

A Goal-Based Approach to Semantic Web Services

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Outline

- 1. Introduction
- 2. Semantic Web services
- 3. A linguistic approach to goal formalisation and classification
- 4. Applying goal formalisation and classification to semantic Web services
- 5. Discussion and conclusion

Introduction

- Definition of Web services:
 - Self-contained, self-describing, modular applications that can be published, discovered and invoked across the Web [Wang et al, 04].
- 3 main standards:
 - SOAP (Simple Object Access Protocol)
 - WSDL (Web Services Description Language)
 - UDDI (Universal Description, Discovery and Integration).
- Reusable software components.
- Interest from a management point of view.

Introduction

- Originally, Web services primarily based on syntax.
- Semantic Web services = semantic Web + Web services.
- This paper => contribution to semantic Web services, drawing from previous research on goal formalisation and classification [Prat 97].
 - A Web service is described by its interface (goal).
 - A goal = a verb with parameters, each parameter having a semantic function.
 - Integrated representation of the goal of the Web service and its parameters.
 - Better representation of semantics.
 - From this formalisation, domain-independent hierarchy of Web services.

Semantic Web services

- Purpose : to add more semantics into Web services so that their meaning and functionality are specified in an unambiguous and machine-interpretable way.
- A semantic Web service description relies on two major constituents [Sabou et al,05]:
 - A *generic Web service description language* to specify the main elements of the service. Examples: OWL-S, DAML-S. In OWL-S, a service is described by (1) a service profile, (2) a process model and (3) the grounding (messages).
 - A *Web service domain ontology*, which specifies domain concepts and functionality types.

Previous work

- [Paolucci et al, 2002]:
 - Web services capabilities represented in DAML-S (in the profile section).
 - Compute a semantic match between Web services advertisements and requests.
 - Web services matched based on their inputs and outputs.
 - Other related papers.
- [Verma et al, 2005]:
 - Environment for publication and discovery of semantic Web services among multiple registries.
 - Mapping based on inputs and outputs.
- [Freisen & Altenhofen, 2005]:
 - Algorithm optimising the discovery process for composed semantic Web services.
 - Semantic matchmaking based on goals.
 - However, not much detail on how goals are formally represented.

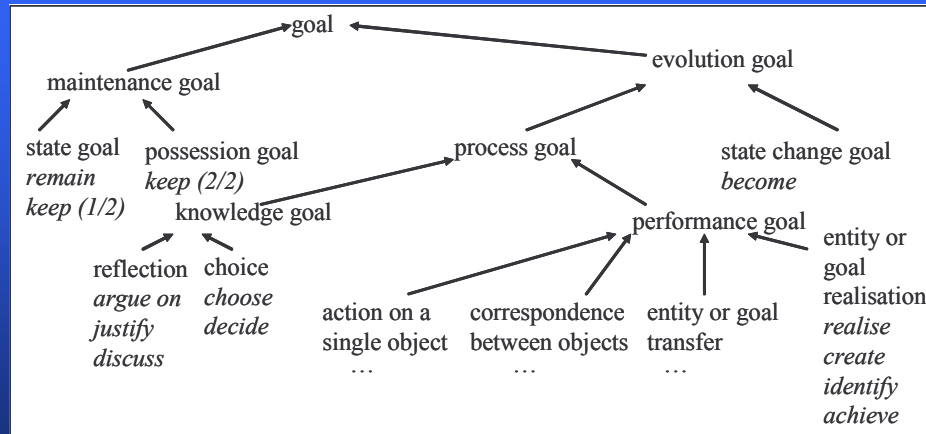
Previous work

- [Klein & Bernstein, 2001]:
 - A set of ideas for improving Web service retrieval.
 - Service publication and retrieval based on the process ontology defined in the MIT Process handbook.
- To sum up:
 - Inputs and outputs often central in describing and matching the interface of Web services.
 - Other characteristics of Web services also recognised as important.
 - However, these different characteristics should be treated homogeneously, in an integrated manner.
 - What we propose : a representation of Web services with their different parameters and the role (i.e. semantic function) of these parameters.

Goal formalisation and classification [Prat, 1997]

- Linguistic approach, based on Fillmore's case grammar and its extensions.
 - Cases (a.k.a. semantic functions) = types of semantic relationships that groups of words have with the verb in any clause.
- A goal = a verb followed by parameters, each parameter having a semantic function.
- 11 semantic functions, e.g. Object, Source, Result or Beneficiary.
- Verb frames, based on semantic functions.
- Domain-independent hierarchy of goal verbs, based on verb frames.

Hierarchy of goal verbs (upper view) [Prat, 1997]



Web services formalisation

- A Web service = a goal with parameters, each parameter having a semantic function.
- For Web services, 5 semantic functions: Object, Result, Source, Manner and Beneficiary.
- **Object (Obj)**
 - Definition: The object(s) affected by the goal.
 - Example:
Update(conference reservations)_{Obj}
- **Result (Res)**
 - Definition: The object(s) effected by the goal, i.e. resulting from its achievement.
 - Example:
Generate(passwords that are strong)_{Res}

Web services formalisation

- **Source (So)**

- Definition: The starting point (generally information source) of the goal.

- Example:

Generate(a chart)_{Res}(from chart parameters)_{So}

- **Manner (Man)**

- Definition: Specifies the way in which the goal is to be achieved.

- Example:

Process(credit card transactions)_{Obj}(in real time)_{Man}

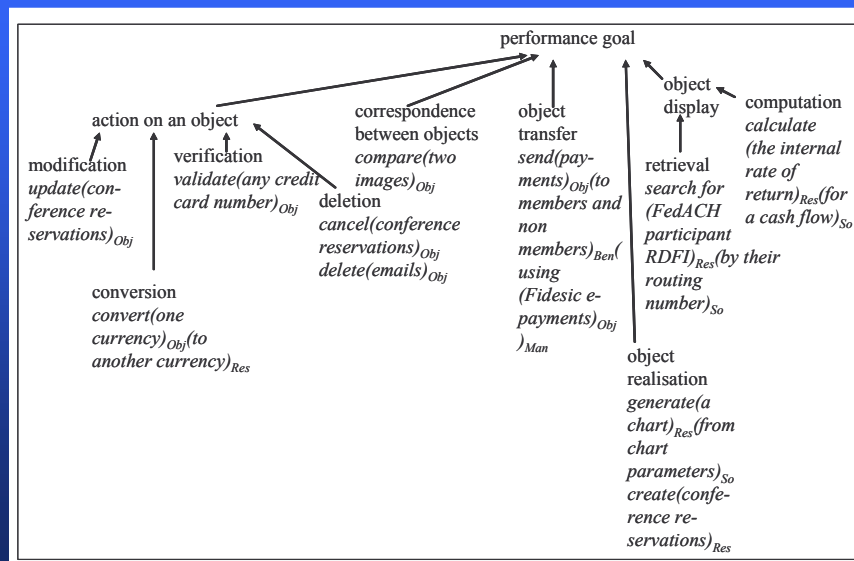
- **Beneficiary (Ben)**

- Definition: The person or group in favour of whom the goal is to be achieved.

- Example:

Send(payments)_{Obj}(to members and non members)_{Ben}(using(Fidesic e-payments)_{Obj})_{Man}

Hierarchy of Web services



Hierarchy of Web services

- Our hierarchy of Web services is domain-independent.
- Applications:
 - Definition of categories and subcategories in a directory of public Web services.
 - Automated discovery of Web services.

Application to Web service discovery

- Matchmaking of Web services advertisements and requests.
- Matchmaking performed by comparing the goal verbs of the advertisement and request, and then their parameters.
- For comparing goal verbs, use of the hierarchy presented above.
- For comparing parameters, use of the semantic functions.
 - Parameters compared in the following order: (1) Result, (2) Object, (3) Source, (4) Beneficiary and (5) Manner.

Conclusion

- Contribution to semantic Web services.
- A Web service is described by its interface, i.e. its goal. A goal is a verb with parameters, each parameter having a semantic function.
- Domain-independent ontology (hierarchy) of Web services.
- Application to Web service discovery.

Discussion

- The verb describing a Web service, as well as the different parameters, are treated homogenously, in an integrated manner.
- Our description of a Web service is richer (and also more conceptual) than the simple distinction between inputs and outputs of Web services.
- Our description is also closer to the natural language description of Web services.
- However, we can establish a correspondence table:

Discussion

	INPUT	OUTPUT
OBJECT	*	*
RESULT		*
SOURCE	*	
MANNER	*	
BENEFICIARY	*	

Correspondence between semantic functions and inputs/outputs

Future work

- Research in progress.
- Future work:
 - Validate/refine the formalisation of Web service goals .
 - Refine the hierarchy of Web services.
 - Refine the algorithm for Web services discovery.