

Towards a new infrastructure for the World Wide Web

Systems Software Lab

Godmar Back

Or:

What Have I Been Up To?

Systems Software Lab

Godmar Back

WHAT YOU BROUGHT TO SEMINAR AND WHAT IT SAYS ABOUT YOU:

Stuff to take notes:
First year. Foolishly
thinks he'll ever
need notes again.

Reading
material: Third
year. Just
here for show.

Didn't bring
anything:
ABD/Postdoc.
Has nothing
better to do.

Laptop: Young
Assistant Professor.
Working on three
proposals at the
same time.

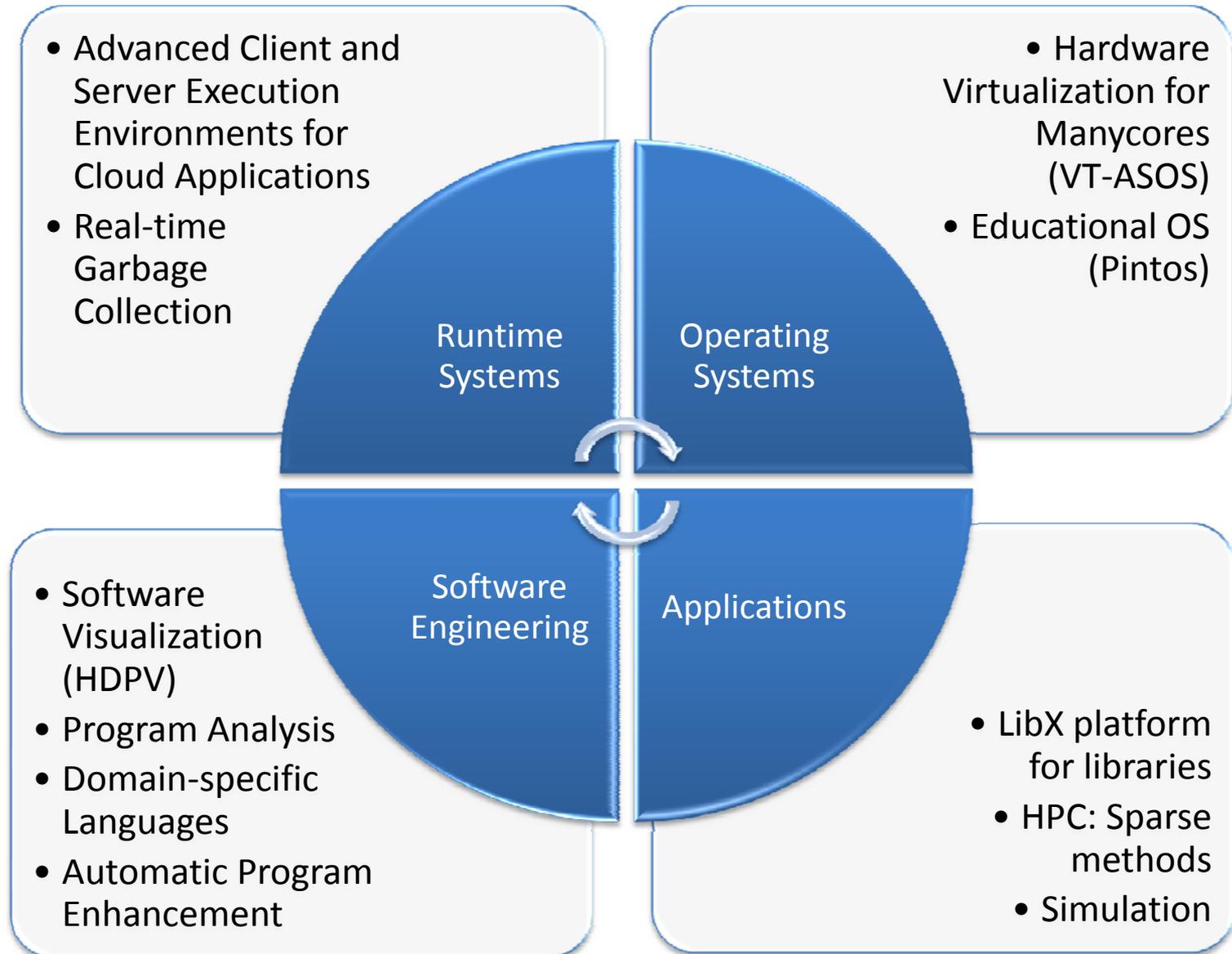
Playing with latest
Gadget/Gizmo:
Full Professor.
Loooves new toys.

JORGE CHAM © 2008



WWW.PHDCOMICS.COM

Systems Software Lab (Dr. Back)



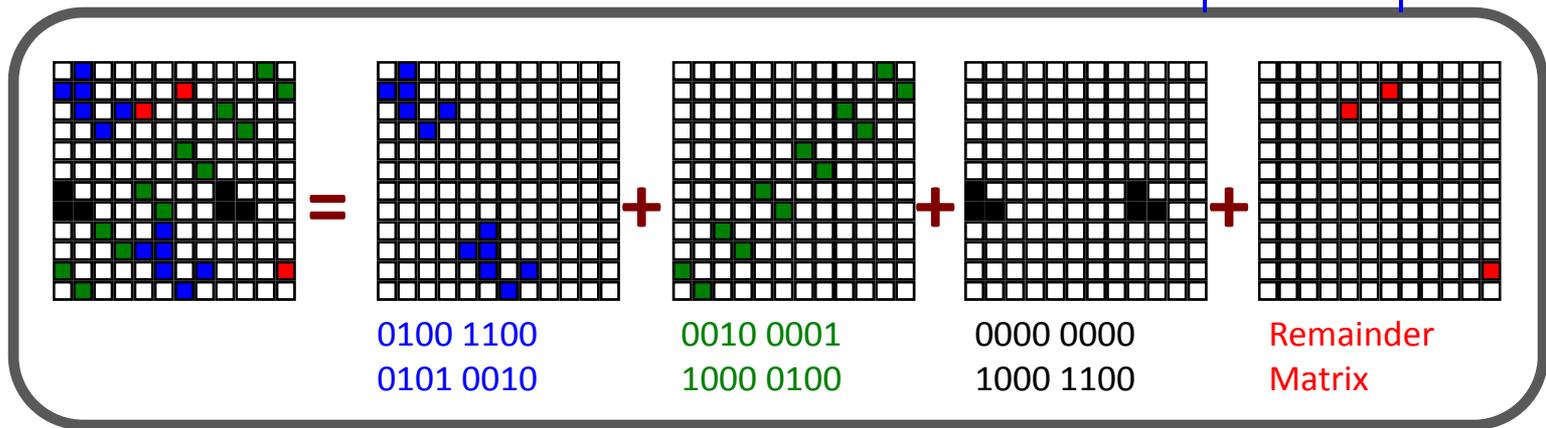
Cool projects I won't talk about today (1)

- **Sparse Methods**

- How can we make iterative solvers for $Ax = b$ faster on current machines?

- collaboration w/ Belgin/Ribbens [ICS07, ICS09, IJPC09]

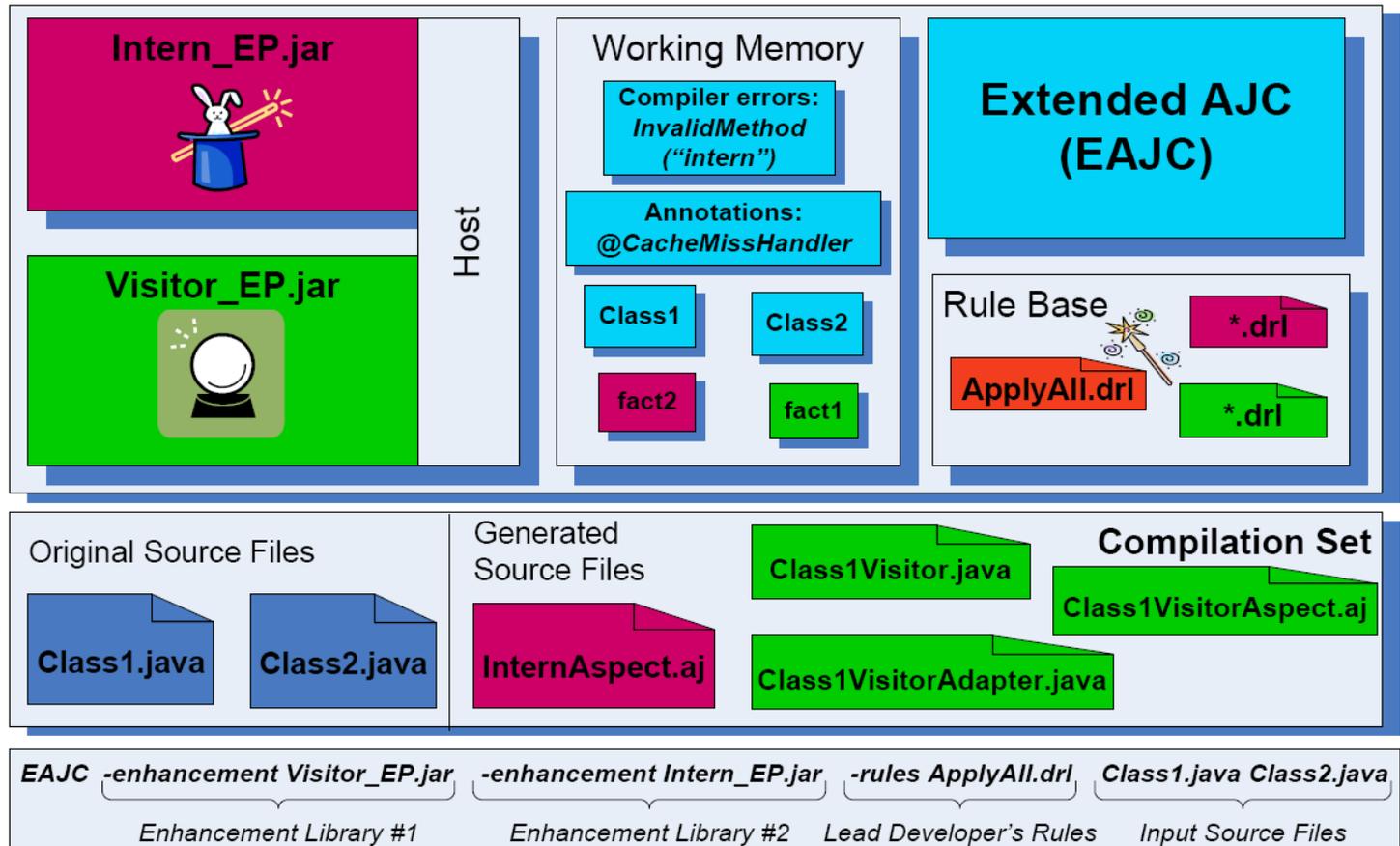
	0	1	2	3	4	5	6	7	8	9	10	11
0		Blue									Green	
1	Blue	Blue					Red					Green
2		Blue		Blue	Red				Green			
3			Blue							Green		
4							Green					
5								Green				
6	Black				Green				Black			
7	Black	Black				Green			Black	Black		
8			Green			Blue						
9				Green	Blue	Blue						
10	Green					Blue		Blue				Red
11		Green					Blue					



Cool projects I won't talk about today (2)

- Automatic Program Enhancement

- How can we let programs complete themselves?

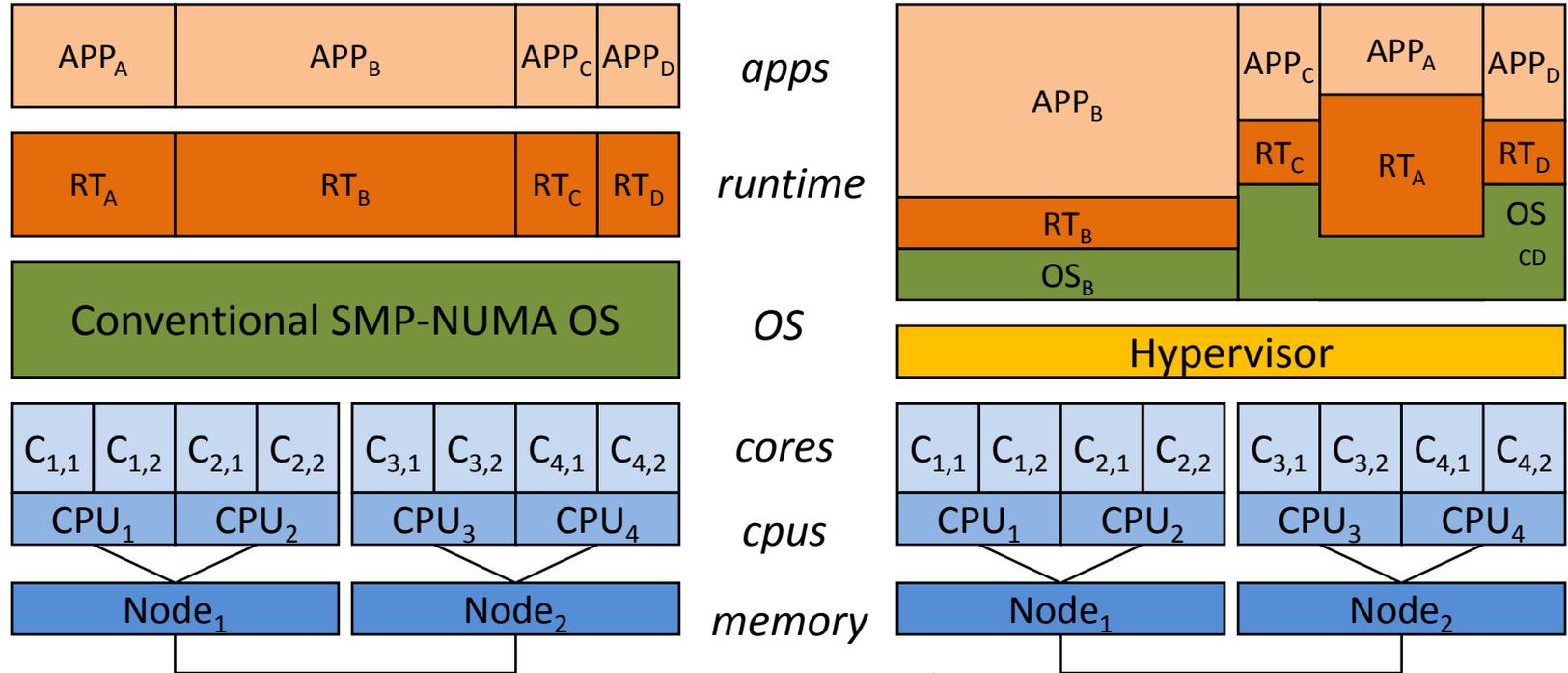


collaboration w/
Tilevich
[AOSD 2008]

Cool projects I won't talk about today (3)

- **VT-ASOS**

– Can we use hardware virtualization to better support manycore environments?

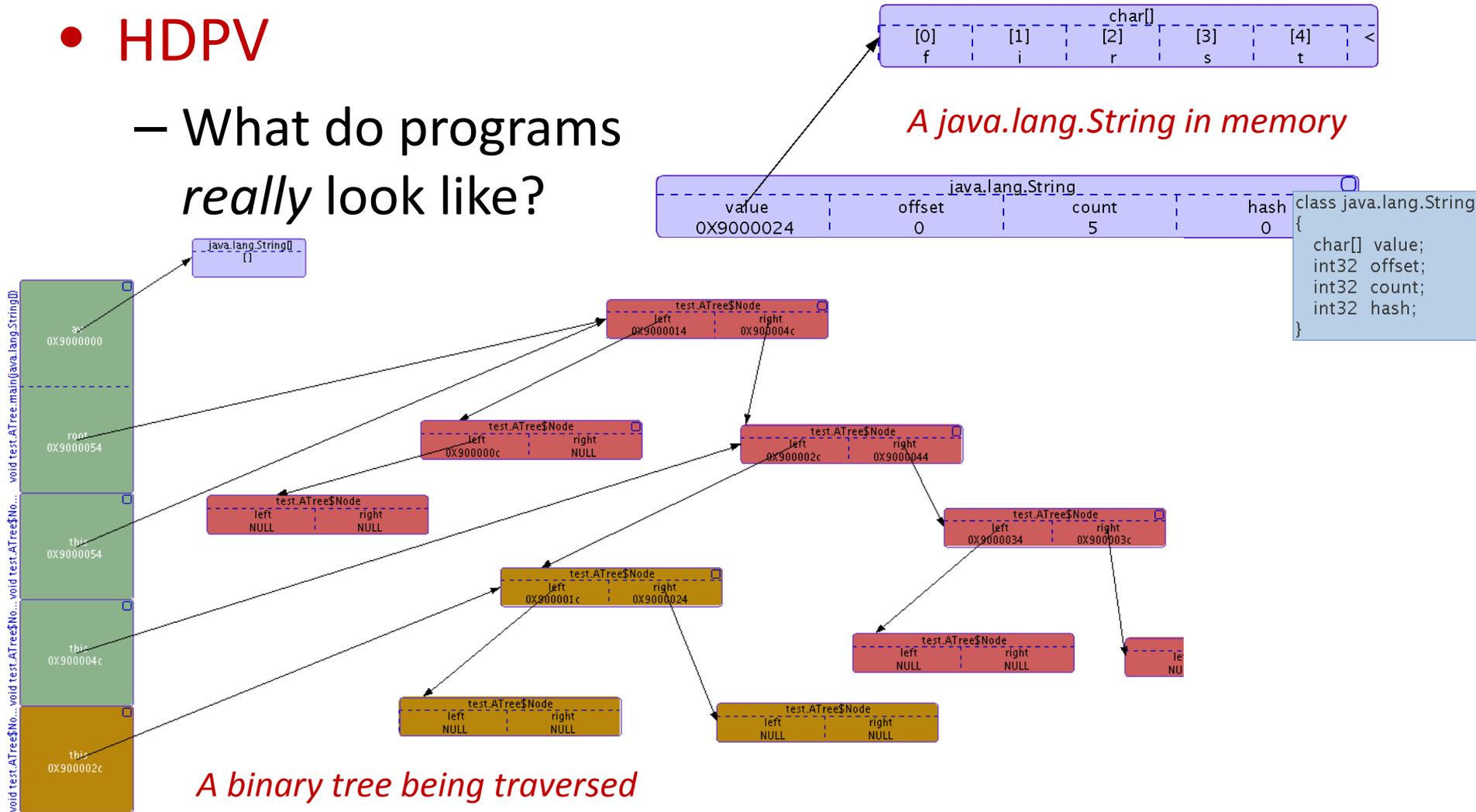


collaboration w/ Peng & Nikolopoulos [STMCS '07], NSF-CSR 0720673

Cool projects I won't talk about today (4)

- HDPV**

– What do programs *really* look like?

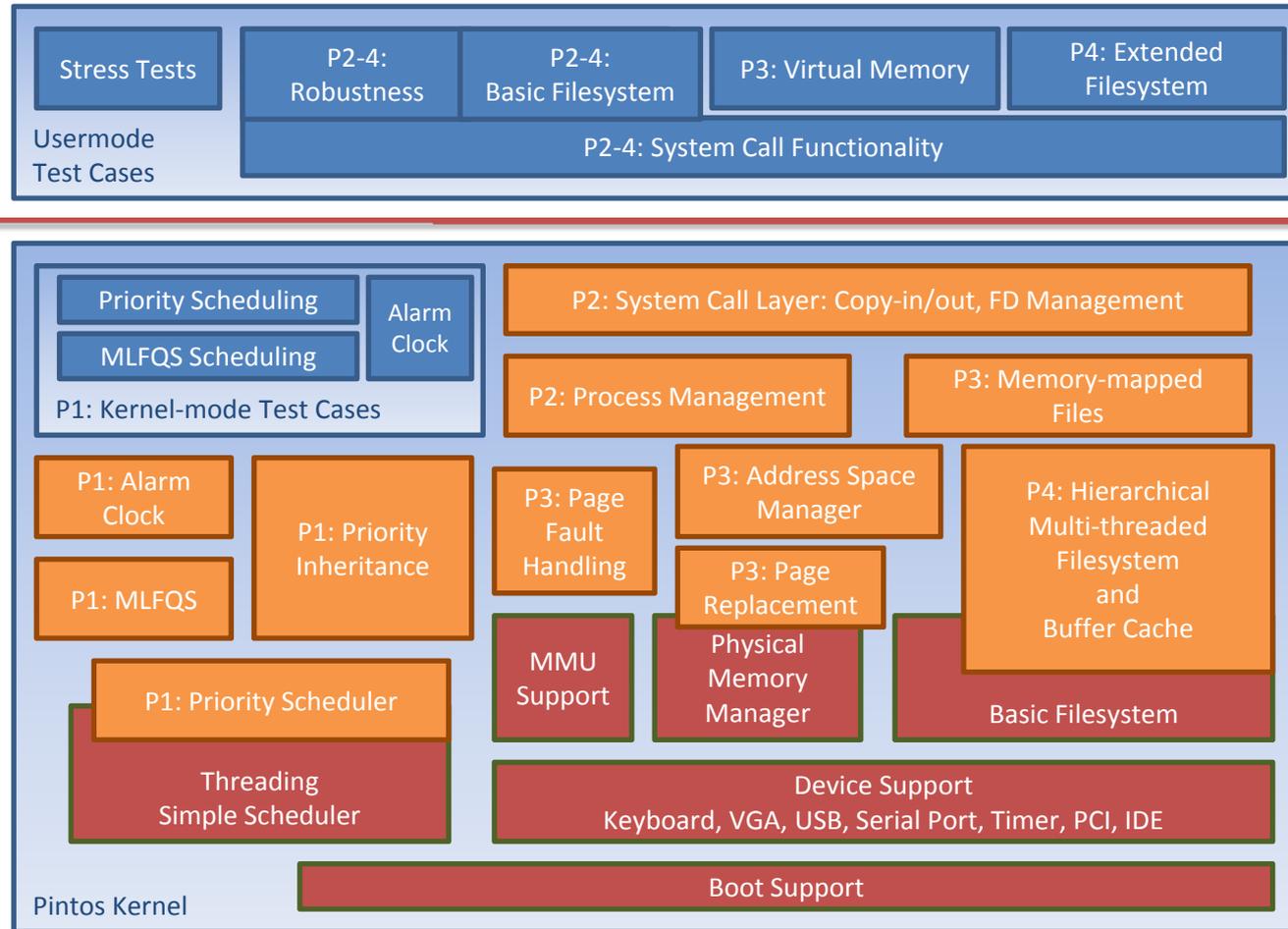
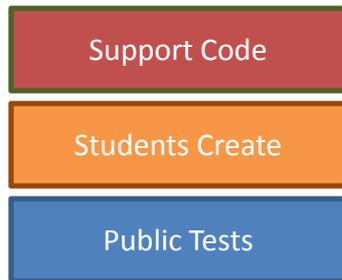


collaboration w/ Sundaramanan [ACM SoftVis 08]

Cool projects I won't talk about today (5)

- **The Pintos Educational OS**

– How do we teach OS in a *realistic* and *state-of-the-art* manner?



collaboration w/ Pfaff & Romano [SIGCSE 2009]

A Bit Philosophy

- Applications drive systems
- Users run applications, they don't care about systems
- Successful systems designers understand applications

LibX: Background

- Brick-and-mortar libraries in the Internet age face a problem
 - Students + researchers forgo library resources
 - Risk becoming irrelevant
- A “virtual librarian” that guides users to library resources while they use the Web
 - integrates access to library resources into the users’ “webflow”
 - no matter which page a user visits (\Rightarrow needs client-side presence!)

LibX 1.0 Features

- Toolbar and right-click context menu
- Adaptive and user-configurable context menus
- OpenURL support
- Magic Button (Google Scholar support)
- Web Localization via Embedded Cues
- Autolinking
- Off-campus access via EZProxy or WAM
- Support for CiteULike
- Support for COinS
- Support for xISBN
- Show/Hide Hotkey

LibX 1.0 Features

LibX - browser plugin for Libraries - Mozilla Firefox

File Edit View Go *Your **continued donations** keep Wikipedia running!*

HDPV - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://portal.acm.org/citation.cfm?id=1409720.1409729&coll=Portal&dl=GUIDE&CFID=47698898&CFTOKEN

acm **PORTAL** [Subscribe \(Full Service\)](#) [Register \(Limited Service, Free\)](#) [Login](#)

Search: The ACM Digital Library The Guide

THE GUIDE TO COMPUTING LITERATURE [Feedback](#)

HDPV: interactive, faithful, in-vivo runtime state visualization for C/C++ and Java

Full text [Pdf \(390 KB\)](#)

Source **Software Visualization** [archive](#)
Proceedings of the 4th ACM symposium on Software visuallization [table of contents](#)
Ammersee, Germany
SESSION: Software visualization for testing and debugging [table of contents](#)
Pages 47-56
Year of Publication: 2008
ISBN: [978-1-60558-112-5](#)

Authors [Jaishankar Sundararaman](#) Virginia Tech
[Godmar Back](#) Virginia Tech

<ul style="list-style-type: none">Contact WikipediaDonate to Wikipedia	Contents [hide] 1 Data binding in general
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LibX Timeline

- 2005
 - Released LibX Virginia Tech as a Firefox extension
 - Offered to share LibX with interested libraries
- 2006
 - Tremendous response from library community
 - Received National Leadership Grant from IMLS to create LibX for IE and Edition Builder
- 2007
 - Received LITA Entrepreneurial Award

The LibX Edition Builder

- A configuration management tool for creating customized versions of LibX
 - Customized version of LibX = **LibX edition**
- Edition configuration includes descriptions of community-local resources:
 - OPACs, OpenURL, Proxy, Databases, Links, Branding, ...
- Edition Builder is easy to use
 - Makes heavy use of OCLC registries
 - Uses sophisticated auto-detection techniques
 - Usable by *librarians*, not just programmers
- Anybody can create, share, and manage editions
- Over 550 edition as of now, new ones created at a pace of 20/month
 - Huge human investment
 - 10's of thousands of end users

EDITION BUILDER DEMO

Demo Backup Slide

LibX Edition Builder

LibX - a browser

All Editions My Editions Announcements

Search or browse public LibX editions.
 Search by name or description:

Build a new LibX edition from scratch.
 You can also go ahead and build your own from scratch.

Id	Version	Date	Edition Description
AL C7C212BD	1.2.2	2007-11-06	Academie Louvain
appstate	1.2.1	2007-09-27	Appalachian State University Libraries Edition
asu	1.1	2006-07-27	Arizona State University Libraries Edition
4E2651AE	1.2.1	2007-12-12	Arkansas State University Edition
fhrc.org	1.1	2007-01-16	Arnold Library

All Editions My Editions

Email:

Password:

Why should I register?

It's okay to contact me for a planned user study.

Select an edition

Id	Description
48D32F4C	KG Copy of Virginia Tech Edition
8ABD4880	KG personal edition

3:41:50 PM Feb 11, 2008 Edition Builder Ready.

All Editions My Editions Description Shortcuts Catalogs & Databases OpenURL Resolvers Proxy Access Options File Management Announcements

Configure the catalogs and databases that are included in your edition. LibX can try to auto-detect your catalog. It will also cross-check other editions to see if a particular catalog has already been configured. To change the order in which catalogs appear in your edition, drag and drop each catalog's entry in the desired position.

Auto Detection: enter the [host name](#) of the machine that runs your library catalog, or enter a [URL](#) to a page that contains a search form. For instance, try addison.vt.edu, worldcat.org, www.citeulike.org, pubmed.gov, hubmed.org, or complete URLs such as http://en.wikipedia.org/wiki/Main_Page.

Enter URL:

OCLC reports that your OPAC may be located at fiu.catalog.fcla.edu.
 probing fiu.catalog.fcla.edu (1 resource found)

Found Endeca catalog 'Florida International University (FIU) - Library Catalog' at <http://fiu.catalog.fcla.edu>

Florida International University (FIU) *(Bookmarklet)*
<http://fiu.catalog.fcla.edu/fi.jsp?N=27&Nty=1&Ntt=%term1&Ntk=%SWITCH{%...>

Required Optional Xisbn

Settings Settings Settings

Required Settings	Value
Bookmarklet Name	Florida International University (FIU)
Bookmarklet URL Template	http://fiu.catalog.fcla.edu/fi.jsp?N=27&Nty=1&Ntt=
Bookmarklet Search Options	Keyword, Title, Journal Title, Author, Subject, ISBN/ISSN, Call Number <input type="button" value="Change"/>

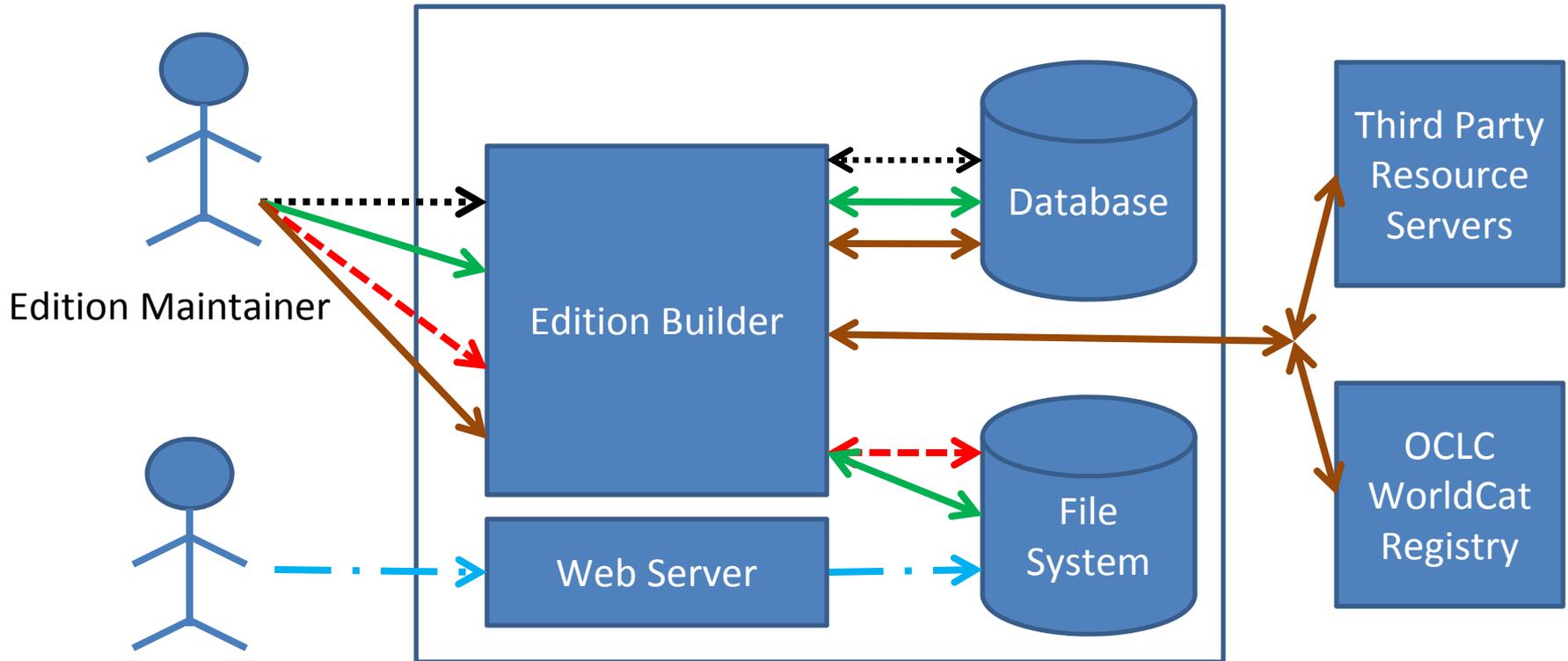
All Editions My Editions Description Shortcuts

Enter brief descriptions for your edition:

- Edition Name**, such as "LibX V..."
- Short Name**, such as "LibX VT..."
- Short Name**, such as "LibX V..."

This name is displayed in the edition's logo. Pick a short name for your project.

Architecture

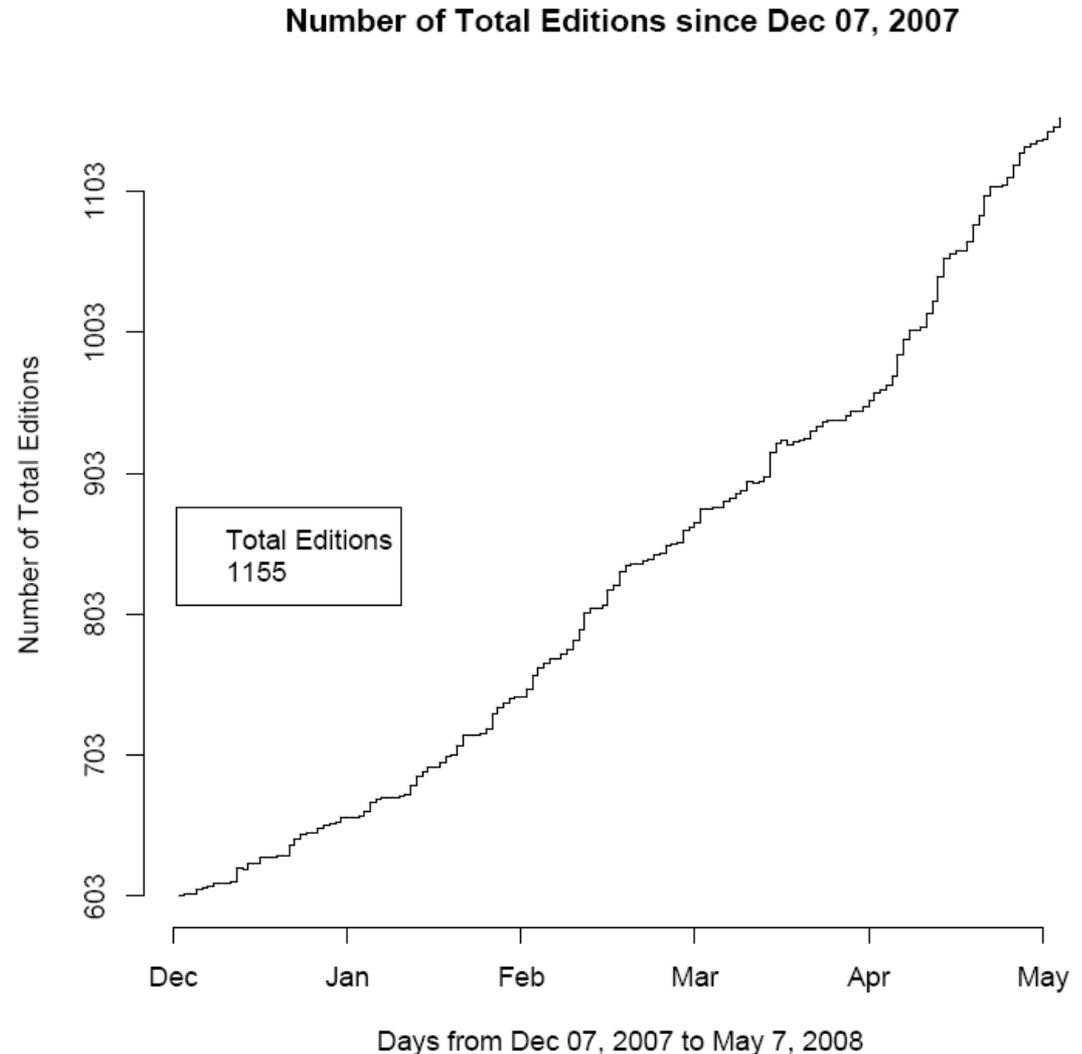


End User

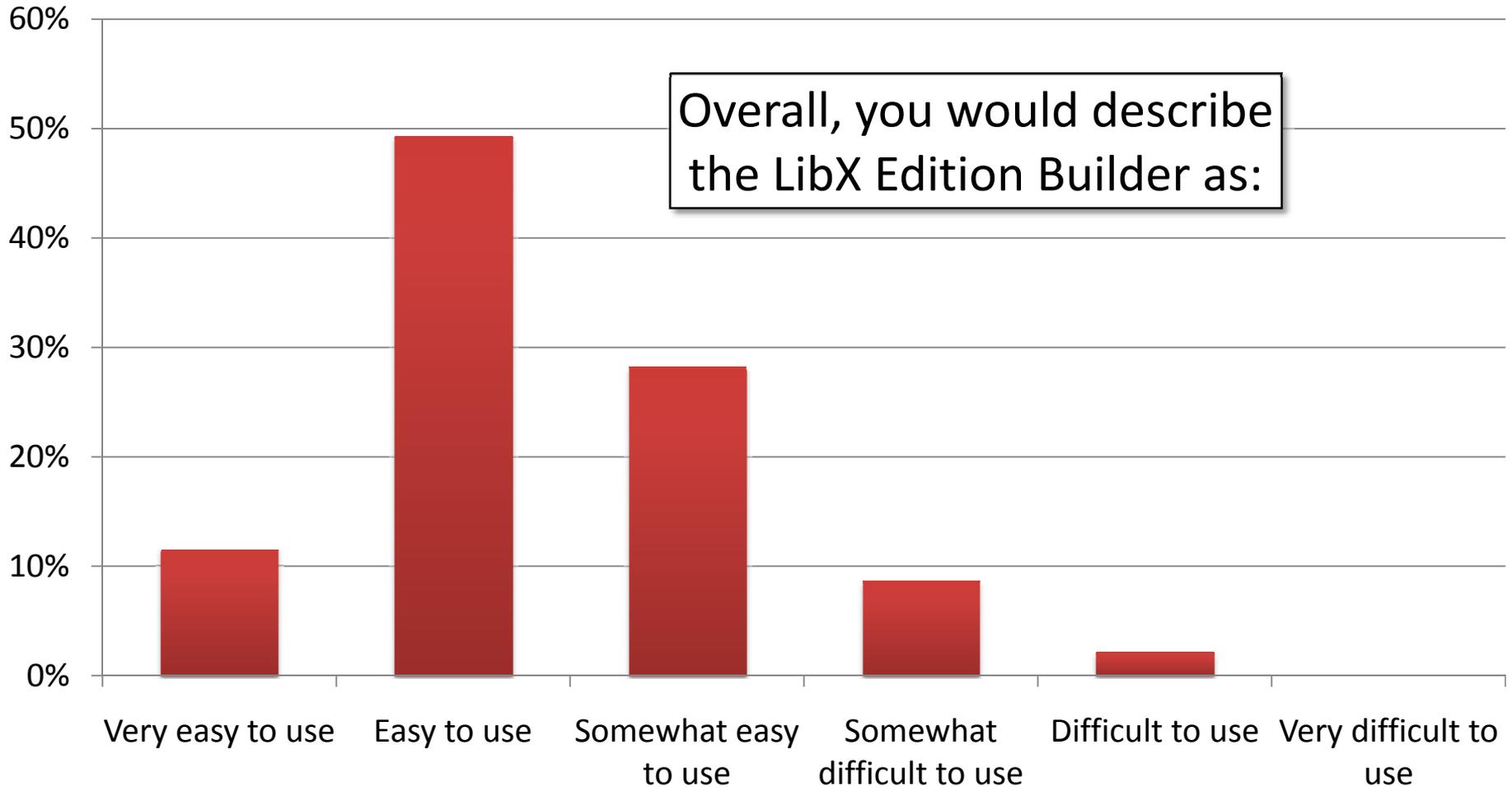
Login	Edition and Revision Management	Changes to Configuration	Auto-discovery	Download customized LibX

Log Data – Adoption of Edition Builder

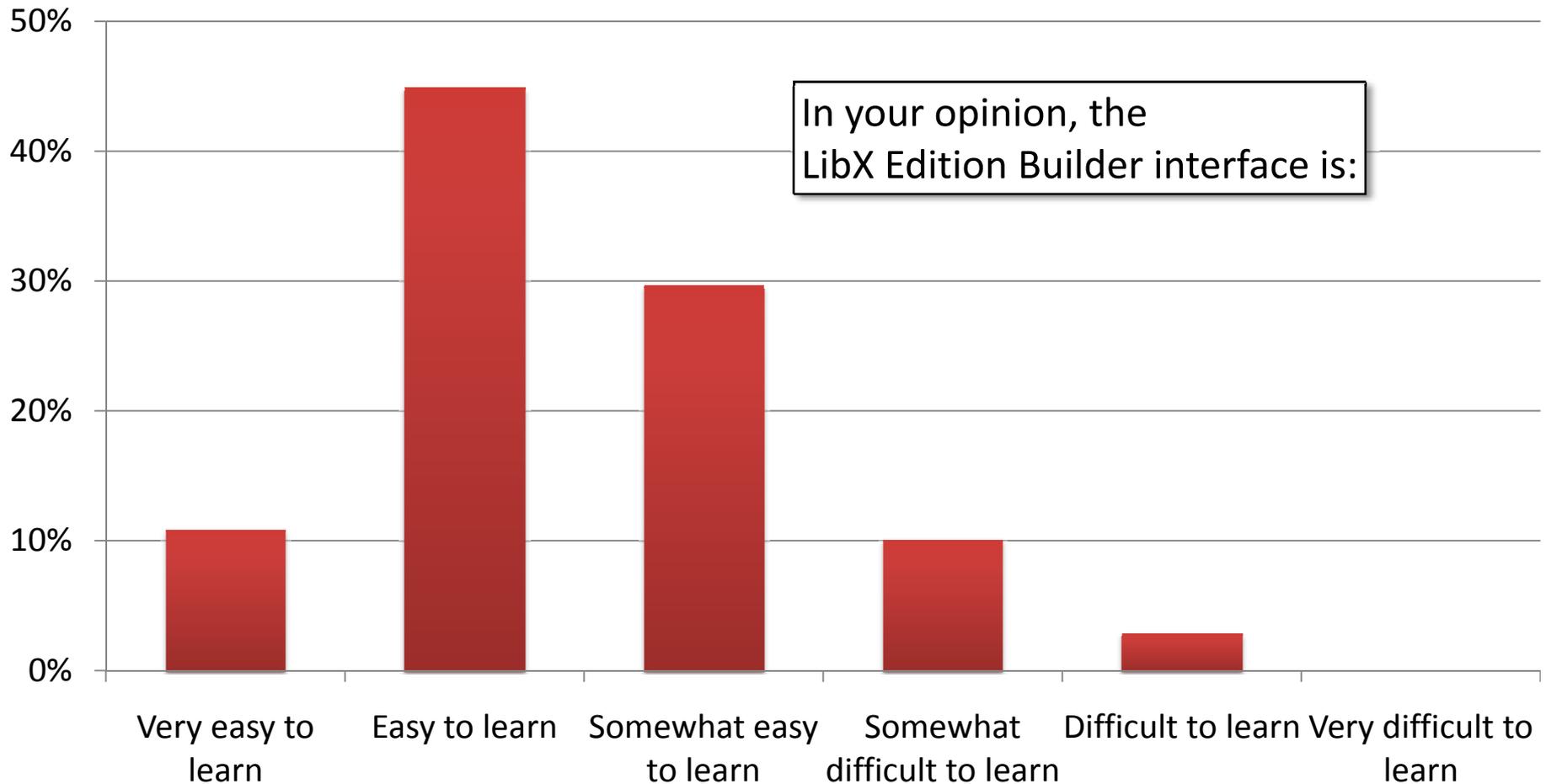
- 1155 total editions present by May 2008
- As of Oct 2008, 1600 total editions
 - 460 were made public
- New editions are being made public at a rate of ~20/month



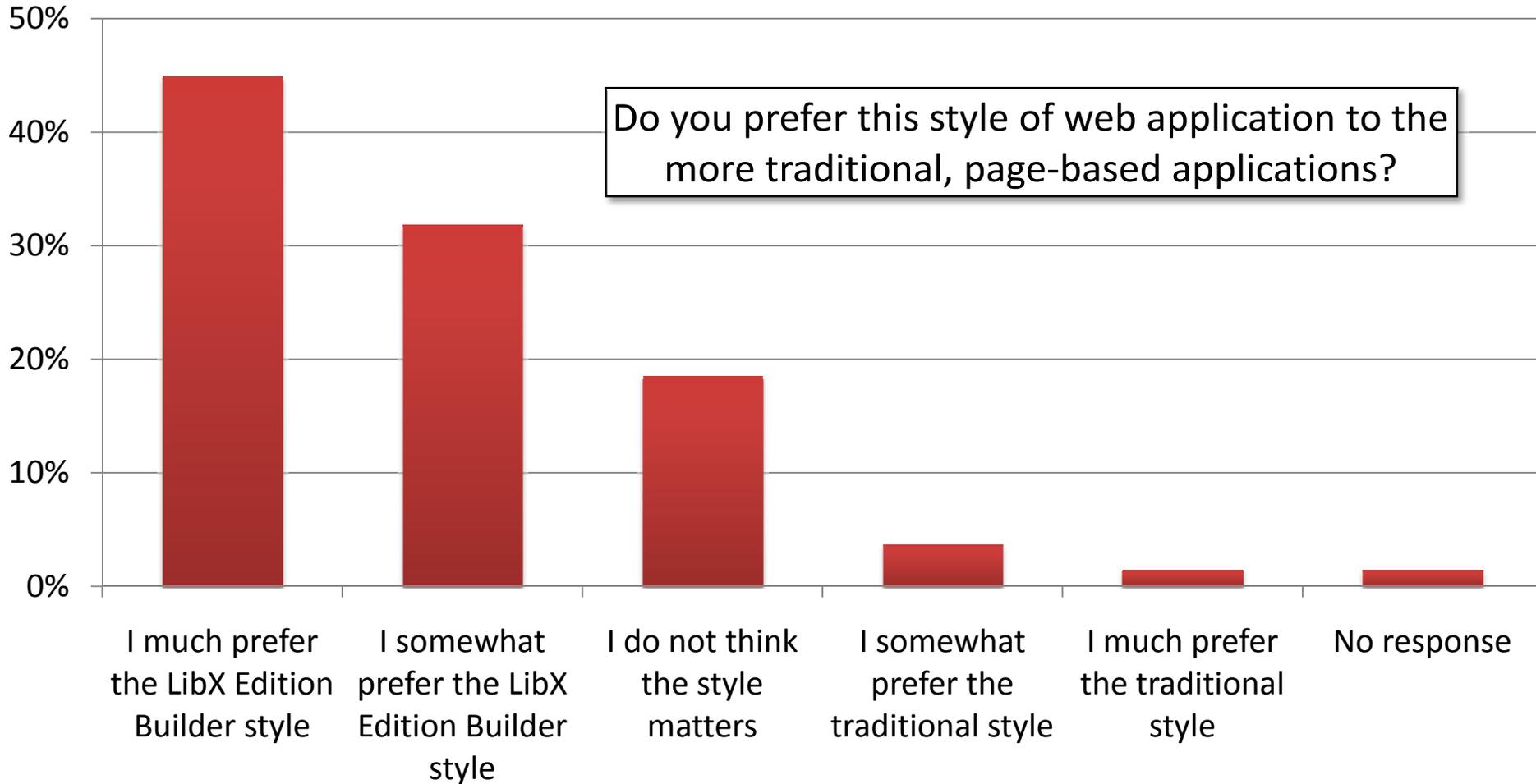
Overall Perceived Ease of Use



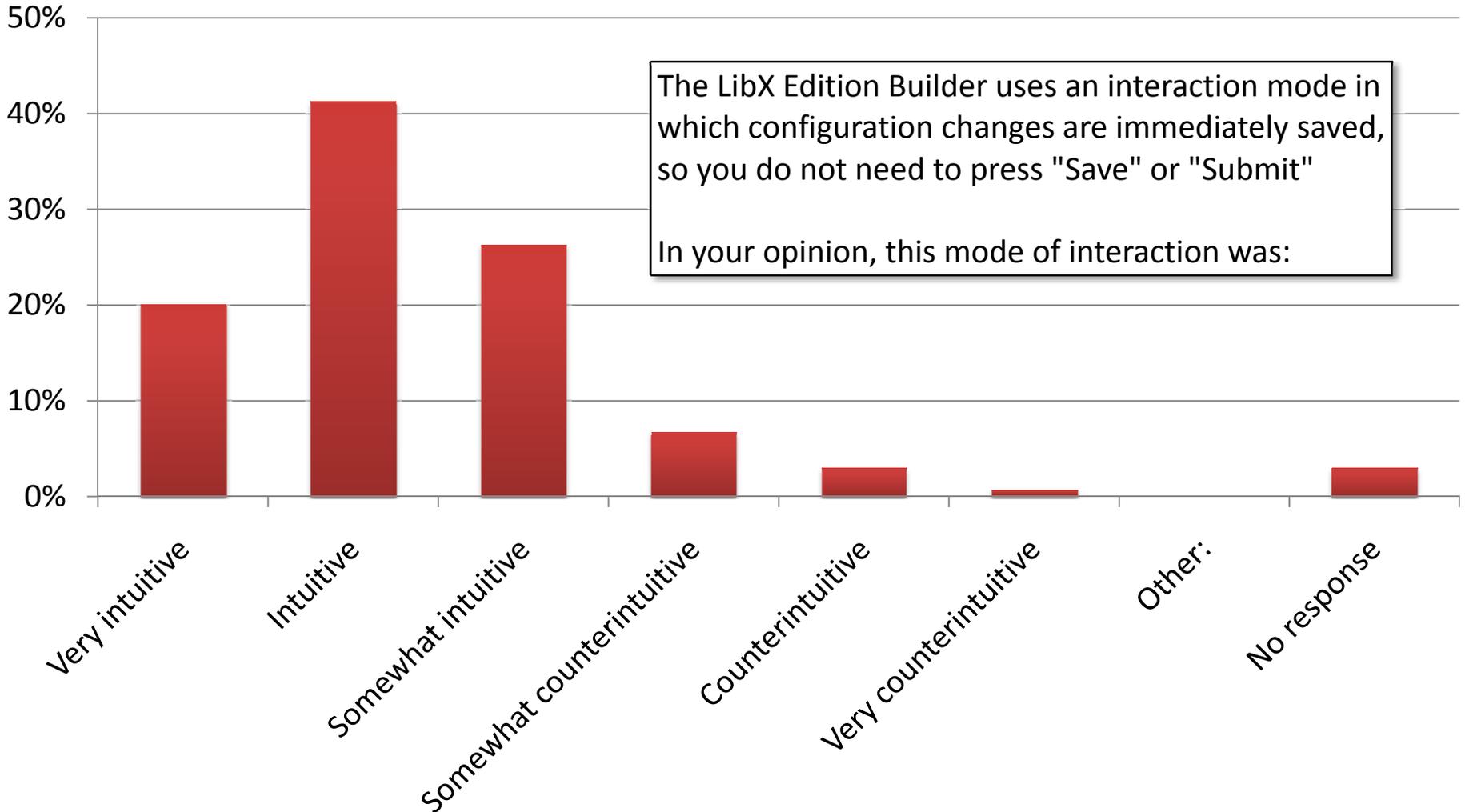
Perceived Learning Curve



Style of Application

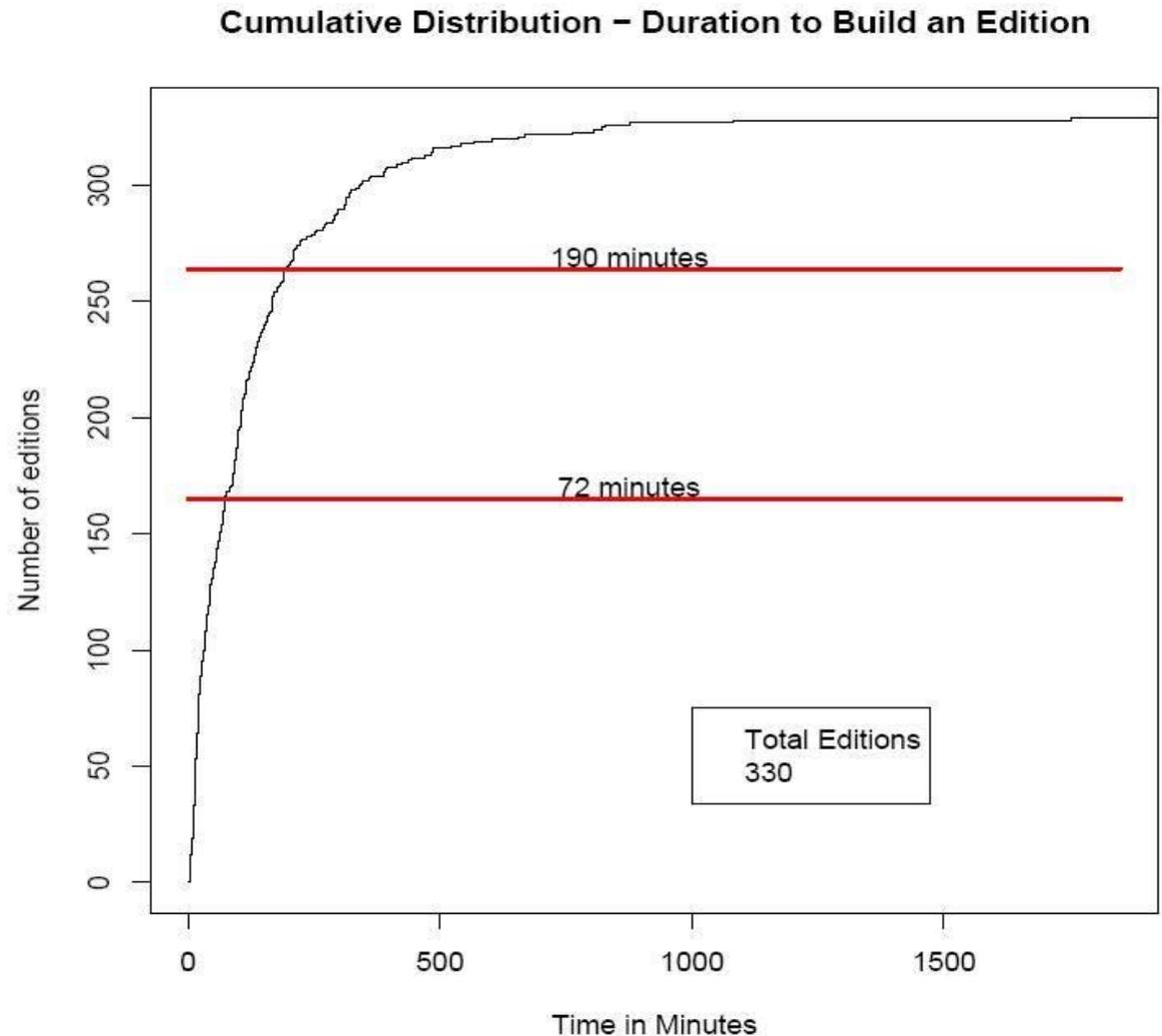


Saving of Changes



Log Data Results (cont'd)

- 50% editions built in 72 minutes or less
- 80% editions built in 190 minutes or less

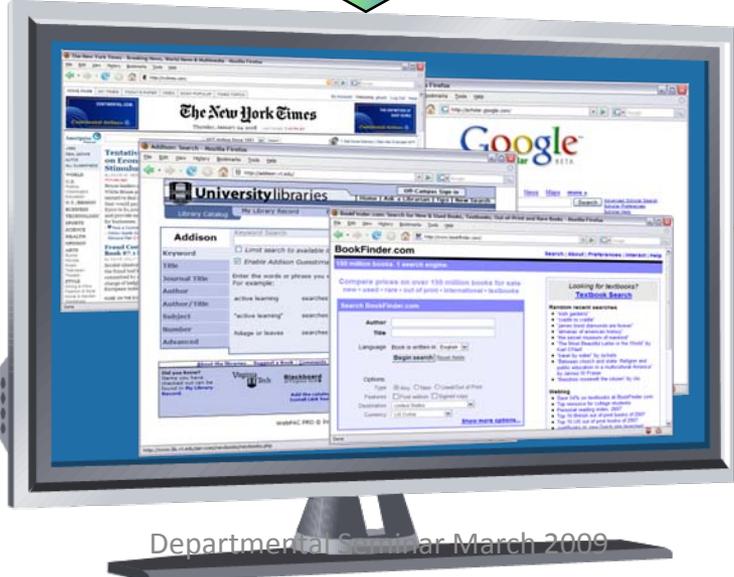
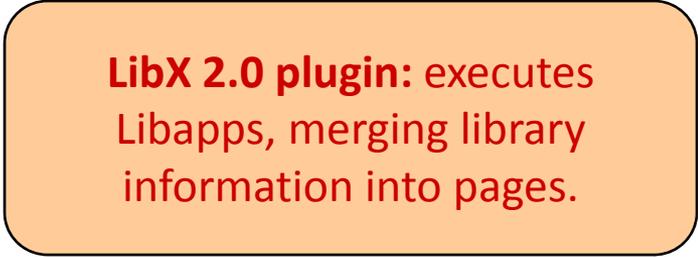
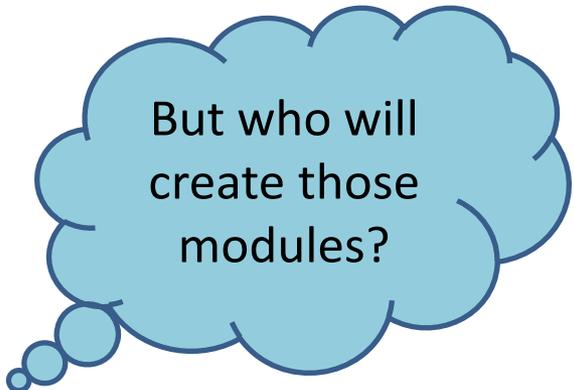


Study Findings

- The LibX Edition Builder
 - is easy to use and learn
 - auto-detection is effective at configuring resources
- Created a community
- Open source spirit
 - Anybody can create, share, publish, copy and adapt editions

Where to go from here?

- A toolbar is great, but...
- Emerging technology trends
 - Service-oriented architectures, web services interfaces – soon even to ILS!
 - Data mash-ups; HTML widgets
- Educational trends: librarians, educators, and users create
 - Online tutorials, subject guides, visualizations
 - Social OPACs: tagging, reviews, recommender services



LIBX 2.0 DEMO

The LibApp Model

- How can the interaction of LibX with web content be modeled?
- Typical tasks involve
 - Examination of the page and extraction of information
 - Processing of information
 - Modification of the page
- A *Module* is a small piece of JavaScript code along with a metadata description of its input and/or output
- A *Libapp* is a group of modules
- A *Package* is a folder of libapps and packages

LibX Tuple Spaces

tuple = TAKE(template)

- If a tuple matching template exists in the tuple space, remove it and return it
- If no tuple exists, wait until a matching tuple is written, remove it and return it

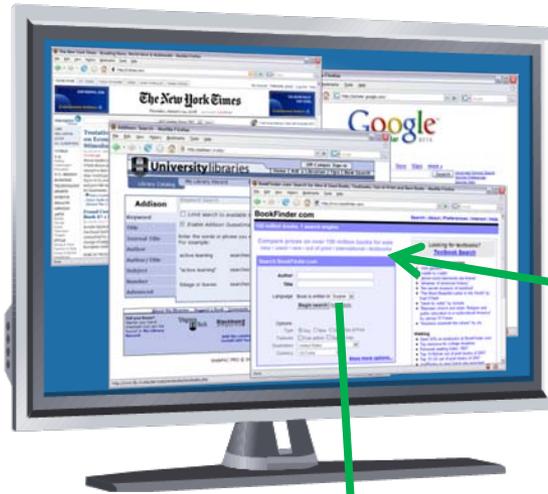
WRITE (tuple)

- Write a tuple into the space
- If a TAKE is pending with a matching template, complete the TAKE

Tuples and Templates are JavaScript objects in JSON notation.

Tuple example: `{ isbn: "0743226720" }`

Template example: `{ isbn : * } // any tuple with 'isbn' field`



Display Result

Guarded-By:
{ display: * }

Name Lookup

```
{ display:
  "published: 1989-2008
  (Novelists, American--20th
  century), most widely held
  work: The client"
}
```

{ name: John Grisham }

Tuple Space

Rationale for Tuple Spaces

Software Engineering

- Low coupling between modules
- Independent composition
- Simplicity
- Suitable for meta-programming

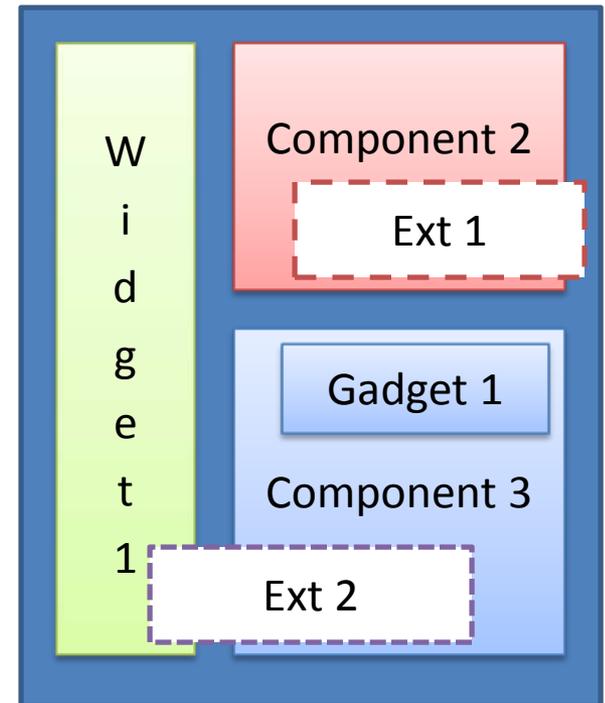
Handling Asynchrony

- User actions happen asynchronously
- Information arrives asynchronously from external sources
- Execution order independence

Back To Systems...

Client Side – Systems Perspective

- Browser's execution environment must support a *mix of components*
 - Coming from the original page
 - Coming from widgets included in original page
 - Coming from extensions such as LibX



Why Existing Browsers Don't Work

- Lack of namespace separation
- Lack of fine-grained security contexts
- Lack of resource management
- Lack of parallelism

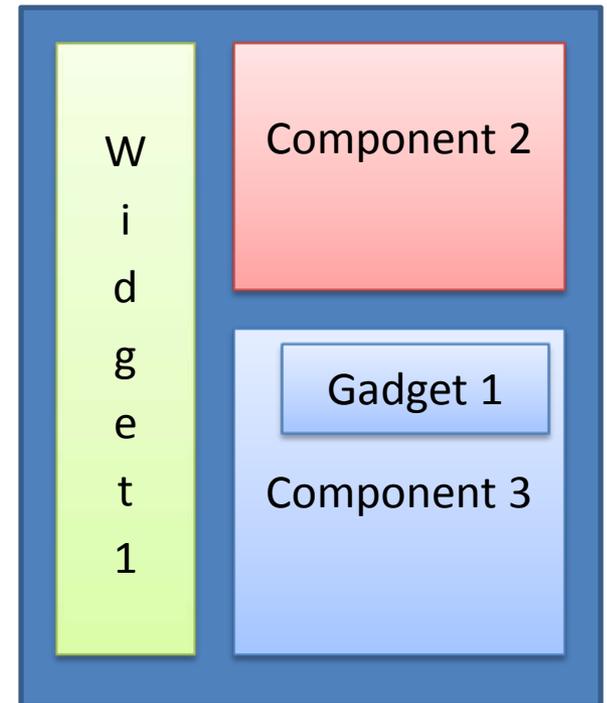
```
<script>
for (var i = 0;; i++)
  setTimeout( function () {
    var list = { data: "some string" };
    for (;;)
      list = {
        next: list,
        data: list.data + list.data
      };
    }, i++);
</script>
```

Script Spaces

- Script space represents execution context
 - May be Tab, Page, Frame, Extension module or Part of Page
- Unit of resource consumption
 - CPU + Memory + Garbage Collection
- Separate security context
- Separately schedulable

Server Side – Systems Perspective

- Many apps use Web as their primary user interface (“AJAX”)
 - E.g. LibX Edition Builder
 - Google Mail, Docs, etc.
- Must manage complex UI state

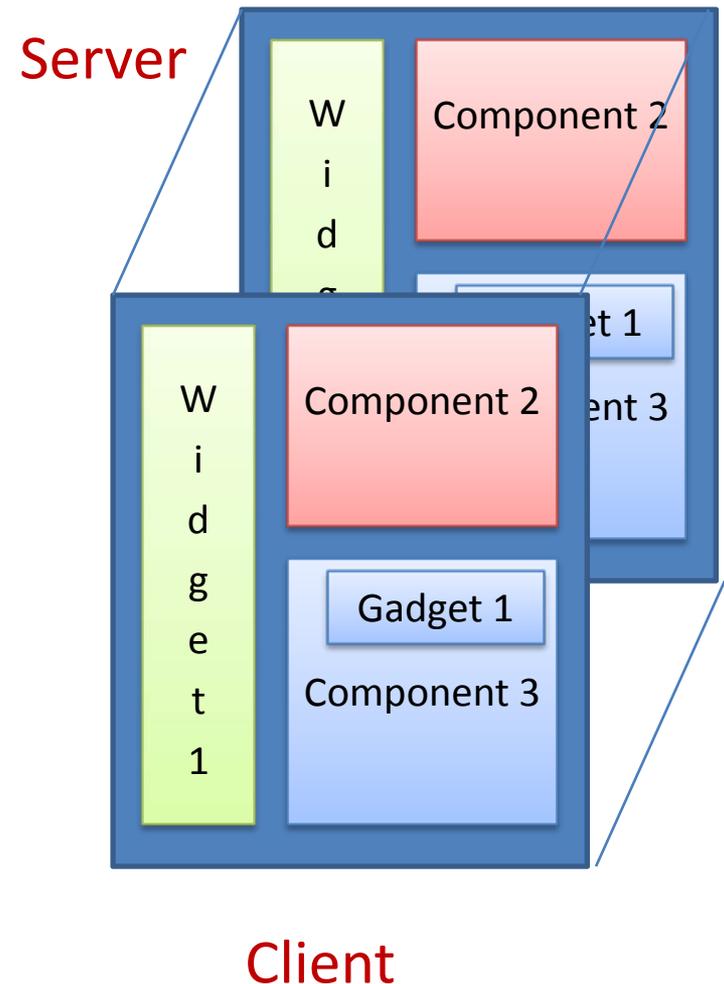


Challenges for Server-side Environments

- Web designed for static documents
 - Interactivity was retrofitted
- Stateless nature of HTTP
 - Must re-render complete presentation state on every request
- If state is kept on client, developer must manage client-server communication
 - Writing distributed applications is hard

Idea: A “remote-display” approach

- Server-centric AJAX Framework
 - Keep presentation state on server side
 - Use aspect-oriented techniques to track changes to presentation state
 - Render on demand
- Drastically simplified design



Conclusion

- To build systems, must understand applications
- Not just theoretically, build and support them

Acknowledgements

LibX Team

- Annette Bailey
- Godmar Back
- Kyrille Goldbeck
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- Arif Khokar
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 - Nathan Baker
 - Tilottama Gaat
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 - Robert Ellis

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 - Amarjyoti Deka
 - Michael Doyle
- Students
 - Mehmet Belgin
 - Peng Lu
 - Ben Pfaff
 - Anthony Romano
 - Jaishankar Sundararaman
- Faculty
 - Dimitris Nikolopoulos
 - Calvin Ribbens
 - Eli Tilevich



Past Student Employment



I'm hiring for multiple open GRA and URA positions