

An XML-Based Model for Supporting Context-Aware Query and Cache Management

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Context aware mobile information systems (CAMISs):

- understand the context within which their users operate,
- process queries of the users based on the user context,
- use caching techniques to optimize query processing time and the energy consumption

In order to support CAMISs, there is a need to

- model the contextual information related to mobile clients,
- model queries issued by these mobile clients, and
- notify these mobile clients by any relevant update to cached data

Although, database systems (DBSs) are state-of-the art for managing complex data in information systems,:

- DBSs are not aware of the context of their usage,
- Query results are retrieved without considering the context of the user/device issuing the query
- DBSs does not have an update notification mechanism

Problem Statement

Move the complexity of managing context-aware query processing and cache management from middlewares to a built-in function within DBMSs.

Objective Statement

- modeling the contextual information related to mobile clients and their queries executed at the DB server, and
- Realizing such model within DBSs to support context-aware query processing and cache management.

XREAL: An XML-Based Model for Queries and Contextual Information

- XREAL stands for **X**ML-Based **R**elational **A**lgebra
- XREAL formalizes:
 - the contextual information of mobile clients
 - queries issued by these clients
 - manipulation operations
- The XREAL specifications are XML documents that could be managed using any DBMS supporting XML management

XREAL: An XML-Based Model for Queries and Contextual Information

DB&IS
Research
Group

Introduction

Background
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Contributions

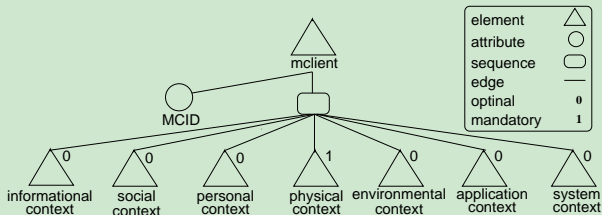
XREAL Model
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Evaluation

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Appendix

The XREAL model for the *mobile client*



XREAL: An XML-Based Model for Queries and Contextual Information

A) Part of the physical context

B) Part of the informational context

A	B
<pre> <relative_position> <country>Germany</country> <city>Bruchsal</city> <area>south</city> <street>Durlacher<street> <postal_code>76646</postal_code> </relative_position> </pre>	<pre> <quote> +<value> +<newspaper> +<section> +<date> +<description> </quote> </pre>

Example

The *QCL* query

retrieve the name, street, and hotline of cinemas in my current location, where the rate of the cinema is greater than four

An equivalent relational algebra for the *QCL* query

$$\underbrace{\pi_{ctab.cname, ltab.street, ctab.hotline}}_{\text{Projection Predicate}} \left(\underbrace{\sigma_{ctab.RATE > 4 \wedge \text{current location}}}_{\text{Selection Predicate}} \left(\underbrace{\left(\rho_{ctab}(\text{cinema_tab}) \bowtie_{ctab.LID = ltab.LID} \rho_{ltab}(\text{location_tab}) \right)}_{\text{Join Predicate}} \right) \right)$$

An equivalent relational algebra for the QCL query

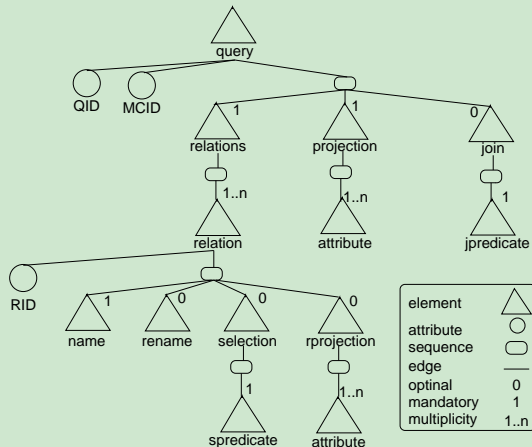
$$\begin{array}{c}
 \text{Projection Predicate} \qquad \qquad \qquad \text{Selection Predicate} \\
 \underbrace{\pi_{ctab.cname, ltab.street, ctab.hotline}}_{\text{Join Predicate}} \left(\underbrace{\sigma_{ctab.RATE > 4 \wedge \text{current location}}}_{\text{Join Predicate}} \left(\rho_{ctab}(\text{cinema_tab}) \bowtie_{ctab.LID = ltab.LID} \rho_{ltab}(\text{location_tab}) \right) \right)
 \end{array}$$

An equivalent relational algebra for the QCL query

$$\begin{array}{l}
 (\pi_{ctab.cname, ctab.hotline, ctab.LID}(\sigma_{ctab.RATE > 4}(\rho_{ctab}(\text{cinema_tab})))) \\
 \bowtie_{ctab.LID = ltab.LID} \\
 (\pi_{ltab.street, ltab.LID}(\sigma_{\text{current location}}(\rho_{ltab}(\text{location_tab}))))
 \end{array}$$

XREAL: An XML-Based Model for Queries and Manipulations

The XREAL model for a relational algebra query



An Example

The XREAL specification of the **QCL** query

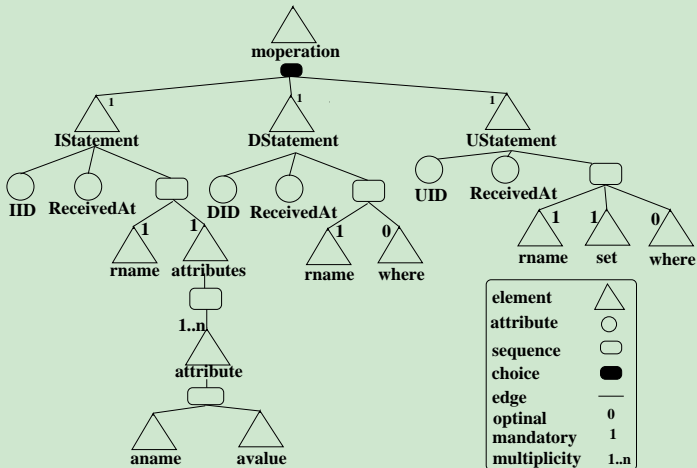
```

<query QID="QID1" MCID="MC101">
  <relations>
    +<relation RID="RID01">
    +<relation RID="RID02">
  </relations>
  <join>
    <jpredicate>
      <simplePredicate>
        <attribute ofRelation="RID01">
          <name>LID</name>
        </attribute>
        <operator>eq</operator>
        <operand>
          <attribute
            ofRelation="RID02">
            <name>LID</name>
          </attribute>
        </operand>
      </simplePredicate>
    </jpredicate>
  </join>
</query>

```

XREAL: An XML-Based Model for Queries and Manipulations

The XREAL model for SQL manipulation operations



An Example

The XREAL specification of the delete operation

```

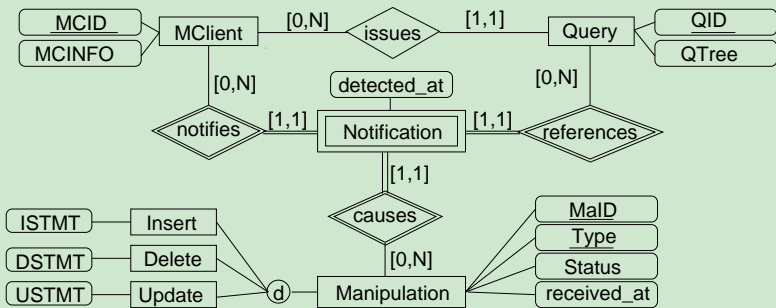
<DStatement DID=" D5001" receivedAt=" 2008-09-12T11:34:27" >
  <lname>cinema_tab</lname>
  <where>
    <spredicate>
      <simplePredicate>
        <attribute>
          <name>CID</name>
        </attribute>
        <operator>eq</operator>
        <operand>
          <value>9903</value>
        </operand>
      </simplePredicate>
    </spredicate>
  </where>
</DStatement>

```

UPTIME :

- is a proof-of-concept system utilizes XREAL to realize within DBMS:
 - a context-aware query processor
 - an update notification mechanism (*Essam Mansour, Hagen Höpfner, EDBT 09*)
- is implemented using Sun Java 1.6 and DB2 Express-C 9.5

The ER diagram of the XReAI Repository



Context-Aware Relational Algebra is a relational algebra with context aware operators, such as:

- current location
- close to
- approaching
- ...

An equivalent relational algebra for the QCL query

$$(\pi_{ctab.cname,ctab.hotline,ctab.LID}(\sigma_{ctab.RATE>4}(\rho_{ctab}(cinema_tab))))$$

$$\bowtie_{ctab.LID=ltab.LID}$$

$$(\pi_{ltab.street,ltab.LID}(\sigma_{\text{current location}}(\rho_{ltab}(location_tab))))$$

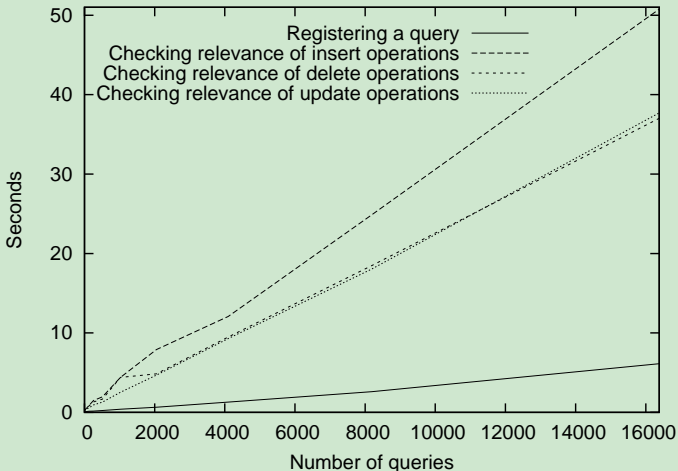
An equivalent relational algebra for the QCL query

$$(\pi_{ctab.cname,ctab.hotline,ctab.LID}(\sigma_{ctab.RATE>4}(\rho_{ctab}(cinema_tab))))$$

$$\bowtie_{ctab.LID=ltab.LID}$$

$$(\pi_{ltab.street,ltab.LID}(\sigma_{postal_code=76646}(\rho_{ltab}(location_tab))))$$

Evaluation of time consumption



- Different research efforts, such as [1, 2], investigated into the topic of XML algebra.
- XREAL is distinguished by providing an XML-based representation for relational algebra queries, and
- XREAL extends relational algebra to support context aware queries.

[1] H. V. Jagadish, Laks V. S. Lakshmanan, Divesh Srivastava, and Keith Thompson. TAX: A Tree Algebra for XML. In DBPL 2001, pages 149–164.

[2] Matteo Magnani and Danilo Montesi. XML and Relational Data: Towards a Common Model and Algebra. In IDEAS 2005, pages 96–101.

The major advantages of the XREAL model:

- the direct integration into modern DBSs,
- XREAL provides context-aware management support within these DBSs, and
- the XREAL specification is to be shared among heterogeneous applications and systems.

- the formalization of the correlation between different contexts
- the formalization of advanced context-aware predicates in the form relational algebra operations, and
- Developing a context-aware query processor within DBMSs based on XREAL.

Thank You

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A generic SQL template for the insert statements

Insert into NOTIFICATION

select *MCID?*, *QID?*, *MaID?*, *Type?* , **current timestamp**
from *sysibm.sysdummy1*

where $0 <$

(a SQL query that

is generated according to the DRUPE method to count
the number of rows in the intersection using *count(*)*)