The Mobile Semantic Web*

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ABSTRACT

The combination of the versatility of smart devices and the capabilities of semantic technologies forms a great foundation for a mobile Semantic Web that will contribute to further realising the true potential of both disciplines. Motivated by a service discovery and matchmaking example, this tutorial provides an overview of background knowledge in ontology languages, basic reasoning problems, and how they are applicable in the mobile environment. It aims at presenting a timely survey of state-of-the-art development and challenges on mobile ontology reasoning, focusing on the reasoning and optimization techniques developed in the mTableaux framework. Finally, the tutorial closes with a summary of important research problems and an outlook of future research directions in this area.

Categories and Subject Descriptors

I.2.4 [**Knowledge Representation Formalisms and Methods**]: [Representation languages]; H.4.m [**Information Systems Applications**]: [Miscellaneous]

Keywords

Semantic Web; mobile computing; ontology; reasoning

1. INTRODUCTION

The recent years have witnessed an explosive growth of smart devices, with the iOS and Android being two leading platforms. Typically equipped with a comprehensive operating system, versatile connectivity options, rich multimedia support, various sensing capabilities and generous computational resources, smart devices has truly enabled ubiquitous and situation-aware communication. We believe it is an area of tremendous growth potential for the adoption of semantic technologies.

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Ontology reasoning is a core service for Semantic Web applications. Reasoning ensures the logical consistency of ontologies and infers implicit knowledge encoded in a knowledge base. After more than a decade of active research, significant progress has been made in ontology reasoning. A number of highly optimised reasoners have been developed for ontology languages of different expressivity.

Such algorithms and systems, however, are designed to be executed on desktop computers. It has been shown in our and other recent works that, for large and complex ontologies, these reasoners still face stiff computational challenges on powerful server-grade computers. Smart devices usually have much more constrained computing power than desktop computers. The utility of ontology reasoning is also constrained by its energy efficiency on a mobile device. Hence, ontology reasoning becomes an even more challenging problem on such devices.

This tutorial presents state-of-the-art development in semantic technologies and outlines challenges and opportunities of ontology reasoning in a mobile setting. It will also survey recent advances in optimisation techniques specifically aimed at improving reasoning efficiency for mobile devices.

2. TUTORIAL DESCRIPTION

The tutorial will be organised into the following four parts.

In the first part, a brief introduction to the Semantic Web and mobile computing will be given to lay the foundation of the tutorial. An example of mobile service discovery will also be presented to motivate the application of semantic technologies in the mobile environment.

Ontology languages and core reasoning tasks on ontologies will be presented in the second part, where we will survey

- The syntacx and semantics of important ontology languages, the description logics underpinning them,
- Core reasoning tasks, including ontology consistency checking, concept satisfiability checking, subsumption checking and classification,
- Main reasoning approaches, including tableau, hypertableau and completion rules-based algorithms, and
- Challenges of ontology reasoning and sources of complexity.

The third part will survey existing works on ontology reasoning techniques for the mobile environment, focusing on the mTableaux technique. We will go over in some detail the main reasoning and optimisation techniques and present an performance evaluation.

Finally, we close the tutorial with a discussion of important future research problems.