



MedioVis

Visual Interface for Searching and Exploring Multimedia Libraries

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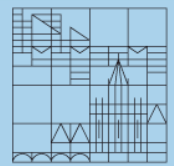
Mathias.Heilig@uni-konstanz.de

mediovis



SOURCEFORGE.NET®

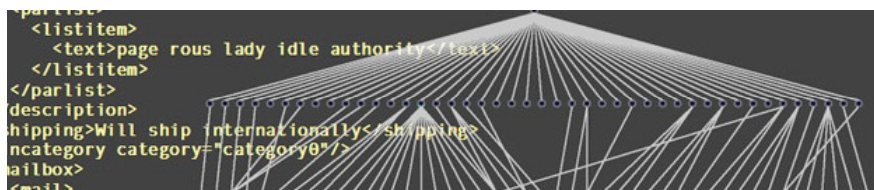
Deutsche
Forschungsgemeinschaft
DFG



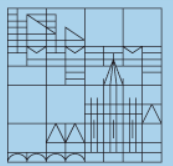
Library of the University of Konstanz
(Director Petra Hätscher)
Application Domain Mediothek



Human-Computer Interaction Group
(Prof. Harald Reiterer)
Interaction Design & Visualization



Database & Information System Group
(Prof. Marc Scholl)
Data Management & Retrieval



Motivation & Goals

Results

New Interaction & Visualization Techniques

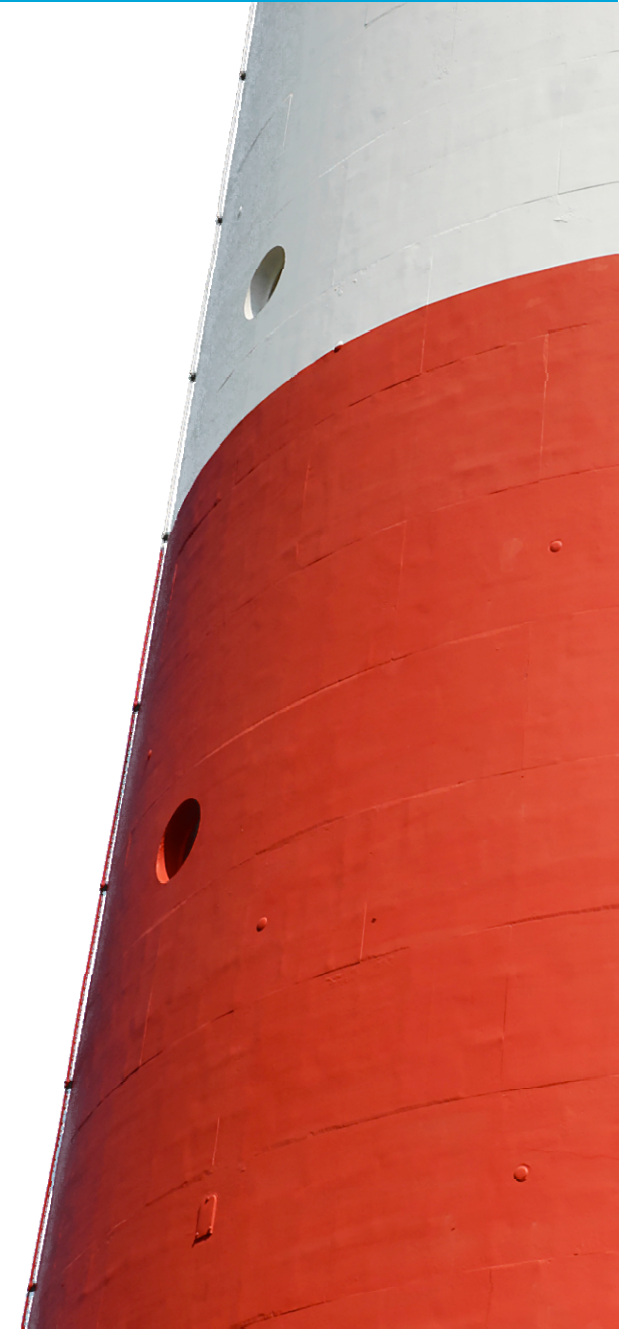
HyperGrid & HyperScatter & Bargrams & Networks

Lessons Learned: Design Principles

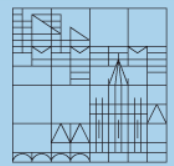
New Data Management & Retrieval Techniques

XML Database System

XQuery/XPath with Fulltext Retrieval & Updates



Motivation I Poor Usability



The image displays three sequential screenshots of a web browser (Microsoft Internet Explorer) showing the library website of the University of Konstanz. The browser's address bar and navigation buttons are visible at the top of each window.

Left Screenshot: The page is titled "Bücher / Medien" under the heading "Bibliothek der Universität Konstanz". It features a search form with the following fields and options:

- Person (Nachname, Vorname): Bergman, Ingrid
- Titelstichwort(e):
- Institution (Phrasen):
- Signatur:
- Einschränkungen: Jahr (von [] bis []), Fachgebiet ([] Kürzel-Liste), Sonderstandort ([] (med / bod)), Suchmodus (trunziert exakt), logische Verknüpfung (und oder).

Buttons for "Suchen" and "Löschen" are present. A link for "Erweiterte Bücher/Medien-Suche" is also visible.

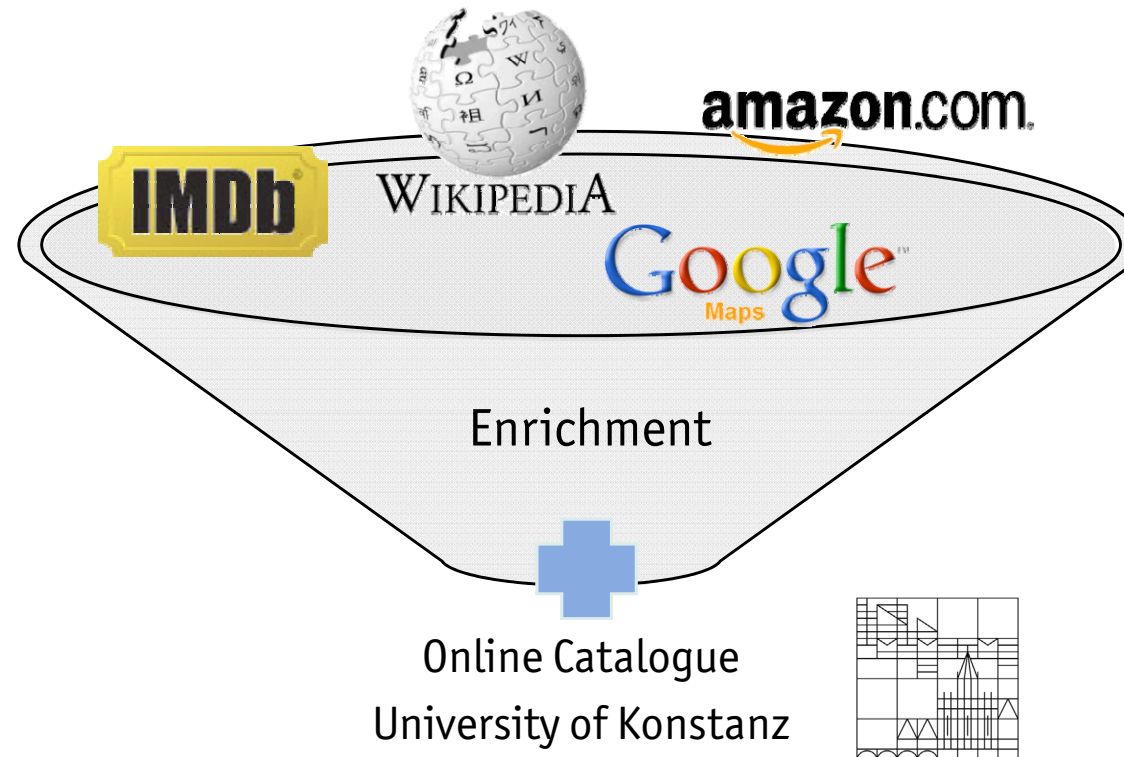
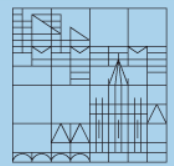
Middle Screenshot: Shows the search results page titled "Lokaler Katalog (Koala)". The search criteria are displayed: "Ihr Suchbegriff in Bücher / Medien war: Name einer Person: Bergman, Ingrid? Suchmodus: trunziert". Navigation buttons for "Vorige Seite" and "Anfang" are shown. A list of search results follows, with the first result being "Casablanca".

Right Screenshot: Shows the detailed record for the book "Casablanca". The title is "Titelanzeige aus der Datenbank: Bücher / Medien". The record includes:

- Author: Curtiz, Michael
- Description: Casablanca / with Humphrey Bogart, Ingrid Bergman, Paul Henreid ... Directed by Michael Curtiz. Untertitel: Christine Kuenstler. - [S.l.], 1942. - 1 Videokassette [VHS] (97 Min.) : s/w
- Language: Engl. Originalton mit dt. Untertiteln
- Subject: Sachgruppe: tff
- Call number: Hinweis: Zaehler: 0:01 - 1:38; Sig.: 6 tff 710:c981/ c18
- Example: Ex. 1: 6 tff 710:c981/ c18; Buchnr: 0050.7428.86
- Status: Normal-Ausleihe bis 17.01.05 garantierte Leihfrist
- Remarks: Vormerkungen: 0, möglich: 3

Navigation links for "Trefferliste" and other menu items are at the bottom.

Motivation II *Infospace = Online Catalog + Web Content & Services*



Content: Users want more than pure Catalog Content because a lot of interesting information are available in the Web.

Services: A lot of useful Web Services are available which should be integrated (Web 2.0).



Traditional UIs are cognitively demanding because ...

- often search function and result visualization are separated and distributed over several pages
- inflexible and static result lists (no filtering, no sorting, ...) without possibilities to control the level of detail or to browse for details on-the-spot
- lots of unstructured content in numerous pop-up windows with demanding window management and without possibilities to visually compare results

Effects of the growing information space:

- searching, finding and analyzing information are becoming the essential tasks,
- therefore users need analytic and goal-directed searching, filtering and comparison ...
- ... as well as browsing-oriented and opportunistic search possibilities.

Our alternative: **mediovis** with zoomable user interfaces (ZUIs)

Client



MedioVis Client Application

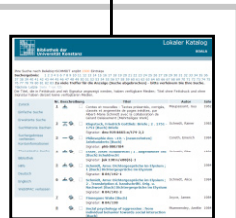
Integ. of functionality of web interface

Integ. of web services and web interfaces of the „Web 2.0“

Visible frontend

Invisible backend

Operational library system with Web OPAC functionality



operational data, e.g. lending, reservation

MedioVis Media Warehouse

XML-Retrieval with XPath

XML-Database
BASE

Integ. of metadata with web crawlers

Data Pumps

MAB2

Library catalog data

Library

amazon.com



„Web 1.0“



WIKIPEDIA

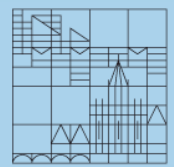


„Web 2.0“

etc.

amazon.com

SERVER



Film	Content	People Involved
<input type="checkbox"/> Flags of Our Fathers	Drama; War	Clint Eastwood
<input type="checkbox"/> Hellboy	Adventure; Horror; Sci-Fi; Action	Guillermo del Toro
<input type="checkbox"/> Million Dollar Baby	Drama	Clint Eastwood
<input type="checkbox"/> Welcome to Mooseport	Comedy	Donald Petrie
<input type="checkbox"/> Épreuves d'artistes	Documentary	Samuel Faure; Gilles Jacob
<input type="checkbox"/> A Decade Under the Influenc...	Documentary	Ted Demme; Richard LaGravenese
<input type="checkbox"/> How to Go Out On a Date In ...	Comedy	Michelle Danner
<input type="checkbox"/> My Big Fat Greek Life	Comedy	Pamela Fryman; Peter Bonerz; Gail Ma...
<input type="checkbox"/> Mystic River	Drama; Crime; Mystery	Clint Eastwood
<input type="checkbox"/> The Blues	Drama; Music; Documentary	Charles Burnett; Clint Eastwood; Mike ...
<input type="checkbox"/> Blood Work	Crime; Thriller; Drama; Mystery	Clint Eastwood
<input type="checkbox"/> Chicago	Musical; Comedy; Crime; Drama	Rob Marshall
<input type="checkbox"/> My Big Fat Greek Wedding	Comedy; Romance	Joel Zwick
<input type="checkbox"/> Kurosawa	Documentary	Adam Low
<input type="checkbox"/> Space Cowboys	Adventure; Sci-Fi; Drama; Comedy	Clint Eastwood
<input type="checkbox"/> Where the Money Is	Drama; Comedy; Crime	Marek Kanievskia
<input type="checkbox"/> Breakfast of Champions	Comedy	Alan Rudolph
<input type="checkbox"/> Onegin	Drama	Martha Fiennes
<input type="checkbox"/> True Crime	Crime; Thriller; Drama	Clint Eastwood
<input type="checkbox"/> AFI's 100 Years... 100 Movie...	Documentary	Tom Donahue
<input type="checkbox"/> Junket Whore	Documentary	Debbie Melnyk
<input type="checkbox"/> Absolute Power	Thriller; Crime; Drama	Clint Eastwood
<input type="checkbox"/> Midnight in the Garden of Go...	Crime; Drama	Clint Eastwood
<input type="checkbox"/> Wild Bill: Hollywood Maverick	Documentary	Todd Robinson

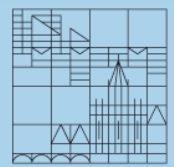
The Table

- well-known and popular in “real life”
 - perfect for sorting, filtering and comparing multidimensional (meta)data
 - trade-off between visible amount of information and usability of large/wide tables
- displays only “the tip of the iceberg”!

The Browser

- popular interaction paradigm: point & click
 - perfect for presenting loosely structured and heterogeneous content on multiple interlinked pages
 - but: only loosely structured and spread over multiple pages → no comparisons and no global overview
- „drills down” into the iceberg!






MedioVis 0.60 (Quentin) - demonstrating visual search on IMDb.com example data

eastwood 95 Hits in 5045 items

Hyperlinked content in a gridstructure = HyperGrid

Film	Content	People Involved	Year
<input type="checkbox"/> A Century of Cinema	Documentary	Caroline Thomas	1994
<input type="checkbox"/> A Decade Under the Influence	Documentary	Ted Demme; Richard LaGravenese	1998
<input type="checkbox"/> A Perfect World	Action; Drama; Crime	Clint Eastwood	1993
<input type="checkbox"/> Absolute Power	Genre: Thriller; Crime; Drama Rating: 6.4 Plot: Based on the novel by David Baldacci, Absolute Power is about the ruthlessness ... User Comment: In the process of pulling his last job, a master thief witnesses a mu... Trivia: This adaptation of David Baldacci's novel omits the novel's hero: Jack Graham... Recommendations: Traffic, Red Dragon, No Way Out, The Guilty, Carlito's Way, Ris... Certification: Argentina:16; Australia:M; Belgium:KNT; Chile:18; Finland:K-16; France:U; Germany:12; Netherlands:16; N...	 <p>Clint Eastwood</p> <p>Alternative name : - Date of Birth : 31 May 1930 Location : St. Francis Hospital, San Francisco, California, USA Filmography as : Actor, Director, Producer, Composer, Miscellaneous Crew, Writer, Himself, Archvmaterial, Notable TV Guest Appearances Movies : Million Dollar Baby</p> <ul style="list-style-type: none"> Blood Work Space Cowboys True Crime Absolute Power The Bridges of Madison County A Perfect World In the Line of Fire Unforgiven... 	1997
<input type="checkbox"/> AFI's 100 Years... 100 Movies...	Documentary	Tom Donahue	1998
<input type="checkbox"/> Amazing Stories	Horror; Fantasy; Sci-Fi; Thriller	Tom Holland; Graham Baker; Bob Balaban; Paul Bartel; Brad Bird; T...	1985
<input type="checkbox"/> Ambush at Cimarron Pass	Western	Jodie Copelan	1958
<input type="checkbox"/> Any Which Way You Can	Comedy	Buddy Van Horn	1980

Rows = individual entries

Columns = Aspects of Interest (AOI)

Clint Eastwood - Microsoft Internet Explorer

http://www.imdb.com/name/nm000142/

IMDb Earth's Biggest Movie Database

Search the IMDb

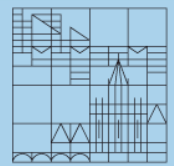
Results: 1 of 76

Clint Eastwood

Date of birth (location)
31 May 1930
San Francisco, California, USA

Mini biography
Perhaps the icon of macho movie stars, and a living legend, Clint Eastwood...

Actor - filmography
(6) [Eastwood](#) (1980) (1980) (1970) (1960) (1950)

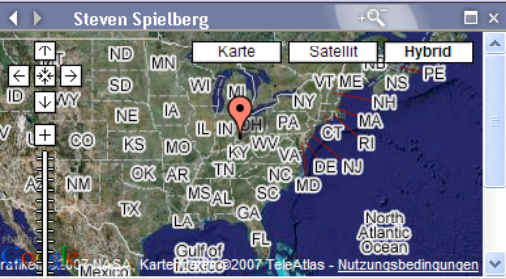



Integration of Multimedia Metadata and Web Services

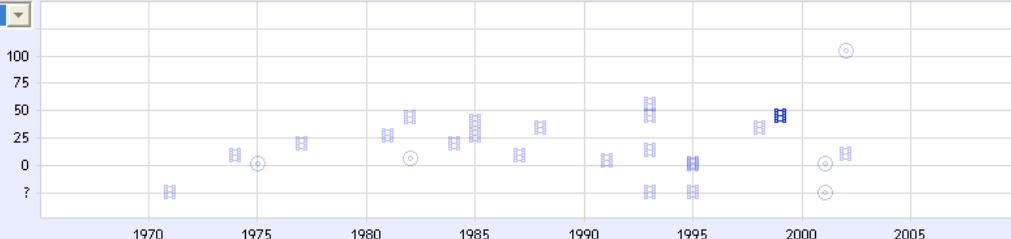
MedioVis 0.81m (Roger, August 2006) - a new search system for the Mediothek of the UB Konstanz

Find! **spielberg** 26 Hits in 64192 Items

Into basket Mail Print Results Basket

Title	Description	Item	Year
<input type="checkbox"/> A. I. - Künstliche Intelligenz	Steven Spielberg, Haley Joel Osment, Jude Law, Frances O'Connor, Ian Wa...	DVD	2001
<input type="checkbox"/> Title: Amistad Original: Amistad [dt.] Subtitle: das Sklavenschiff Poster:	 Steven Spielberg	Media Type: Video Status: verfügbar (Frist: 1 Woche) Section: Theater/Tanz/Film/Funk/ Fernsehen Signature: 6 tff 710:s755/a54a Format: 1 Videokassette (VHS, 141 Min.): farb. Annotation: Vorspann und Nachspann fehlen bei KNUB Location:	1998
<input type="checkbox"/> Band of brothers	Kirk Acevedo, Elon Bailey, Michael Cudlitz, Stephen E. Ambrose, Michael K...	DVD	2001
<input type="checkbox"/> Catch me if you can	Steven Spielberg, Leonardo DiCaprio, Tom Hanks, Christopher Walken, Fr...	Video	2002
<input type="checkbox"/> Das Reich der Sonne	Steven Spielberg, Christian Bale, John Malkovich, Miranda Richardson, Ja...	Video	1987
<input type="checkbox"/> Title: Der Soldat James Ryan Original: Saving private Ryan [dt.] Subtitle: der Auftrag ist ein Mensch Poster:	 Steven Spielberg Name: Steven Spielberg Alternative Namen: Steve Spielberg; Steven Spielrock	Media Type: Video Status: verfügbar (Frist: 1 Woche) Section: Theater/Tanz/Film/Funk/ Fernsehen Signature: 6 tff 710:s755/s19 Format: 1 Videokassette (VHS, 164	1999

Popularity



Legend

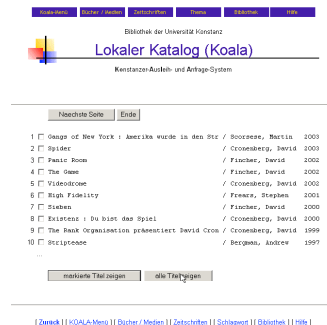
- DVD
- Video
- Multiple Media
- Zoom: left and right mouse button
- Selection: click

Year

Reiterer, Harald; Jetter, Hans-Christian; König, Werner A.; Gerken, Jens; Grün, Christian: Zoomtechniken zur Exploration komplexer Informationsräume am Beispiel "HyperGrid", in: Proceedings of Mensch & Computer 2005, Oldenbourg Verlag, Linz, Sep 2005

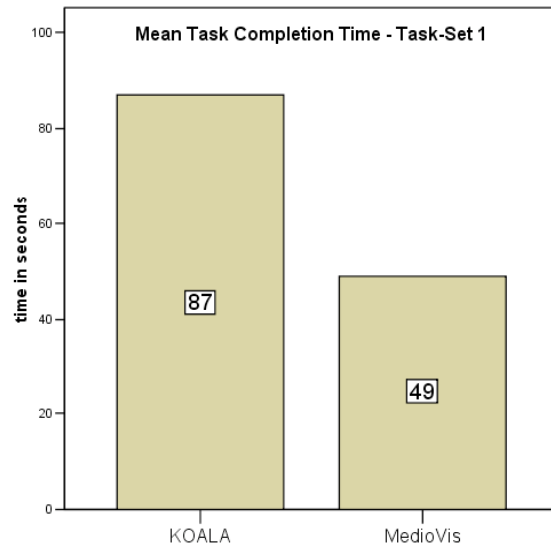
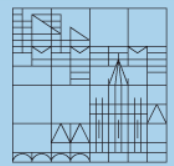


- Quantitative Usability Test – KOALA vs. MedioVis
- Test Null-Hypothesis:
 - No significant difference in terms of task completion time (**efficiency**)
 - No significant difference in terms of user satisfaction (**subjective user rating**)

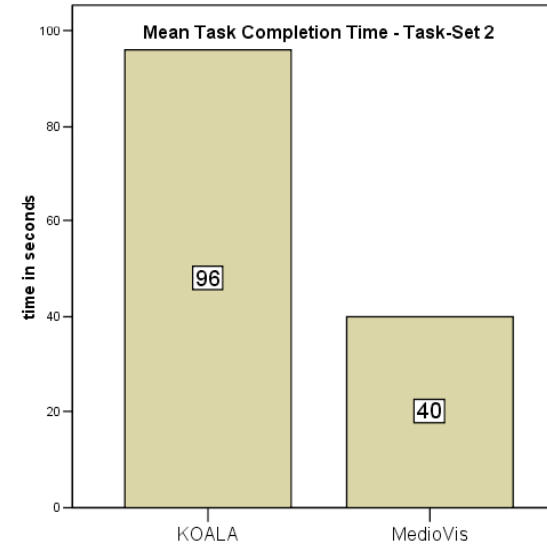


Time frame	Dec '04/Jan '05
Participants	24 (16 female, 8 male)
Age	~23 years, StD.: 2,69
Occupation	Students at the University of Konstanz
Field of study	11 x Literature, Art & Media Science (main target group)
	13 x very heterogenous fields but no computer science students
Computer experience	Beginner to advanced user
System knowledge	Koala: unexperienced to very experienced
	MedioVis: no subject had used MedioVis before

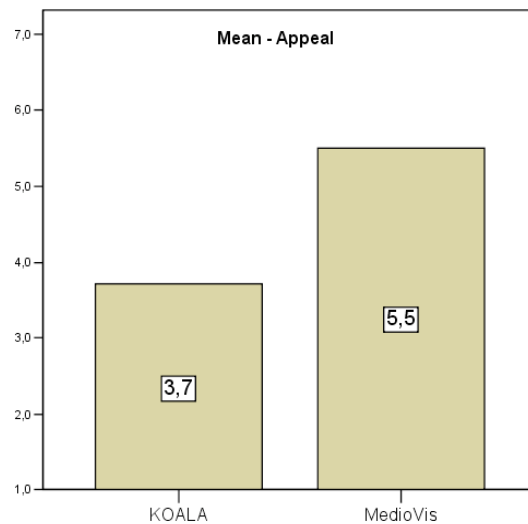
Evaluation Results



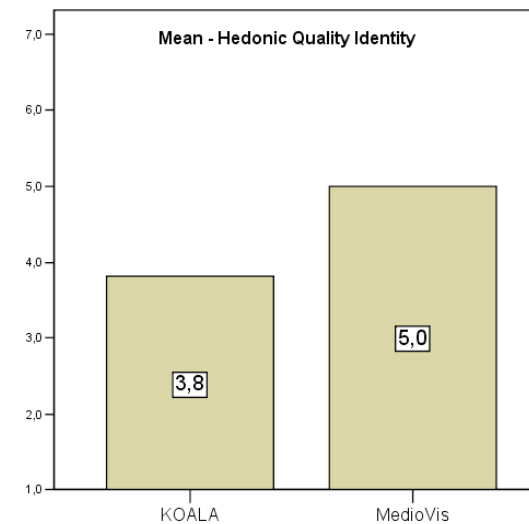
$F(1,22) = 48,265; p < 0,01$
(significant)
Standard Deviation:
15,27s (Koala);
11,08s (MedioVis)



$F(1,22) = 107,768; p < 0,01$
(significant)
Standard Deviation: 15,06s
(Koala); 11,40s (MedioVis)

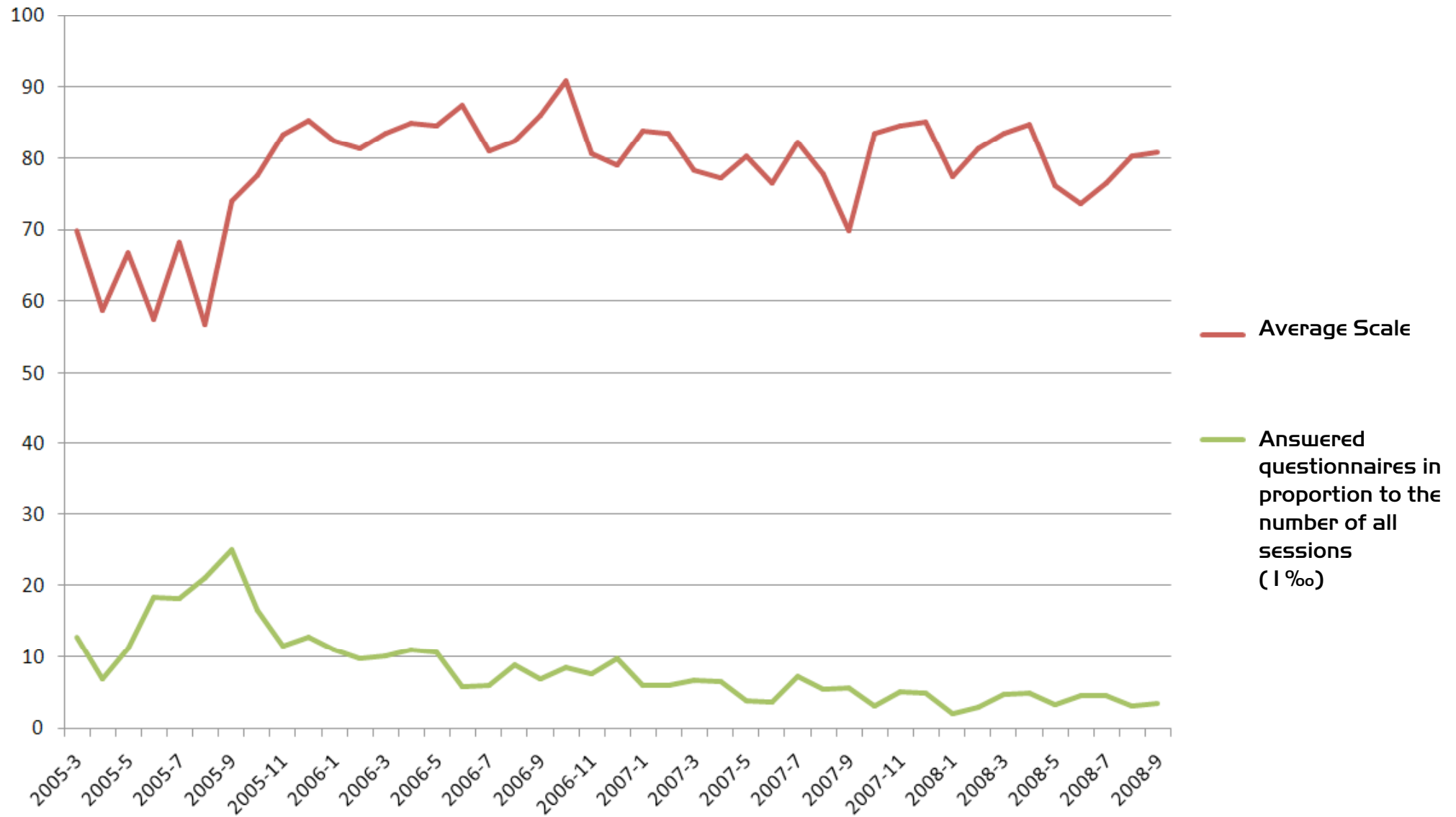


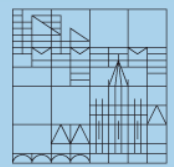
Attrakdiff
 $F(1,22) = 43,89; p < 0,01$
(significant)
Standard Deviation:
0,91 (Koala);
0,76 (MedioVis)



Attrakdiff
 $F(1,22) = 38,18; p < 0,01$
(significant)
Standard Deviation:
0,84 (Koala);
0,54 (MedioVis)

Field Study *Questionnaire - System Usability Scale*





The screenshot shows the Outlook interface with the following components:

- Portal:** Search bar with 'Washington' and 'Find!' button. Below it, 'Sacramento' with '2301 Hits in 65,863 Items'.
- Processing:** Buttons for 'Select all', 'Remove', 'Add', 'E-Mail', and 'Print'.
- Visualizations:** Buttons for 'HyperGrid', 'Scatterplot', 'Bargrams', and 'Network'.
- Layout:** Buttons for window management.
- HyperScatter:** A 2D scatterplot showing 'Rating' (y-axis, -1.0 to 9.5) vs 'Number of Votes' (x-axis, 0 to 275,000). A movie poster for 'The Matrix' is highlighted.
- Network:** A zoomable network graph showing relationships between nodes.
- Parallel Bargrams:** A series of bargrams for 'Rating', 'Genres' (Action, Comedy, Documentary, Drama, Horror, Misc), 'Gross (US)', and 'Rentals (US)'. The bargrams are coordinated across the different metrics.
- HyperGrid:** A table with columns for 'Movie', 'Casting & Content', and 'Business Data & Crew'. It lists various movies and their associated data.

HyperScatter

(semantic) zoomable
2D-Scatterplot
Overview & correlation

Network

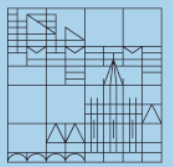
Zoomable network
Visualize relations

Parallel
Bargrams

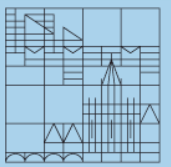
Bargrams+ Parallel
Coordinates
correlation,
distribution &
filtering

HyperGrid

Zoomable table
relating, sorting,
Comparing &
browsing



Let us have a look **inside** ...



Large datasets need a DBMS

Complex datasets are tedious in an RDBMS

Text data need full-text retrieval

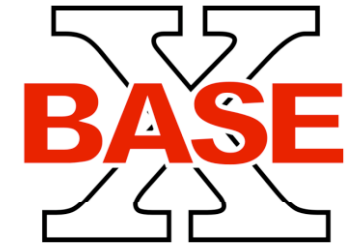
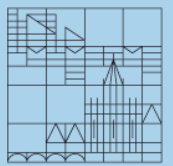
“Everything” is in XML, anyway

3 criteria for DBMS selection:

→ Performance, performance, performance

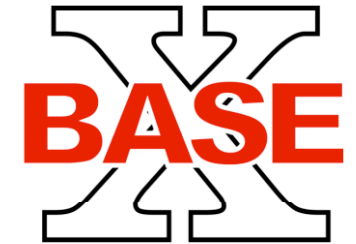
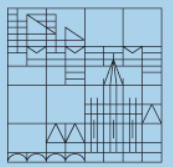


... BaseX is your friend



History

- DBIS Group: Research on XML since 2000
- [XPath Accelerator](#)²⁰⁰¹, [Staircase Join](#)²⁰⁰³, [LoopLifting](#)²⁰⁰⁴:
early, frequently referenced works on XML storage and querying
- Results have influenced BaseX:
 - flat table storage of tree-structured input
 - elegant and efficient query algorithms
 - + [Content/Index-based](#) query evaluation
 - + [XQuery Full-Text](#): bringing the DB and IR community together
 - + [XQuery Update](#): fulfilling classical database requirements



Indexing

- Straightforward in relational databases:

```
SELECT year FROM media WHERE title = "Crime and Punishment"
```

→ access `title` index, return `year` values of matching tuple

- Tricky query optimization in XML, different queries → same results:

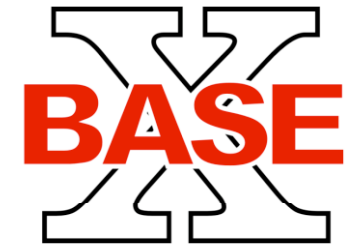
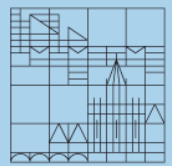
- `//*[title = "Crime and Punishment"]/year`

- `/path/to/media[where/title = "Crime and Punishment"]/year`

- `//media/year[../title = "Crime and Punishment"]`

→ access `title` index, check specified descendants/ancestors, return `year`

- But: flexibility of XML pays out...

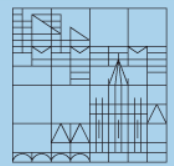


Querying Hierarchical Data

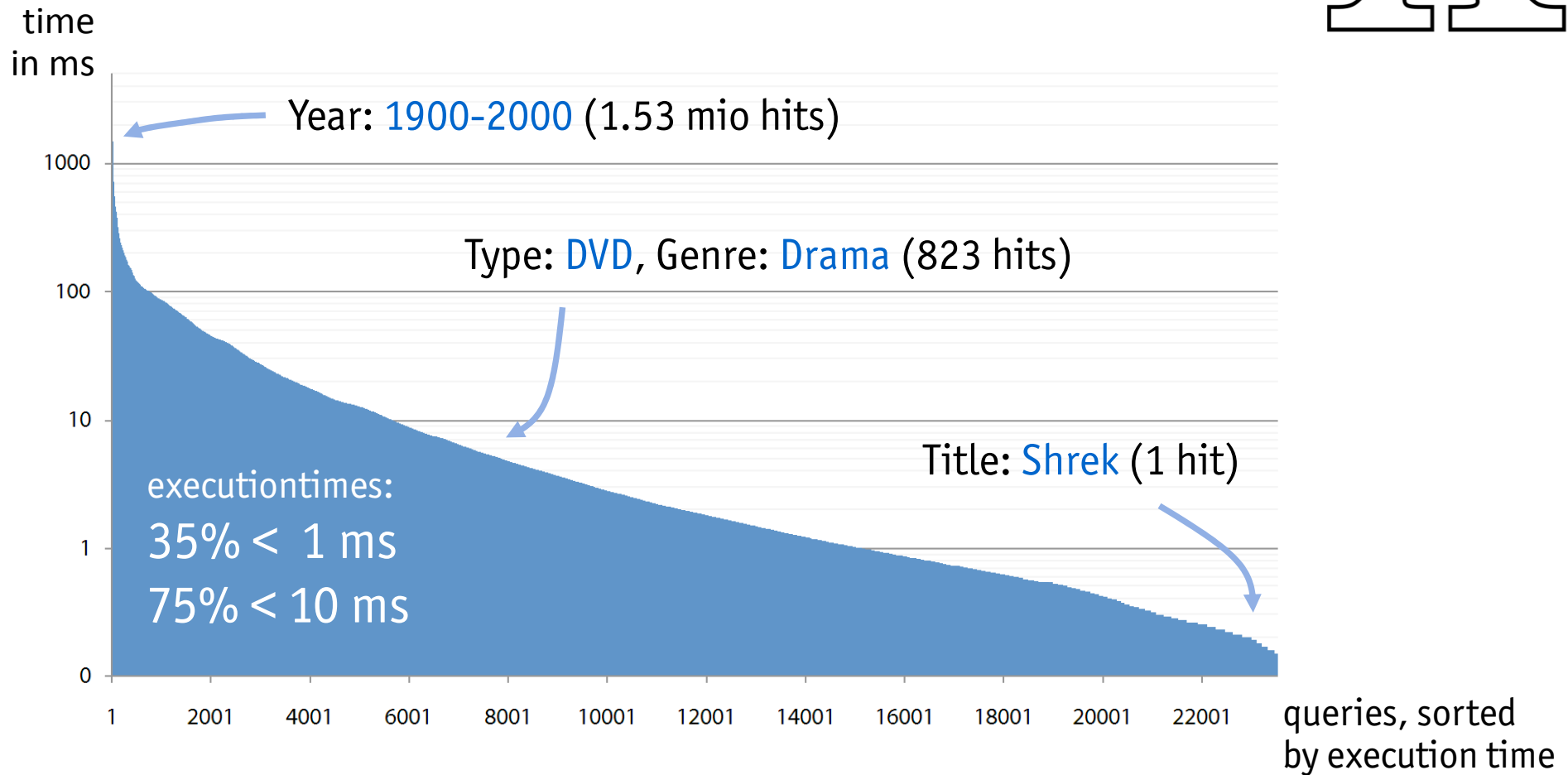
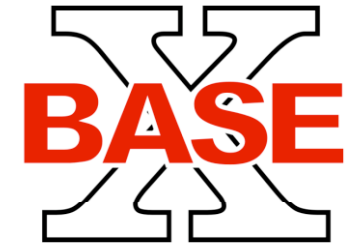
```
<Medium id="303-357-556857">  
<Title>Learning Italian</Title>  
<Type>Multi-Part</Type>  
<Section>Teaching/Languages</Section>  
<Medium>  
<Title>Master Book</Title>  
<Type>Book</Type>  
<Description>Lectons 1 - 7</Description>  
<Signature>6 fsi 470/l24-nb1</Signature>  
</Medium>  
<Medium>  
<Title>Listening Examples</Title>  
<Type>CD</Type>  
<Description>Lectons 1 - 7</Description>  
<Signature>6 fsi 470/l24-nb2</Signature>  
</Medium>  
</Medium>  
...
```

Find Media with "Italy" in the Title and CDs attached...

```
//Medium[Title ftcontains "Italy" with stemming][.//Type = "CD"]
```



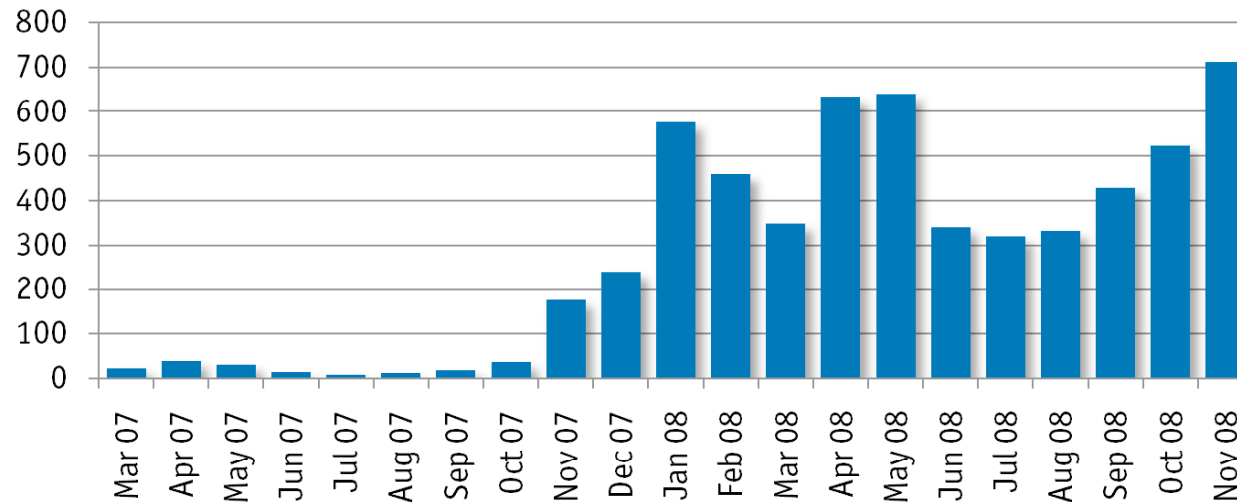
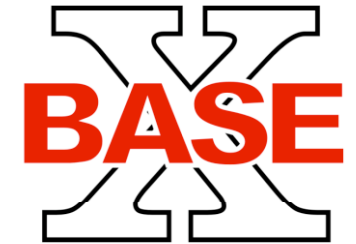
23,000 Library queries, U Konstanz





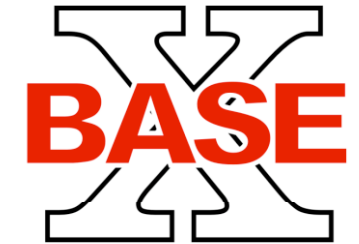
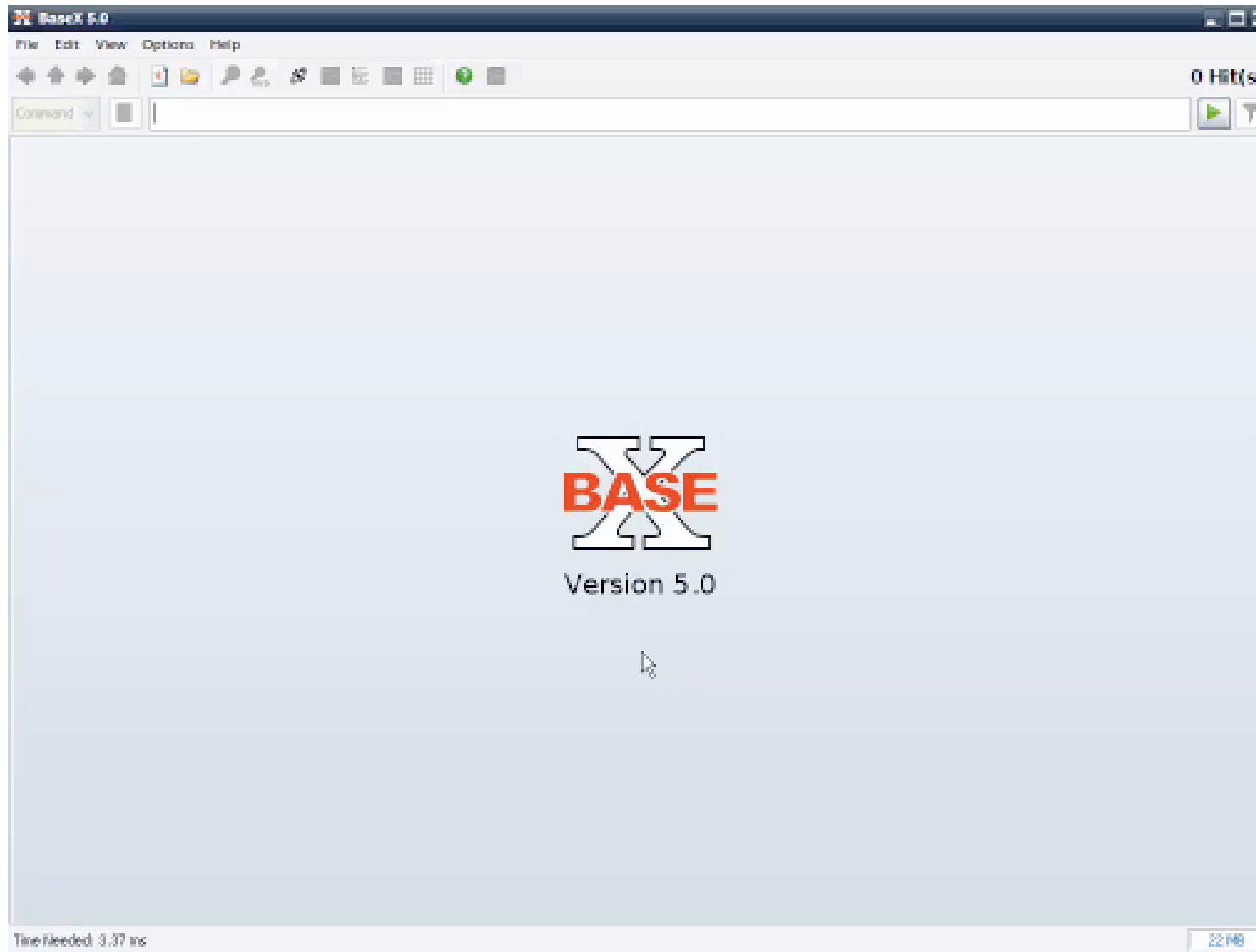
Application Fields

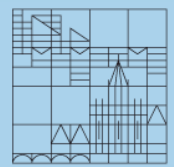
- Focus on library catalogs
→ many **query optimizations** inspired by library data
- Downloads @ Sourceforge since first official release:



...many other application fields, different **user groups** world wide:
Computer Scientists, Linguists, Historians, Biologists

BaseX - Querying the Library Data





BaseX 5.0 - 11mb

File Edit View Options Help

53 Hit(s)

Search muenster

Text

```
<from>Yasuharu Carrera mailto:Carrera@uni-muenster.de</from>
<to>Lunjin Stroud mailto:Stroud@uni-muenster.de</to>
<to>Guorong Esbelin mailto:Esbelin@uni-muenster.de</to>
<from>Tanguy Luft mailto:Luft@uni-muenster.de</from>
<to>Kyunghee Gerbig mailto:Gerbig@uni-muenster.de</to>
<from>Issam Chattopadhyay mailto:Chattopadhyay@uni-muenster.de</from>
```

11mb.xml

site

regions

africa australia namerica

asia

open_auctions

europa

people

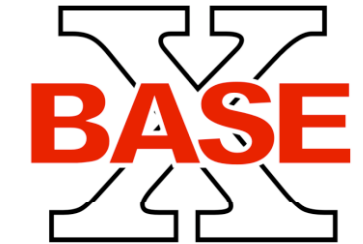
closed_auctions

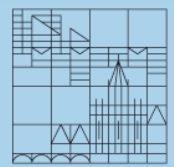
person

open_auction	emailaddr..	categ..	name	hom..	cr..	id	p..	s..	c..
open_auction1..	mailto:Noy..	categ..	Stven..	http/..	26..	pe..	+		
open_auction9..	mailto:Ogu..	categ..	Filipp..	http/..	90..	pe..			
	mailto:Lan..		Yingf..		29..	pe..	+		
open_auction4..	mailto:Miku..		Foste..	http/..	95..	pe..			
	mailto:Bie..	categ..	Anshu..			pe..	+		
open_auction1..	mailto:Burk..		Witold..		59..	pe..	+		

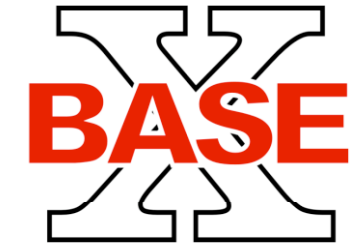
age Y person X @income

doc("11mb.xml")/site/people/person 15 MB

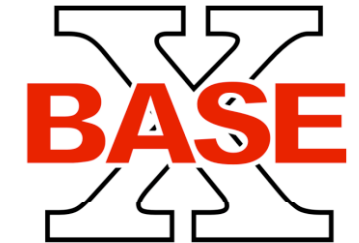
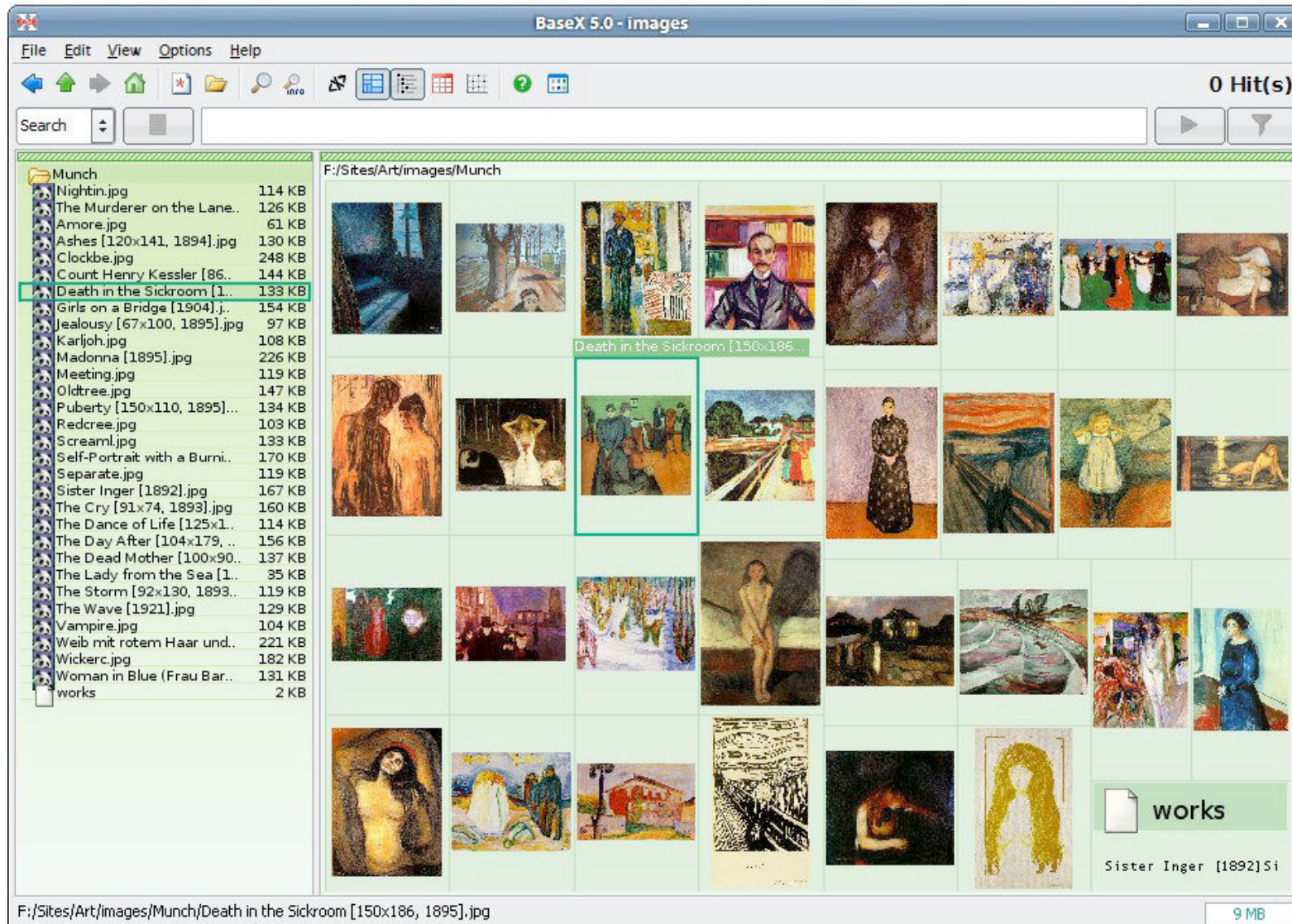
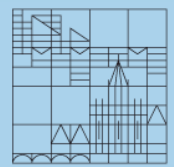


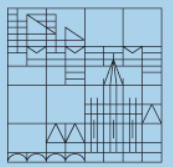


The screenshot shows the BaseX 5.0 - locations application interface. The main window displays a world map with numerous red data points. A tooltip for 'Sao Filipe' is visible, showing coordinates: -2.42848E7 | 1.45306E7. The left sidebar contains XML data for 'Rabah Bitat', 'Mohamed Boudiaf', and 'Ech-Chelif'. Below the XML is a 'locations.xml' section with a grid of geographical regions (EUR, USA, AFR, M., SPA, CAN, L., SAM, PAC, E..). The bottom status bar shows the XPath: doc("locations.xml")/Locations/Area/Location and a file size of 47 MB.



BaseX - Frontend





Thankyouforyourattention!

-  <http://hci.uni-konstanz.de/MedioVis>
-  <http://sourceforge.net/projects/mediovis>
-  <http://basex.org>

mediovis

