Managing State for Ajax-Driven Web Components

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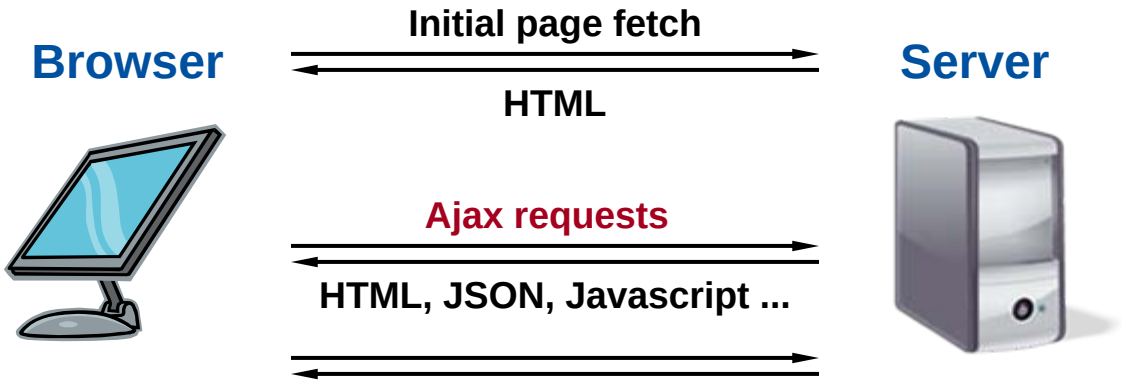
Introduction

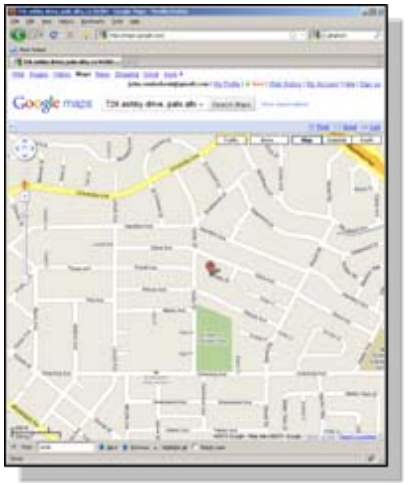
- ✗ **Problem: Ajax complicates Web applications**
- ✓ **Solution: reusable Ajax components that hide complexity**
- ✗ **Problem: components require state that spans Web requests**
- ✓ **2 possible solutions:**
  - Reminders: store state on browsers
    - ✗ Security issues
  - Page properties: store state on servers
    - ✗ Garbage collection issues

Overall, better to store state on servers

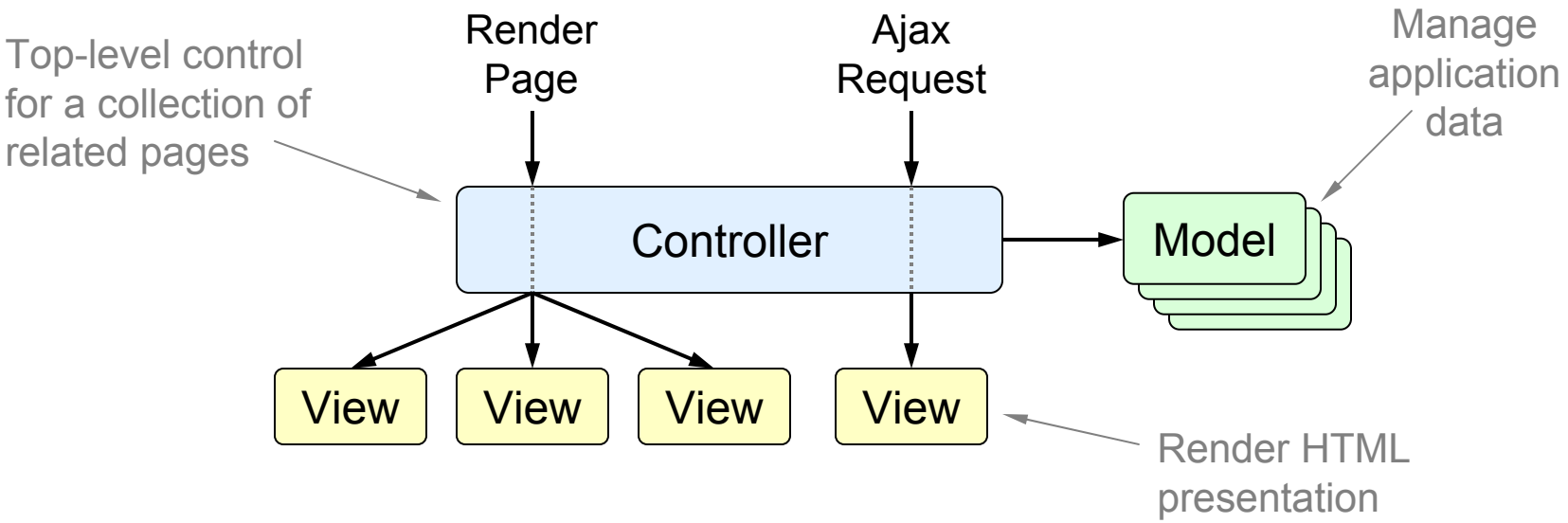
Ajax Basics



- **Incremental updates to existing Web pages**
- **Enables richer interactions:**
  - Draggable maps
  - Auto-complete
  - Live feeds and updates



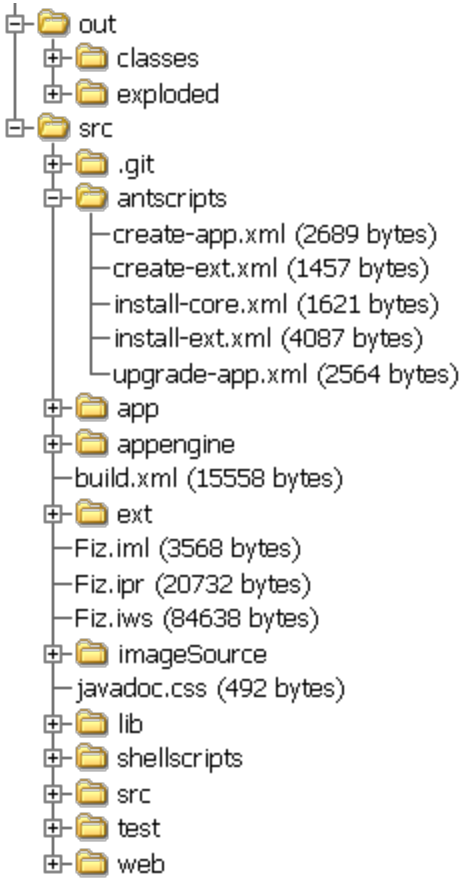
Ajax Adds Complexity



- **Every Ajax request must pass through controller**
- **Exposes controller to internals of views**
- **Scales poorly as pages get more complex**

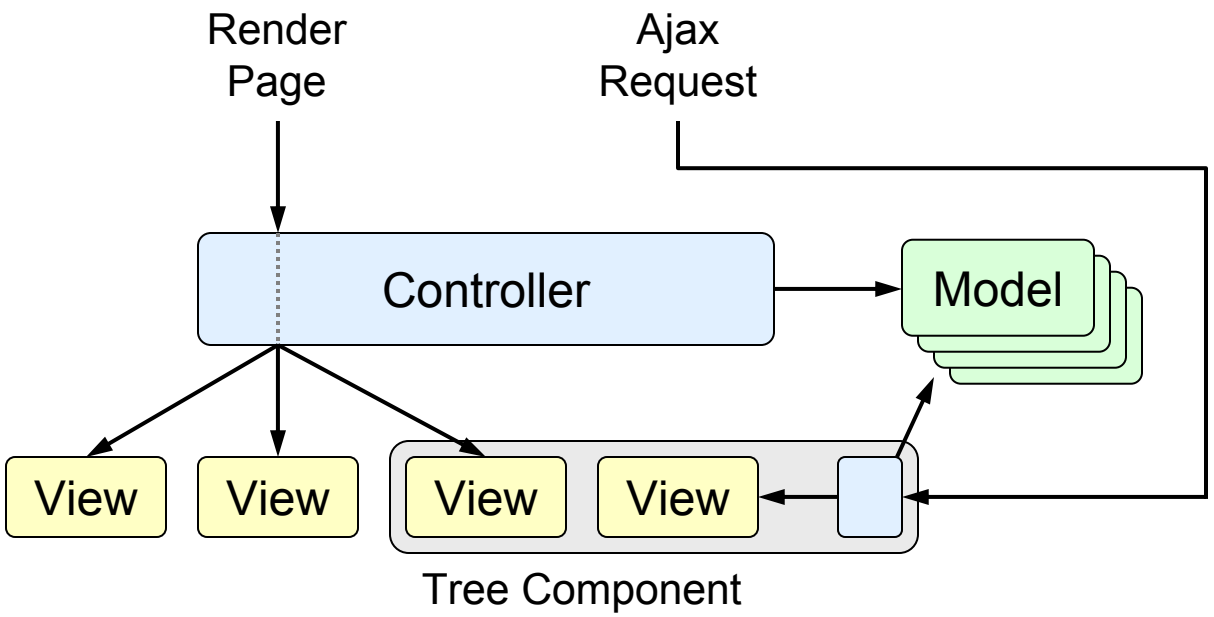
Goal: Use Components

- **Hide complex Ajax behavior in components**
- **Fiz: component-based framework**
- **E.g., tree component manages:**
  - HTML tree layout
  - Javascript event handlers
  - Ajax calls for incremental expansion
  - Communication with external data source
- **Controller provides:**
  - Data source
  - Formatting (icons, etc.)



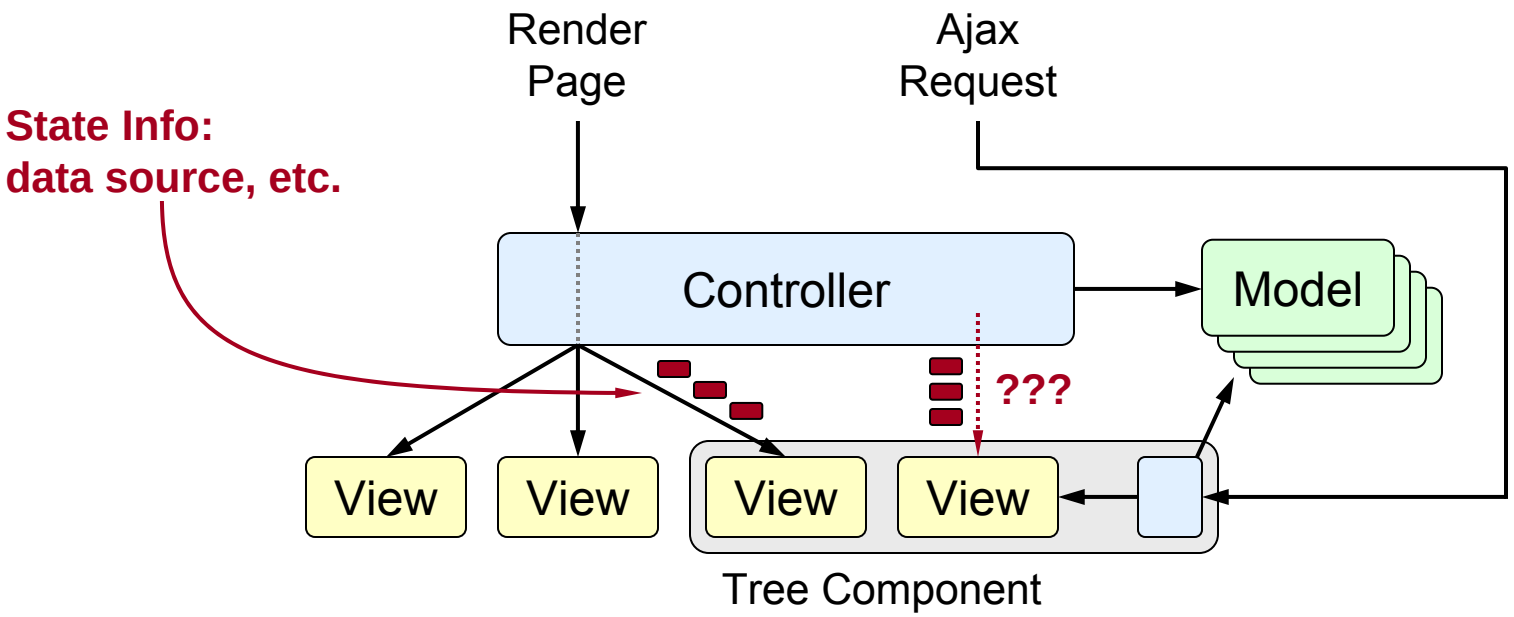

```
new TreeSection("FS.fileInDir", "code/Fiz");
```

Ajax Component with MVC



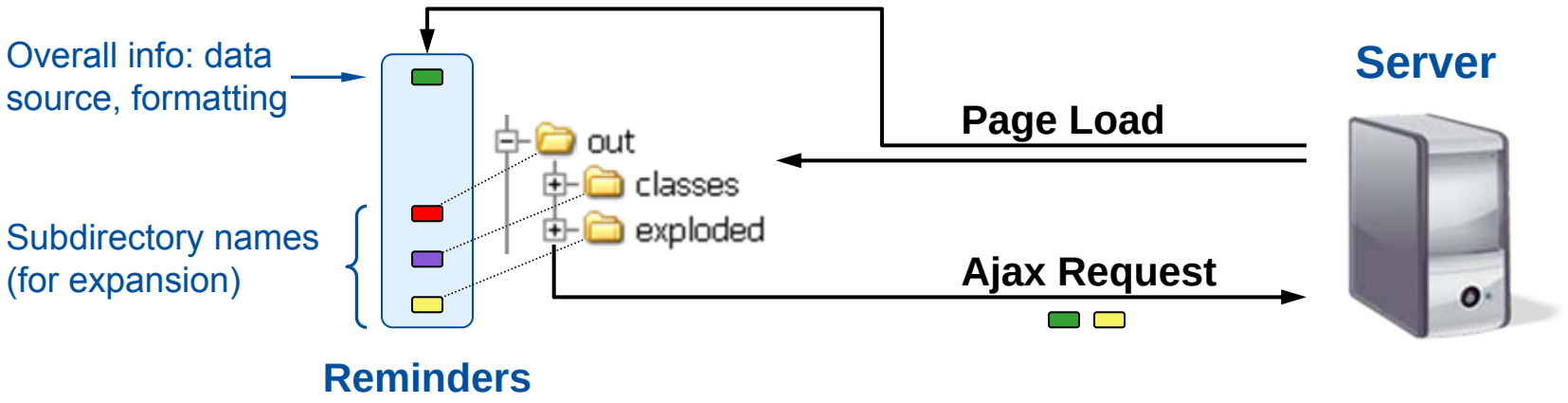
- **Bypass controller during Ajax requests**
  - Change URL routing rules

Problems with State



- **Bypass controller during Ajax requests**
  - Change URL routing rules
- **During Ajax requests, state from original rendering no longer available**

Reminders



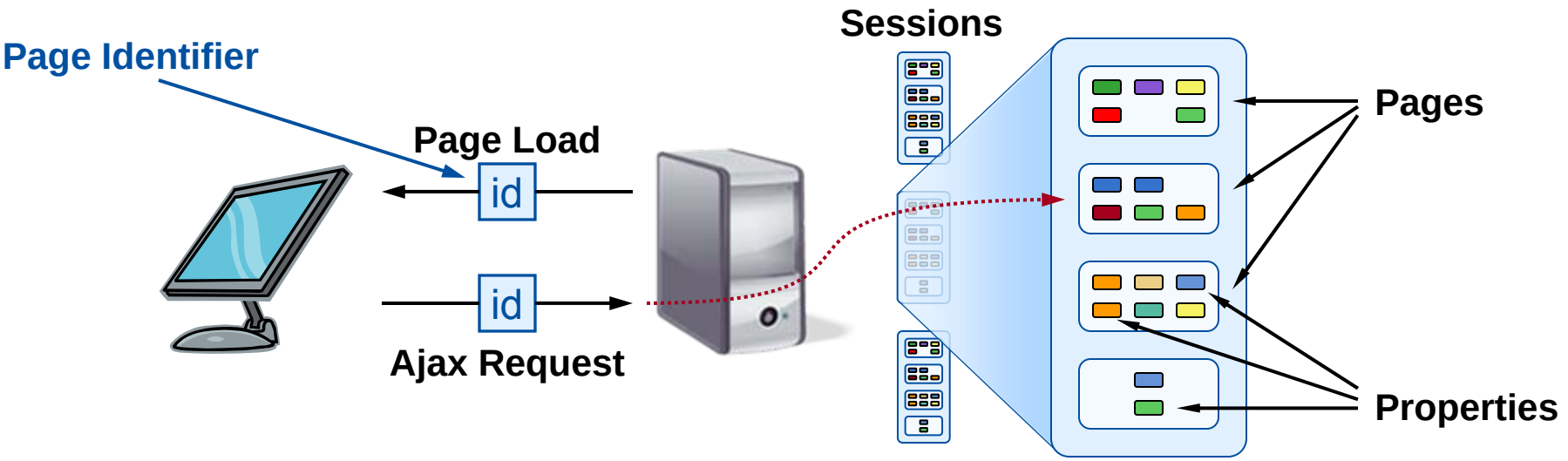
- **Reminder: collection of name/value pairs**
- **Embedded in page by server-side component**
- **Returned selectively in Ajax requests**
- **Similar to ASP.net ViewState, except granular**

Reminder Evaluation

- ✓ **Allows Ajax encapsulation: state visible only to components**
- ✗ **Additional overhead for transmitting reminders**
  - ✓ Reminders typically small
- ✗ **Security implications:**
  - ✗ Reminders store internal server state; potentially sensitive
  - ✗ Must protect integrity (MACs)
  - ✗ May need encryption also
  - ✗ Granularity enables mix-and-match replays

Unlikely that developers will recognize security risks

Page Properties



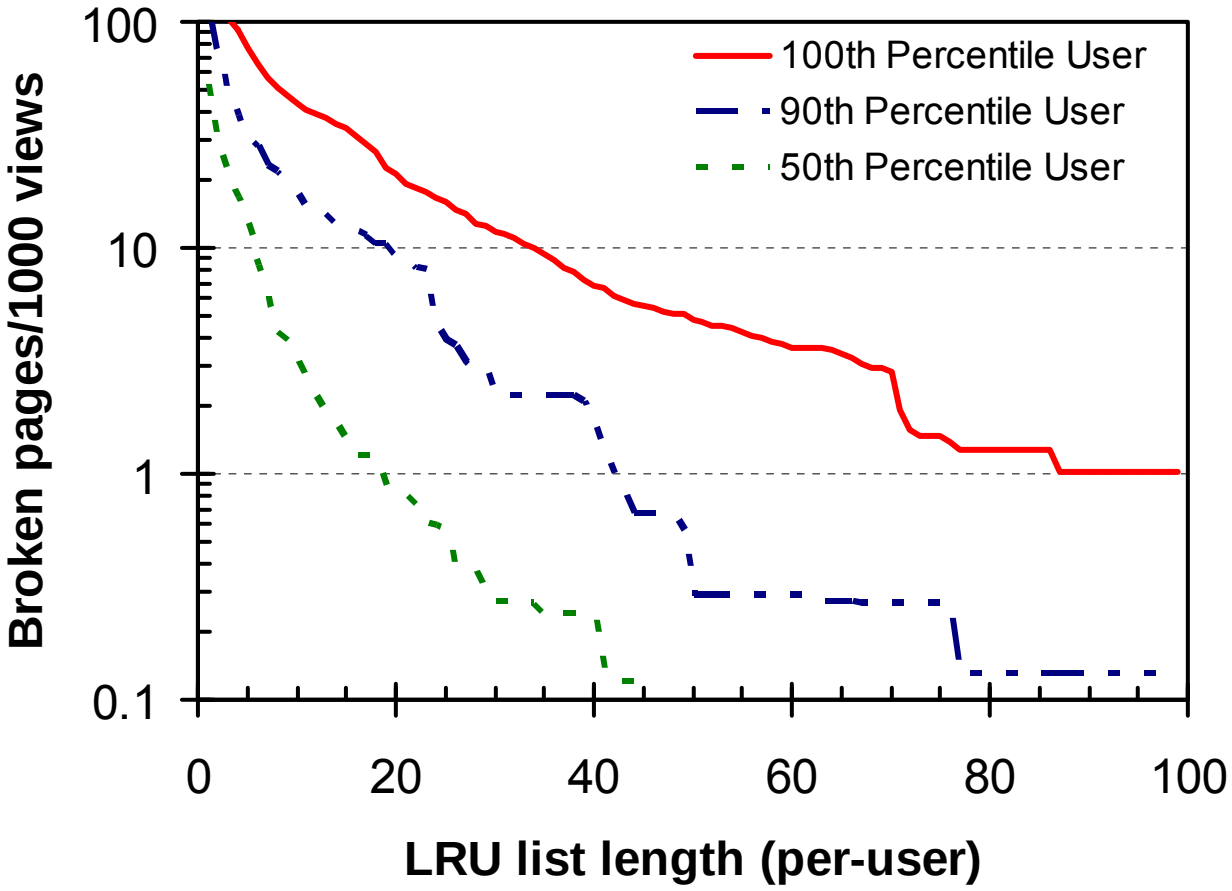
- **Page properties: name-value pairs specific to a page**
  - Stored in session
  - Created during initial page rendering
  - Accessible/modifiable during later Ajax requests
- **Page identifier:**
  - Stored with page on browser
  - Included in Ajax requests to find appropriate properties

Page Property Evaluation

- ✓ **Allows Ajax encapsulation**
- ✓ **No security issues: all state kept on server**
- ✗ **Overhead for saving page properties**
  - ✗ Must be persisted with session data
- ✗ **Garbage collection**
  - ✗ When is it safe to delete old page properties?
  - ✗ Can return to old pages at any time (tabs)
  - ✗ Potential for "broken pages" (forced refresh)

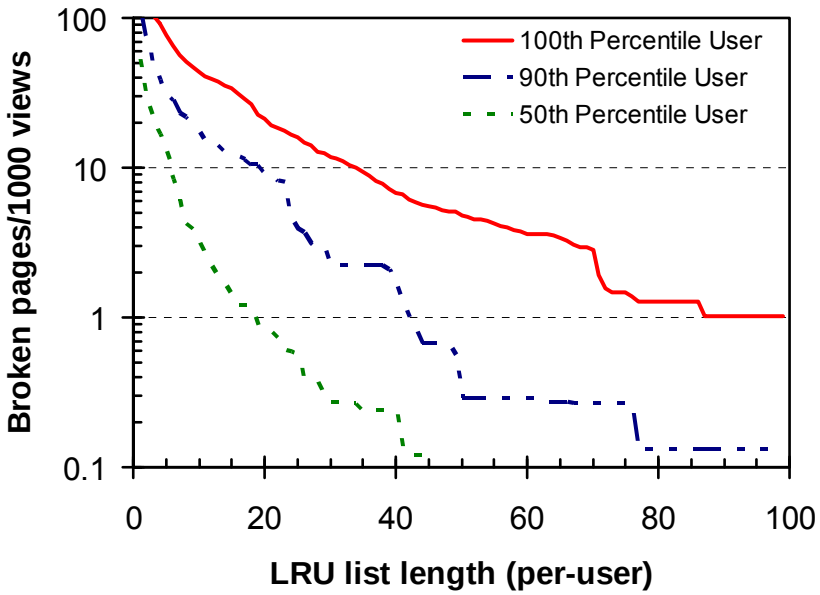
How much state must be retained to keep users happy?

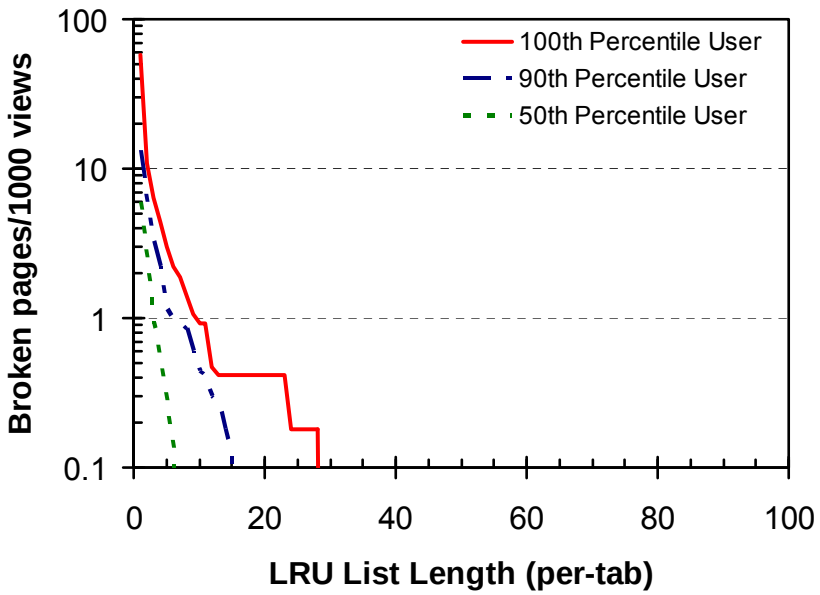
Trace-Driven Simulation



- **Data from 30 Firefox users over 2 months (200,000 page views)**

Per-Tab LRU Lists





- **Unfortunately, browsers don't identify tabs/windows**
- **Would be a useful and simple addition**

Conclusions

- **Managing Web application state is hard**
  - State distributed between browser and server
  - Servers don't maintain state between requests
  - Ajax makes things even worse
    - Finer-grain interactions
  - Components make things worse
    - Need more state to maintain modularity
- **Neither reminders nor page properties ideal**
  - Reminders: security problems
  - Page properties: garbage collection problems
- **Overall, page properties are probably better**
- **Browsers should provide tab identifiers**

Related Work

- **ViewState in Microsoft ASP.net**
  - Monolithic: all state for entire page sent with each request
- **Javascript-driven applications (e.g. Gmail):**
  - Application exists as Javascript in browser
  - Server provides data only
  - All page state kept in Javascript
  - Security issues simpler/more obvious
  - ✗ Overheads for downloading Javascript
  - ✗ Business rules must still be enforced on the server