Inheritance Approach to Semantic Enrichment of XML Schema to Transform Association Relationships in ODL Schema

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ABSTRACT

This paper presents an inheritance approach to Semantic Enrichment of eXtensible Markup Language (XML) Schema to Transform Association Relationships in Object Definition Language (ODL) Schema. Possibility of realizing the concepts of ODL in a model of XML schema was presented in the previous works and an enrichment concretizing these concepts in the XML Schema models was proposed. The purpose of their works was to automate transformation process of an XML schema to an ODL database by focusing on preserving semantics transformation of association relationships and describing a set of rules to create ODL classes from an enriched XML schema. This approach was however insufficient and limited in the enrichment of the XML schema. Thus, this paper improved on the existing system by developing an inheritance relationship which is a better mapping compared to the association relationship used in the previous work.

Keywords: Semantic Enrichment, eXtensible Markup Language (XML), Object Definition Language (ODL), database, XML schema.

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1. INTRODUCTION

Extensible Markup Language is a meta language that allows users to define their own customized markup languages, it is characterized by its flexibility and extensibility. Due to all its qualities, it's considered as a hot topic for describing and interchanging data through the internet and between different systems. The migration of database appears today very interesting and promotes organizations to move towards new technology. Since information is a valuable resource for organizations, the mapping process must be submitted before any shift to a new technology. The characteristics of the XML Schema and query languages are more powerful, such that they attempt to encourage the migration of an existing database into a new environment. The purpose of most the reviewed works was to automate transformation process of an XML schema to an ODL database. Their works focused on preserving semantics transformation of association relationships and some set of the rules were described to create ODL classes from an enriched XML schema.

However, a better mapping can be achieved by using inheritance relationships as an improvement over the association relationship that was used in the previous works. This article focuses on improving the existing work by introducing an inheritance relationship.

1.1 XML Schema

According to W3C recommendation, eXtensible Markup Language (XML), much like Hypertext Markup Language (HTML) is a software and hardware independent tool for storing and transporting data (W3C, 2017). XML Schema is a language for expressing constraints about XML documents. Presently there are several different schema languages in widespread use today, but the main ones are Document Type Definitions (DTDs), Relax-NG, Schematron and W3C XSD (XML Schema Definitions). Schema can be used to provide a list of elements and attributes in a vocabulary, associate types, such as integer, string, or more specifically such as hatsize, sock_colour, with values found in documents. Schema can also be used to constrain where elements and attributes can appear, and what can appear inside those elements, such as saying that a chapter title occurs inside a chapter, and that a chapter must consist of a chapter title followed by one or more paragraphs of text. Providing documentation that is both human-readable and machine-processable and giving a formal description of one or more documents, schema can be used (W3C, 2015). Information in schema documents is often used by XML-aware editing systems so that they can offer users the most likely elements to occur at any given location in a document.

Checking a document against a Schema is known as validating against that schema; for a DTD, this is just validating, but for any other type of schema the type is mentioned, such as XSD Validation or Relax-NG validation.

The Service Modeling Language (SML) provides a framework for relating multiple XSD documents to one or more documents in a single validation episode. Since XSD supports associating data types with element and attribute content, it is also used for data binding, that is, for software components that read and write XML representations of computer programming-language objects. Inheritance relationship is a relationship that defines an entity/class in terms of another. It organizes the classes in taxonomies based on their similarities and differences. The ancestor or super-class holds common information, while the descendants or sub-classes can inherit this information or specify additional contents. The inherited information can be reused or overridden by the sub-classes Stroustrup (1994). There are various types of inheritance such as single, multiple and multilevel inheritance based on paradigm and specific language.

1.2 Single inheritance

In a single inheritance (Fig. 1), subclasses inherit the features of one superclass. A class acquires the properties of another class.

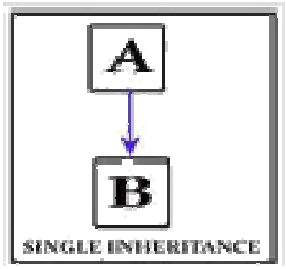

Fig. 1: Single inheritance

1.3 Multiple inheritance

In multiple inheritance (Fig. 2), one class can have more than one superclass and inherit features from all parent classes.

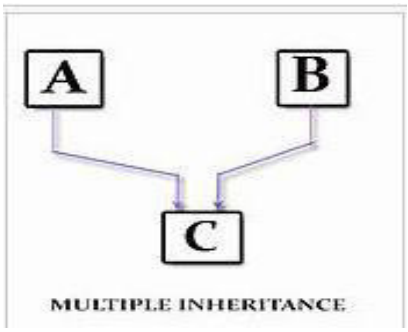

Fig. 2: Multiple inheritance

1.4 Multilevel inheritance

A subclass is inherited from another subclass in multilevel inheritance. It is not uncommon that a class is derived from another derived class as shown in figure 3.

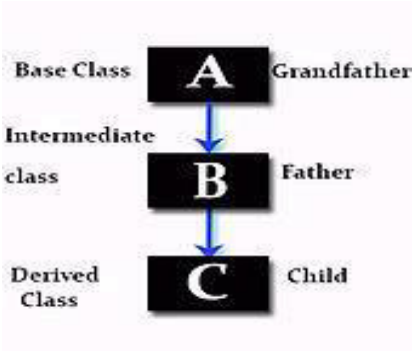

Fig. 3: Multilevel inheritance

The class A serves as a base class for the derived class B, which in turn serves as a base class for the derived class C. The class B is known as intermediate base class because it provides a link for the inheritance between A and C. The chain ABC is known as inheritance path. In this paper, the focus is on single inheritance, which involves a subclass inheriting the features of the superclass or parent class.

2. RELATED WORKS

Many authors have worked on the mapping from XML to object-oriented databases, Xiao et. al. (2001) discussed modeling of XML and the need for transformation where some generic transformation rules of the conceptual model OO to the XML schema were presented, accentuated on transforming inheritance and aggregation relationships. Malki and Bahaj (2015) worked on Semantic Enrichment of XML Schema to Transform Association Relationships in ODL Schema with the aim to automate transformation process of an XML schema to an ODL

ODL Schema with the aim to automate transformation process of an XML schema to an ODL database. Eric and Wenny (2004) worked on Updating Inheritance Relationship in XML Documents, the main focus of their work was on preserving the inheritance relationship semantics. The paper proposed the mapping of inheritance relationships in the conceptual level to the XML Schema. Robust Representation for Conversion of UML Class into XML Document using DOM was presented by Noreddine and Mohamed (2001). The paper presented a Framework for converting a class diagram into an XML structure and showed how to use Web files for the design of data warehouses based on the classification of UML. Preserving Conceptual Constraints during XML Updates was presented by Eric and Wenny (2004). The objectives of majority of these works was to automate the transformation process of an XML schema to an ODL database by focusing on preserving semantics transformation of association relationships and describing a set of rules to create ODL classes from an enriched XML schema. This approach was limited in the enrichment of the XML schema; hence, a need to develop an inheritance relationship.

3. METHODOLOGY

In the XML schema we introduced the inheritance relationship between the superclass "PERSON" and the subclass "STUDENT based on the association relationship between the two entities "PERSON" and "HOUSE" with the property "livesIn" which links them to each other. This link indicates that a person lives in a house, but our focus is the relationship between the superclass and the subclass, the subclass inherits all the property or behavior of the superclass. A student is a person, and since a person lives in a house, this implies that a student lives in a house. This relationship is depicted in figure 4 below.

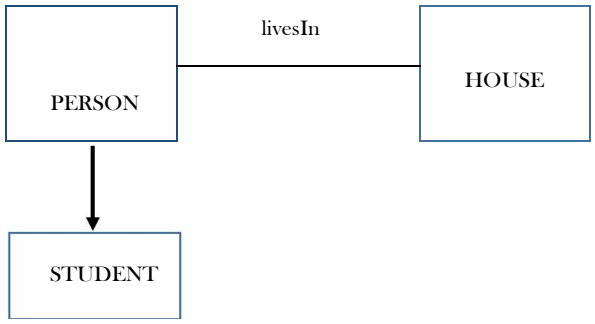

Figure 4: Example of inheritance relationship

Based on this inheritance, XML schema to achieve that is given on the next page

XML Schema

```
<xsd:element
  name="person"
  >
  <xsd:complexT
  ype>
  <xsd:sequence>
    ...
   </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element
  name="
  house">
  <xsd:complex
  Type>
  <xsd:sequence
  >
      ...
   </xsd:sequence>
  </xsd:complexType>
</xsd:element>
<xsd:element
  name="
  student">
  <xsd:complexTy
  pe>
  <xsd:sequence>
      ...
   </xsd:sequence>
   </xsd:attribute name=”inherits” type=”inheritance” value=”person” use=”required”/>
  </xsd:complexType>
</xsd:element>
<xsd:key
  name="CT1_K
  "> <xsd:
  selector
  xpath=".//E1"/>
  <xsd: field
  xpath="attr1"/>
</xsd:key>
<xsd:key
  name="CT2_K">
  <xsd: selector
  xpath="// CT2"/>
  <xsd: field
  xpath="attr2"/>
</xsd:key>
<  xsd: keyref name="CT1_CT2_Ref" refer=" CT1_K">
  <  xsd: selector xpath = "CT2"/>
  <  xsd: field xpath="@attr1"/>
</keyref>
<  xsd: keyref name="CT2_CT1_Ref" refer="CT1_K">
  <  xsd: selector xpath = "CT1"/>
  <  xsd: field xpath="@attr1"/>
</keyref>
```

4. ALGORITHM FOR SCHEMA TRANSLATION

The table below shows the algorithm of XML_ODL for mapping XML schema into ODL schema. The algorithm reads each XML complex type one by one and maps it to ODL. In line 4, the complex type is mapped to a class, the algorithm maps all its elements to attributes of the class and forms the relationship with other classes. Line 5 was added to define the subclass which is an extension of the superclass.

Table 1: Algorithm mapXML_ODL

Algorithm mapXML_ODL
Input:
Cdm:CDM

```
1.  For ( complex type CTn in the CDM cdm CTn E cdm)
2.  {
8.  // map CTn into a class with same name
4.  Procedure map_CT_Class(CTn)
5.  Procedure map_CT_Subclass(CTn)
6.  if cla.tag<> R then
7.  {
8.  // map all elements | attribute to attributes with the same name and data type in class
    CTn
9.  Procedure map_clan_t(cla.clan, cla.t)
10. // if cla.tag = = K then
11. // Mention clan as a key
12. Procedure key(cla.clan)
18. }
14. Else if Rel.Occ = = 0.1
15. // map elementrole to relationship as one
16. // add relationships
17. Procedure add_rel_one (Rel. CTn_referred_to, cla.clan,Rel.
    F_xpath_of_CTn_referred_to)
18. Else Rel.Occ = = unbounded then
19. // map elementrole to relationship as many
20. // add relationship as set|bag
21. Procedure add_rel_may (Rel. CTn_referred_to, cla.clan,Rel.
    F_xpath_of_CTn_referred_to)
22. }
28. }
```

5. DISCUSSION

The XML_ODL algorithm developed maps XML schema into an ODL schema. A subclass which is an extension of the superclass was introduced. The development of an inheritance is a better mapping method compared to the association relationship used in the work of Malki and Bahaj, 2015.

6. CONCLUSION

In this work, an inheritance relationship which is an improvement on the existing work was developed. The preservation of semantic transformation is possible because inheritance relationship permits the subclass to inherit the properties of the superclass without any loss of the semantic.

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