

Relational Database Adaptors

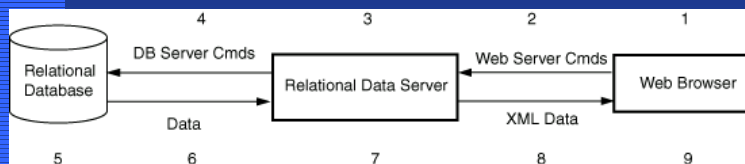
Mark Graves

*This presentation is Copyright
2001, 2002 by Mark Graves and
contains material Copyright 2002
by Prentice Hall PTR. All rights
reserved.*

Agenda

- **Rendering relational data as XML**
- **Browsing by following foreign keys**
- **Data Access Process**
- **Commercial Tools**

Rendering Relational Data



1. User specifies a relational query to the web browser as a URL or XML request. ➤
2. Web browser sends the request to the data server.
3. Data server parses the request and creates a SQL query. ➤
4. Data server passes the SQL query to the database server.
5. Database server executes the query.
6. Database server returns the relational report to the data server. ➤
7. Data server renders the report as XML. ➤
8. Data server returns the XML report to the web browser.
9. Web browser parses the XML report and displays it to the user. ➤

Specify Query as URL (#1)

- **Example URL**

```
http://localhost/servlets/com.xweave.xmldb.demo.XMLServlet?
cmd=rdb&tablename=gene&stylesheet=/ss/simple.xsl
```

- **Aspects of URL format**

- **base:** http://localhost/servlets/
- **class:** com.xweave.xmldb.demo.XMLServlet?
- **command:** cmd=rdb&
- **query:** tablename=gene&
- **presentation:** stylesheet=/ss/simple.xsl

Specify Query as JSP Taglib (#1)

```
<HTML>
<H1>List all Genes</H1>
<%@ taglib uri="xmldb-taglib.tld" prefix="xmldb" %>
<%@ taglib uri="xsl.tld" prefix="xalan" %>
<xalan:apply xsl="ss/simple.xsl">
  <xmldb:simplecmd name="RDB">
    <xmldb:field name="tablename">GENE</xmldb:field>
  </xmldb:simplecmd>
</xalan:apply>
</HTML>
```

Relational Database Query (#3,#6)

Select * from gene;

NAME	DESCRIPTION	PATHWAY
TYR1	PREPHENATE DEHYDROGENASE	TYROSINE BIOSYNTHESIS
GRD19	GOLGI PROTEIN RETENTION	SECRETION
SEC72	ER PROTEIN TRANSLOCATION SUBCOMPLEX SUBUNIT	SECRETION
TAF60	TFIID 60 KD SUBUNIT	TRANSCRIPTION
RHO3	GTP-BINDING PROTEIN, RHO FAMILY	CYTOSKELETON
YFH1	FRATAXIN HOMOLOG	IRON HOMEOSTASIS, MITOCH
SNF6	COMPONENT OF SWI/SNF GLOBAL ACTIVATOR COMPLEX	TRANSCRIPTION
PDE1	3',5'-CYCLIC-NUCLEOTIDE PHOSPHODIESTERASE	PURINE METABOLISM
ECM37	UNKNOWN	CELL WALL BIOGENESIS
ECM27	UNKNOWN	CELL WALL BIOGENESIS

Render Relational Data as XML (#7)

Pseudo-code

```
procedure
  writeXMLEmbedElements(table)
  print "<?xml version='1.0'?"
  print "<collection>"
  for each row in table
    print "<record>"
    for each column in row
      print "<" columnname ">"
      print value
      print "</" columnname ">"
    end
    print "</record>"
  end
  print "</collection>"
end
```

XML

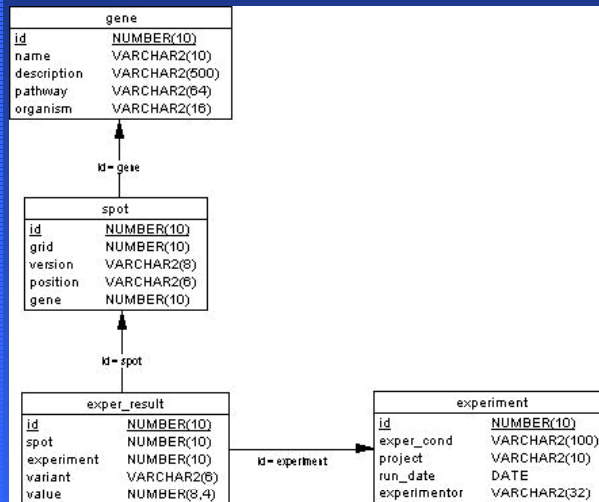
```
<?xml version="1.0"?>
<?xml:stylesheet type="text/xsl"
  href="/ss/simple.xsl"?>
<collection>
<record>
  <NAME>TYR1</NAME>
  <DESCRIPTION>PREPHENATE
    DEHYDROGENASE</DESCRIPTION>
  <PATHWAY>TYROSINE
    BIOSYNTHESIS</PATHWAY>
</record>
<record>
  <NAME>GRD19</NAME>
  <DESCRIPTION>GOLGI PROTEIN
    RETENTION</DESCRIPTION>
  <PATHWAY>SECRETION</PATHWAY>
</record>
</collection>
```

Relational Data via XSL (#9)

Address: http://127.0.0.1/servlets/com.xweave.xmldb.demo.XMLServlet?cmd=db&tablename=gene&stylesheet=/ss/simple.xsl&reportargs=name,description

NAME	DESCRIPTION	PATHWAY
TYR1	PREPHENATE DEHYDROGENASE (NADP+	TYROSINE BIOSYNTHESIS
GRD19	GOLGI PROTEIN RETENTION	SECRETION
SEC72	ER PROTEIN TRANSLOCATION SUBCOMPLEX SUBUNIT	SECRETION
TAF60	TFIID 60 KD SUBUNIT	TRANSCRIPTION
RHO3	GTP-BINDING PROTEIN, RHO FAMILY	CYTOSKELETON
YFH1	FRATAxin HOMOLOG	IRON HOMEOSTASIS, MITOCH
SNF6	COMPONENT OF SWI/SNF GLOBAL ACTIVATOR COMPLEX	TRANSCRIPTION
PDE1	3',5'-CYCLIC-NUCLEOTIDE PHOSPHODIESTERASE	PURINE METABOLISM
ECM37	UNKNOWN	CELL WALL BIOGENESIS
ECM27	UNKNOWN	CELL WALL BIOGENESIS
SEC2	GDP/GTP EXCHANGE FACTOR FOR SEC4P	SECRETION
TFC1	TFIIIC 95 KD SUBUNIT	TRANSCRIPTION

Example Microarray Database



Microarray Database Browsing

EXPER_RESULT LISTING

ID	SPOT	EXPERIMENT	VARIANT	VALUE
8299	1094	102	240	0.21
8300	1094	102	270	0.18
8301	1094	102	300	-0.15
8302	1094	102	330	0.19
8303	1094	102	360	0.04
8304	1094	102	390	0.07
8305	1094	103	10	-0.23
8306	1094	103	38	-0.25
8307	1094	103	50	-0.32
8308	1094	103	70	-0.45
8309	1094	103	90	-0.67
8310	1094	103	110	-0.58
8311	1094	103	130	-0.74

SPOT ID=1094

GRID ID: 1
VERSION:
POSITION: 95
GENE: 1094

GENE ID=1094

NAME: PAK1
DESCRIPTION: PROTEIN KINASE, SUPPRESSES POL ALPHA MUTATIONS
PATHWAY: DNA REPLICATION
ORGANISM:

EXPERIMENT ID=102

EXPER_COND: Ets
PROJECT: EISEN
RUN_DATE:
EXPERIMENTOR:

Rendering Foreign Keys

- Extract primary and foreign keys from system table
- When rendering value for a column, check foreign key table
- If column is a foreign key, create “proxy” element with foreign key table and column value
- Render “proxy” element as hypertext link to database query command

Extract Foreign Keys

SQL (IBM DB2)

```
select c.tabname child_table, c.colname child_column,  
       p.tabname parent_table, p.colname parent_column  
from syscat.references l, syscat.keycoluse c, syscat.keycoluse p  
where l.constname = c.constname  
       and l.refkeyname = p.constname  
       and l.tabschema = c.tabschema  
       and l.reftabschema = p.tabschema  
       and c.colseq = p.colseq
```

CHILD_TABLE	CHILD_COLUMN	PARENT_TABLE	PARENT_COLUMN
SPOT	GENE	GENE	ID
EXPER_RESULT	SPOT	SPOT	ID
EXPER_RESULT	EXPERIMENT	EXPERIMENT	ID

Render Proxy as Hypertext Link

XML `<proxy tablename="SPOT" id="1094"/>`

XSL `<xsl:template match="proxy">
 <xsl:element name="a">
 <xsl:attribute name="href">http://localhost/servlets?
 tablename=<xsl:value-of select="@tablename"/>&
 id=<xsl:value-of select="@id"/>&
 stylesheet=http://localhost/ss/generic.xsl
 </xsl:attribute>
 <xsl:value-of select="@id"/>
 </xsl:element>
</xsl:template>`

HTML `<a href="http://localhost/servlets?tablename="SPOT"&id="1094"
&stylesheet="http://localhost/ss/generic.xsl">1094`

Process: Webserver Call

- **Create a servlet (or CGI) that accesses data through URL parameter list:**
 - Oracle account
 - Tablename
 - Unique identifier
 - Stylesheet
 - Depth
 - Query constraints on column

Process: Database Connection

- **Extract data from Oracle database using JDBC**
- **Retrieve table relationships from system tables (Data Dictionary) -- foreign key constraints**
- **Format data as XML using table and column names as element type names**
- **Recursively embed XML associated with child (parent) tables until depth limit is reached**
- **Embed proxy in XML with tablename and unique identifier**

Process: Document Rendering

- Web browser receives XML document with embedded stylesheet information
- Determine which XSL template to use based on document content (one record or many)
- Format XML using stylesheet and display as HTML
- Create hyperlinks for proxies and embedded records

Commercial Relational DBMS

- IBM DB2 XML Extender
(www.ibm.com/developer/xml/) or
(www.ibm.com/software/data/db2/).
- Informix (www.informix.com/xml/).
- Microsoft SQL Server 2000
(msdn.microsoft.com/xml/default.asp).
- Oracle XSQL
(technet.oracle.com/tech/xml/).

XML Adaptors for RDBMS

- BeanStalk (www.transparency.com)
- HiT Software (www.hit.com)
- Merant (www.merant.com)
- Xaware (www.xaware.com)
- XML-DB Link (www.roguewave.com)
- XML-DBMS (www.rpbouret.com)
- XML Shark (www.infoshark.com)