Semantic XML Filtering by Ontology Combination

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Abstract. An XML document search method which expands XML query through conceptual structuring and association on intra/inter-ontology is proposed. The method can filter out semantic information from various XML documents and can be effective for a large application.

1 Introduction

Expanding XML queries based on ontology enables filtering out semantic information from various forms of XML documents: [1],[2]. To do this, complete and elaborate ontology is required: [3]. However, building and accessing such ontology is very hard and inefficient. To be effective and efficient in XML document filtering, combining ontology is attempted in expanding XML query. A query expanding algorithm is first developed through conceptual structuring and concept association for intra-ontology. Then, the algorithm is generalized for inter-ontology structuring and association.

As an application example, ontology ‘College-Research-Center’ is combined with ontology ‘Programming-Skills’ and ‘College-Courses’ shown by dotted lines in Fig. 1. XQL(XML Query Language) is used for query application and the effectiveness of XML filtering is tested by a sample XML document.

2 Query Expansion by Ontology Combination

Expansion by conceptual structuring: Add sub-concepts to XML query. Query ‘//Person[skill=”C”]’ is expanded to ‘//(Person | Professor | Engineer | Student | MasterStudent | PhDStudent)[skill=”C”]’ in ‘College-Research-Center’.

Expansion by concept association: Set an association between concepts A and B if attribute of concept A is concept B and vice versa. In ‘College-Research-Center’, concepts ‘Student’ and ‘Project’ are associated as shown by a solid line in Fig. 1(b). The following is the corresponding rule for query expansion.

FORALL Pers1, Proj1

Proj1 : Project[member ->> Pers1] <-> Pers1 : Student[project ->> Proj1]

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Fig. 1. Ontology Combination

Combined expansion by conceptual structuring: Conceptual structuring is generalized to include other ontology. By combining ‘College-Research-Center’ and ‘Programming-Skills’ by the following rules, query on attribute ‘skill’ of concept ‘Person’ can include skill ‘C++’.

FORALL Obj1, Obj2

Obj1 : C -> Obj2 : Student[skill ->> Obj1]

FORALL Obj1, Obj2

Obj1 : ProgrammingSkill -> Obj2 : Student[skill ->> Obj1]

Combined expansion by concept association: Concept association is also generalized to include other ontology. By combining ‘College-Research-Center’ and ‘College-Courses’ by the rule given below, concepts ‘Student’ and ‘Course’ can be associated for inter-ontology query expansion.

FORALL Pers1, Cour1

Cour1 : Course[student ->> Pers1] <-> Pers1 : Student[takesCourse ->> Cour1]

3 Semantic XML Filtering Application

Semantic XML filtering effect is tested by the XML document in Table 1. By conceptual structuring and concept association, queries ‘//Student[name=”Kim”]’ and ‘//Student[project]’ are expanded to ‘/(Student | MasterStudent | PhDStudent)[name=”Kim”]’ and ‘//Project[member]’ respectively.

Table 1. XML Document Example

<ResearchCenter>	<takesLecture>C</takeLecture>
<Person>	<project>Home Page Production
<Professor>	</project>
<name>Kong</name>	</Student>
<email>yhkong@sch.ac.kr</email>	</Person>
<attendLecture>Artificial Intelligence	<Project>
</attendLecture>	<title>Semantic XML Query</title>
<project>Laser Slice</project>	<chief>Kong</chief>
<project>Semantic XML Query	<member>Lee</member>
</project>	<skill>Java</skill>
</Professor>	<background>XML</background>
<PhDStudent>	</Project>
<name>Kim</name>	<Project>
<email>mskim@sch.ac.kr</email>	<title>Home Page Production</title>
<skill>C++</skill>	<chief>Kong</chief>
<skill>Open GL</skill>	<member>Kim</member>
<takeLecture>Artificial Intelligence	<member>Shin</member>
</takeLecture>	</Project>
<attendLecture>Assembly	</ResearchCenter>
</attendLecture>	
<project>Laser Slice</project>	<Course>
</PhDStudent>	<BasicSubject>
<MasterStudent>	<subjectTitle>C</subjectTitle>
<name>Lee</name>	<professor>Kong</professor>
<email>kslee@sch.ac.kr</email>	<student>Shin</student>
<skill>C</skill>	</BasicSubject>
<skill>Java</skill>	<MajorSubject>
<takeLecture>Artificial Intelligence	<subjectTitle>Home Page Production
</takeLecture>	</subjectTitle>
<project>Semantic XML Query	<professor>Chun</professor>
</project>	<student>Kim</student>
</MasterStudent>	<student>Lee</student>
<Student>	</MajorSubject>
<name>Kim</name>	<Course>
<skill>ASP</skill>	

Query ‘//Student[skill=”C”]’ is expanded to ‘/(Student | MasterStudent | PhDStudent)[skill=”C”’, “C++”]’ by combining ‘Programming-Skills’. And query //Student[takeLecture] is expanded to /(Course | BasicSubject | MajorSubject)[student] by combining ‘College-Courses’. As seen in Fig. 2, the expanded queries by ontology combination successfully filter out the necessary XML documents which were not possible to search before the expansion.

Fig. 2. XML Filtering by Ontology Combination

4 Conclusions

To filter out semantic information from various forms of XML documents and to be effective to a large domain application, a semantic XML filtering method expands XML queries by conceptual structuring and association in inter-ontology as well as inter-ontology. Experimental result showed that the XML filtering method effectively extracts important information which was undetected before.

References

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