

Linked (Open) Data

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Concepts

Open Data

- Openly available (on the web), under an open license
 - *“Open data and content can be freely used, modified, and shared by anyone for any purpose”* – <http://opendefinition.org>
- But not necessarily “free” of charge

Linked Data

- Practical and simple Web of Data
- Based on W3C’s Semantic Web standards
 - *”Rebranding Semantic Web”, focus on simple practical semantics*
- Includes also closed data

Outline

Web of Data

- Basics
- Data production
- Data harvesting and aggregation
- Content publishing and using

Linked Data publishing platform example: Linked Data Finland
LDF.fi

Web of Data: basics

What is Web of Data?

Current web is a network that links pages: Web of Pages

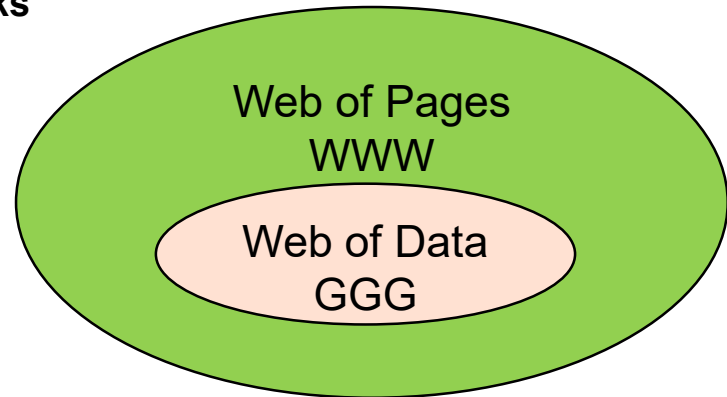
- Can be searched/browsed with a traditional web browser
- Links connect pages

Data network has emerged inside the web: Web of Data

- Can be searched/browsed with a semantic application
- Links connect information (e.g., parrot → bird)

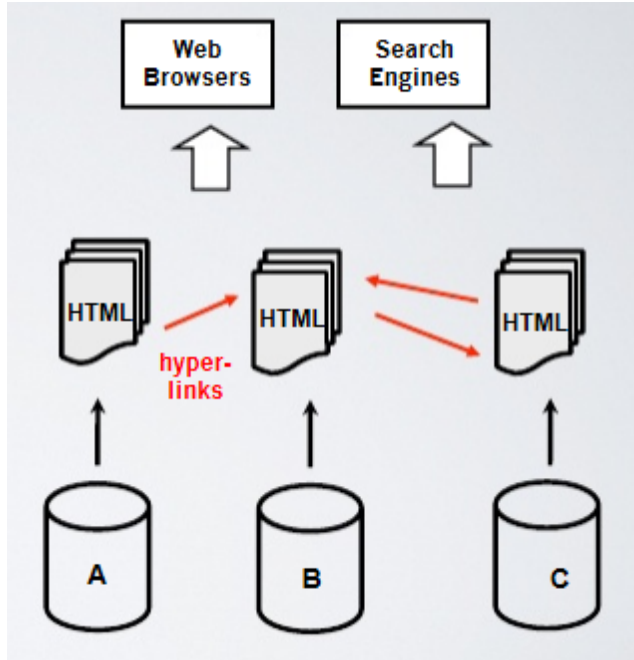
New (semantic) web consists of *both* of the networks

- Web of Pages (for humans)
 - *WWW World Wide Web*
- Web of Data (for machines)
 - *GGG Giant Global Graph*
 - *Google Knowledge Graph*
 - *Microsoft Satori*



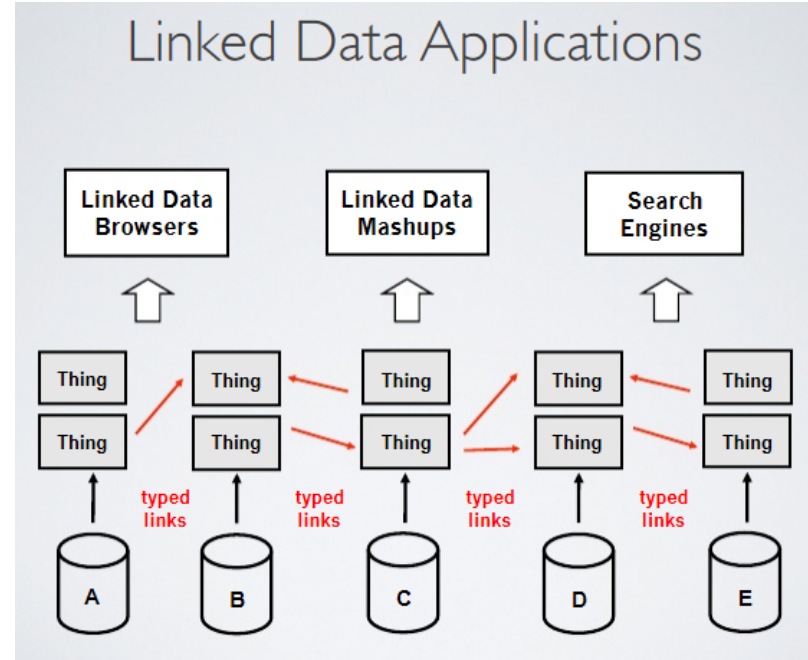
WWW and GGG coexistence

WWW



(Anja Jentzsch, 2012)

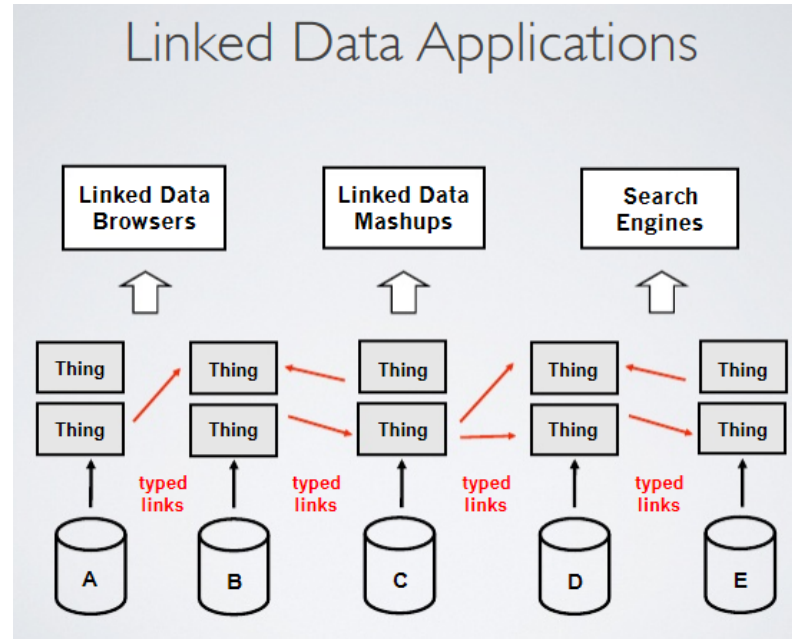
GGG



(Anja Jentzsch, 2012)

Dimensions of application development

- Services for
 - *Humans*
 - *Machines*
- Data linking
- Data aggregation
- Data harvesting
- Data production



(Anja Jentzsch, 2012)

Web of Data: data production

Web of Data: content production

Embedded in web pages

- Microformats
- Microdata
- RDFa

Standalone RDF data

- RDF files and APIs

Linked Data, Semantic web

1. Content production: Microformats

- Structured data embedded in web pages
- HTML tags are used for information representation
- Information represented with a set of properties and their values
- Formats tailored at specific need
 - *E.g., hCard, hCalendar, hRecipe ...*
 - *Simplicity; no common, cross-domain “semantics”*
- Structured data enables
 - *More focused search*
 - *More accurate classification and visualization of search results*
- Can be transformed into RDF with GRDDL (XSLT)

Example: hRecipe for food recipes

- hrecipe Metadata about a recipe
- fn Title of the recipe
- ingredient Ingredients

```
<p class="ingredient"><span class="value">125</span><span class="type">ml</span> milk</p>
```

- yield Quantity of production
- instructions Description of the process
- duration How long does it take
- photo Accompanying image
- ...

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See how to make a classic deli-style pasta salad. »**Low-Fat Faves** Eat well, feel great. »**Top Spring Recipes**


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By: Lalena

"This pasta dish incorporates some of the flavors of Greece. It makes a wonderfully complete and satisfying meal. For extra flavor, toss in a few kalamata olives."

★★★★★

[Rate/Review](#) | [Read Reviews](#) (683) Add a photo

40,074 Saves

 Like

293



2

1 of 22 Photos

Prep Time:	Cook Time:	Ready In:
15 Min	15 Min	30 Min

Servings (Help)

Calculate

Original Recipe Yield: 6 servings

Ingredients

- 1 pound uncooked pasta
- 1 tablespoon olive oil
- 2 cloves garlic, crushed
- 1/2 cup chopped red onion
- 1 pound skinless, boneless chicken breast meat - cut into bite-size pieces
- 1 (14 ounce) can marinated artichoke hearts, drained and chopped
- 1 large tomato, chopped
- 1/2 cup crumbled feta cheese
- 3 tablespoons chopped fresh parsley
- 2 tablespoons lemon juice
- 2 teaspoons dried oregano
- salt and pepper to taste
- 2 lemons, wedged, for garnish

Directions

1. Bring a large pot of lightly salted water to a boil. Cook pasta in boiling water for 8 to 10 minutes, or until al dente; drain.
2. Meanwhile, heat olive oil in a large skillet over medium-high heat. Add garlic and onion, and saute for 2 minutes. Stir in the chicken. Cook, stirring occasionally, until chicken is no longer pink and the juices run clear, about 5 to 6 minutes.
3. Reduce heat to medium-low, and add the artichoke hearts, tomato, feta cheese, parsley, lemon juice, oregano and cooked pasta. Stir until heated through, about 2 to

kitchenapproved Add to Recipe Box Add to Shopping List Print this Recipe Share/Email supporting members Create Menu Customize Recipe Kitchen-friendly View

Recipe Box

Menus

Shopping Lists

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**Chicken and Sausage Orzo Pasta**

The orzo pasta in this chicken and sausage recipe is cooked risotto-style.

[More How-To and Recipe Videos »](#)**Related Menus**


```
1279 <div class="ingredients" style="margin-top: 10px;">
1280 <h3>
1281   Ingredients</h3>
1282
1283   <ul>
1284
1285     <li class="plaincharacterwrap ingredient">
1286       1 pound uncooked pasta</li>
1287
1288     <li class="plaincharacterwrap ingredient">
1289       1 tablespoon olive oil</li>
1290
1291     <li class="plaincharacterwrap ingredient">
1292       2 cloves garlic, crushed</li>
1293
1294     <li class="plaincharacterwrap ingredient">
1295       1/2 cup chopped red onion</li>
1296
1297     <li class="plaincharacterwrap ingredient">
1298       1 pound skinless, boneless chicken breast meat - cut into bite-size pieces</li>
1299
1300     <li class="plaincharacterwrap ingredient">
1301       1 (14 ounce) can marinated artichoke hearts, drained and chopped</li>
1302
1303     <li class="plaincharacterwrap ingredient">
1304       1 large tomato, chopped</li>
1305
1306     <li class="plaincharacterwrap ingredient">
1307       1/2 cup crumbled feta cheese</li>
1308
1309     <li class="plaincharacterwrap ingredient">
1310       3 tablespoons chopped fresh parsley</li>
1311
1312     <li class="plaincharacterwrap ingredient">
1313       2 tablespoons lemon juice</li>
1314
1315
```

Searching "chicken pasta" with "lemon"

The screenshot shows a Google search interface. The search bar contains the text "chicken pasta". Below the search bar, the results are filtered to "Recipes with lemon". Two recipe cards are visible:

- Easy Lemon Pasta with Chicken**: From www.foodnetwork.com, 322 reviews, 35 mins. Ingredients: lemon, penne, chicken, pepper, garlic, olive oil, parsley, grated ...
- Chicken Piccata Pasta Toss**: From www.foodnetwork.com, 215 reviews, 30 mins. Ingredients: lemon, olive oil, chicken, pepper, butter, garlic, onion, flour ...

In the bottom left corner, there is a filter table for ingredients:

Ingredients	Yes	No
lemon	<input checked="" type="checkbox"/>	<input type="checkbox"/>
penne	<input type="checkbox"/>	<input type="checkbox"/>
mint	<input type="checkbox"/>	<input type="checkbox"/>
...	<input type="checkbox"/>	<input type="checkbox"/>

A red circle highlights the "lemon" row in this table.

2. Content production: Microdata

Extension of the HTML5 specification

- Primitives for information representation
- Simple semantics compared to the Semantic Web standards
- W3C working draft:
<https://www.w3.org/TR/microdata/>

<http://schema.org>

- Schemas for structured data mark-up on web
- Google, Yahoo, Microsoft
- Launched in June 2011

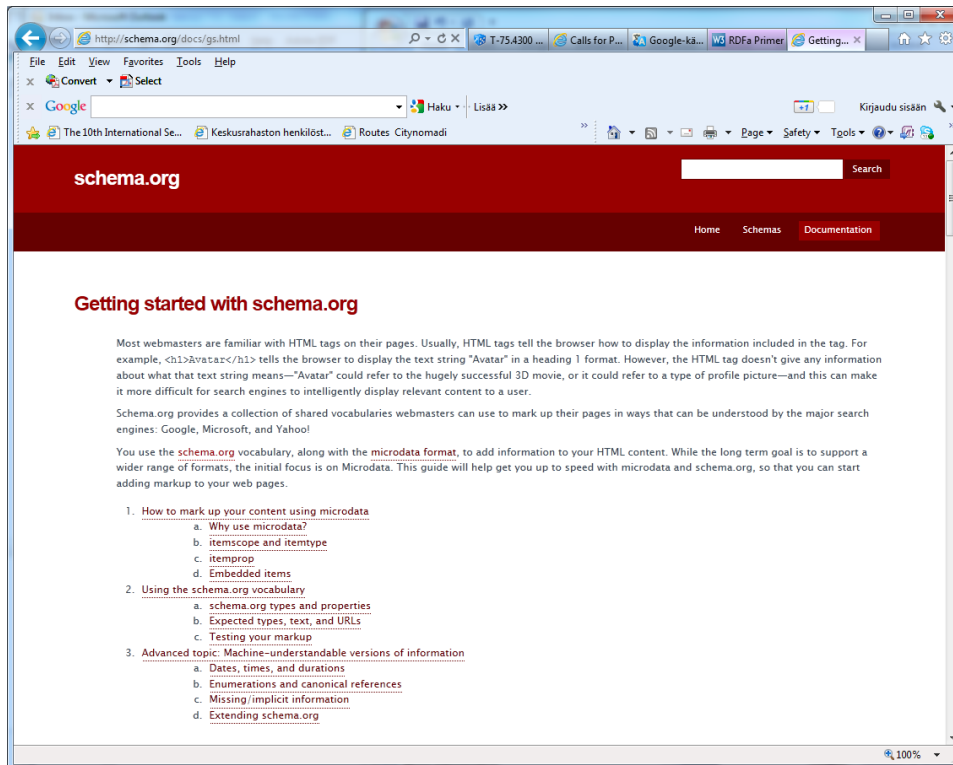


Example: Microdata

```
<section itemscope itemtype="http://data-vocabulary.org/Person">
  Hello, my name is
  <span itemprop="name">John Doe</span>,
  I am a
  <span itemprop="title">graduate research assistant</span>
  at the
  <span itemprop="affiliation">University of Dreams</span>.
  My friends call me
  <span itemprop="nickname">Johnny</span>.
  You can visit my homepage at
  <a href="http://www.JohnnyD.com" itemprop="url">www.JohnnyD.com</a>.
  <section itemprop="address" itemscope itemtype="http://data-vocabulary.org/Address">
    I live at
    <span itemprop="street-address">1234 Peach Drive</span>
    <span itemprop="locality">Warner Robins</span>
    ,
    <span itemprop="region">Georgia</span>.
  </section>
</section>
```

Embedded metadata on the Web: <http://schema.org>

- Used by Google, Yahoo, Bing, Yandex (RDFa, Microdata, Microformats)
- Web of (meta)data is coming ...



Schema.org type hierarchy (ontology) (only part)

Thing: description, image, name, url

CreativeWork: about, accountablePerson, aggregateRating, alternativeHeadline, associatedMedia, audio, author, awards, comment, contentLocation, contentRating, contributor, copyrightHolder, copyrightYear, creator, dateCreated, dateModified, datePublished, discussionUrl, editor, encodings, genre, headline, inLanguage, interactionCount, isFamilyFriendly, keywords, mentions, offers, provider, publisher, publishingPrinciples, reviews, sourceOrganization, thumbnailUrl, version, video

Article: articleBody, articleSection, wordCount

BlogPosting

NewsArticle: dateline, printColumn, printEdition, printPage, printSection

ScholarlyArticle

Blog: blogPosts

Book: bookEdition, bookFormat, illustrator, isbn, numberOfPages

ItemList: itemListElement, itemListOrder

Map

MediaObject: associatedArticle, bitrate, contentSize, contentURL, duration, embedURL, encodesCreativeWork, encodingFormat, expires, height, interactionCount, offers, playerType, regionsAllowed, requiresSubscription, uploadDate, width

AudioObject: transcript

ImageObject: caption, exifData, representativeOfPage, thumbnail

MusicVideoObject

VideoObject: caption, productionCompany, thumbnail, transcript, videoFrameSize, videoQuality

Movie: actors, director, duration, musicBy, producer, productionCompany, trailer

MusicPlaylist: numTracks, tracks

MusicAlbum: byArtist

MusicRecording: byArtist, duration, inAlbum, inPlaylist

Painting

Photograph

Recipe: cookTime, cookingMethod, ingredients, nutrition, prepTime, recipeCategory, recipeCuisine, recipeInstructions, recipeYield, totalTime

Review: itemReviewed, reviewBody, reviewRating

Sculpture

TVEpisode: actors, director, episodeNumber, musicBy, partOfSeason, partOfTVSeries, producer, productionCompany, trailer

TVSeason: endDate, episodes, numberOfEpisodes, partOfTVSeries, seasonNumber, startDate, trailer

TVSeries: actors, director, endDate, episodes, musicBy, numberOfEpisodes, producer, productionCompany, seasons, startDate, trailer

WebPage: breadcrumb, isPartOf, mainContentOfPage, primaryImageOfPage, significantLinks

Embedding in web pages

RDFa

3. Content production: RDFa

- W3C's recommended way to embed semantic information in an HTML page
- Schema.org supports since RDFa 1.1
 - *RDF data can be embedded also as JSON-LD*
- Open Graph Protocol (OGP)
 - *Significant user of RDFa*
 - *Used in Facebook*
- Yahoo! research (Mika, Potter, 2012) found that 25% of web pages contain RDFa markup



RDFa: bridging the human and data webs



On the left, what browsers see. On the right, what humans see. Can we bridge the gap so browsers see more of what we see?

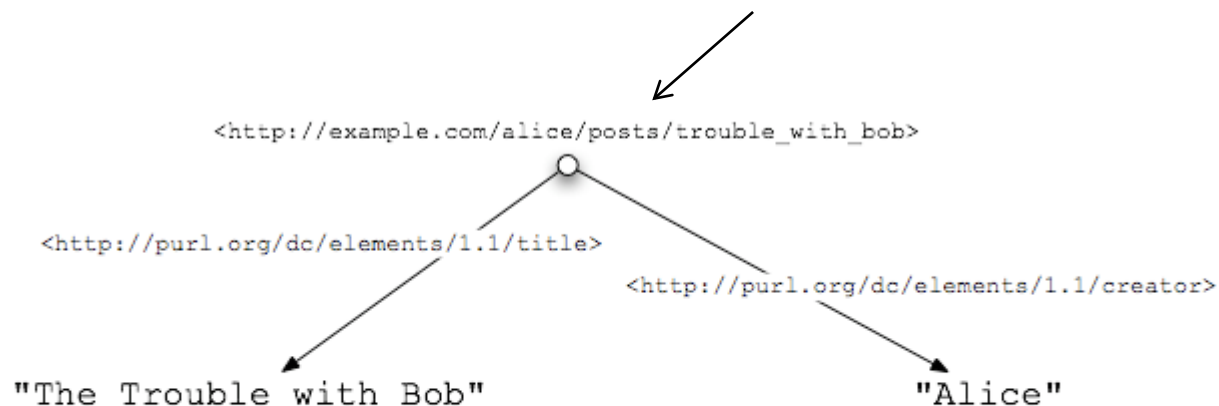
- Bridge by embedding RDF in XHTML
- Software can then extract the RDF graph for the machine
- See also interactive RDFa “playground”

Example of using RDFa

```
<div>  
  <h2>The trouble with Bob</h2>  
  <h3>Alice</h3>  
  ...  
</div>
```



```
<div xmlns:dc="http://purl.org/dc/elements/1.1/">  
  <h2 property="dc:title">The trouble with Bob</h2>  
  <h3 property="dc:creator">Alice</h3>  
  ...  
</div>
```



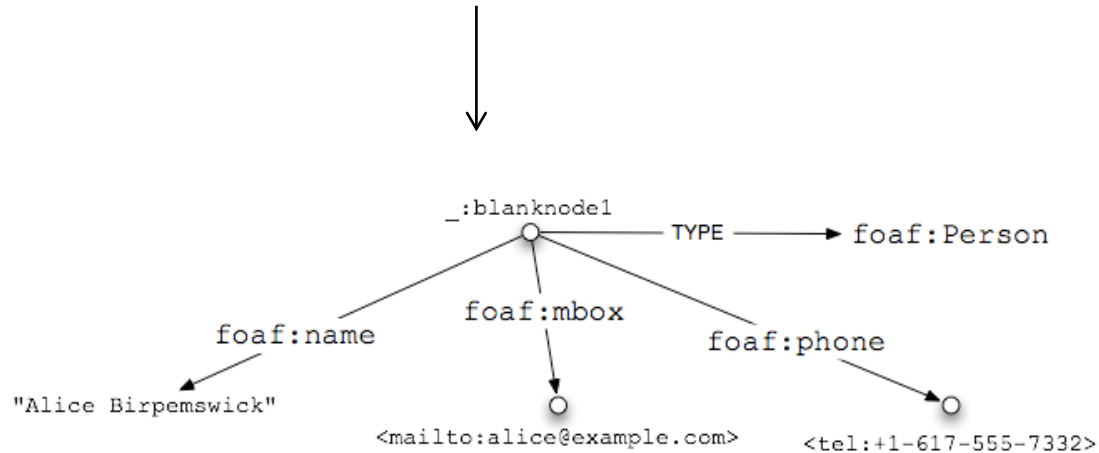
Literal Properties: RDFa lets Alice connect not just one URL to another—for example to connect her blog entry URL to the Creative Commons license URL— but also to connect one URL to a string such as "The Trouble with Bob". All arrows are labeled with the corresponding property name, which is also a URL.

Another example

```
<div typeof="foaf:Person" xmlns:foaf="http://xmlns.com/foaf/0.1/">
  <p property="foaf:name">
    Alice Birpemswick
  </p>

  <p>
    Email: <a rel="foaf:mbox" href="mailto:alice@example.com">alice@example.com</a>
  </p>

  <p>
    Phone: <a rel="foaf:phone" href="tel:+1-617-555-7332">+1 617.555.7332</a>
  </p>
</div>
```



Real-life example

RDFa 1.1 Distiller and Parser

- <http://www.w3.org/2012/pyRdfa/>
- Try it, e.g., with Svenska YLE news:
- <http://svenska.yle.fi/artikel/2014/01/21/krav-pa-egen-laptop-leder-till-ojamlikhet>



RDFa 1.1 Distiller and Parser

Warning: This version implements [RDFa 1.1 Core](#), including the handling of the [Role Attribute](#). The distiller can also run in XHTML+RDFa 1.0 mode (if the incoming XHTML content uses the RDFa 1.0 DTD and/or sets the `version` attribute). The [package available for download](#), although it may be slightly out of sync with the code running this service.

Distill by URI Distill by File Upload Distill by Direct Text Input

Distill by URI

URI:

Output Format:

Returned content:

Expand vocabularies:

Generate warnings for non RDFa 1.1 Lite usage:

▶ More (non-standard) options

Go!

Real-life example: web page

yle SVENSKA.YLE.FI ARENAN YLE FEM RADIO VEGA X3M BUU Google™ Anpassad sökning yle.fi

Huvudstadsregionen Svenska Yle

Inrikes Utrikes Sport Kultur och nöje **Huvudstadsregionen** Västnyland Åboland Osterbotten Östnyland Väder Kontakta oss

"Krav på egen laptop leder till ojämlikhet"

Publicerad för ungefär 5 timmar sedan. Uppdaterad för ungefär 3 timmar sedan



Copyright YLE/Ted Urho

Hem och Skolas verksamhetsledare Micaela Romantschuk-Pietilä tror att kravet på att nya gymnasieelever [själva ska bekosta bärbar dator](#) kan leda till att en del väljer bort gymnasiet.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Nya artiklar

- [Berghäll blommade och fick pris!](#)
- [Nya ambulanser kom aldrig – Helsingfors säger upp kontrakt](#) 4
- [Nojor för eld i Tisdagsnacket](#)
- ["Krav på egen laptop leder till ojämlikhet"](#) 15
- [Bastu efterlyst av polisen](#)
- [Nyhetsöversikt svenska.yle.fi](#)

Relaterat

- [I år måste alla gymnasieelever ha egen laptop](#)
- [Lite bättre för Merituuleverna](#)
- [Skrivstilen snart ett minne blott](#)
- [Sex alternativ för skolor och dagvård i södra Borgå](#)
- [Inget intresse för Solbergs skola](#)

Mest kommenterade

- [Staten satsar flera hundratusen euro på Guggenheim-tävling](#) 32
- [Minister om Guggenheimstöd: Finns ingen skyldighet att informera](#) 29
- [Guggenheim ser ut att få tomten i Södra kajen](#) 28

Real-life example: extracted RDF

```
1 http://svenska.yle.fi/artikel/2014/01/21/krav-pa-egen-laptop-leder-till-ojamlikhet<?xml version="1.0" encoding="utf-8"?>
2 <rdf:RDF
3   xmlns:foaf="http://xmlns.com/foaf/0.1/"
4   xmlns:sioc="http://rdfs.org/sioc/types#"
5   xmlns:dc="http://purl.org/dc/terms/"
6   xmlns:content="http://purl.org/rss/1.0/modules/content/"
7   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
8   xmlns:ns1="http://www.w3.org/1999/xhtml/vocab#"
9   xmlns:sioc="http://rdfs.org/sioc/ns#"
10 >
11 <sioc:Comment rdf:about="http://svenska.yle.fi/artikel/2014/01/21/krav-pa-egen-laptop-leder-till-ojamlikhet#comment-102347">
12   <dc:title xml:lang="sv">Sluta göra beslut som trycker</dc:title>
13   <sioc:reply_of>
14     <foaf:Document rdf:about="http://svenska.yle.fi/artikel/2014/01/21/krav-pa-egen-laptop-leder-till-ojamlikhet">
15       <dc:title xml:lang="sv">Krav på egen laptop leder till ojämlikhet</dc:title>
16       <dc:date rdf:datatype="http://www.w3.org/2001/XMLSchema#dateTime">2014-01-21T11:39:21+02:00</dc:date>
17       <sioc:num_replies rdf:datatype="http://www.w3.org/2001/XMLSchema#integer">15</sioc:num_replies>
18       <rdf:type rdf:resource="http://rdfs.org/sioc/ns#Item"/>
19       <content:encoded xml:lang="sv">Hem och Skolas verksamhetsledare Micaela Romantschuk-Pietilä tror att kravet på att nya gym
20 I höst förutsätts alla som börjar gymnasiet att ha en egen bärbar dator, i och med den nya elektroniska studentexamen.
21 Micaela Romantschuk-Pietilä från Hem och Skola konstaterar att gymnasiestudier redan nu kostar en hel del för gymnasisterna, och at
22 - Det finns uträkningar om att läroböckerna för hela gymnasietiden kostar ungefär 1500 euro, och det kommer ju andra utgifter på. I
23 Ojämlikhet
24 Att gymnasieutbildningen innebär så höga kostnader kan påverka valet av andra stadiets utbildning, tror Romantschuk-Pietilä. Spela
25 - Redan nu är yrkesskolans utgifter för en elev mycket lägre, så jag är lite rädd för att de ganska höga kostnaderna i vissa fall l
26 Hem och Skolas verksamhetsledare konstaterar att det finns ett starkt samband mellan föräldrars akademiska bakgrund och elevernas r
27 - Jag tycker att vi borde komma ifrån att man på grund av ekonomiska orsaker i familjer väljer bort ett alternativ - det vill säga
28 "Borde få gratis dator!"
29 Romantschuk-Pietilä tycker inte att det är orimligt att tänka sig att gymnasieeleverna gratis skulle få en bärbar dator, som de ju
30 - Man vet att gymnasiestudier för staten och kommunen är ett billigare alternativ. En gymnasieelev kostar ungefär sjutusen euro, me
31 Ett argument som tas upp när man motiverar varför det är rimligt att gymnasieelever har egen laptop är att det på sikt blir billiga
32 - Det finns än så länge väldigt lite e-läromedel på finlandssvenskt håll. Dessutom är de inte helt gratis heller, utan eleverna ska
33 Läs också I år måste alla gymnasieelever ha egen laptop
34 </content:encoded>
35   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p15018"/>
36   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p9729"/>
37   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p11320"/>
38   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p5509"/>
39   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p32775"/>
40   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p48358"/>
41   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p18749"/>
42   <dc:subject rdf:resource="http://www.yso.fi/onto/koko/p510"/>
43   <dc:created rdf:datatype="http://www.w3.org/2001/XMLSchema#dateTime">2014-01-21T11:39:21+02:00</dc:created>
44   </foaf:Document>
45   </sioc:reply_of>
46   <content:encoded xml:lang="sv">Sluta göra beslut som trycker ner fattiga familjer ännu mera, en laptop är en utgift på flere h
47 </content:encoded>
48   <rdf:type rdf:resource="http://rdfs.org/sioc/ns#Post"/>
49   <sioc:has_creator>
```

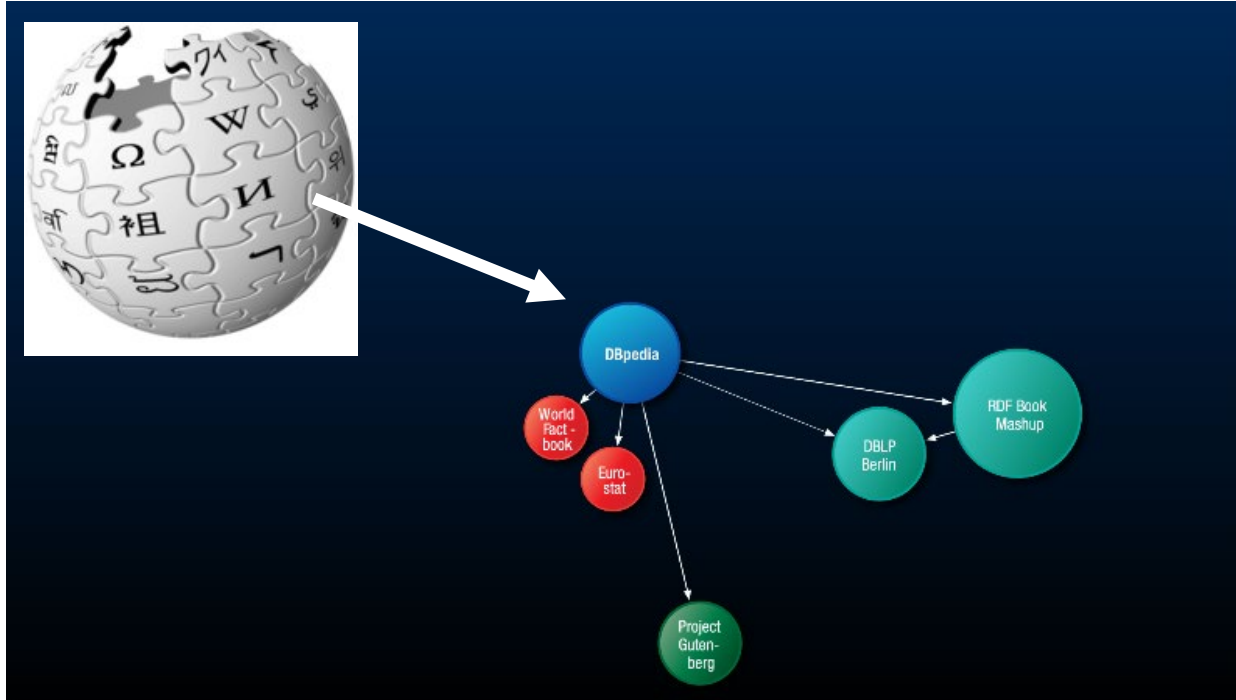
Example: Open Graph Protocol RDFa

```
<html prefix="og: http://ogp.me/ns#">
<head>
<title>The Rock (1996)</title>
<meta property="og:title" content="The Rock" />
<meta property="og:type" content="video.movie" />
<meta property="og:url" content="http://www.imdb.com/title/tt0117500/" />
<meta property="og:image" content="http://ia.media-imdb.com/images/rock.jpg" />
...
</head>
...
</html>
```

Idea of Linked Data

- Creating datasets in RDF
- Linking datasets together
 - *Cross-referencing data in other datasets*
 - E.g., place "Finland" in GeoNames.org to president "Niinistö" in DBpedia.org
 - *Identifying same concepts in different datasets*
 - E.g., "Helsinki" in GeoNames.org vs. DBpedia.org
- Lightweight Semantic Web technologies used
 - *"A Little Semantics Goes a Long Way" – Jim Hendler*
- Linked Open Data (LOD) community
 - <http://linkeddata.org/>

Linked Open Data Story so Far Starting 2005



(Tim Berners-Lee)

New Datasets Linked with Others



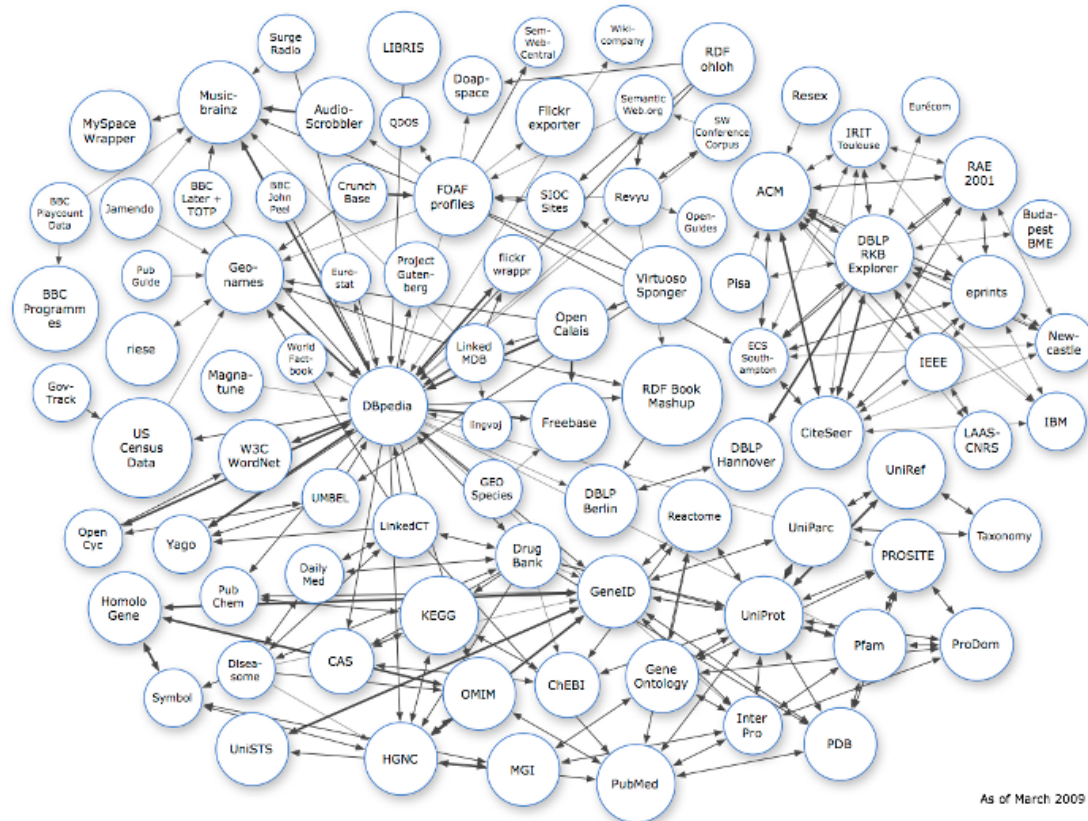
(Tim Berners-Lee)

And more datasets...



(Tim Berners-Lee)

Linked Open Data cloud 2009

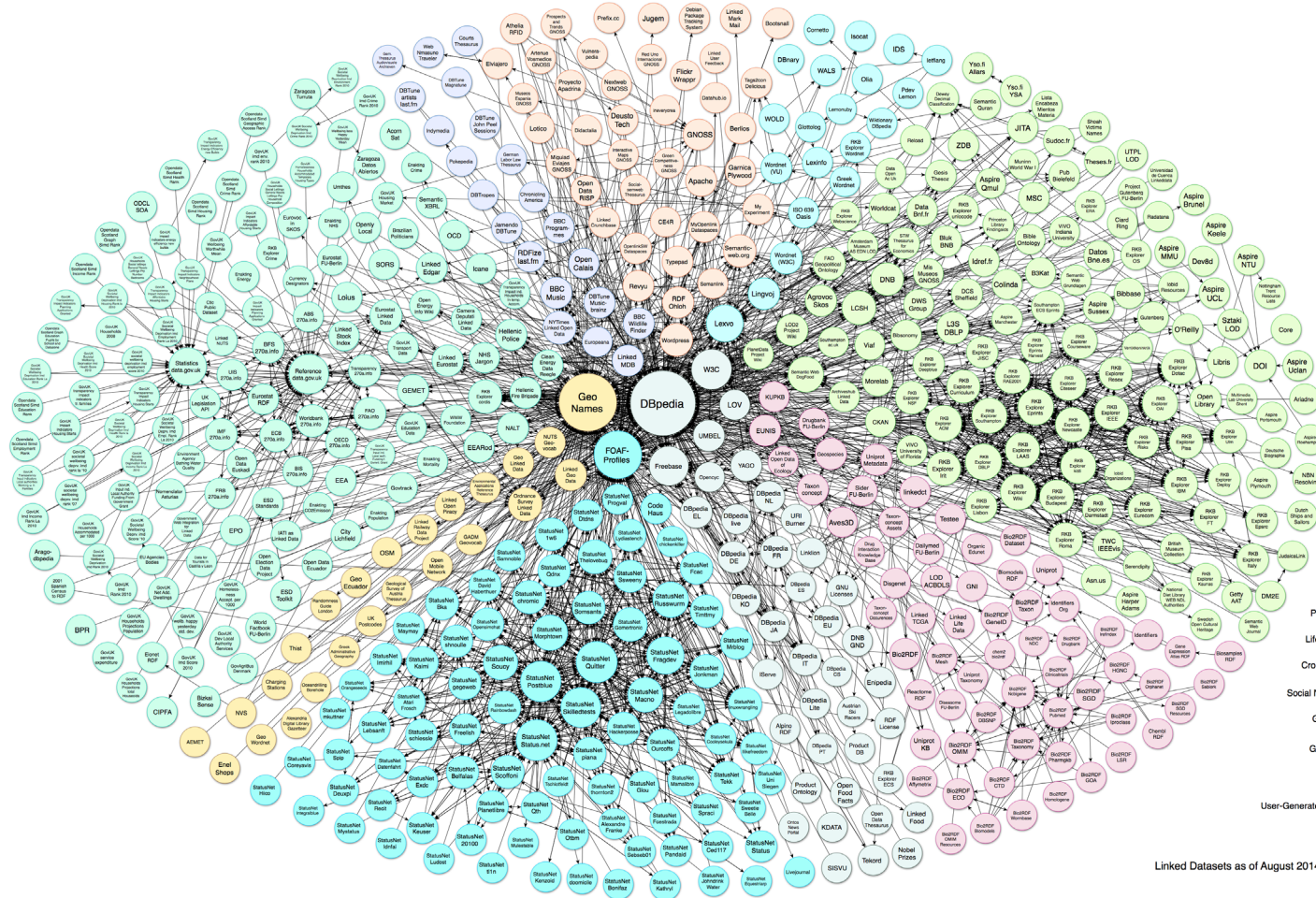


As of March 2009

(<http://linkeddata.org>, 2009)

Linked Open Data cloud 2014

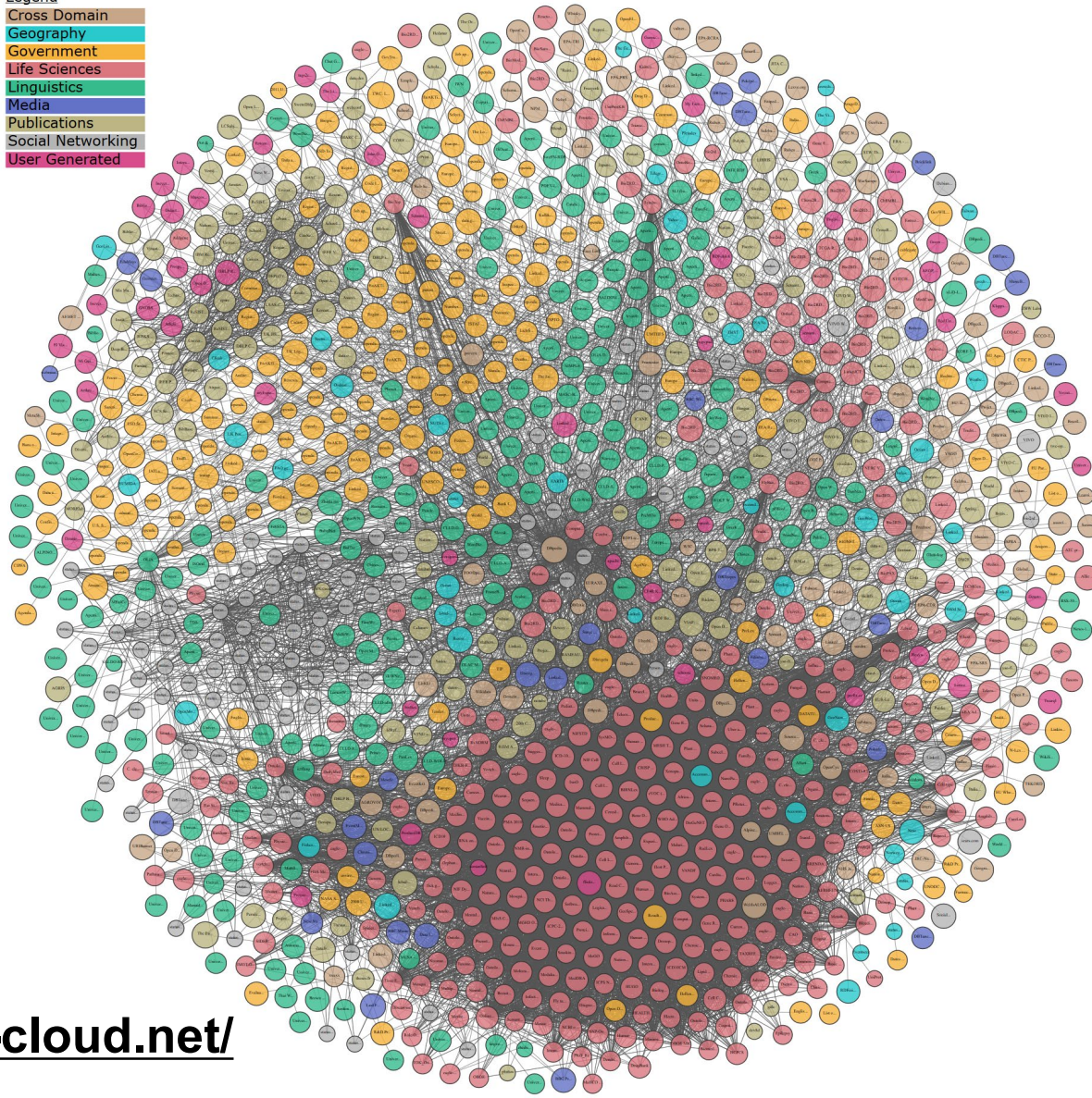
(<http://linkeddata.org>, 2014)



- Publications
- Life Sciences
- Cross-Domain
- Social Networking
- Geographic
- Government
- Media
- User-Generated Content
- Linguistics

2019

- Legend
- Cross Domain
 - Geography
 - Government
 - Life Sciences
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 - Media
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 - User Generated



<https://lod-cloud.net/>

Knowledge Graph utilized in Google search results

The image shows a Google search interface for the query "barack obama". At the top, the search bar contains the text "barack obama" and a magnifying glass icon. Below the search bar are navigation tabs for "All", "Images", "Videos", "News", "Maps", "More", and "Search tools". The search results indicate "About 177 000 000 results (0,87 seconds)".

The first search result is a Wikipedia link: "Barack Obama - Wikipedia, the free encyclopedia" with the URL https://en.wikipedia.org/wiki/Barack_Obama. A snippet of the article text follows: "Barack" and "Obama" redirect here. For his father, see Barack Obama, Sr. For other uses of "Barack", see Barack (disambiguation). For other uses of "Obama", ... Below this are several related search suggestions: "Michelle Obama - Barack Obama, Sr. - Ann Dunham - Early life and career of Barack".

The "In the news" section features a news article titled "Exclusive: Obama on Iowa, Clinton, Sanders and 2016" from Politico, published 23 hours ago. The snippet reads: "Barack Obama, that prematurely gray elder statesman, is laboring mightily to remain neutral ...". Below this are two more news links: "Barack Obama: Why we must rethink solitary confinement" from the Washington Post (9 hours ago) and "Obama's Tortured Love Affair With Gadgets | MIT Technology Review" from MIT Technology Review (13 hours ago). A link for "More news for barack obama" is also present.

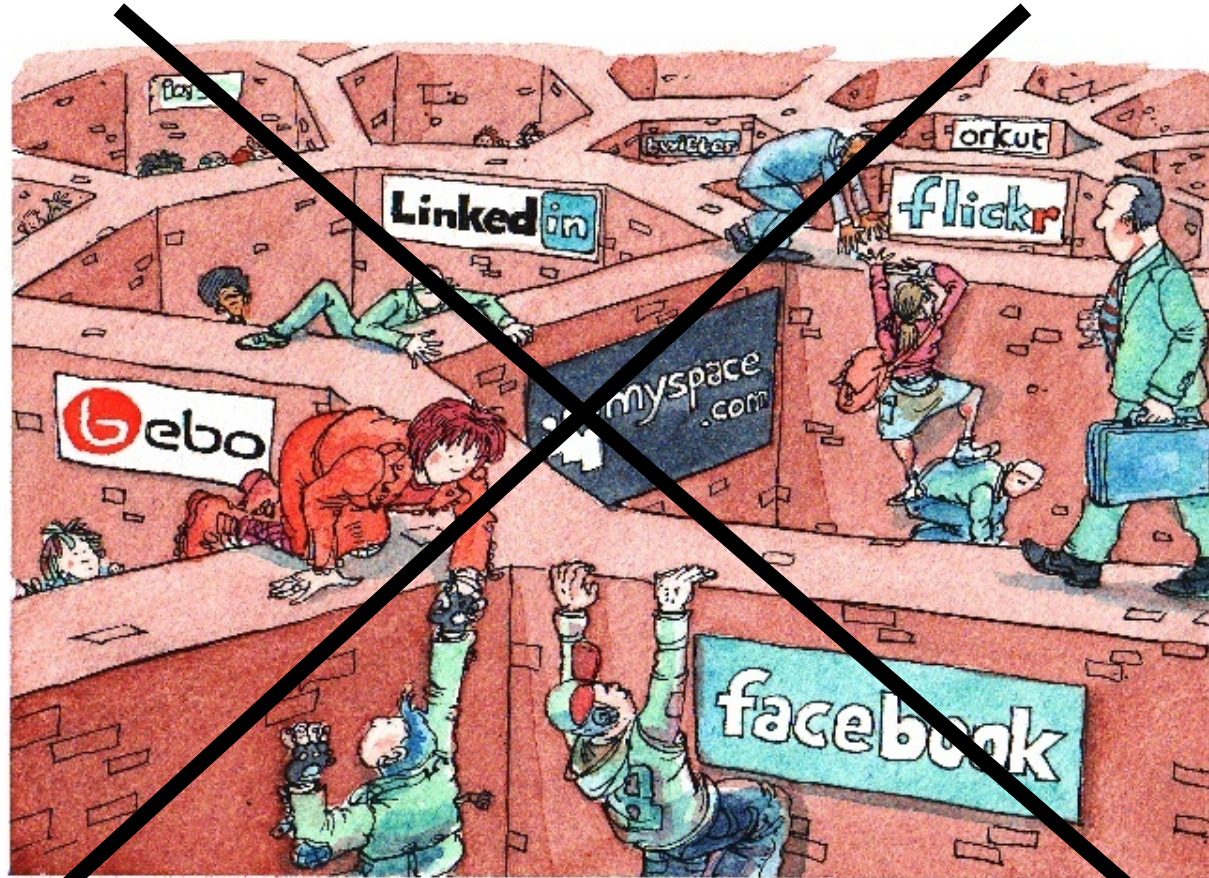
The "Barack Obama (@BarackObama) | Twitter" section shows two tweets. The first, from 11 hours ago, includes a small image of Barack Obama and the text: "Time's running out to #GetCovered before the January 31 deadline. Check out your options: ofa.bo/g9gW". The second tweet, from 13 hours ago, says: "Take a look at President Obama's latest common-sense step to help fight climate change: ofa.bo/h9qt #ActOnClimate".

On the right side of the page is a Knowledge Panel for Barack Obama. It features a large portrait of Obama and a grid of smaller images. The panel title is "Barack Obama" with the subtitle "44th U.S. President · barackobama.com". The main text describes him as "Barack Hussein Obama II is an American politician currently serving as the 44th President of the United States, the first African American to hold the office." It lists his birth date as August 4, 1961 (age 54) in Honolulu, Hawaii, United States; his spouse as Michelle Obama (m. 1992); his office as President of the United States since 2009; his parents as Ann Dunham and Barack Obama, Sr.; his education at Harvard Law School (1988–1991); and his children as Malia Ann Obama and Natasha Obama.

Below the Knowledge Panel is a "Profiles" section with icons for social media platforms: Twitter, Facebook, Google+, Instagram, and Myspace.

Web of Data: data harvesting and aggregation

Traditional model: data silos + difficult to use

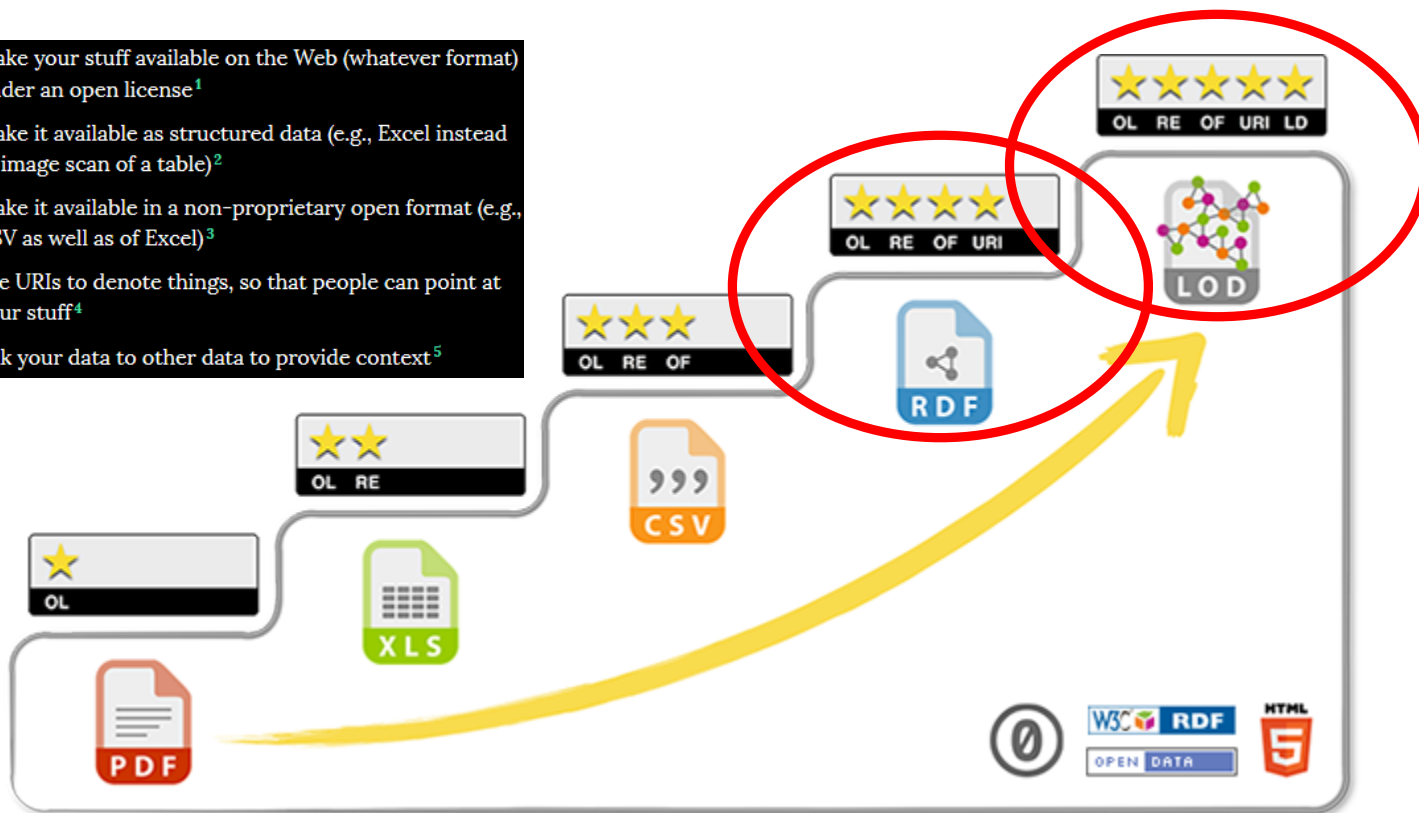


”Linked Data principles” (Tim Berners-Lee)

1. Use URIs as names for things
2. Use HTTP URIs, so that people can look up those names
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL)
4. Include links to other URIs, so that they can discover more things

How to publish Linked Open Data? 5-star model

- ★ make your stuff available on the Web (whatever format) under an open license¹
- ★★ make it available as structured data (e.g., Excel instead of image scan of a table)²
- ★★★ make it available in a non-proprietary open format (e.g., CSV as well as of Excel)³
- ★★★★ use URIs to denote things, so that people can point at your stuff⁴
- ★★★★★ link your data to other data to provide context⁵



(Tim Berners-Lee)
<http://5stardata.info>

Naming things with URI/IRIs (to get the 4th star!)

Use HTTP URIs

- Domain name system makes distributed URI minting easy
- HTTP URIs can be used to access more information
- Avoid URNs, DOIs, etc. for these reasons

Avoid confusion between

- Objects themselves and
- Web documents that describe them
- E.g. <http://www.aalto.fi>
 - *A university or a document about it?*

Cool URIs = simple, stable, manageable

URI dereferencing

Return right information about a URI/URL using HTTP

- As specified by HTTP header request fields
 - *E.g., Accept: text/plain*
 - *E.g., a web browser requests an HTML page*
- Server decides what to return
- This is called **content negotiation**

Dereferencing Strategies

Two strategies are in use

- 303 URIs
- Hash URIs

303 URI Strategy

- Real world objects / abstract concepts cannot be returned, only documents
- Therefore, for such a URI
 - *Server returns a 303 See Other response code (HTTP redirect)*
 - *Client can find a related document by following the redirect*
 - *An RDF description or an HTML page*
- E.g., <http://data.finlex.fi/eli/sd/2008/521/luku/1/pykala/1/ajantasa/20160101> →
 - <http://data.finlex.fi/eli/sd/2008/521/luku/1/pykala/1/ajantasa/20160101.html>

Hash URI Strategy

303 URI strategy needs two requests

- Hash URIs avoid this

URI format: use # and fragment identifier

- E.g., `http://example.fi/vocab/course#Seminar`

Procedure

- Client truncates URI at #
 - *E.g., remove #Seminar*
- Client sends a GET request
 - *E.g., `http://example.fi/vocab/course`*
- The result is an RDF or an HTML document
- Notice: an entire document is returned, not only info about #Seminar
 - *Since the fragment is not seen by the server*

303 URIs vs. Hash URIs

Hash URIs good for only small RDF descriptions (e.g., schemas)

- Extra HTTP request can then be saved
- The client must filter response further

303 URIs are used to access parts of RDF descriptions

- Extra HTTP call is needed
- Only relevant data is transmitted
- Further filtering not needed

Linked Data interfaces and APIs

- **Human application interface.** Ordinary browsing/searching of application HTML pages
- **Reading RDF data of a URI.** Based on URI dereferencing
- **Linked Data browsing.** Linked Data browser interface based on URI dereferencing
 - *Browsing based on RDF properties, rendered in HTML*
 - *E.g., http://dbpedia.org/page/Jean_Sibelius*
 - *Using LD browsers for the Web of Data*
 - *E.g., <http://uriburner.com/>*
- **SPARQL endpoint.** For querying the data in a standard way for, e.g., mash-up applications
- **Download.** Downloading the data as an RDF data dump
 - *See, e.g., Museum Finland data: <http://www.ldf.fi/dataset/mufi/>*

DBpedia.org URI model

Using several URIs

- a URI for the real-world object itself
- a URI for a related information resource that describes the real-world object and has an HTML representation
- a URI for a related information resource that describes the real-world object and has an RDF representation

Example:

- <http://dbpedia.org/resource/Helsinki> # Object
- <http://dbpedia.org/page/Helsinki> # HTML represent.
- <http://dbpedia.org/data/Helsinki> # RDF data

Example: identifying events in DBpedia

- How to represent the "Battle of Albert" in WWI
- What language to use?
 - *Bataille d'Albert?* (fr)
 - *Alberthin taistelu?* (fi)
- Which battle?
 - *Battle of Albert (1914) (25–29 September 1914)*
 - *encounter battle during the Race to the Sea*
 - *Battle of Albert (1916) (1–13 July 1916)*
 - *opening phase of the Battle of the Somme, 1916*
 - *Battle of Albert (1918) (21–23 August 1918)*
 - *opening phase of the Second Battle of the Somme, 1918*
- Is "Battle of Albert (1914)" a web page, concept, or identifier?

Linked Data solution in DBpedia: dereferencing "Battle of Albert, 1914"

Web of Data (GGG) for machines:

- URI identifier
 - [http://dbpedia.org/**resource**/Battle of Albert \(1914\)](http://dbpedia.org/resource/Battle_of_Albert_(1914))
- Web page URL
 - [http://dbpedia.org/**page**/Battle of Albert \(1914\)](http://dbpedia.org/page/Battle_of_Albert_(1914))
- (Meta)data on the web
 - [http://dbpedia.org/**data**/Battle of Albert \(1914\)](http://dbpedia.org/data/Battle_of_Albert_(1914))

There is also...

Wikipedia pages (WWW) for humans:

- The actual Wikipedia information page(s)
 - [http://en.wikipedia.org/wiki/Battle_of_Albert_\(1914\)](http://en.wikipedia.org/wiki/Battle_of_Albert_(1914))

Wikidata shared by different wikis

- Collaboratively edited knowledge base
 - <http://www.wikidata.org/wiki/Q786656>

And application interfaces...

[http://dbpedia.org/page/Battle_of_Albert_\(1914\)](http://dbpedia.org/page/Battle_of_Albert_(1914))

Starlight Xpr... TS Guiding... Skywatcher... SKOS/XML... The CIDOC... FINLEX @ - ... D About: B... x


File Edit View Favorites Tools Help

Convert Select Google aalto promotioo 2012 Haku Jaa Sidewiki Tarkista Sanakäännös Automaattinen täyttö Lisää Eero Hyvonen

WWW2012 Proceedings Linked Data on the Web (EMHI) Etusivu - fi - Aalto Inside Routes Citynomadi Avaruus.fi - keskustelu... Login Espoo - Foreca Sää Page Safety Tools

About: [Battle of Albert \(1914\)](#)

An Entity of Type : [Battles of World War I involving Germany](#), from Named Graph : <http://dbpedia.org>, within Data Space : [dbpedia.org](#)



La Battaglia di Albert iniziò il 25 settembre 1914 come parte della Corsa al mare durante la prima guerra mondiale. È immediatamente precedente alla prima battaglia della Marna ed alla prima battaglia dell'Aisne. La 10 Armata francese iniziò ad ammassarsi ad Amiens a partire dalla metà di settembre, ed il 25 iniziò a spingersi verso est.

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rdfs:label	<ul style="list-style-type: none">Bataille d'Albert (1914)Battaglia di Albert (1914)Battle of Albert (1914)Битва при Альберте (1914)

100%

[http://dbpedia.org/resource/Battle_of_Albert_\(1914\)](http://dbpedia.org/resource/Battle_of_Albert_(1914)) → [http://dbpedia.org/page/Battle_of_Albert_\(1914\)](http://dbpedia.org/page/Battle_of_Albert_(1914))

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    <owl:sameAs rdf:resource="http://dbpedia.org/resource/Battle_of_Albert_%281914%29"/>
    <rdf:comment xml:lang="en">The Battle of Albert began on September 25, 1914 as part of the Race to the Sea during World War I. It directly followed the First Battle of the Marne and the First Battle of the Aisne as progress toward advancing the trench lines to the sea continued. The French Tenth Army began to assemble at Amiens from mid-September and on September 25 began to push eastwards.</rdf:comment>
    <rdf:comment xml:lang="it">La Battaglia di Albert iniziò il 25 settembre 1914 come parte della Corsa al mare durante la prima guerra mondiale. È immediatamente precedente alla prima battaglia della Marna ed alla prima battaglia dell'Aisne. La 10 Armata francese iniziò ad ammassarsi ad Amiens a partire dalla metà di settembre, ed il 25 iniziò a spingersi verso est.</rdf:comment>
    <rdf:comment xml:lang="ru">Битва при Альбере — сражение между французскими и германскими войсками во время Первой мировой войны, часть т. н. «Бега к морю». Французская 10-я армия с середины сентября концентрировалась у Амьена, и с 25 сентября начала продвижение на восток. После того, как попытка удлинить линию фронта на север провалилась, Де Кастельно по приказу Жозефа организовал фронтальную атаку германских позиций возле Альбера.</rdf:comment>
    <rdf:comment xml:lang="fr">La bataille d'Albert commença le 25 septembre 1914, dans le cadre de la Course à la mer, au début de la Première Guerre mondiale. Elle eut lieu dans le prolongement immédiat de la première bataille de la Marne et de la première bataille de l'Aisne alors que le creusement des tranchées vers la mer avait débuté. La avait commencer à se rassembler à Amiens depuis la mi-septembre et le 25 septembre elle fit marche à l'est.</rdf:comment>
    <rdfs:label xml:lang="it">Battaglia di Albert (1914)</rdfs:label>
    <rdfs:label xml:lang="fr">Bataille d'Albert (1914)</rdfs:label>
    <rdfs:label xml:lang="en">Battle of Albert (1914)</rdfs:label>
    <rdfs:label xml:lang="ru">Битва при Альбере (1914)</rdfs:label>
    <dbpedia-owl:abstract xml:lang="en">The Battle of Albert began on September 25, 1914 as part of the Race to the Sea during World War I. It directly followed the First Battle of the Marne and the First Battle of the Aisne as progress toward advancing the trench lines to the sea continued. The French Tenth Army began to assemble at Amiens from mid-September and on September 25 began to push eastwards. De Castelnau, under the command of Joffre, launched a frontal attack on the German lines near Albert after attempts to stretch the line northward failed. De Castelnau was met with immediate resistance and counterattack as the German Sixth Army had reached Bapaume on September 26 and advanced to Thiepval on the 27th, in the midst of what was to become the Somme battlefield of 1916. The German aim was to drive westward to the English Channel, seizing the industrial and agricultural regions of Northern France, cutting off the supply route of the British Expeditionary Force (BEF) and isolating Belgium. Neither side was able to make any decisive ground and the battle around Albert ended around September 29 as the fighting moved northwards towards Arras and Lille and into West Flanders. This confrontation and those to follow were deemed draws as the fighting settled into prolonged trench warfare.</dbpedia-owl:abstract>
    <dbpedia-owl:abstract xml:lang="ru">Битва при Альбере — сражение между французскими и германскими войсками во время Первой мировой войны, часть т. н. «Бега к морю». Французская 10-я армия с середины сентября концентрировалась у Амьена, и с 25 сентября начала продвижение на восток. После того, как попытка удлинить линию фронта на север провалилась, Де Кастельно по приказу Жозефа организовал фронтальную атаку германских позиций возле Альбера. Германская 6-я армия немедленно контратаковала, 26 сентября достигла Бapaуме, а 27 сентября — Тьеппвал. Ни одна из сторон не смогла достигнуть значительных результатов, и 29 сентября район боевых действий сместился к северу.</dbpedia-owl:abstract>
    <dbpedia-owl:abstract xml:lang="it">La Battaglia di Albert iniziò il 25 settembre 1914 come parte della Corsa al mare durante la prima guerra mondiale. È immediatamente precedente alla prima battaglia della Marna ed alla prima battaglia dell'Aisne. La 10 Armata francese iniziò ad ammassarsi ad Amiens a partire dalla metà di settembre, ed il 25 iniziò a spingersi verso est. Edouard De Castelnau, sotto il comando di Joseph Joffre, lanciò un attacco frontale contro le linee tedesche presso Albert dopo che i tentativi di forzare la linea del fronte in direzione nord fallirono. De Castelnau incontrò immediatamente resistenza e subì il contrattacco, dato che la 6 Armata tedesca aveva raggiunto Bapaume il 26 settembre ed avanzò in direzione di Thiepval il 27, nel mezzo di quella che era diventata il terreno della battaglia della Somme. Lo scopo tedesco era di dirigersi a occidente verso la Manica, conquistando le regioni industriali ed agricole della Francia settentrionale, tagliando così fuori le rotte di rifornimento del Corpo di Spedizione inglese ed isolando il Belgio. Nessuno dei due lati riuscì a fare alcun significativo progresso sul campo, e gli scontri intorno ad Albert terminarono intorno al 29 settembre, mentre il vivo della battaglia si spostò verso nord in direzione di Arras e Lille e nelle Fiandre occidentali. Questo scontro e quelli che seguirono furono tentativi senza costrutto, dato che il panorama bellico andò rapidamente verso la guerra di trincea.</dbpedia-owl:abstract>
    <dbpedia-owl:abstract xml:lang="fr">La bataille d'Albert commença le 25 septembre 1914, dans le cadre de la Course à la mer, au début de la Première Guerre mondiale. Elle eut lieu dans le prolongement immédiat de la première bataille de la Marne et de la première bataille de l'Aisne alors que le creusement des tranchées vers la mer avait débuté. La avait commencer à se rassembler à Amiens depuis la mi-septembre et le 25 septembre elle fit marche à l'est. Le général de Castelnau, sous le commandement du général Joffre, lança une attaque frontale sur les positions allemandes près d'Albert, après que des tentatives d'étendre le front au nord eurent échoué. De Castelnau dut faire face à une forte résistance et à la contre-offensive de la Vimodécie. L'armée allemande qui atteint Bapaume le 26 septembre et Thiepval le jour suivant, dans une région qui allait être le théâtre de la bataille de la Somme, en 1916. L'objectif des Allemands était de pousser vers l'ouest, vers la Manche, pour s'emparer des régions industrielles et agricoles du Nord de la France, coupant ainsi le ravitaillement du Corps expéditionnaire britannique et isolant la Belgique. Aucun des deux camps ne fut capable de réaliser des gains significatifs lors de cet affrontement, et la bataille d'Albert se termina le 29 septembre avec le déplacement des combats au nord, vers Arras, Lille et dans la Flandre-Occidentale. Cette confrontation et celles qui suivirent ne dégagèrent pas de grands vainqueurs, et la guerre ne tarda guère à se transformer en guerre de tranchées.</dbpedia-owl:abstract>
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  </rdf:Description>
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```

Wikipedia article page for "Battle of Albert (1914)".

Browser: Internet Explorer 8.0.6002.6288. Address bar: http://en.wikipedia.org/wiki/Battle_of_Albert_(1914). Search: battle of albert 1914.

Battle of Albert (1914)

From Wikipedia, the free encyclopedia

Not to be confused with [Battle of Albert \(1916\)](#) or [Battle of Albert \(1918\)](#).

This article does not cite any references or sources. Please help [improve this article](#) by adding citations to [reliable sources](#). Unsourced material may be [challenged](#) and removed. *(April 2008)*

The **Battle of Albert** began on September 25, 1914 as part of the **Race to the Sea** during World War I. It directly followed the **First Battle of the Marne** and the **First Battle of the Aisne** as progress toward advancing the trench lines to the sea continued.

The **French Tenth Army** began to assemble at Amiens from mid-September and on September 25 began to push eastwards. **De Castelnau**, under the command of Joffre, launched a frontal attack on the German lines near **Albert** after attempts to stretch the line northward failed. De Castelnau was met with immediate resistance and counterattack as the **German Sixth Army** had reached **Bapaume** on September 26 and advanced to **Thiepval** on the 27th. In the midst of what was to become the **Somme** battlefield of 1916. The German aim was to drive westward to the **English Channel**, seizing the industrial and agricultural regions of Northern France, cutting off the supply route of the **British Expeditionary Force** (BEF) and isolating Belgium.

Neither side was able to make any decisive ground and the battle around Albert ended around September 29 as the fighting moved northwards towards **Arras** and **Lille** and into **West Flanders**. This confrontation and those to follow were deemed draws as the fighting settled into prolonged **trench warfare**.

 *This World War I article is a stub. You can help Wikipedia by expanding it.*

 *This article about a battle in French history is a stub. You can help Wikipedia by expanding it.*

 *This article about a battle in German history is a stub. You can help Wikipedia by expanding it.*

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I am highly knowledgeable about this topic (optional)

Help improve this article

What's this?

Did you find what you were looking for?



Course of the "Race to the Sea" showing dates of encounters and highlighting the significant battles.

V · T · E **Race to the Sea** [hide]

1st Picardy · **Firey · Albert** · Arras · La Bassée · Messines · Armentières · Yser · 1st Ypres

End-user interface: Events on the map and timeline: Battle of Albert 1914

[+] agent

[-] combat related

no 32

yes 62

[-] deportations

no 83

yes 13

[+] destroyed buildings

[-] human shields

no 70

yes 26

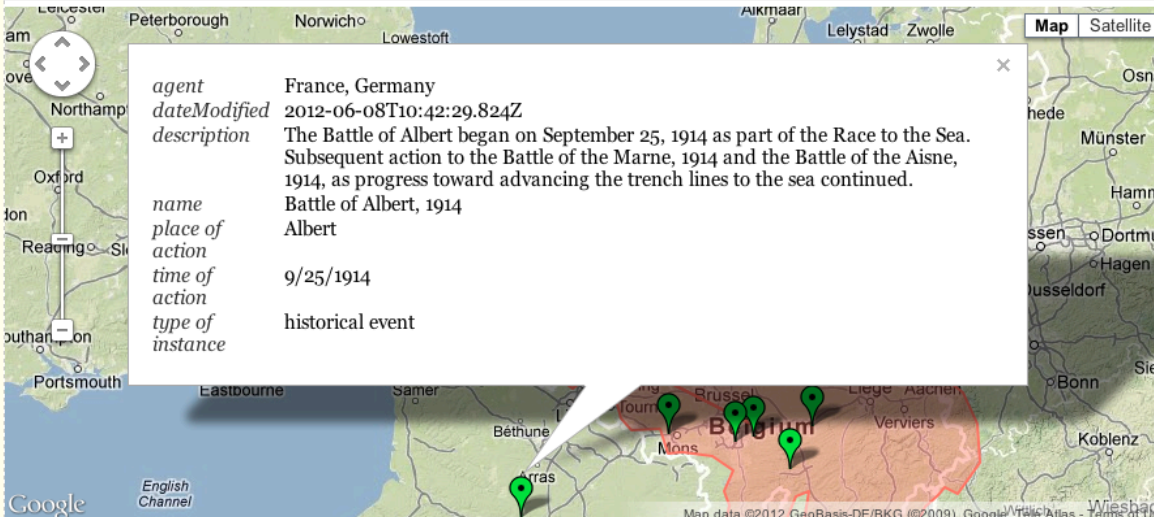
[+] killings

[-] panic

no 70

yes 25

List Map



agent France, Germany

dateModified 2012-06-08T10:42:29.824Z


description The Battle of Albert began on September 25, 1914 as part of the Race to the Sea. Subsequent action to the Battle of the Marne, 1914 and the Battle of the Aisne, 1914, as progress toward advancing the trench lines to the sea continued.

name Battle of Albert, 1914

place of action Albert

time of action 9/25/1914

type of instance historical event



Event	Sep	Oct	Nov	Dec	1915	Feb	Mar	Apr	May
Atrocities in Herve									
Battle of Nonne Bosschen									
Atrocities in Linsmeau									
Atrocities in Baelen									
Atrocities in Francorchamps									
Battle of Albert, 1914									
Atrocities in St Truiden									

Data linking across datasets (to get the 5th star!)

Relationship links

- Pointers to additional information
 - *E.g., persons to places where they lived*

Identity links

- Pointers to similar resources in other datasets
 - *E.g., sameAs -links*

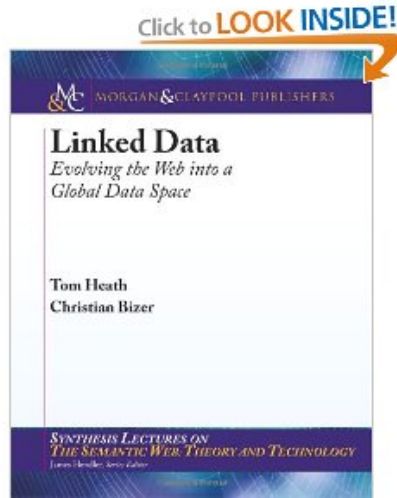
Vocabulary links

- Pointers to vocabulary terms (in metadata models) in related datasets
 - *E.g., using Dublin Core dump-down principle*

Ontology links

- Pointers to concepts in ontological vocabularies
 - *E.g., keyword thesauri for subject descriptions*

More information: read the chapters 1–2 from the Linked Data course book



- Openly available on the web: <http://linkeddatabook.com/editions/1.0/>
- Printed book: Morgan & Claypool, Palo Alto, CA, USA, 2011

Web of Data: data publishing and using

In the UK: <http://data.gov.uk>

The screenshot shows the data.gov.uk website interface. At the top, there is a navigation bar with the following items: Home, Data, Participate, Apps, **Location**, **Linked Data**, **Libra**, Lab, and About. The 'Location', 'Linked Data', and 'Libra' items are circled in red. Below the navigation bar, there are several featured articles and sections:

- What is Linked Data?** An Introduction to Linked Data (with a portrait of a man).
- SEARCH AND PREVIEW** New map widgets (with a red circular icon).
- BATHING QUALITY DATA AS LINKED DATA** A BLOG BY Dr IAN DICKINSON (with a green background and a link icon).
- User Survey** 2012 User Survey – Now Open (with a portrait of a man).
- DEPARTMENTAL OPEN DATA STRATEGIES** (with a portrait of a man).

Below these articles, there are two search boxes, each showing 8979 Datasets. The bottom section features 'Latest datasets' and 'Latest blogs, forums and ideas'. At the very bottom, there is a cookie consent banner with the text: "We use cookies on this site to enhance your user experience. By clicking any link on this page you are giving your consent for us to set cookies." and buttons for "Yes, I agree" and "No, I want to find out more".

Lots of applications online

The screenshot shows the Data.gov.uk website in a browser window. The browser's address bar displays 'http://data.gov.uk/apps'. The website header includes the HM Government logo and the 'DATA.GOV.UK Beta' logo with the tagline 'Opening up Government'. A navigation menu contains links for Home, Data, Participate, Apps, Location, Linked Data, Library, Lab, and About. The 'Apps' section is active, displaying a carousel of application thumbnails. The first thumbnail, 'Accident Black Spots in England 2010', is circled in red. This application is described as a series of embeddable maps showing accident rates per thousand registered vehicles in England using 2010 data from the Department of Transport. Below the carousel is a search bar for apps and a section for popular tags including 'map', 'crime', 'uk', 'london', 'maps', 'local authority', 'transport', 'iphone', 'schools', 'mapping', 'travel', 'postcode', 'tfl', 'traffic', 'bus', 'rtns', and 'data'. A cookie consent banner is visible at the bottom of the page.

In the USA: <http://www.data.gov>

Search for a Dataset - Data... x +

https://catalog.data.gov/dataset?res_format=RDF&res_format_limit=0

Search Data.Gov

DATA TOPICS ▾ IMPACT APPLICATIONS DEVELOPERS CONTACT

DATA CATALOG / Datasets Organizations ?

Search datasets...

Order by: Select an option ▾

Datasets ordered by Popular

Formats: RDF ✕

Filter by location Clear

Enter location...

Map data CC-BY-SA by [OpenStreetMap](#)
Tiles by [MapQuest](#)

Topics Clear All

A-Z 1-9

Local Government (6286)

7,070 datasets found

Crimes - 2001 to present [407 recent views](#)

City of Chicago – This dataset reflects reported incidents of crime (with the exception of murders where data exists for each victim) that occurred in the City of Chicago from 2001...

CSV RDF JSON XML

Leading Causes of Death by ZIP Code, 1999-2013 [390 recent views](#)

U.S. Department of Health & Human Services – Deaths by Cause of Death, by Zip Code 1999-2013 (By Place of Residence): This dataset is for death of California residents, by cause of death, by Zip Code, for year...

CSV RDF JSON xsl

Lottery Powerball Winning Numbers: Beginning 2010 [299 recent views](#)

State of New York – Go to <http://on.ny.gov/1GpWiHD> on the New York Lottery website for past Powerball results and payouts.

City

Federal

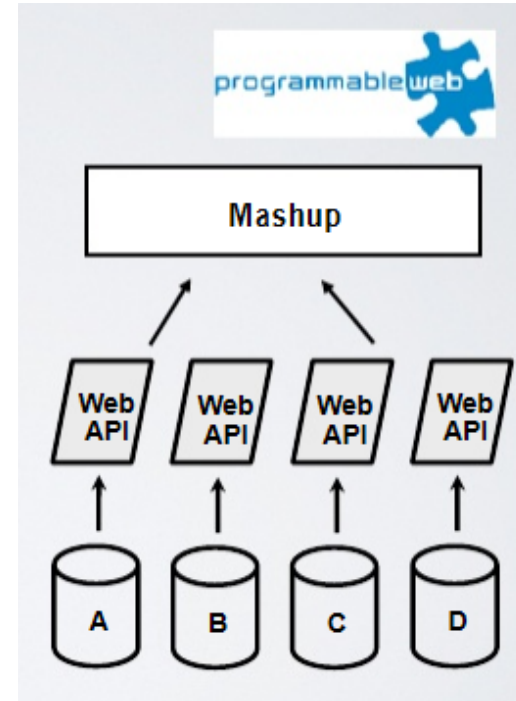
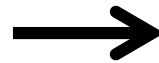
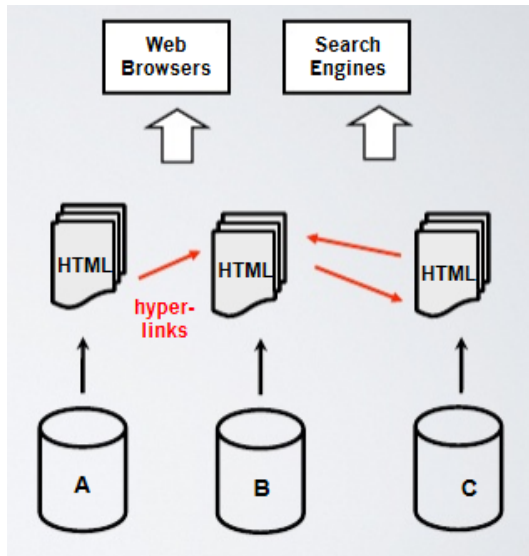
State

Use cases

W3C's Working Group Note: Data on the Web Best Practices Use Cases & Requirements

1. Introduction
2. Use Cases
 - 2.1 ASO: Airborne Snow Observatory
 - 2.2 BBC
 - 2.3 Bio2RDF
 - 2.4 BuildingEye: SME use of public data
 - 2.5 Dados.gov.br
 - 2.6 Digital archiving of Linked Data
 - 2.7 Dutch Base Registers
 - 2.8 GS1 Digital
 - 2.9 ISO GEO Story
 - 2.10 The Land Portal
 - 2.11 LA Times' Reporting of Ron Galperin's Infographic
 - 2.12 LusTRE: Linked Thesaurus fRamework for Environment
 - 2.13 Machine-readability and Interoperability of Licenses
 - 2.14 Mass Spectrometry Imaging (MSI)
 - 2.15 OKFN Transport WG
 - 2.16 Open City Data Pipeline
 - 2.17 Open Experimental Field Studies
 - 2.18 Resource Discovery for Extreme Scale Collaboration (RDESC)
 - 2.19 Recife Open Data Portal
 - 2.20 Retrato da Violência (Violence Map)
 - 2.21 Share-PSI 2.0: Uses of Open Data Within Government for Innovation and Efficiency
 - 2.22 Tabulae - how to get value out of data
 - 2.23 UK Open Research Data Forum
 - 2.24 Uruguay Open Data Catalog
 - 2.25 Web Observatory
 - 2.26 Wind Characterization Scientific Study
3. General Challenges
 - 3.1 A Word on Open and Closed Data
 - 3.2 Requirements by Challenge

Using Web of Data as service



Linked Data publishing platform example: Linked Data Finland LDF.fi

Linked Data Finland Living Lab

<http://ldf.fi>



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[Services](#)

[Policies](#)

[Documentation](#)

[Validation](#)

[Applications](#)

[Your Data?](#)

Linked Data Finland

Living Laboratory Data Service for the Semantic Web

This site is the Living Laboratory of the [Linked Data Finland](#) research initiative, conducted by the [Semantic Computing Research Group](#) at [Aalto University](#) in collaboration with University of Helsinki and a large consortium of Finnish public organizations and companies.

Our goal is to make life easier for both publishers as well as consumers of structured data on the Web. We base our work on the [Linked Data](#) paradigm and stack of standards, which combines an expressive, semantic data model ([RDF](#)) with standardized access mechanisms ([SPARQL](#) and [live HTTP URIs](#)).

5-star Linked Data

The baseline of our work is the [5-star Linked Data model](#), proposed [originally](#) by Tim Berners-Lee.

- ★ Make data available on the Web in whatever format.
- ★★ Make data available as structured data (e.g., Excel instead of an image scan of a table).
- ★★★ Use non-proprietary formats (e.g., CSV instead of Excel format).
- ★★★★ Use URIs to denote things, so that people can point at your data.
- ★★★★★ Link your data to other data to provide context.

7-star Linked Data Service

However, in our opinion, providing 5-star Linked Data is just the beginning. To actually make use of the datasets, consumers need more support in getting to know and access them, as well as a better grasp of their quality and provenance. To this end, we extend the model with two additional stars:

- ★★★★★ Provide your data with a schema and documentation so that people can *understand and re-use* your data easily.
- ★★★★★ Validate your data and denote its provenance so that people can *trust the quality* of your data.

This added support should come with as little extra work as possible to the data publisher. Our hypothesis is that a lot of this can be done automatically, basing on the Linked Data core. A data publisher needs only to provide

Linked Open Universities

Linked Open Aalto: <http://data.aalto.fi>



Aalto University

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[Visualizations](#)

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[SPARQL Endpoint](#)

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[Licenses](#)

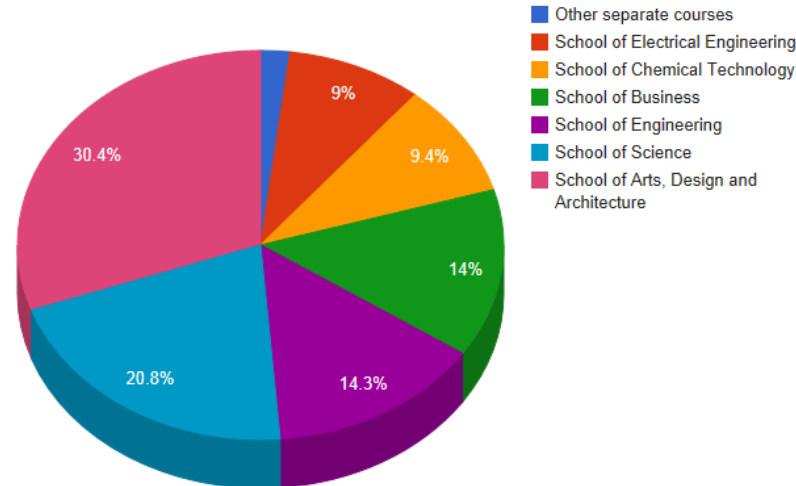
Linked Open Aalto Data Service

Opening Aalto University Content for Applications

Linked Open Aalto Visualizations

These visualizations represent the linked data that has been converted from various legacy sources. Visualizations have been made with the Linked Open Aalto [Visualization Playground](#) that can create visualizations on the fly with the Google Chart Editor.

Number of courses offered by schools of Aalto University



Our "7-star" model and LDF.fi data hotel

Goals: enhance re-usability and data quality

7-star Linked Data Service

However, in our opinion, providing 5-star Linked Data is just the beginning. To actually make use of the datasets, consumers need more support in getting to know and access them, as well as a better grasp of their quality and provenance. To this end, we extend the model with two additional stars:



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Validate your data and denote its provenance so that people can *trust the quality* of your data.

This added support should come with as little extra work as possible to the data publisher. Our hypothesis is that a lot of this can be done automatically, basing on the Linked Data core. A data publisher needs only to provide their data in the RDF format, and the LDF.fi portal will do the rest automatically. See the [overview paper](#) (in ESWC 2014 Proceedings, Springer-Verlag) for some more details about the underlying ideas.



Burj Al Arab

Why LDF.fi?

Living Laboratory for publishing Linked Open Data

- Same idea as in **ontology services** (e.g., ONKI <http://onki.fi>)
- But for **data** and **schemas**

Data Services for

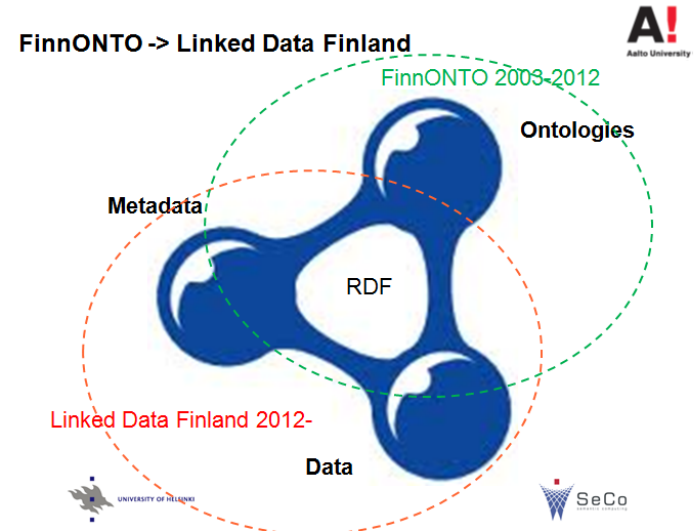
- Linked datasets
- Schemas

Links to

- Related services
- Related applications

Learning Center

- For publishing and using Linked Data
- <http://linda.seco.cs.aalto.fi>



Implementation

Based on Fuseki SPARQL server

- http://jena.apache.org/documentation/serving_data/

Varnish web application accelerator front-end for dereferencing URIs

- <https://www.varnish-cache.org>

Dataset home pages are generated automatically

- Based on the metadata
- JavaScript and jQuery