INFO/CS 4302
Web Information Systems

FT 2012

Week 3: The Web Architecture:
hands-on http
(Lecture 5)

Theresa Velden

Housekeeping

- Progress Team Formation
- Cross Cutting Issue Poll: still open for another few hrs
  - Internet Censorship
  - Internet Surveillance
  - Net Neutrality & Openness

Web Architecture

RECAP: IDENTIFICATION & INTERACTION

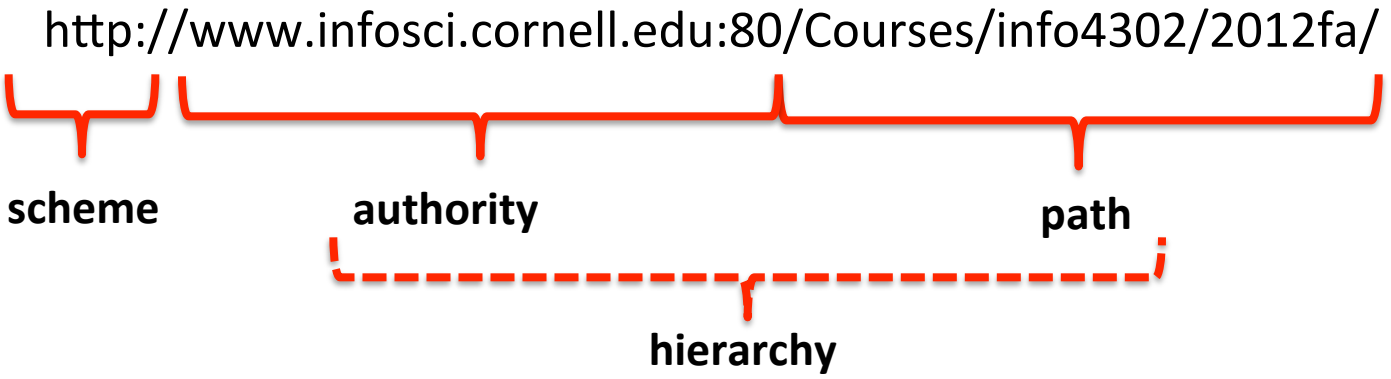
Recap: A web resource is

- An entity with an identity (URI)
- An abstract: you can't see, smell, touch…
- A service point for initiating protocol (HTTP) actions
- A target of hyperlinks

  <a href="http://google.com">

Recap: (http) URIs

- identifiers for web resources associated with the hierarchical namespace governed by a DNS authority
  - who potentially could set up a http origin server as a host at the given address, listening for TCP connections on a given port
- http URI syntax:



Recap: Cool URIs

What makes a cool URI?
A cool URI is one which does not change.
What sorts of URI change?
URIs don't change: people change them.

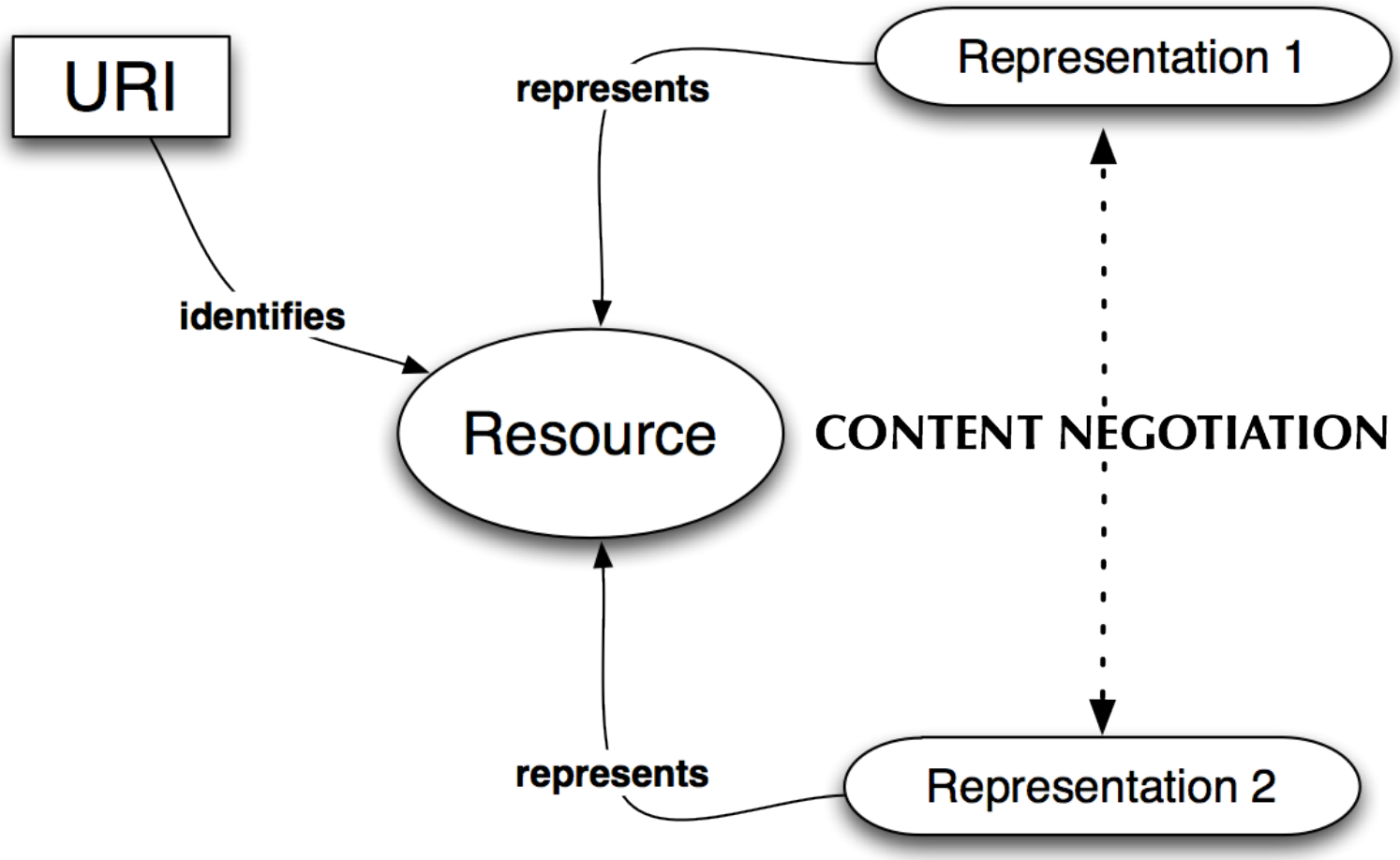
Tim Berners-Lee (http://www.w3.org/Provider/Style/URI)

- Generic vs. content-type specific URIs
  - Cool URIs don’t change with the emergence of a new internet media type for web resource representations
    - Generic:
    - Content type specific:
- Remember that a content-type specific URI represents a ‘Leap of faith’: there is no guarantee that a representation conforms to a particular Internet Media Type that is indicated by the URI string

Recap: A representation is

- The result of applying a service request upon a resource
- What the server determines to be the state of the resource
  - Parameters: time, space, request parameters
- A package
  - Metadata about the request, server actions, agent
  - Data (pay load) in a specific Internet Media Type (MIME)
- The entity processed by a web agent (browser, crawler)
  - Agents such as crawlers make extensive use of metadata (e.g. last-modified)
- The entity that is the source of links
  - <a href="http://google.com">

Refined View of The Web Architecture



Warning: overuse of content negotiation can be bad for the web's health

Time Berners-Lee - "Cool URIs"

[based on Carl Lagoze INFO/CS 4301, Fall 2011]

Recap: http

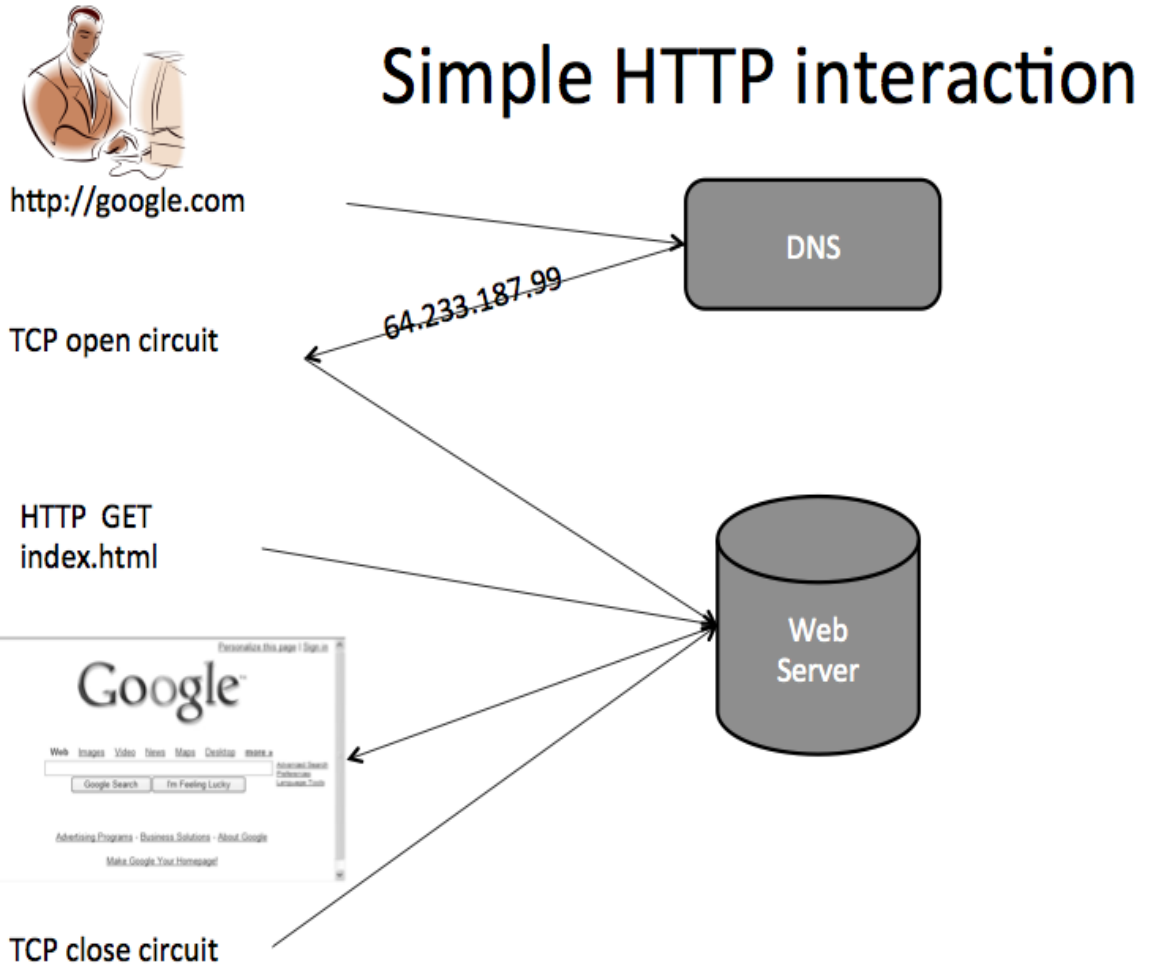
- http defines an interface for interaction with a resource identified by an URI
- Presumes a reliable underlying transport protocol guaranteeing in-order delivery of requests and responses
  - by default TCP/IP with port:80 unless client is configured otherwise (e.g. proxy server)

Recap: http Verbs

- Retrieve a representation of a resource: GET
- Create a new resource: PUT and get a new URI, POST and specify a new URI
- Modify an existing resource: PUT to an existing URI
- Delete and existing resource: DELETE
- Get metadata about an existing resource: HEAD
- See which verbs a resource understands: OPTIONS

http session:
sequence of request-response

- an HTTP client initiates a request
- it uses DNS to resolve domain name
- it establishes a TCP connection to a particular port (typically 80) on a host (e.g. google.com)
- an HTTP Server listening on that port waits for a clients request message
- upon receiving the request, the server sends back a status line (e.g., "HTTP/1.1 200 OK") and a message of its own (body, error message, some other information)



[indebted to Bernhard Haslhofer & Carl Lagoze]

http session example

```
dhcp103-45:~ theresavelden$ curl -v http://
www.infosci.cornell.edu/Courses/info4302/2012fa/

* About to connect() to www.infosci.cornell.edu port 80 (#0)
*   Trying 128.84.97.36... connected
* Connected to www.infosci.cornell.edu (128.84.97.36) port 80 (#0)
> GET /Courses/info4302/2012fa/ HTTP/1.1
> User-Agent: curl/7.19.7 (universal-apple-darwin10.0) libcurl/
7.19.7 OpenSSL/0.9.8r zlib/1.2.3
> Host: www.infosci.cornell.edu
> Accept: */*
>
< HTTP/1.1 200 OK
< Connection: close
< Date: Wed, 05 Sep 2012 22:52:09 GMT
< Content-Type: text/html
< Server: Microsoft-IIS/6.0
< X-Powered-By: PHP/4.4.0
< MicrosoftOfficeWebServer: 5.0_Pub
< X-Powered-By: ASP.NET
<
<!doctype html>
.
.
.
* Closing connection #0
```

TCP/IP

http Request

http Response header (metadata)

http Response data

TCP/IP

http request


```
> GET /Courses/info4302/2012fa/ HTTP/1.1
> User-Agent: curl/7.19.7 (universal-apple-da
> Host: www.infosci.cornell.edu
> Accept: */*
```

Start line:

- Consists of method, path, version, e.g.

`GET /Courses/info4302/2012fa/ HTTP/1.1`

Header fields:

- The HTTP/1.1 protocol version requires a Host: field

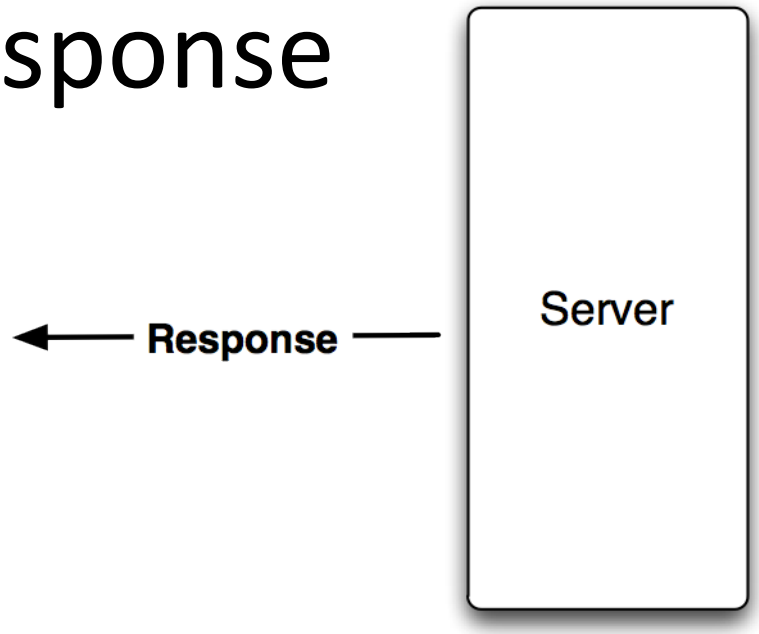
`Host: www.infosci.cornell.edu`

- Many others: list of header fields at http://en.wikipedia.org/wiki/List_of_HTTP_header_fields

Optional body content

http response

```
< HTTP/1.1 200 OK
< Connection: close
< Date: Wed, 05 Sep 2012 22:52:09 GMT
< Content-Type: text/html
< Server: Microsoft-IIS/6.0
< X-Powered-By: PHP/4.4.0
< MicrosoftOfficeWebServer: 5.0_Pub
< X-Powered-By: ASP.NET
<
<!doctype html>
```



Start line:

- Consists of HTTP version, status code and reason phrase

  `HTTP/1.1 200 OK`

Header fields, e.g.:

`Content-Type: text/html`

Many others: list of header fields at http://en.wikipedia.org/wiki/List_of_HTTP_header_fields

Content, e.g.

`<!doctype html>`

http Connection

dhcp103-45:~ theresavelden$ curl --head http://www.infosci.cornell.edu/Courses/info4302/2012fa/default.php

HTTP/1.1 200 OK

Connection: close

Date: Wed, 05 Sep 2012 19:02:53 GMT

Content-Type: text/html

Server: Microsoft-IIS/6.0

X-Powered-By: PHP/4.4.0

MicrosoftOfficeWebServer: 5.0_Pub

X-Powered-By: ASP.NET

dhcp103-45:~ theresavelden$ curl --head http://www.infosci.cornell.edu/Courses/info4302/2012fa/default.php#main

HTTP/1.1 400 Bad Request

Connection: Keep-Alive

Content-Length: 34

Date: Wed, 05 Sep 2012 19:03:03 GMT

Content-Type: text/html

Default behavior in HTTP 1.1

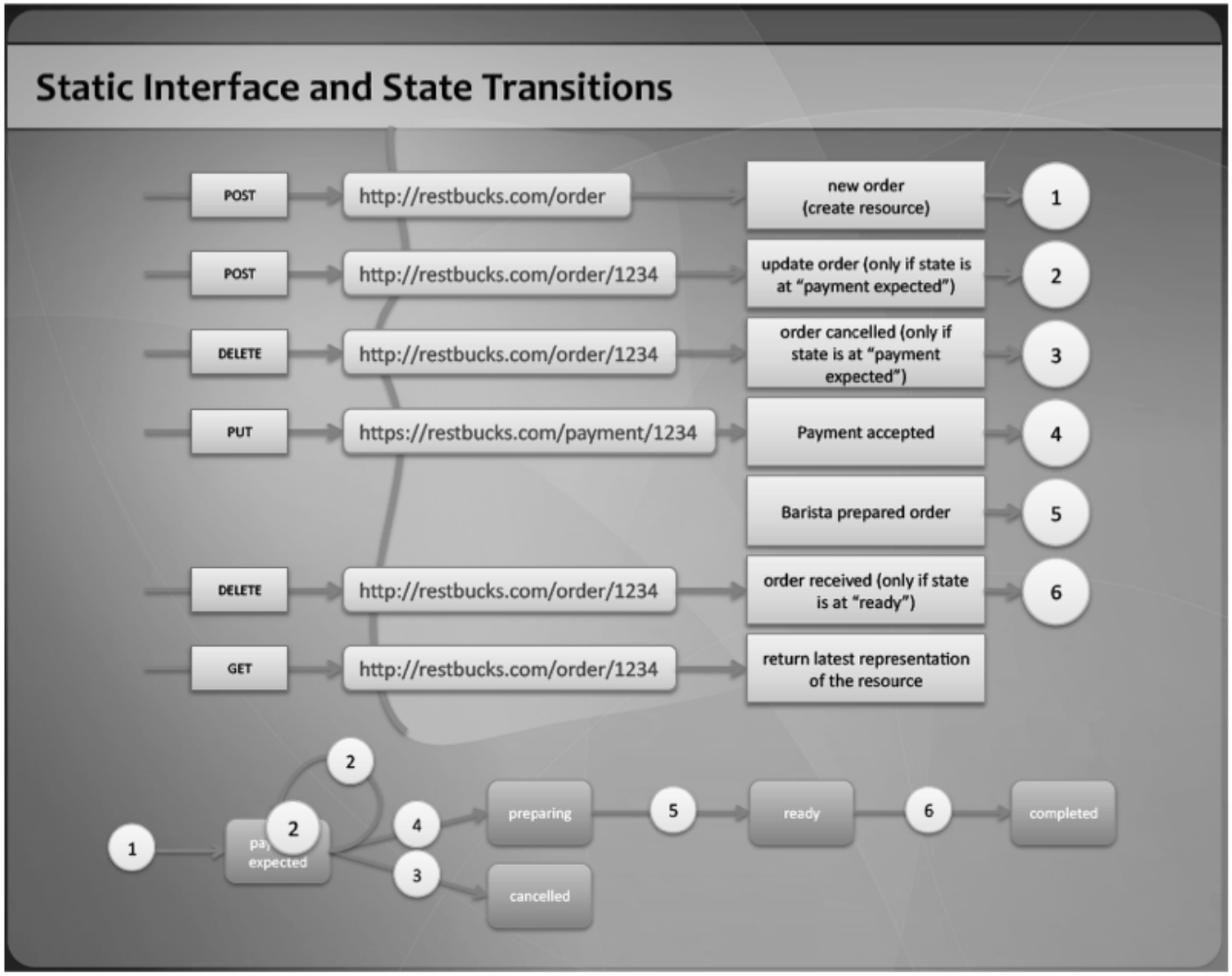
Web Architecture

ADVANCED TOPICS

Web Forms and Content Negotiation?

- **Forms** enable interactions with web resources that may result in new resources (addressable or non-addressable) or change the state of a resource (reflected in a changed representation)
- Content negotiation is about providing an alternative (equivalent) representation of a web resource in response to a GET request

Web Forms and Content Negotiation?



REST in Practice – Webber, Parastatidis, Robinson

URI Encoding

- URL encoding converts characters into a format that can be transmitted over the Internet
  - i.e. ascii ("American Standard Code for Information Interchange", 128 characters)
- http URIs can contain non-ascii characters, but need to be escaped when communicated over the internet e.g. in an http request

http://www.w3schools.com/tags/ref_urlencode.asp

Fragments

- A URI reference identifies a target resource
- A user agent resolves the URI reference to its absolute form to obtain target URI
- Target URI excludes a potential fragment identifier component
- Fragment identifier components are reserved for client side processing

Fragment Identifier

Discussions

- http://www.w3.org/DesignIssues/Fragment.html
- http://www.w3.org/QA/2011/05/hash_uris.html

Web Architecture

HANDS-ON

Useful Debugging Tools

- Browser add-ons: Developer View
- Command line tool: curl

Web Developer View: Example 1

Unsing Safari: Develop > Show Web Inspector)

Request URL:
http://www.cs.cornell.edu/~tvelden/

Analysis:

- Processing and rendering of retrieved resource representations is determined by user agent
- Web browser interprets URI references in HTML potentially triggering a sequence of resource requests
  - value of the href attribute
    - schema.org
    - <link href=``apple-touch-icon.png‘‘>
  - value of src attribute
    - <img class="foto" src=“picture.png”>

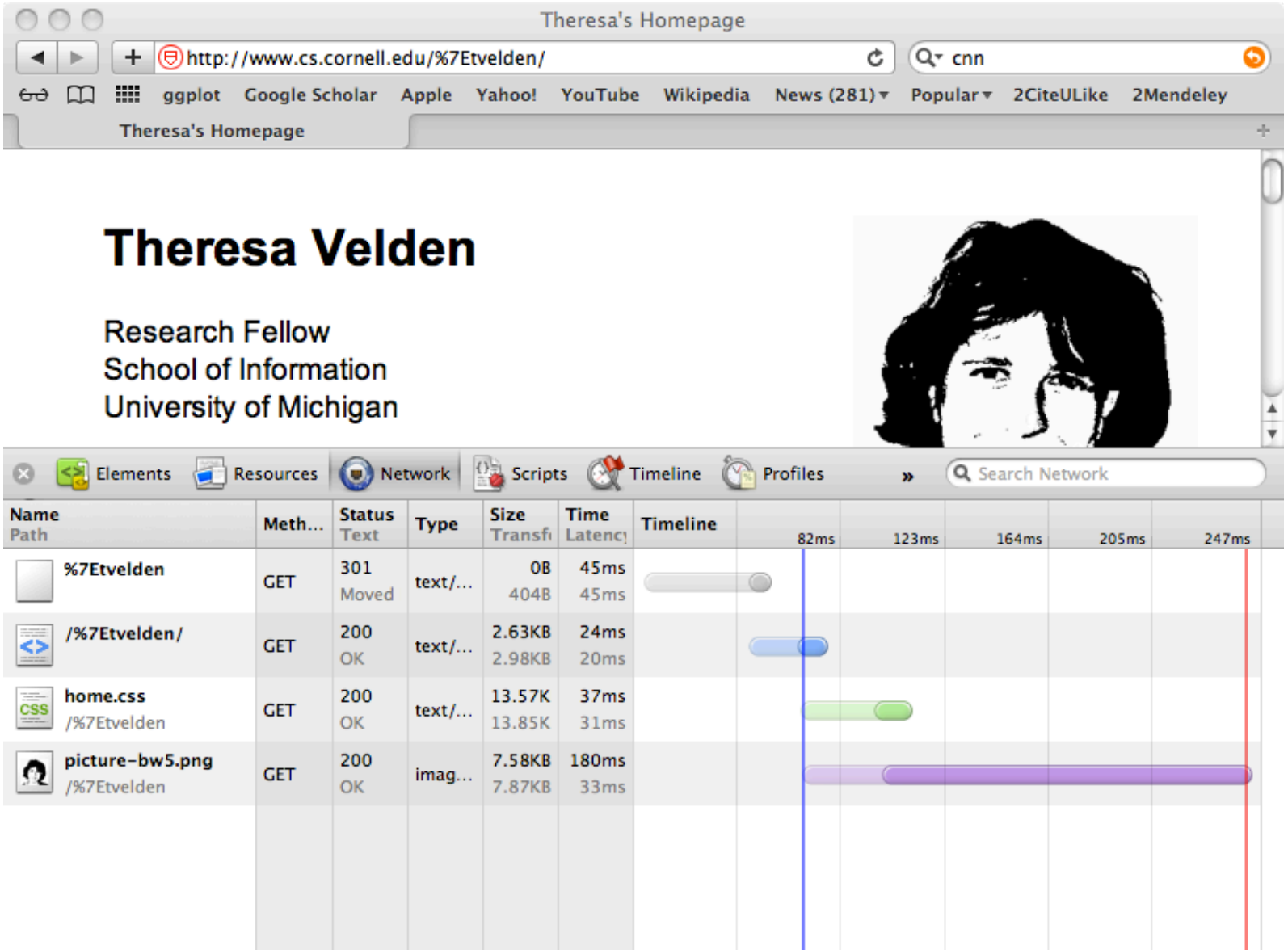
Web Developer View: Example 2

Using Safari: Develop > Show Web Inspector

- Request URL:

  http://www.cs.cornell.edu/~tvelden

Request URL http://www.cs.cornell.edu/%7Etvelden



Analysis

- URI equivalence via “301 Moved Permanently”
  - http://www.cs.cornell.edu/~tvelden equivalent to http://www.cs.cornell.edu/~tvelden/
- Documentation of http requests/response incomplete

curl

curl –v URI

- Verbose, shows entire request and response
- GET is default verb used in request

curl --head URI

- Only resource metadata: HEAD verb

curl: Example 1(a)

curl -v
http://www.infosci.cornell.edu/Courses/info4302/2012fa/

As seen before:

- TCP/IP part
- HTTP GET Request (Method, path, Protocol Version)
- HTTP Response Headers (HTTP/1.1 200 OK)
- HTTP Response Body
- TCP/IP Connection closed

Note: no secondary web resources retrieved; curl acts not like a browser does but executes only single URI dereferencing

curl: Example 1(b)

curl -v
http://www.infosci.cornell.edu/Courses/info4302/2012fa/picture-bw5.png

As seen before:

- TCP/IP part
- HTTP GET Request (Method, path, Protocol Version)
- HTTP Response Headers (HTTP/1.1 200 OK)
- HTTP Response Body
- TCP/IP Connection closed

Body is now a png file (not rendered)

Comments

- Curl option –v shows record of entire interaction
  - TCP IP, HTTP Request , HTTP Response , TCP/IP
- no secondary web resources retrieved
  - curl acts not like a browser does but executes only single http request to dereference URI

- Curl default: GET request
- Curl -- head/-I: HEAD request

Content Negotiation:
Option to express client preferences

- **Accept:** specifies certain media type responses that are acceptable to the client (e.g., application/json, application/atom+xml)
  - **Accept-Charset**: indicates in which character sets the response should be represented that are acceptable to the client
  - **Accept-Encoding**: restricts the content encodings. Can be used to indicated compression (compress;q=0.5, gzip;q=1.0)
  - **Accept-Language**: restricts the set of natural languages that are preferred as a response to the request

- the **User-Agent** header can also be used for content negotiation (e.g., serve different representation for mobile devices)

curl: Example 2

Language Negotiation

curl -v --head --header "Accept-Language: fr" http://www.google.com

curl: Example 3 (a)

Format Negotiation

- curl -I --head -H "Accept: text/html" http://vocab.deri.ie/dcat

- curl -I --head -H "Accept: application/rdf+xml" http://vocab.deri.ie/dcat

curl: Example 3 (a)

Format Negotiation

dhcp103-45:~ theresavelden$ curl -I --head -H **"Accept: text/html"** http://vocab.deri.ie/dcat

HTTP/1.1 200 OK

Date: Thu, 06 Sep 2012 12:23:02 GMT

Server: Apache/2.2.9 (Debian) PHP/5.2.6-1+lenny4 with Suhosin-Patch

X-Powered-By: PHP/5.2.6-1+lenny4

Set-Cookie: SESS972ddc872c5c8bd5c673d923b3fb5ebf=b1fc21cc1d55dcbeeb8dba8499363f5e; expires=Sat, 29 Sep 2012 15:56:22 GMT; path=/; domain=.vocab.deri.ie

Expires: Sun, 19 Nov 1978 05:00:00 GMT

Last-Modified: Thu, 06 Sep 2012 12:23:02 GMT

Cache-Control: store, no-cache, must-revalidate

Cache-Control: post-check=0, pre-check=0

Vary: Accept,Accept-Encoding

Content-Location: http://vocab.deri.ie/dcat.html

Access-Control-Allow-Origin: *

Content-Type: text/html; charset=utf-8

curl: Example 3 (a)

Format Negotiation

dhcp103-45:~ theresavelden$ curl -I --head -H **"Accept: application/rdf+xml"** http://vocab.deri.ie/dcat

HTTP/1.1 200 OK

Date: Thu, 06 Sep 2012 12:23:06 GMT

Server: Apache/2.2.9 (Debian) PHP/5.2.6-1+lenny4 with Suhosin-Patch

X-Powered-By: PHP/5.2.6-1+lenny4

Set-Cookie: SESS972ddc872c5c8bd5c673d923b3fb5ebf=abd3c6d239034c89f19fc57212ca4f54; expires=Sat, 29 Sep 2012 15:56:26 GMT; path=/; domain=.vocab.deri.ie

Expires: Sun, 19 Nov 1978 05:00:00 GMT

Last-Modified: Thu, 06 Sep 2012 12:23:06 GMT

Cache-Control: store, no-cache, must-revalidate

Cache-Control: post-check=0, pre-check=0

Vary: Accept,Accept-Encoding

Content-Location: http://vocab.deri.ie/dcat.rdf

Access-Control-Allow-Origin: *

Content-Type: application/rdf+xml; charset=utf-8

Content Negotiation: Importance of Client Preferences

- Quality values (**qvalue**) are short floating point numbers to indicate the relative importance (weight) of various negotiation parameters
  - 0 is the minimum value (= "not acceptable")
  - 1 is the maximum value

curl: Example 3 (b)

Format Negotiation w relative importance

- curl -I --head -H "Accept: application/rdf +xml;q=0.2" -H "Accept: text/html;q=0.2" http://vocab.deri.ie/dcat

- curl -I --head -H "Accept: application/rdf +xml;q=0.5" -H "Accept: text/html;q=0.2" http://vocab.deri.ie/dcat

Comments

- Format negotiation: final decision with server

Curl Example 4

Conditional GET

- curl --head -H "If-Modified-Since: Sun, 02 Sep 2012 00:00:00 GMT" http://www.cs.cornell.edu/~tvelden/

Curl Example 4

dhcp103-45:~ theresavelden$ curl --head -H "If-Modified-Since: Sun, 02 Sep 2012 00:00:00 GMT" http://www.cs.cornell.edu/~tvelden/

HTTP/1.1 304 Not Modified

Connection: Keep-Alive

Date: Thu, 06 Sep 2012 12:38:04 GMT

Content-Location: http://webpub.cs.cornell.edu/~tvelden/index.html

ETag: "03c662acd80cd1:5897"

Server: Microsoft-IIS/6.0

Last-Modified: Thu, 23 Aug 2012 01:18:13 GMT

Accept-Ranges: bytes

MicrosoftOfficeWebServer: 5.0_Pub

X-Powered-By: ASP.NET

Comments

- eTag field:
  - provides the current value of the entity tag for the requested variant

curl: Example 5

- curl -I -H "Accept: application/rdf+xml" http://www4.wiwiss.fu-berlin.de/dblp/resource/person/103481
- curl -I -H "Accept: text/html" http://www4.wiwiss.fu-berlin.de/dblp/resource/person/103481

curl: Example 5

dhcp103-45:~ theresavelden$ curl -I -H "Accept: application/rdf+xml" http://www4.wiwiss.fu-berlin.de/dblp/resource/person/103481

Response:

HTTP/1.1 303 See Other

Date: Thu, 06 Sep 2012 15:45:04 GMT

Server: Jetty(6.1.1)

Location: http://www4.wiwiss.fu-berlin.de/dblp/**data**/person/103481

Content-Type: text/plain

curl: Example 5

- curl -I -H "Accept: text/html" http://www4.wiwiss.fu-berlin.de/dblp/resource/person/103481

Response:

HTTP/1.1 303 See Other

Date: Thu, 06 Sep 2012 15:48:39 GMT

Server: Jetty(6.1.1)

Location: http://www4.wiwiss.fu-berlin.de/dblp/**page**/person/103481

Content-Type: text/plain

Homework 1

WEB SCIENCE / LINKED DATA

Ethical Principles of Web Science

- Decentralization
- Openness
- Fairness

Linked Data

- Challenge & Solution

Resources

- Tutorials http://www.w3schools.com/
- http header field definitions (RFC 2616 Fielding, et al.)
  http://www.w3.org/Protocols/rfc2616/rfc2616-sec14.html
- cURL http://curl.haxx.se/

Next Week:

- Third component of Web Architecture:
  - Standardized Document Formats (HTML, XML)