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WSC-08: Continuing the Web Services Challenge

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Abstract

The capabilities of organizations can be openly exposed, easily searched and discovered, and made readily-accessible to humans and particularly to machines, using service-oriented computing approaches. Artificial intelligence and software engineering researchers alike are tantalized by the promise of ubiquitously discovering and incorporating services into their own business processes (i.e. composition and orchestration). With growing acceptance of service-oriented computing, an emerging area of research is the investigation of technologies that will enable the discovery and composition of web services. The Web Services Challenge (WSC) is a forum where academic and industry researchers can share experiences of developing tools that automate the integration of Web services. In the fourth year (i.e. WSC-08) of the Web Services Challenge, software platforms will address several new composition challenges. Requests and results will be transmitted within SOAP messages. In addition, semantics will be represented as ontologies written in OWL, services will be represented in WSDL, and service orchestrations will be represented in WS-BPEL.

1. Introduction

Succeeding the EEE-05 [3] [9], WSC-06 and WSC-07 Challenges [2] [8], the 2008 Web Services Challenge (WSC-08) [8] is the fourth year of this SOA venue [1] that looks to benchmark software applications that automatically manage web services. WSC-08, held at the *IEEE Joint Conference on Electronic Commerce Technology (CEC 2008) and Enterprise Computing, E-Commerce, and E-Services (EEE 2008)* continues to provide a forum where researchers can collaborate on approaches, methods and algorithms in the domain of web service discovery and automated composition. This forum provides quantitative and qualitative evaluation results on the performance of participating matchmaking and automated composition software and facilitates the dissemination of results that advance this field.

This fourth year extends the original criteria of the first two competitions which focused on service discovery and service composition based on the syntactic matching of WSDL part names. WSC-08 is a continuation of the evolution of the challenge considering the adoption of ontologies written in OWL to provide semantics. It has been the tradition of the WSC events to adhere to technology-independent approaches to semantics. In this way, the competition attempts to circumvent debates on representations, such as differences between approaches such as OWL-S [5] [4] and WSDL-S [10]. In 2006, the use of pure XML-based semantics allowed for a *bi-partisan* approach. In 2007, we have evolved the challenge by mirroring the XML-based semantics with equivalent representations using an OWL ontology. During the previous three years, web service challenge focused on optimizing the discovery and composition process solely using abstractions from real-world situations. The taxonomies of semantic concepts as well as the involved data formats were purely artificial. In 2008, we have further evolved the challenge by using data formats and contest data based on OWL, WSDL, and WSBPEL schemas for ontologies, services, and service orchestrations.

In the earlier competitions, web service composition applications (i.e. participant entries) were constructed as stand-alone applications. In 2007, participating software had to be implemented *as* web services. As such, requests and results of composition routines are transmitted as SOAP messages to and from the participating software applications. This natural progression in the WSCs allowed the competition itself to take place within a SOA environment. In 2008 also, the participating software will have to be implemented as web services.

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Although in 2005, composition problems included the requirement to handle concurrent threads for composition routines, in 2006, the problem sets did not contain multiple branches. In WSC-07, concurrency was re-introduced into the composition problem sets. The combination of complex, workflow-based heuristics with semantically-rich representations required participants to create new software that is both robust and efficient. The problem sets in WSC-08 will also have concurrency in them.

2. Related Challenges/Competitions

Although WSC is perhaps the first competition, other unique venues have been established to investigate the need for solutions to the service composition problem. The Semantic Web Services (SWS) Challenge [6] is less of a competition and more of a challenge. Both business cases and solution applications are the focus of SWS. Participants are placed in a forum where they can incrementally and collaboratively learn from each other. While WSC is more driven by application, SWS concentrates more on the environment. As such, the SWS places more focus on semantics where the WSC favors applied, short-term solutions with semantic and syntactical approaches.

Alternatively, the SOA Contest [7] held at the International Conference on Services Computing (SCC2006, SCC2007, and SCC2008) allows participants to openly choose the problems that best demonstrate their approach. The benefit of SOA contest is that participants can show the best approach for a particular domain-specific problem. In contrast, WSC attempts to set a common problem where approaches can be evaluated side-by-side.

There is a unique niche for each forum and the *composition* of the results from all the venues will undoubtedly advance the state-of-the-art in service-oriented computing.

3. The Challenge

In the competition, we adopt the idea of so-called Semantic Web Services that represent Web Services with a semantic description of the interface and its characteristics. The task is to find a composition of services that produces a set of queried output parameters from a set of given input parameters. The overall challenge procedure is shown in Figure 1.

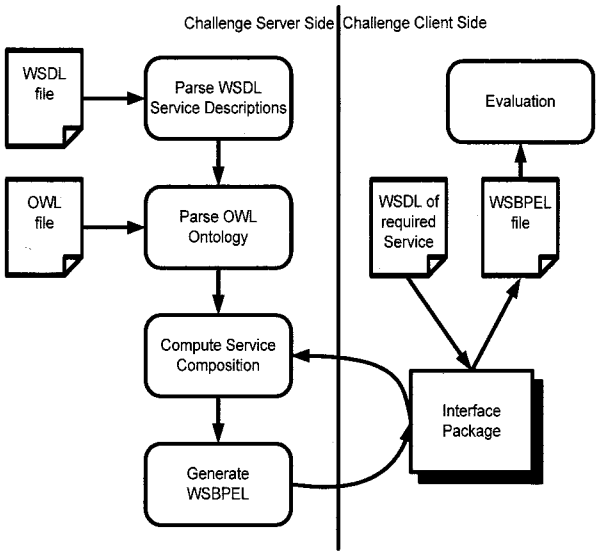

Figure 1. The 2008 Web Service Challenge procedure.

The composer software of the contestants is placed on the server side and started with a bootstrap procedure. First of all, the system is provided with a path to a WSDL file. The WSDL file contains a set of services along with annotations of their input- and output parameters. The number of services will change from challenge to challenge. Every service will have an arbitrary number of parameters. In addition to the WSDL file, we also provide the address of the OWL file during the bootstrapping process. This file contains the taxonomy of concepts used in this challenge in OWL format. The bootstrapping process includes loading the relevant information from these files. The challenge task will then be sent to the composer via a client-side GUI very similar to last year's challenge. After the bootstrapping on the server side is finished, the GUI queries the composition system with the challenge problem definition. The contestant's software must now compute a solution – one or more service compositions – and answer in the solution format which is a subset of the WSBPEL schema. When the WSBPEL document is received by the GUI, we will stop a time measurement and afterwards evaluate the compositions themselves.

3.1. New Technical Innovations

- **Document Formats**: OWL Ontologies, WSDL-Queries, WSBPEL solutions schemas.
- **XSD-Types**: The challenge will include matching XSD-Type definitions like arrays, simple types, complex types with substructures and enumerations.
- **Parallel Execution**: The WSBPEL schema supports the specification of parallel execution of services. Valid parallel execution will positively influence the systems challenge score.
- **No results**: The challenge will include sets of services that actually deliver no solution. The system should act accordingly and cancel the discovery in time.

3.2. Semantics

Ontologies are usually expressed with OWL [12], an XML format [13]. We use the OWL format in the 2008 challenge, but like in the previous years, we limit semantic evaluation strictly to taxonomies consisting of sub- and super-class relationship between semantic concepts only. In addition to semantic concepts (OWL-Classes), OWL allows to specify instances of classes called individuals. While we also distinguish between individuals and classes in the competition, the possibility to express equivalence relations between concepts is not used. In OWL, the semantics is defined with statements consisting of subject, predicate, and object, e.g. ISBN-10 is a ISBN (ISBN subsumes ISBN-10). Such statements can be specified with simple triplets but also with XML-Hierarchies and XML-References. The implementation of an OWL-Parser is hence not trivial. In order to ease the development of the competition contributions, we will stick to a fixed but valid OWL-Schema.

3.3. Evaluation

The Web Service Challenge awards the most efficient system and also the best architectural solution. The best architectural effort will be awarded according to the contestant's presentation and system features. The evaluation of efficiency consists of two parts as described below.

1. Time Measurement: The time measurement is done by the interface package. We take the time after submitting the query and the time when the composition result is fully received. The bootstrap mechanism is excluded from the assessment. There will be a time limit for bootstrapping after which a challenge is considered as failure.

2. Composition Evaluation:
   - Completeness: The amount of compositions discovered by the system.
   - Composition Length: The shortest composition.
   - Composition Efficiency: Parallel versus sequential execution of services.

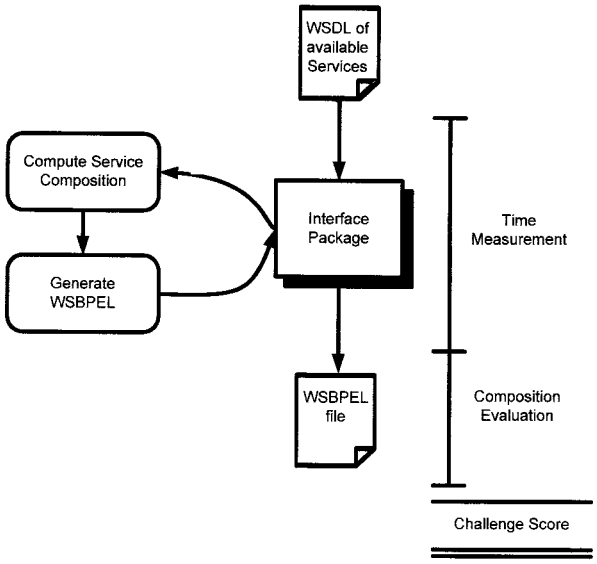

Figure 2. Evaluation for WSC-08

4. Logistics of the Web Services Challenge

WSC-08 has attracted international teams which come from universities and research organizations in countries including Canada, China, Germany, Netherlands, and the United States. The organization of this event is divided into two phases: The first phase focuses on evaluating the technical viability of the methodologies proposed by the participating teams. A four-page technical description submitted from each team is peer-reviewed and included in the proceedings

of the joint conferences (CEC/EEE2008). Once the reviewing and acceptance notification have completed, teams that successfully complete this first phase are asked to submit a version of their software for evaluation. Preliminary tests are conducted using the evaluation version to ensure the compatibility and applicability during the final competition. The main objective is to avoid in advance the potential format related problems that may otherwise occur when the competition takes place.

The second phase is the final competition which is scheduled for two days at CEC/EEE-08. On the first day, all the participating teams will present their approaches in a specialized session of the conference. On the same day, the participants are schedule times to install the latest version of their software on the evaluations services located onsite at the conference. On the second day, the teams must execute their software using a customized data set prepared specifically for the competition.

Participating software is measured for performance during any indexing phases and during the actual composition routine. Composition results are evaluated against known solutions for correctness and completeness. In 2008 there will be multiple sets of correct answers with variable length chains. Applications will be judged with weighted scores based on the best solutions that they present.

The solution application with the best qualitative and quantitative scores when run against several datasets is awarded first place. The competition typically has a winner and several runner-ups.

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