

Learning Client Hypermedia from the Ground Up

Mike Amundsen
@mamund
@RWCBook



Day One - 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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Day Two - 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

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Resources

- The Slack Channel is open (and will stay open)
 - <https://oreillyonlinetraining.slack.com/messages/G66CQBHCL/>
 - Feel free to post Qs throughout the course
 - Continue the convos w/ fellow students after the course is completed
- The online repo will host all the materials
 - <https://github.com/apiacademy/2017-07-safari-hypermedia-workshop>
 - Slides
 - Code
 - Notes
- 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!

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Day One: From Zero to Links

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What is Hypermedia and why use it?

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Lecture:

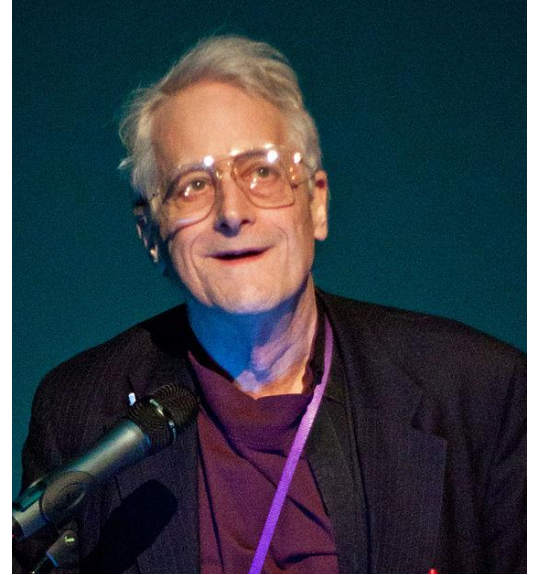
Hypermedia Basics



Created by Iconfactory Team
from Noun Project

Ted Nelson's hyperlinks (1965)

The words hypertext, hyperlink, and hypermedia were coined by Ted Nelson around 1965.

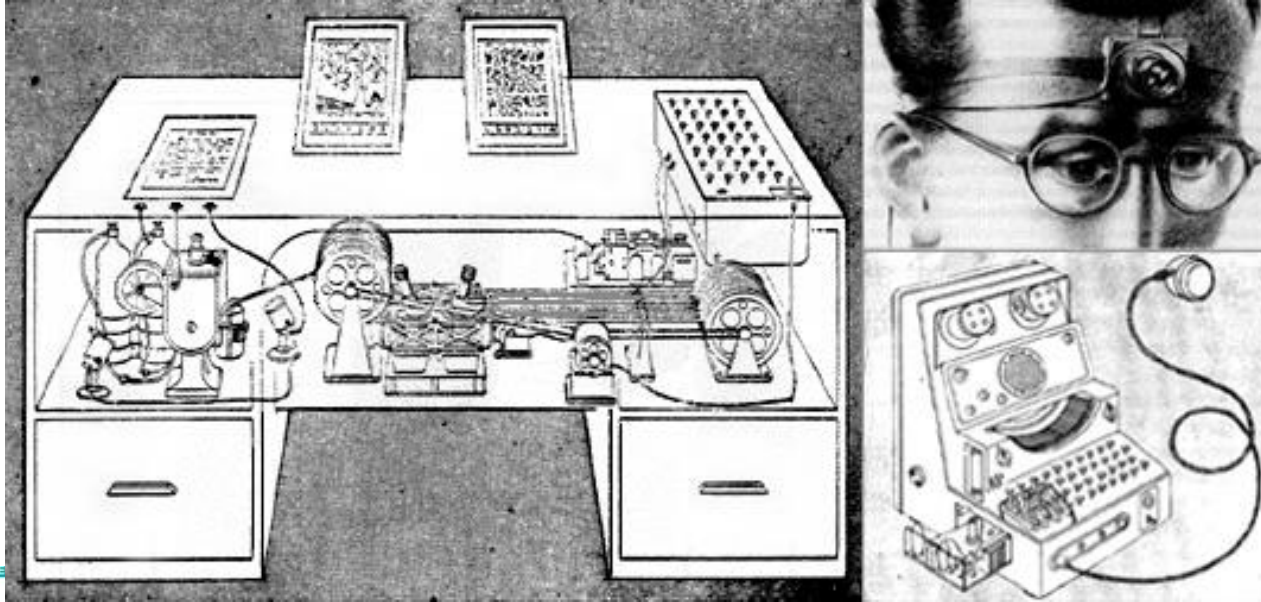


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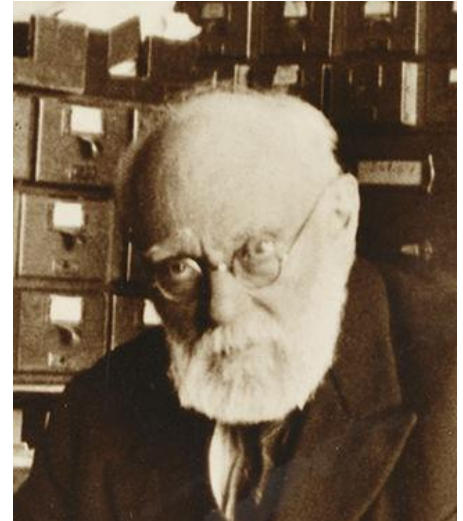
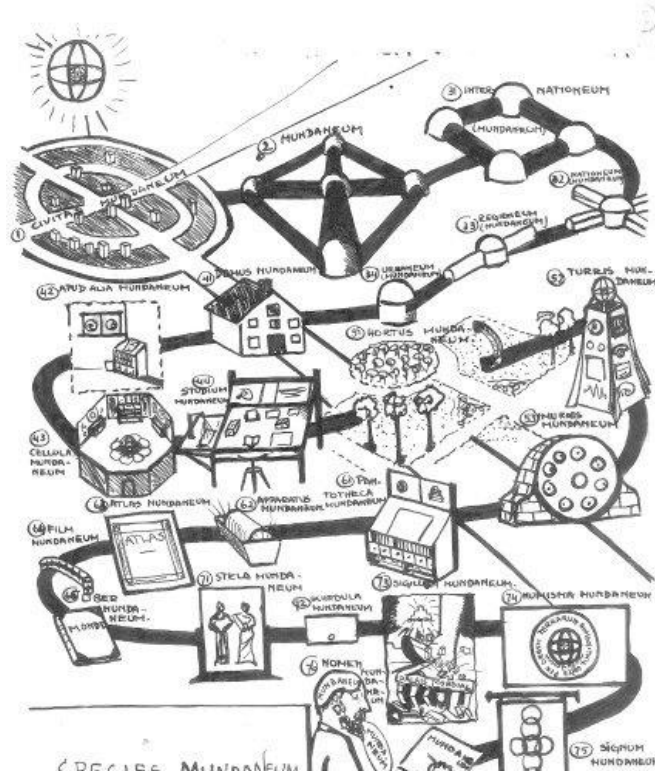
By Dgies - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=13691666>

Vannevar Bush's Reader (1945)



Public Domain, <https://commons.wikimedia.org/w/index.php?curid=1633052>

Paul Otlet's World Wide Network (1934)



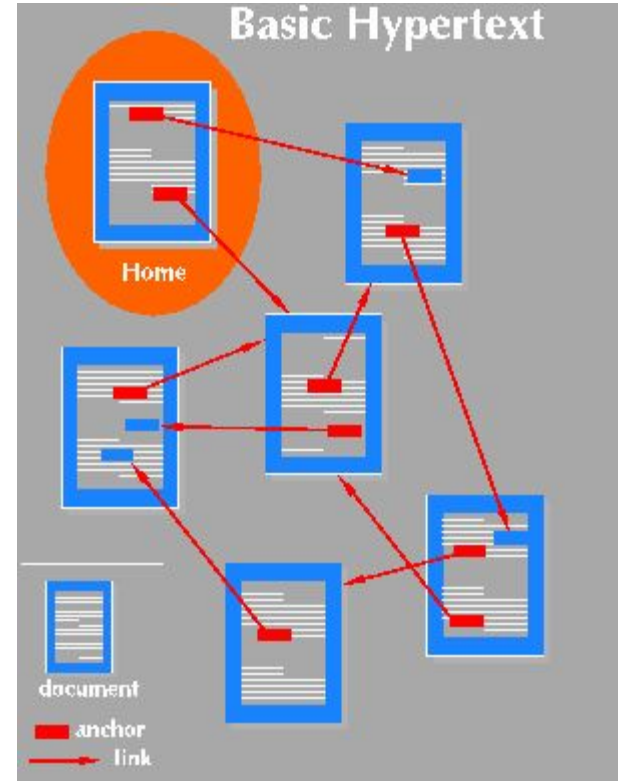
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By Paul Otlet - Mundaneum, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=38324530>

What is Hypermedia?

Hypertext is text which is not constrained to be linear.

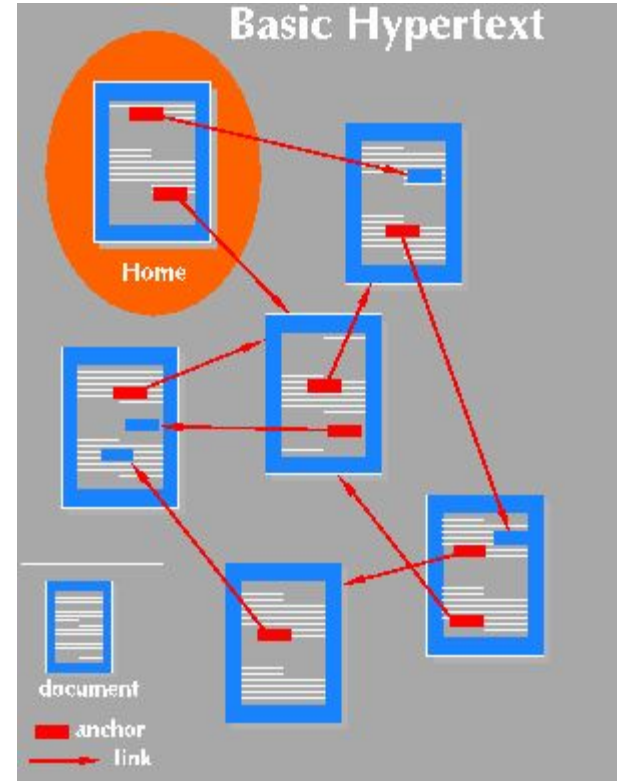


What is Hypermedia?

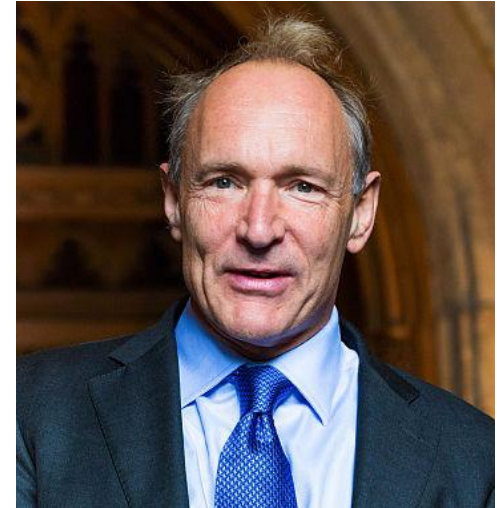
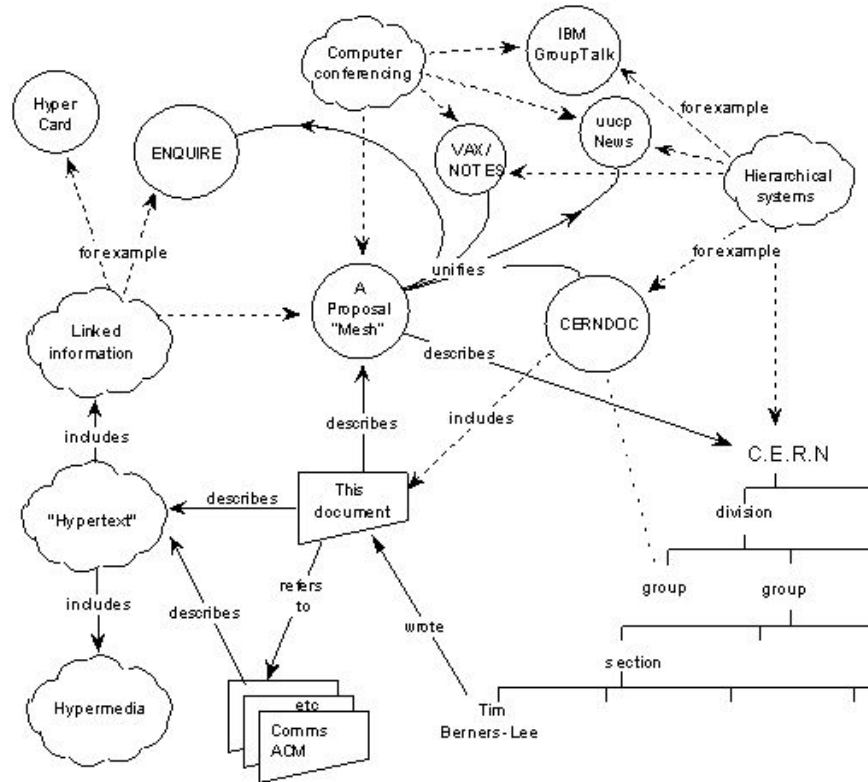
Hypertext is text which is not constrained to be linear.

Hypertext is text which contains links to other texts.

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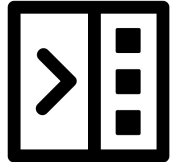
Tim Berners-Lee WWW (1989)



By Paul Clarke - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=37435469>

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

Sidebar: H-Factors



Created by Blake Stevenson
from Noun Project

H-Factors

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



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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)



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H-Factors

1. Link Support

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

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

```

```

H-Factors

1. Link Support

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- **[LI]** Idempotent updates

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```
<!-- Link Embed (LE) -->  
  
  
<!-- Link Outbound (LO) -->  
<a href="http://www.example.org/search" title="view search page">Search</a>
```

H-Factors

1. Link Support

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


<!-- Link Outbound (LO) -->
<a href="http://www.example.org/search" title="view search page">Search</a>

<!-- 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" />
</form>
```

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  <label>Search term:</label>
  <input name="query" type="text" value="" />
  <input type="submit" />
</form>

<!-- 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>Search term:</label>
  <input name="query" type="text" value="" />
  <input type="submit" />
</form>

<!-- 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>

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

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- **[LI]** Idempotent updates

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

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

H-Factors

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- **[LO]** Outbound links
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- **[LI]** Idempotent updates

```
<!-- 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>
```

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

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<!-- 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>

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

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

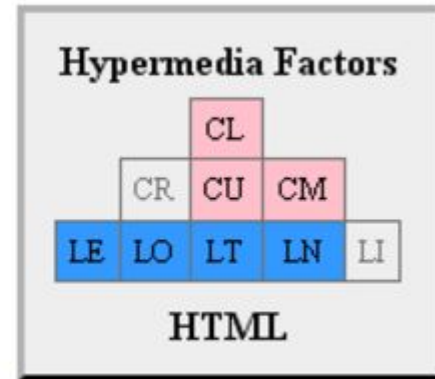
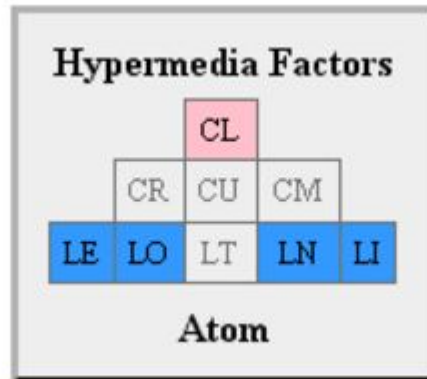
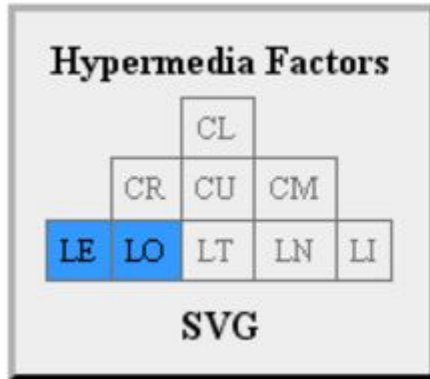
<!-- Control Method (CM) -->
<form method="post" action="http://www.example.org/my-keywords" />
  <label>Keywords:</label>
  <input name="keywords" type="text" value="" />
  <input type="submit" />
</form>

<!-- 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>
```

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H-Factors



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Quiz:

Where's the H-Factor?




```
<?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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```
<?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>
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```

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

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  <link href="http://example.org/">
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  <author>
    <name>John Doe</name>
  </author>
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    <summary>Some text.</summary>
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</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.websiteaddress.com' />
  </head>
  <body>

    
    <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"/>
    </code>

  </body>

  <script src="/scripts/startup.js" type="text/javascript"/>

</html>
```

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    </map>

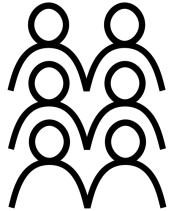
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    </code>

  </body>

  <script src="/scripts/startup.js" type="text/javascript"/>

</html>
```

Group Discussion: Hypermedia Advantages and Drawbacks



Created by Magicion
from Noun Project

Live Screen Session...



Created by Focus
from Noun Project

The Plain JSON Client

Mike Amundsen
@mamund
@RWCBook



Lecture:

The Classic CRUD Pattern



Created by Iconfactory Team
from Noun Project

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."



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

**THE
DATA-BASE
ENVIRONMENT**

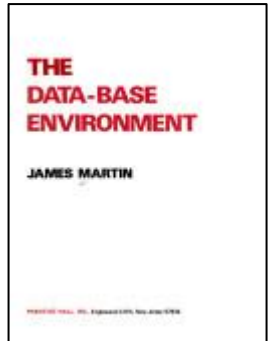
JAMES MARTIN

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

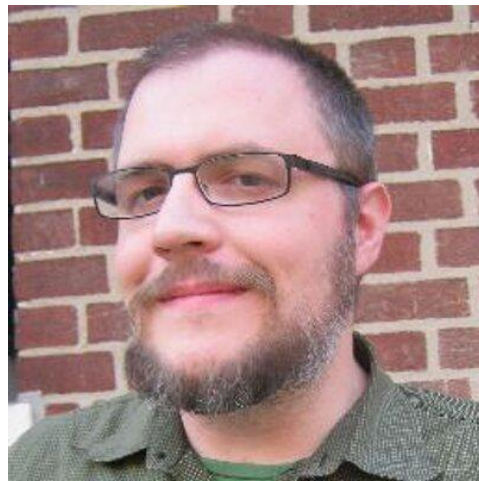


By Neokoenig - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=26886185>

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

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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?



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2006 blog post by Joe Gregorio (from XML.com). http://bitworking.org/news/How_to_create_a_REST_Protocol

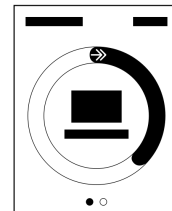
Common CRUD Guidance

- 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`

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Exercise: Install and Run Client



Created by Joel Wisneski
from Noun Project

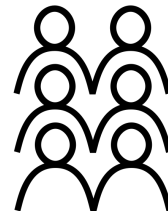
Live Screen Session...



Created by Focus
from Noun Project

Group Discussion:

Where Does CRUD Fall Short?



Created by Magicon
from Noun Project

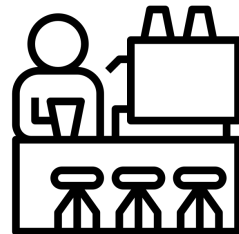
Live Screen Session...



Created by Focus
from Noun Project

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Created by Becris
from Noun Project

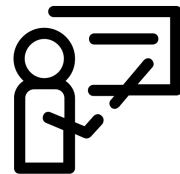
Plain JSON Client and Change

Mike Amundsen
@mamund
@RWCBook



Lecture:

Adding the Email Field



Created by Iconfactory Team
from Noun Project

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?

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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

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Adding the Email Field

Views Affected:

- List
- Item
- Add
- Edit

Also, add a new filter form (FilterByEmail)

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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.

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Client Changes...

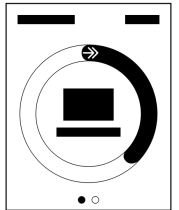
- Update client object model (to include email field)
- Update client list display
- Update Add Form
- Update Edit Form
- Add FilterByEmail Form

Release the new version of the client.

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Exercise: Add Email Support



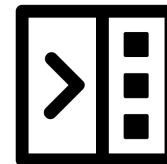
Created by Joel Wisneski
from Noun Project

Live Screen Session...



Created by Focus
from Noun Project

Sidebar: The OAA Challenge



Created by Blake Stevenson
from Noun Project

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.

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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

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*How can we support OAA changes
without changing client code?*

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The JSON Link Client

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Lecture:

Describing Links/Addresses



Created by Iconfactory Team
from Noun Project

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

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Is this a LINK?

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

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Is this a LINK?

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

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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

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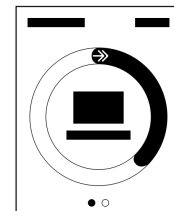
Describing Links

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

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Exercise: Consuming Links



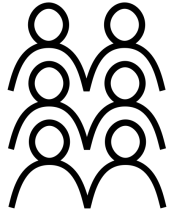
Created by Joel Wisneski
from Noun Project

Live Screen Session...



Created by Focus
from Noun Project

Group Discussion: **Why Not Stop Here?**



Created by Magicon
from Noun Project

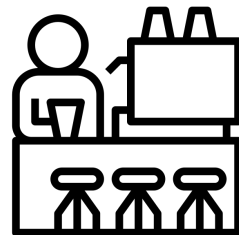
Live Screen Session...



Created by Focus
from Noun Project

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Created by Becris
from Noun Project

Link JSON Client and Change

Mike Amundsen
@mamund
@RWCBook



Lecture:

Adding the MarkComplete Action



Created by Iconfactory Team
from Noun Project

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?

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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

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Service Changes...

- Add support for MarkCompleted (update) request/responses

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

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Client Changes...

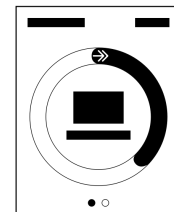
- Add MarkCompleted Form/Button

Release the new version of the client.

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Exercise: Including MarkComplete Support



Created by Joel Wisneski
from Noun Project

Live Screen Session...



Created by Focus
from Noun Project

Sidebar: The HAL Media Type



Created by Blake Stevenson
from Noun Project

The HAL Media Type

Hypertext Application Language (HAL)

Mike Kelly, 2010

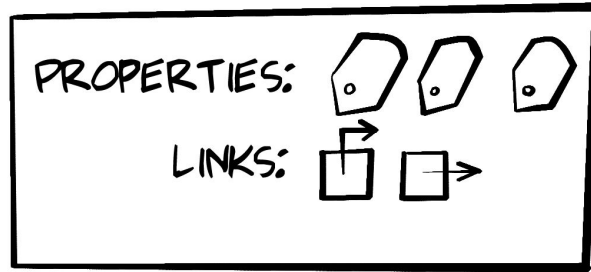
"The roadmap for the product [I was working on] included significant backend changes which were going to affect URL structures in the API. I wanted to design the API so that we could roll out those changes with as little friction as possible, and hypermedia seemed like the ideal style for that."

http://stateless.co/hal_specification.html

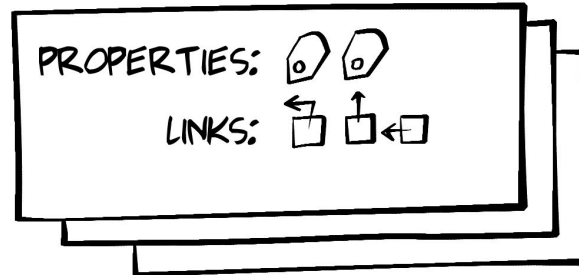


The HAL Media Type

RESOURCE



EMBEDDED RESOURCES



The HAL Media Type

ORILEY



```
{
  "_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"
      }
    ]
  }
}
```

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

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Day One Review

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Day One Review : From Zero to Links

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



Day Two Preview : From Templates to Profiles

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

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Day One: From Zero to Links

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