Chapter 16

MAXDOR Model

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ABSTRACT

This chapter gives a full description of the proposed model introduced by the authors. The new model is called MAXDOR for mapping XML document into relational database. The description includes mathematical concepts that are used in this model, the labelling method used to label XML document and identify its content, and the design framework used to maintain the document structure, parent-child, ancestor-descendant, and siblings relations among document contents. It also presents a set of algorithms for mapping, reconstructing, updating, and retrieving XML documents.

MAXDOR THEORY

Storing XML document into relational database means storing ordered, hierarchical and structured information into an unordered tables. XML manipulation is still facing some problems such as retrieving information, updating data contents, concurrency control and multi-user access. These problems can be overcome by using relational database to store, update and retrieve XML documents contents. Labelling techniques are used in order to preserve XML document structure, and the relations among its contents. MAXDOR adopts the Global Labelling method with some modifications (Tatarinov et al., 2002). Global Labelling is modified to make the cost of the execution time of XML document updating constant, and to preserve parent-child and ancestor-descendant relationships. The modified method uses document structure information to guide the mapping process, Consequently DTD or XML Schema information availability is not required.

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**Theory Background**

The hierarchy of XML document could be represented as a tree structure. XML tree can clearly represent the relationships between nodes of document content. Definitions 1 and 2 identify composite and associative relations between XML document elements, both as parent-child and ancestor-descendant relations. These relations help retrieve XML document contents as regular XPath expressions, and optimize query process. More details are given in section 4.2.4.

**Definition 1: Composite relation:** Given that \( f \) is a parent-child relation between \( X \) and \( Y \), in a way that \( f: X \rightarrow Y \), and \( g \) is a parent-child relation between \( Y \) and \( Z \), \( g: Y \rightarrow Z \), then the composition \( h: g \circ f \) is ancestor-descendant relation between \( X \) and \( Z \) as \( h: X \rightarrow Z \), (Oosten, July 2002). Figure 1 illustrates this composite relation.

**Definition 2: Associative relation:** Suppose \( f \) is a parent-child relation between \( X \) and \( Y \) as \( f: X \rightarrow Y \), \( g \) is a parent-child relation between \( Y \) and \( Z \) as \( g: Y \rightarrow Z \), and \( h: Z \rightarrow W \), then the composition \( i: g \circ f \) is ancestor-descendant relation between \( X \) and \( Z \), \( j: h \circ g \) is ancestor-descendant relation between \( Y \) and \( W \), and \( K: (h \circ g) \circ f = h \circ (g \circ f) \) is also ancestor-descendant relation between \( X \) and \( W \), (Oosten, July 2002). Figure 2 illustrates this associative relation.

**Definition 3:** An XML tree is a collection of many nested subtrees of depth two. It can be denoted as follows:

\[
T = \sum_{i=1}^{n} \sum_{j=1}^{m} S_{ij}
\]  

(1)

where:

- \( J = 1, 2, \ldots, m \) represent the order of subtree number within \( i^{th} \) level;
- \( I = 1, 2, \ldots, n \) represents tree level number and 1 also represents the tree root; and
- \( S_{ij} \) represents a subtree structure and is denoted as

\[
S_{ij} = E \left( \sum_{r=1}^{k} X_{pr} \sum_{z=1}^{l} A_{r} \sum_{a=1}^{b} E_{pr} \sum_{i=1}^{h} G_{ia} \right)
\]

(2)

where:
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