Building web applications using XML technologies

XML, XQuery, XForms, XHTML — A uniform technology stack

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Dr. Christian Grün, Dr. Alexander Holupirek

BaseX.org - The Open Source XML Database and XQuery processor
BaseX GmbH - Professional XML Data Services
Database and Information System Group, U Konstanz
Who we are and where we come from ...

Database and Information System (DBIS) Group, U Konstanz

Christian Grün
Alex Holupirek
Prof. Dr. Marc H. Scholl

BaseX was born here and is still used in active research projects
Who we are and what we are proud of ...

100% Open Source - BSD licensed XML DBMS
  · database and source code is completely free
  · small (~250 people), but steadily growing community
    · users help users
  · see how BaseX / XML is used in the wild

Community
  · Join our mailinglists:
    baseX-talk, baseX-announce, baseX-commits
  · Fork us on github.com/BaseXdb/baseX.git
  · Check documentation docs.baseX.org
Who we are and how we earn a living …

Consultancy and Training
- We help to run BaseX in heterogeneous system architectures
- We provide trainings on XML, XQuery and BaseX itself

Software Development
- Web applications in a pure X* technology stack
- BaseX enhancements, sponsored features

Legal entity to foster the Open Source project
- Currently 3 full-time employees and 6 part-time workers
The BaseX project

Priorities

- High compliance rate to W3C standards
  - XPath / XQuery
  - Extensions: XQuery Update, XQuery Full-Text
- High usability and stability
- Performance, Performance, Performance
What is XQuery 3.0?
- (more than a) query language for XML data
- (more than a) counterpart to SQL
- is a functional language
  - prominent examples: Haskell, Scheme, OCAML, R
  - based on the evaluation of functions: one input, one output
  - no side effects (that would change the state of a program)
  - higher-order functions: functions as arguments
- extensible via user-defined functions and modules
- general purpose language?

Extensions
- Full Text
- Update Facility
- Scripting Extension

Alternatives
- XSLT: comparable features, but specialized on transformations
- SQL 2005: tries to combine SQL and XQuery

Information Processing Language
XML: the data / XQuery: the tool

The BaseX GUI
- focus: ease of use
- interactive visualizations
- keyword search
- real-time querying and filtering
- integrated XQuery editor

Visualizations
- give you better insight into your own data
- built on top of database
  (low main memory usage)
TreeView - XML Data Visualization
XQuery Editor: Query Your Data

```xquery
for $city in doc('factbook')/city/name/text()
where starts-with($city, 'Mu')
order by $city
return $city
```

Query Info
Total Time: 328.48 ms

**Query:** for $city in doc('factbook')/city/name/text()

**Compiling:**
- rewriting where clause to predicate(s)
- pre-evaluating doc("factbook")
- optimizing descendant-or-self step(s)
XQuery
for $file in //file
  where $file[/Name contains text
      ("Woman", "night", "colours") any
  }
return $file

Time Needed: 2.97 ms

XQuery
for $file in //file
  where $file[/pixelHeight < 400]
return $file

Time Needed: 2.7 ms
Main Area of Activity

Web Application Development using XML Technologies
Starting situation

- Data is present as XML

```xml
<file name="05_Like_A_Rolling_Stone.mp3">
  <metadata>
    <title>Like A Rolling Stone</title>
    <artist>Bob Dylan</artist>
    <composer>Bob Dylan</composer>
    <album>Greatest Hits</album>
    <track>5/10</track>
    <recording_date>1965-06-21</recording_date>
    <genre>Folk</genre>
    <encodedby>iTunes 8.0.2</encodedby>
  </metadata>
</file>
```
XML Technologies

- W3C XML Schema
- W3C XQuery
- W3C XQuery Full-Text
- W3C XForms
- W3C XSLT

... use them!
Standard for the generation of electronic forms

- All form widgets are working
- on the same XML data model
- in a synchronized manner
- Widget are directly coupled to the data model

XML data model

```xml
<xf:model>
  <xf:instance>
    <data>
      <!-- ... -->
    </data>
  </xf:instance>
</xf:model>
```
XML data model

```xml
<xf:model>
  <xf:instance>
    <file name="05_Like_A_Rolling_Stone.mp3">
      <metadata>
        <title>Like A Rolling Stone</title>
        <artist>Bob Dylan</artist>
        <composer>Bob Dylan</composer>
        <album>Greatest Hits</album>
        <track>5/10</track>
        <recording_date>1965-06-21</recording_date>
        <genre>Folk</genre>
        <encodedby>iTunes 8.0.2</encodedby>
      </metadata>
    </file>
  </xf:instance>
</xf:model>
```

Output form

```xml
<xf:output ref="/title">
  <xf:label>Current title is: </xf:label>
</xf:output>
```

Input form

```xml
<xf:input ref="/title" incremental="true">
  <xf:label>Change title to: </xf:label>
</xf:input>
```
XML Data Model - matches BaseX-FS' bi-directional transducer for mp3 files

```xml
<file name='05_Like_A_Rolling_Stone.mp3'>
  <metadata>
    <title>Like A Rolling Stone</title>
    <artist>Bob Dylan</artist>
    <composer>Bob Dylan</composer>
    <album>Greatest Hits</album>
    <track>5/10</track>
    <recording_date>1965-06-21</recording_date>
    <genre>Folk</genre>
    <encodedby>iTunes 8.0.2</encodedby>
  </metadata>
</file>
```

XForm Widgets - coupled to and synchronized with XML Data Model

**Output forms**
- Current title is: Like A Rolling Stone
- Artist set to: Bob Dylan
- Date of Recording: 06/21/1965
- Selected genre: Folk

**Input forms**
- Change title to: Like A Rolling Stone
- Change artist to: Bob Dylan
- Change recording date: 06/21/1965
- Genre: Folk
General Solution Strategy

- Use **established industry standards**
- Leverage consistent, **uniform technology stack**
Real Life Application
Lindau Nobel Laureate

- Nobelpreisträgertagung Lindau Bodensee
- Alumni-Portal powered by XQuery
- ... supported by XForms
- Web Application implemented with XML Technologies
Alumni Directory

The Lindau Nobel Laureate Meetings
Educating, Inspiring, Connecting Scientific Generations since 1951

Please Login

Name: Sekretariat
Password: **************
Login

Alumni Directory Lindau Nobel Laureate Meeting
WEB APPLICATIONS

XHTML
Search Forms
Web Services

APPSERVER
Servlet:
Cookies
Sessions
Templating

BASEX
DB:
Persistence
Indexing
Querying

DB Client

Representational State Transfer - programming paradigm for web applications
website generated with XQuery completely
Alumni Profile

Marta Bailey

Research Interests

Motivation for Science

Contact me

Back
Input

Forms

Looking for

Research Interest

Applying and engineering novel biocatalytic tools to provide fundamental understanding to complex biological responses with special focus on the physics of processes taking place at the cell surface.

Motivation for Science

My fascination for scientific research stems in the first place from my own curiosity and from the intellectual challenge of understanding and describing natural phenomena. I enjoy constantly tackling new unanswered questions. While, for a major part of my research work...
Interactive Search
Discography Database

Data: 4,297,128 releases, 14 GB of XML input
Source: http://discogs.com/data/

Artist: Alfred Schnittke
Title: Symphony

Web Applications

XHTML

Search Forms

Web Services

AppServer

Servlet:
Cookies
Sessions
Templating

BaseX

DB:
Persistence
Indexing
Querying

DB Client

Representational State Transfer - programming paradigm for web applications
**Discography Database**

**Data:** 4,297,128 releases, 14 GB of XML input

**Source:** [http://discogs.com/data/](http://discogs.com/data/)

**Artist:** Alfred Schnittke

**Title:** Symphony

---

**Client**

GET or POST Request

GET: `/app/controller/index`

---

**AppServer**

Servlet

GET/

`/app/controller/index`

controller.xq

business logic

index.xq

template

---

**BaseX**

Result

XQuery

---

**Result**

Layout

Response Object

Body

Cookies

---

**BaseX**

DB: Persistence

Indexing

Querying

DB Client

Database

DB:

Persistence

Indexing

Querying

Web Services

XHTML

Search Forms

Servlet Cookies

Templating

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**To maximize your productivity and workflows, we offer professional support, highly customized software solutions and individual trainings on XML, XQuery and BaseX. Our product itself is completely Open Source (BSD-licensed) and platform independent!**

BaseX is a very light-weight, high-performance and scalable XML Database engine and XPath/XQuery Processor, including full support for the W3C Update and Full Text extensions. An interactive and user-friendly GUI frontend gives you great insight into your XML documents.
Discography Database

Data: 4,297,128 releases, 14 GB of XML input
Source: http://discogs.com/data/

Found: 127 results for "Alfred Schnittke" and 14,501 results for "Symphony".

Alfred Schnittke: Symphony # 1
Label: Gramzapis Company GCD 00062
Released: 1987
Country: Russia
Genre: Classical
Style: Post-Modern
Tracklist:
1.1 Senza Tempo. Moderato
1.2 Allegretto
1.3 Lento
1.4 Lento. Allegro

Alfred Schnittke: Symphony No. 6 · Symphony No. 7
Label: BIS BIS-CD-747
Released: 1996-02-00
Country: Sweden
Genre: Classical
Style: Post-Modern
Tracklist:
Symphony No. 6
1 Allegro Moderato
2 Presto
3 Adagio - Attacca -
4 Allegro Vivace
Symphony No. 7
5 Andante - Attacca -
Thank You!

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