Towards Community-Driven Ontology Matching

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ABSTRACT

We introduce community-driven ontology matching and demonstrate the added value to conventional ontology matching solutions of being community-driven. Further, we present an approach to construction of a prototype for community-driven ontology matching. The prototype was made available on the Web and its usage was observed.

Categories and Subject Descriptors

D.2.12 Interoperability – *data mapping*;
D.2.13 Reusable Software – *domain engineering, reusable libraries*;
I.2.4 Knowledge Representation Formalisms and Methods – *semantic networks*;
I.2.6 Learning – *knowledge acquisition*.

General Terms

Algorithms, Design, Experimentation, Human Factors.

Keywords

Ontologies, Semantic heterogeneity, Matching, Alignment, Knowledge acquisition, Reuse, Web communities, Social networking.

INTRODUCTION

At present, individuals and communities generate a large amount of data that can be reused by other individuals and communities on the Web. Ontology matching is one of the plausible approaches for coping with problems in reusing ontological content.

Matching takes two ontologies, each consisting of a set of discrete entities (e.g., classes, properties, rules, predicates) as input and determines as output the relationships (e.g., equivalence, subsumption) holding between these entities. The matching operation determines the *alignment*.

Many diverse solutions to the matching problem have shown that ontology matching is very difficult to perform automatically with a generally satisfactory precision [3]. Most of the ontology matching algorithms require human involvement to produce highly accurate mappings, and therefore are costly. Meanwhile, once established ontology mappings can be ontologically represented and reused in a

personalized fashion, as any other data located on the Web. We introduce the approach of community-driven ontology matching, where creation and reuse of diverse alignments are performed by large user and developer communities and are facilitated by using profiles of communities and individuals.

COMMUNITY-DRIVEN ONTOLOGY MATCHING

Community-driven ontology matching extends conventional ontology matching. Formally, one can define *community-driven ontology matching* as a process that takes a request and personal profiles of an end-user/developer and two ontologies, each consisting of a set of discrete entities (e.g., classes, properties, rules, predicates), as input and produces as output the relations (e.g., equivalence, subsumption) between entities of these two and possibly other ontologies.

Alignments resulting from community-driven ontology matching are customized for the specific user and his/her specific task. In particular, community-driven ontology matching facilitates alignment discovery and satisfaction from alignment reuse via employing individual and community user profiles and social networking. The facilitation is grounded on the basis that alignments established by a contributor are most likely valid and valuable for his/her community.

Generally, we see the following values being added by community-driven ontology matching compared to commonly practiced ontology matching:

- Adequate investment distribution among the ontology entities (e.g., classes and properties) and alignments;
- More comprehensive representation of the domain and connection with other domains;
- Higher dynamicity and up-to-dateness;
- Improved treatment of alignment contexts by being user and community aware;
- Permanent improvement of existing ontology matching systems due to competition for the users.

IMPLEMENTATION

The implemented prototype of the community-driven alignment service[1] allows semi-automatic ontology

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[1] The implemented community-driven ontology matching service is available online: http://align.deri.org

matching and saving the verified by humans alignments in a publicly available storage, currently, as an OWL file accessible over the Web[2].

Architecture

The application runs on a Tomcat server, reusing two software components: INRIA API [2] and Jena 2 [1]. This infrastructure can be easily enriched by additional algorithms, ontology mapping formalisms support and interfaces. A JSP interface to make the application available for the final user and to realize the semi-automatic matching process was implemented.

Functionality

A user interface allowing interaction with applications and services employing matching modules and extended mapping annotation schemata for capturing community-related information is developed for community-driven ontology matching.

With the current implementation, the following functions are offered to the user:

- Choosing two ontologies to match;
- Choosing a matching algorithm/service;
- Providing feedback on automatically generated alignment;
- Storing the alignment;
- Reusing the alignment.

USAGE ANALYSIS

The usage analysis characterizing criteria and observations from the online prototype usage are listed in Table 1. "Positive" observations for the community-driven ontology matching include demonstrated feasibility of ontology mapping acquisition from ordinary Web contributors. Among the "negative" observations in the prototype usage, one can count the fact that no new to the system ontology namespaces were acquired from the Web community. All 8 involved ontology namespaces were present in the ontologies offered to the prototype users as examples.

From the experiments with the prototype, small number of ontologies available for ontology matching, absence of adding-value services supporting reuse of acquired ontology mappings, insufficient number of powerful tools for automatic ontology matching, and absence of shared APIs between tools for automatic ontology matching are identified as facts restricting development of community-driven ontology matching.

Table 1: Usage Analysis

Criteria	Observations
quantity and frequency of the aligned entities acquired	52 different ontology entities
quantity and frequency of the alignments acquired	29 different alignments
quantity of ontologies processed/namespaces known via the communities involved	8 different namespaces
identification on who and when used the community-driven ontology matcher	accessed by anonymous Web users from more than 30 countries within a time period from November 2004 till April 2005
quantity and frequency of the alignments reused by the communities	n/a

CONCLUSIONS

We introduced an approach of community-driven ontology matching, presented a prototype supporting this approach and analyzed the prototype usage, identifying the limitations hindering construction of full-fledged community-driven ontology matchers.

For the future work, we are interested to apply the principles of community-driven ontology matching as a part of community-driven ontology management [4] in practical case studies and scenarios, where human contributors benefit from creating and reusing ontology mappings.

ACKNOWLEDGMENTS

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[2] The alignments acquired from human contributors by the matching service are available online:
http://align.deri.org:8080/people/mappings.owl