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Survey on Ontology Mapping

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Abstract

To create a sharable semantic space in which the terms from different domain ontology or knowledge system, Ontology mapping become a hot research point in Semantic Web Community. In this paper, motivated factors of ontology mapping research are given firstly, and then 5 dominating theories and methods, such as information accessing technology, machine learning, linguistics, structure graph and similarity, are illustrated according their technology class. Before we analyses the new requirements and takes a long view, the contributions of these theories and methods are summarized in details. At last, this paper suggest to design a group of semantic connector with the ability of migration learning for OWL-2 extended with constrains and the ontology mapping theory of axiom, so as to provide a new methodology for ontology mapping.

Keywords:Ontology; Mapping; Survey

1.Introduction

The study of Ontology mapping [1,2] is committed to access and represent the semantic association between similar elements of different ontology, and to overcome the drawbacks of subjective limitations caused by single ontology and of lack of semantic interpretation capabilities, achieving knowledge exchange and sharing on the semantic Web, and interoperability of Web applications. The following factors are motivations for the study of ontology mapping theory and methods [3, 4, 5]: (1) The distribution property of ontology development leads to coverage of partial content of a large number of ontology. When they are reused, merger, integration, mapping or re - scheduling of ontology should be done first. (2) Agent and Web services are main form of software in the open Web environment. But, multi-source heterogeneous ontology hinders their mutual communication and interoperability; (3) Information retrieval of cross-Ontology on semantic Web requires timely modifying or rewriting of the query and parameters on the basis of ontology mapping. Therefore, in order to achieve the exchange of knowledge on the Semantic Web, reuse and interoperability of data, automatic or semi-automatic ontology

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mapping method has become a focus of researching persons [5, 6]. The necessity and importance of the study of this issue have been well presented in OMEN project [7] of Stanford University, the OAEI Ontology Mapping Contest [8] of annual ISWC and OM International Symposium.

2.Overview of Ontology Mapping Research

In recent years, the main ontology mapping theories, techniques and methods are as the following.

The ontology mapping based on the information accessing technology [10, 11, 12] used the glossary search engine mapping the examples to the concepts of the different ontology in order to judge the equivalence or inclusion relation between the concepts from different ontology, and the glossary searched engine comprehensive considers the factors of concept of connotation (such as name, label, notes and attribute constraints, etc.) and the structural characteristics (such as the ancestor, parent, children and brother branches, etc.) and so on. PRIOR+[11] set up the complete overview of the ontology model VSM, and get the concept of classification for the common instance set. Literature [13] respectively used the method of the testing of concept extension set and inspection of concept connotation structural, which was based on the relations of contains, and construct the concept lattice; then reduced in the concept lattice, and remained the link between the concept and its direct parent class, finally, realized the mapping, fusion, reduction of the distributed ontology. Experimental results show that the proportion of Nir-to-Ncr declining from 3.13 to 1.05.

In the respect of the ontology mapping based on machine learning, the GLUE system [14] on the basis of the statistical analysis, and used the different learning strategies as for the concept examples and classification structure, and then integrated learning outcomes; the system used the method of the loose label to search the configuration of the ontology mapping which meet the area limitations and common sense, and in natural language processing and hypertext classification demonstrate very good results. Literature [15] posed a learning method of independent instance, and made the problem from the ontology mapping converse to the binary classification. The learning method was not depend on the sufficient examples, just to start from the characteristics of linguistics, structure and the Eigen value of Web, but the accuracy of the classification and training data have related with the test data.

Linguistics is widely used in the ontology mapping [16, 17, 18], mainly refers to the grammatical form and context information of the ontology representation language. LILY [16] is a common ontology mapping system, and ontology constraints are not considered, and according to the linguistic features and the structure information of the ontology build the semantic sub graph. The system according to the mapping task set the size of the sub graph by hand, and inefficient for large-scale ontology mapping. Literature [17] posed a virtual file technology to match with linguistic, created a collection of words with weight (called virtual file), that file contains the local description of terms and the context information of semantic which the file reflects. The realization of similarity calculation of the file is used the traditional vector space technology. RiMOM [18] posed a risk minimization method of ontology mapping, and changed the ontology mapping into a decision-making, and auto-discovery the mapping of 1:1、n:1、1:null and null:1, and resolved the name conflict in the mapping process, which was based on the NLP and statistical techniques.

Structure graph [19, 20, 21] effectively expressed the structural characteristics among the ontology factors. Similarity Flooding [19] proposed a matching algorithm which was based on the fixed-point calculations. The input of the algorithm is two graphs and the output is the mapping relations of the corresponding nodes in the graphs, and after algorithm running the results depended on manual checking and adjustment. PROMPT [20] with the goal of the ontology reuse created a kit which served for ontology comparison, scheduling, integration, consolidation and maintenance. ANCHOR-PROMPT components used the structure of the graph to find the relationship between the concepts of the different ontology, and offered the ancillary information to I-PROMPT components. The system of LILY [16, 21] considered the

semantic features of the ontology elements, and first created the connected sub-graph which was posed by Faloutsos [22] before the similarity calculated, and precisely described the semantic of the ontology elements. The sub-graph is n-dimensional semantic graph which is build for the nodes or edges in the ontology graphs.

Similarity calculated and the coordination of multi-similarity is one of the mainstream technologies of the ontology mapping. ASMOV [23] is an automated ontology mapping tools, which computed the concept similarity from different ontology by analyzing text description features, etc, and distributed weight according to the different features, and pre-defined rules to adjust the static weight distribution, finally, purified mapping results by analyzing the semantic inconsistencies of the mutual exclusion mapping and many-to-one mapping. Falcon-AO [24] contained three basic ontology matcher, such as V-Doc, I-Sub and GMO, and a ontology splitter PBM. Make the complex ontology which is be about to mapping split into multiple smaller clusters and then to match; V-Doc, I-Sub and GMO calculated separately the similarity of concept connotation (the establishment of vector space model), string similarity and structural similarity. Literature [25] constructed the similar part according to the hierarchy structure of the ontology concept, finally, get the similarity of the ontology hierarchy, and get well application in the semantic communication of the Web services. PRIOR + [26] calculated separately the similarity of the name, the concept connotation and the structure, and achieved an approach which was adaptive similarity of coalescence and coordination.

The contribution of the above research is mainly summarized as follows: (1) Evaluate the relationship of the ontology elements separately from the string similarity and the concept of upper and lower structural characteristics of the ontology elements (such as the concept of the parent, the number of brother nodes and examples), part of the study took into account context background of the formation of the concept of the upper and lower; (2) In the grammatical and structural level with calculations and coordination of the similarity obtained indicate the relationship expression between the different elements of the ontology, and the form of the expression included bridge axioms, mapping expressions and instances of ontology mapping, etc.; (3) Taking into account the number and complexity of ontology, the above work are automatic or semi-automatic ontology mapping, heuristic information and supervised learning has been adopted; (4) A large number of ontology mapping system emergence, including GLUE, QOM[27], PROMPT, RiMOM, LILY and ASMOV, most of these mapping systems through OAEI benchmark, and achieved better race results in the previous ontology mapping.

3.Analysis of Achieved Research Results

Nevertheless, the limitations and weaknesses of the existing ontology mapping method still hinder its practical applications on the semantic Web, and the main reasons include:

- Design the ontology mapping rules and programs just aim at the factors of the body parts and map results only represent as classes, natures and equivalent or contain of individual. There are very few considerations on the property restrictions and characteristics; Additionally, OWL 2 draft[28] put out in October 2008. It expanded the data types map and the limit, type attribute expressions and the limit and ontology axioms (Class expression axioms; Object properties axiom; Data property axioms and assertions) for using the reasoning algorithm. At the same time it expanded axiom notes based on natural language to strengthen readability. The ontology definition gives the obvious expressions of its intension. But it can give the precise semantics within the confines of the classes and properties. It can ratiocinate and constitute a complete knowledge system at the support of the axiom. Ontology mapping should judge equivalence or inclusion relation of the basic elements on the comprehensive factors. This basic factor includes content properties (contains property expressions, data range and the axiom of limitation), the explanation of the formal semantics based on the mutual individual sets, the limitation of classes

and properties and axiom sets etc. In particular, the import of the limitation, axiom and reasoning put forward the demand of innovation the ontology mapping theory.

- Most of the means of ontology mapping didn't provide the formal semantics in the mapping structure. The reasoning machine can't exert and then manipulation such as Cross-Ontology query can't carry out; The existing research work is limited to the similarity calculation of the grammatical features and structure. Moreover, weight distribution of the similarity calculation lack scientific basis. Mapping method based on grammar can receive the effective mapping rules in most cases. But there was an abundance of cases Mapping Failure just the same [29]. Using semantic search engine called Swoogle [30] to search semantic data as the background of ontology Mapping (share semantic space). It can review mapping relations between the ontology elements and improve the accuracy and the rate of recalling of the ontology mapping.
- The single Ontology mapping system can not fit the disruption features of the Ontology and the open features of the semantic Web, and a large number of applications supported by the Ontology are arranged on the Web, such as the semantic Web service. Simultaneously, Web service description, discovery, invocation and composition, and collaboration of Agent and so on involve two or more ontology, so the interaction and communication of ontology is a key technology, which create the shared semantic space [31]. The semantic communication and sharing, which are based on the ontology mapping, need timeliness and configurability, using that building can serve effectively for the Web information-sharing, interoperability, and software development and collaborative environment with sufficient capacity to semantic interpretation. Therefore, the expected ontology mapping system is a group of knowledge background self-adaptive operator which according to the test of configuration, online, common and independent of the ontology used to realize the form of semantic integration.

In view of the above analysis, the project aims to be based on the existing work [13, 25, 31-34] of the applicants, comprehensive consideration, using another way. Design a group of semantic connector with the ability of migration learning for OWL-2 extended with constrains and the ontology mapping theory of axiom, so as to provide a new methodology for ontology mapping, to build the software development and collaborative environment which is supported by formal semantics.

4.Conclusion

Focusing on ontology mapping, this paper gives a summary about ontology mapping, and analyses the current research results. Based on these, we suggest a new way to form the high layer ontology by transfer leaning, and extract mapping relations so as to descript inter-relation between distributed ontologies.

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