Introduction to Database Systems
CSE 444

Lecture 12
Xquery in SQL Server

October 22, 2007

Announcements

- Project phase 2 due Saturday night
- Midterm Next Monday. To study (tentative)
  - SQL
  - E/R diagrams
  - Functional dependencies and BCNF
  - XML Basics (notation, DTDs)
    - But hw3 is xquery/xpath, so most XML details on final
- Open book exam !!

Sorting in XQuery

```
<publisher_list>
 { FOR $b IN document("bib.xml")//book[year = “97”]
   ORDER BY $b/price/text()
   RETURN <book>
                    {  $b/title ,
                       $b/price
                    }
               </book>
 }
</publisher_list>
```

If-Then-Else

```
FOR $h IN //holding
RETURN <holding>
              {  $h/title,
                 IF $h/@type = "Journal"
                        THEN $h/editor
                 ELSE $h/author
               }
          </holding>
```

Existential Quantifiers

```
FOR $b IN //book
WHERE SOME $p IN $b//para SATISFIES
                    contains($p, "sailing")
                    AND contains($p, "windsurfing")
RETURN { $b/title }
```

Universal Quantifiers

```
FOR $b IN //book
WHERE EVERY $p IN $b//para SATISFIES
                    contains($p, "sailing")
RETURN { $b/title }
```

Duplicate Elimination

- distinct-values(list-of-text-values)
- How do we eliminate duplicate “tuples” ?

```
<row>  <a>3</a>  <b>100</b> </row>
<row>  <a>8</a>  <b>500</b> </row>
<row>  <a>3</a>  <b>100</b> </row>
<row>  <a>3</a>  <b>200</b> </row>
<row>  <a>8</a>  <b>500</b> </row>
```

⇨

```
<row>  <a>3</a>  <b>100</b> </row>
<row>  <a>8</a>  <b>500</b> </row>
<row>  <a>3</a>  <b>200</b> </row>
```

FOR v.s. LET

FOR

- Binds *node variables* → iteration

LET

- Binds *collection variables* → one value

FOR vs. LET

```
FOR $x IN /bib/book
RETURN <result> { $x } </result>
```

Returns:

```
<result> <book>...</book></result>
<result> <book>...</book></result>
<result> <book>...</book></result>
...
```

```
LET $x := /bib/book
RETURN <result> { $x } </result>
```

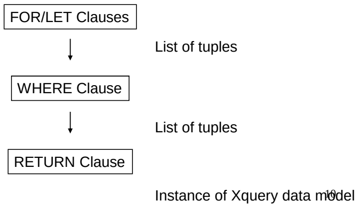
Returns:

```
<result> <book>...</book>
         <book>...</book>
         <book>...</book>
         ...
</result>
```

XQuery

Summary:

- FOR-LET-WHERE-RETURN = FLWR



Collections in XQuery

- Ordered and unordered collections
  - /bib/book/author/text() = an *ordered* collection: result is in *document order*
  - distinct-values(/bib/book/author/text()) = an unordered collection: the output order is implementation dependent
- LET $a := /bib/book → $a is a collection
- $b/author → a collection (several authors...)

```
RETURN <result> { $b/author } </result>
```

Returns:

```
<result> <author>...</author>
         <author>...</author>
         <author>...</author>
         ...
</result>
```

Collections in XQuery

What about collections in expressions ?

- $b/price → list of n prices
- $b/price * 0.7 → list of n numbers
- $b/price * $b/quantity → list of n x m numbers ??
- $b/price * ($b/quant1 + $b/quant2) ≠ $b/price * $b/quant1 + $b/price * $b/quant2   !!

Other XML Topics

- Name spaces
- XML API:
  - DOM = “Document Object Model”
- XML languages:
  - XSLT
- XML Schema
- Xlink, XPointer
- SOAP

Available from www.w3.org
(but don’t spend rest of your life
reading those standards !)

XML in SQL Server 2005

- Create tables with attributes of type XML
- Use Xquery in SQL queries
- Rest of the slides are from:

Shankar Pal et al., *Indexing XML data stored in a relational database*, VLDB’2004

```
CREATE TABLE DOCS (
      ID int primary key,
      XDOC xml)
```

```
SELECT ID, XDOC.query(’
   for $s in  /BOOK[@ISBN= “1-55860-438-3”]//SECTION
   return <topic>{data($s/TITLE)} </topic>')
FROM DOCS
```

XML Methods in SQL

- Query() = returns XML data type
- Value() = extracts scalar values
- Exist() = checks conditions on XML nodes
- Nodes() = returns a rowset of XML nodes that the Xquery expression evaluates to

Examples

- From here: http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnsql90/html/sql2k5xml.asp

XML Type

```
CREATE TABLE docs (
      pk INT PRIMARY KEY,
      xCol XML not null
)
```

Inserting an XML Value

```
INSERT INTO docs VALUES (2,
'<doc id="123">
    <sections>
   <section num="1"><title>XML Schema</title></section>
   <section num="3"><title>Benefits</title></section>
   <section num="4"><title>Features</title></section>
    </sections>
</doc>')
```

Query( )

```
SELECT pk, xCol.query('/doc[@id = 123]//section')
FROM   docs
```

Exists( )

```
SELECT xCol.query('/doc[@id = 123]//section')
FROM   docs
WHERE  xCol.exist ('/doc[@id = 123]') = 1
```

Value( )

```
SELECT xCol.value(
   'data((/doc//section[@num = 3]/title)[1])', 'nvarchar(max)')
FROM docs
```

Nodes( )

```
SELECT nref.value('first-name[1]', 'nvarchar(50)')
                    AS  FirstName,
              nref.value('last-name[1]', 'nvarchar(50)')
                     AS LastName
FROM   @xVar.nodes('//author') AS R(nref)
WHERE  nref.exist('.[first-name != "David"]') = 1
```

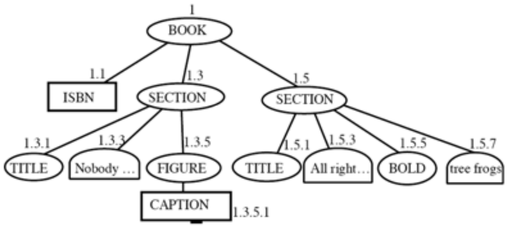
Nodes( )

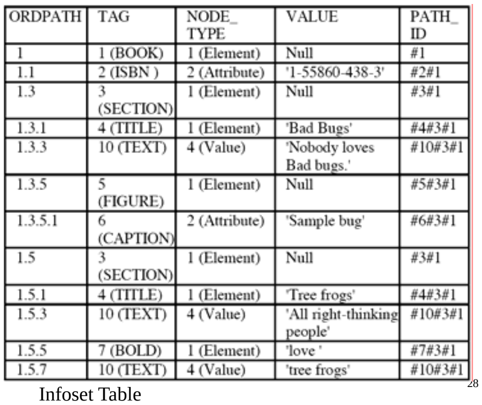
```
SELECT nref.value('@genre', 'varchar(max)') LastName
FROM docs CROSS APPLY
          xCol.nodes('//book') AS R(nref)
```

Internal Storage

- XML is “shredded” as a table
- A few important ideas:
  - Dewey decimal numbering of nodes; store in clustered B-tree indes
  - Use only odd numbers to allow insertions
  - Reverse PATH-ID encoding, for efficient processing of postfix expressions like //a/b/c
  - Add more indexes, e.g. on data values

```
<BOOK ISBN=“1-55860-438-3”>
  <SECTION>
    <TITLE>Bad Bugs</TITLE>
    Nobody loves bad bugs.
    <FIGURE CAPTION=“Sample bug”/>
  </SECTION>
  <SECTION>
   <TITLE>Tree Frogs</TITLE>
   All right-thinking people
   <BOLD> love </BOLD>
   tree frogs.
  </SECTION>
</BOOK>
```





ORDPATH	TAG	NODE_ TYPE	VALUE	PATH_ ID
1	1 (BOOK)	1 (Element)	Null	#1
1.1	2 (ISBN)	2 (Attribute)	'1-55860-438-3'	#2#1
1.3	3 (SECTION)	1 (Element)	Null	#3#1
1.3.1	4 (TITLE)	1 (Element)	'Bad Bugs'	#4#3#1
1.3.3	10 (TEXT)	4 (Value)	'Nobody loves Bad bugs.'	#10#3#1
1.3.5	5 (FIGURE)	1 (Element)	Null	#5#3#1
1.3.5.1	6 (CAPTION)	2 (Attribute)	'Sample bug'	#6#3#1
1.5	3 (SECTION)	1 (Element)	Null	#3#1
1.5.1	4 (TITLE)	1 (Element)	'Tree frogs'	#4#3#1
1.5.3	10 (TEXT)	4 (Value)	'All right-thinking people'	#10#3#1
1.5.5	7 (BOLD)	1 (Element)	'love '	#7#3#1
1.5.7	10 (TEXT)	4 (Value)	'tree frogs'	#10#3#1

Infoset Table

/BOOK[@ISBN = “1-55860-438-3”]/SECTION

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```
SELECT SerializeXML (N2.ID, N2.ORDPATH)
FROM infosettab N1  JOIN infosettab N2 ON (N1.ID = N2.ID)
WHERE N1.PATH_ID = PATH_ID(/BOOK/@ISBN)
    AND N1.VALUE = '1-55860-438-3'
    AND N2.PATH_ID = PATH_ID(BOOK/SECTION)
    AND Parent (N1.ORDPATH) = Parent (N2.ORDPATH)
```