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Interpreting Inference Engine for Semantic Web

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***Abstract*— Semantic web is a web of data, where data should be related to one another and also Knowledge will be organized in conceptual spaces according to its meaning. To understand and use the data and knowledge encoded in semantic web documents requires inference engine. There are number of inference engines used for consistency checking and classification like Pellet, Fact, Fact++, Hermit, Racer Pro, KaON2, and Base Visor. Some of them are reviewed and tested for few prebuilt ontologies. This paper presents the analysis of different inference engines with set of ontologies. It requires assessment and evaluation before selecting an appropriate inference engine for a given application.**

Keywords—Description logic, HTML, Inference, OWL, RDF, RDFS.

I. INTRODUCTION

Today's Web uses the hyperlinks that define relationship between current page and target page whereas semantic web define relationships among data on web has motivate creation of new technologies and standards to analyze and understand large amount of data on web and infer new knowledge.

Semantic Web is an emerging technology regarded as the next generate on Web paradigm providing machine understandable information that is based on meaning (Tim Berners-Lee 2001). It has been recognized as a promising new area of research to define and describe relationships among data (resources) on the Web. Semantic Web is an extension of Web 2.0.

Today's Web which is used for coding a body of text with images is mainly written in Hypertext Markup Language (HTML). Whereas The Semantic Web uses languages such as Resource Description Framework (RDF), Web Ontology Language (OWL) and Extensible Markup Language (XML) specifically designed for data that can describe arbitrary things. The Web Ontology Language (OWL) is an approach for knowledge representation which describes basic concepts and defines relationships among data. The Semantic Web is generally built on syntaxes which use URIs to represent data, usually in triples based structures; these syntaxes are called RDF (Resource Descriptive Framework).

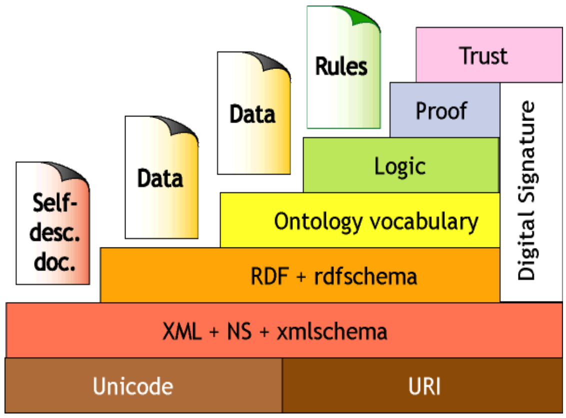

Figure 1: Semantic web architecture

The semantic web architecture defined by W3C is of step by step layered model. RDF, RDFS, OWL are standards of semantic web.

RDF Resource Description Framework is a basic data model, like the entity- relationship model, for writing simple statements about Web objects (resources). It is a semantic web standard for defining information on the Web. RDF provides the language for expressing the meaning of terms and concepts in a form that machines can readily process. RDF statement contains 3 main parts: Subject, Property, and Object, respectively. Subject that identifies things for that statement, Predicate that identifies property/characteristics of the subject specifies and Object that identifies value of that property.

In terms of the simple graph above, the:

- ✓ Subject is the T-shirt
- ✓ Predicate (property) is the color
- ✓ Object is yellow

RDF does not make assumptions about any particular domain and does not define semantics of any domain. This can be done using RDFS.

RDFS (Resource Descriptive Framework Schema) is an extension of RDF in which it allows to describing taxonomies of classes and properties. It also allows the description of class hierarchy and property hierarchy. RDF

Schema can be viewed as a essential language for writing ontologies. But there is a need for more powerful ontology languages which can expand RDF Schema and allow the representations of more complex relationships between Web objects.

OWL (Web Ontology Language) is an ontology language that extends expressiveness of RDFS. OWL is a declarative knowledge representation language which formally defines meaning for creating ontology. OWL has three sublanguages like OWL-Lite, OWL-DL, and OWL-Full. OWL-Lite and OWL-DL are based on Description logics.

II. INTRODUCTION TO INFERENCE ENGINE

Inference on semantic web is used derive a new relationship. For the semantic web, inference is a process to infer a new relationship from existing resources and some addition information in form of "set of rules". From some addition information can be define to given sources using vocabularies or rules set. Inference is requiring for processing given knowledge available on semantic web. Inference base technique is also use to check data inconsistency at time of data integration.

The inference engine can be described as a form of finite state machine with a cycle consisting of three action states: match rules, select rules, and execute rules [1]. In the first match rules state, the inference engine finds all of the rules that are predefined in database. Then in next step the inference engine passes the data set to the second state which known as select rules. Finally the selected databases are passed to the third state which is known as execute rules. The inference engine executes the selected rules, with the selected data items as parameters.

Example:
Here, we have following fact:

- A is parent of C,
- B is parent of C,
- A is men,
- B is Women

Based on given fact, we derive new information is that "B is wife of A".

Inference engine derive a new fact based on existing fact by using some sets of rules. Rules are very important for controlling the steps of inference process. The inference rules are specifying by means of ontology language and description language. Reasoners use some logic to perform reasoning task like Description logic, First Order logic (FOL), Predicate logic and Propositional logic.

Inference engine can be used for reasoning task for Ontologies and their instances. Based on, it derives a new knowledge based on existing knowledge available on web. Most of the inference engine is use query language for reasoning task. In Current world, it widely use in knowledge engineering and artificial intelligence.

There are three alternative strategies to manage inferred knowledge:

- ✓ Forward Chaining Method:
  In forward chaining method it starts with the available data and uses inference rules to extract more data until a goal is reached.

- ✓ Backward Chaining Method:
  Backward chaining starts with a list of goals and works backwards from the data available.

- ✓ Hybrid Method:
  This method is more complex so it is widely use in expert system. In this method, the rules of both forward and backward chaining can apply.

III. INFERENCE ENGINES

INFERENCE ENGINES In our comparative analysis we have studied following

1)PELLET

Pellet is an OWL DL reasoner for semantic web which uses tableaux algorithms for development of DL description logics and decision procedure. It supports the full expressivity OWL DL including reasoning, SROIQ and also SWRL rules. Library of Jena and OWL API is used for conjunction. Pellet API provides functionalities to see the species validation, check consistency of ontologies, classify the taxonomy, check entailments and answer a subset of RDQL queries.

2) FACT

FaCT is known as "Fast Classification of Terminologies" . It is a Description Logic (DL) classifier that is used for modal logic satisfiability testing. The most interesting features of the FaCT are its expressive logic, SHIQ is sufficiently expressive to be used as a reasoner for the Dedicated Logic Register (DLR) logic; and its support for reasoning with arbitrary knowledge bases and other is its optimised tableaux implementation and its Common Object Request Broker Architecture - CORBA based client-server architecture.

3) FACT++

FaCT++ an improved version of FaCT employs tableaux algorithms for SHOIQ(D) description logic that support general A-boxes and T-boxes and implemented in C++ but has very limited user interface and services as compared to other reasoner[2]. It supports the OWL-API, the lisp-API and the DIG interface.

4) RACERPRO

Racerpro is lips based OWL DL reasoner. It supports expressivity of SHIQ. It implements a tableau-based decision procedure for general T-Boxes (subsumption, satisfiability, classification) and A-Boxes (retrieval, nRQL query answering). It supports the OWL-API and the DIG interface. It follows the multiple optimization strategies for better reasoning, etc. support including dependency-directed backtracking, and transformation of axioms, model caching and merging.

5) KAON2

KAON2 is free java based reasoner. It is based on OWL-DL and Frame Logic. It is an infrastructure of managing OWLDL, SWRL and F-Logic ontologies. It supports answering conjunctive queries, although without true non-distinguished variables. KAON2 is a successor of KAON project used extension of RDFS [26]. It implements a resolution-based decision procedure for general TBoxes (subsumption, satisfiability, classification) and ABoxes (retrieval, conjunctive query answering). It support Java based interface and DIG interface.

6) HERMIT

HermiT is a free java based OWL reasoner that use novel "hyper-tableau" calculus [3]. Hermit reasoner employs reasoning on SHIQ (D). It is available free for non-commercial usage. Takes OWL file as input and perform various reasoning tasks like consistency checking, identify subsumption relationships between classes and more. It also computes partial order of classes occurring in OWL. It is different from other reasoner like Pellet and Fact such a way that it implements hyper-tableau for SHIQ(D) which is much less non-deterministic than the existing tableau algorithms. It supports the interface of OWL API.

Inference Engine	FaCT	FaCT++	Pellet	RacerPro	Hermit	KaON2
Availabiity	Free (Open source)	Free (Open Source)	Free (Open Source)	Non Free (Closed Source)	Free (Open Source)	Free (Open Source)
Plateform	Windows/Linux	Windows/Linux	Windows	Windows	Windows	Windows/Linux
Version	0	1.5 (DIG interface	2.3.0 (DIG interface	2	3	–
OWL Support	OWL- DL	OWL- DL	OWL- DL	OWL-DL	OWL-DL	OWL- DL
Logic	SHIQ(D) (DL)	SHIN(D) (DL)	Combina tion of SHIF(D) and SHON(DL)	SHIQ(D) (DL)	SHIQ(D) DL	Horn logic, SHIQ(D) (DL)
Reasoning Algorithm	Tableau	Tableau	Tableau	Tableau	Hyper-Tableau	First Order Resolution Calculus

IV. CONCLUSION

Based on findings to understand and use the semantic data on the web there is a requirement of inference engine. This paper describes comparison of various inference engines on different measurement criteria. Here we have tried to be exhaustive in comparison but there may be other engines which we have not discussed. Our comparative analysis table may be further helpful in selecting inference engines for semantic web applications and for future research works.

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REFERENCES

[1] A Comparative Study Of Inference Engines by Swapna Singh, Ragini Karwayun, 7th International conference on Information Technology, 2010.
[2] http://kaon2.semanticweb.org
[3] http://owl.man.ac.uk/hoolet/
[4]http://www2012.wwwconference.org/about/submit/call-for-papers/semantic-web/
[5] "Reducing OWL entailment to description logic satisfiability" Ian Horrocks and Peter Patel-Schneider Journal of Web Semantics, 1(4):345{357, 2004.}
[6] Tim Berners-Lee, James Hendler, and Ora Lassila. The semantic web. Scienti_c American, 284(5):34{43, 2001.
[7] B. Parsia, E. Sirin, Pellet: An owl dl reasoner. In: Proc. International Semantic Web Conference. (2005).
[8] Racer: A Core Inference Engine for the Semantic Web by Volker Haarslev† and Ralf M¨oller., 2003.
[9] F-OWL: an Inference Engine for the Semant ic Web by Youyong Zou, Tim Finin and Harry Chen, 2003
[10] Bossam: An Extended Rule Engine for OWL Inferencing by Minsu Jang and Joo-Chan Sohn, 2004
[11] FIRE – A Description logic Based Rule Engine for OWL Ontologies with SWRL-like Rules by Kruthi Bhupalam, 2005
[12] OWLer : A semantic web ontology inference engine,by young-ku-ha, in 7th International conference on advanced communication tecchnology,2005
[13] Maryland Information and Network Dynamics Lab.: Pellet OWL Reasoner. (2003)