Overview of ISWC-2010 Tutorial: "Web Rules: Fundamentals, Applications, and Standards"
(Nov. 8 half-day: afternoon)

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Tutorial Abstract:

The area of semantic rules is perhaps the most important frontier today for the Semantic Web's core technology and standards. Rules extend databases and ontologies with more powerful, flexible, and active forms of "structured" knowledge (as opposed to "unstructured" knowledge such as text), and have a number of close relationships to other aspects of the overall Semantic Web such as ontologies, query/search, trust, and services. There are a number of exciting research issues. Recent progress includes major initial industry standards from W3C and OMG having received finalization, including W3C Rule Interchange Format and OWL 2 RL Profile (i.e., the Rules subset of OWL). Recent progress also includes fundamental advances in the underlying knowledge representation techniques in declarative logic programs, including most recently SILK's efficient higher-order defaults with sound integration of clausal first order logic ontologies. Recent progress further includes methods to use rules for, or with, more expressive OWL ontologies; increasing integration of rules with query/search in SPARQL and relational databases; substantive translations between heterogeneous types of commercial rule engines; development of open-source tools for inferencing and interoperability; performance benchmarking of rule systems; a wide range of emerging applications including in business, science, and trust; and accelerating industry investments/acquisitions in the technology including by integrated software companies such as Oracle, IBM, and Microsoft. Major software companies such as Oracle are now supporting web rules functionality in their core products. Most semantic web researchers (and developers) are not yet up to speed in this area. This tutorial will help them get there by providing a comprehensive and up-to-date introduction to these developments and to the fundamentals of the key technologies and outstanding research issues involved. It will explore example application scenarios, overall requirements and challenges, and touch upon business/social value and strategy considerations.

Prerequisite Knowledge:

The tutorial will cater to those first learning about semantic web rules, as well as those who already have some background in them. It will assume only background knowledge of:

- basics of logical knowledge representation: first order logic and relational DBMS; and
- basics of XML, RDF, and OWL.

(Almost all of the ISWC audience actually has this background.)

Outline (Preliminary):

Note: Examples (use cases and application scenarios) will be liberally embedded throughout all the sections. Standards, languages, and systems will be interleaved throughout. The details in the bulletized outline below focus primarily on the technology and its uses, for sake of brevity.

A. Intro & Uses (~60min)

1. Overview of tutorial, and get acquainted
2. What are: Rules on the Web, Semantic Rules

3. Uses and Kinds of rules
    - Commercial, web. Current, envisioned.
    - Requirements. Business value, IT lifecycle.
    - Strategic roadmapping of future adoption
4. Example Use Cases
    - E-commerce pricing, ordering policies, contracts
    - E-Science: cell biology, ecological process, physics mechanics
    - Trust, compliance, policies, financial services
    - Info integration, ontology mapping, business reporting
    - Processes: policy-based workflow, causal action effects, Semantic Web Services

B. Concepts & Foundations (~120 min, plus coffee break)

1. Overview of Logical Knowledge Representations
    - Logic Programs (LP) and its relationship to First Order Logic (FOL)
    - Rule-based Ontologies: Description Logic, Description LP, OWL RL
2. SILK's Hyper LP: Putting it all together
3. Basics: Horn Case; Functions
4. F-Logic, Frame Syntax, Object Oriented Style
5. HiLog, Higher-Order Syntax, Reification, Meta-Reasoning
6. W3C Rule Interchange Format: Dialects, Framework
    - Rules in W3C OWL 2 RL; via RIF
7. Nonmonotonicity: Defaults, Negation, Priorities; FOL's Glass Bubble
    - Semantics for Default Negation
    - Courteous LP, Argumentation Theories
    - Hyper Rules, FOL-Soundness, Remedying FOL's Fragility
8. Procedural Attachments to Actions, Queries, Built-ins, and Events
    - Production/Situated LP, Production Rules
9. Additional Features: Integrity Constraints, Inheritance, Lloyd-Topor, Equality, Skolemization, Aggregation, Datatypes, "Constraints"

C. Conclusions & Directions (~30 minutes)

1. More about Tools
2. … including SILK
3. Conclusions
4. Directions for Future research
5. Appendix: References and Resources
6. (General Discussion)

Presenters' Biographies: (including expertise and presentation experience related to the tutorial)

Benjamin Grosof (lead presenter) is a Senior Research Program Manager at Vulcan Inc., the parent company of Paul G. Allen (co-founder of Microsoft). There he conceived and leads a new large research program in the area of rule-based semantic technologies and artificial intelligence, which includes developing the SILK knowledge representation language and system. In addition, he has a part-time expert consulting business, advising companies large and small on technology and related strategy. Previously he was an IT professor at MIT Sloan (2000-2007) and a senior

software scientist at IBM Research (1988-2000). He has pioneered semantic technology and standards for rules, their combination with ontologies, their application in e-commerce and business policies, and business roadmapping of the Semantic Web. He co-founded the influential RuleML industry standards design effort. He was lead inventor of the rule-based technique which rapidly became the currently dominant approach to commercial implementation of OWL, and of several other fundamental technical advances in knowledge representation. Two W3C industry standards are based largely on his research work: Rule Interchange Format (RIF, currently in last phase of finalization) and OWL 2's RL rule-based subset (Nov. 2009). His notable technical contributions also include fundamental advances in conflict handling for rules (i.e., defaults) and integration of rules with machine learning. He co-founded the International Conference on Rules and Rule Markup Languages for the Semantic Web (which since became the RR and RuleML conferences). His background includes three major industry software releases, two years in software startups, a Stanford PhD, a Harvard BA, and over 50 refereed publications.

Dr. Grosof has given numerous invited talks about rules on the Web, and developed several MIT courses with substantial focus on it. He presented (with co-authors) related tutorials at the Intl. Joint Conf. on Artificial Intelligence (2001), ACM Conf. on E-Commerce (2004), Intl. Semantic Web Conf. (2004, 2005, 2006,2009), and the WWW conference (2006, 2009).

Mike Dean is a Principal Engineer at Raytheon BBN Technologies. As Principal Investigator for Integration and Transition within the DARPA Agent Markup Language (DAML) program, he chaired the Joint US/EU ad hoc Markup Language Committee responsible for the DAML+OIL and SWRL languages, co-edited the OWL Web Ontology Language Reference, and was a member of the W3C RDF Core and Web Ontology Working Groups and the Architecture Committee of the Semantic Web Services Initiative. He remains a member of the RuleML Steering Committee and the W3C Rule Interchange Format Working Group. He is the developer of a number of Semantic Web tools and reference data sets and has been actively using SWRL in a variety of Semantic Web applications. He holds a B.S. in Computer Engineering from Stanford University.

Mr. Dean has given numerous talks on the Semantic Web, including an early tutorial "DAML+OIL for Application Developers" and tutorials (with Benjamin Grosof) at the Intl. Semantic Web Conf. (2004, 2005, 2006, 2009) and WWW (2006, 2009).

Michael Kifer is a Professor with the Department of Computer Science, State University of New York at Stony Brook, USA. He received his Ph.D. in Computer Science in 1984 from the Hebrew University of Jerusalem, Israel, and the M.S. degree in Mathematics in 1976 from Moscow State University, Russia. Dr. Kifer's interests include Web information systems, knowledge representation, and database systems. He has published four text books and numerous articles in these areas. In particular, he co-invented F-logic, HiLog, and Transaction Logic, which are among the most widely cited works in Computer Science and, especially, in Semantic Web research. Dr. Kifer serves on the editorial boards of several computer science journals and chaired several conferences. Twice, in 1999 and 2002, he was a recipient of the prestigious ACM-SIGMOD "Test of Time" awards for his works on F-logic and object-oriented database languages. In 2006, he was a Plumer Fellow at Oxford University's St. Anne's College and in 2008 he received SUNY Chancellor's Award for Excellence in Scholarship.