Modeling, verifying and reasoning about web services (Extended Abstract) ⋆

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This paper describes the research activities carried out in the context of the Italian MIUR Project PRIN 2005 "Specification and verification of agent interaction protocols", concerning the area of modeling, verification and reasoning about web services.

Web services are an emergent paradigm for implementing business collaborations over the web. Each service has an interface that is accessible through standard protocols and that describes the interaction capabilities of the service. It is possible to develop new applications by combining and integrating existing web services. In this scenario, various languages have been developed for modeling processes and their interaction protocols. In particular, the language WS-BPEL has emerged as the standard for specifying the business processes of single services, while the global view of the interaction is captured by the concept of choreography, expressed by using specific languages like WS-CDL. Nowadays, in many application domains it is getting more and more common describing and realizing the offered services by means of a set of communicating *agents*. Techniques for the specification and verification of the interactive behavior of open agent systems find an immediate application in web services.

The goal of our project is to prove the usefulness and the applicability of techniques based on declarative approaches for tackling issues typical of the web service application area. Our claim is that web service interactions should be represented according to some formalism which relies on well-founded models with a clear semantics. Furthermore, automated tools for reasoning about such a description and performing tasks of interest must be developed.

The goal of the project is pursued through three main steps:

- Definition of suitable formalisms for the specification and verification of interaction protocols/choreographies;
- Development of techniques for automatic property verification and reasoning about web services;
- Translation of modeling languages into the formal languages developed in the project.

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In particular, we are considering the following issues:

Specification and verification of interaction protocols. We are defining and comparing different formalisms. The first approach is based on *abductive logic programming*, and exploits the *S*CIFF framework, developed in the European project SOCS. Within the *S*CIFF framework, a language suitable for specifying global protocols has been provided, and an abductive proof procedure has been developed [2].

A different approach makes use of a formalism for *reasoning about actions*. Web services can be described by specifying their interaction protocols in an action theory based on a temporal logic. The proposed framework provides a simple formalization of the communicative actions in terms of their effects and preconditions, and the specification of an interaction protocol by means of temporal constraints [5].

Conformance verification. We are studying the issue of verifying whether the business process of some peers will produce interactions which are conformant to the agreed protocol (legality issue). Such issue is tackled by the so called *conformance test*, considered as a means for certifying the capability of interacting of the involved parts [4].

Reasoning about web service behavior. Formalisms for reasoning about actions are suitable for dealing with web service composition and selection. In particular, we have applied planning techniques to the problem of composing web services, and to the problem of *personalizing* web service selection and composition w.r.t. user preferences [3].

We have also tackled the problem of dynamically understanding if two web services can inter-operate, without having a-priori knowledge of each one capabilities, but reasoning on policies exchanged at run-time [1].

Implementation of Prolog-based agents. Another direction of research is aimed at factoring the three technologies of web services, intelligent agents, and Prolog, for implementing Prolog-based agents that reason about interaction protocols specified using WS-BPEL and WSDL [6].

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