (NFPs) of a service. Service selection deals with finding the service that best matches the user's criteria and, as such, is a central challenge in the context of any SOA. The selection process is twofold: First, consider only the services matching the functional criteria. Then, to find the best one, rank those services according to how good they fulfill the non-functional criteria.

While functional matching is a necessary part of any service selection, it has already been intensively studied. Matching based on NFPs, on the other hand, has been drawing more and more attention, but it is far from being as well-understood. We think that one aspect in particular has not yet received the attention it deserves: The variability of NFPs. We consider the variability of both the NFPs' values and their descriptions, which are found in contracts. The values of a lot of NFPs exhibit an inherent variability. For instance, response time is not a constant value at all, yet in typical contracts, NFPs are represented by their maximum value only, whereas probability distributions would be much more accurate. The distributions of two services regarding response time can be quite different, though they share the same maximum value. This means that different users might prefer one over the other, which we think should be reflected in the selection. We therefore propose using probability distributions throughout the whole selection process.

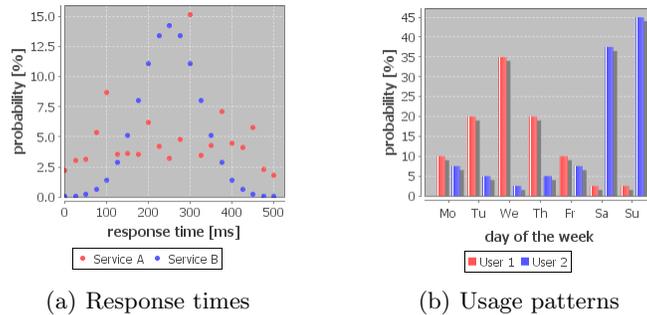


Fig. 1. Probability distributions

The description itself also often exhibits variability. Commonly, in a contract, there is only one description for each NFP, specifying its value(s). A provider can, of course, offer multiple contracts, but, since customization inside a contract is not possible, cannot really tailor a single contract for a specific kind of user. For example, if we take a look at mobile phone providers: They succeeded in catering to specific kinds of users, because what is charged per minute depends on several conditions, enabling each user to find a contract that best matches his needs. We think that, in a SOA, this possibility for providers to differentiate themselves is becoming increasingly important, as more and more functionally equivalent services are made available. We therefore introduce the concept of conditional contracts. Providers can specify several descriptions of each NFP in a contract, and conditions according to which one of them will be chosen. Additionally, because it is important to provide users with an easy way to find the service that best matches their needs, the selection process should be adapted accordingly. The key to do so is to take usage patterns into account. For instance, consider a contract for a service s that, compared to the average, is very expensive during the week, yet very cheap during the weekend: Given two users u_1 and u_2 and their corresponding usage patterns from Fig. 1(b), it is clear that u_2 should use s , whereas an average service would be a better choice for u_1 .

In a nutshell, we propose a probabilistic approach to leverage the variability of NFPs: we use conditional contracts and usage patterns, while treating NFPs as probability distributions throughout the whole selection process. This gives providers an opportunity to differentiate themselves and users a very easy way to find the best match. Our evaluation will show that not only does our approach make novel kinds of contracts possible, it also allows for better selection in existing scenarios.