Learning Client Hypermedia from the Ground Up

Mike Amundsen
@mamund
@RWCBook

Morning - From Zero to Links

- What is Hypermedia and Why Use It?
- The Plain JSON Client
- BREAK
- Plain JSON and Change
- The JSON Link Client
- BREAK
- The Link Client and Change
- Daily Wrap-Up and Look Ahead

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Afternoon - From Templates to Profiles

- The JSON Template Client
- The JSON Template Client and Change
- BREAK
- The JSON Profile Client
- The JSON Profile Client and Change
- BREAK
- Course Summary

Resources

- The online repo will host all the materials
  - https://github.com/apiacademy/2017-yow-hyperclient
  - Slides
  - Code
  - Discussions
- This repo will stay "alive" after the course is over
  - Feel free to use the Issues section to discuss details
  - Submit PRs to improve the content

General Remarks

- We'll have a short Q&A review after each section
- Feel free to post questions throughout the day.
- We'll have breaks every hour
- If needed, you can step away from the terminal any time

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Let's get started!

Morning:
From Zero to Links

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Lecture:
Hypermedia Basics

Ted Nelson's hyperlinks (1965)

The words hypertext, hyperlink, and hypermedia were coined by Ted Nelson around 1965.
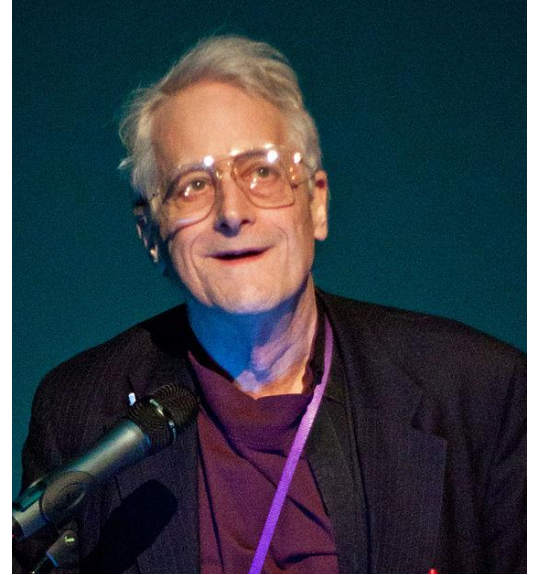
Vannevar Bush's Reader (1945)
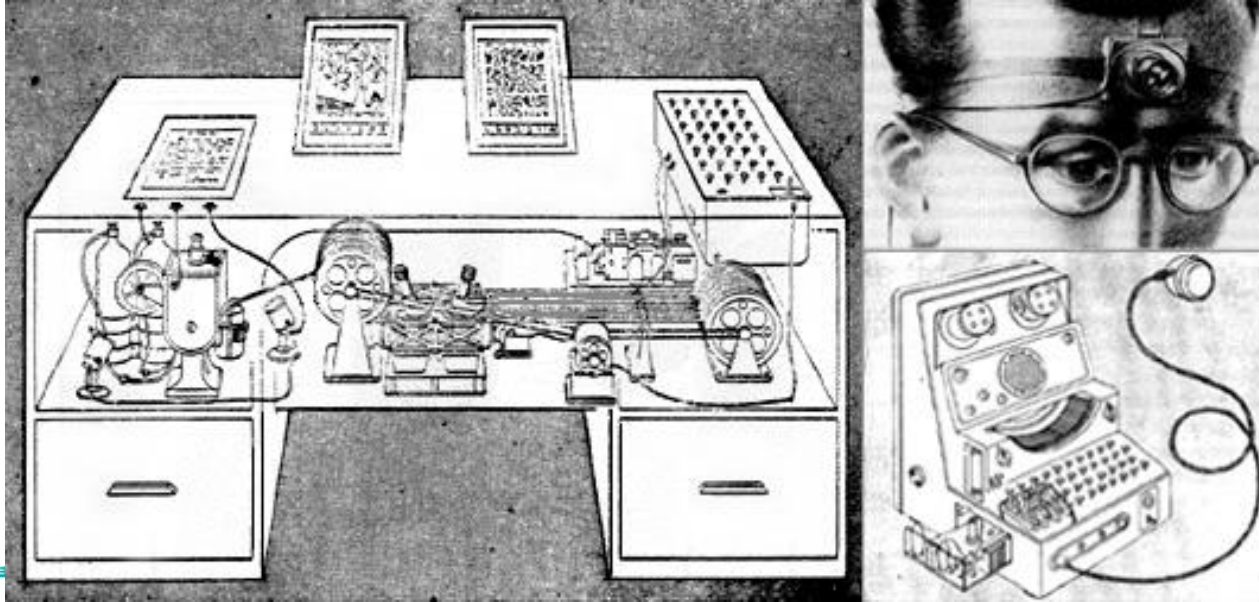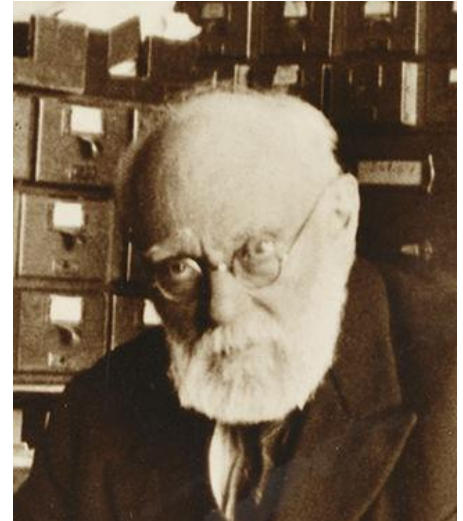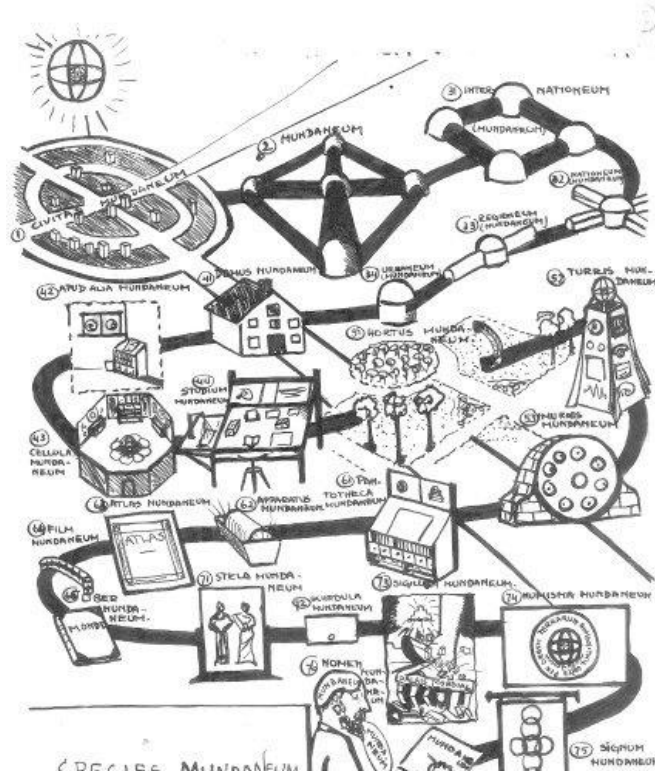
Paul Otlet's World Wide Network (1934)

What is Hypermedia?

Hypertext is text which is not constrained to be linear.

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Basic Hypertext

Home

document

anchor
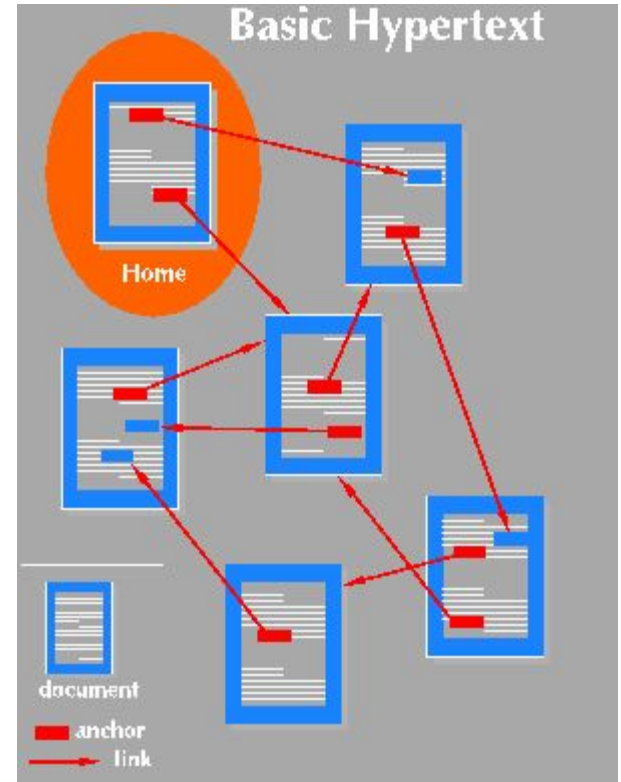
link

What is Hypermedia?

Hypertext is text which is not constrained to be linear.

Hypertext is text which contains <u>links</u> to other texts.
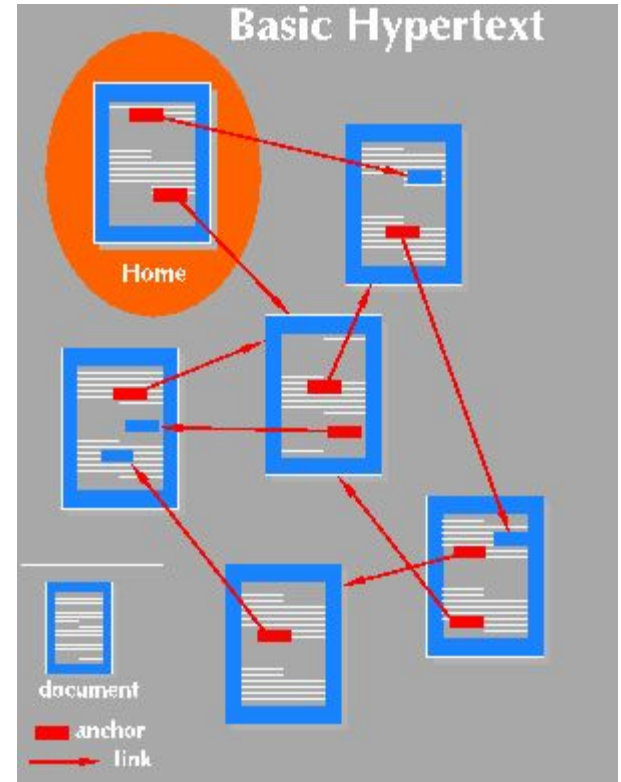
Basic Hypertext

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Tim Berners-Lee WWW (1989)
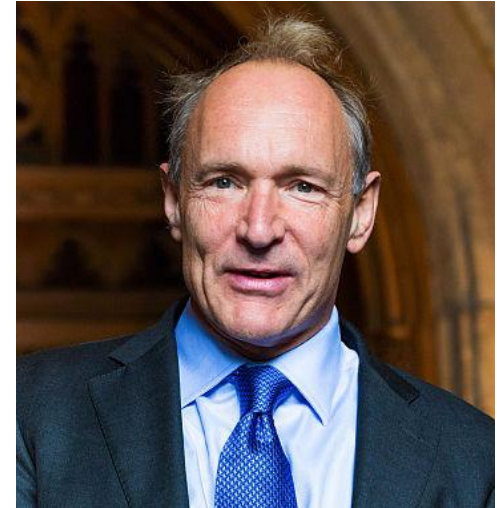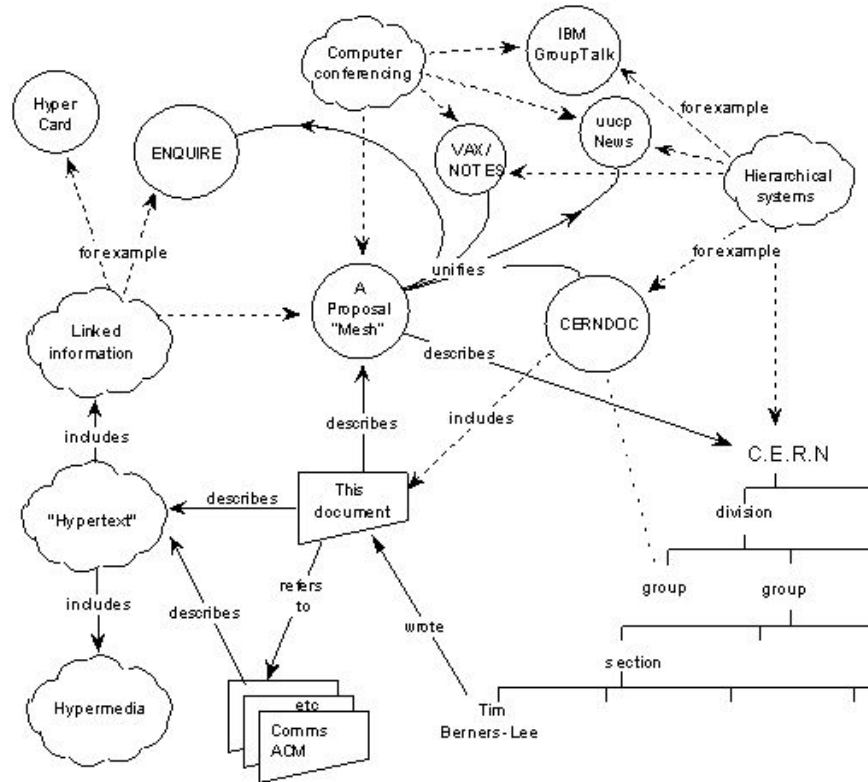
This [Wikipedia](#) and [Wikimedia Commons](#) image is from the user [Chris 73](#) and is freely available at //commons.wikimedia.org/wiki/File:WorldWideWebAroundWikipedia.png under the [creative commons cc-by-sa 3.0](#) license.

Sidebar:
H-Factors
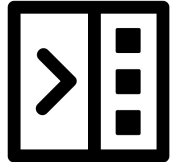
H-Factors

"The H Factor of a media-type is a measurement of the level of hypermedia support and sophistication of a media-type."

H-Factors

"The H Factor of a media-type is a measurement of the level of hypermedia support and sophistication of a media-type."

"H Factor values can be used to compare and contrast media types in order to aid in selecting the proper media-type(s) for your implementation."

- Mike Amundsen (2010)

H-Factors

1. Link Support
   - **[LE]** Embedding links
   - **[LO]** Outbound links
   - **[LT]** Templated queries
   - **[LN]** Non-Idempotent updates
   - **[LI]** Idempotent updates

O'REILLY

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```
<!-- Link Embed (LE) -->

<img src="http://www.example.org/images/logo" title="company logo" />
```

H-Factors

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<!-- Link Template (LT) -->
<form method="get" action="http://www.example.org/results">
  <label>Search term:</label>
  <input name="query" type="text" value="" />
  <input type="submit" />
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```

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<!-- Link Non-Idempotent (LN) -->
<form method="post" action="http://www.example.org/my-keywords"/>
  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>
```

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  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>


<!-- Link Idempontent (LI) -->
<form onsubmit="deleteRecord();">
  <label>Record ID:</label>
  <input name="id" type="text" value="" />
  <input type="submit" text="Delete" />
</form>
```

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2. Control Data Support
   - **[CR]** Control data for read requests
   - **[CU]** Control data for update requests
   - **[CM]** Control data for interface methods
   - **[CL]** Control data for links

```
<!-- Control Read (CR) -->
<xsl:include href="http://www.exmaple.org/newsfeed" accept="application/rss" />
```

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```xml
<!-- Control Read (CR) -->
<xsl:include href="http://www.exmaple.org/newsfeed" accept="application/rss" />

<!-- Control Update (CU) -->
<form method="post" action="http://www.example.org/my-keywords"
      enctype="application/x-www-form-urlencoded" />
  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>
```

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  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>


<!-- Control Method (CM) -->
<form method="post" action="http://www.example.org/my-keywords" />
  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>
```

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  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>


<!-- Control Method (CM) -->
<form method="post" action="http://www.example.org/my-keywords" />
  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>


<!-- Control Link (CL) -->
<entry xmlns="http://www.w3.org/2005/Atom">
  <title>Atom-Powered Robots Run Amok</title>
  <id>urn:uuid:1225c695-cfb8-4ebb-aaaa-80da344efa6a</id>
  <updated>2003-12-13T18:30:02Z</updated>
  <author><name>John Doe</name></author>
  <content>Some text.</content>
  <link rel="edit" href="http://example.org/edit/first-post.atom"/>
</entry>
```
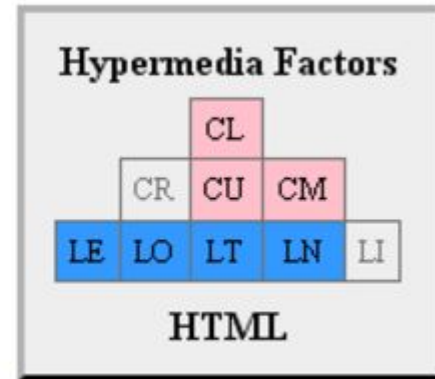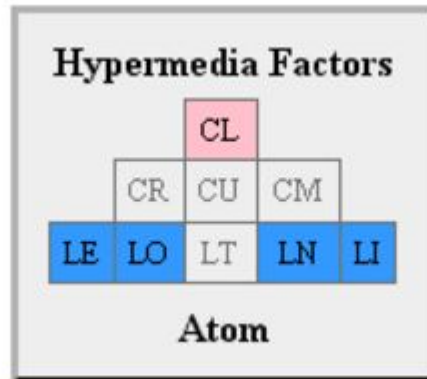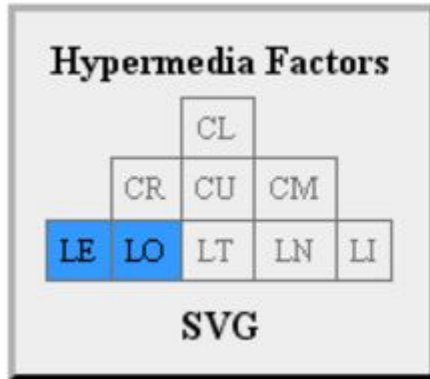
H-Factors

Quiz:
Where's the H-Factor?

```xml
<?xml version="1.0" encoding="utf-8"?>
<feed xmlns="http://www.w3.org/2005/Atom">

  <title>Example Feed</title>
  <link href="http://example.org/"/>
  <updated>2003-12-13T18:30:02Z</updated>
  <author>
    <name>John Doe</name>
  </author>
  <id>urn:uuid:60a76c80-d399-11d9-b93C-0003939e0af6</id>

  <entry>
    <title>Atom-Powered Robots Run Amok</title>
    <link href="http://example.org/2003/12/13/atom03"/>
    <id>urn:uuid:1225c695-cfb8-4ebb-aaaa-80da344efa6a</id>
    <updated>2003-12-13T18:30:02Z</updated>
    <summary>Some text.</summary>
  </entry>

</feed>
```

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    <id>urn:uuid:1225c695-cfb8-4ebb-aaaa-80da344efa6a</id>
    <updated>2003-12-13T18:30:02Z</updated>
    <summary>Some text.</summary>
  </entry>

</feed>
```

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<?xml version="1.0"?>
<html xmlns="http://www.w3.org/1999/xhtml" xmlns:xi="http://www.w3.org/2001/XInclude">
  <head>
    <link rel="alternate" type="application/rss+xml" href="/rss/" />
    <meta name='url' content='http://www.websiteaddrress.com' />
  </head>
  <body>

    <img src="planets.gif" width="145" height="126" alt="Planets" usemap="#planetmap">
    <map name="planetmap">
      <area shape="rect" coords="0,0,82,126" href="sun.htm" alt="Sun">
      <area shape="circle" coords="90,58,3" href="mercur.htm" alt="Mercury">
      <area shape="circle" coords="124,58,8" href="venus.htm" alt="Venus">
    </map>

    <code>
      <xi:include href="source.txt" parse="text" accept="text/plain"/>
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  <script src="/scripts/startup.js" type="text/javascript"/>

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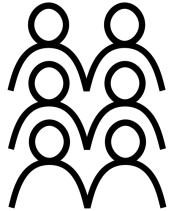
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Group Discussion:
Hypermedia Advantages and Drawbacks

Live Screen Session...

The Plain JSON Client

Mike Amundsen
@mamund
@RWCBook

Lecture:
The Classic CRUD Pattern

Create-Read-Update-Delete (CRUD)

"In computer programming, create, read, update, and delete (as an acronym CRUD) are the four basic functions of persistent storage."

THE
DATA-BASE
ENVIRONMENT

JAMES MARTIN

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Web Clients

Create-Read-Update-Delete (CRUD)

"In computer programming, create, read, update, and delete (as an acronym CRUD) are the four basic functions of persistent storage."

*"The term was likely first popularized by James Martin in his 1983 book **Managing the Data-base Environment**."*

-- Wikipedia
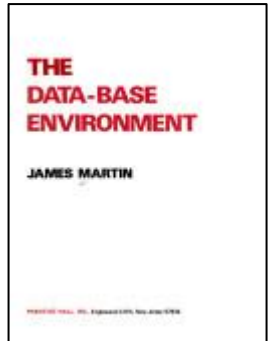
By Neokoenig - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=26886185

RESTful Web Services

"To build a fully general web service client you need an HTTP library with these features it must support at least the five main HTTP methods: GET, HEAD, POST, PUT, and DELETE."

-- Leonard Richardson in "RESTful Web Services" (2007)
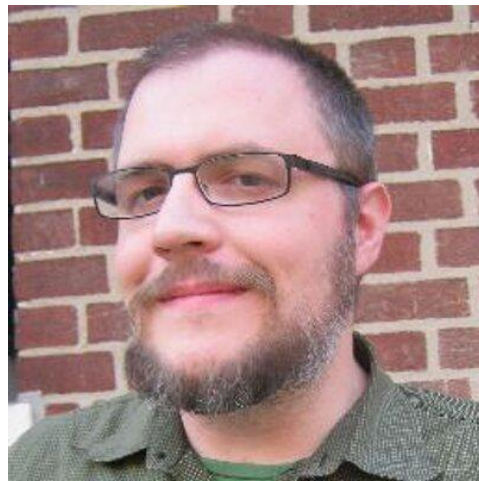
CRUD in one slide

Resource	Method	Representation	Status Codes
Employee	GET	Employee Format	200, 301, 410
Employee	PUT	Employee Format	200, 301, 400, 410
Employee	DELETE	N/A	200, 204
All Employees	GET	Employee List Format	200, 301
All Employees	POST	Employee Format	201, 400

Gregorio's Four Questions

1. What are the URIs?
2. What are the formats?
3. What methods are supported at each URI?
4. What status codes could be returned?

Common CRUD Guidance

- URI design is the primary task
  `http://{server}/{collection}/{id}`

- Focus on serializing domain objects
  `{customer: {name:"mike",...}}`

- Use URIs to express object relationships
  `http://example.com/users/abc/friends/xyz`

- Use controller URIs to handle service tasks
  `http://example.com/reports/1`

Exercise:
Install and Run Client
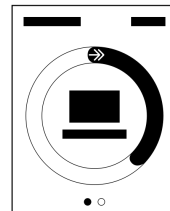
Live Screen Session...

Group Discussion:
Where Does CRUD Fall Short?
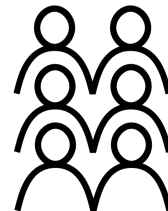
Live Screen Session...

BREAK
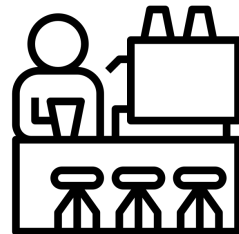
Plain JSON Client and Change

Mike Amundsen
@mamund
@RWCBook

RESTful
Web Clients

Lecture:
Adding the Email Field
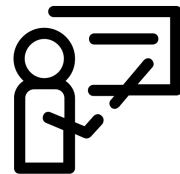
What happens when you add a new field?

- Initial release when fine but…
- "We need to add a new field!"
- What changes on the service?
- How will the client react to the changes?

Adding the Email Field

Feature Request:

Add a new field (Email) that appears for every ToDo record.
- Email is an optional field.
- Support client-side validation of a valid email value.
- Support adding the email value when creating new records.
- Support editing the email value for existing records.
- Support filtering the list by email (or portion of the email) value

Adding the Email Field

Views Affected:
- List
- Item
- Add
- Edit

Also, add a new filter form (FilterByEmail)

Service Changes...

- Modify storage model
- Update object model
- Change representation model
- Update add/edit validations (to support new field)
- Add support for FilterByEmail request/responses

Also, do all this without breaking any existing client apps.

RESTful
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Client Changes...

- Update client object model (to include email field)
- Update client list display
- Update Add Form
- Update Edit Form
- Add FilterByEmail Form

Release the new version of the client.

Exercise:
Add Email Support
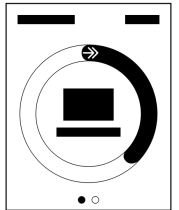
Live Screen Session...

Sidebar:
The OAA Challenge
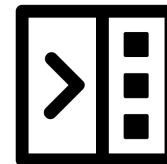
The OAA Challenge

- All client apps need to deal with three key elements
  - Objects (Oxx)
  - Addresses (xAx)
  - Actions (xxA)
- Typically this is handled in client **code.**
- When any details of the OAA change, the client code MUST change, too.

The OAA Challenge

- Adding a field (email support) is a change to the Object ("O" in "OAA")
- Changing the URLs is a change to the Addresses
- Adding a new filter operations is a change to the Actions

How can we support OAA changes without changing client code?

The JSON Link Client

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Lecture:
Describing Links/Addresses

Tackling Step One in OAA Challenge: Addresses

- Addresses are the LINKS (LO/LE)
- Remove the LINKS from the code
- Place the LINKS in the responses
- Now changes to the LINKS doesn't break the client

Is this a LINK?

http://api.example.org/todo/

Is this a LINK?

http://api.example.org/todo/

Describing Links

- Links are more the URLs
- Links are the meta-information about the URLs
  - rel
  - name/id
  - prompt/title
  - response/format type
  - possible variables

Describing Links

```json
{
  "link" : {
    "rel" : "self",
    "id" : "todo-list",
    "prompt" : "Load List",
    "type" : "application/json",
    "href" : "http://api.example.org/todo/"
  }
}
```

Exercise:
Consuming Links
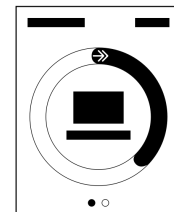
Live Screen Session...

Group Discussion:
Why Not Stop Here?
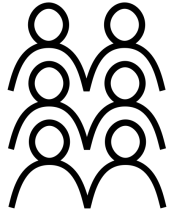
Live Screen Session...

BREAK
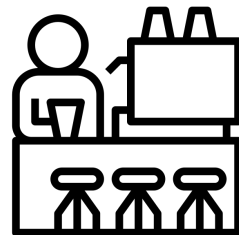
Link JSON Client and Change

Mike Amundsen
@mamund
@RWCBook

Lecture:
Adding the MarkComplete Action
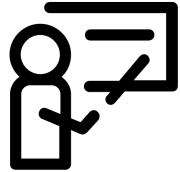
What happens when you add a new ACTION?

- Second release went fine but…
- "We need to add a new action!"
- What changes on the service?
- How will the client react to the changes?

Adding the MarkComplete Action

Feature Request:

Add a new action (MarkComplete) that is valid for every ToDo record.

- Changes the `completed` value from "false" to "true"
- This is an Update action (CRUD)

Views Affected:

- Item

Service Changes...

- Add support for MarkCompleted (update) request/responses

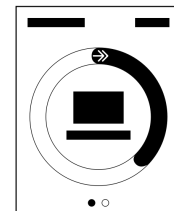*Also, do all this without breaking any existing client apps.*

Client Changes...

- Add MarkCompleted Form/Button

Release the new version of the client.

Exercise:

Including MarkComplete Support

Live Screen Session...

Sidebar:
The HAL Media Type

The HAL Media Type

**Hypertext Application Language (HAL)**
Mike Kelly, 2010

"*The roadmap for the product [I was working on] included significant backend changes which were going to affect URL structures in the API. I wanted to design the API so that we could roll out those changes with as little friction as possible, and hypermedia seemed like the ideal style for that.*"
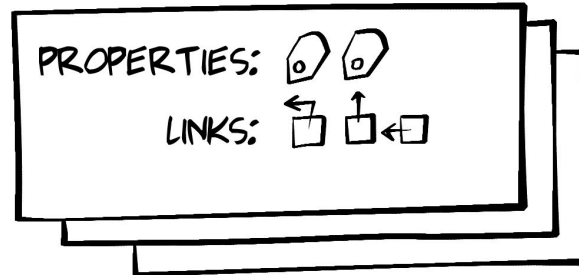
http://stateless.co/hal_specification.html

The HAL Media Type
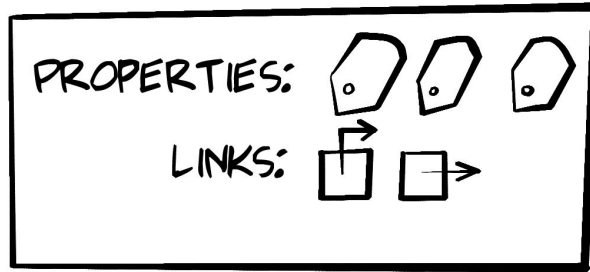
The HAL Media Type

```
{
  "_links": {
    "self": {"href": "/orders"},
    "next": {"href": "/orders?page=2"},
    "find": {"href": "/orders{?id}", "templated": true},
    "admin": [
      {"href": "/admins/2", "title": "Fred"},
      {"href": "/admins/5", "title": "Kate"}
    ]
  },
  "currentlyProcessing": 14,
  "shippedToday": 20,
  "_embedded": {
    order": [
      {
        "_links": {
          "self": {"href": "/orders/123"},
          "basket": {"href": "/baskets/98712"},
          "customer": {"href": "/customers/7809"}
        },
        "total": 30.00,
        "currency": "USD",
        "status": "shipped"
      },
      {
        "_links": {
          "self": {"href": "/orders/124"},
          "basket": {"href": "/baskets/97213"},
          "customer": {"href": "/customers/12369"}
        },
        "total": 20.00,
        "currency": "USD",
        "status": "processing"
      }
    ]
  }
}
```

O'REILLY

RESTful
Web Clients

ENABLING REUSE THROUGH HYPERMEDIA

The HAL Media Type

- HAL has excellent support for LINKS
- We can use HAL to solve the "Addresses" part of the OAA Challenge
- HAL doesn't support describing ACTIONS within the response
- HAL doesn't support describing OBJECTS within the response

Morning Review

Morning Review : From Zero to Links

- Hypermedia Basics
- Classic CRUD Pattern
- The OAA Challenge
- The HAL Media Type

Afternoon Preview : From Templates to Profiles

- Describing Actions
- The Siren Media Type
- Display Profiles
- The Collection+JSON Media Type

Morning:
From Zero to Links

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