Programming with HTTP/REST

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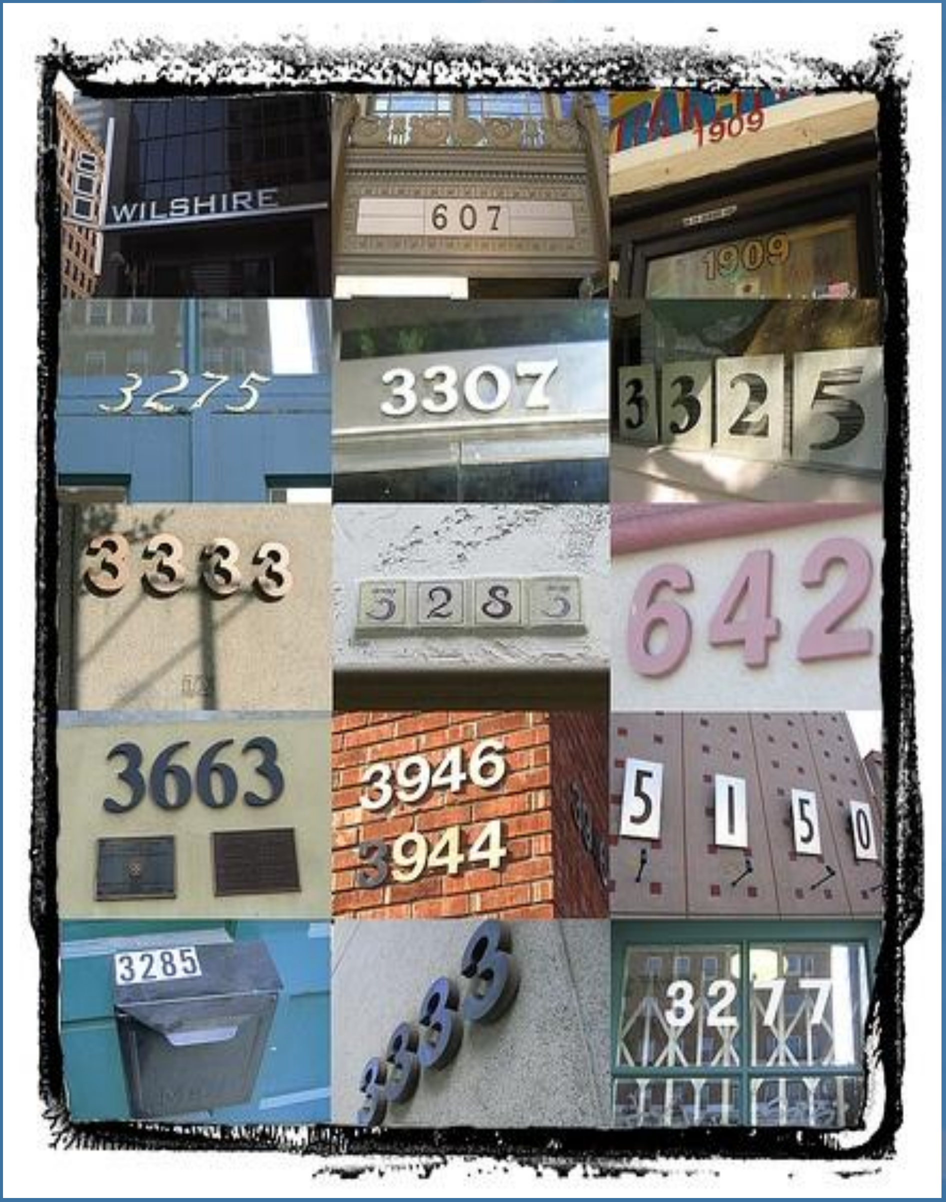
By the Numbers

- 1 Protocol
- 1 Style
- 3 Questions
- 4 Constraints
- 4.5 Demos
- 5 Concepts
- 8 Libraries
- 5 “Killer Ds”
- 1 Radical Idea
- All in 60 minutes!



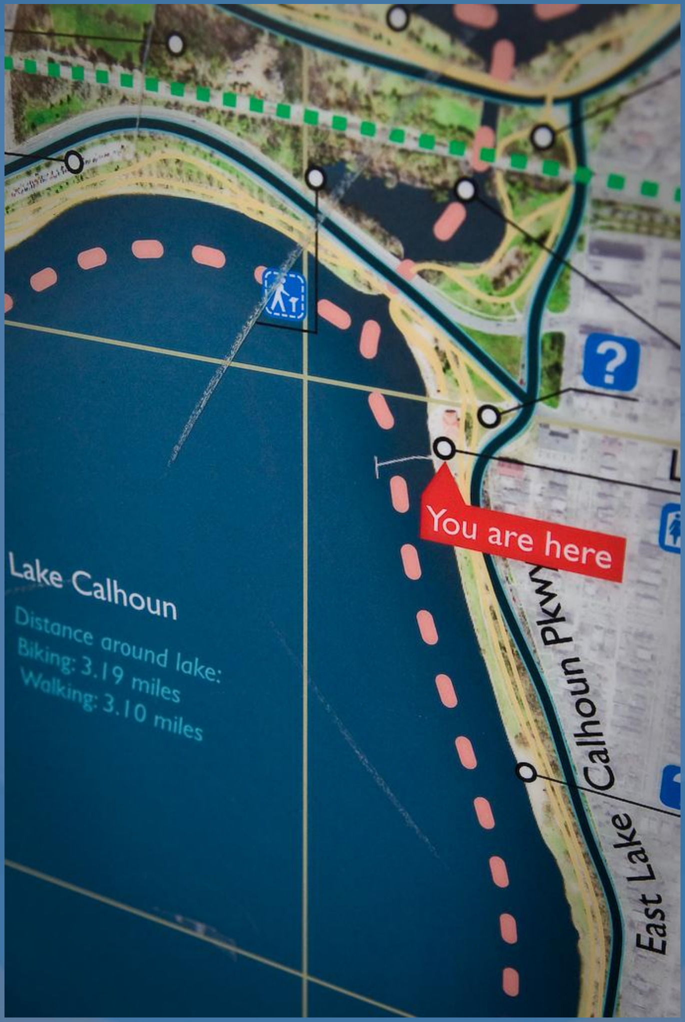
But First:
Three Questions

- What Do You Do?
- What Do You Think About?
- Why Are You Here?

What I Do

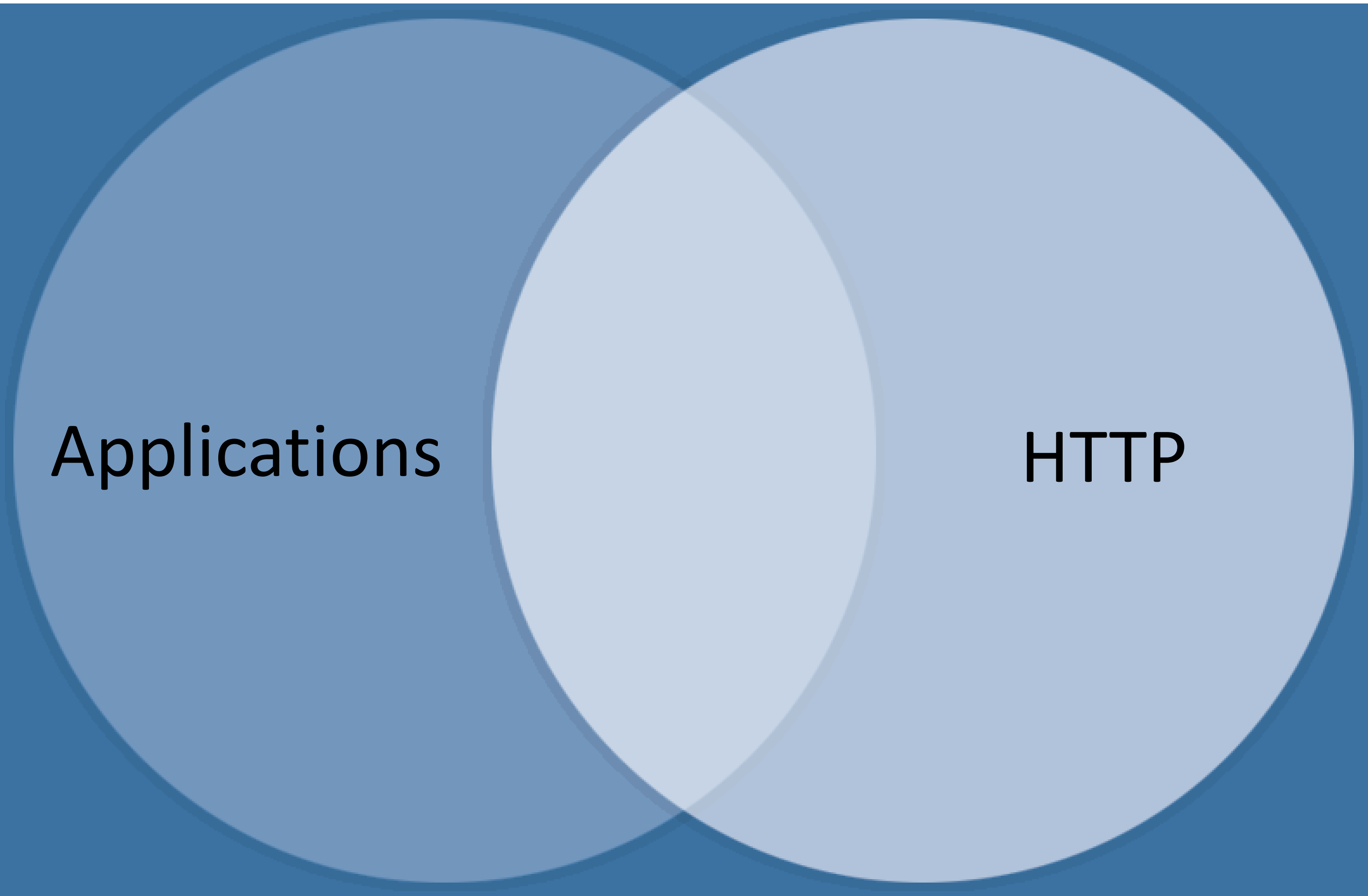
What I Think About…

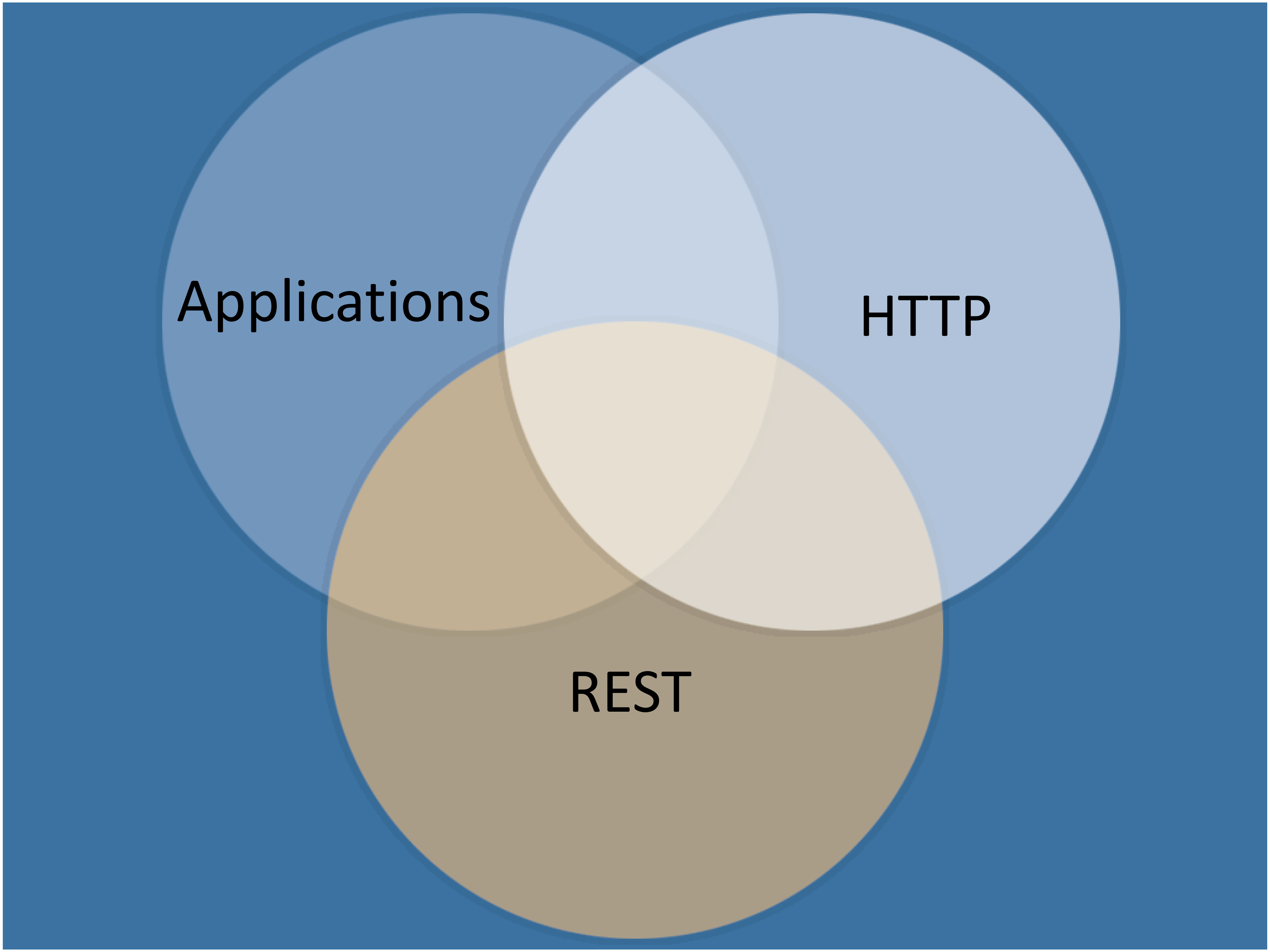
Why *Am* I Here?

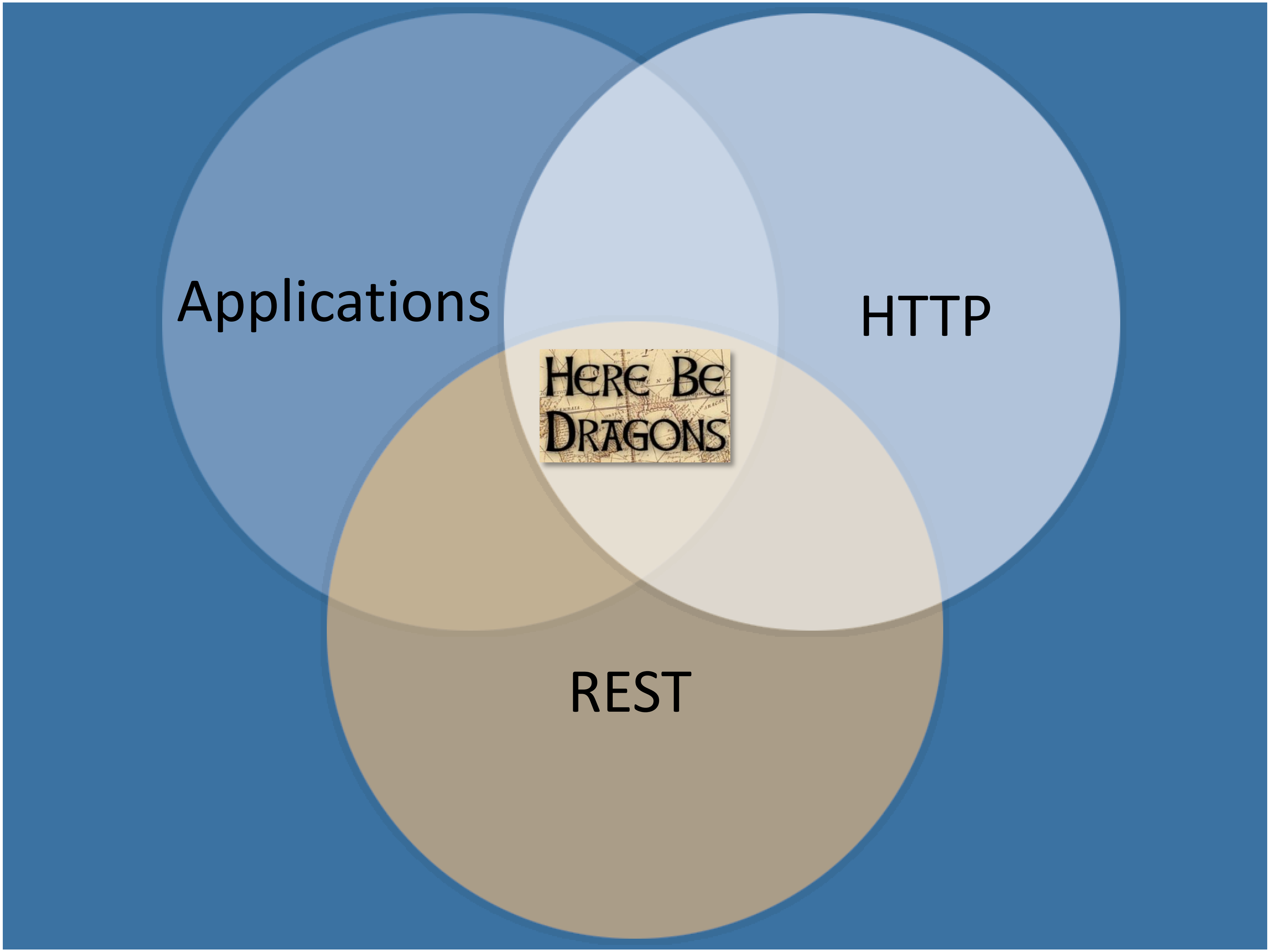

Lake Calhoun
Distance around lake:
Biking: 3.19 miles
Walking: 3.10 miles
You are here
East Lake Calhoun Pkwy

Let’s Get Started!

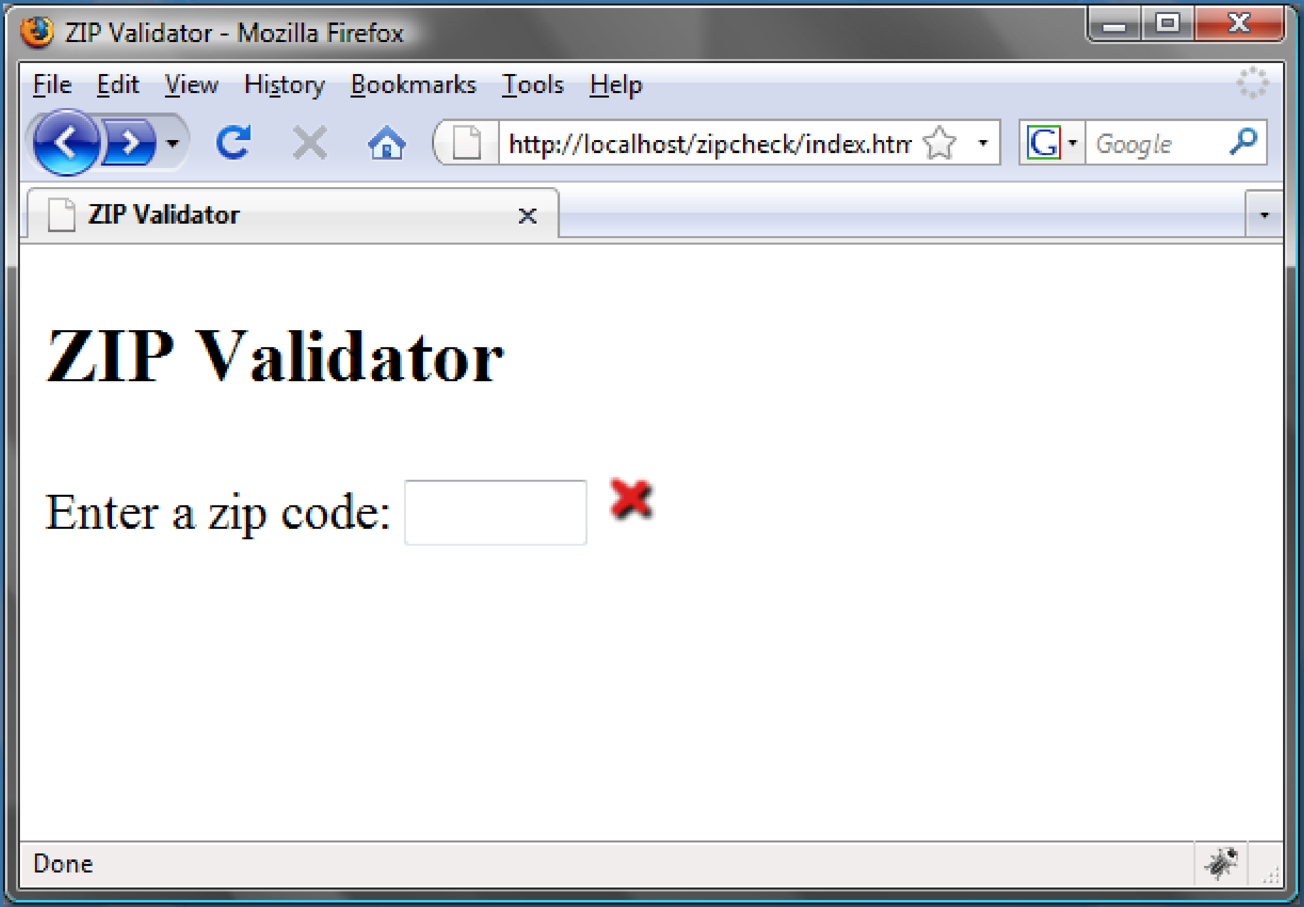
Applications


Applications
HTTP


Applications
HTTP
REST


Applications
HTTP
Here Be Dragons
REST

Demo #1


ZIP Validator - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://localhost/zipcheck/index.htm
Google
ZIP Validator
Done

ZIP Validator

Enter a zip code:

The Big Picture

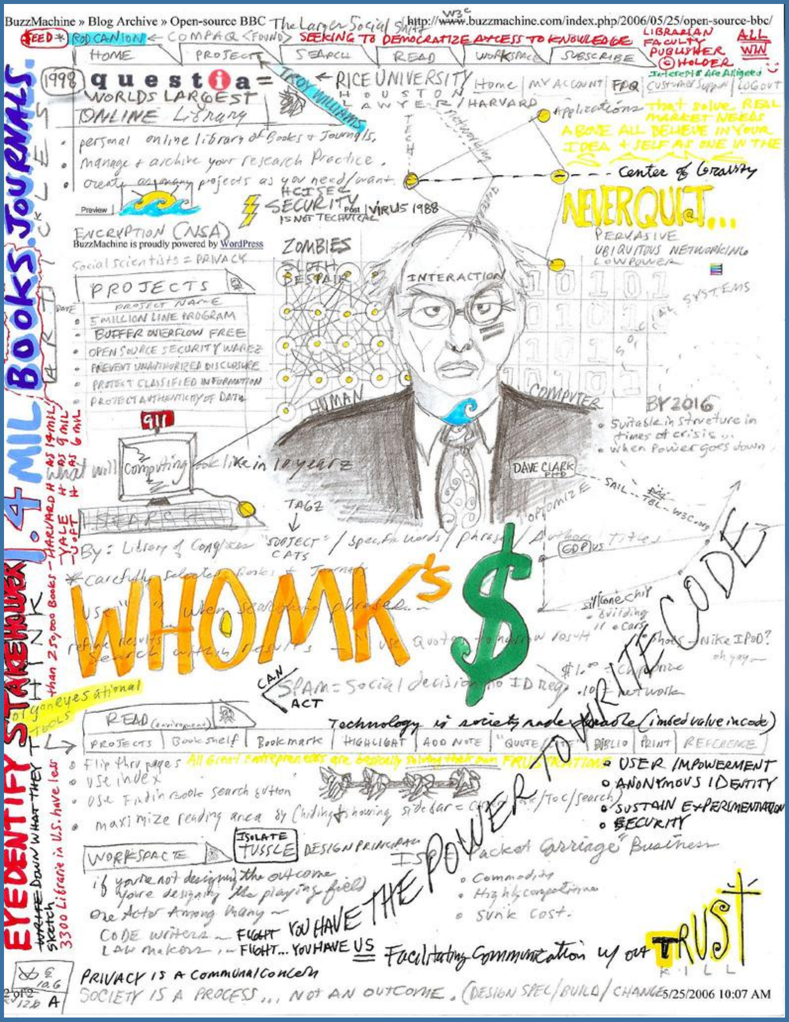
- HTTP & REST
- Programming Concepts
- HTTP Toolkit
- RESTful Approach

HTTP

HTTP is a Protocol

HTTP
is an
Application
Protocol

HTTP is Optimized for…



BuzzMachine » Blog Archive » Open-source BBC
http://www.buzzmachine.com/index.php/2006/05/25/open-source-bbc/
The Larger Social Shift
SEEKING TO DEMOCRATIZE ACCESS TO KNOWLEDGE
LIBRARIAN FACULTY PUBLISHER HOLDER
ALL WIN
HOME
PROJECTS
SEARCH
READ
WORKSPACE
SUBSCRIBE
questia
WORLDS LARGEST ONLINE Library
RICE UNIVERSITY
HOUSTON LAWYER / HARVARD
Center of Gravity
NEVER QUIT...
PERVASIVE UBIQUITOUS NETWORKING LOW POWER
SECURITY IS NOT TECHNICAL
VIRUS 1988
ENCRYPTION (NSA)
BuzzMachine is proudly powered by WordPress
ZOMBIES
INTERACTION
HUMAN
COMPUTER
BY 2016
PROJECTS
DAVE CLARK
1.4 MIL BOOKS. JOURNALS.
ARTICLES
EYEDENTIFY STAKEHOLDER
WHOMK's $
WRITE THE CODE
Technology is society made durable
USER EMPOWERMENT
ANONYMOUS IDENTITY
SUSTAIN EXPERIMENTATION
SECURITY
ISOLATE TUSSLE
DESIGN PRINCIPLE
WORKSPACE
YOU HAVE THE POWER TO
Facilitating Communication w/ out TRUST
PRIVACY IS A COMMUNAL CONCERN
SOCIETY IS A PROCESS... NOT AN OUTCOME.
5/25/2006 10:07 AM

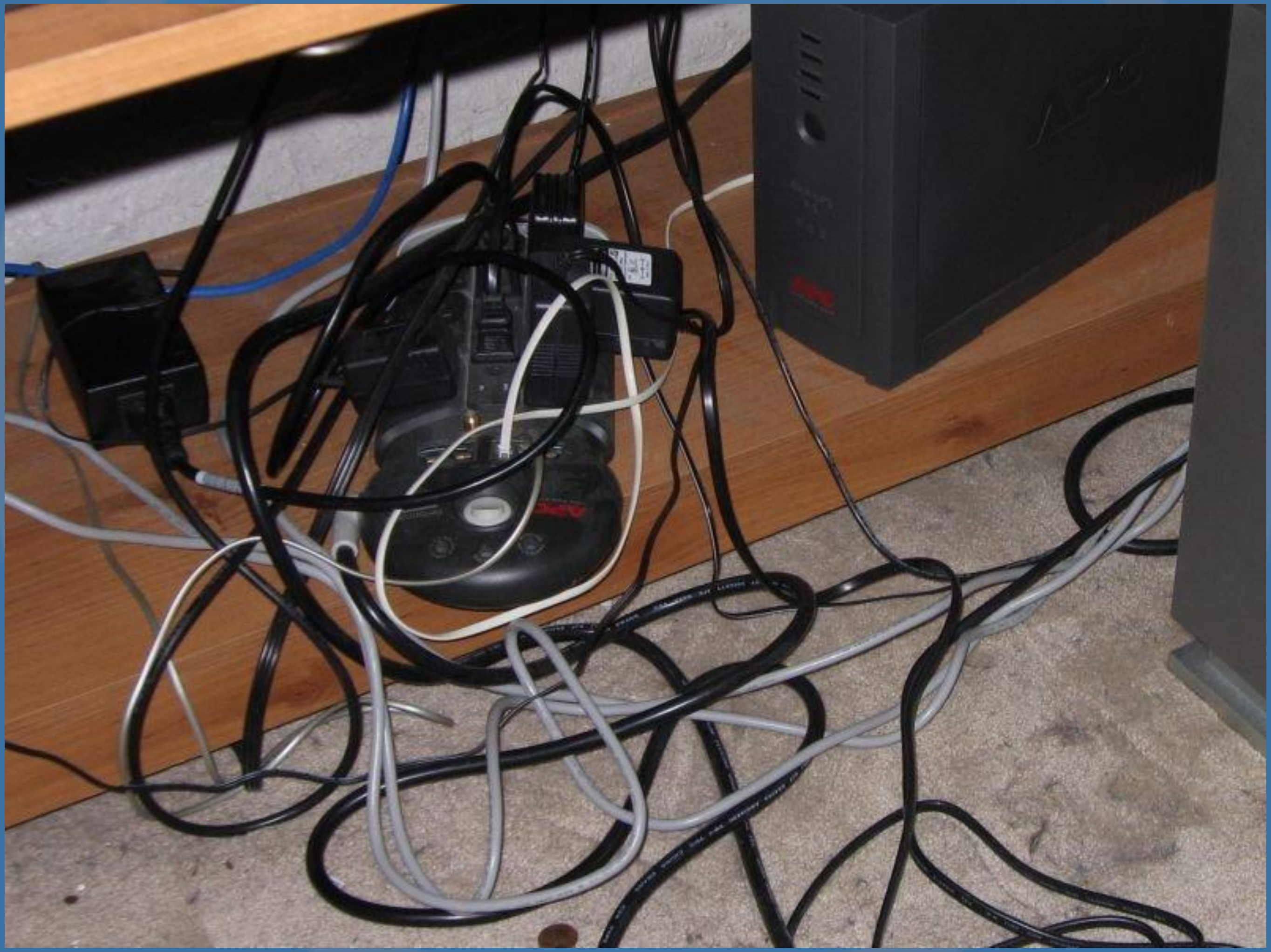
Large Networks

Heterogeneous Clients

High Latency

The BORING Store
LET THE BORING STORE TEND TO YOUR CARRIER PIGEON'S NEEDS
Is your pigeon being bullied?
STUDDED HARNESS $15
Has your pigeon lost his luster?
IMPORTED VITAMINS $13
Does you pigeon have a date?
EXOTIC BANGLES $400

Unreliable Connections



Unstable Content

REST

REST
is a
Style

REST
is an
Architectural
Style

REST Focuses on…

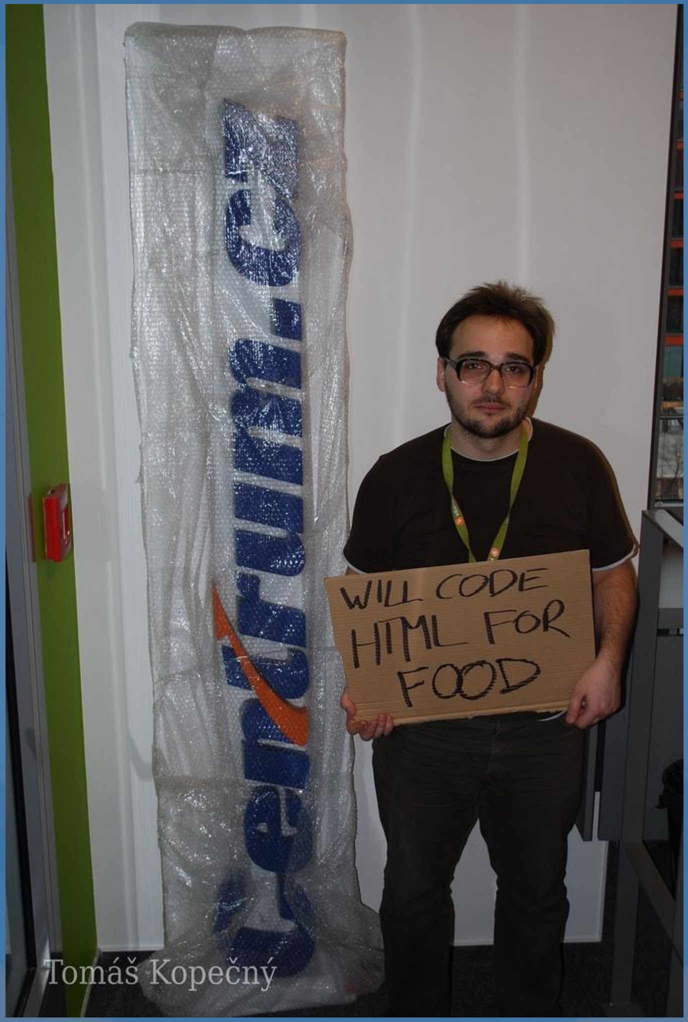
A Common Interface

Addressability

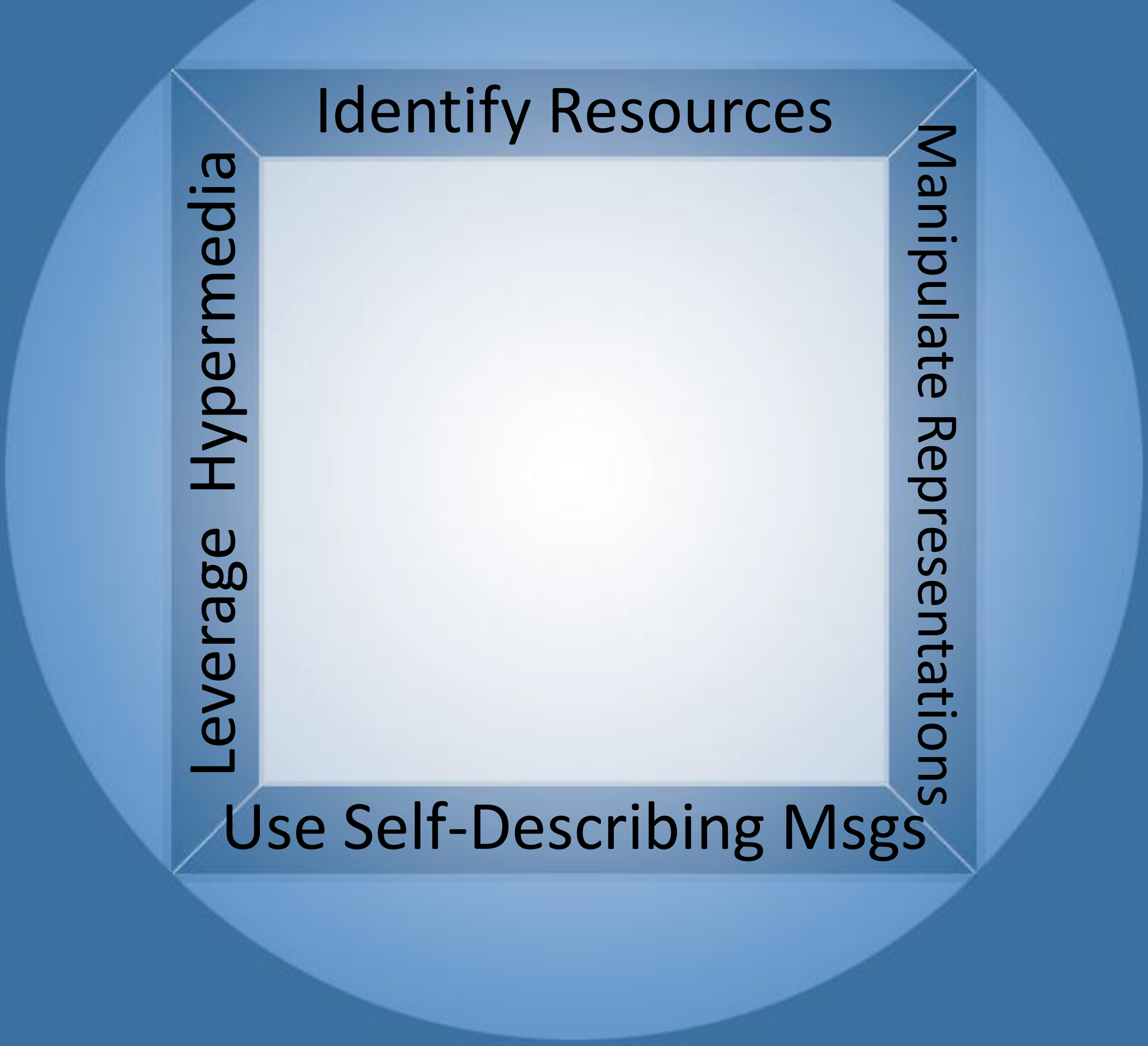
Message v. Metadata

Support for Intermediaries

Code-on-Demand



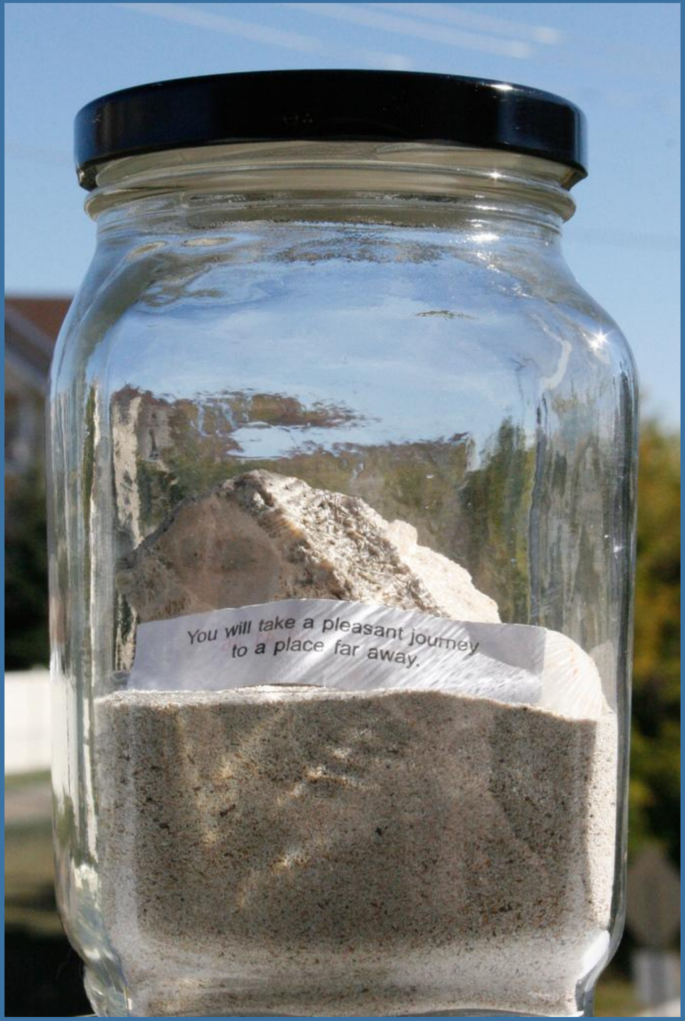
REST Concepts



Identify Resources

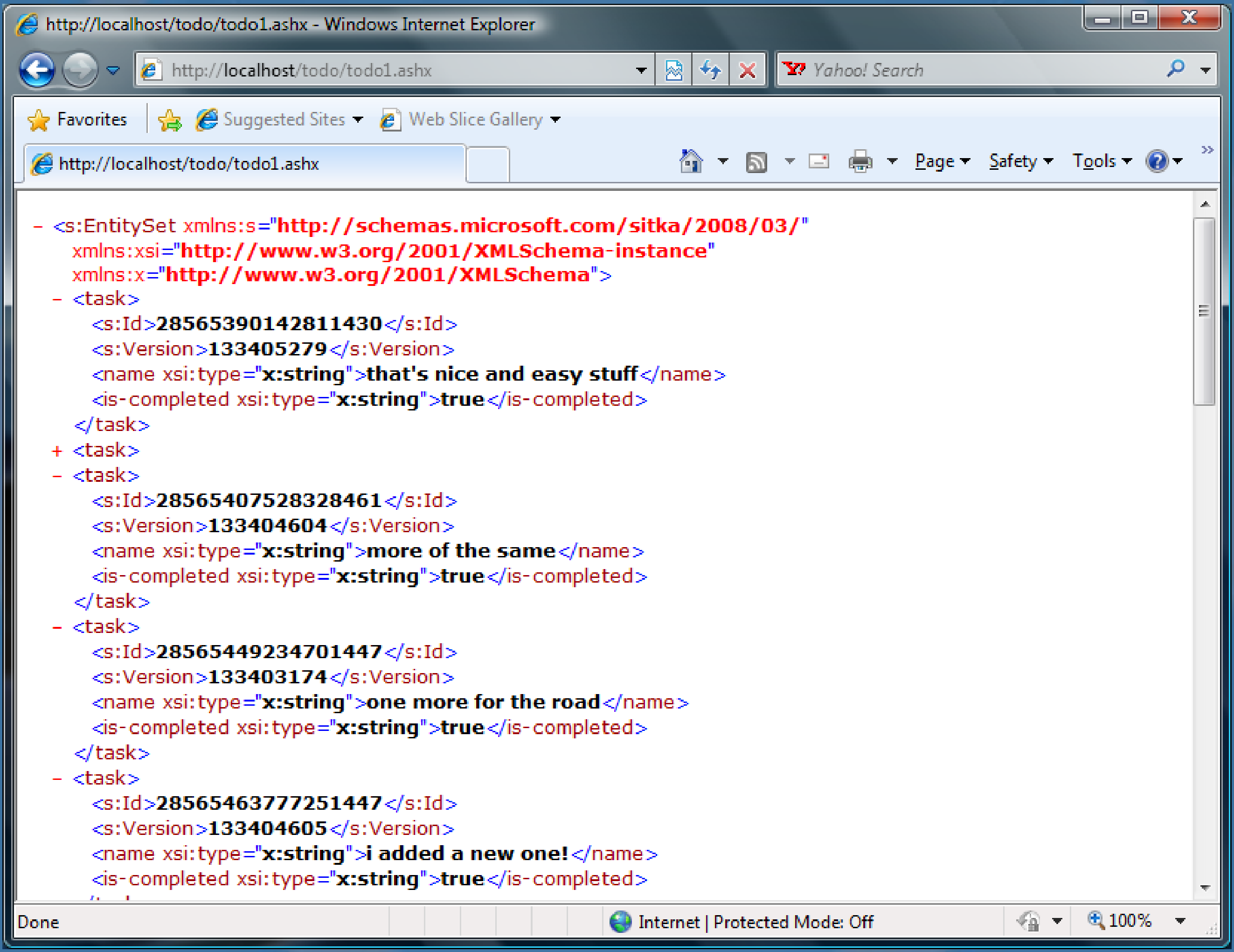
Manipulate Representations

Use Self-Describing Messages



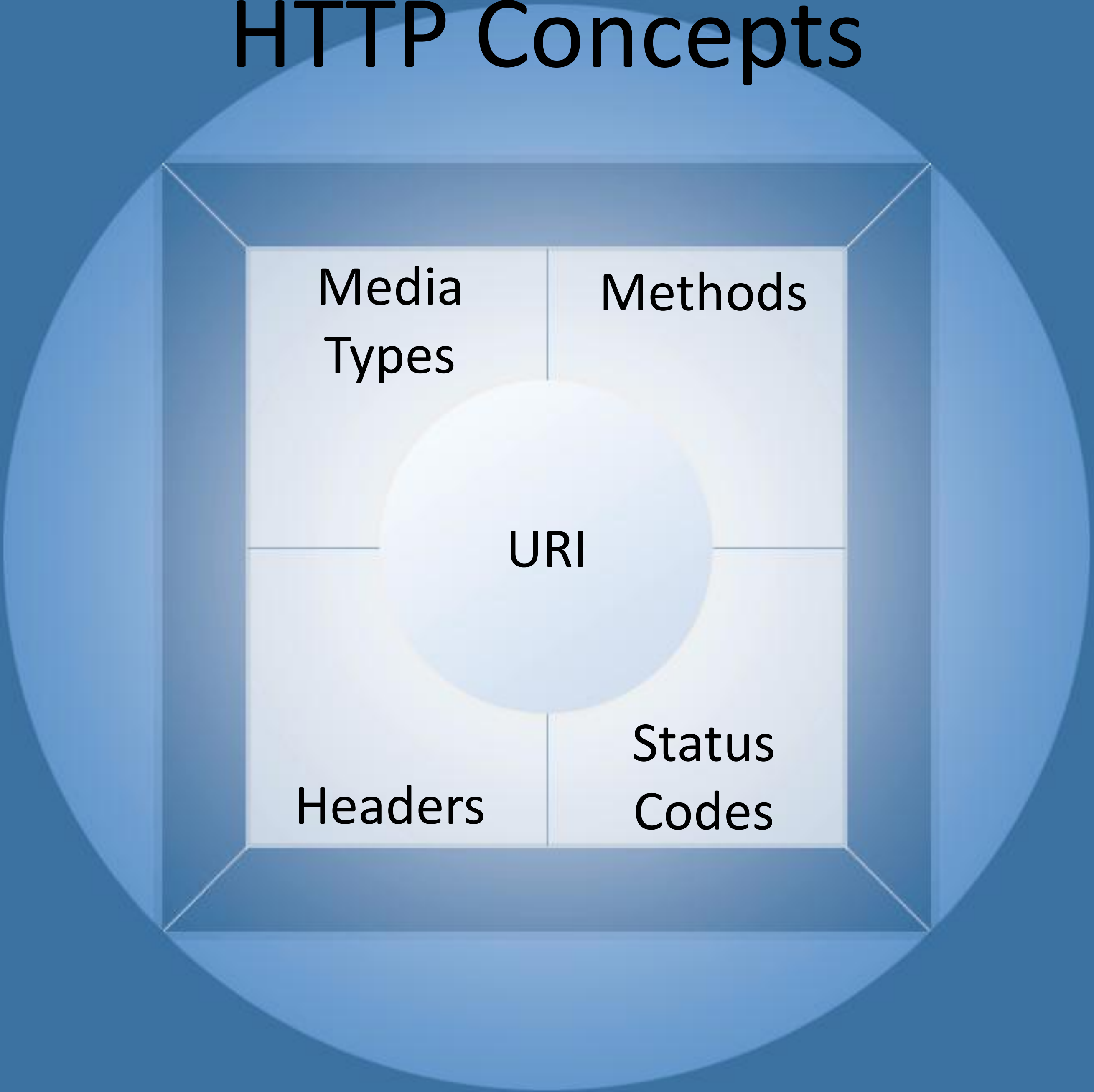
Leverage Hypermedia

Demo #2


http://localhost/todo/todo1.ashx - Windows Internet Explorer
http://localhost/todo/todo1.ashx
Yahoo! Search
Favorites
Suggested Sites
Web Slice Gallery
http://localhost/todo/todo1.ashx
Page
Safety
Tools
Done
Internet | Protected Mode: Off
100%

```
- <s:EntitySet xmlns:s="http://schemas.microsoft.com/sitka/2008/03/"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:x="http://www.w3.org/2001/XMLSchema">
  - <task>
      <s:Id>28565390142811430</s:Id>
      <s:Version>133405279</s:Version>
      <name xsi:type="x:string">that's nice and easy stuff</name>
      <is-completed xsi:type="x:string">true</is-completed>
    </task>
  + <task>
  - <task>
      <s:Id>28565407528328461</s:Id>
      <s:Version>133404604</s:Version>
      <name xsi:type="x:string">more of the same</name>
      <is-completed xsi:type="x:string">true</is-completed>
    </task>
  - <task>
      <s:Id>28565449234701447</s:Id>
      <s:Version>133403174</s:Version>
      <name xsi:type="x:string">one more for the road</name>
      <is-completed xsi:type="x:string">true</is-completed>
    </task>
  - <task>
      <s:Id>28565463777251447</s:Id>
      <s:Version>133404605</s:Version>
      <name xsi:type="x:string">i added a new one!</name>
      <is-completed xsi:type="x:string">true</is-completed>
```

HTTP Concepts



Media Types

- “The [media-type] is the ***message***”
- Classes of media-types
  - Free form (text/plain)
  - Well-formed (application/xml, application/json)
  - Validated (application/atom+xml)
- (X)HTML is?
- Custom Types
  - application/vnd.amundsen.tasks+xml
- “The media-type is the ***interface***”

HTTP Methods

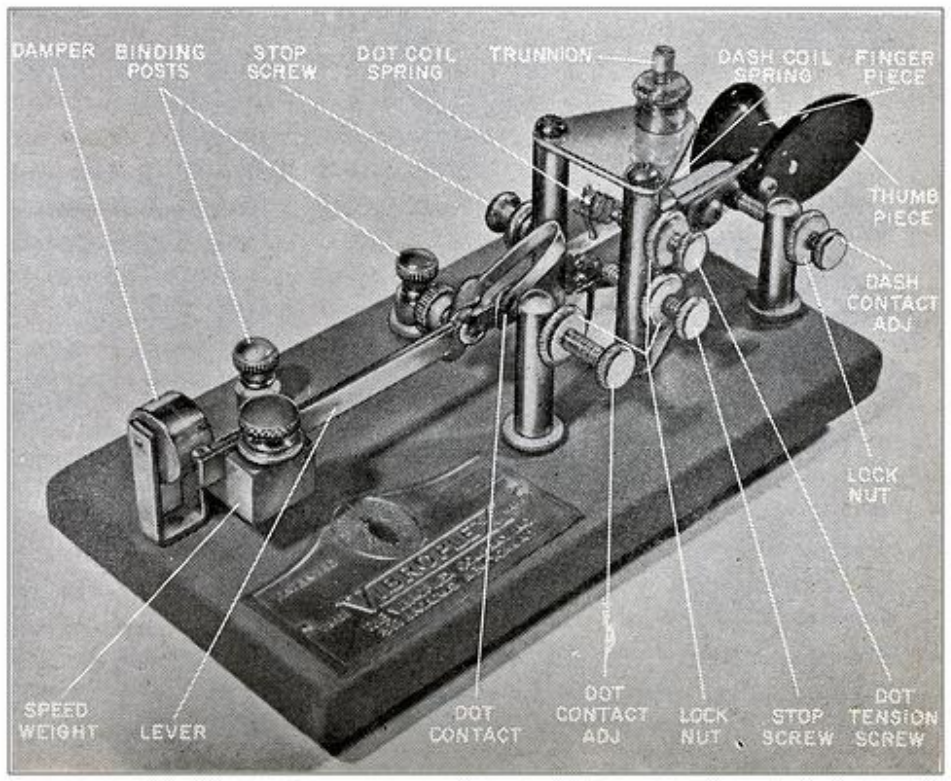
- Limited set of methods = wide range of clients

- **Safe**
  - Repeatable w/o harm
- **Idempotent**
  - Repeatable w/ same results

- **GET**
- **HEAD**
- **OPTIONS**
- **PUT**
- **DELETE**
- **POST**

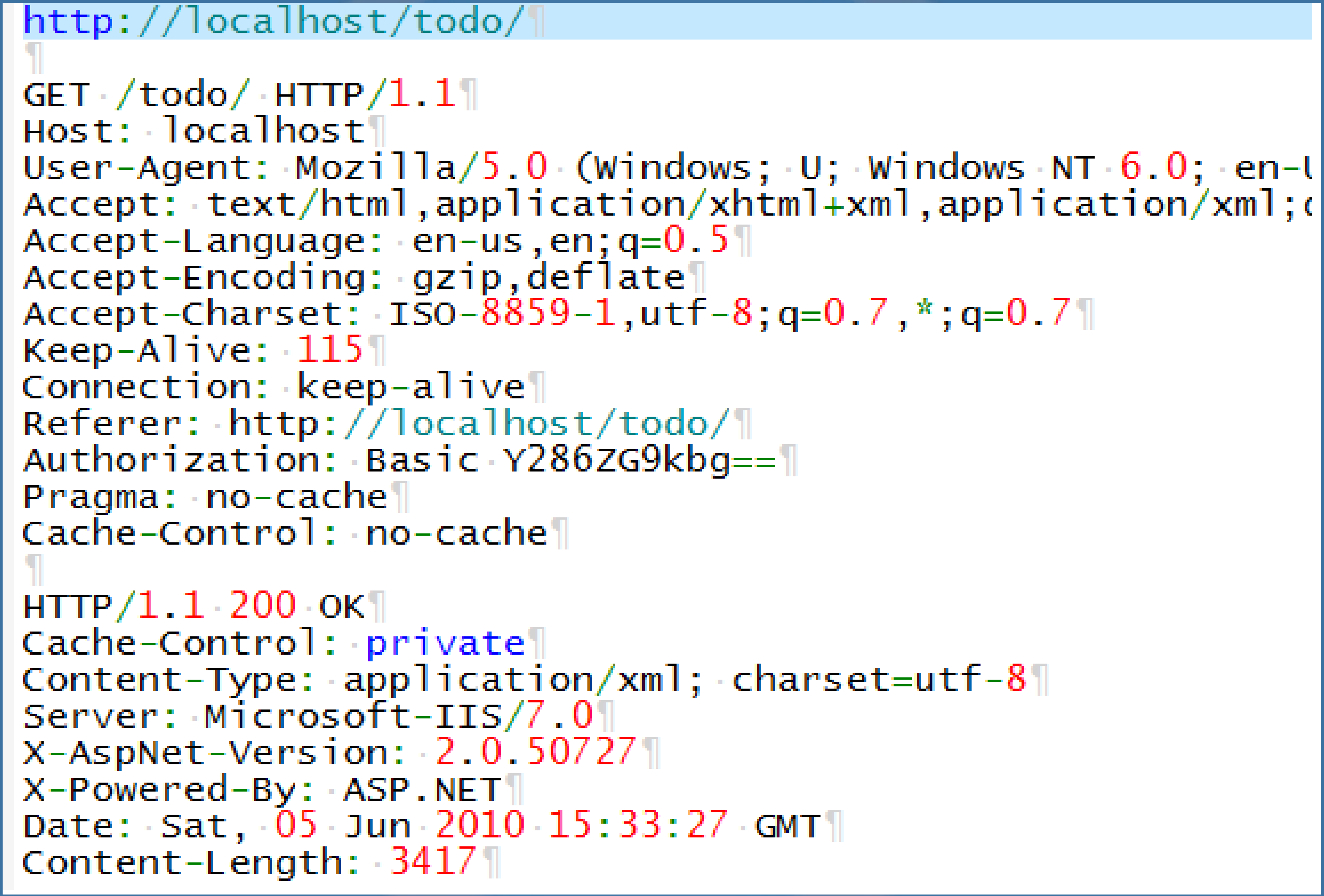
Status Codes

- 1xx
  - "Things are fine, proceed…"
- 2xx
  - "Yep, I got your back."
- 3xx
  - "Well, almost…"
- 4xx
  - "Hey, don't do that!"
- 5xx
  - "Oops, my bad."



HTTP Headers

- Metadata for the message
- Request Headers from the client **Accept**
- Response Headers from the server **Host**
- Entity Headers from everyone **Content-MD5**

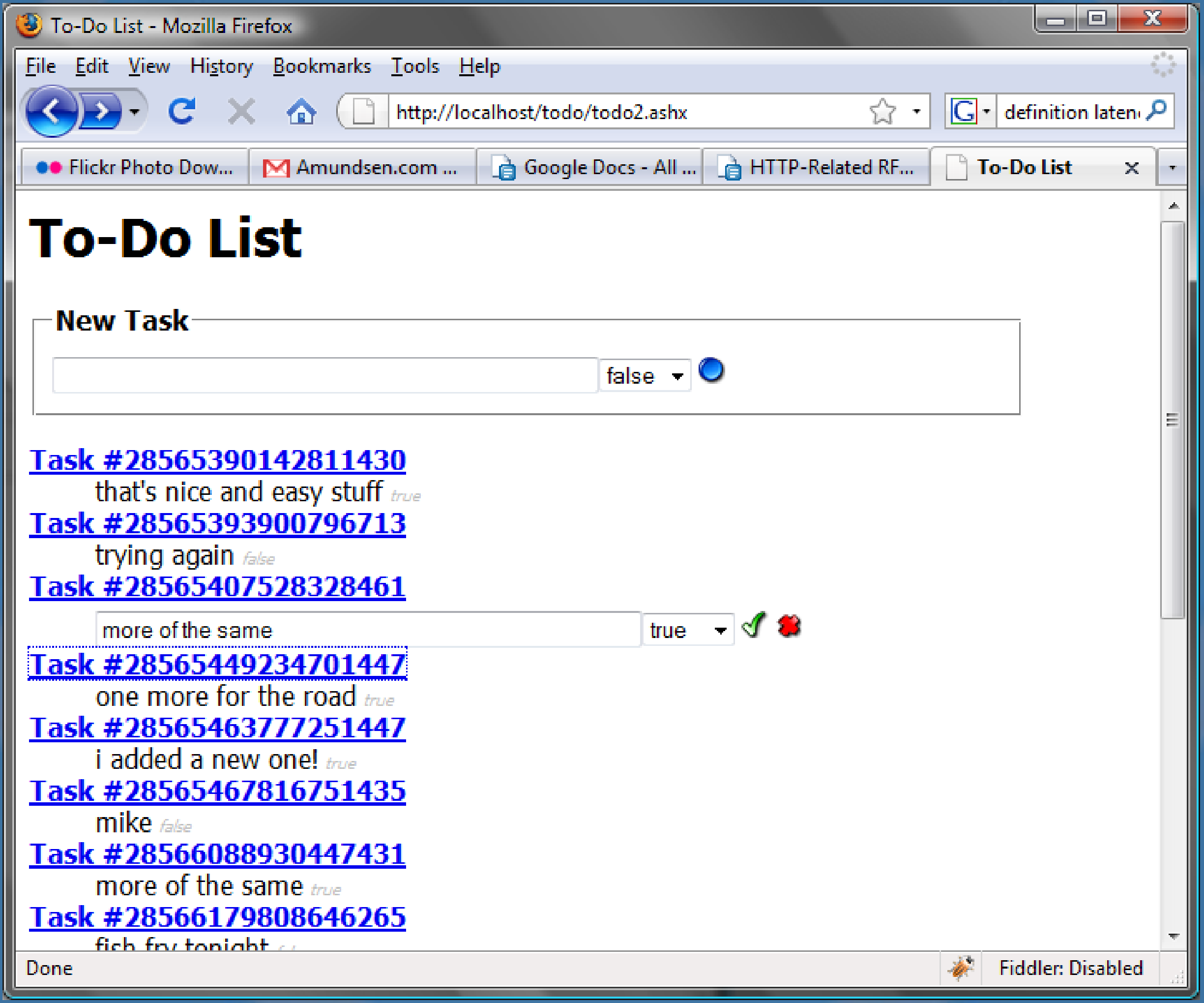


```
http://localhost/todo/

GET /todo/ HTTP/1.1
Host: localhost
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.0; en-
Accept: text/html,application/xhtml+xml,application/xml;
Accept-Language: en-us,en;q=0.5
Accept-Encoding: gzip,deflate
Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7
Keep-Alive: 115
Connection: keep-alive
Referer: http://localhost/todo/
Authorization: Basic Y286ZG9kbg==
Pragma: no-cache
Cache-Control: no-cache

HTTP/1.1 200 OK
Cache-Control: private
Content-Type: application/xml; charset=utf-8
Server: Microsoft-IIS/7.0
X-AspNet-Version: 2.0.50727
X-Powered-By: ASP.NET
Date: Sat, 05 Jun 2010 15:33:27 GMT
Content-Length: 3417
```

URIs

- There is an unlimited supply of URIs
- Every resource as ***at least*** one URI
- Every URI has ***only one*** resource
- URIs are opaque to the client
- One of the two intractable problems in programming

Demo #3



http://localhost/todo/todo2.ashx

To-Do List

New Task

false

Task #28565390142811430
that's nice and easy stuff true
Task #28565393900796713
trying again false
Task #28565407528328461
more of the same true
Task #28565449234701447
one more for the road true
Task #28565463777251447
i added a new one! true
Task #28565467816751435
mike false
Task #28566088930447431
more of the same true
Task #28566179808646265
fish fry tonight

HTTP Toolkit

Programming Tools

- Request Dispatcher
- URI Handler
- Mime Parser
- Request Handler
- Transformer
- HTTP client
- Caching
- Authentication

Request Dispatcher

- Accepts request from client
- Knows how to route it to the proper code
- **ASP.NET URL Rewriter**
- **Apache rewrite_mod**
- **ISAPI_Rewrite**

Decouple public URI from your code!

URI Handler

- Understands all parts of the URI
- Scheme (*http*)
- Authority (*www.example.org*)
- Path (*/this/is/a/folder/and/item*)
- Query (*?x=the_spot*)
- Fragment (*#plan_9*)
- `HttpContext.Request.Url.*`

Regex comes in handy here

Resource Handler

- Accepts incoming request
- Examines body (when applicable)
- Handles all logic and storage interactions
- **ASP.NET HttpHandlers**
- **ASP.NET Page**
- **ASP.NET MVC**

Most interesting work is done here

Media-Type Parser

- Inspects the Accept and Content-Type headers
- Can negotiate types between client/server
- `MimeParser.cs`

Gnarly math; already worked out

Transformation Library

- Converts stored data into response
- Uses negotiated media-types as a guide
- Abstracts storage from representation
- **XSLT**
- **Xquery**
- **Other templating libraries**
- **Image processing**

Tight binding is death by a thousand cuts

HTTP Client

- Able to act as your “agent”
- Makes requests
- Understands responses
- Your own ‘browser’
- **`HTTPClient.cs`**

Biggest ‘missing link’ in .NET Web space

Caching Library

- Store/Retrieve local copies of responses
- Understands HTTP rules on caching
- One of the two intractable problems in computer programming…
- `CacheService.cs`

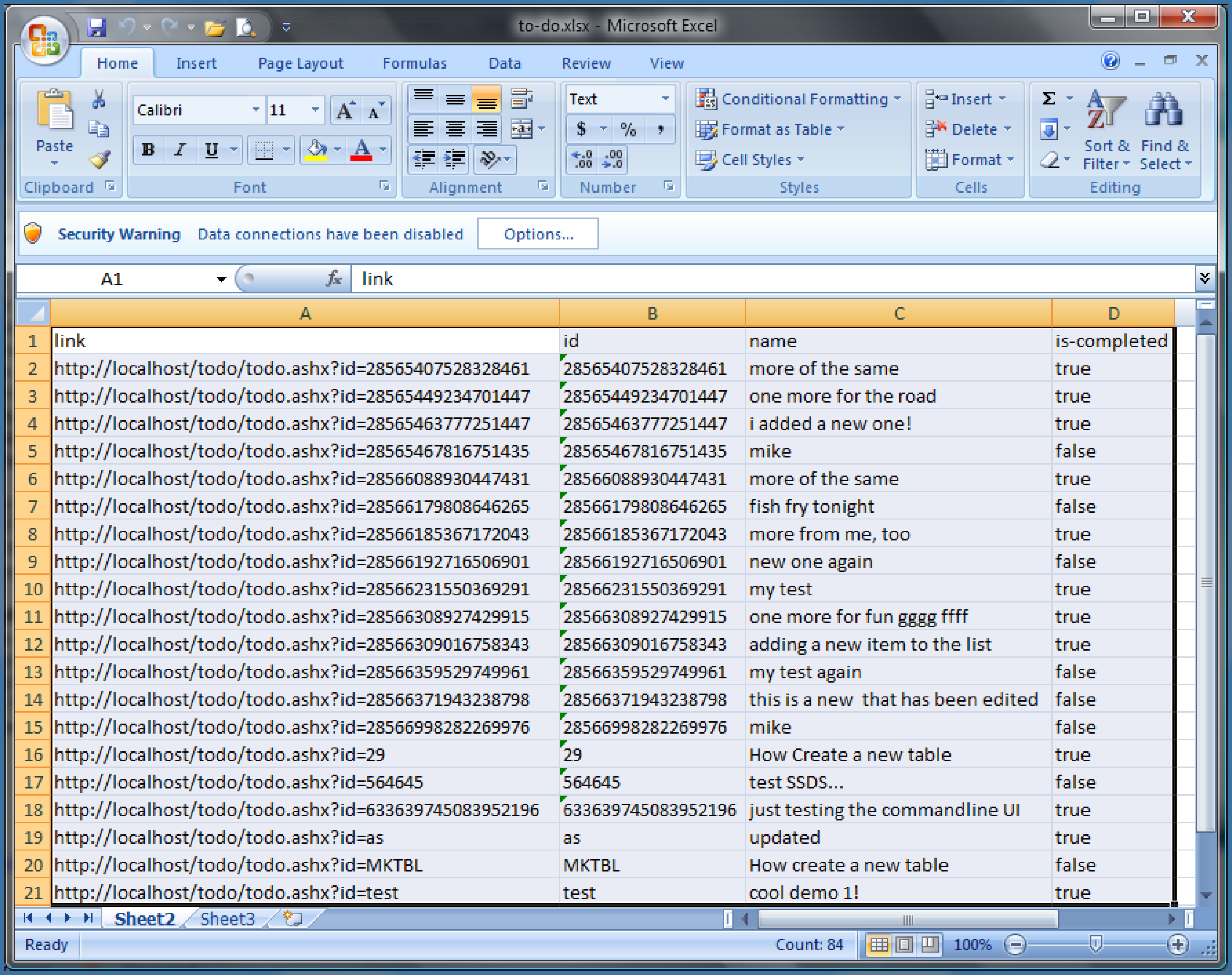
Reduce Bandwidth, Increase Speed

Authentication Library

- Can craft valid credentials for requests
- Understands server responses
- Supports wide range of encryption/hashing
- `Hashing.cs`

Learn the 'auth patterns', too.

Demo #3.5



A1 link

	A	B	C	D
1	link	id	name	is-completed
2	http://localhost/todo/todo.ashx?id=28565407528328461	28565407528328461	more of the same	true
3	http://localhost/todo/todo.ashx?id=28565449234701447	28565449234701447	one more for the road	true
4	http://localhost/todo/todo.ashx?id=28565463777251447	28565463777251447	i added a new one!	true
5	http://localhost/todo/todo.ashx?id=28565467816751435	28565467816751435	mike	false
6	http://localhost/todo/todo.ashx?id=28566088930447431	28566088930447431	more of the same	true
7	http://localhost/todo/todo.ashx?id=28566179808646265	28566179808646265	fish fry tonight	false
8	http://localhost/todo/todo.ashx?id=28566185367172043	28566185367172043	more from me, too	true
9	http://localhost/todo/todo.ashx?id=28566192716506901	28566192716506901	new one again	false
10	http://localhost/todo/todo.ashx?id=28566231550369291	28566231550369291	my test	true
11	http://localhost/todo/todo.ashx?id=28566308927429915	28566308927429915	one more for fun gggg ffff	true
12	http://localhost/todo/todo.ashx?id=28566309016758343	28566309016758343	adding a new item to the list	true
13	http://localhost/todo/todo.ashx?id=28566359529749961	28566359529749961	my test again	false
14	http://localhost/todo/todo.ashx?id=28566371943238798	28566371943238798	this is a new that has been edited	false
15	http://localhost/todo/todo.ashx?id=28566998282269976	28566998282269976	mike	false
16	http://localhost/todo/todo.ashx?id=29	29	How Create a new table	true
17	http://localhost/todo/todo.ashx?id=564645	564645	test SSDS...	false
18	http://localhost/todo/todo.ashx?id=633639745083952196	633639745083952196	just testing the commandline UI	true
19	http://localhost/todo/todo.ashx?id=as	as	updated	true
20	http://localhost/todo/todo.ashx?id=MKTBL	MKTBL	How create a new table	false
21	http://localhost/todo/todo.ashx?id=test	test	cool demo 1!	true

RESTful Approach

The Five Ds

1. *Describe*
2. *Define*
3. *Design*
4. *Decorate*
5. *Defend*

Describe the Workflow

- What work has to get done?
- What data will be requested? stored?
- Typical storyboards, etc.
- Same as most any other style/medium

Define the Resources

- Based on workflow, what needs to be exposed
- Resources are *not* records or pages!
- Users, Customers, Orders, Reports, etc.
- Consider composite resources, too.

Design the Representations

- What clients will request data?
- What formats (media-types) will be needed?
- Representations are *sent* as well as *requested*
- Symmetry is not required/desirable
- Start simple, add more later
- Don’t forget binary formats (image, PDF, etc.)

Spend most of your time here

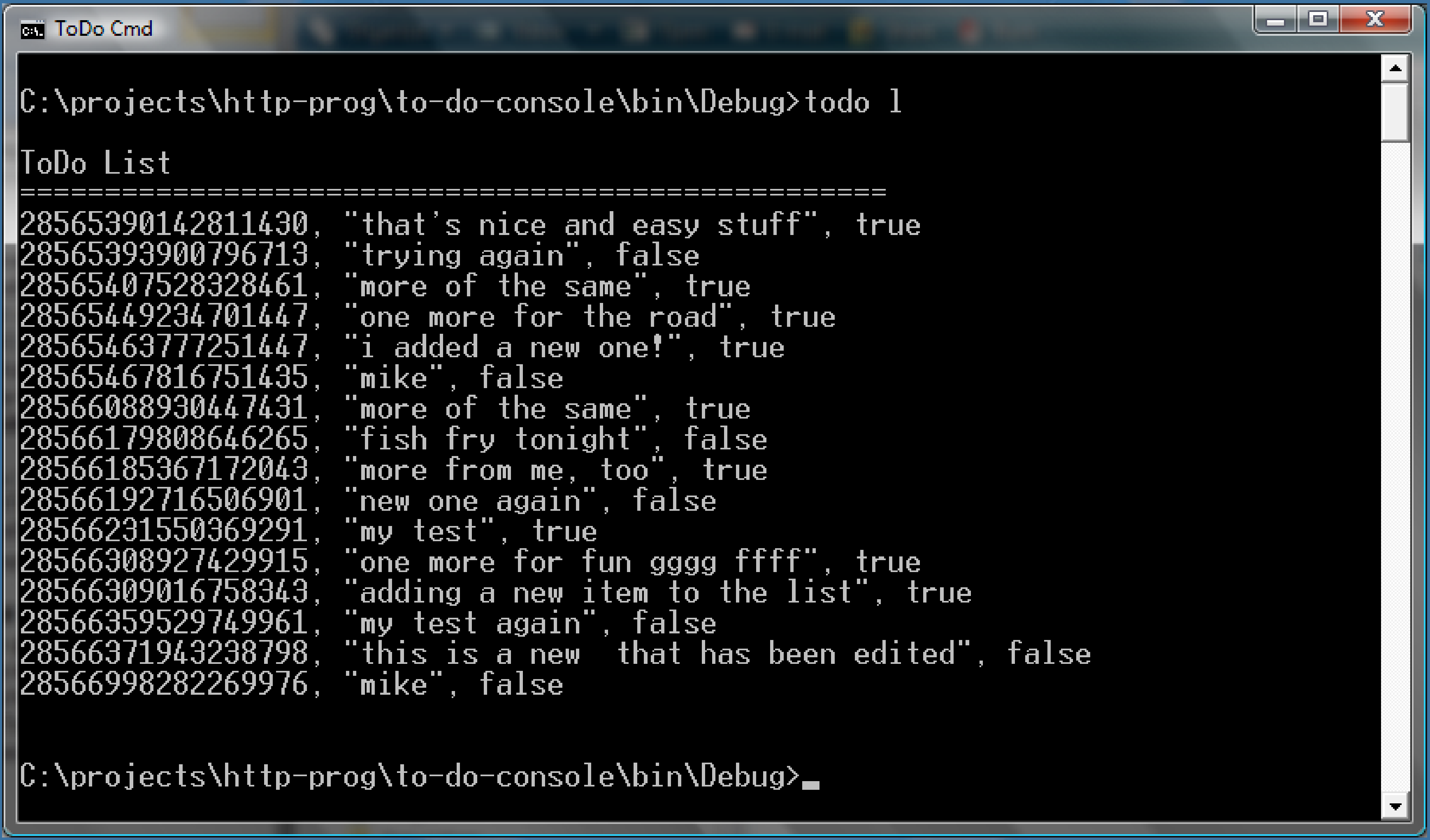
Decorate with Metadata

- Now you can focus on details, optimizations
- Caching (*cache-control: no-cache*)
- Encoding (*content-encoding: gzip*)
- Languages (*accept-languages:en,es*)
- Concurrency (*etag, last-modified-date*)

Defend with Authentication

- What resources need to be restricted?
- What HTTP methods need to be controlled?
- URI + Method + User = security matrix
- Use browser auth (yeah, it’s ugly)
- Consider login-form + cookie (all on the client)
- Non-browser clients have no problems.

Demo #4



```
C:\projects\http-prog\to-do-console\bin\Debug>todo l

ToDo List
==================================================
28565390142811430, "that's nice and easy stuff", true
28565393900796713, "trying again", false
28565407528328461, "more of the same", true
28565449234701447, "one more for the road", true
28565463777251447, "i added a new one!", true
28565467816751435, "mike", false
28566088930447431, "more of the same", true
28566179808646265, "fish fry tonight", false
28566185367172043, "more from me, too", true
28566192716506901, "new one again", false
28566231550369291, "my test", true
28566308927429915, "one more for fun gggg ffff", true
28566309016758343, "adding a new item to the list", true
28566359529749961, "my test again", false
28566371943238798, "this is a new  that has been edited", false
28566998282269976, "mike", false


C:\projects\http-prog\to-do-console\bin\Debug>_
```

Radical Thinking

- It's the ***representation*** that really matters
  - Not the URI
  - Not the view
  - Not the business logic
  - Not the stored record
- True separation of concerns:
  - Address (URI)
  - Resource (object of interest)
  - Processing (biz logic/flow)
  - Representation (via media types)
  - Storage (database, file system, etc.)

Summary

- Study the RFCs (whadda geek!)
- Fill out your HTTP programming toolkit
- Build apps w/ HTTP in a REST-ful style
- Rinse and Repeat

References #1

- URLS - http://www.ietf.org/rfc/rfc1738.txt
- HTTP 1.1 - http://www.ietf.org/rfc/rfc2616.txt
- HTTP Auth - http://www.ietf.org/rfc/rfc2617.txt
- State Mgmt - http://www.ietf.org/rfc/rfc2965.txt
- Generic URI - http://tools.ietf.org/rfc/rfc3986.txt
- AtomPub - http://tools.ietf.org/rfc/rfc5023.txt

- Formats:
- CSV - http://tools.ietf.org/rfc/rfc4180.txt
- Atom Format - http://tools.ietf.org/rfc/rfc4287.txt
- JSON - http://tools.ietf.org/rfc/rfc4627.txt

References #2

- Other:
- Header Registration - http://www.ietf.org/rfc/rfc4229.txt
- Language Tags - http://tools.ietf.org/rfc/rfc4646.txt

- IANA:
- Atom Link Relations - http://www.iana.org/assignments/link-relations/link-relations.xhtml
- HTTP Status Codes - http://www.iana.org/assignments/http-status-codes
- Language Sub-Tag Registry - http://www.iana.org/assignments/language-subtag-registry
- MIME Media Types - http://www.iana.org/assignments/media-types/index.html

References #3

- W3C:
- HTML 4.01 - http://www.w3.org/TR/REC-html40/
- XHTML - http://www.w3.org/TR/xhtml1/
- XHTML Basic 1.1 - http://www.w3.org/TR/xhtml-basic/
- XML - http://www.w3.org/TR/xml/
- XML 1.1 - http://www.w3.org/TR/xml11/
- XML Schema - http://www.w3.org/XML/Schema#dev
- XML Namspaces - http://www.w3.org/TR/xml-names/
- XSLT 1.0 - http://www.w3.org/TR/xslt
- XSLT 2.0 - http://www.w3.org/TR/xslt20/
- XPath 1.0 - http://www.w3.org/TR/xpath
- XPath 2.0 - http://www.w3.org/TR/xpath20/,
- XQuery - http://www.w3.org/TR/xquery/
- XInclude - http://www.w3.org/TR/xinclude/
- SVG - http://www.w3.org/TR/SVG11/

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Programming with HTTP/REST

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