CHARIOT SOLUTIONS

OPTIMIZING YOUR
INVESTMENT IN
JAVA TECHNOLOGY

Practical AJAX

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Where were you when…

And later…

And don't forget...

And they keep coming...

Basecamp™

Gabbly

kiko
BETA
A new kind of online calendar

Zimbra

BACKBASE

(beta) writely

flickr BETA

Gmail™
+talk BETA

pixoh
Edit pictures online

typo

clipmarks

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And yet...

AJAX applications use technologies that have been around for years.

All that's been missing is vision.

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Agenda

- **What is AJAX?**
- **Top 10 AJAX Sightings**
- **Top 10 AJAX Problems**
- **Popular Tools**
- **Popular Frameworks**
- **Where to Learn More**

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What is AJAX?

An Acronym?

- **A**synchronous
  - Calls are made asynchronously with XMLHttpRequest
  - Doesn't hang browser or interrupt user
- **J**avaScript
  - Old CW: Toy or Pest
  - New CW: Powerful dynamic language
- **A**nd
  - and... lots of other stuff that doesn't get star billing
  - e.g. CSS and DHTML
- **X**ML
  - Can request/retrieve semantic XML data
  - (Text/HTML snippets are more common in practice)

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A Design Philosophy?

- **AJAX applications do not...**
  - **reload the entire page to change one part**
  - **limit users to a small set of HTML input widgets**
  - **block user activity while waiting for a server response**
  - **let pages get stale in between page loads**

- **AJAX applications do...**
  - **load a lot of data in the first page request (usually)**
  - **frequently fetch snippets to update parts of the page**
  - **push useful information to the user**
  - **provide flexible user input controls**

- **AJAX applications feel...**
  - **responsive**
  - **fresh**
  - **productive**

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A Promised Land?

- **All the richness of desktop applications**
  - **Complex input widgets**
  - **Immediate feedback**
  - **Drag and drop**
  - **Animations**
  - **Sub-second response time**

- **All the power of web applications**
  - **Easy, cross-platform deployment**
  - **Instant updates across entire install base**
  - **Graphic design power and flexibility**
  - **Easy integration with other web applications**
  - **Server-side security and stability**

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10 lines of JavaScript Magic?

```
xhr = new XMLHttpRequest();
function getMessage(){
    xhr.onreadystatechange=displayMessage;
    xhr.open("GET", "/getMessage");
    xhr.send(null);
}
function displayMessage() {
    msg = xhr.responseText;
    document.getElementById("messageBox").value=msg;
}
...
<input id="messageBox" type="text" />
<input type="button" value="Get" onclick="getMessage();" />
```

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100 lines of JavaScript Hell?

```javascript
var xhr;

try {
    xhr = new ActiveXObject("Msxml2.XMLHTTP");
} catch (e) {
    try {
        xhr = new ActiveXObject("Microsoft.XMLHTTP");
    } catch (e) {
        xhr = false;
    }
}
if (!xhr && typeof XMLHttpRequest != 'undefined') {
    xhr = new XMLHttpRequest();
}
...
```

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The Reality

- **"AJAX" now means more than just remoting**
  - **DOM manipulation**
  - **CSS magic**
  - **DHTML**
  - **Compound effects**
  - **Rich user experience**
- **Great tool for taking webapps to the next level**
- **Simple frameworks mitigate JavaScript pain**
- **Easy to use just a little in a regular webapp**
- **Building a completely AJAX-based app is a lot like building a rich desktop client, with JavaScript as the implementation language**

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Top 10 AJAX Sightings

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Auto-Complete

- **When to use it?**
  - **Cascading select boxes**
  - **Dynamic search boxes**
  - **Auto-population of related or dependent form fields**
  - **Tab completion in form fields**

- **How does it work?**
  - **XHR sent to server from onkeypress, onblur, onchange**
  - **Results returned and used to populate other form fields or a floating div with values that can be selected**

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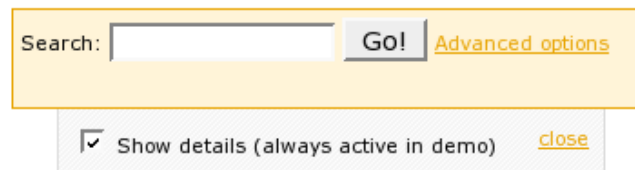
Drill Down

- ## When to use it?
  - ### Email-like interfaces with list and preview pane
  - ### Wherever users can browse lists and drill down on items

- ## How does it work?
  - ### XHR sent to server from onclick or onkeypress
  - ### Results returned and used to populate drilldown area

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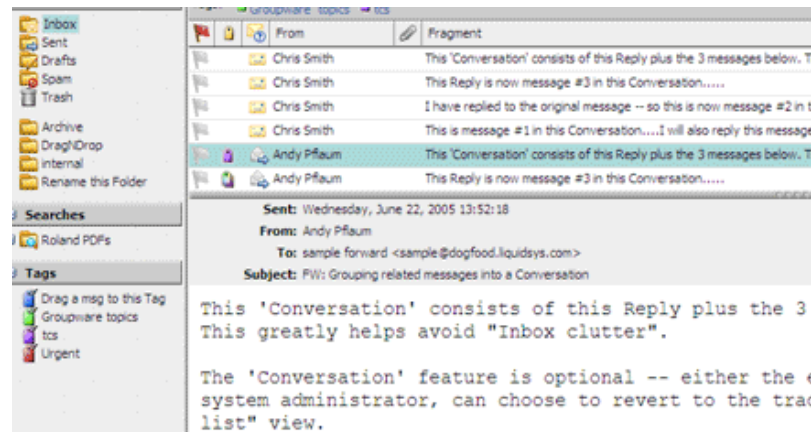
Pop-up Control Panels

- ## When to use them?
  - **Sidebars with controls that aren't always needed**
  - **Advanced search drop down from simple search field**
  - **Buttons that bring up useful options for current item**

- ## How do they work?
  - **Hidden div contains control panel**
  - **During onclick, it is positioned and made visible**
  - **User can interact, sometimes triggering XHRs**
  - **Some mechanism is provided to close the panel**
  - **Often, sliding effects are used during open/close**

Search: [   ] [Go!] Advanced options

☑ Show details (always active in demo)   close

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Drag and Drop

- **When to use it?**
  - **Content scheduling applications**
  - **List reordering**
  - **Shopping carts**
  - **Portlet rearrangement**

- **How does it work?**
  - **Easiest to use a JavaScript framework**
  - **Register draggable items and drop targets**
  - **Mouse listeners are registered for draggable items**
  - **Drag is accomplished by moving during mouse events**
  - **On mouse up, position is checked against known drop targets**
  - **If recognized, XHR is triggered to tell the server**
  - **Otherwise, animation used to revert draggable item**

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Instant Validation

- **When to use it?**
  - **Displaying error if username is already taken**
  - **Displaying format errors**
  - **Expanding alternatively formatted input**

- **How does it work?**
  - **Similar to auto-complete**
  - **XHR triggered either onkeypress or onblur**
  - **Non-blocking error is displayed next to field if necessary**

Username: |bill   Username Unavailable!

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Status Indicators

- **When to use them?**
  - **Long-running operations (e.g. searching flights)**
  - **File uploads**
  - **Dashboards and countdowns that need to sync with server**
  - **Any asynchronous call that might take a few seconds**

- **How do they work?**
  - **User triggers some sort of long-running operation**
  - **XHR is sent and animation is made visible**
  - **When response is received, animation is stopped**
  - **In more complex scenarios, the page may use client-side or server-side timers to periodically update a value (e.g. percent complete)**

Music
Currently listening to **A State of Trance Episode 199** by **Armin van Buuren presents** from **Digitally Imported** (www.di.fm)

01:07:36   02:05:22

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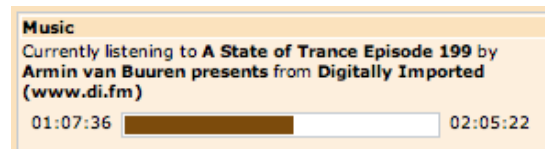
User Profiling

- **When to use it?**
  - **Storing display decisions (e.g. table vs. thumbnails)**
  - **Tracking time spent on each page**
  - **Tracking which fields cause forms to be abandoned**
  - **Gathering usability statistics**

- **How does it work?**
  - **User actions that adjust the page display issue a small XHR to a preference service that stores the decision in the user's profile for future reference**
  - **Javascript timers are used to periodically send a heartbeat XHR to the server, which can be used to track time spent**
  - **XHR can be sent on every form field transition to track how much time is spent and understand usability characteristics**

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Virtual Space

- ## When to use it?
  - **Map services (e.g. GoogleMaps)**
  - **Any application with image zoom features**
  - **Very large graphs or images**

- ## How does it work?
  - **Image data or graph is broken up into tiles**
  - **Current visible tile IDs stored in JavaScript array**
  - **Large div is nested within a smaller one with overflow clipped**
  - **Inner div displays visible tiles in a grid**
  - **On every drag, grid is moved and visible tiles are updated (via XHR requests) if necessary**
  - **Requires some prefetching and cleanup**

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User Notifications

- **When to use them?**
  - **Long-running process has finished or has errors**
  - **New item or message has arrived**
  - **Another user is working in the same area of the app**

- **How do they work?**
  - **Page contains fixed-position, invisible message area**
  - **JavaScript timer used to periodically wake up and poll server with XHRs**
  - **Resulting messages are displayed to the user in the message area until user chooses to clear them or timeout is reached**
  - **User may be allowed to interact with message using pop-up control panel**

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Visual Effects

- **When to use them?**
  - **Call attention to a successful AJAX action**
  - **Animate addition or deletion of page elements**
  - **Highlight recently added or modified page elements**
  - **Provide smooth animations for complex DHTML widgets**

- **How do they work?**
  - **Timed JavaScript sequence begins which alters size, position, color, visibility and other style attributes**
  - **Usually hidden away in Effects framework**
  - **Need to take care to handle failed requests**
  - **Need to eventually fade away any highlighting**

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Top 10 AJAX Problems

No Feedback

- **Problem:**
  - **User triggers remote actions without realizing it**
  - **Not sure if actions "took" on the server**
  - **May make duplicate requests**
  - **May accidentally interrupt a long-running action**

- **Solution:**
  - **Display a discreet but consistent animation whenever there is a pending XHR**
  - **Use effects libraries to signal successful outcomes**
    - Pulsate a drop target
    - Display a brief message that fades away
    - Highlight a newly added page element
  - **Be sure to display error messages for failed requests**

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Can't Deep Link

- **Problem:**
  - **Large sections of content are updated without a page load**
  - **Search spiders will only ever see the initial content**
  - **Users can't send links to friends**
  - **Users can't bookmark content**
  - **Difficult to link from one part of the app to another**

- **Solution:**
  - **Use explicit page loads for important transitions**
  - **Support both incremental updates and full page entrypoints**
  - **Provide links to let users get a permanent URL**
  - **Provide links to let users email URLs to other people**

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Broken Back Button

- **Problem:**
  - **Enthusiastic AJAX apps may have only one full page load**
  - **User is used to using the back/forward buttons to navigate**
  - **May accidentally back out of the app, losing all page state**

- **Solution:**
  - **Take steps to support deep linking (see previous slide)**
  - **Use a framework with great cross-browser back button support (e.g. Dojo)**
    - Significant browser differences here
    - Don't bother implementing this yourself

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Violating User's Web Expectations

- **Problem:**
  - **Form data saved without submit, and users don't realize that**
  - **Lots of individually scrollable regions within a scrollable page**
  - **Broken back button, bookmarks, etc.**
  - **Inconsistent DHTML versions of standard form controls**
  - **Pauses at unexpected times**

- **Solution:**
  - **Be explicit about forms/controls that save automatically**
  - **Be consistent throughout the application**
  - **Use popular frameworks for effects, widgets, etc. so that users are more likely to recognize them**
  - **Exercise moderation**

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Violating User's Rich Client Expectations

- **Problem:**
  - **AJAX application has replaced conventional desktop app**
  - **Looks like a desktop app (e.g. Outlook)**
  - **Doesn't support common rich client features**
    - Undo and Redo
    - Auto-save
    - Warning when trying to close unsaved documents
  - **User is lured into false sense of security, loses data**

- **Solution:**
  - **Implement undo, redo, auto-save and close warnings**
  - **Ensure that back button won't take user out of the app**
  - **Ensure that links won't open in same tab, replacing the app**

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Ignoring Errors

- **Problem:**
  - **User does something that triggers remote action**
  - **XHR times out or returns failure code**
  - **User thinks action succeeded**
  - **Page is mangled or gets out of sync with server**

- **Solution:**
  - **Check HTTP status code on responses, not just ready state**
  - **Write error routines for catch clauses and bad return codes**
  - **Don't display success effects until XHR returns – just display some sort of progress indicator**
  - **Develop a consistent and obvious way of indicating failure (error messages, red highlighting, etc.)**

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Inconsistent Freshness

- **Problem:**
  - **One part of the page is constantly polling the server and updating itself**
  - **Another part is static until the next full page refresh**
  - **Confusing to users**
  - **Data can be inconsistent**

- **Solution:**
  - **Don't mix static data and dynamic data – choose one**
  - **Don't forget to update more than one part of the page if the same data is repeated in several places**

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Not Degrading Gracefully

- **Problem:**
  - **Some functionality is only available through AJAX**
  - **Users with incompatible browsers are left out in the cold**

- **Solution:**
  - **Provide a plain HTML way of achieving every basic use case**
  - **Test with JavaScript turned off**
  - **Test in older browsers**

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Too Many Connections

- **Problem:**
  - **Dashboard pages may have 20 status indicators polling the server**
  - **Browsers limit the number of simultaneous connections**
  - **Risk of conflicting changes to the DOM**
  - **Risk of annoying slowdowns**

- **Solution:**
  - **Be conscious of how many connections you're likely to use**
  - **Queue status requests and execute in sequence, or as one combined call**
  - **Use different callbacks for any simultaneous requests so that you can update the right status indicators**

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DOM Explosion

- **Problem:**
  - **XHR results are stored in DOM without removing old information**
  - **Dynamic page elements are created for every use and just hidden when no longer needed**

- **Solution:**
  - **Remove elements from the DOM when you're done with them**
  - **Reuse pop-up divs, status indicators, message boxes, etc.**

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Popular Tools

Live Source Viewers

- **We rely on "View Source" to debug normal webapps**
  - **Not very pretty**
  - **Doesn't help when JavaScript is dynamically inserting/removing content**
- **Get a tool that can translate the current DOM model to a source view**
- **Check out these Firefox extensions:**
  - **View Rendered Source Chart**
  - **View Formatted Source**
- **Also, try Ctrl-A and then "View Selection Source" to get syntax-highlighted live source view**

Firefox Plugin:
View Rendered Source Chart

Firefox Plugin:
View Formatted Source

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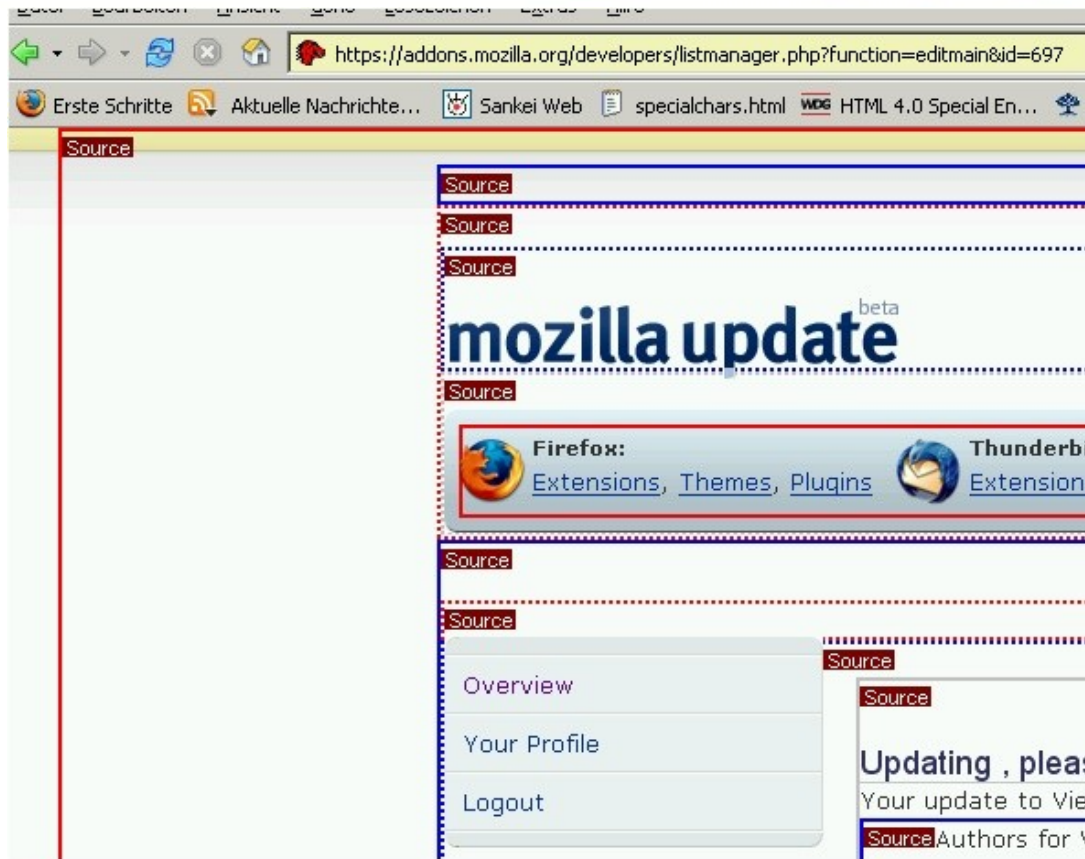
DOM Inspectors

- **Must have for browser-based JavaScript development**

- **Navigate the entire DOM tree**

- **View properties of each element**

- **See how CSS styles are being computed**

- **Check out:**
  - **Firefox's built-in DOM Inspector (in Tools Menu)**
  - **Safari Debug Menu and Web Inspector (enable first!)**
  - **Internet Explorer Developer Toolbar and DOM Inspector**

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Firefox DOM Inspector

Safari Web Inspector

Internet Explorer DOM Inspector

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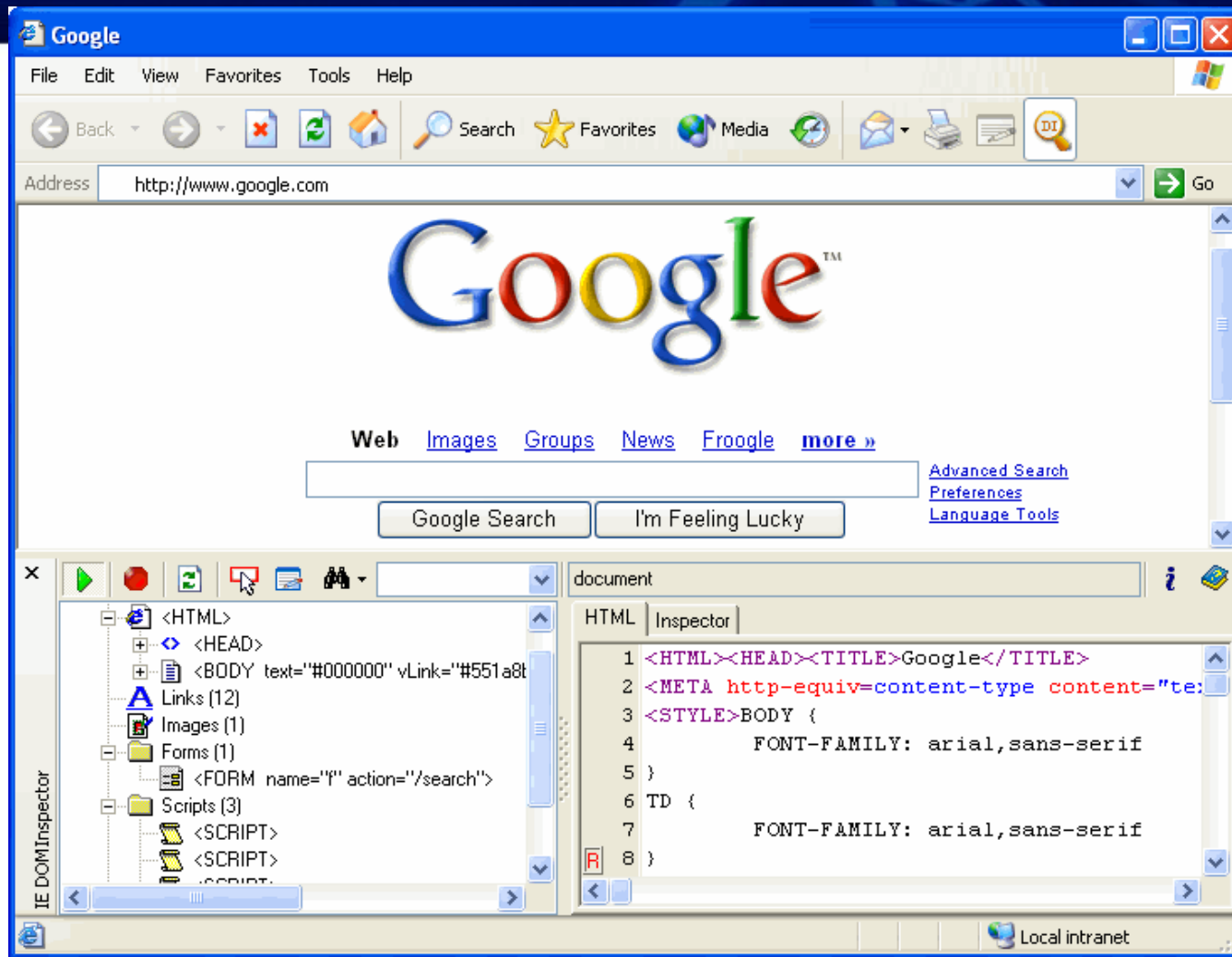
JavaScript Debuggers

- **Every AJAX app is going to have a lot of JavaScript**

- **Browsers – particularly non-Mozilla browsers – make debugging difficult**

- **No easy way to log debug information in a way that survives a page reload**

- **Check out:**
  - **Venkman JavaScript Debugger**
  - **MyEclipse JavaScript Debugger (and other AJAX Tools)**
  - **Microsoft Script Debugger**

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JavaScript Debuggers - Venkman

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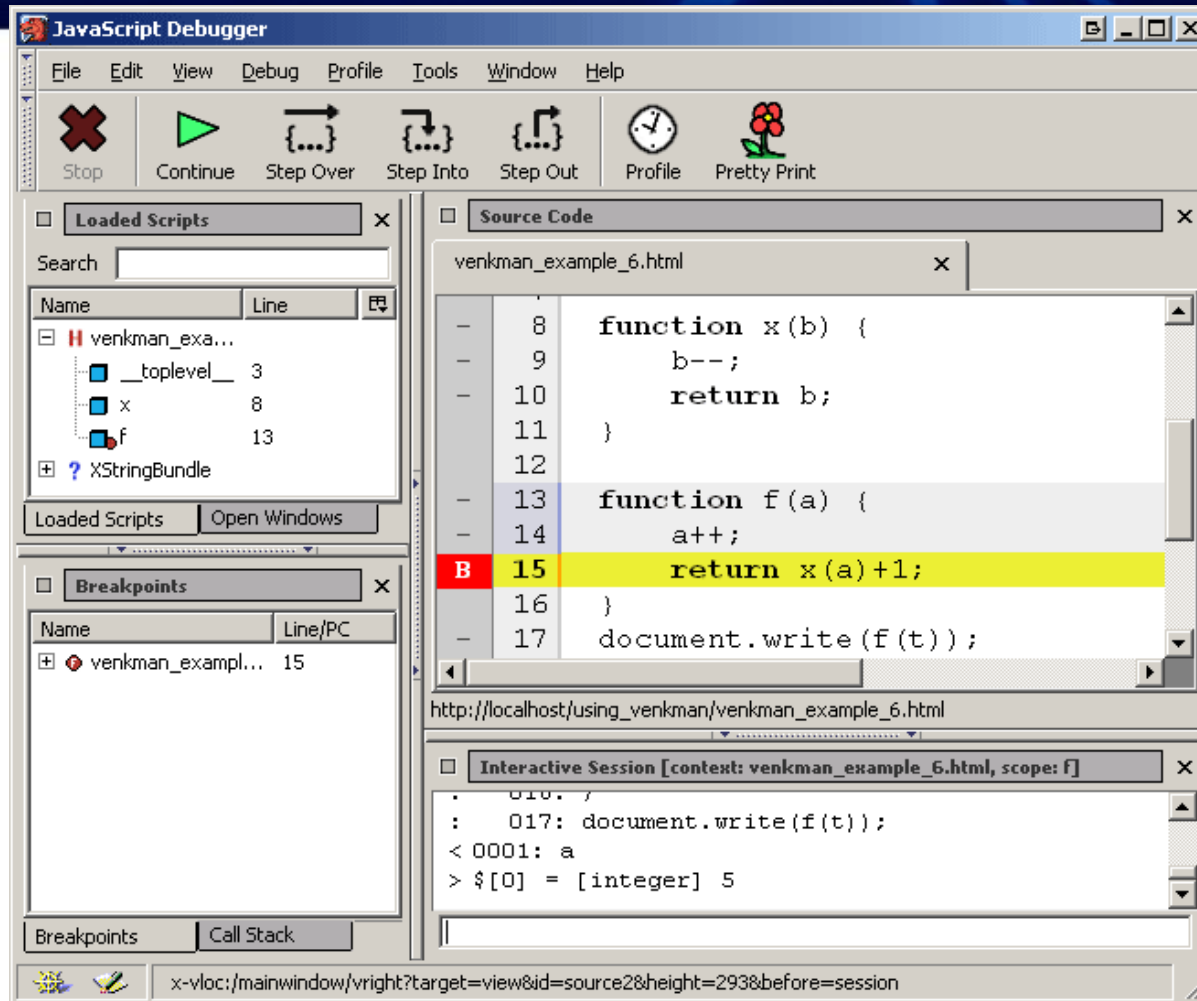
JavaScript Debuggers - MyEclipse

Popular Frameworks

Framework Flavors

- **Specialized JavaScript Libraries**
  - Remoting, Effects, Drag and Drop, DHTML Components
  - Can be mixed and matched

- **Comprehensive JavaScript Libraries**
  - Provide most of the functionality above and more
  - Clean interface between server-side and client-side

- **Language-Specific JavaScript Wrappers**
  - Convenient helpers/macros for hiding JavaScript details
  - Great for adding small AJAX features to webapps
  - Still JavaScript/DOM-based at heart

- **Language-Specific AJAX Implementations**
  - Not dependent on externally developed JS libraries
  - Can expose language features to JavaScript layer
  - Can integrate well with existing web frameworks

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AJAX Styles – Fragment Response

- **How does it work?**
  - XHR returns text or HTML snippet
  - This is used to replace the contents of a page element
  - Sometimes called "DOM Replacement"
- **Advantages**
  - Really easy to program
  - Re-uses initial rendering code
  - Minimal JavaScript (framework does everything)
  - Less Processing
- **Disadvantages**
  - May use more bandwidth
  - Not as easy to re-use generic web services
  - Difficult to update several different parts of the page

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AJAX Styles – Semantic Response

- **How does it work?**
  - XHR returns XML or JSON data
  - JavaScript interprets this and updates individual page elements

- **Advantages**
  - Minimizes bandwidth
  - Reusable across different applications
  - Easy to update different parts of the page

- **Disadvantages**
  - XML requires parsing, which is more intensive
  - Different approaches for initial render vs. update
  - Lots of app-specific JavaScript

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AJAX Styles – Script Response

- **How does it work?**
  - XHR returns JavaScript
  - JavaScript is executed and modifies DOM structure

- **Advantages**
  - Minimal JavaScript in pages
  - Easy to take advantage of main implementation language to track DOM, manage updates, etc.

- **Disadvantages**
  - Fragile if mixed with other JavaScript libraries that manipulate the DOM
  - Intimately tied to page structure – difficult to reuse

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Popular Frameworks – DOJO

- **General-purpose JavaScript Toolkit**
- **Massive and comprehensive, including**
    - **JavaScript utility libraries**
    - **DOM/CSS manipulation**
    - **Event libraries**
    - **Collections**
    - **Remoting**
    - **JSON support**
    - **XML Parsing**
    - **Widgets**
    - **WYSIWIG Text Editor**
    - **Effects**
    - **Drag and Drop**
    - **Validation**
    - **Graphics manipulation**

Popular Frameworks – Prototype

- **General-purpose JavaScript Library**
- **Provides some basic JavaScript convenience methods**
  - **e.g. ${foo} instead of document.getElementById('foo')**
- **Provides basic AJAX functionality**
  - **Remoting**
  - **Periodic updates**
  - **JSON evaluation**
- **Lightweight and easily integrated with other JavaScript libraries**

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Popular Frameworks – Rico

- **JavaScript-based AJAX Library**
- **Based on Prototype**
- **Provides basic AJAX functionality**
  - **Remoting**
  - **Drag and Drop**
  - **Effects (including Rounded Corners)**
  - **Widgets (including Accordion and LiveGrid)**
- **Favors DOM Replacement**
  - **Lightly wrapped in XML**
  - **Supports updating more than one page element from a single response**
- **Lightweight and easily integrated with other JavaScript libraries**

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Popular Frameworks – Script.aculo.us

- **Multi-purpose JavaScript Library**
- **Based on Prototype**
- **Supports remoting**
- **Favors DOM replacement**
- **Supports drag and drop**
- **Includes large library of effects**
  - **Basic transforms and distortions**
  - **Compound effects like "1 second spotlight"**
- **Developed alongside and distributed with Ruby on Rails**
- **Plays nicely with other JavaScript libraries**

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Popular Frameworks – Ruby on Rails

- **Ruby-based web framework**
- **Wraps Script.aculo.us JavaScript Libraries**
  - **Remoting**
  - **Effects**
  - **Drag and Drop**
- **Supports DOM replacement**
- **Supports Script Response (RJS Templates)**
- **Possible to upgrade underlying JS libraries, but not always compatible**

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Popular Frameworks - AjaxTags

- **Java-based AJAX framework**
- **Attempts to shield developers from almost all JavaScript**
- **Custom JSP tags for things like:**
  - **autocomplete**
  - **callout**
  - **DOM replacement**
  - **cascading selects**
  - **cascading field updates**
- **Integrates effects for progress indicators**
- **Great for sprinkling AJAX, not full-fledged**
- **Not to be confused with the Struts AJAXTags project, which is now part of Java Web Parts**

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Popular Frameworks - DWR

- **DWR = Direct Web Remoting**
- **Java-based AJAX framework**
- **Acts a lot like RMI, giving access to server-side Java classes from client-side JavaScript code**
- **Favors semantic response style**
- **Adds convenience**
  - **Responses come back as objects, not XML**
  - **Utility methods for things like updating a set of options based on an array**
- **Very popular**
- **Integrated with leading Java frameworks (Struts, Tapestry, Spring, JSF...)**
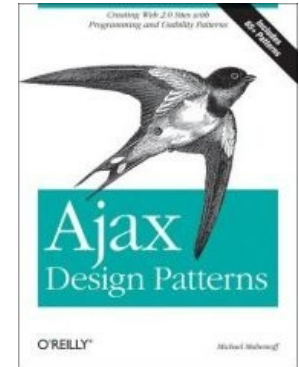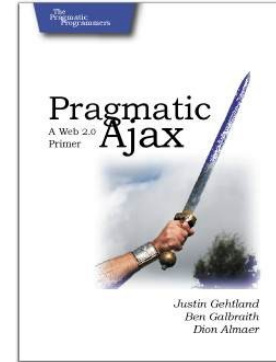
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Where to Learn More

Resources

- **Books**
  - **Pragmatic AJAX** (Manning, 2006)
  - **AJAX Design Patterns** (O'Reilly, 2006)
  - **AJAX in Action** (Manning, 2005)

- **Sites**
  - **AjaxPatterns.org** – great catalog of AJAX techniques
  - **AlistApart.com** – hotbed of CSS/DHTML design innovation
  - **W3Schools.com** – tutorials on HTML, CSS, JavaScript
  - **Ajaxian.com** – blog and news site devoted to AJAX

Chariot Training

For more information, contact:
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- **Ready for more than a one-hour presentation?**

- **Chariot Solutions offers in-depth team training on AJAX and many other technologies**

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  - **In-depth coverage of 2-3 frameworks based on:**
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    - your AJAX goals (e.g. usability, enabling complex user interfaces)

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- **Follow-on mentoring, review, implementation and support services are available**

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