05371 Abstracts Collection
Principles and Practices of Semantic Web Reasoning
— Dagstuhl Seminar —

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Abstract. From 11.09.05 to 16.09.05, the Dagstuhl Seminar 05371 "Principles and Practices of Semantic Web Reasoning" was held in the International Conference and Research Center (IBFI), Schloss Dagstuhl. During the seminar, several participants presented their current research, and ongoing work and open problems were discussed. Abstracts of the presentations given during the seminar as well as abstracts of seminar results and ideas are put together in this paper. The first section describes the seminar topics and goals in general. Links to extended abstracts or full papers are provided, if available.

Keywords. Semantic Web, reasoning, rules, ontologies, Advanced Web Applications, rule-based reasoning

05371 Executive Summary – Dagstuhl Seminar "Principles and Practice of Semantic Web Reasoning" (PPSWR)

Uta Schwertel (Universität München, D)

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 Roc-quencourt, 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.

Keywords: Semantic Web, reasoning, rules, ontologies, Advanced Web Applications, rule-based reasoning

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/477

Integrating Positional and Slotted Knowledge on the Semantic Web

Harold Boley (University of New Brunswick at Fredericton, CDN)

The design space of Semantic Web languages is reconstructed by introducing orthogonal dimensions to separate concerns such as positional vs. slotted arguments, typing via RDFS or OWL taxonomies, and the presence of (Web) Object Identifiers. Based on our exploration of this space with RuleML, the POSL (positional-slotted) formalism is introduced as a high-level language interconvertible with the Object-Oriented RuleML serialization. POSL reconciles Horn logic's positional and F-logic's slotted formulas for representing facts and rules on the Web, optionally referring to RDFS or OWL-DL classes for order-sorted typing. The POSL semantics directly enhances Herbrand models for n-ary relations by accommodating slotted clause instantiation and ground equality, further restricted through optional signatures and types. Analogous enhancements apply to unification in the proof theory and (Java-based) OO jDREW implementation. Webizing uses URIs in the IETF form of N3 for individuals, relations, slots, and types. Webized atoms further permit the (OID) representation of F-logic objects and RDF descriptions as slotted facts enhanced by rules. F-logic's object-nesting shorthand is adopted by POSL, while its ∧-composition shorthand is restricted to independent groups of object slots only.

POSL's coherent treatment of relations and objects permits cross-fertilizations such as relational results about independent ∧-parallelism being transferred to distributed object definitions. RDF blank nodes become clause-global, module-local Skolem constants. The online converter from POSL to OO RuleML and POSL engine OO jDREW have enabled applications such as information integration in the New Brunswick Business Knowledge Base.

Keywords: F-logic, Horn logic, Prolog, N3, SWRL, RuleML, POSL, OWL, RDF, XML, slotted knowledge representation, positional knowledge representation

Descriptive Typing Rules for Xcerpt

Wlodzimierz Drabent (Polish Academy of Sciences, PL)

We present typing rules for the Web query language Xcerpt. The rules provide a descriptive type system: the typing of a program is an approximation of its semantics. The rules can also be seen as an abstract form of a type inference algorithm (presented in previous work), and as a stage in a formal soundness proof of the algorithm.

The paper considers a substantial fragment of Xcerpt; the main restriction is that we deal with data terms corresponding to trees (instead of general graphs), and we do not deal with Xcerpt rule chaining. We provide a formal semantics for the fragment of Xcerpt and a soundness theorem for the presented type system.

Joint work of: Berger, Sacha; Coquery, Emmanuel; Drabent, Wlodzimierz; Wilk, Artur

Full Paper:
http://dx.doi.org/10.1007/11552222_9

See also: "Principles and Practice of Semantic Web Reasoning; Third International Workshop, PPSWR 2005", Springer LNCS 3703, 2005, pp. 85-100.

XChange: From the Query Language Xcerpt to a Reactive Language

Michael Eckert (Universität München, D)

Reactivity, the ability to detect events and respond to them automatically through reactive programs, is a key requirement in many present-day information systems. Work on Web Services reflects the need for support of reactivity on a higher abstraction level than just message exchange by HTTP.

   This talk introduces XChange, a reactive language for the Web based on Event-Condition-Action rules. XChange builds upon and extends the Web query language Xcerpt, following a pattern-based approach for querying event data, Web data, and updating Web data. The language supports composite events, complex updates, as well as reasoning with Web data by means of deduction rules.

Keywords: Reactivity, Reactive Language, Event-Condition-Action rules, ECA

Joint work of: Eckert, Michael; Patranjan, Paula-Lavinia; Bry, François

CLP(XML) Constraint Logic Programming over Semi-Structured Data

François Fages (INRIA Rocquencourt, F)

In this talk, we review how semi-structured data can be handled as a constraint domain and how constraint programming technology can then be used to solve combinatorial problems and combine constraint reasoning with ontological reasoning on the semantic web.

Logical reconstruction of RDF and ontology languages (extended version)

Enrico Franconi (Free University - Bozen, I)

Abstract. In this sketchy paper we introduce a logical reconstruction of the RDF family of languages and the OWL-DL family of languages.

We prove that our logical framework is equivalent to the normative W3C definitions of RDF/RDFS and OWL-DL/Lite. The main aim is to have a unified model theoretic semantics for both worlds. As a consequence we get various complexity results and a model theoretic semantics for basic SPARQL.

This is an extended version - submitted elsewhere with the title "Logical reconstruction of normative RDF"

Keywords: RDF, OWL-DL, SPARQL, first order logics, semantics, model theory

Joint work of: Franconi, Enrico; Tessaris, Sergio

Marriages of Convenience: Triples and Graphs, RDF and XML

Tim Furche (Universität München, D)

Metadata processing is recognized as a central challenge for database research in the next decade. Already, novel desktop data man- agement and search applications (cf. Apple's Spotlight and Microsoft's WinFS) are enabled by rich metadata. Efficient and effective access to such data becomes a crucial issue for more and more application scenar- ios. In this article, we focus on metadata represented in RDF. A number of query languages for RDF have been presented in recent years. This article argues that most of these approaches fail to address properly two core issues: the provision of rich operators and constructs to adequately support RDF's graph data model and the ability to intertwine access to metadata (in RDF format) and data (in XML format). To address this points, two XML views over RDF data are expressed in the query lan- guage Xcerpt and discussed. Furthermore, it is shown how these views together with Xcerpt's rich graph patterns allow the succinct expression of complex, but common queries against RDF graphs.

Keywords: Semantic Web, RDF, XML, meta-data processing, querying, Xcerpt, rules

Joint work of: Furche, Tim; Bry, François; Bolzer, Oliver

Full Paper:
  http://idefix.pms.ifi.lmu.de:8080/idefix/index.html#PMS-FB-2005-38

Ten Theses on Logic Languages for the Semantic Web

Tim Furche (Universität München, D)

This articles discusses the logic, or logic-based, languages required for a full deployment of the Semantic Web.

It presents ten theses addressing (1) the kinds of logic languages needed, (2) data and data processing, (3) semantics, and (4) engineering and rendering issues.

Keywords: Semantic Web, RDF, XML, meta-data processing, querying, Xcerpt, rules

Joint work of: Bry, François; Marchiori, Massimo; Furche, Tim

Full Paper:
 http://www.pms.ifi.lmu.de/publikationen#PMS-FB-2005-7

See also: François Bry and Massimo Marchiori: Ten Theses on Logic Languages for the Semantic Web. Proceedings of W3C Workshop on Rule Languages for Interoperability, Washington D.C., USA (27th - 28th April 2005).

Reasonable Web Querying: Patterns and Rules

Tim Furche (Universität München, D)

This tutorial will give both an introduction to Xcerpt, a novel versatile Web query language for XML and RDF, and a discussion of common issues in Web querying illustrated along examples in the Xcerpt language. The three main aims of this tutorial are to

1.) provide a basic understanding of Xcerpt, its design principles, and its concepts.
2.) raise awareness of issues such as optional query parts and incompleteness that are common to Web query languages.
3.) illustrate "technological" use cases that are both believable and can serve to showcase certain properties of Web query languages. This is done along realisations in Xcerpt.

A General Markup Framework for Integrity and Derivation Rules

Adrian Giurca (BTU Cottbus, D)

We propose a general markup framework for integrity and derivation rules (R2ML). Rule concepts are defined with the help of MOF/UML, a subset of the UML class modeling language proposed by the Object Management Group (OMG) for the purpose of 'meta-modeling', i.e. for defining languages conceptually on the level of an abstract (semi-visual) syntax.

From these MOF/UML language models we can obtain concrete markup syntax by applying a mapping procedure for generating corresponding languages from parameterized DTDs.

Keywords: Rule markup languages, integrity rules, derivation rules, rule meta-models

Joint work of: Wagner, Gerd; Giurca, Adrian; Lukichev, Sergey

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2006/479

Faster OWL Using Split Programs

Pascal Hitzler (Universität Karlsruhe, D)

We propose a new technique for approximate ABox reasoning with OWL DL ontologies. Essentially, we obtain substantially improved reasoning performance by disregarding non-Horn features of OWL DL. Our approach comes as a side-product of recent research results concerning a new transformation of OWL DL ontologies into negation-free disjunctive datalog, and rests on the idea of performing standard resolution over disjunctive rules by treating them as if they were non-disjunctive ones. We analyse our reasoning approach by means of non-monotonic reasoning techniques, and present an implementation, called Screech.

Keywords: OWL DL, Approximate Reasoning, Logic Programming

Joint work of: Hitzler, Pascal; Vrandecic, Denny

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2006/480

See also: P. Hitzler and D. Vrandecic, Resolution-based approximate reasoning for OWL DL. In: Proceedings of ISWC2005, Galway, Ireland, November 2005. To appear.

Principles of Inductive Reasoning on the Semantic Web: A Framework for Learning in AL-log

Francesca Alessandra Lisi (University of Bari, I)

The design of the logical layer of the Semantic Web, and subsequently of the mark-up language SWRL, has renewed the interest in hybrid knowledge representation and reasoning. In this paper we discuss principles of inductive reasoning for this layer. To this aim we provide a general framework for learning in $\mathcal{AL}$-log, a hybrid language that integrates the description logic $\mathcal{ALC}$ and the function-free Horn clausal language DATALOG, thus turning out to be a small yet sufficiently expressive subset of SWRL. In this framework inductive hypotheses are represented as constrained DATALOG clauses, organized according to the $\mathcal{B}$-subsumption relation, and evaluated against observations by applying coverage relations that depend on the representation chosen for the observations. The framework is valid whatever the scope of induction (description vs. prediction) is. Yet, for illustrative purposes, we concentrate on an instantiation of the framework which supports description.

A general language for Evolution and Reactivity in the Semantic Web

Wolfgang May (Universität Göttingen, D)

In this paper we define the basic concepts for a general language for evolution and reactivity in the Semantic Web. We do this by exposing an UML model that specifies an ontology for the language.

The proposed language is based on Event-Condition-Action rules, where different languages for events (including languages for composite events), for conditions (queries) and actions (including complex actions) may be composed, this way catering for language heterogeneity (besides heterogeneity on the data-model) that we think is essential for dealing with evolution and reactivity in the Semantic Web.

A Geospatial World Model for the Semantic Web

Hans-Jürgen Ohlbach (Universität München, D)

The Semantic Web is an endeavour aiming at enhancing Web data with meta-data and data processing, as well as processing methods specifying the 'meaning' of such data and allowing Web-based systems to take advantage of 'intelligent' reasoning capabilities. The representation of the meaning of data essentially requires the development of a world model. Ontologies, for example, are logical descriptions of world models. In this paper we investigate what it means to develop a world model for 'geospatial' data that can be used for semantic web applications. Different aspects are analysed and a proposal for a concrete architecture is developed. The architecture takes into account that geospatial data (road maps etc.) are usually owned by companies and only accessible through their interfaces. The article also argues that, to complement standard, general purpose, logic-based data modelling and reasoning methods, as e.g. offered by RDF and OWL and reasoners for these languages, location reasoning is best

tackled using graphs for data modelling and well-established algorithms for reasoning. Hence, the article illustrates, for the practical case of location reasoning for providing guidance, the thesis that, on the Semantic Web, 'theory reasoning' is a desirable complement to 'standard reasoning'.

Keywords: Semantic web, geospatial reasoning

Joint work of: Bry, François; Lorenz, Bernhard; Ohlbach, Hans Jürgen; Rosner, Mike

Full Paper:
  http://idefix.pms.informatik.uni-muenchen.de:8080/rewerse/index.html
#REWERSE-RP-2005-60

See also: Proceedings of Third Workshop on Principles and Practice of Semantic Web Reasoning, Springer LLNC 3703, pp.145–159

Computational Treatment of Temporal Notions: The CTTN-System

Hans-Jürgen Ohlbach (Universität München, D)

The CTTN–system is a computer program which provides advanced processing or temporal notions. The basic data structures of the CTTN–system are time points, crisp and fuzzy time intervals, labelled partitionings of the time line, durations, and calendar systems. The labelled partitionings are used to model periodic temporal notions, quite regular ones like years, months etc., partially regular ones like timetables, but also very irregular ones like, for example, dates of a conference series.

These data structures can be used in the temporal specification language GeTS (GeoTemporal Specifications). GeTS is a functional specification and programming language with a number of built-in constructs for specifying customised temporal notions. CTTN is implemented as a Web server and as a C++ library.

This paper gives a short overview over the current state of the system and its components.

Keywords: Calendrical calculation

Full Paper:
  http://idefix.pms.informatik.uni-muenchen.de:8080/rewerse/index.html
#REWERSE-RP-2005-59

See also: Proceedings of Third Workshop on Principles and Practice of Semantic Web Reasoning, Springel LNCS 3703, pp 133-144

A Revised Architecture for Semantic Web Reasoning

Peter Patel-Schneider (Bell Labs - Murray Hill, USA)

The current architecture for the Semantic Web, with its emphasis on RDF syntactic and semantic compatability, has severe problems when expressive Semantic Web languages are incorporated. An architecture less tied to RDF is proposed. In this architecture different Semantic Web languages can have different syntaxes but must use the same models.

This revised architecture provides significant advantages over the currrent Semantic Web architecture while still remaining true to the vision of the Semantic Web.

Keywords: Semantic web, reasoning, RDF, OWL

Semantic Web Architecture: Stack or Two Towers?

Peter Patel-Schneider (Bell Labs - Murray Hill, USA)

We discuss language architecture for the Semantic Web, and in particular different proposals for extending this architecture with a rules component. We argue that an architecture that maximises compatibility with existing languages, in particular RDF and OWL, will benefit the development of the Semantic Web, and still allow for forms of closed world assumption and negation as failure.

Keywords: Semantic web, architecture, RDF, OWL

Joint work of: Horrocks, Ian; Parsia, Bijan; Patel-Schneider, Peter; Hendler, James

REWERSE from the Outside In

Peter Patel-Schneider (Bell Labs - Murray Hill, USA)

This talk provides an external view of the REWERSE Network of Excellence.

Keywords: Semantic Web, REWERSE

Semantic and computational advantages of the safe integration of ontologies and rules

Riccardo Rosati (Università di Roma I, I)

Description Logics (DLs) are playing a central role in ontologies and in the Semantic Web, since they are currently the most used formalisms for building ontologies.

Both semantic and computational issues arise when extending DLs with rule-based components. In particular, integrating DLs with nonmonotonic rules requires to properly deal with two semantic discrepancies:

(a) DLs are based on the Open World Assumption, while rules are based on (various forms of) Closed World Assumption;
(b) The DLs specifically designed for the Semantic Web, i.e., OWL and OWL-DL, are not based on the Unique Name Assumption, while rule-based systems typically adopt the Unique Name Assumption.

In this paper we present the following contributions:

(1) We define safe hybrid knowledge bases, a general formal framework for integrating ontologies and rules, which provides for a clear treatment of the above semantic issues;
(2) We present a reasoning algorithm and establish general decidability and complexity results for reasoning in safe hybrid KBs;
(3) As a consequence of these general results, we close an open problem, i.e., decidability of OWL-DL with DL-safe rules.

Keywords: Description logics, rules, ontologies, nonmonotonic reasoning

Full Paper:
 http://dx.doi.org/10.1007/11552222_6

SomeWhere in the Semantic Web

Marie-Christine Rousset (Université Paris Sud, F)

In this paper, we describe the SomeWhere semantic peer-to-peer data management system and report experiments showing that it already scales up to a thousand of peers. SomeWhere promotes a "small is beautiful" vision of the Semantic Web based on simple personalized ontologies (e.g., taxonomies of classes) but which are distributed at a large scale. In this vision of the Semantic Web, no user imposes to others his own ontology. Logical mappings between ontologies make possible the creation of a web of people in which personalized semantic marking up of data cohabits nicely with a collaborative exchange of data.

In this view, the Web is a huge peer-to-peer data management system based on simple distributed ontologies and mappings.

Keywords: Semantic Web, peer to peer, ontologies, mappings

Joint work of: Adjiman, Philippe; Chatalic, Philippe; Goasdoue Francois; Rousset, Marie-Christine; Simon, Laurent

The EFGT Net: Reasoning about concepts in a time-geo-topic-entity space

Klaus U. Schulz (CIS - Universität München, D)

Named entities (e.g., "Ludwig van Beethoven", "Daimler-Chrysler", "Dresdner Bank", "Kofi Annan", "Second World War", "Coca-Cola") are ubiquitous in documents in the web and other document repositories. The information that a human user associates with named entities occurring in a document often suffices to derive a simplified picture, or a fingerprint, of its contents. It thus represents adequate meta-information for the document. In order to use this kind of information in automated document processing, resources are needed that make the information implicitly carried by named entities explicit, formalizing it in an appropriate way. The EFGT net [SW03], currently developed at CIS, University of Munich, represents such a resource, focussing on thematic fields (F), geographic locations (G) and temporal periods (T) associated with the entities (E).

Entries of these four types are positioned in a well-founded (i.e., acyclic) navigation space. Large (small) entries w.r.t. the navigation order represent general (specific) topics and large (small) geographic or temporal areas. This acyclic organization of knowledge aims to support classification and indexing tasks. Each entry comes with a unique identifier that describes the role of the entry. A semi-formal semantics for the language of identifiers is given. The current version of the EFGT net contains ca. 8.000 entries. An important feature of the system is the following: when adding a new entry, the position in the hierarchy is computed in a fully automated way. Relations such as thematic, geographic or temporal inclusion are taken into account. The same deduction mechanisms can be used for searching in documents and for semantic indexing.

The talk at the seminar will given a succinct overview of the EFGT net in its current state. The focus is on the practical application of the resource to web browsing. A prototype of an EFGT-enabled web browser will be presented which tags web pages with semantical data from the EFGT net in a multilingual environment.

Keywords: EFGT net, named entities, semi-formal ontologies, semantic annotation, classification, information extraction, semantic search

Joint work of: Schulz, Klaus U.; Weigel, Felix; Brunner, Levin; Torres-Schumann, Eduardo

Description Logic Programs: A Practical Choice For the Modelling of Ontologies

York Sure (Universität Karlsruhe, D)

Knowledge representation using ontologies constitutes the heart of semantic technologies. Despite successful standardization efforts by the W3C, however, there are still numerous different ontology representation languages being used, and interoperability between them is in general not given. The problem is aggrevated by the fact that current standards lay foundations only and are well-known to be insufficient for the modelling of finer details. Thus, a plethora of extensions of the basic languages is being proposed, rendering the picture of ontology representation languages to be chaotic, to say the least. While semantic technologies start to become applicable and are being applied in adjacent areas of research and in research projects with industrial participation, and can soon be expected to become an integral part of industrial applications, the practitioner is faced with the difficult task of choosing his basic ontology representation paradigm. We will argue that the OWL subset known as Description Logic Programs constitutes a very reasonable choice.

A Framework for Aligning Ontologies

He Tan (Linköping University, S)

Ontologies are an important technology for the Semantic Web. In different areas ontologies have already been developed and many of these ontologies contain overlapping information. Often we would therefore want to be able to use multiple ontologies and thus the ontologies need to be aligned. Currently, there exist a number of systems that support users in aligning ontologies, but not many comparative evaluations have been performed. In this paper we present a general framework for aligning ontologies where different alignment strategies can be combined. Further, we exemplify the use of the framework by describing a system (SAMBO) that is developed according to this framework. Within this system we have implemented some already existing alignment algorithms as well as some new algorithms. We also show how the framework can be used to experiment with combinations of strategies. This is a first step towards defining a framework that can be used for comparative evaluations of alignment strategies. For our tests we used several well-known bio-ontologies.

ERDF - Turning RDF into an Expressive Ontology Language by Adding Negations and Rules

Gerd Wagner (BTU Cottbus, D)

Ontologies and automated reasoning are the building blocks of the Semantic Web initiative. Derivation rules can be included in an ontology to define derived concepts based on base concepts. For example, rules allow to define the extension of a class or property based on a complex relation between the extensions of the same or other classes and properties. On the other hand, the inclusion of negative information both in the form of negation-as-failure and explicit negative information is also needed to enable various forms of reasoning. In this paper, we extend RDF graphs with weak and strong negation, as well as derivation rules. The ERDF stable model semantics of the extended framework (Extended RDF) is defined, extending RDF(S) semantics. A distinctive feature of our theory, which is based on partial logic, is that both truth and falsity extensions of properties and classes are considered, allowing for truth value gaps. Our framework supports both closed-world and open-world reasoning through the explicit representation of the particular closed-world assumptions and the ERDF ontological categories of total properties and total classes.

Keywords: RDF, negation, rules, closed-world reasoning

Joint work of: Wagner, Gerd; Analyti, Anastasia; Antoniou, Grigoris; Damasio, Carlos Viegas

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Felix Weigel (CIS - Universität München, D)

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Artur Wilk (Linköping University, S)

We present typing rules for the Web query language Xcerpt. The rules provide a descriptive type system: the typing of a program is an approximation of its semantics. The rules can also be seen as an abstract form of a type inference algorithm (presented in previous work), and as a stage in a formal soundness proof of the algorithm. The paper considers a substantial fragment of Xcerpt; the main restriction is that we deal with data terms corresponding to trees (instead of general graphs), and we do not deal with Xcerpt rule chaining. We provide a formal semantics for the fragment of Xcerpt and a soundness theorem for the presented type system.

Keywords: Type system

Joint work of: Berger, Sacha; Coquery, Emmanuel; Drabent, Wlodzimierz; Wilk, Artur