The Río de la Plata Ontology Group

TANGO: Theory ANd desiGn of Ontologies

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1 Research Statement

Ontologies are generally used to specify and communicate domain knowledge in a generic way. While in a formal sense "ontology" means study of concepts, the word "ontology" can be used as a concept repository about a particular area of interest. In the Computer Science area there is a well establish definition of Ontology, provided by Tom Gruber, as *a formal, explicit specification of a shared conceptualization*. Ontologies are very useful for structuring and defining the meaning of the metadata terms that are collected inside a domain community. They are a popular research topic in knowledge engineering, natural language processing, databases, intelligent information integration and multi-agent systems. Ontologies are also applied in the World Wide Web community where they provide the ability for making the semantics of metadata machine understandable. This vision refers also to an ontology *as a conceptual model of the reality*.

Nowadays, autonomously developed ontologies emerge quite naturally in different domains (health, tourism, learning, quality of services, etc.). These ontologies, each one built for different purpose, are used together in complex applications. However, how they are combined is usually hidden in the application code. The lack of an approach for explicitly expressing the way how ontologies are combined for a specific purpose, leads to think on ontology networks as a new ontology engineering concept. Currently, new approaches emerge and consider the building of ontology networks as a new development paradigm, based on the reuse and re-engineering of knowledge resources, as well as the collaborative and argumentative ontology development. This ontology network paradigm is being increasingly applied, instead of custom-building new ontologies from scratch.

This problem has been identified as an interest topic since several years as it has been shown by the WoMO (Workshop of Modular Ontology) community, who states that: ñ*constructing large ontologies typically requires collaboration among multiple individuals or groups with expertise in specific areas, with each participant contributing only a part of the ontology. Therefore, instead of a single, centralized ontology, in most domains, there are multiple distributed ontologies covering parts of*

*the domain. Because no single ontology can meet the needs of all users under every conceivable scenario, the ontology that meets the needs of a user or a group of users needs to be assembled from several independently developed ontology modules. Thus, in realistic applications, it is often desirable to logically integrate different ontologies, wholly or in part, into a single, reconciled ontology. Ideally, one would expect the individual ontologies to be developed as independently as possible from the rest, and the final reconciliation to be seamless and free from unexpected results. This would allow for the modular design of large ontologies and would facilitate knowledge reuse. Few ontology development tools, however, provide any support for integration, and there has been relatively little study of the problem at a fundamental level*ò.

Key aspects of this task are the quality design of these networked ontologies and the complete understanding of the theory underlining them in order to allow the development of a new generation of complex systems, which can make the most of the availability of reusable semantic resources.

An ontology network differs from a set of interconnected single ontologies, due to in an ontology network the meta-relationships among the different ontologies involved are explicitly expressed.

The design of ontology networks which modelling complex systems requires specific considerations. It is not only important to formally expressing the correspondences between the networked ontologies but also to have a theoretical approach that assures the coherence and consistency of the whole ontology network specification, such that the new knowledge inferred in the ontology network does not result in semantic contradictions with the set of axioms of each ontology.

1.1 List of the research topics pursued by the group:

1) Networked Ontologies
2) Ontology-based Multiple Domain Application Design
    a) Semantic Recommender System
    b) Educational Information Systems
    c) Semantic Interoperability of Health Information Systems
    d) Ontology-based methodology for conceptual DW Design
3) Collaborative Ontology Development
    a) Personal Semantic Information Management in Semantic Wikis
    b) Semantic Information Refactoring in Semantic Wikis

2 Brief History of the TANGO Group

The development of complex information systems, especially those involving autonomous and heterogeneous data sources, requires specification of metadata at descriptive and operational level, to guide their maintenance and evolution. Special cases of these systems are recommender systems, semantic web applications, e-learning, e-health and decision support systems.

First works around these subjects at InCo has been conducted by Regina Motz since 2004. The initial goals were the design and use of ontologies for information

extraction from the web [1-5] and for modeling metadata quality in e-learning [6]. Then the focus has been on its use in decisional systems [7], adaptive systems [8] and personalization [9,10].

One approach has been the analysis of theoretical problems for the use of ontologies in the acquisition and administration of the quality factors of the sources of a web data warehouse [11]. On the other hand, this approach has been complemented by the development of an ontology based methodology to assist the conceptual design of Data Warehouses [12].

In the generic scenario of exploitation of ontologies to ensure adaptive information systems, the work has been concentrated in the reuse of ontologies for managing changes in the components of a system. In this sense, a relevant topic has been the study of the use of ontologies, specifically OWL-S, for semantic web service discovery [13, 14].

In parallel, works at LIFIA group, conducted by Alicia Díaz focus on the collaborative development of ontologies. Some results in these areas are: (i) Co-Protégé [15, 16], an extension of Protégé to support the collaborative development of ontologies, (ii) considering the ontology development as a collaborative knowledge building process [17-19]; and refactoring of ontologies [20]. Last two topics are study in the context of semantic wikis. In (ii), the research focuses on study how ontology emerges as result of the adding of semantic annotation of wiki pages by a community and how personal information management can be supported. In (iii), a software engineering approach it is follow to improve the collaborative design of a ontology underlined in a semantic wikis. In this work was developed a catalog of ñbad smellsò that can be automatically detected in the underlined ontology in a semantic wiki, and a catalog of ñrefactoringò to fix the bad smells. Both (ii) and (iii) are developed in the context of Semantic MediaWiki.

Since the confluence of both groups at the CYTED-SALUS project [21, 22], they begin to work together focusing on the theoretical aspects of ontology networks applied to recommender systems [23].

One of the main objectives of the TANGO group is the development of recommender systems based on ontologies that are sensitive to the context of social personal recommendation. At the same time, it is of great interest that these recommendations provide tools for reasoning about the recommendation criteria and to easily visualize and track the recommendation.

To achieve these goals, there are two case studies that are being studied: the health website recommendations [24] and a semantic educational recommender system [25].

Meanwhile, a key subject is the formalization of relationships among the networked ontologies. A primary step in this direction has been published in [26]. The main characteristics of an ontology network design are discussed in the works [27, 28] while aspects of the scope of ontologies and reasoning rules for maintaining consistency of the system are presented in [29, 30].

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