Dagstuhl Seminar 05371
Principles and Practices of Semantic Web Reasoning (PPSWR)
Executive Summary

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The seminar "Principles and Practice of Semantic Web Reasoning" took place from September 11-16, 2005. It was organised by F. Bry (Univ. München, DE), F. Fages (INRIA Rocquencourt, FR), M. Marchiori (MIT – Cambridge, US) and H. J. Ohlbach (Univ. München, DE). The seminar was a forum for discussing various forms of reasoning that are or can be used on the Semantic Web. Moreover, it addressed both reasoning *methods* for the Semantic Web and Semantic Web *applications* relying upon various forms of reasoning.

The seminar was attended by 50 researchers that work in the area of "Reasoning on the Web". 29 of these participants are members of the European Network of Excellence REWERSE ("Reasoning on the Web with Rules and Semantics") that is funded by the EC and Switzerland. REWERSE is a leading project in the area of rule-based reasoning and applications for the Semantic Web. REWERSE started on March 1, 2004 and is scheduled for four years (cf. http://rewerse.net).

The technical program of the Dagstuhl seminar consisted of talks, tutorials, panel discussions, demo sessions and general discussion sessions.

Talks

- 12 presentations of peer-reviewed papers that were accepted for the annual workshop "Principles and Practice of Semantic Web Reasoning 2005" (PPSWR'05) (http://rewerse.net/PPSWR05/) which was embedded into the Dagstuhl seminar. The proceedings have been published by Springer in Lecture Notes in Computer Science (LNCS), Vol. 3703. These talks were grouped into sessions on architectures, languages and reasoning.

- 3 invited talks
  - François Bry: Ten Theses on Logic Languages for the Semantic Web (talk given by Tim Furche)
  - Stefan Decker: 'Use Cases for Reasoning with Metadata' or 'What have Web Services to do with Integrity Constraints?'
  - Florian Sohler: Generating Contexts for Expression Data using Pathway Queries

- 6 additional talks by seminar participants and several informal discussions and short presentations

Tutorials

- 3 invited tutorials detailing concrete languages and theories for reasoning on the Web:
  - Tim Furche: 'Reasonable' Web Querying: Patterns and Rules (Xcerpt)
  - Michael Eckert: Reactivity on the (Semantic) Web (XChange)
  - Stephanie Spranger: CaTTS – A Type Language for Calendars

System Demonstrations

- 6 system demonstrations on Semantic Web Reasoning issues:
    – Semantic Web Browsing with the EFGT net (Felix Weigel)
    – SAMBO – A system for aligning and merging bio-ontologies (He Tan)
    – PROVA – Language for rule-based scripting and reactive agents in Java (Alexander Kozlenkov)
    – GoPubMed – Ontology-mapped search (Alexander Kozlenkov)
    – ASD Eclipse plugin for graph-matching based service discovery with UML2 (Alexander Kozlenkov)
    – Screech – Faster OWL Using Split Programs (Pascal Hitzler)
    – "SomeWhere – P2P Semantic Web Platform: A Scenario (Philippe Adjiman)

Panel discussions

- A panel discussion on "Research Perspectives for Rule-Languages on the (Semantic) Web" has been lead by François Fages. Further panellists were Harold Boley, Stefan Decker, Enrico Franconi, Marie-Christine Rousset and Gerd Wagner.

- A further discussion session was devoted to the project REWESE. Two REWESE external speakers (Enrico Franconi, Peter F. Patel-Schneider) and two REWERSE speakers (Jan Małuszyński, Wolfgang May) presented their views on "Internal perspectives and external impact" of REWERSE.

Emerging research topics from the seminar

While the presented talks, demos and tutorials showed significant progress in various specific research areas of "Reasoning on the Web" in particular the seminar panels and discussions revealed a number of challenges for the current research on rules and reasoning for the Semantic Web. Some of the addressed challenges were:

- **Rules need well-defined semantics**. Frameworks for rule-languages need a thorough definition of their semantics. This is essential since, depending on the semantics of rules, certain queries lead to different answers.

- **Rules necessary for making ontologies inter-operable**. For the Semantic Web Vision to be realised it is important that ontologies are inter-operable. This requires rules (with a clear semantics).

- **Semantic Web requires general high-level rule languages**. The very challenge of the Semantic Web is that it is distributed and diverse. Existing rule-languages, however, are usually special purpose languages. The real challenge is to construct *general* high-level rule languages since many problems like policies or business rules require a computation independent modelling. Formalisms are then needed to connect these general languages with specific languages.

- **Relevance of Rule Interchange Languages**. Important questions concerning rule interchange are: Which types of rules are to be interchanged? How can rule interchange languages be defined? The latter issue is currently investigated by the W3C "Rule Interchange Format" Working Group.

- **Concrete foundational research issues**. Which forms of negation (monotonic or non-monotonic) are needed on the Web under which conditions? How to combine closed-world assumption with open-world reasoning? How to handle conflicts when merging rule-sets of different sorts?

- **Viewpoints on Rule Languages**. Some more theoretically oriented researchers view rule-languages mainly in the context of Knowledge Representation, while others view rules as necessary for practically working with metadata on the Semantic Web. Current research tends to focus on the former view, while, what is often needed for the Semantic Web, is rather the latter.

- **Truth on the Web is "context-dependent"**. Data on the (Semantic) Web is messy, often wrong, outdated or inconsistent. Therefore the concept "truth" on the Web is "context dependent" and it is important to have trust-mechanisms that rank the quality of certain pages. Rule languages need to take into account that Web data is messy, and that – depending on the context – there can be more than one "truth".

- **Semantic Web community has to be aware of previous research.** Reasoning with rules has been studied for more than 30 years. The Semantic Web community should be (more) aware of this work. Therefore, workshops like PPSWR are very relevant for the Semantic Web community.

- **Scalability of reasoning in a completely decentralized setting.** Depending on the target application expressivity is more important than scalability, or vice versa. For restricted domains higher expressivity does not necessarily prevent scalability. However, applied to the whole Web scalability becomes a major issue. This needs to be kept in mind when applying expressive logic languages like Description Logics to the Semantic Web. Starting with simple fragments that have a clear semantics is recommended.

- **Trends towards mainstreaming of rules.** There are several trends to mainstream rule formalisms, e.g. W3C's working group on Rule Interchange Formats, also OMG, OASIS aim at standards. Also, business rules and reactive rules (for Web services) require mainstreaming.

- **Central role of use cases**. Language principles should be illustrated with well worked-out use cases. Use cases also foster the industry take-up of research results. In particular, use cases should show the real use of metadata and which forms of reasoning these uses require.

- **Start with simple but relevant use cases**. Research on reasoning on the Web should firstly be concerned with simple, but relevant examples that can be realistically solved. Only when a consensus on the solution of simple examples is achieved should larger use cases and more complicated examples be extensively studied.

General Conclusions from the Seminar

General conclusions from the seminar are very positive. The seminar contained very good presentations also by young researchers, had very lively and fundamental discussions profiting from the contributions of senior researchers, fostered the co-operation between different communities working in the area of "Reasoning on the Web with Rules and Semantics" and showed the relevance of for further meetings and workshops of this type. In particular, showcasing the relevance for practical applications was frequently commented as a central task for the coming months.