Basics of Web Development

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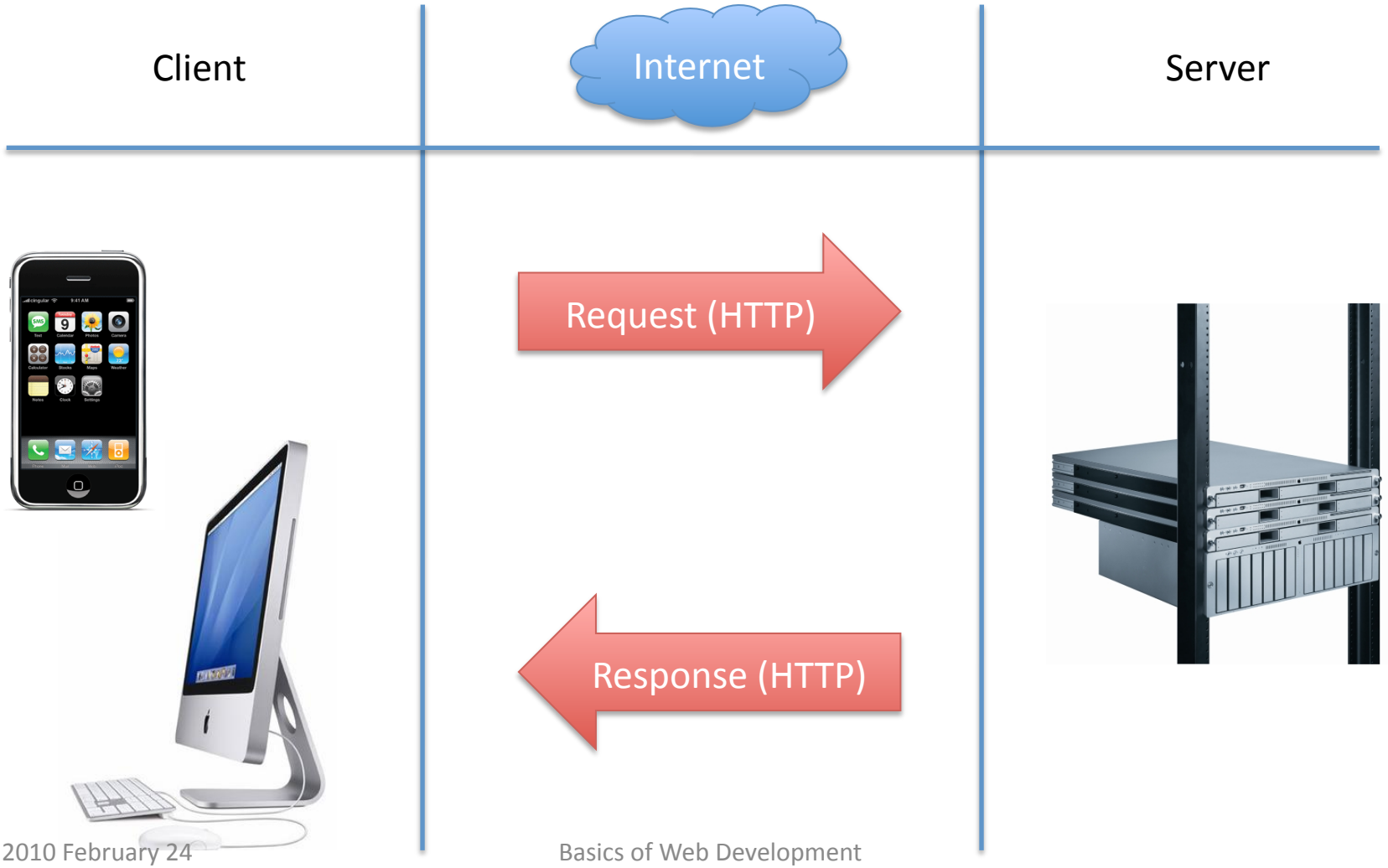
Outline

- Web Development
- Client-Side
  - Document, Style, Dynamics
  - Mobile Devices
- Server-Side
  - Web Server, Scripting, Database
  - Content Management
- Other
  - Web 2.0
  - Hosting
  - Resources

The Web – Big Picture

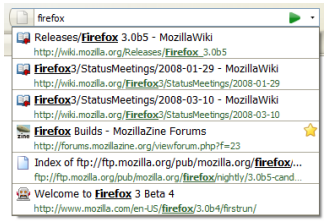


Example

Client

Internet

Server



```
GET /index.html HTTP/1.1
 Host: www.mozilla.com
```


```
HTTP/1.1 200 OK
 Date: Sun, 21 Feb 2010
11:12:34 GMT
 Server: Apache/1.3.3.7
(Unix)  (Red-Hat/Linux)
 Last-Modified: Wed, 08
Jan 2003 23:11:55 GMT
…
```

Hypertext Transfer Protocol (HTTP)

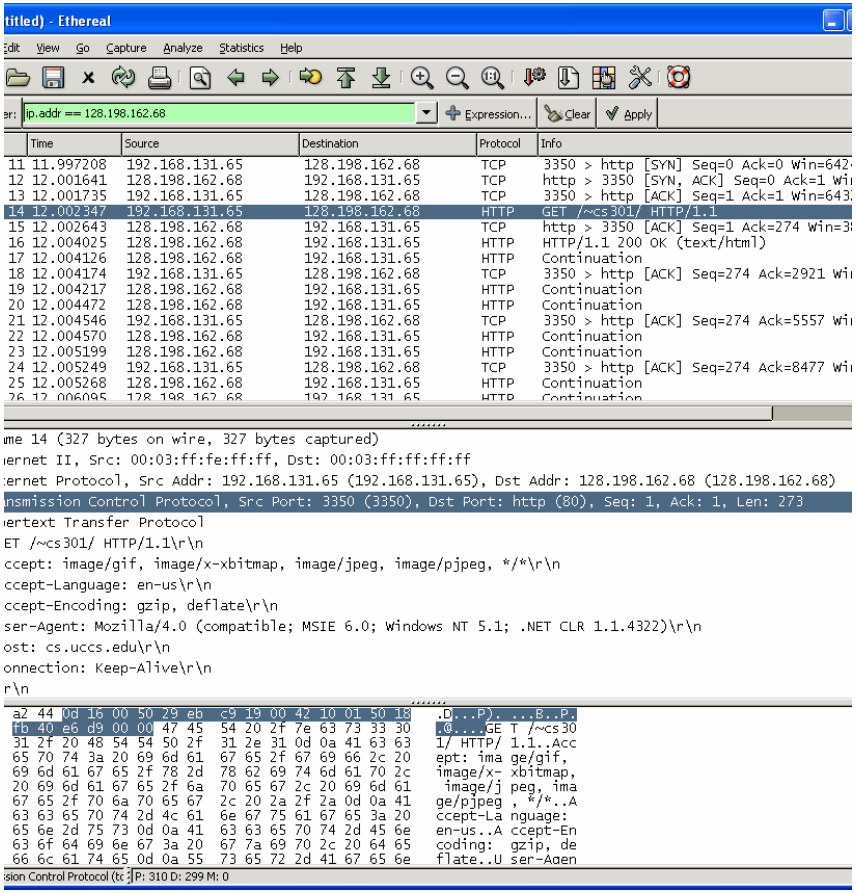
- Protocol, typically above TCP/IP, for distributed, client-server computing
- Stateless
- Session
  - Request
  - Response

HTTP Request

- URL
  - http(s)://username:password@domain:port/path?query_string#anchor
- Method
  - GET
    - Retrieve resource of interest, “safe”
  - POST
    - Submit changes to resource state

HTTP Response

- Status
- Body
  - Representation of resource



The Client

- Any software that is capable of issuing HTTP requests
- A general purpose software application for requesting HTTP resources and displaying responses to the user is a **web browser**

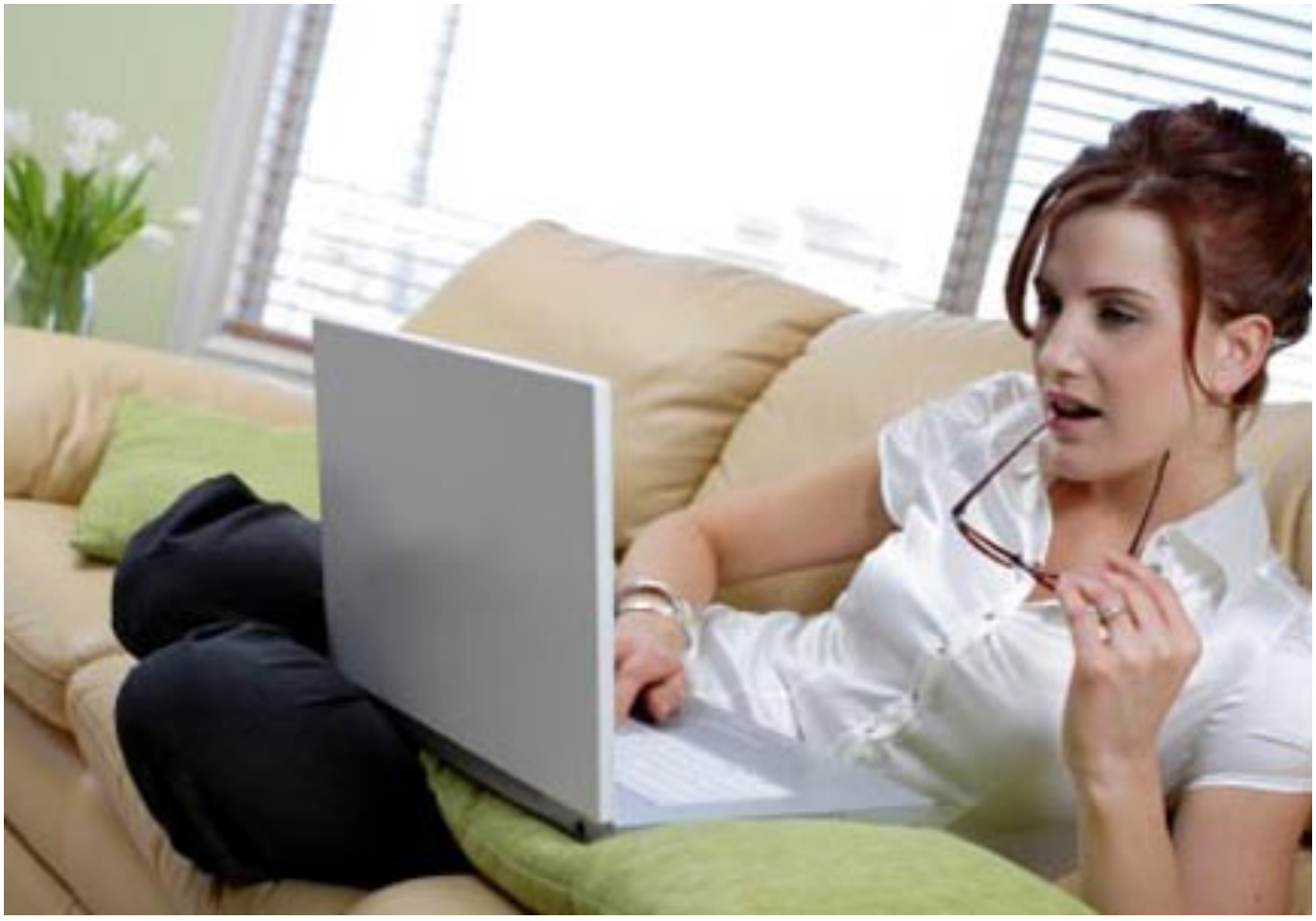
Web Resources

- Page/Document
  - Typically written in Hyper Text Markup Language (HTML) or Extensible Markup Language (XML)
- File/Data
  - Images
  - Music
  - Executable Objects
  - …

What is Web Development?

- Developing dynamic, automated, server-side "producers" for client-side "consumers"
  - Focus on content, service, and interface, not complex computation
- The Good
  - Platform independence (almost)
  - Lots of tools, libraries, etc.
- The Bad
  - Need to be adept at MANY languages/technologies
    - Baseline: HTML, CSS, JS, SQL, PHP/Python/Perl, …

Client-Side



Client-Side Technologies

- Document structure/content
  - HTML, XML
- Document styling
  - CSS
- Dynamics
  - JavaScript, Java, Flash, Silverlight

HTML

- Markup to support structured documents
- Semantics for…
  - Text (headings, paragraphs, lists, tables, etc)
  - Multimedia (images, music, video, etc)
  - Links to other resources
  - Forms
  - Styling
  - Scripting

HTML Hello World

```
<html>
  <head>
    <title>howdy</title>
  </head>
  <body>
    <p>hello</p>
    <p>world</p>
  </body>
</html>
```

HTML Elements

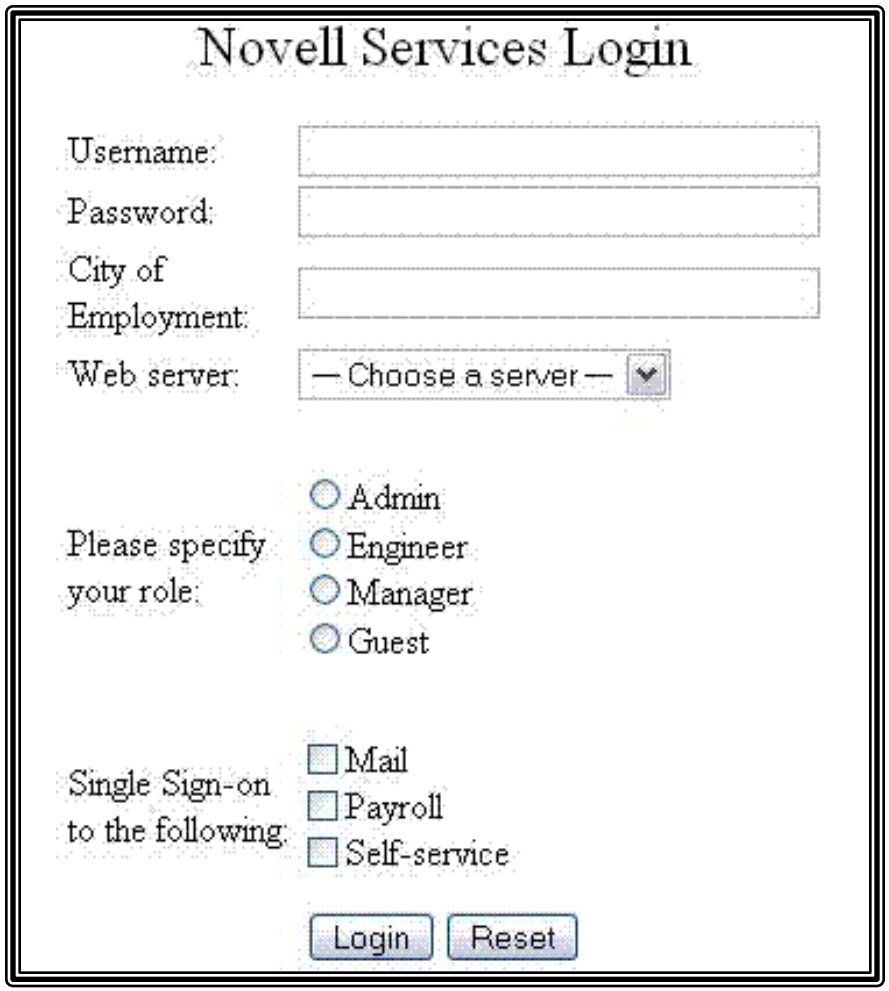
- HTML is a hierarchical bag of elements
  - Start/end tag
    - <element></element>
  - Attribute/value pairs
    - <element key1="value1" key2="value2" … />
  - Content
    - <element key="value">content</element>

Typical HTML Document Structure

- head
  - title – shown in the browser
  - meta – used for automated processing
  - styling, scripting, etc.
- body
  - p – paragraph
    - img – image
    - ul, ol – unordered/ordered list
      - li – list item
    - a – “anchor” (link to other resources)
  - forms, tables, etc.

HTML Forms

- Define method and destination resource
  - <form method="get/post" action="url">
- Provide input form elements
  - Single/multi-line input
  - Single/multiple element selection lists
  - Check/radio boxes
  - File upload
  - Buttons



XML

- Serves an important role for a common, computer-readable data exchange format
  - Common in software products, business exchanges
- Has fallen out of favor as a web document format
  - XHTML, XML+XSLT
  - However, very important for AJAX (more later)

Document Styling

- It can be advantageous to separate document *structure/content* from *presentation*
  - Supports modularity, consistency, maintainability
- Cascading Style Sheets (CSS) is a language for describing document presentation semantics
  - Fonts, layout, colors, etc.
  - Hierarchical, object-oriented
  - Support for medium-specificity

CSS Example

```
body {
    background-color: black;
    color: white;
    font-family: Georgia, “Times New Roman”;
    font-size: 16px;
}

p {
    padding: 10px 0px;
}

.heavy {
    font-weight: bold;
}
```

CSS Usage

- Element
  - <p style="…">
- Document
  - <head><style type="text/css">…</style></head>
- Linked
  - <head><link rel="stylesheet" href="style.css" type="text/css" media="print" /></head>

CSS Trends

- Shift to minimalist HTML + site-linked CSS
  - Improves readability, consistency, accessibility
- UI Libraries
  - Helps browser compatibility issues (ACID)
  - Yahoo YUI
    - Base
  - Google Web Toolkit (GWT)
  - jQuery UI

Adding Dynamics

- Till now, all client languages/technologies were about describing a static document
- Two classes of dynamics
  - Browser Scripting
    - Supported by the browser
    - JavaScript
  - Rich Internet Application
    - Browser plug-in
    - Java, Flash, Silverlight

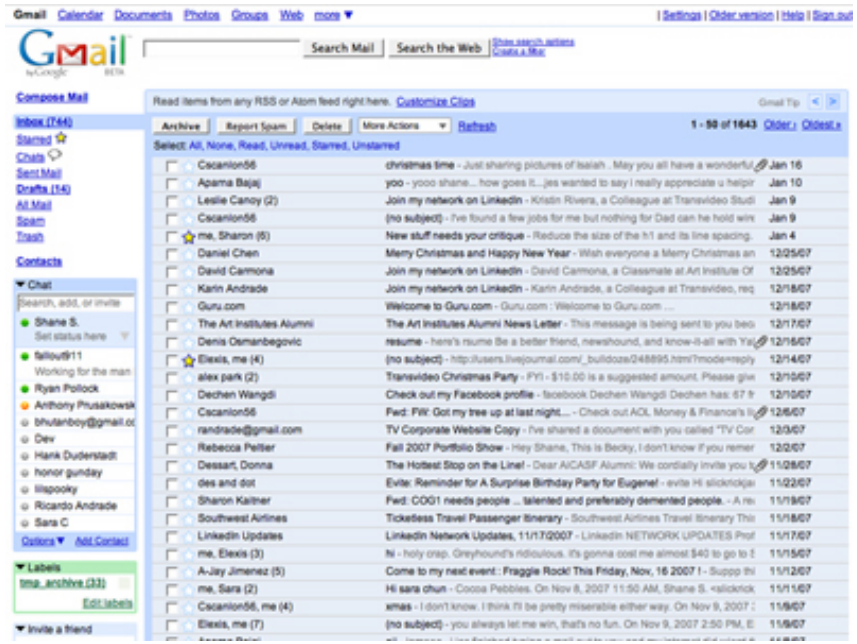
JavaScript Features

- Document Object Model (DOM)
  - Exposes HTML elements to programmatic manipulation
  - Provides event hooks (onclick="…")
- Interpreted, C/Java-like syntax
  - Functions
  - Classes

Asynchronous JavaScript

- A grouping of technologies to support interactive, data-driven applications without having to change UI elements
- Basic recipe
  - Load page in full
  - On some event (click, timer, etc), JS makes HTTP request to server
  - When HTTP response is received, a callback function is called and result is handled

Asynchronous JavaScript Example



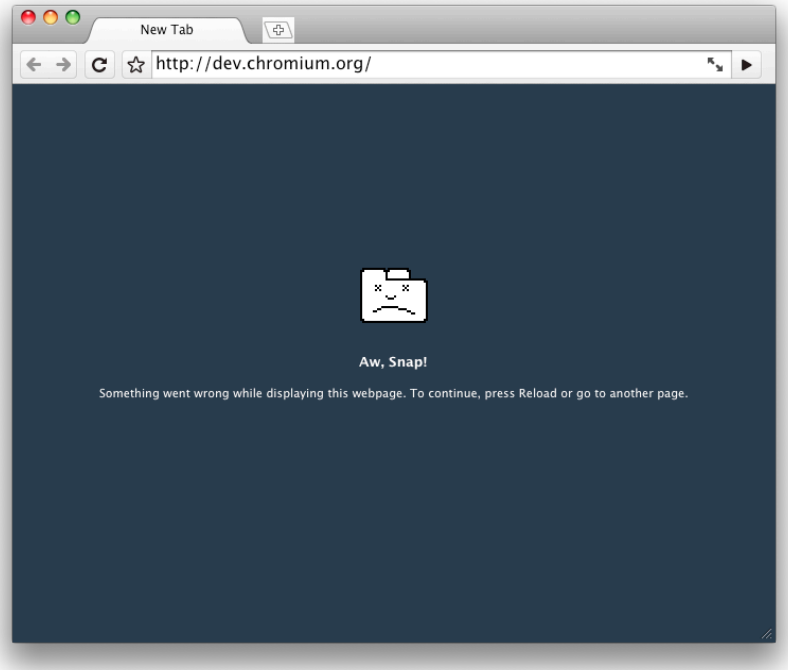
- Constant UI
  - Inbox (default)
  - Message (hidden)
- On message click
  - Request message body
  - On response, dynamically change UI for message
- On Inbox click
  - Revert UI

Asynchronous JavaScript And …

- HTTP response body will take a form
  - AJAX: XML
  - AJAJ: JavaScript Object Notation (JSON)
- Typically this will be more efficient than a full document
- Motivates de-coupling data access from presentation on server-side

JavaScript Pitfalls

- Major differences in browser support/ implementation
  - YUI, GWT, jQuery
- Security
  - Cross-site scripting (XSS) attacks
  - Sandboxing
- Speed
  - SunSpider benchmark
- Accessibility
  - Pages should gracefully degrade



Rich Internet Applications

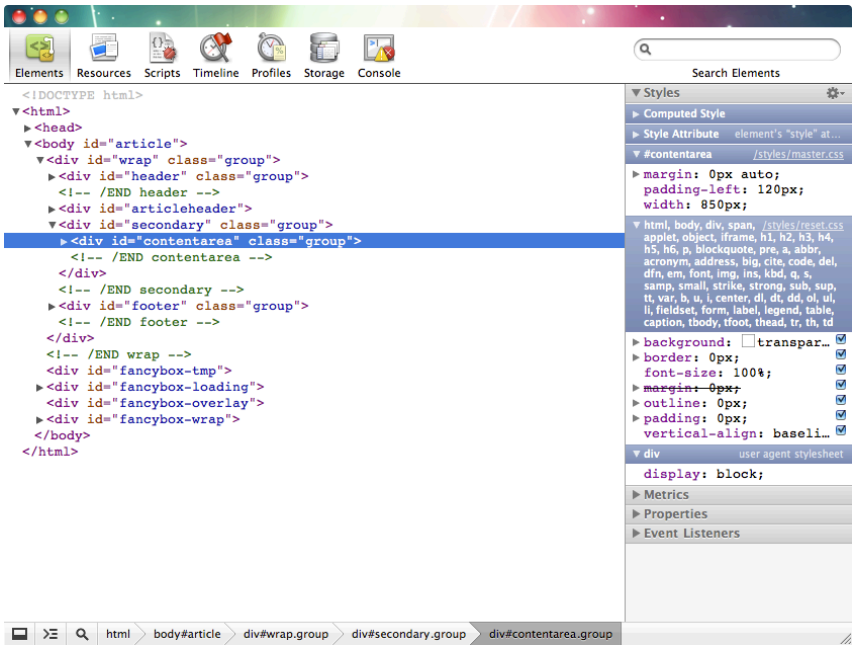
- Provides many aspects of desktop applications as an extension to the browser via plug-in
  - Java, Flash, Silverlight, etc.
- Pro
  - Speed (via binary), IDE, richness
  - Security, stability, compatibility pushed to plug-in
- Con
  - Proprietary plug-in/tools, search-ability, power

Trends

- HTML 5
  - A response to JS vs. Flash/Silverlight, Gears
  - Better support for drawing, video, forms, expressive UI, offline data
- Unifying desktop & web
  - AIR
  - Chrome OS
  - WebKit

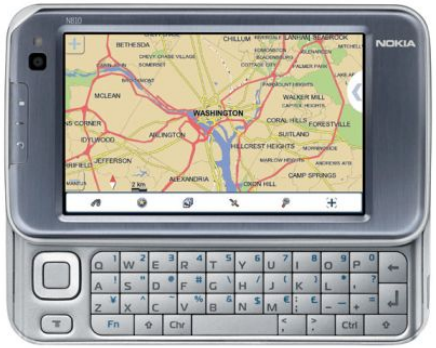
Debugging

- FireBug/Web Inspector
  - Visualize DOM
  - Debug JS
  - See computed CSS
  - View resource timing



Mobile Devices

- The advent of low-power computing, touch screens, and widely accessible wireless networking has led to a variety of web-capable mobile devices
  - Smart phones, tablets, etc.



Mobile Device Issues

- Power
  - Flash on iPhone
- Interface
  - Screen size
  - Touch vs. Mouse
  - iUI
- Data Cost
- Browser vs. App

Server-Side

Review

- The role of server-side web development is to satisfy resource requests made by clients
  - URL
    - http(s)://username:password@domain:port/path?query_string#anchor
  - Method
    - GET
      - Retrieve resource of interest, “safe”
    - POST
      - Submit changes to resource state

Server-Side Technologies

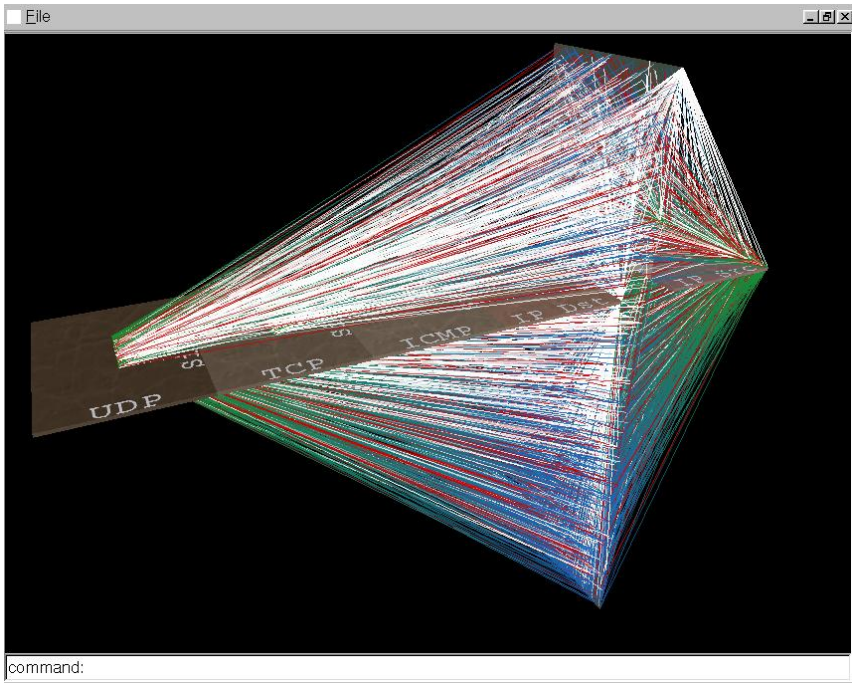
- Web Server
  - Apache (54%), IIS (24%)
- Database Server
  - MySQL, PostgreSQL, Oracle, SQL Server
  - SQLite
- Scripting
  - PHP, Python, Perl, Ruby, JSP, ASP, CGI

Web Server

- The primary role of a web server is to satisfy client HTTP requests
- Typical process
  - Receive HTTP request
  - Reference configuration
  - Retrieve resource
  - Send HTTP response

Other Web Server Functions

- Virtual hosting
- Throttling
- Server-side scripting
- Security
  - DoS
- Local configuration



Database Server

- Databases provide safe storage of and efficient access to persistent data
- Flavors
  - **Relational** vs. XML vs. OO
  - **Client-Server** vs. File-Based
  - **OSS** vs. Proprietary
- Typically uses Structured Query Language (SQL) for data addition, modification, and querying

Relational Database Structure

- Database: set of Tables
- Table: fixed Schema and rows of data
- Schema: set of pairs (name, data type)
- Data: value for each schema pair
- Other
  - Cross-table constraints/keys
  - Triggers
  - Indexes, views

SQL

- CREATE/DROP
  - Adds/removes a database/table/etc
- INSERT/UPDATE/DELETE
  - Adds/modify/removes row(s) to/in/from a table
- SELECT
  - Retrieves data from the database

Server-Side Scripting

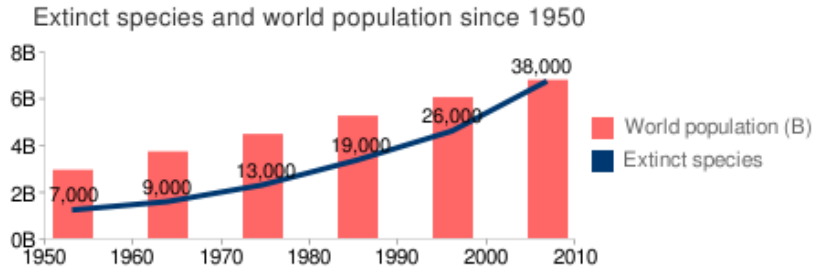
- The web server executes a script whose result is packaged and sent to the client as a HTTP response
  - HTML document
  - Image
  - Download
  - Arbitrary text
    - XML/JSON for AJAX/AJAJ
    - Linked CSS/JavaScript

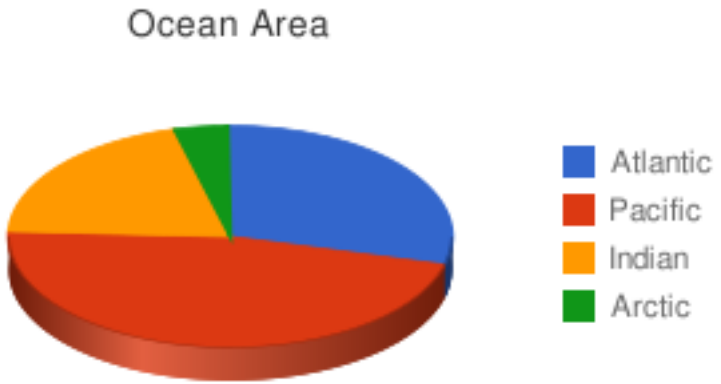
Example PHP Script

```
<?php
   echo '<html>';
      echo '<head>';
         echo '<title>howdy</title>';
      echo '</head>';
      echo '<body>';
         echo '<p>hello</p>';
         echo '<p>world</p>';
      echo '</body>';
   echo '</html>';
?>
```

Example: Google Chart API

- URL -> chart image
  - Parse URL for data, visualization parameters
  - Output appropriate headers and PNG data





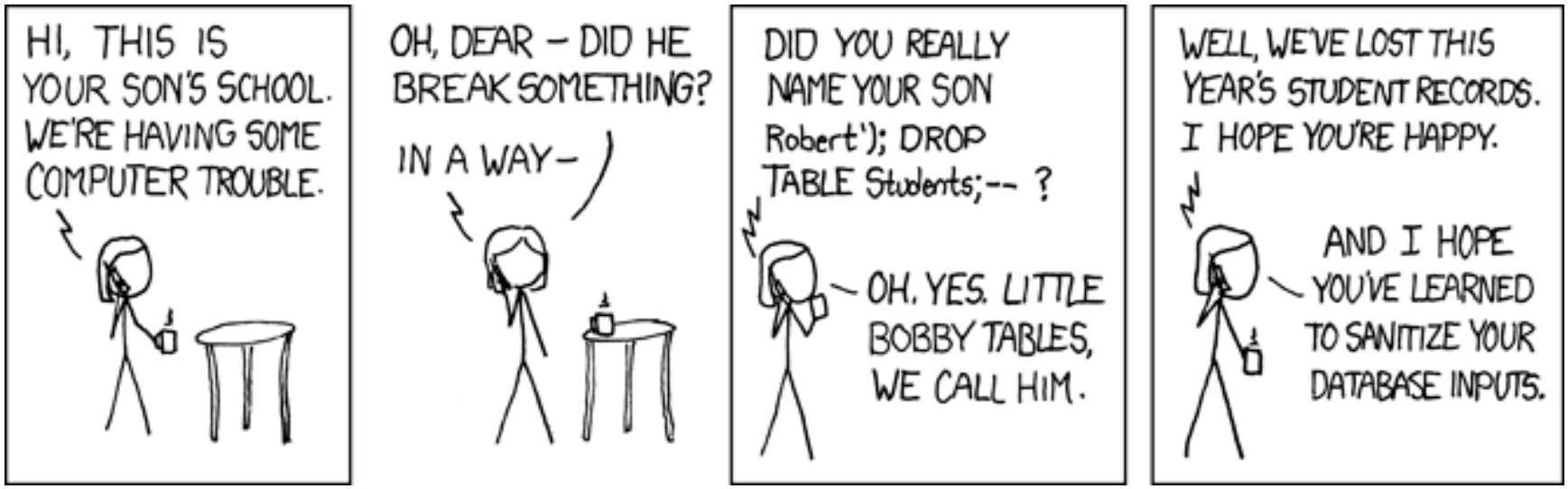
Example: Syndication

- Single database, multiple output formats
  - HTML
  - RSS
  - iCal
  - JSON -> AJAJ
  - XML -> iPhone App
  - E-mail notifications
  - …

Issues

- Spaghetti code
  - Too easy to intermix data access/manipulation/etc with presentation
  - Hampers AJAX
  - Motivates frameworks/patterns
    - Model-View-Controller (MVC)
- Security
  - SSL
  - SQL Injection
- Performance
  - Throttling, caching

SQL Injection ala XKCD



Issues

- URL Query Strings
  - http://domain/path/file?key1=value1&key2=value2…
- Authentication
  - HTTP/WebServer (dynamic & static)
- Cookies & Sessions
- Terminal scripting

Content Management Systems (CMS)

- Web application that provides infrastructure for managing data
  - Data management, editing, workflows, syndication, collaboration/delegation, etc.
  - Standardized client- and server-side components
- Examples
  - Wikis (MediaWiki), Blogs (WordPress)
  - Drupal, Joomla
  - SharePoint

Loose Ends

Web 2.0

- Focus on web applications that support information-sharing, inter-operability, hosted services
  - "Network as Platform"
- Syndication: scraping vs. XML/RSS
- Web APIs
  - Client/server-side access to remote resources

Web Hosting

- Local
  - Significant security risks
- Remote
  - Shared vs. dedicated hosting
    - Price vs. performance/resources
  - Virtual Private Server (VPS)
    - Trending towards virtualization for security, reliability
  - Control panel + ssh/sftp

LAMP

- **L**inux
- **A**pache
- **M**ySQL
- **P**HP/Python/Perl

Resources

- HTML: http://www.w3schools.com/tags
- CSS: http://www.w3schools.com/css
- SQL: http://www.w3schools.com/sql
- “Dynamic HTML: The Definitive Reference”
  - O’Reilly
- Pro Drupal Development
  - http://www.drupalbook.com/

Recommendations

- PHP
  - http://www.php.net
  - MVC: CakePHP, Symfony
  - PEAR
  - PHPlot
- phpMyAdmin
- Drupal
- jQuery
- iUI
- YUI

Thanks :)

Questions?