Pathfinder assembles relational XQuery processing techniques into a purely relational XQuery processing stack.

- **FLWOR**, node construction, ...
- **loop-lifting** (VLDB 2004)
- **staircase join** (VLDB 2003)
- **XPath accelerator** (SIGMOD ’02)
- **SQL**, relational algebra

**Diagram:**
- **RDBMS**
- **Tree Encoding**
- **XPath Axes**
- **Compiler**
- **XQuery**

**Jens Teubner, TU München**
We provide **full XQuery support.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
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</thead>
<tbody>
<tr>
<td>literals</td>
<td>42, &quot;foo&quot;, (), ...</td>
</tr>
<tr>
<td>arithmetics</td>
<td>$e_1 + e_2, e_1 - e_2, ...</td>
</tr>
<tr>
<td>built-in functions</td>
<td>fn:sum($e), fn:count($e), fn:doc($uri), ...</td>
</tr>
<tr>
<td>variable bindings</td>
<td>let $v := $e_1 return $e_2</td>
</tr>
<tr>
<td>iteration</td>
<td>for $v at $p in $e_1 return $e_2</td>
</tr>
<tr>
<td>conditionals</td>
<td>if $p$ then $e_1$ else $e_2</td>
</tr>
<tr>
<td>sequence construction</td>
<td>$e_1, e_2</td>
</tr>
<tr>
<td>function calls</td>
<td>$f(e_1, e_2, ..., e_n)$</td>
</tr>
<tr>
<td>element construction</td>
<td>element $e_1$ { $e_2$ }</td>
</tr>
<tr>
<td>XPath steps</td>
<td>$e/\alpha::\nu$ (full axis feature)</td>
</tr>
</tbody>
</table>

- Expressions nest arbitrarily!
A rather standard relational algebra suffices.

\( \pi \) column projection, renaming
\( \sigma \) row selection
A rather standard relational algebra suffices.

\[\pi\] column projection, renaming

\[\sigma\] row selection

\[\bowtie\] equi-join

\[\times\] Cartesian product

\[\cup, \setminus\] disjoint union, difference

\[\delta\] duplicate elimination
A rather standard relational algebra suffices.

- $\pi$: column projection, renaming
- $\sigma$: row selection
- $\bowtie$: equi-join
- $\times$: Cartesian product
- $\cup$, \setminus: disjoint union, difference
- $\delta$: duplicate elimination
- $\varrho$: row numbering
A rather standard relational algebra suffices.

### Operators

- **π** column projection, renaming
- **σ** row selection
- **⋈** equi-join
- **×** Cartesian product
- **∪, \** disjoint union, difference
- **δ** duplicate elimination
- **ϱ** row numbering
- **+xml** staircase join*
- **ε, τ** element/text node construction*

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*Syntactic sugar; expressible by remaining operators.*
A rather standard relational algebra suffices.

- $\pi$: column projection, renaming
- $\sigma$: row selection
- $\bowtie$: equi-join
- $\times$: Cartesian product
- $\cup$, \$: disjoint union, difference
- $\delta$: duplicate elimination
- $\rho$: row numbering
- $\rho$*: staircase join*
- $\varepsilon, \tau$: element/text node construction*
- $\odot$: arithm./comparison operator *

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- Operates on node (not tree!) level, 1NF relations.

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- \( \delta \) duplicate elimination
- \( \varrho \) row numbering
- \( \text{staircase join}\)
- \( \varepsilon, \tau \) element/text node construction
- \( \odot \) arithm./comparison operator

- Operates on node (not tree!) level, 1NF relations.

*Syntactic sugar; expressible by remaining operators.
Version 0.8 of MonetDB/XQuery was released on May 30.

- Unsurpassed scalability, beyond 10 GB input document size.
The Pathfinder project is a joint effort of the Technische Universität München, CWI Amsterdam, and the University of Twente.

Optimizations:
- Algebraic join detection
- Order awareness (avoid $\varrho$)
- Use functional and multi-valued dependencies for algebraic optimization

Open Source Implementation:

http://www.pathfinder-xquery.org/

- Backed by main memory DBMS MonetDB.

See you in Demo Group 7 (today, 16:00; tomorrow, 16:00)!