Modern Web Development
From Angle Brackets to Web Sockets

Pete Snyder <psnyde2@uic.edu>

Outline (or, what am i going to be going on about…)

1. What is the Web?

2. Why the web matters

3. What's unique about web development?

4. What goes into a modern web project?

5. Making it fun and getting it done

6. Web development challenges

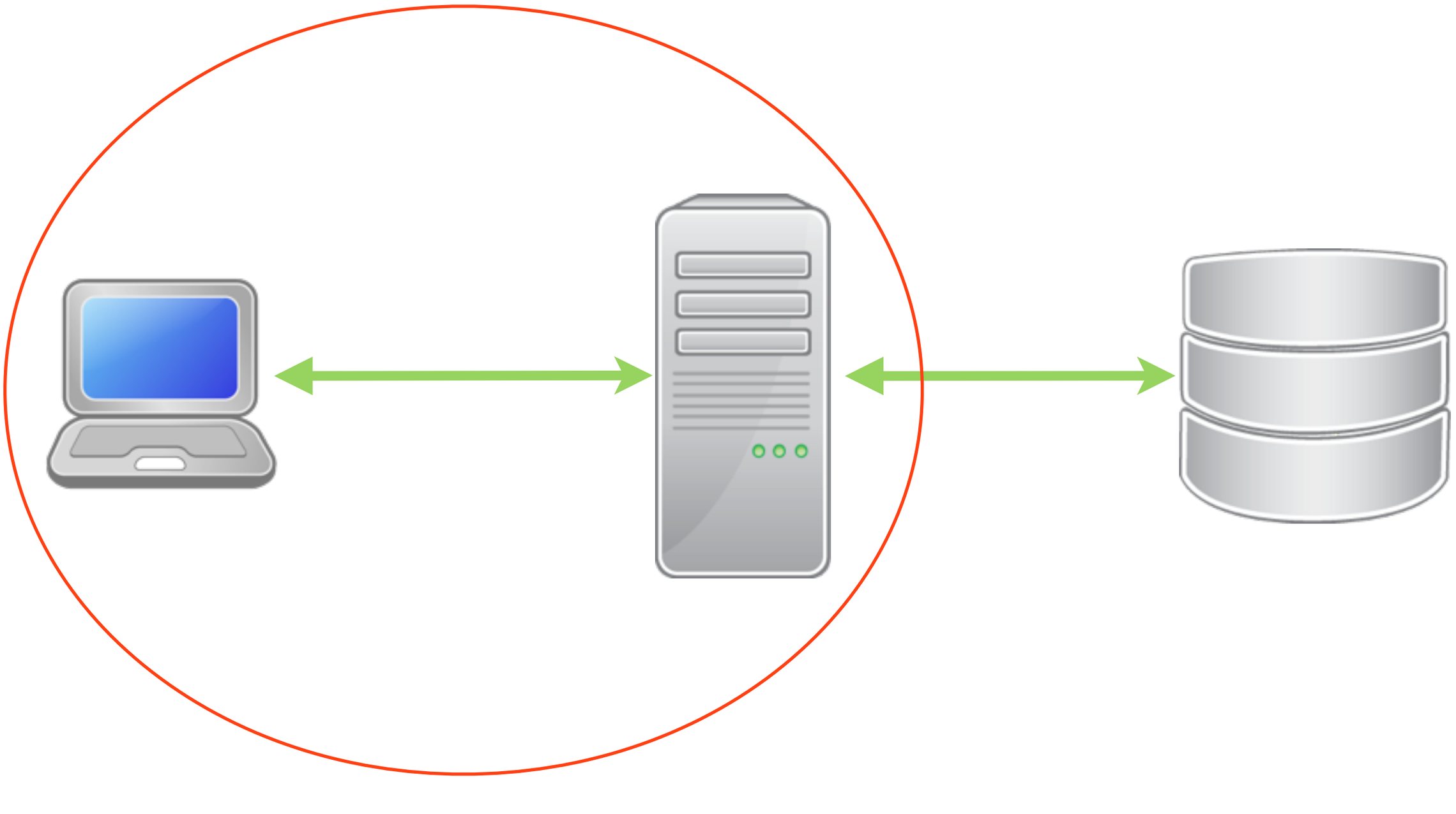
1. What is the Web?

(or, lets define terms)

1. What is the Web? (1/2)

- Markup: (X)HTML, JSON, YAML, XML…
- Protocols: HTTP(S), WebSockets, SPDY…
- WebServices: SOAP, REST, XML-RPC…
- Browsers: Moasic ... Chrome…
- Design strategies: Response, Accessible…
- Languages: Javascript, Python, PHP, Ruby…
- Databases: MySQL, MSSQL, MongoDB, CouchDB…
- Scaling: Reverse Proxies, load balancers, CDNs…
- Servers: Tomcat, Apache, Nginx, Node.js…
- Frameworks: Ruby on Rails, Django, Drupal, Symphony…
- Standards: RSS, ATOM, RDFa…

1. What is the Web? (2/2)



2. Why the Web Matters

(or, why this isn't all a waste of time)

2. Why the Web Matters

- Most popular application platform (by far)
- Everything talks “the web”
- Building for other platforms requires the web

3. What's Unique About Web Development?

(or, bad news / good news)

What's Unique About Web Development? (1/2)

Bad Bits

1. Unplanned Environment

2. Everything Needs to Work Everywhere

3. Many Parts / Languages / Environments

What's Unique About Web Development? (2/2)

Good Bits

1. Heavily OpenSource

2. High Level Languages / Abstractions

3. Popular!

4. What Goes Into a Modern Web Project?

(or, how the sausage is made)

4. What Goes Into a Modern Web Project?

1. Static Web Pages

4.1 Static Web Pages: HTTP

- Application layer protocol
- Usually sent over TCP
- Usually port 80
- Plain text

4.1 Static Web Pages: More HTTP

```
   GET /index.html HTTP/1.1
Host: www.example.com
{\r\n}
{\r\n}
```

```
HTTP/1.1 200 OK
Date: Mon, 23 May 2005 22:38:34 GMT
Server: Apache/1.3.3.7 (Unix) (Red-Hat/Linux)
Last-Modified: Wed, 08 Jan 2003 23:11:55 GMT
Accept-Ranges:  none
Content-Length: 438
Connection: close
Content-Type: text/html; charset=UTF-8

{Body}
```

4.1 Static Web Pages: HTML

- Plain text markup
- Angle brackets
- Well defined tags and attributes
  <p>: Paragraph
  : Division / Section
  : Unordered List
  : Ordered List
  <h[1-5]>: Section Headers
  <img>: An image
  etc…
- “id” and “class” for overloading

```
<html>
    <head>
        <title>Todo Page</title>
    </head>
    <body>
        <h1>My TODOs</h1>
        <p>Boy, its a long list.</p>

        <img src="http://localhost/img/lots.jpg">

        <ul id="todo-list">
            <li>
                First Thing
            </li>
            <li class="important">
                Second Thing
            </li>
            <li class="important">
                Third Thing
            </li>
        </ul>
    </body>
</html>
```

4.1 Static Web Pages: The Dom

HTML

```
<html>
    <head>
        <title>Todo Page</title>
    </head>
    <body>
        <h1>My TODOs</h1>
        <p>Boy, its a long list.</p>

        <img src="http://localhost/img/lots.jpg">

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            <li>
                First Thing
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            <li class="important">
                Second Thing
            </li>
            <li class="important">
                Third Thing
            </li>
        </ul>
    </body>
</html>
```

DOM

```
HTML
  - HEAD
    - TITLE[text="Todo Page"]
  - BODY
    - H1[text="Things I gotta Do Today"]
    - P[text="This is Quite Exciting"]
    - IMG[src="http://localhost/img/lots.jpg"]
    - UL[id="todo-list"]
      - LI[text="First Thing"]
      - LI[class="important-item",
           text="Second Thing"]
      - LI[class="important-item",
           text="Third Thing"]
```

4.1 Static Web Pages: Display

DOM

Render

```
HTML
  - HEAD
    - TITLE[text="Todo Page"]
- BODY
  - H1[text="Things I gotta Do Today"]
  - P[text="This is Quite Exciting"]
  - IMG[src="http://localhost/img/lots.jpg"]
  - UL[id="todo-list"]
    - LI[text="First Thing"]
    - LI[class="important-item",
         text="Second Thing"]
    - LI[class="important-item",
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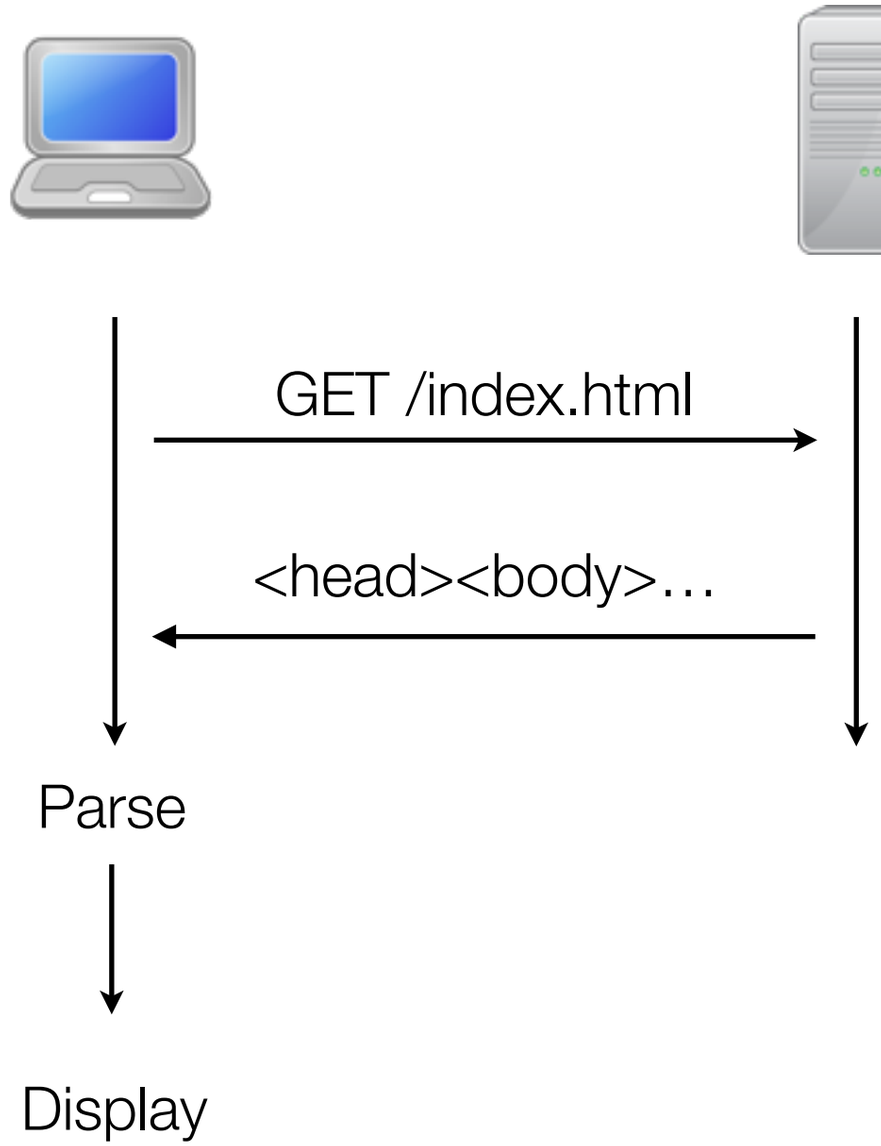
```


4.1 Static Web Pages: Putting It All Together

- Browser makes HTTP request
- Server responds with HTML (or other asset
- Client Parses HTML to DOM
- Client Renders DOM



4. What Goes Into a Modern Web Project?

1. Static Web Pages

2. Presentation

4.2 Presentation: CSS

- CSS: Cascading Style Sheets
- Plain text
- Included in document
- Separates content and presentation
- Pairs of “selectors” and “rules”
- Controls positioning, colors, fonts, animations, etc

```
body {
    background: lightgrey;
}

img {
    border: 2px solid black;
}

li.important {
    color: red;
    font-weight: bold;
}

#todo-list {
    background-color: yellow;
}
```

4.2 Presentation: CSS

```
<html>
  <head>
    <title>Todo Page</title>
    <link type="text/css" rel="stylesheet"
    href="http://localhost/styles.4-2.css">
  </head>
  <body>
    <h1>My TODOs</h1>
    <p>Boy, its a long list.</p>

    <img src="http://localhost/img/lots.jpg">

    <ul id="todo-list">
      <li>
        First Thing
      </li>
      <li class="important">
        Second Thing
      </li>
      <li class="important">
        Third Thing
      </li>
    </ul>
  </body>
```

```
body {
    background: lightgrey;
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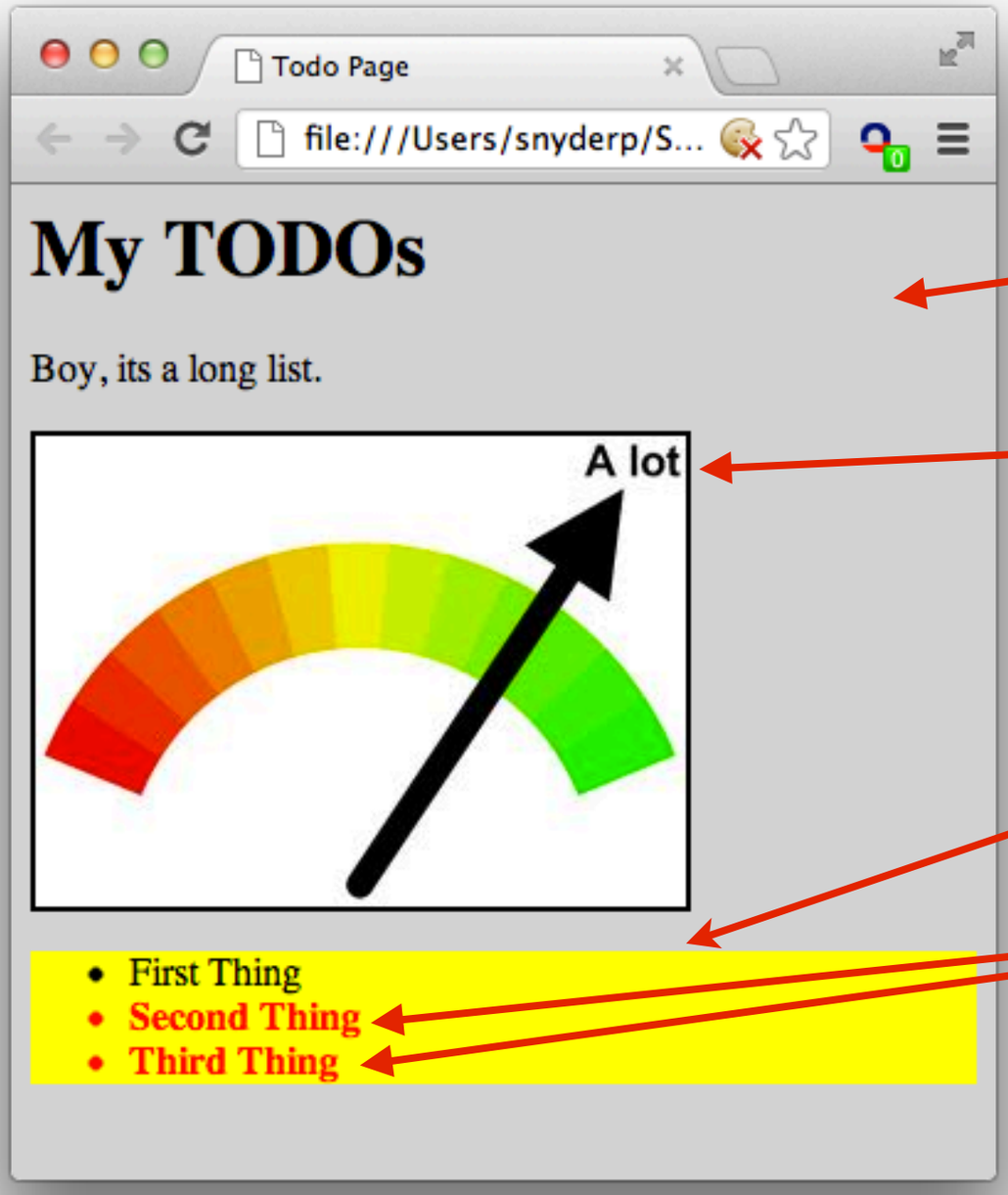
4.2 Presentation: CSS




```
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    background: lightgrey;
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li.important {
    color: red;
    font-weight: bold;
}
```

4. What Goes Into a Modern Web Project?

1. Static Web Pages
2. Presentation
3. Dynamic Page Generation

3. Dynamic Page Generation

- Need a way to send input from browser to server
- Need a way to process that information

3. Dynamic Page Generation: Forms

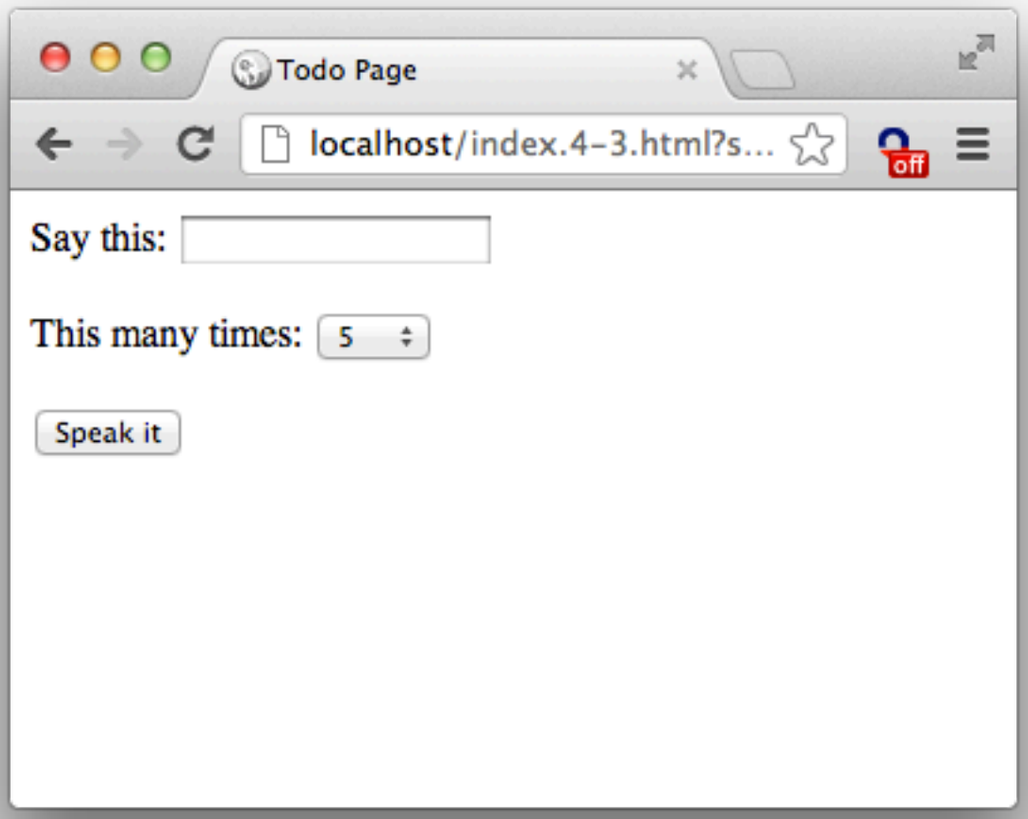
HTML Form

```
<form>
  <p>
    <label for="statement">
      Say this:
    </label>
    <input name="statement">
  </p>

  <p>
    <label for="count">
      This many times:
    <label>
    <select name="count">
      <option value="5">5</option>
      <option value="10">10</option>
      <option value="15">15</option>
    </select>
  </p>

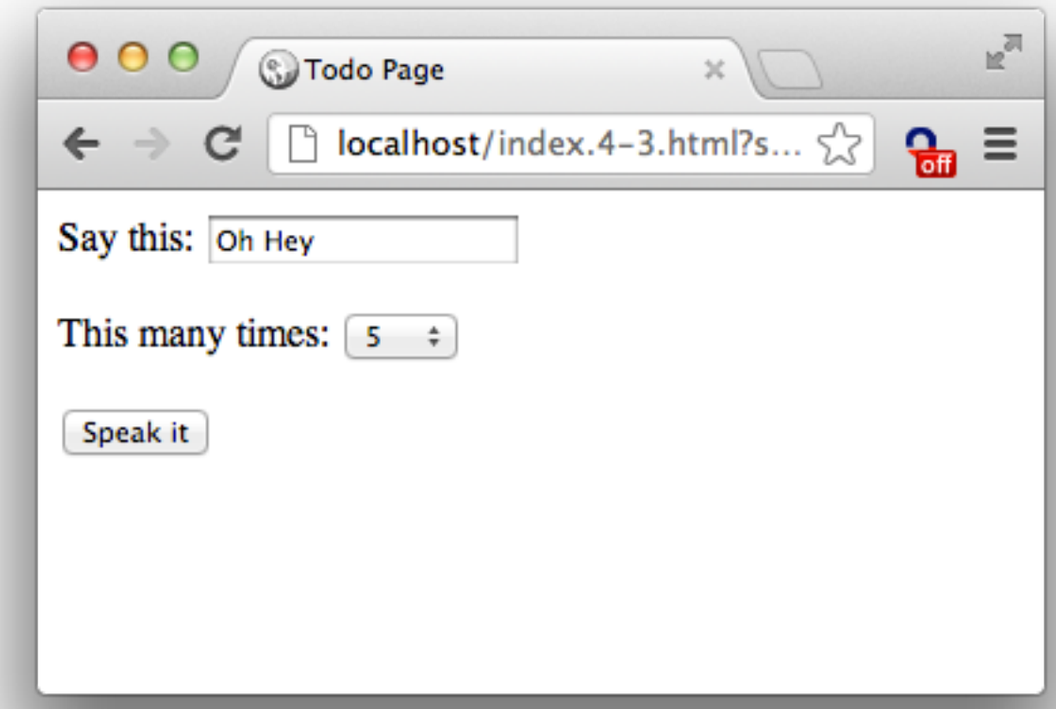
  <button type="submit">Speak it</button>
</form>
```

Rendering



3. Dynamic Page Generation: HTTP

Form



GET

```
GET /index.4-3.html ↩
 → ?statement=Oh+Hey&count=5 HTTP/1.1
Host: localhost
```

POST

```
POST /index.4-3.html HTTP/1.1
Host: localhost

statement=Oh+Hey&count=5
```

HTTP Request

3. Dynamic Page Generation: HTTP

HTTP Request

```
GET /speaker.php ↩
 → ?statement=Oh+Hey&count=5 HTTP/1.1
Host: localhost
```

Server Side Program

```php
<?php

$num_times = $_GET['count'];
$phrase = $_GET['statement'];

echo "<ol>\n";

for ($i = 0; $i < $num_times; $i++) {
    echo "<li>" . $phrase . "</li>";
}

echo "</ol>\n";
```

3. Dynamic Page Generation: HTTP

Server Side Program

```php
<?php

$num_times = $_GET['count'];
$phrase = $_GET['statement'];

echo "<ol>\n";

for ($i = 0; $i < $num_times; $i++) {
    echo "<li>" . $phrase . "</li>";
}

echo "</ol>\n";
```

→

Dynamic Output

```html
<ol>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
</ol>
```

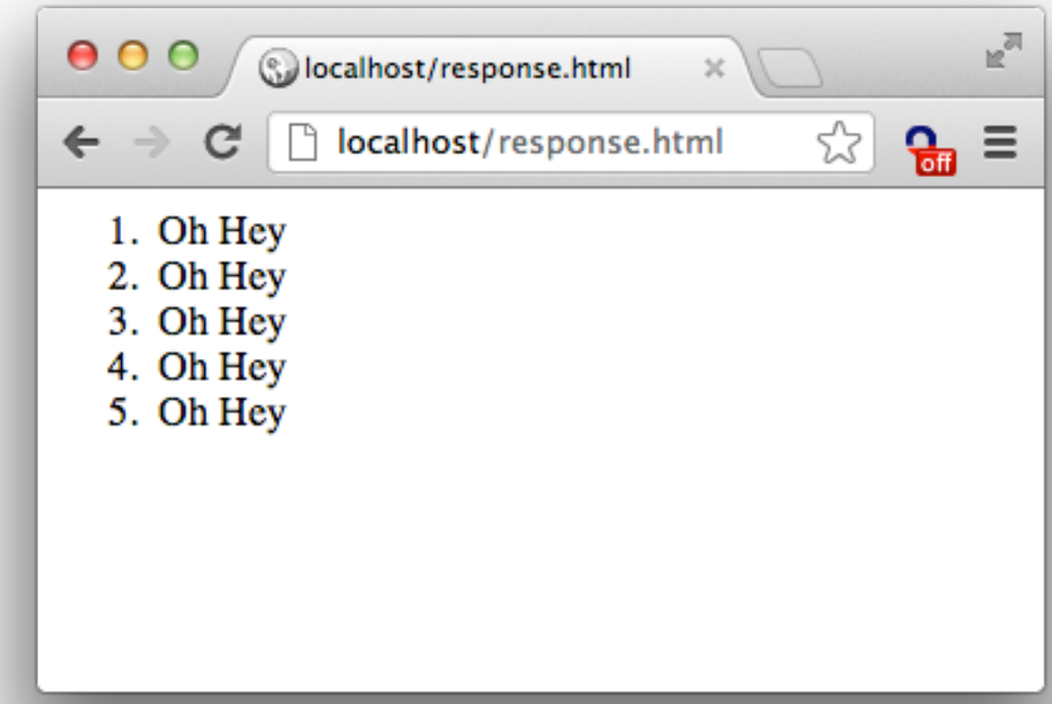
3. Dynamic Page Generation: HTTP

Dynamic Output

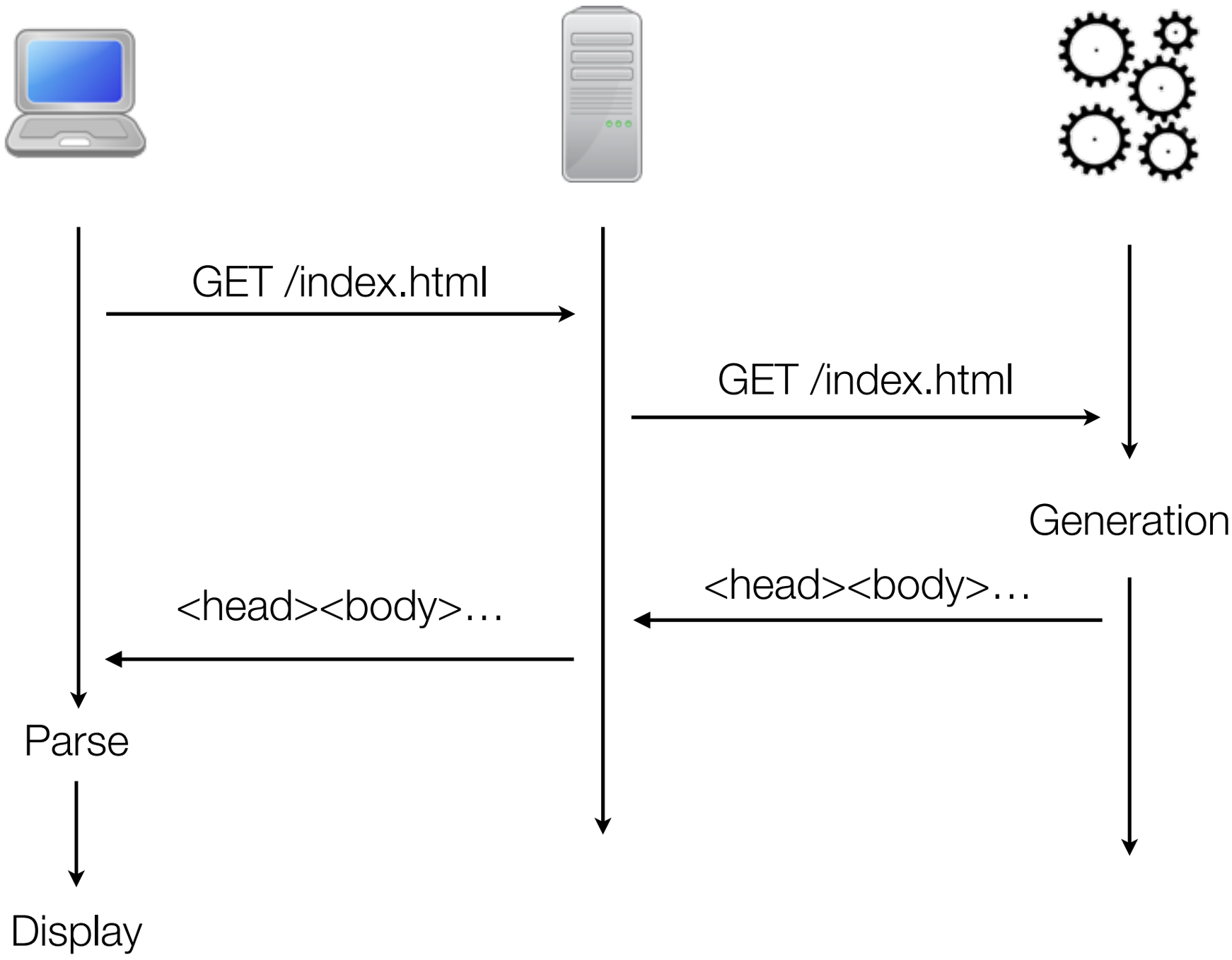
```
<ol>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
    <li>Oh Hey</li>
</ol>
```

→

Browser Rendering



3. Dynamic Page Generation: Complete



4. What Goes Into a Modern Web Project?

1. Static Web Pages
2. Presentation
3. Dynamic Page Generation
4. Persistence

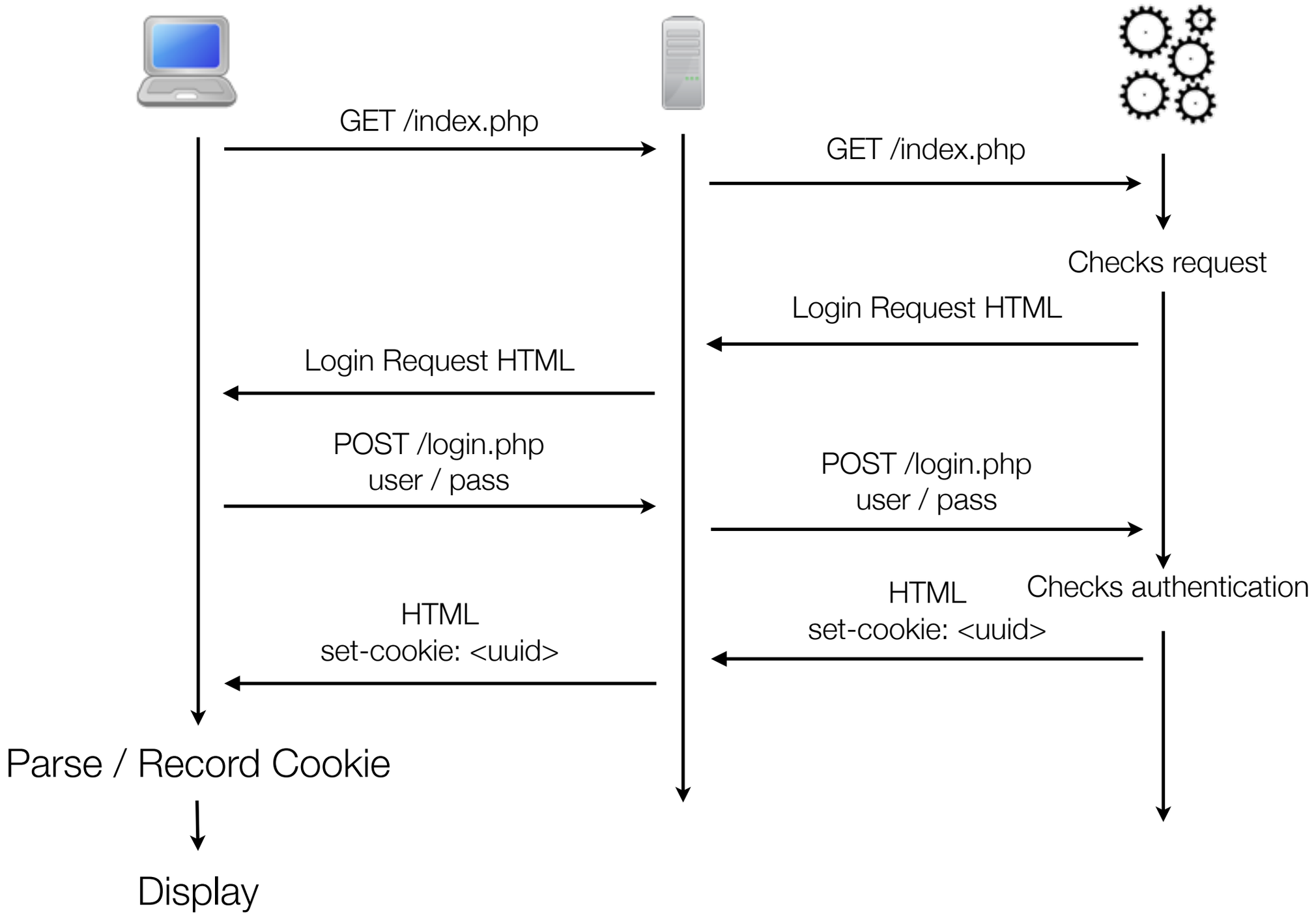
4.4 Persistence: Cookies and Sessions

- Values that browsers automatically include

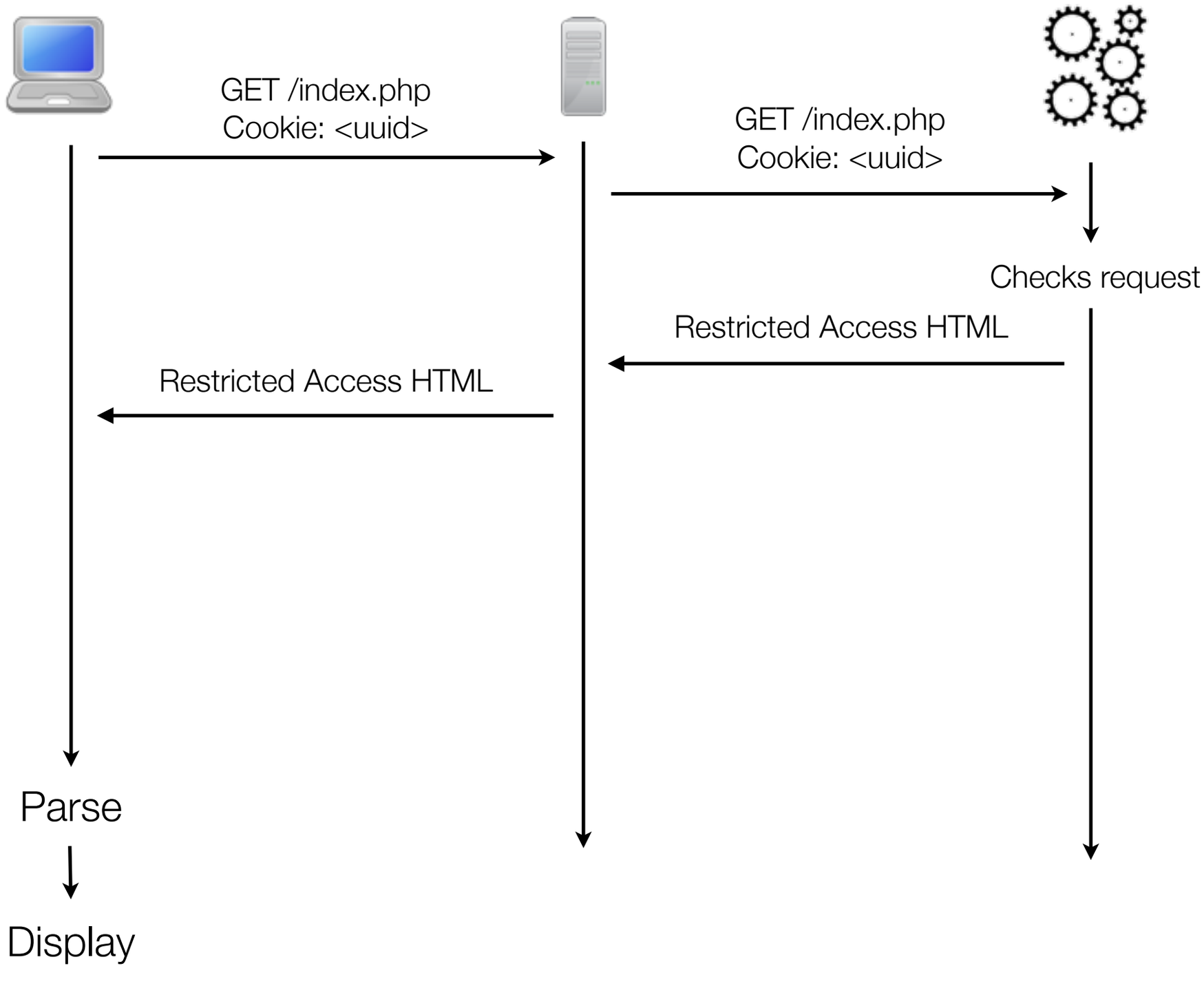
- Allow sites to distinguish users across requests

- Along with server side persistent stores, allows for “sessions”

4.4 Persistence: Cookies and Sessions



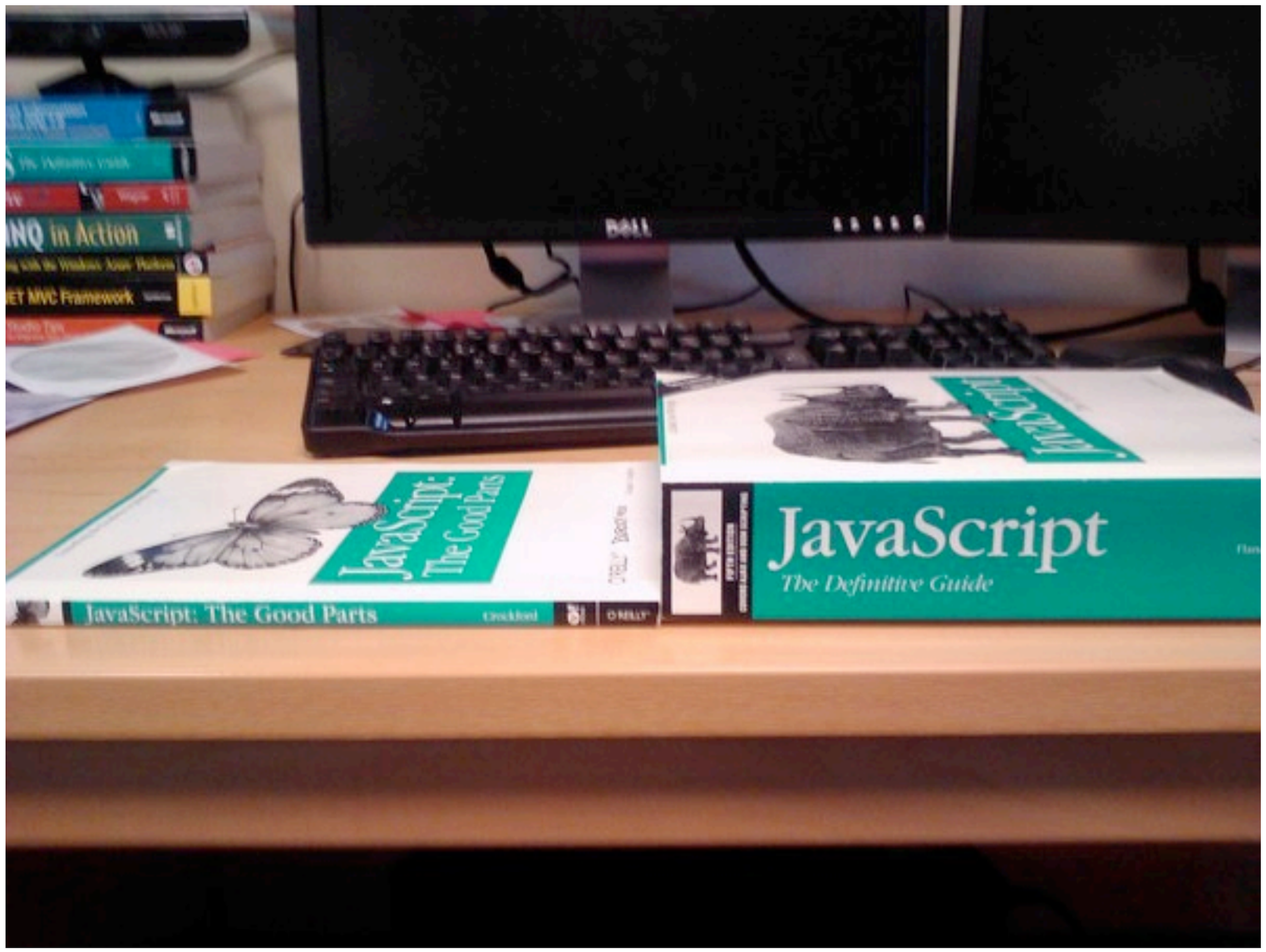
4.4 Persistence: Cookies and Sessions



4. What Goes Into a Modern Web Project?

1. Static Web Pages
2. Presentation
3. Dynamic Page Generation
4. Persistence
5. Client Side Logic

4.5 Client Side Programming: Javascript (1/6)



- Javascript
- Client / Browser side programming
- History: Originally developed by Netscape in 1995 by Brendan Eich **in 10 days!**
- AKA ECMAscript, Livescript and JScript
- Not at all related to Java

4.5 Client Side Programming: Looks Like C… (2/6)

- Curly braces
- for / while / do-while loops
- Semi-colon terminated statements
- Functions look C-“ish”
- Trips lots of people up

```
function doubler (a) {
    return a + a;
};

var i = 0,
    value = 1;

for (i = 0; i < 10; i += 1) {
    value = doubler(value);
}

// Will print: 'Value' now equals 1024
alert("'Value' now equals " + value);

do {
    i -= 1;
    value = value / 2;
} while (i > 0);

// Will print: 'Value' now equals 1
alert("'Value' now equals " + value);
```

4.5 Client Side Programming: Not Like C! (3/6)

```
(function () {

    var cat = {
        voice: "meow",
        speak: function () {
            alert(this.voice);
        }
    };

    var dog = Object.create(cat);
    dog.voice = "woof";
    cat.speak(); // Alerts "meow"
    dog.speak(); // Alerts "woof"

    var adder = (function () {
        var initial = 0;
        return function (value) {
            initial + value;
            return initial;
        };
    }());

    // Error because initial is undefined
    alert("initial = " + initial);
}());
```

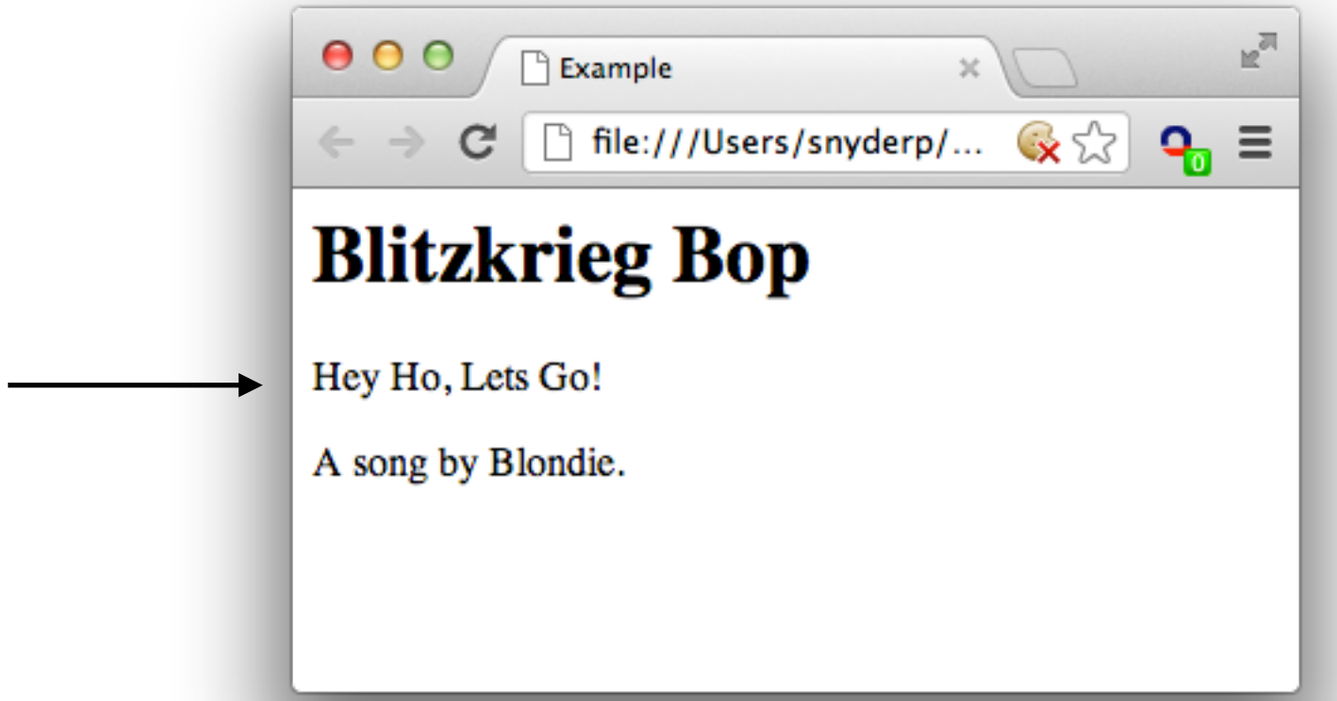
- Dynamically typed
- First class functions
- Lambda / anonymous functions
- Prototypal inheritance
- Function Scope

4.5 Client Side Programming: The DOM API (4/6)

- API for interacting with DOM
- Buggy, unintuitive and inconsistent
- Events / effects / styles, etc.

4.5 Client Side Programming: Example (5/6)

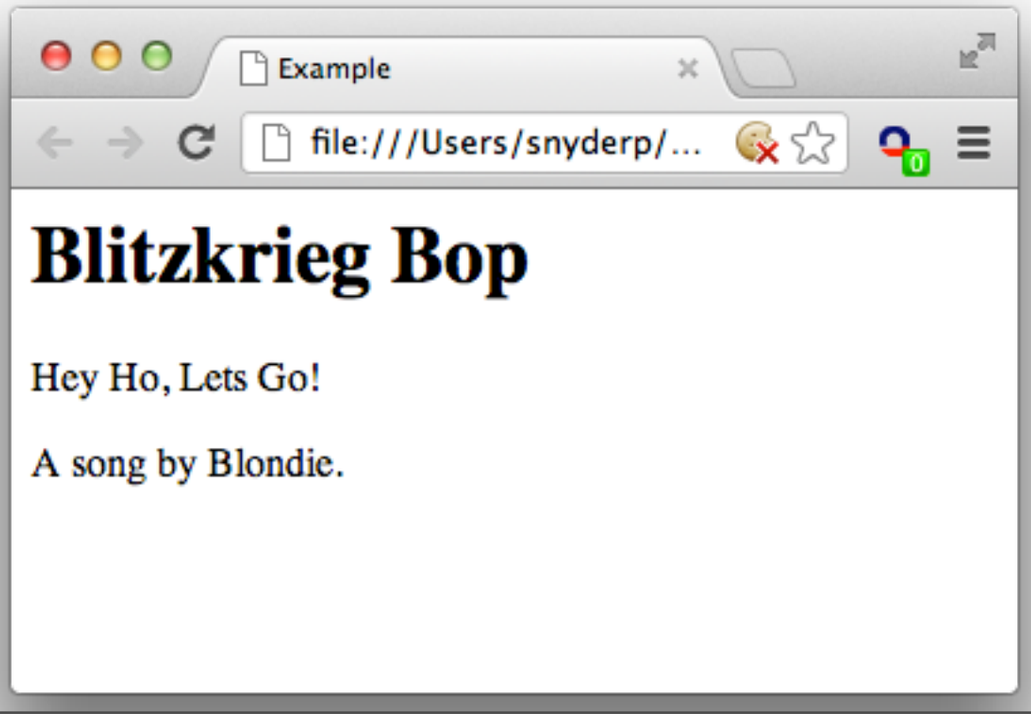
```
<html>
  <head>
    <title>Example</title>
  </head>
  <body>
    <h1>Blitzkrieg Bop</h1>
    <p>Hey Ho, Lets Go!</p>

    <p>A song by <span id="band-name
    ">Blondie</span>.<p>
</body>
</html>
```

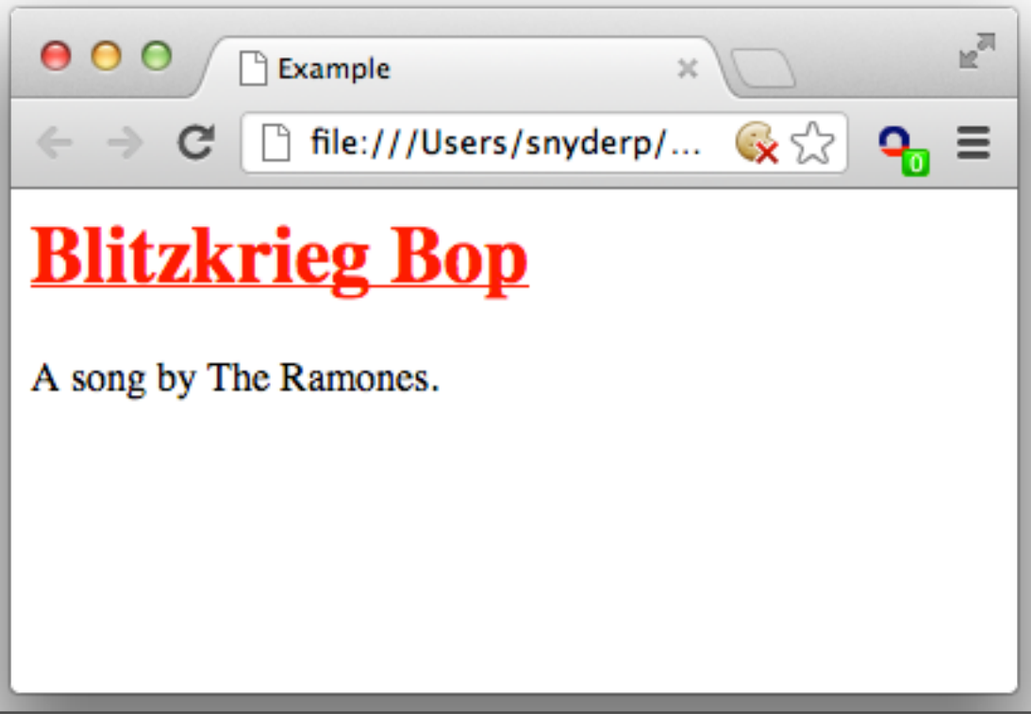


4.5 Client Side Programming: Example (6/6)

```
<html>
  <head>
    <title>Example</title>
    <script src="http://localhost/script.
      js"></script>

  </head>
  <body>
    <h1>Blitzkrieg Bop</h1>
    <p>Hey Ho, Lets Go!</p>

    <p>A song by <span id="band-name">
    Blondie</span>.<p>
  </body>
</html>
```

```
var band_name = document.getElementById("band-name"),
    title_tag = document.getElementsByTagName("H1"),
    paragraphs = document.getElementsByTagName("P");

band_name.innerHTML = "The Ramones";

title_tag[0].style.color = "red";
title_tag[0].style.textDecoration = "underline";

paragraphs[0].parentNode.removeChild(paragraphs[0]);
```





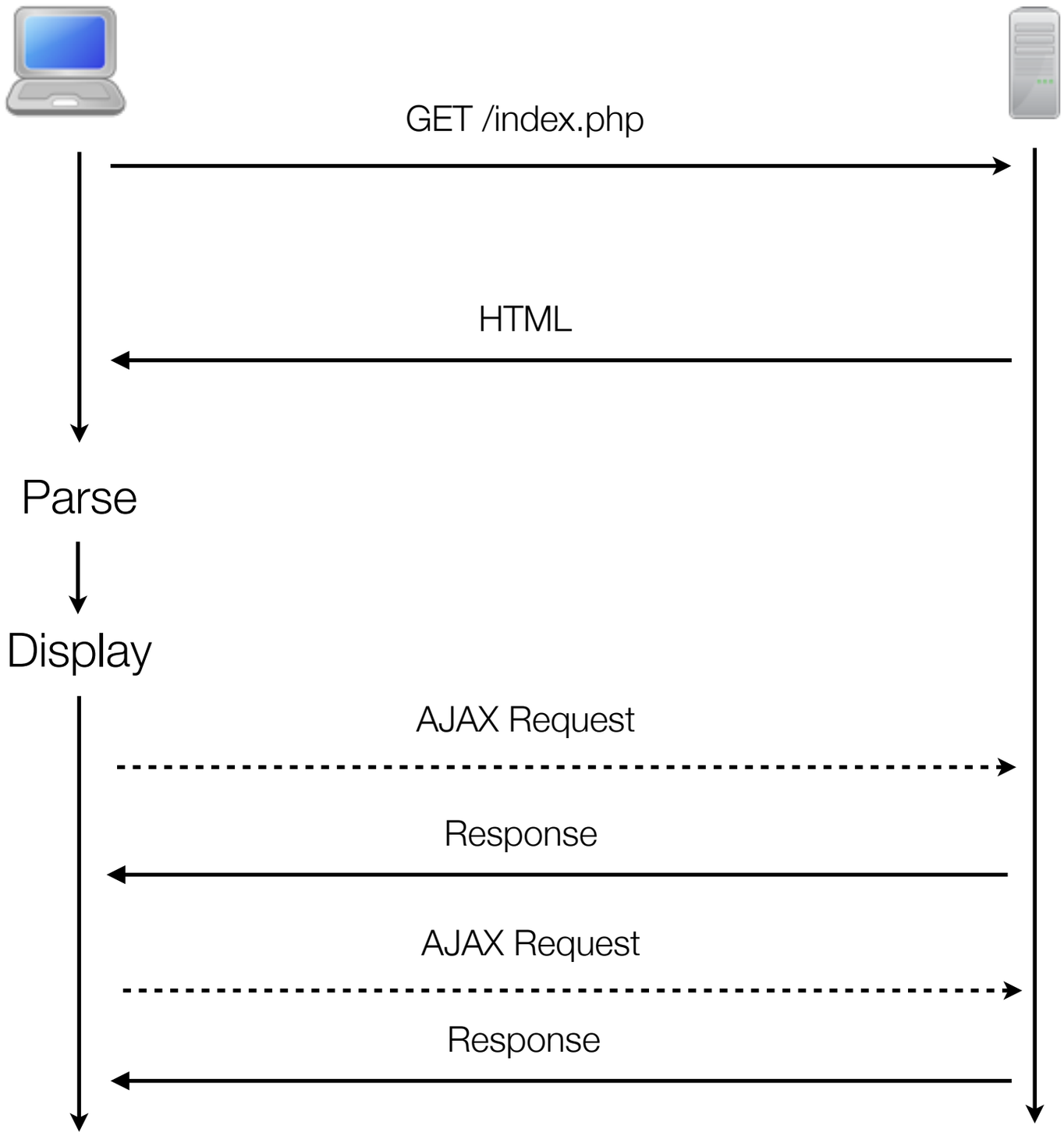
4. What Goes Into a Modern Web Project?

1. Static Web Pages
2. Presentation
3. Dynamic Page Generation
4. Persistence
5. Client Side Logic
6. Background Client/Server Interaction (AJAX)

4.6 Background Interaction: AJAX (1/3)

- Asynchronous Javascript and XML
- Allows for the browser to do background requests
- Javascript API
- Ends page response model
- Talk HTML / JSON / XML / YAML / etc.

4.6 Background Interaction: Flow (2/3)



4.6 Background Interaction: Formats (3/3)

JSON

```
{"topic": "Web Development",
 "languages": ["Javascript", "Python",
               "Ruby", "PHP"],
 "ongoing": true}
```

XML

```
<Document>
    <topic>Web Development</topic>
    <languages>
        <language>Javascript</language>
        <language>Python</language>
        <language>Ruby</language>
        <language>PHP</language>
    </languages>
    <ongoing>true</ongoing>
<Document>
```

YAML

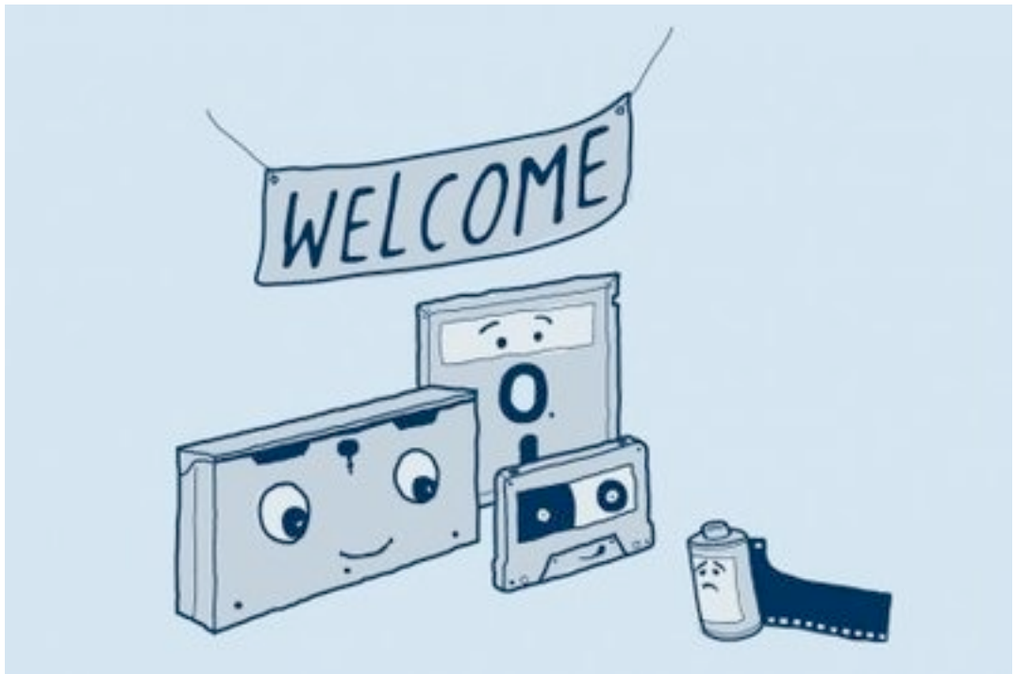
```
---
topic: "Web Development"
languages:
  - Javascript
  - Python
  - Ruby
  - PHP
ongoing: true
```

4. What Goes Into a Modern Web Project?

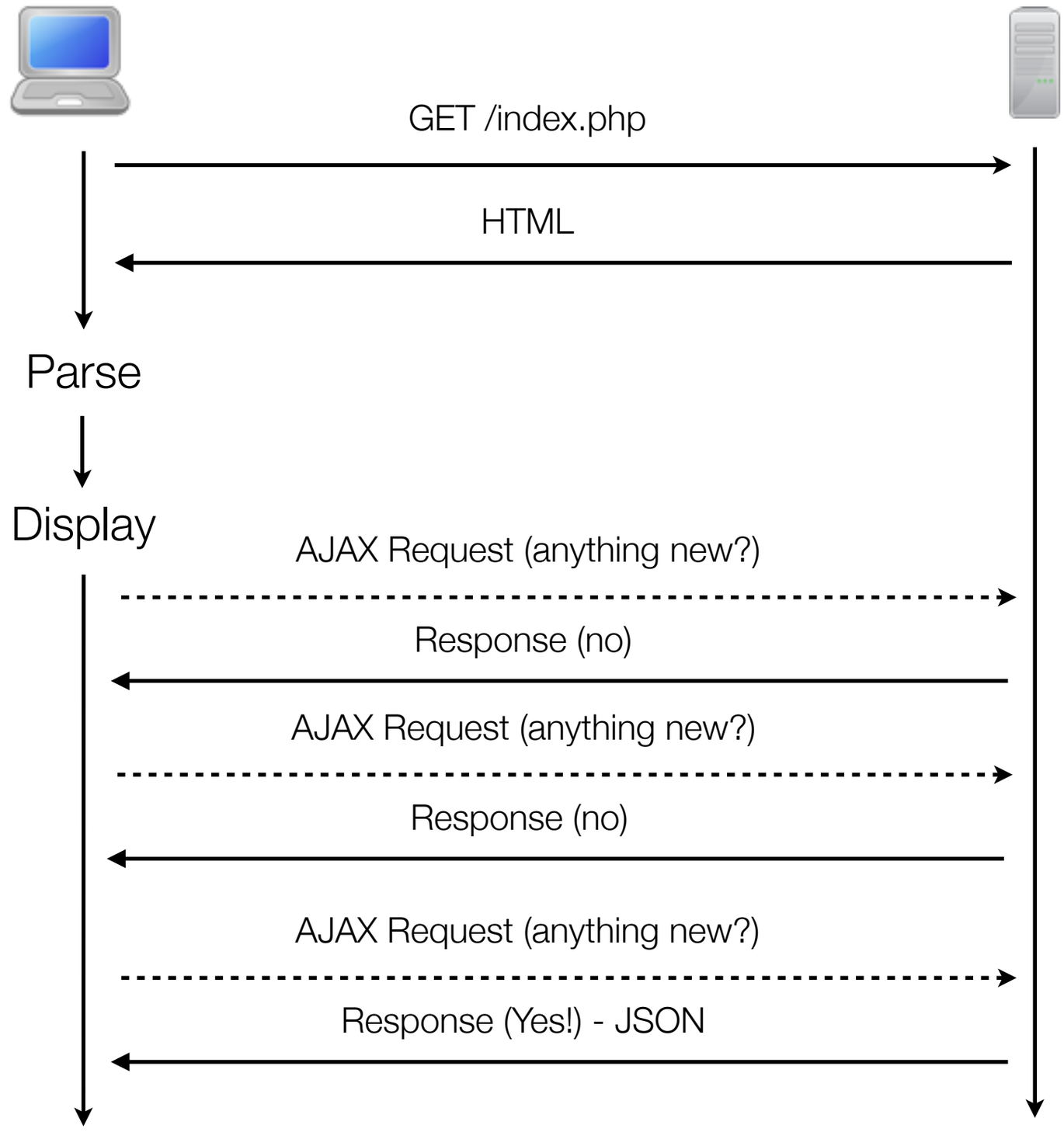
1. Static Web Pages
2. Presentation
3. Dynamic Page Generation
4. Persistence
5. Client Side Logic
6. Background Client/Server Interaction (AJAX)
7. Two Way Communication

4.7 Two Way Communication: Old Way (1/4)

- AJAX Polling
- Client checks periodically for updates
- Wasteful but reliable



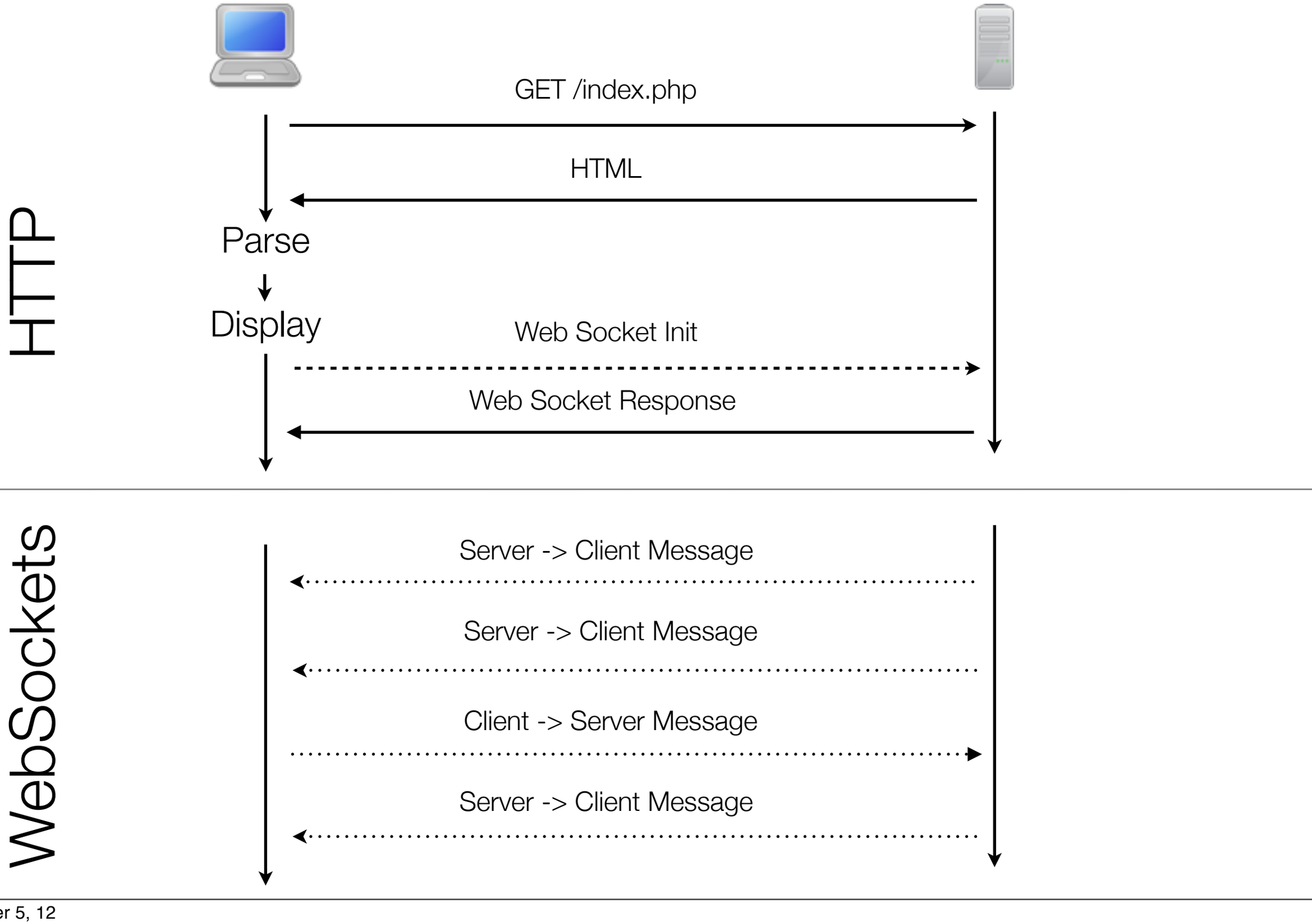
4.7 Two Way Communication: Polling Flow (2/4)



4.7 Two Way Communication: WebSockets (3/4)

- Allows servers to push updates to clients
- Starts on HTTP, updates to lighter protocol
- Available in all latest browsers
- Javascript API talks to implementing server

4.7 Two Way Communication: WebSockets (4/4)



4. What Goes Into a Modern Web Project?

1. Static Web Pages
2. Presentation
3. Dynamic Page Generation
4. Persistence
5. Client Side Logic
6. Background Client/Server Interaction (AJAX)
7. Two Way Communication
8. HTML5 (The Kitchen Sink)

4.8 Looking Forward: HTML5

- LocalStorage (javascript API for structured DB storage in the browser)
- Canvas API
- WebGL
- Failure condition specs
- New CSS
- <audio> / <video>
- New Markup (<article>, <section>)
- Lots more!

5. Making Web Development Fun

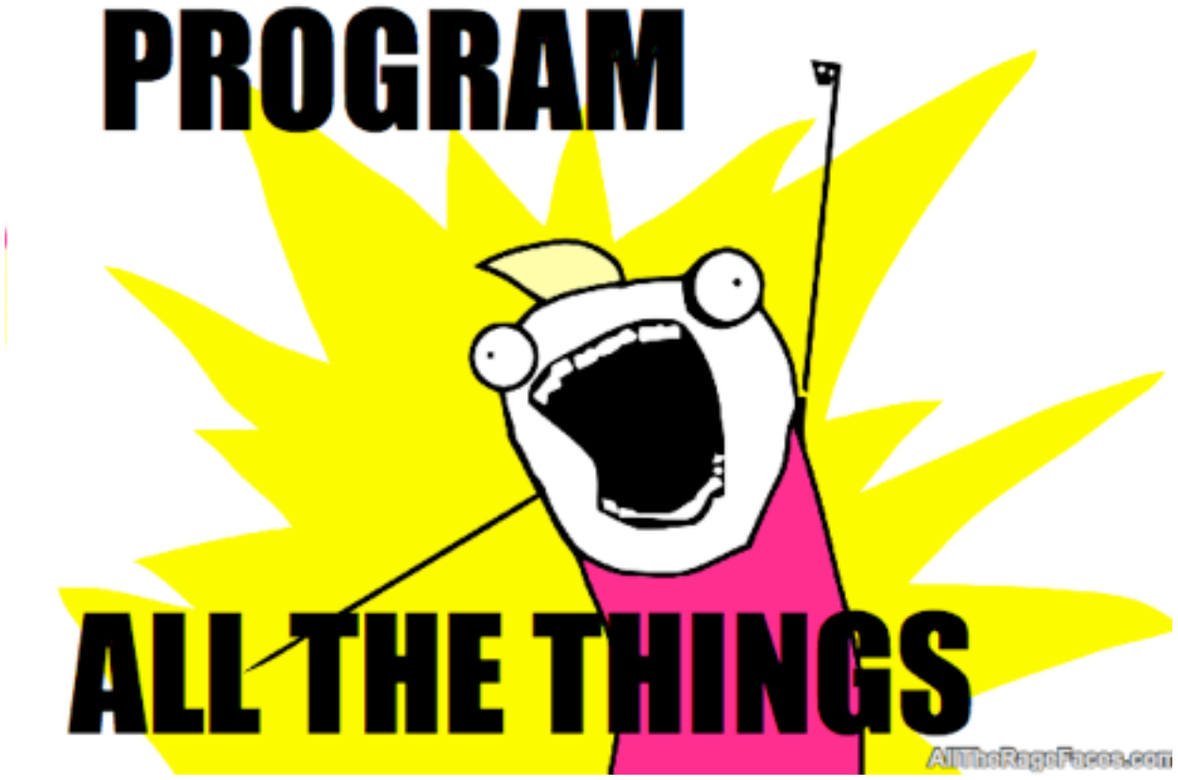
(or, at least easing the pain)

5. Making This All Fun

- Use client side (CSS/JS) frameworks
  - Bootstrap / Blueprint
  - jQuery / YUI

- Use compile down languages
  - LESS
  - CoffeeScript

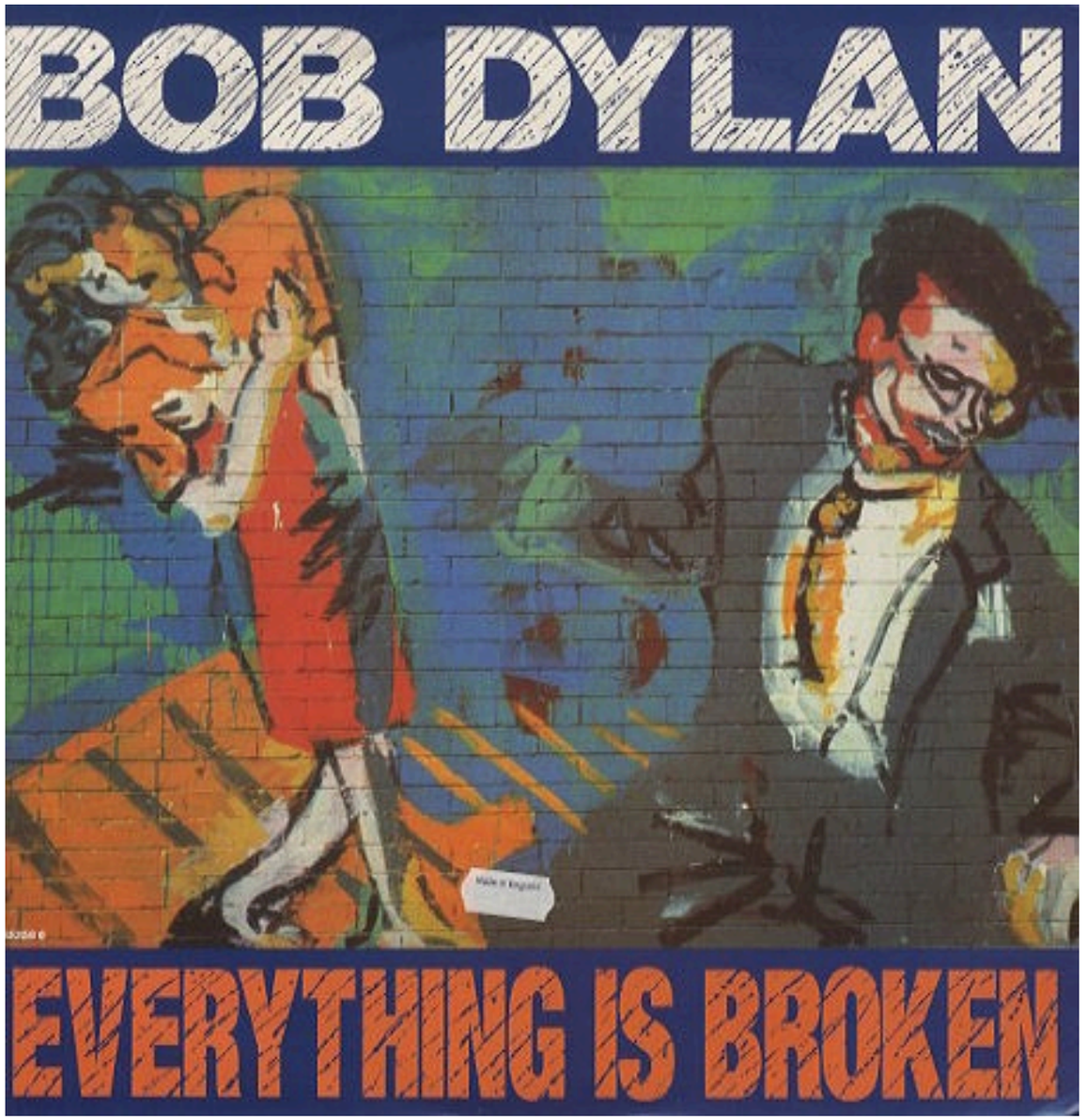
- Use Server Side Frameworks
  - PHP: Symphony, Drupal, CodeIgniter, Zend
  - Ruby: Rails
  - Python: Django, web2py, Twisted, Tornado



6. Web Development Challenges

(or, everything is broken)

6. Web Development Challenges



- Following best practices is tedious!
- HTTP is not a good protocol for all this!
- Scaling this is really hard!
- Web security is really hard!

Thanks Very Much!

Pete Snyder <psnyde2@uic.edu>