

A Proposal for a W3C XG on Uncertainty Reasoning for the World Wide Web

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Abstract. The Semantic Web envisions effortless cooperation between humans and computers, seamless interoperability and information exchange among web applications, and rapid and accurate identification and invocation of appropriate Web services. At the current stage of evolution in Semantic Web research, there is a growing understanding that a major step towards this vision involves the implementation of principled uncertainty representation and reasoning in SW applications. This position paper introduces initial thoughts on how the World Wide Web Consortium (W3C) Incubator XG process could be employed to move forward the concept of a Web with uncertainty.

Motivation

The ability of current-generation Web technology to handle uncertainty is extremely limited, providing an inadequate foundation for knowledge interchange and application interoperability. Different applications have different ontologies, different semantics, and different knowledge and data stores. Legacy applications are usually only partially documented and may rely on tacit usage conventions that even proficient users do not fully understand or appreciate. Further, the data that must be exchanged in the context of the Semantic Web is often fraught with uncertainty.

This suggests that effective methods for representing and reasoning under uncertainty in complex, open-world environments could be of vital importance to the success of the Semantic Web (SW). Although OWL provides the means for annotating ontologies with numeric uncertainty measures and has the power to represent much of the necessary structural information, there is no established foundation for doing so. This means each developer must come up with his/her own set of OWL constructs for representing uncertainty. This is a recipe for disaster in an environment so dependent on interoperability among systems and applications.

Apart from the interoperability nightmare caused by proprietary uncertainty representation schemas for SW applications/systems, there are ancillary issues such as representational power vs. simplicity of uncertainty representations, which uncertainty

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representation technique(s) meet the requirements posed by SW applications, how to ensure the consistency of probabilistic representational models and ontologies, etc. None of these issues can be addressed in a principled way by using the current classical logic-based OWL formalism.

Moving Forward Using W3C Incubator XG

The W3C has recently created the Incubator process [<http://www.w3.org/2005/Incubator/about.html>] to provide a formal, yet flexible venue to better understand Web-related challenges and their potential solutions. It encourages a public exploration of the issues and potential solutions before the solutions are mature enough for standardization, and provides a “head start” if the Incubator experimental group, the XG, is able to adequately formulate the principles and techniques that will likely gain consensus in the wider community.

The Incubator XG process provides an attractive mechanism to explore and better define the challenges of reasoning with and representing uncertain information in the context of Semantic Web development. Even further, it could leverage work being done on Semantic Web Services (SWS) to identify where the combination of semantics and uncertainty can further the Web Services vision of quickly and efficiently composing services and data resources to address the needs of user in an ever-changing world.

To this end, the objectives of an Uncertainty Reasoning for the World Wide Web XG (URW3-XG) would be twofold: first, to identify and describe situations on a Web scale for which uncertainty reasoning would significantly increase the potential for extracting useful information; second, to identify methodologies that can be applied to these situations and the fundamentals of a standardized representation that could serve as the basis for information exchange necessary for these methodologies to be effectively used.

For the first objective, the URW3-XG would compile a set of use case descriptions, based on an initial list of examples to be included in the URW3-XG charter and then soliciting and further developing other examples of the kinds of information management challenges that would benefit (and if available, have already benefited) most from mechanisms for reasoning under uncertainty. Areas to be considered include situations related to Web services, such as runtime identification of processing and data resources and resolution of policy objectives, and how probabilistic reasoning techniques could help to deal with trust issues.

For the second objective, the URW3-XG will investigate proposed and implemented solutions that may be applied to the use cases developed under the first objective and that show promise as candidate solutions for uncertainty reasoning in the Semantic Web. In part, this will also involve exploring the feasibility and desirability of layering uncertainty reasoning with existing Semantic Web reasoning languages and tools. The investigation would not advocate the choice of any one particular solution over others, but would seek to identify the type of information that would need to be saved as part of a resource description and transmitted to a reasoning engine for useful processing. The output of this work could form the basis of a future standardization effort.