

# Introduction to Linked Open Data

[bit.ly/SWIBLODintro](https://bit.ly/SWIBLODintro)

Uldis Bojārs, National Library of Latvia  
Christina Harlow, Stanford University  
Huda Khan, Cornell University

SWIB 2017, 4 December 2017  
Hamburg, Germany

**Workshop Resources:**  
**[bit.ly/SWIBLODintro](https://bit.ly/SWIBLODintro)**

# Workshop Etiquette

## (influenced by the Hacker School Rules)

- Feel free to ask questions
- Help others where you can
- Be open to different domain expertise & experiences
- Be kind

More info on the “Hacker School Rules”:

<https://www.recurse.com/blog/38-subtle-isms-at-hacker-school>

<https://www.recurse.com/manual#sub-sec-social-rules>

# Schedule

<b>13:00 - 13:15</b>	General Workshop Introduction
<b>13:15 - 14:00</b>	RDF Introduction: Create Your Graph
<b>14:00 - 14:30</b>	Linked Data Intro.: Link Your Graph to Your Group
<b>14:30 - 15:30</b>	Linked Data & Semantic Web: Expanding Your Graph
<b>15:30 - 16:00</b>	<i>30 minute break, cake served in the foyer</i>
<b>16:00 - 16:15</b>	Linked Open Data & Licensing: License Your Graph
<b>16:15 - 17:15</b>	Linked Data Experimentation: SPARQL & Vis.
<b>17:15 - 17:30</b>	<i>15 minute break</i>
<b>17:30 - 18:00</b>	Linked Data Examples, Resources & Datasets
<b>18:00 - 19:00*</b>	Wrap-up & Help Moving Forward ( <i>optional</i> )

# Our Goals for this Workshop

- Introduce & Leverage the RDF data model
- Create & Refine RDF Documents
- Explain Fundamentals of Linked Data Technologies
- Introduce & Discuss Basic Issues of Linked **Open** Data
- Apply Open Data Principles to RDF data
- Understand Advantages of Modeling in RDF
- Understand Advantages of Publishing Linked Data
- Share LOD Tools, Projects, Resources, Examples

# Your goals for this Workshop?

- Why are you attending this workshop?
- What are your goals - immediate or long-term?
- What's your level of comfort & experience with Linked Data?

# **RDF Introduction: Create Your Graph**

# Facilitator's Example

```
@prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
```

```
@prefix schema: <http://schema.org/> .
```

```
z:ub schema:name "Uldis" .
```

```
z:ub schema:location "Riga" .
```

```
z:ch schema:name "Christina" .
```

```
z:ch schema:location "San Francisco" .
```

```
z:hk schema:name "Huda" .
```

```
z:hk schema:location "Ithaca" .
```



# Facilitator's Example

**B** *I* U ~~S~~













 1

```
1 @prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#>
2 @prefix schema: <http://schema.org/> .
3
4 z:ub schema:name "Uldis" .
5 z:ub schema:location "Riga" .
6
7 z:ch schema:name "Christina" .
8 z:ch schema:location "San Francisco" .
9
10 z:hk schema:name "Huda" .
11 z:hk schema:location "Ithaca" .
```

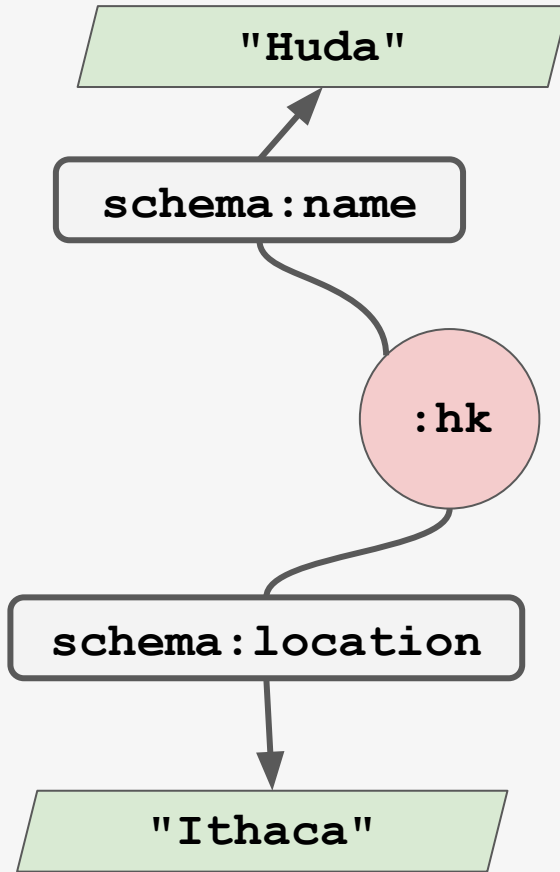
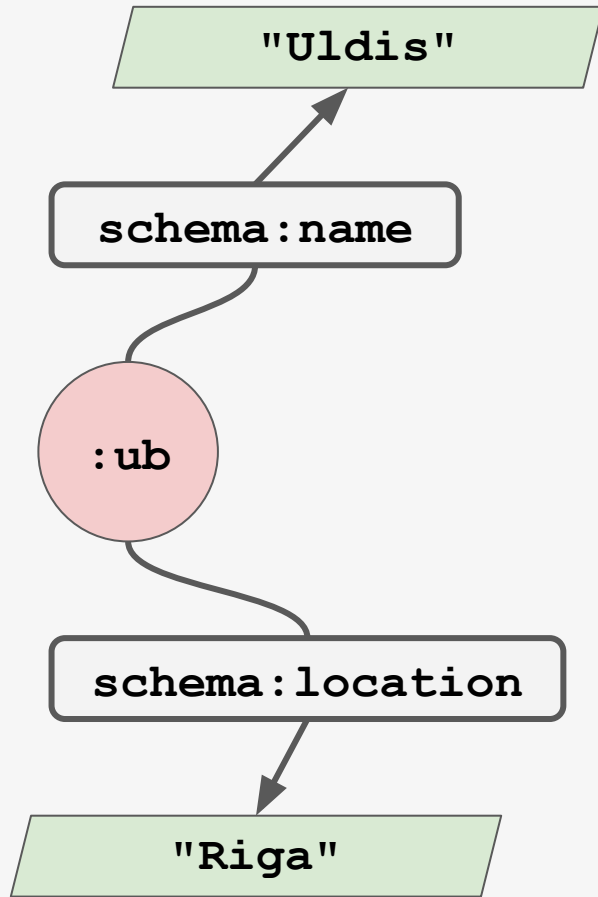
Christina

# Resource Description Framework (RDF)

The Resource Description Framework (RDF) is used to describe arbitrary things.

RDF is based on the concept of **triples**, which consist of **subject**, **predicate** and **object**. It is an abstract model for which several notations exist.

Today we will be using [Turtle](#) for our RDF serialization.



# Your turn!

1. Fill out your name tag.
2. Then transfer your nametag data into the Etherpad of your group.

<https://pad.riseup.net/p/swib-17-ws>

# **Linked Data Introduction: Link Your Graph to Your Group Member's**

# Facilitator's Example

```
@prefix z: <https://pad.riseup.net/p/swib-17-ws-z#> .
```

```
@prefix schema: <http://schema.org/> .
```

```
z:ub schema:name "Uldis" .
```

```
z:ub schema:location "Riga" .
```

```
z:ub schema:knows z:ch .
```

```
z:ub schema:knows z:hk .
```

```
z:ch schema:name "Christina" .
```

```
z:ch schema:location "San Francisco" .
```

```
z:hk schema:name "Huda" .
```

```
z:hk schema:location "Ithaca" .
```

# Facilitator's Example



The screenshot displays the Etherpad interface. At the top, there is a toolbar with various icons for text formatting (bold, italic, underline, strikethrough), list creation, undo, redo, and a code editor icon. On the right side, there are icons for favorite, sync, refresh, settings, and a user profile icon showing 1 person.

The main content area shows a JSON-LD document with the following lines:

```
1 @prefix z: <http://etherpad.lobid.org/p/swibl6-ws-z#> .  
2 @prefix schema: <http://schema.org/> .  
3  
4 z:ub schema:name "Uldis" .  
5 z:ub schema:location "Riga" .  
6 z:ub schema:knows z:ch .  
7 z:ub schema:knows z:hk .  
8  
9 z:ch schema:name "Christina" .  
10 z:ch schema:location "San Francisco" .  
11  
12 z:hk schema:name "Huda" .  
13 z:hk schema:location "Ithaca" .
```

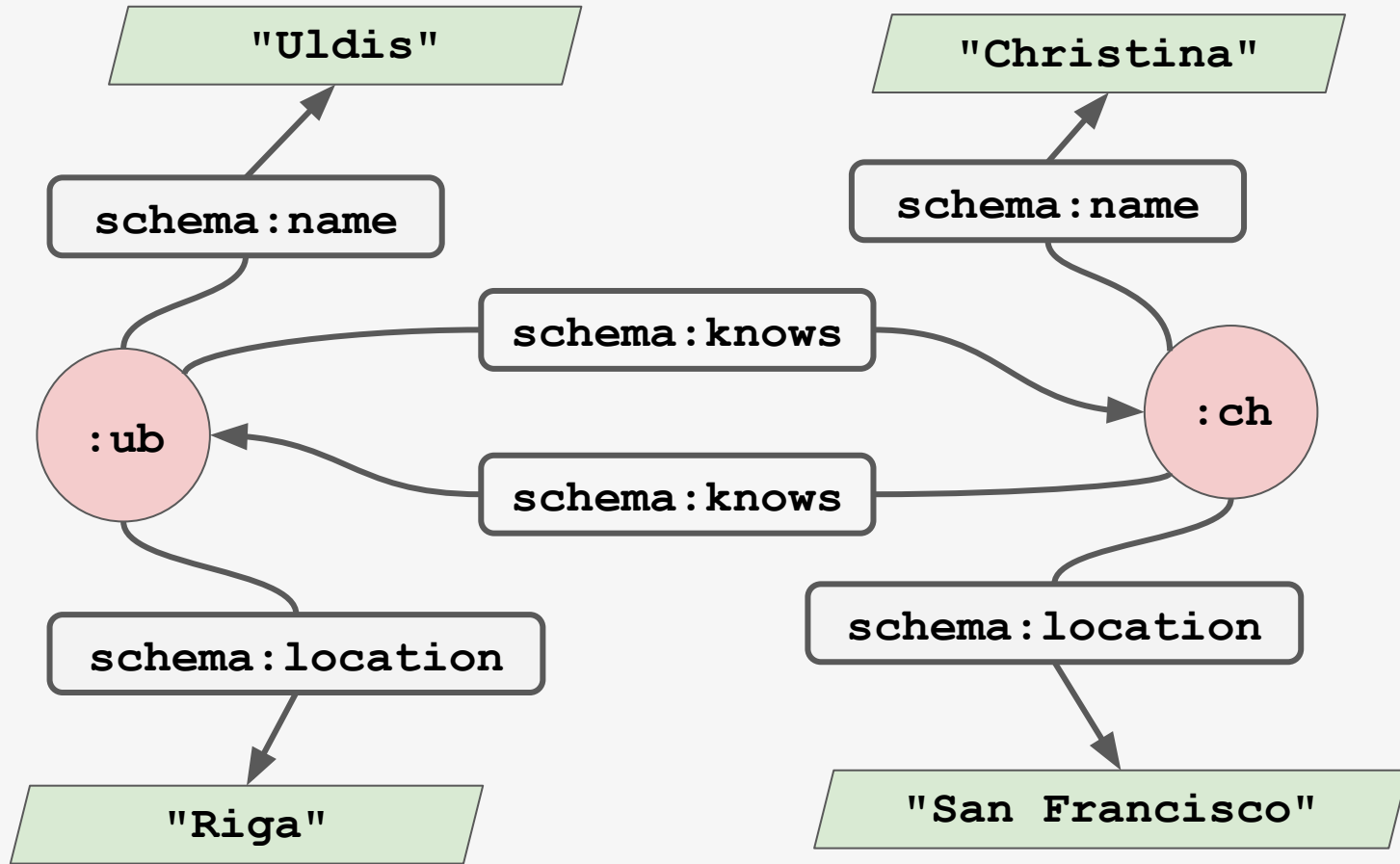
On the right side, a user profile card is visible for a user named Christina, indicated by a brown square icon and a text input field containing the name "Christina".

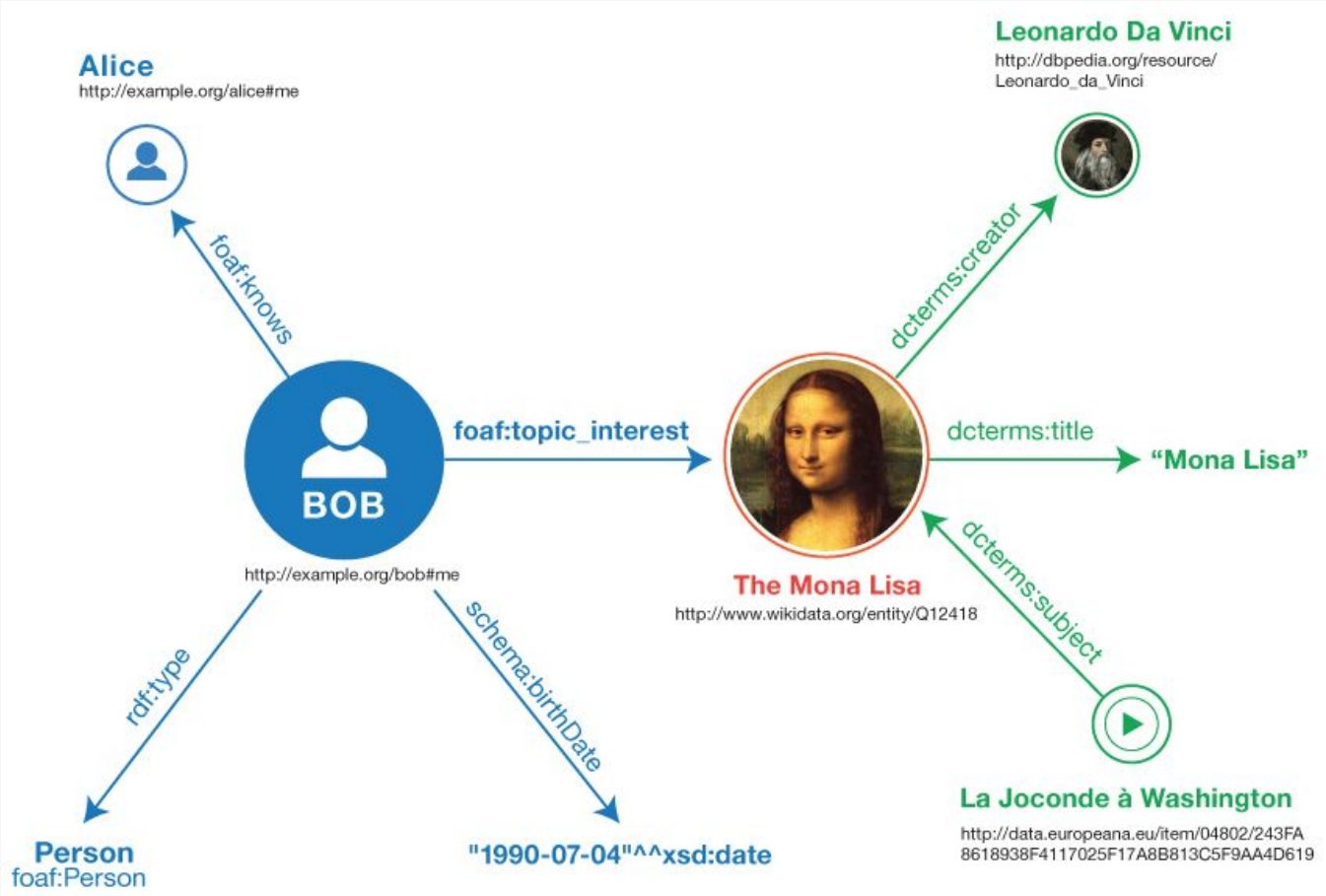
# Linked Data

When using RDF, things are **named** by **Uniform Resource Identifiers** (URIs). By describing and linking things, **graphs** emerge.

Social **networks** such as Facebook or LinkedIn are well-known examples of this approach.





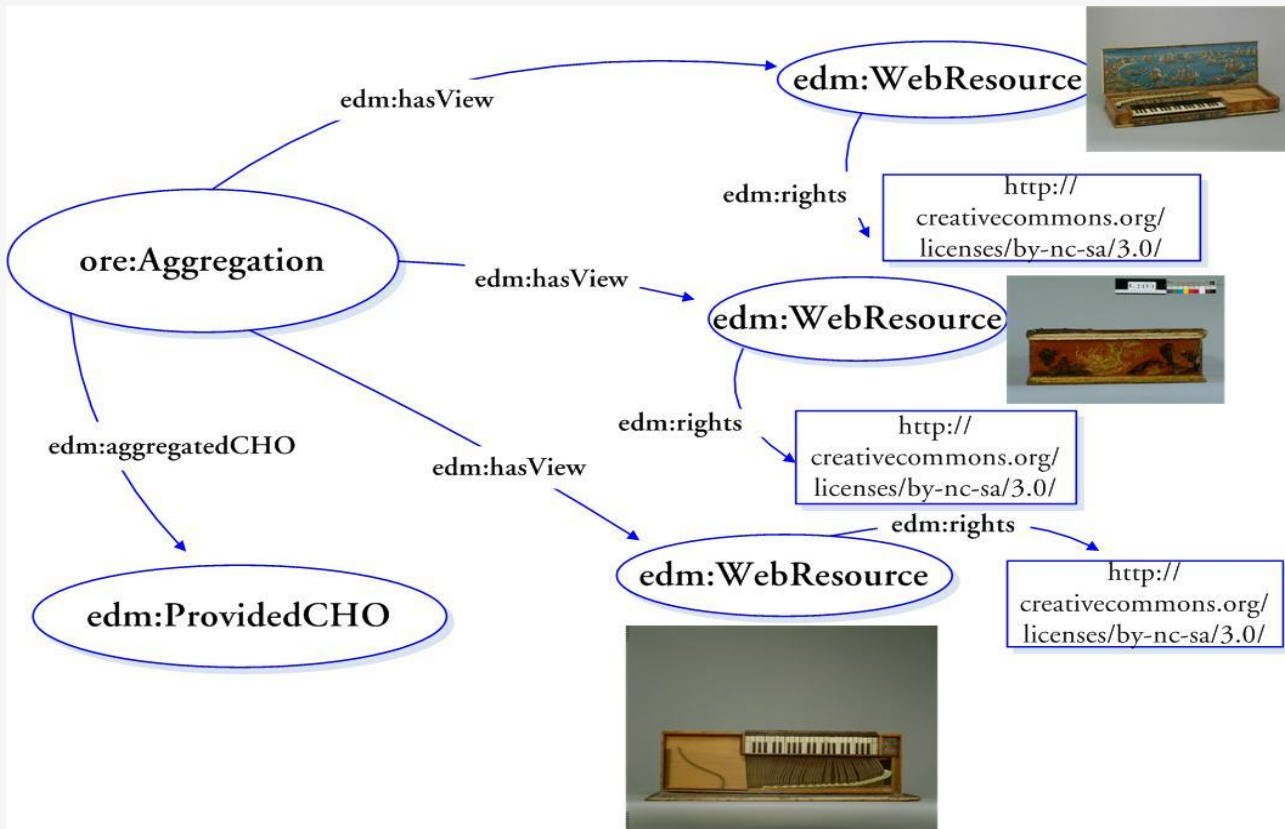


RDF 1.1 Primer - Copyright © 2003-2014 W3C

<http://www.w3.org/TR/rdf11-primer/>

[bit.ly/SWIBLODintro](http://bit.ly/SWIBLODintro)

# Graphs Let Europeana Grow..



# Your turn!

Introduce yourself to the other members of your group. After doing so, document your new acquaintances in the Etherpad data using `schema:knows`.

# **Linked Data Introduction: Link Your Graph to Members of other Groups**

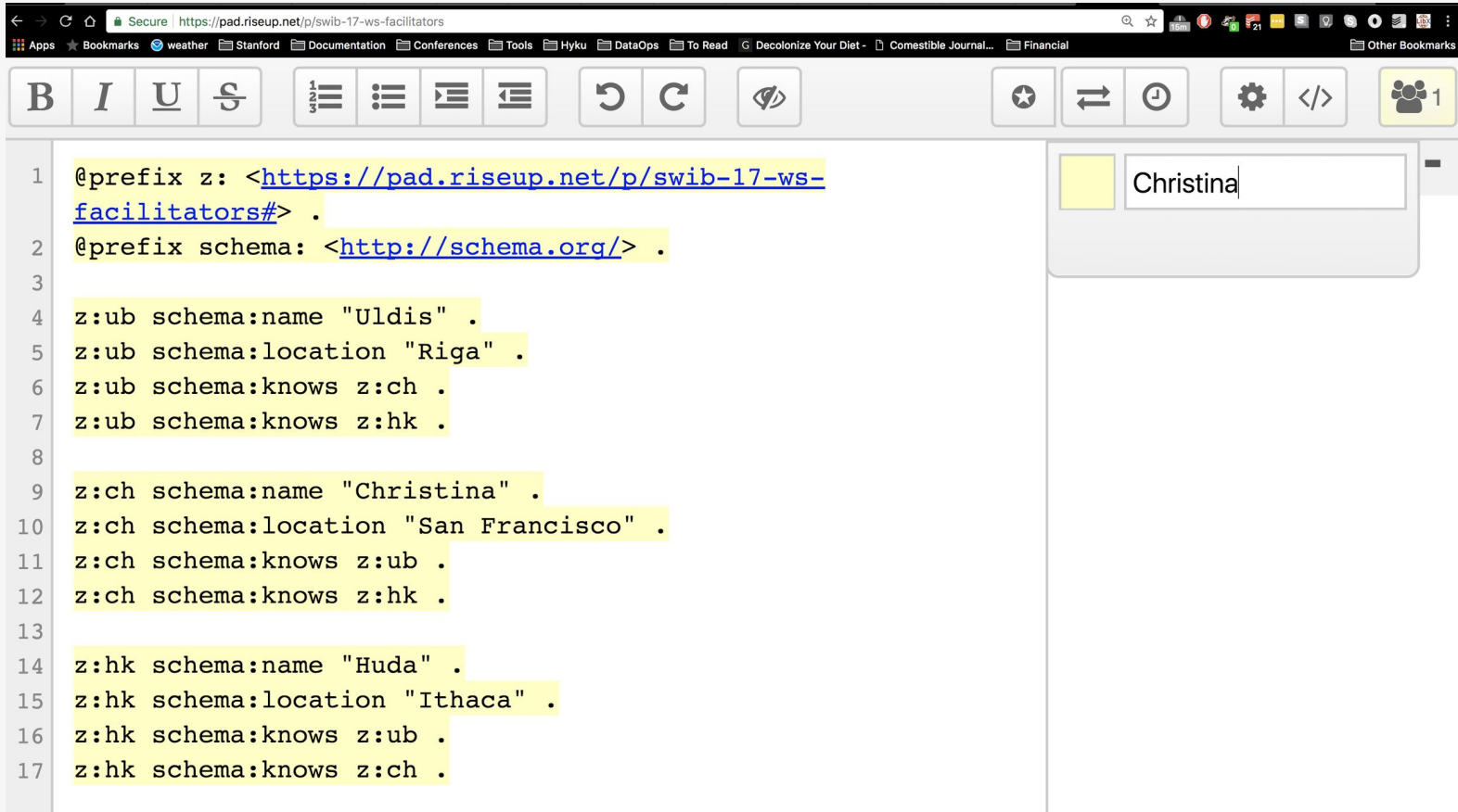
# Facilitator's Example

```
@prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .  
@prefix a: <https://pad.riseup.net/p/swib-17-ws-a#> .  
@prefix schema: <http://schema.org/> .
```

*...[truncated example data]*

```
z:ch schema:name "Christina" .  
z:ch schema:location "San Francisco" .  
z:ch schema:knows z:ub .  
z:ch schema:knows z:hk .  
  
z:hk schema:name "Huda" .  
z:hk schema:location "Ithaca" .  
z:hk schema:knows z:ub .  
z:hk schema:knows z:ch .
```

# Facilitator's Example



The screenshot shows a web browser window with the URL `https://pad.riseup.net/p/swib-17-ws-facilitators`. The browser's address bar and tabs are visible at the top. Below the browser window is a toolbar with various icons for text formatting (bold, italic, underline, strikethrough), list creation, undo, redo, and other editing functions. The main content area is a code editor with 17 lines of text, each preceded by a line number. The text is as follows:

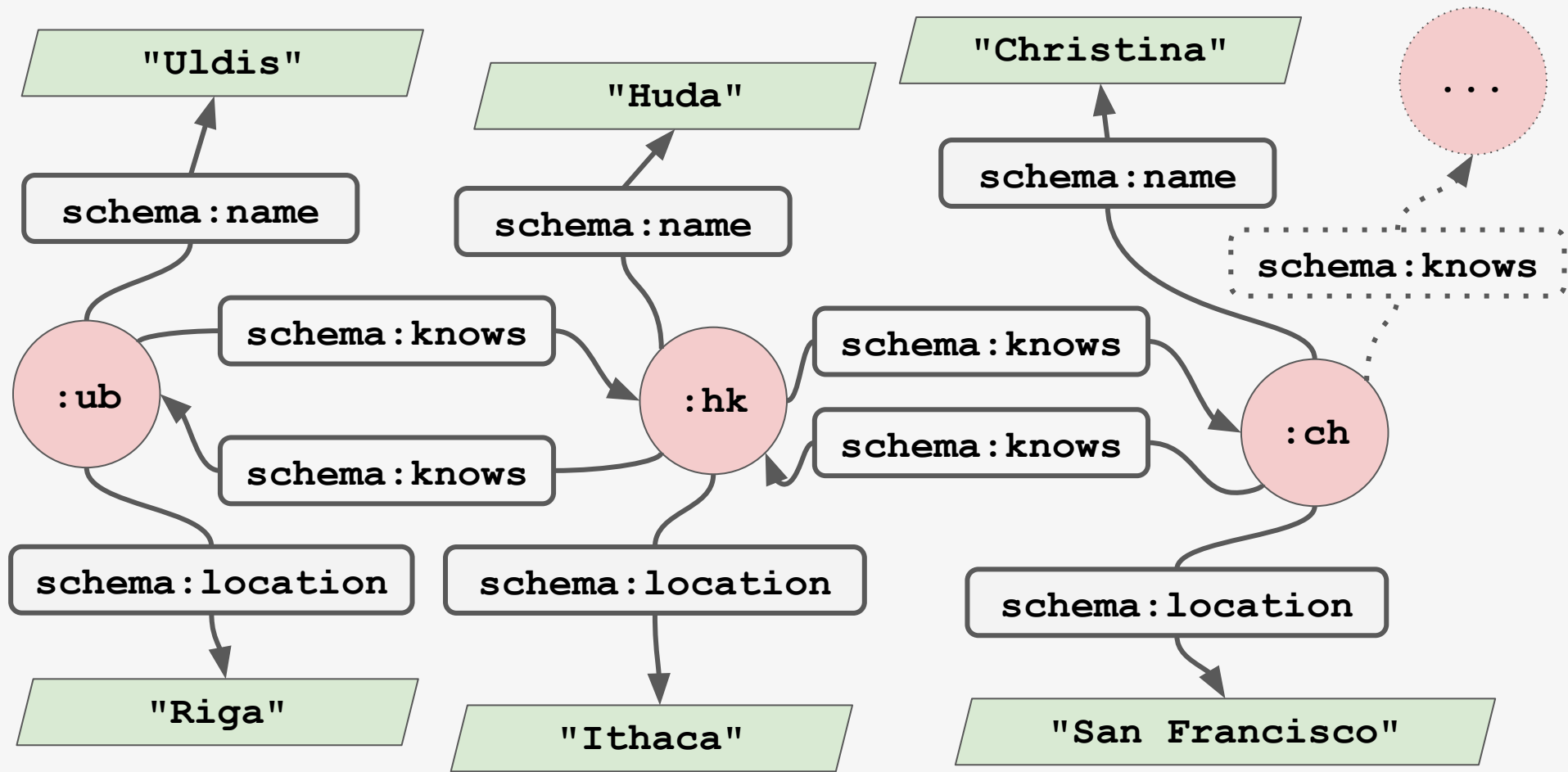
```
1 @prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
2 @prefix schema: <http://schema.org/> .
3
4 z:ub schema:name "Uldis" .
5 z:ub schema:location "Riga" .
6 z:ub schema:knows z:ch .
7 z:ub schema:knows z:hk .
8
9 z:ch schema:name "Christina" .
10 z:ch schema:location "San Francisco" .
11 z:ch schema:knows z:ub .
12 z:ch schema:knows z:hk .
13
14 z:hk schema:name "Huda" .
15 z:hk schema:location "Ithaca" .
16 z:hk schema:knows z:ub .
17 z:hk schema:knows z:ch .
```

On the right side of the editor, there is a participant list box. It contains a yellow square icon and the name "Christina" in a text input field. A small minus sign is visible to the right of the input field.

# The simple power of the Link

Even a **single link** can greatly expand a graph,  
because many new connections can join the  
network.





# Your turn!

Extend your set of acquaintances linking out to people beyond your group. As before, document these new connections in the Etherpad.

# Turtle RDF Serialization & Syntax

- **Turtle (Terse RDF Triple Language):** format for expressing data in RDF.
- Each RDF triple starts on new line & ends with a full stop (.).
- **URIs:** Enclosed in angle brackets, i.e. `<http://www.ex.com/ex>`
- **Literals** are written *usually* using double-quotes (“”).
- Blank spaces / white spaces (outside of Literal quotes) are only to separate components of RDF statement.
- **Comments:** Preceded by ‘# ’ & continue to end of line.
- **Prefixes:** Letters preceding colon that are an abbreviation for an ontology namespace URI defined above in the Turtle document.
- **Online Turtle Validator:** <http://ttl.summerofcode.be/>

# Linked Data & Semantic Web: Expanding Your Graph

# Facilitator's Example

https://en.wikipedia.org/wiki/Riga

Not logged in | Talk | Contributions | Create account | Log in

Article | **Talk** | Read | Edit | View history | Search Wikipedia

## Riga

From Wikipedia, the free encyclopedia

Coordinates: 56°56′56″N 24°6′23″E﻿ / ﻿56.94889°N 24.10639°E﻿ / 56.94889; 24.10639

*This article is about the Latvian capital. For other uses, see [Riga \(disambiguation\)](#).*

**Riga** (/ˈriːɡə/; Latvian: *Rīga*, pronounced [ˈriːɡa] (listen (help·listen))) is the capital and the largest city of Latvia. With 696,593 inhabitants (2015), Riga is the largest city of the Baltic states and home to one third of Latvia's population.<sup>[6]</sup> The city lies on the Gulf of Riga, at the mouth of the Daugava. Riga's territory covers 307.17 square kilometres (118.60 square miles) and lies between one and ten metres (3 feet 3 inches and 32 feet 10 inches) above sea level,<sup>[7]</sup> on a flat and sandy plain.<sup>[7]</sup>

Riga was founded in 1201 and is a former Hanseatic League member. Riga's historical centre is a UNESCO World Heritage Site, noted for its Art Nouveau/Jugendstil architecture and 19th century wooden architecture.<sup>[8]</sup> Riga was the European Capital of Culture during 2014, along with Umeå in Sweden. Riga hosted the 2006 NATO Summit, the Eurovision Song Contest 2003, and the 2006 IIHF Men's World Ice Hockey Championships. It is home to the European Union's office of European Regulators for Electronic Communications (BEREC). Riga is served by Riga International Airport, the largest airport in the Baltic states.

Riga is a member of Eurocities,<sup>[9]</sup> the Union of the Baltic Cities (UBC)<sup>[10]</sup> and Union of Capitals of the European Union (UCEU).<sup>[11]</sup>

**Contents** [hide]

### Riga

#### City



From top, left to right: the Freedom Monument,

# Facilitator's Example

An Entity of Type : [city](#), from Named Graph : <http://dbpedia.org>, within Data Space : [dbpedia.org](#)

Riga (/ˈriːɡə/; Latvian: Rīga, pronounced [ˈriːɡa] ) is the capital and the largest city of Latvia. With 696,593 inhabitants (2015), Riga is the largest city of the Baltic states and home to one third of Latvia's population. The city lies on the Gulf of Riga, at the mouth of the Daugava. Riga's territory covers 307.17 km2 (118.60 sq mi) and lies between 1 and 10 metres (3.3 and 32.8 ft) above sea level, on a flat and sandy plain. Riga is a member of Eurocities, the Union of the Baltic Cities (UBC) and Union of Capitals of the European Union (UCEU).

Property	Value
<a href="#">dbpedia:PopulatedPlace/area</a>	<ul style="list-style-type: none"><li>1.0E-6</li></ul>
<a href="#">dbpedia:PopulatedPlace/areaMetro</a>	<ul style="list-style-type: none"><li>10133.0</li></ul>
<a href="#">dbpedia:PopulatedPlace/areaTotal</a>	<ul style="list-style-type: none"><li>304.0</li></ul>
<a href="#">dbpedia:PopulatedPlace/populationMetroDensity</a>	<ul style="list-style-type: none"><li>101.4</li></ul>
<a href="#">dbpedia:abstract</a>	<ul style="list-style-type: none"><li>Riga (<span><span>/<span><span>ˈ</span><span>r</span><span>iː</span><span>ɡ</span><span>ə</span></span>/</span></span>; Latvian: Rīga, pronounced <span>[ˈriːɡa]</span> ) is the capital and the largest city of Latvia. With 696,593 inhabitants (2015), Riga is the largest city of the Baltic states and home to one third of Latvia's population. The city lies on the Gulf of Riga, at the mouth of the Daugava. Riga's territory covers 307.17 km2 (118.60 sq mi) and lies between 1 and 10 metres (3.3 and 32.8 ft) above sea level, on a flat and sandy plain. Riga was founded in 1201 and is a former Hanseatic League member. Riga's historical centre is a UNESCO</li></ul>

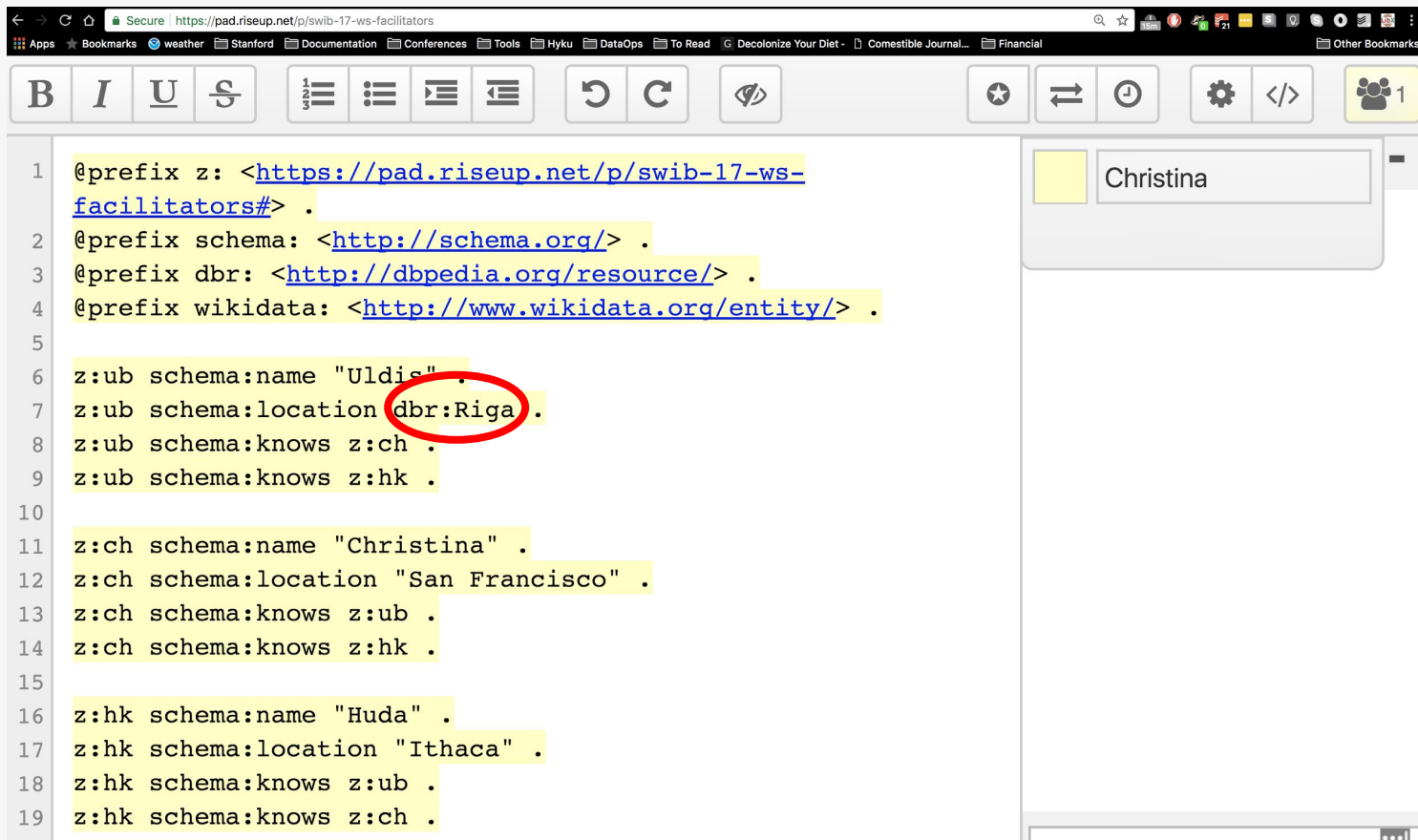
# Facilitator's Example

```
@prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
@prefix schema: <http://schema.org/> .
@prefix dbr: <http://dbpedia.org/resource/> .
@prefix wikidata: <http://www.wikidata.org/entity/> .

z:ub schema:name "Uldis" .
z:ub schema:location dbr:Riga .
z:ub schema:knows z:ch .
z:ub schema:knows z:hk .

...[truncated example data]
```

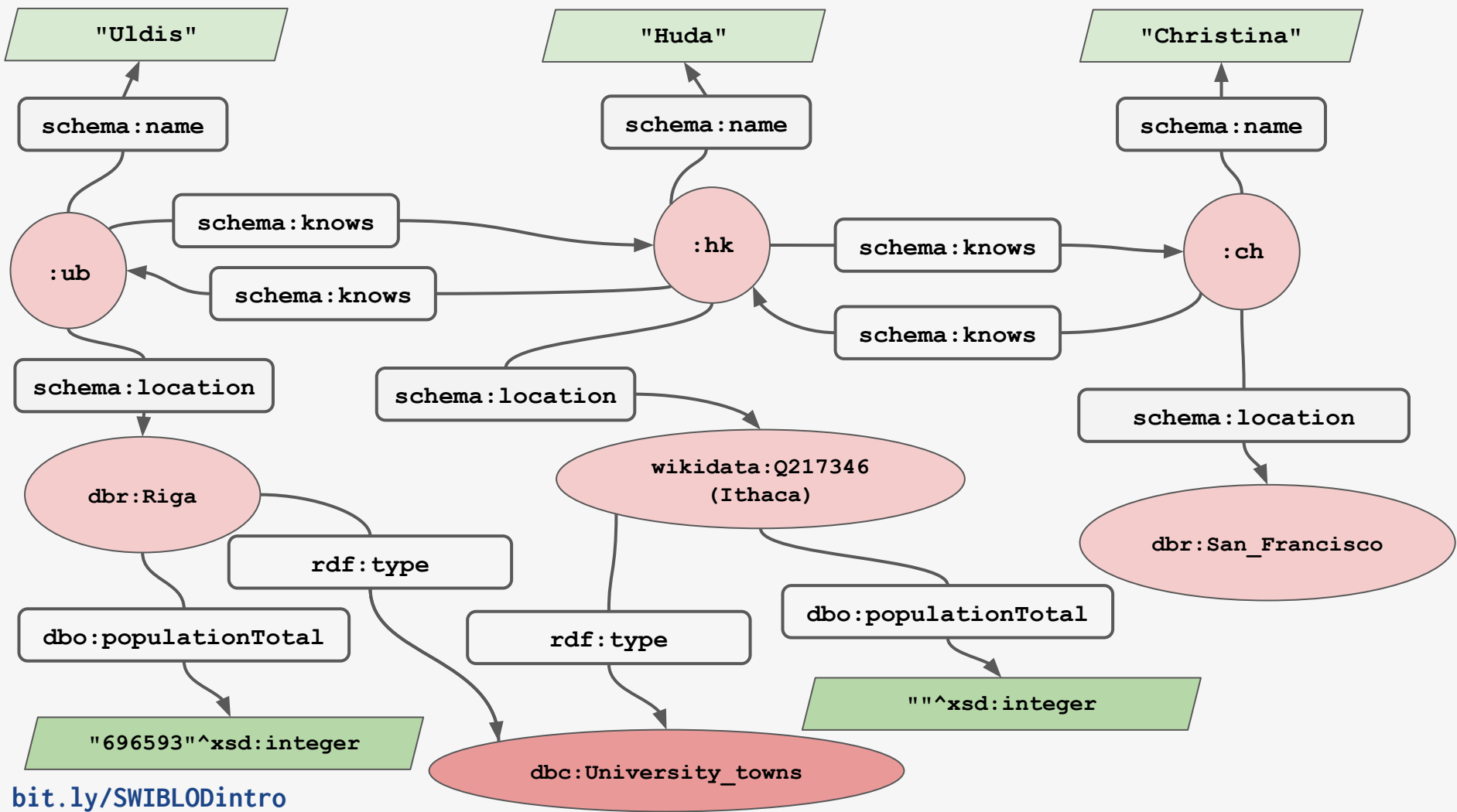
# Facilitator's Example



The screenshot shows a web browser window with the URL `https://pad.riseup.net/p/swib-17-ws-facilitators`. The browser's address bar and tabs are visible at the top. Below the browser window is a rich text editor toolbar with various icons for text formatting (bold, italic, underline, strikethrough), list creation, indentation, undo, redo, and link management. The main content area is a code editor with a light gray background and line numbers on the left. The code is written in a monospaced font and contains several lines of text, many of which are highlighted in yellow. A red circle highlights the text `dbr:Riga` in line 7. To the right of the code editor is a vertical sidebar containing a list of participants. The first participant is 'Christina', with a yellow square next to her name. The sidebar also has a minus sign icon and a '1' in a circle, indicating one participant is currently active.

```
1 @prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix dbr: <http://dbpedia.org/resource/> .
4 @prefix wikidata: <http://www.wikidata.org/entity/> .
5
6 z:ub schema:name "Uldis" .
7 z:ub schema:location dbr:Riga .
8 z:ub schema:knows z:ch .
9 z:ub schema:knows z:hk .
10
11 z:ch schema:name "Christina" .
12 z:ch schema:location "San Francisco" .
13 z:ch schema:knows z:ub .
14 z:ch schema:knows z:hk .
15
16 z:hk schema:name "Huda" .
17 z:hk schema:location "Ithaca" .
18 z:hk schema:knows z:ub .
19 z:hk schema:knows z:ch .
```





# The Giant Global Graph

By using **HTTP-URIs**, Linked Data builds upon a technology that is proven to **scale** globally. With reference to the World Wide Web, the term **Giant Global Graph** is sometimes used. What is true for the WWW is also true for the GGG:  
**Anyone can say anything about anything.**

# Linked Data Principles

**Tim Berners-Lee**

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

<https://www.w3.org/DesignIssues/LinkedData.html>

# Your turn!

First, find your location in Wikipedia.

Then, Replace the name of your location in your RDF with a reference to DBpedia (or other vocabulary) using the Wikipedia URL key.



# Facilitator's Example

```
@prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
@prefix schema: <http://schema.org/> .
@prefix dbr: <http://dbpedia.org/resource/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .

z:ub schema:name "Uldis" .
z:ub schema:location dbr:Riga .
z:ub schema:knows z:ch .
z:ub schema:knows z:hk .
z:ub foaf:interest dbr:Music .
Z:ub foaf:interest dbr:Semantic_Web .

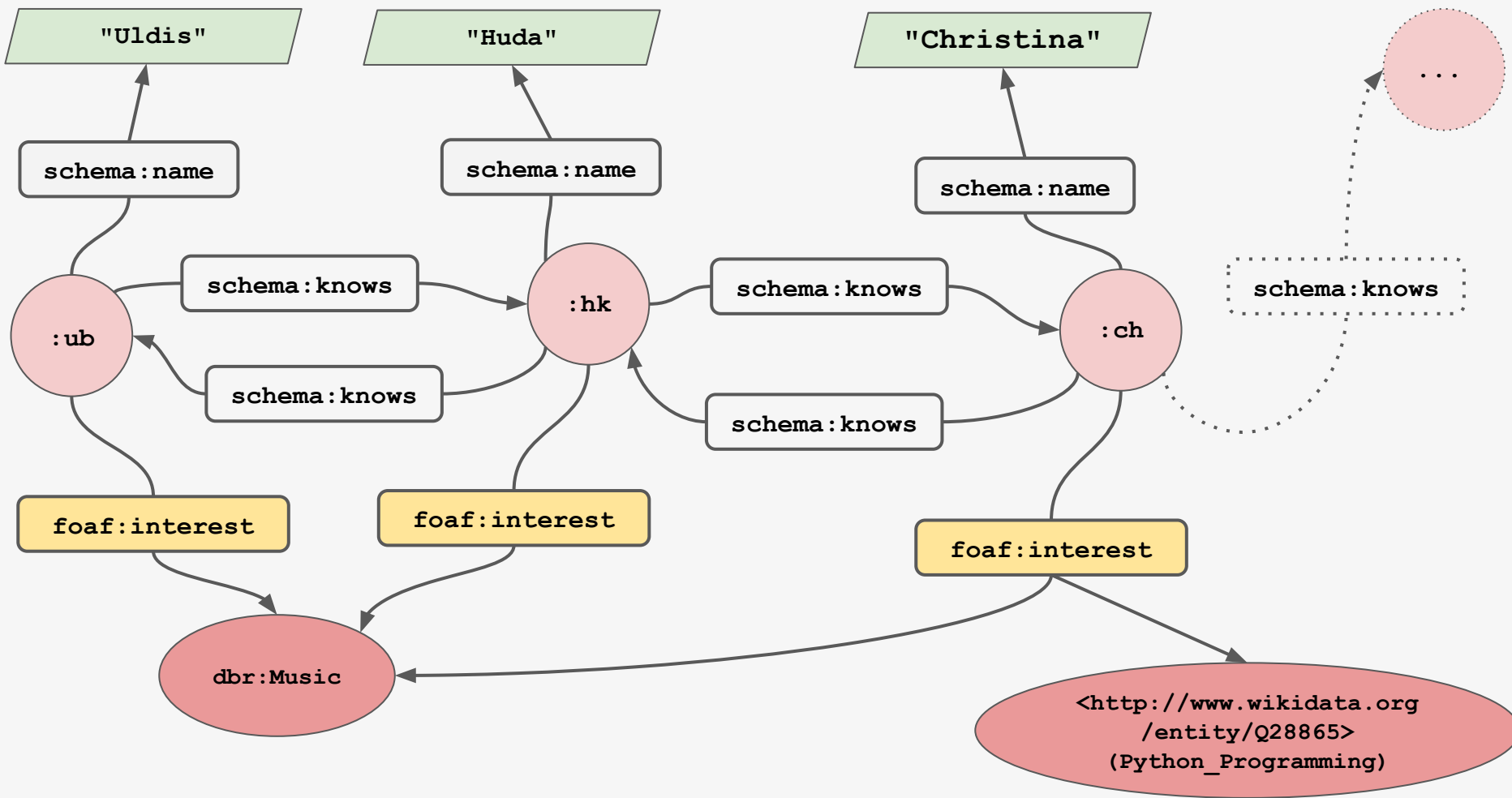
...[truncated example data]
```

# Facilitator's Example

```
Secure | https://pad.riseup.net/p/swib-17-ws-facilitators
Apps | Bookmarks | weather | Stanford | Documentation | Conferences | Tools | Hyku | DataOps | To Read | Decolonize Your Diet

B | I | U | S | [List Icons] | [Refresh] | [Print]

1 | @prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
2 | @prefix schema: <http://schema.org/> .
3 | @prefix dbr: <http://dbpedia.org/resource/> .
4 | @prefix wikidata: <http://www.wikidata.org/entity/> .
5 | @prefix foaf: <http://xmlns.com/foaf/0.1/> .
6 |
7 | z:ub schema:name "Uldis" .
8 | z:ub schema:location dbr:Riga .
9 | z:ub schema:knows z:ch .
10 | z:ub schema:knows z:hk .
11 | z:ub foaf:interest dbr:Music .
12 | Z:ub foaf:interest dbr:Semantic_Web .
13 |
14 | z:ch schema:name "Christina" .
15 | z:ch schema:location dbr:San_Francisco .
16 | z:ch schema:knows z:ub .
17 | z:ch schema:knows z:hk .
18 |
19 | z:hk schema:name "Huda" .
20 | z:hk schema:location wikidata:Q217346 .
21 | z:hk schema:knows z:ub .
22 | z:hk schema:knows z:ch .
```





# Your turn!

Enhance your profile with interest you have.  
Again, refer to DBpedia (or other) entries to  
do so, remembering to use URIs, not URLs.

<http://ttl.summerofcode.be>

# Other Element (Predicate, Field) Sets

- [FOAF \(Friend of a Friend\)](#)
- [vcard](#) (people and organisations)
- [schema.org](#)
- [geo](#) (to express geo-coordinates)
- [Void](#) (to describe datasets)
- [Prov](#) (provenance information)
- ... and many more.
- See:
  - [Linked Open Vocabularies \(LOV\)](#) to look up ontologies & vocabularies
  - [prefix.cc](#) to look up namespaces

# Library-Related Element Sets

- [Dublin Core Metadata Terms](#)
- [Simple Knowledge Organisation System \(SKOS\)](#)
  - Examples of Vocabularies using SKOS: [Agrovoc](#), [STW Thesaurus for Economics](#), many small controlled vocabularies (for example, [RDA value vocabularies](#))
  - SKOS schemas in BARTOC: [http://bartoc.org/en/search/advanced?f\[0\]=field\\_format%3A24](http://bartoc.org/en/search/advanced?f[0]=field_format%3A24)
- [GND Ontology](#), [Getty Authorities Ontology](#)
- [RDA Elements sets](#)
- [EDM \(Europeana Data Model\)](#)
- [BIBFRAME \(Version 2.0\)](#)
- And a growing number more...

# (Instance) Datasets

- [DBpedia](#), [Wikidata](#)
- [BNF](#), [BL](#), [BNE](#), [DNB](#), [LoC](#), ...
- [GeoNames](#)
- [VIAF](#)

See [datahub.io](#) for many more ...

**30 minutes Break  
(Return at 15:50)**

# Linked Open Data & Data Licensing

# “Open”?

*“Open data and content can be **freely** used, modified, and shared by anyone for any purpose”*

[The Open Definition](#)

# Openness involves...

- **Access:** no passwords, quantity restrictions, etc.
- **License:** only allowed restrictions are *attribution* and *share-alike*, i.e.:
  - CC0, CC-BY, CC-BY-SA
  - no non-commercial (NC) licenses
- **Formats:** no proprietary formats without freely accessible specification. Supports reuse of data



# Some Data License Options

- [Public Domain Dedication and License \(PDDL\)](#): “Public Domain for data/databases”, [opendatacommons.org/licenses/pddl/](https://opendatacommons.org/licenses/pddl/)
- [Open Data Commons Attribution \(ODC-By\)](#): “Attribution for data/databases”, [opendatacommons.org/licenses/by/](https://opendatacommons.org/licenses/by/)
- [Open Database License \(ODC-ODbL\)](#): “Attribution Share-Alike for data/databases”, [opendatacommons.org/licenses/odbl/](https://opendatacommons.org/licenses/odbl/)
- [CC0 1.0 Universal](#): “Creative Commons public domain waiver”, [creativecommons.org/publicdomain/zero/1.0/](https://creativecommons.org/publicdomain/zero/1.0/)

# Licensing data

STW Thesaurus for Economics (v 9.0, 2015-06-15) • Suggestions and comments to the [thesaurus team](#) •

Mailing lists: [stw-announce](#), [stw-user](#)

ZBW - Leibniz Information Centre for Economics - [Imprint](#)



The STW Thesaurus for Economics is licensed under an [Open Database License \(ODbL\) 1.0](#). Permissions beyond the scope of this license are available at [ZBW](#).

```
@prefix cc: <http://creativecommons.org/ns#> .
```

```
<http://zbw.eu/stw>
```

```
cc:attributionName "ZBW - Leibniz Information Centre for  
Economics"@en, "ZBW - Leibniz-Informationszentrum Wirtschaft"@de ;
```

```
cc:attributionURL "http://zbw.eu" ;
```

```
dcterms:rights "see cc:license"@en, "siehe cc:license"@de ;
```

```
cc:license <http://opendatacommons.org/licenses/odbl/1-0/> ;
```

```
...
```

# Facilitator's Example

```
@prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
@prefix schema: <http://schema.org/> .
@prefix dbr: <http://dbpedia.org/resource/> .
@prefix wikidata: <http://www.wikidata.org/entity/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dcterms: <http://purl.org/dc/terms/> .

<> dcterms:creator z:ub .
<> dcterms:creator z:ch .
<> dcterms:creator z:hk .
<> schema:license <https://creativecommons.org/publicdomain/zero/1.0/>.

z:ch schema:name "Christina" .
z:ch schema:location "Ithaca" .
... [truncated example data]
```

# Facilitator's Example

```
B I U S [list] [list] [list] [list] [undo] [redo] [refresh]
1 @prefix z: <https://pad.riseup.net/p/swib-17-ws-facilitators#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix dbr: <http://dbpedia.org/resource/> .
4 @prefix wikidata: <http://www.wikidata.org/entity/> .
5 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
6 @prefix dcterms: <http://purl.org/dc/terms/> .
7
8 <> dcterms:creator z:ub .
9 <> dcterms:creator z:ch .
10 <> dcterms:creator z:hk .
11 <> schema:license <https://creativecommons.org/publicdomain/zero/1.0/> .
12
13 z:ub schema:name "Uldis" .
14 z:ub schema:location dbr:Riga .
15 z:ub schema:knows z:ch .
16 z:ub schema:knows z:hk .
17 z:ub foaf:interest dbr:Music .
18 Z:ub foaf:interest dbr:Semantic_Web .
19
20 z:ch schema:name "Christina" .
21 z:ch schema:location dbr:San_Francisco .
22 z:ch schema:knows z:ub .
23 z:ch schema:knows z:hk .
24 z:ch foaf:interest dbr:Music .
25 z:ch foaf:interest wikidata:Q28865 .
26
27 z:hk schema:name "Huda" .
28 z:hk schema:location wikidata:Q217346 .
29 z:hk schema:knows z:ub .
30 z:hk schema:knows z:ch .
31 z:hk foaf:interest dbr:Music .
```

# Other GLAM-focused Open Data/Licenses

- [RightsStatement.org](https://rightsstatement.org/) (for Digital Objects)
- [Europeana Dataset](#)
- [DPLA \(Digital Public Library of America\) Dataset](#)
- [Getty Vocabularies & Ontology](#)
- [Data on the Web Best Practices W3C Recommendation](#)  
[Section on Licensing](#)
- [Share-PSI \(Public Sector Information\) Localised Guide](#)  
[Pages for Open Data](#)

# Moving towards 5 Star Linked Data

★ make your stuff available on the Web (whatever format) under an open license

★★ make it available as structured data (e.g., Excel instead of image scan of a table)

★★★ make it available in a non-proprietary open format (e.g., CSV as well as of Excel)

★★★★ use URIs to denote things, so that people can point at your stuff

★★★★★ link your data to other data to provide context

# Your turn!

Allow the reuse of your data. In order to do so, document your authorship (add `dcterms:creator`) and apply a CC0 or another license as you see fit (add `schema:license`).

# Linked Data Experimentation: SPARQL & Visualization(s)



# About LODLive

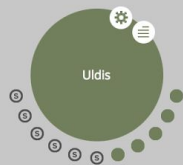
- Uses Linked Data standards (RDF, SPARQL) to browse RDF data.
- Spread Linked Data Ideas through Easy & Reusable Interface.
- Browse by Querying Endpoint for Specific Resource or Start from a Given Example URI.
- LODLive built with:
  - jQuery plug-in (lodlive-core.js)
  - JSON configuration map (lodlive-profile.js)
  - HTML page with a few images (sprites)
  - Few other jQuery public plug-ins
- <http://en.lodlive.it/> & <https://github.com/dvcama/LodLive>

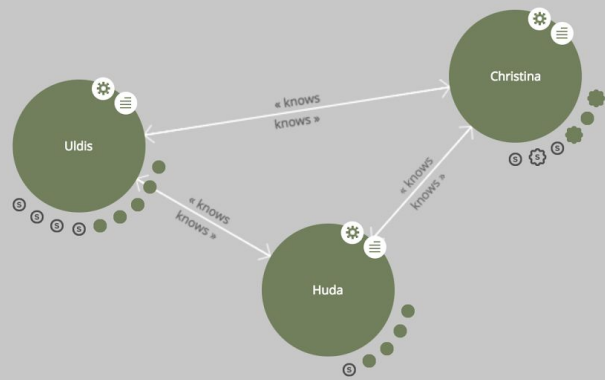
# LODLive Viz

Browse, collect and view the group graphs we have created



iod:live





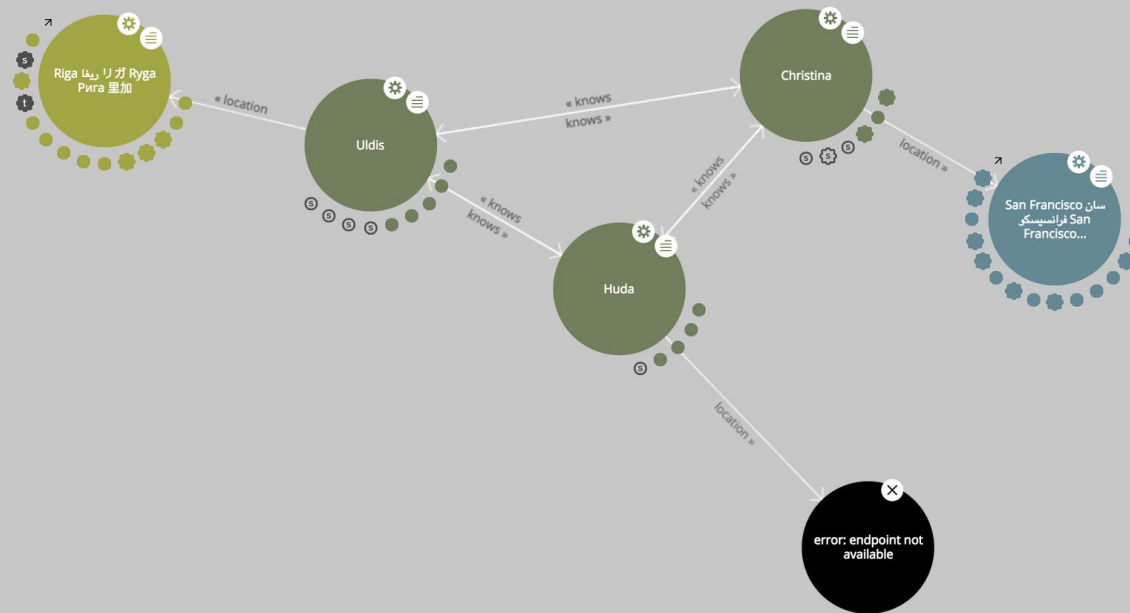
<http://cmharlow.webfactional.com/fuseki/swib-workshop/sparql>

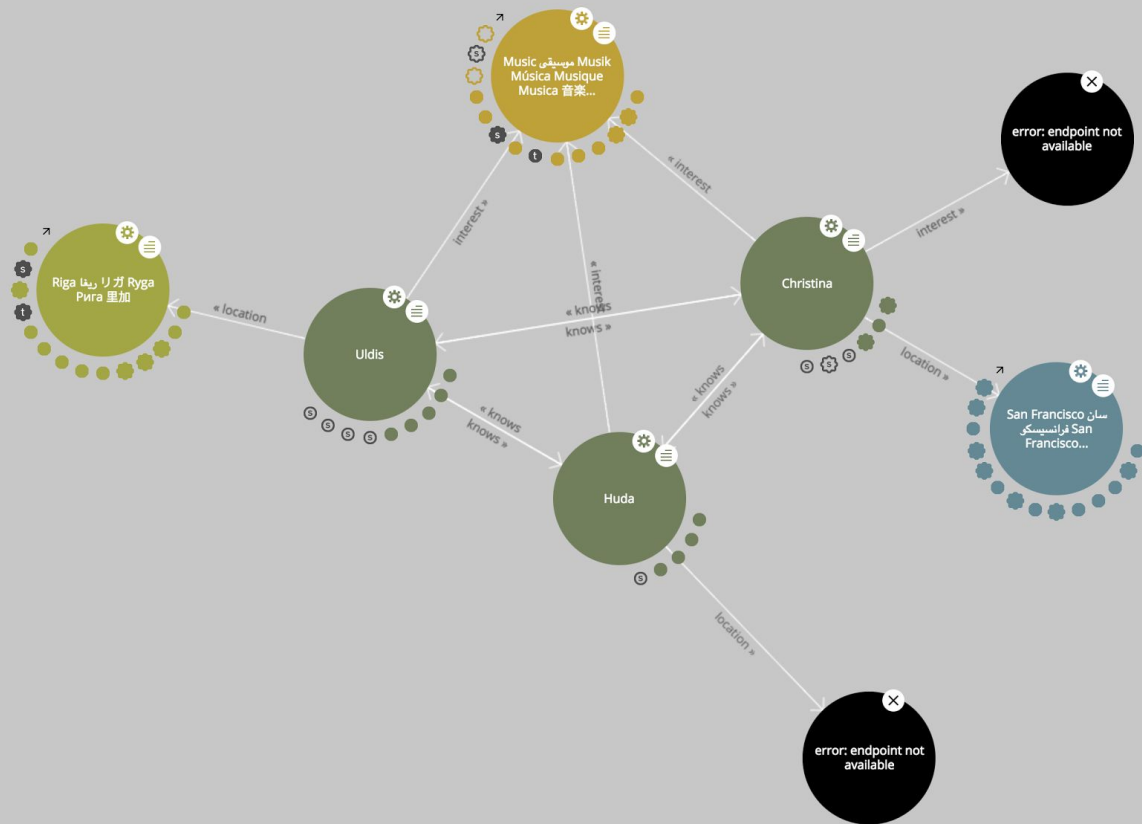
---

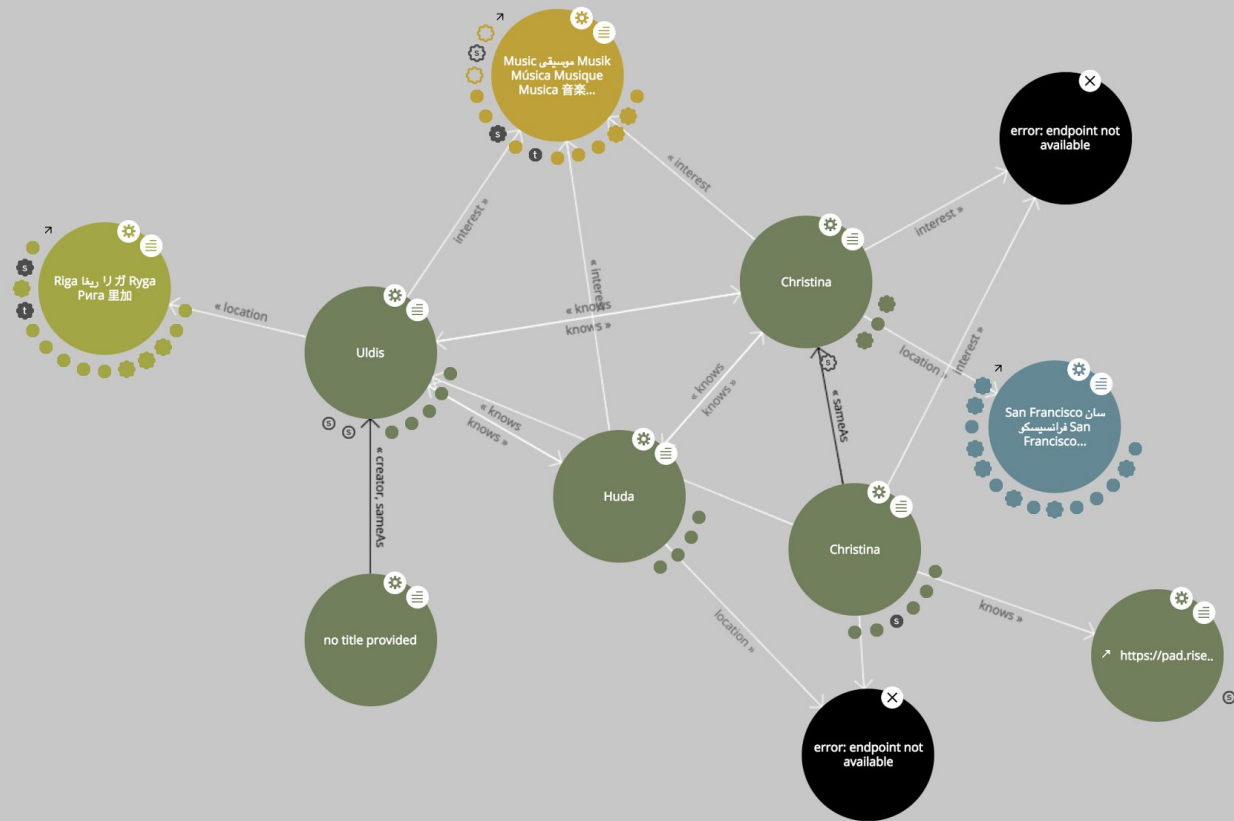
Christina

---

<https://pad.riseup.net/p/swib-17-ws-facilitators#ch>







# LODLive live demo

Try this first:

[http://cmharlow.webfactional.com/lodlive/app\\_en.html](http://cmharlow.webfactional.com/lodlive/app_en.html)

Back-up (try second):

<http://en.lodlive.it/?http://dbpedia.org/resource/Riga>



# SPARQL / Fuseki

Browse, collect and query the group graphs we have created:

<http://cmharlow.webfactional.com/fuseki/>

Select /swib-workshop and query

# Triplestores & SPARQL

Scattered machine readable descriptions are useful, but we can do better! RDF is a **distributed data** model which makes it easy to **combine descriptions**. Special databases called **triplestores** exist that allow to query the aggregated data using the query language **SPARQL**.

# SPARQL Query General Form

```
PREFIX test: <http://testNamespace.edu>

SELECT ?variable FROM <http://testNamespace.edu/dataset.rdf>
WHERE {

    ?variable ?predicate ?obj .

}

ORDER by ?variable
```

# SPARQL: Names of the participants

SPARQL ENDPOINT: swib-workshop

CONTENT TYPE (SELECT): JSON

CONTENT TYPE (GRAPH): Turtle

```
1 # Names of Workshop Participants
2 PREFIX schema: <http://schema.org/>
3 SELECT * WHERE {
4   ?person schema:name ?name .
5 }
```

QUERY RESULTS

Table Raw Response

Showing 1 to 25 of 25 entries

Search:  Show 50 entries

	person	name
1	<https://pad.riseup.net/p/swib-17-ws-facilitators#ub>	"Uldis"
2	<http://etherpad.lobid.org/p/swib16-ws-z#ub>	"Uldis"
3	<https://pad.riseup.net/p/swib-17-ws-facilitators#ch>	"Christina"
4	<http://etherpad.lobid.org/p/swib16-ws-z#ch>	"Christina"
5	<https://pad.riseup.net/p/swib-17-ws-facilitators#hk>	"Huda"
6	<http://etherpad.lobid.org/p/swib16-ws-z#jh>	"Jana"
7	<http://etherpad.lobid.org/p/swib16-ws-b#oj>	"Olaf"
8	<http://etherpad.lobid.org/p/swib16-ws-b#ag>	"Astrid"

# Acquaintances

SPARQL ENDPOINT: swib-workshop

CONTENT TYPE (SELECT): JSON

CONTENT TYPE (GRAPH): Turtle

```
1 # Acquaintances of workshop participants
2 PREFIX schema: <http://schema.org/>
3 SELECT * WHERE {
4   ?who schema:knows ?whom .
5 }
```

QUERY RESULTS

Table Raw Response

Showing 1 to 50 of 102 entries

Search:  Show 50 entries

who	whom
1 <https://pad.riseup.net/p/swib-17-ws-facilitators#ch>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ub>
2 <https://pad.riseup.net/p/swib-17-ws-facilitators#hk>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ub>
3 <http://etherpad.lobid.org/p/swib16-ws-z#ch>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ub>
4 <http://etherpad.lobid.org/p/swib16-ws-z#jh>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ub>
5 <https://pad.riseup.net/p/swib-17-ws-facilitators#ub>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ch>
6 <https://pad.riseup.net/p/swib-17-ws-facilitators#hk>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ch>
7 <http://etherpad.lobid.org/p/swib16-ws-z#ub>	<https://pad.riseup.net/p/swib-17-ws-facilitators#ch>

# Acquaintances by name

SPARQL ENDPOINT: swib-workshop

CONTENT TYPE (SELECT): JSON

CONTENT TYPE (GRAPH): Turtle

```
1 # Acquaintances of workshop participants by name
2 PREFIX schema: <http://schema.org/>
3 SELECT ?namewho ?namewhom WHERE {
4   ?who schema:knows ?whom .
5   ?who schema:name ?namewho .
6   ?whom schema:name ?namewhom .
7 }
```

QUERY RESULTS

Table Raw Response


Showing 1 to 50 of 95 entries

Search:  Show 50 entries

	namewho	namewhom
1	"Christina"	"Uldis"
2	"Huda"	"Uldis"
3	"Christina"	"Uldis"
4	"Jana"	"Uldis"
5	"Uldis"	"Christina"
6	"Huda"	"Christina"
7	"Uldis"	"Christina"
8	"Jana"	"Christina"
9	"Uldis"	"Huda"

# Localities and Countries

PREFIXES

rdf rdfs owl xsd 


SPARQL ENDPOINT: swib

CONTENT TYPE (SELECT): JSON

CONTENT TYPE (GRAPH): Turtle

```
2
3 PREFIX schema: <http://schema.org/>
4 PREFIX dbo: <http://dbpedia.org/ontology/>
5
6 SELECT * WHERE {
7   ?person schema:location ?place .
8   ?place dbo:country ?country .
9 }
```

QUERY RESULTS

Table Raw Response 

Showing 1 to 9 of 9 entries

Search:  Show 50 entries

	person	place	country
1	<http://etherpad.lobid.org/p/swib16-ws-g#ls>	<http://dbpedia.org/resource/Gothenburg>	<http://dbpedia.org/resource/Sweden>
2	<http://etherpad.lobid.org/p/swib16-ws-z#ub>	<http://dbpedia.org/resource/Riga>	<http://dbpedia.org/resource/Latvia>
3	<https://pad.riseup.net/p/swib-17-ws-facilitators#ub>	<http://dbpedia.org/resource/Riga>	<http://dbpedia.org/resource/Latvia>
4	<http://etherpad.lobid.org/p/swib16-ws-b#ml>	<http://dbpedia.org/resource/Budapest>	<http://dbpedia.org/resource/Hungary>
5	<http://etherpad.lobid.org/p/swib16-ws-f#kp>	<http://dbpedia.org/resource/Stockholm>	<http://dbpedia.org/resource/Sweden>
6	<http://etherpad.lobid.org/p/swib16-ws-f#hs>	<http://dbpedia.org/resource/Stockholm>	<http://dbpedia.org/resource/Sweden>

# Shared Interests

```
1 # Shared Interests of workshop participants
2 PREFIX schema: <http://schema.org/>
3 PREFIX dbo: <http://dbpedia.org/ontology/>
4 PREFIX z: <https://pad.riseup.net/p/swib-17-ws-facilitators#>
5 PREFIX foaf: <http://xmlns.com/foaf/0.1/>
6 SELECT * WHERE {
7   z:ub foaf:interest ?interest .
8   ?person foaf:interest ?interest .
9   FILTER (?person != z:ub)
10 }
```

QUERY RESULTS

 **Table**

Showing 1 to 10 of 10 entries

Search:  Show  entries

interest	person
1 <http://dbpedia.org/resource/Music>	<http://etherpad.lobid.org/p/swib16-ws-c#r>
2 <http://dbpedia.org/resource/Music>	z:hk
3 <http://dbpedia.org/resource/Music>	<http://etherpad.lobid.org/p/swib16-ws-z#jh>
4 <http://dbpedia.org/resource/Music>	z:ch
5 <http://dbpedia.org/resource/Music>	<http://etherpad.lobid.org/p/swib16-ws-e#ml>
6 <http://dbpedia.org/resource/Music>	<http://etherpad.lobid.org/p/swib16-ws-z#ub>
7 <http://dbpedia.org/resource/Music>	<http://etherpad.lobid.org/p/swib16-ws-b#ag>



# Metropolitans (Cities of certain size)

SPARQL ENDPOINT: swib

CONTENT TYPE (SELECT): JSON

CONTENT TYPE (GRAPH): Turtle

```
2
3 PREFIX schema: <http://schema.org/>
4 PREFIX dbo: <http://dbpedia.org/ontology/>
5
6 SELECT * WHERE {
7   ?person schema:location ?place .
8   ?place dbo:populationTotal ?population .
9   FILTER (?population > 100000) .
10 }
11
```

QUERY RESULTS

Table Raw Response

Showing 1 to 9 of 9 entries

Search:  Show 50 entries

person	place	population
<a href="http://etherpad.lobid.org/p/swib16-ws-g#ls">http://etherpad.lobid.org/p/swib16-ws-g#ls</a>	<a href="http://dbpedia.org/resource/Gothenburg">http://dbpedia.org/resource/Gothenburg</a>	"549789"^^xsd:nonNegativeInteger
<a href="http://etherpad.lobid.org/p/swib16-ws-z#ub">http://etherpad.lobid.org/p/swib16-ws-z#ub</a>	<a href="http://dbpedia.org/resource/Riga">http://dbpedia.org/resource/Riga</a>	"696593"^^xsd:nonNegativeInteger
<a href="https://pad.riseup.net/p/swib-17-ws-facilitators#ub">https://pad.riseup.net/p/swib-17-ws-facilitators#ub</a>	<a href="http://dbpedia.org/resource/Riga">http://dbpedia.org/resource/Riga</a>	"696593"^^xsd:nonNegativeInteger
<a href="http://etherpad.lobid.org/p/swib16-ws-b#ml">http://etherpad.lobid.org/p/swib16-ws-b#ml</a>	<a href="http://dbpedia.org/resource/Budapest">http://dbpedia.org/resource/Budapest</a>	"1759407"^^xsd:nonNegativeInteger

# SPARQL live demo

<http://cmharlow.webfactional.com/fuseki/dataset.html?tab=query&ds=/swib-workshop>

# Your turn!

Explore your social network using the SPARQL-Endpoint and the interactive LodLive visualization. Details & links:

<https://pad.riseup.net/p/swib-17-ws>

# Overview of Some (More) Linked Data Technologies

# SPARQL & Triplestores

- Triplestores are like SQL databases, but Optimised to manage Triples or RDF statements
- SPARQL isn't just for Querying - e.g. SPARQL update
- Triplestores versus Graph Stores
- Some Triplestores:
  - [Apache Jena Fuseki](#)
  - [Apache Jena TDB](#)
  - [Blazegraph](#)
  - Virtuoso, Stardog, Marmotta, ...

# Subset of Random Other RDF Tech

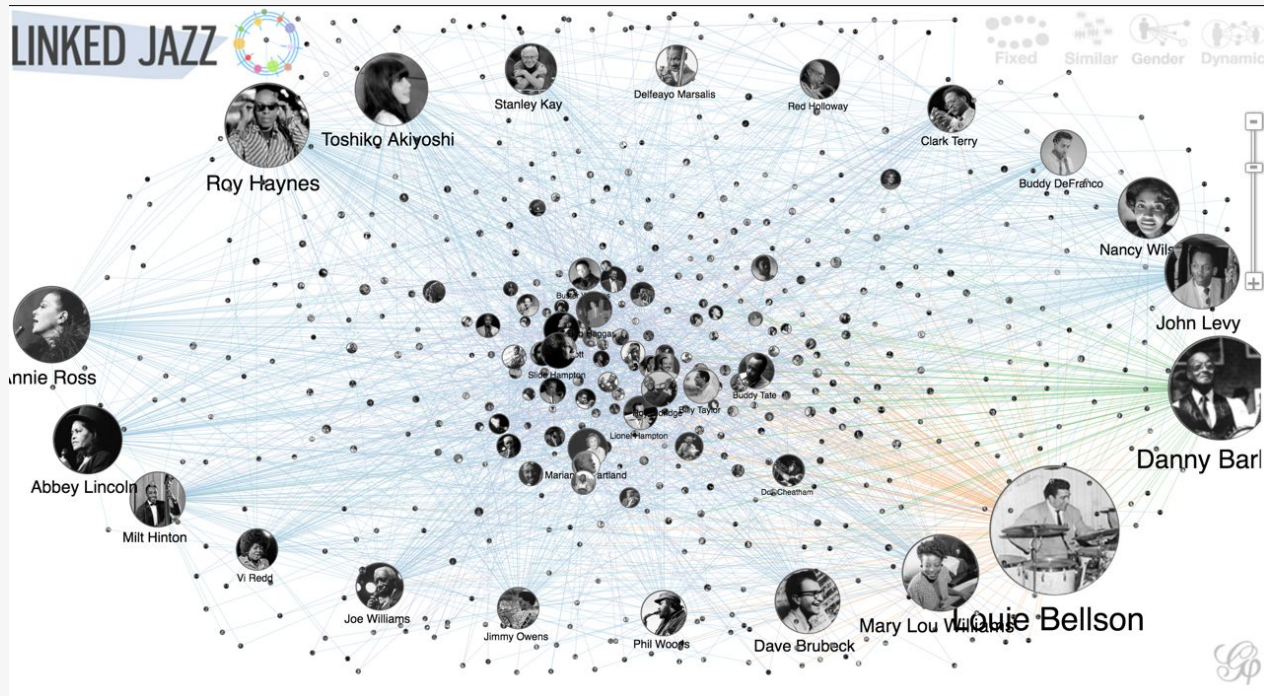
- [W3C RDF Validator](#) (expects RDF/XML)
- [Turtle Validator](#)
- [SHACL](#) (Shapes Constraint Language), [ShEx](#) (Shapes Expr.)
- [Structured Data \(RDFa\) Linter](#) (See what structured data machines can pick up from your website)
- [Python RDFLib](#) (Library for working with RDF in Python)
- [Ruby RDF.rb](#) (Library for working with RDF in Ruby)
- [Raptor](#) (RDF Parsers written in C that are used in many other programming libraries with RDF)

**15 minutes Break  
(Return at TBD)**

# Linked Data Examples, Resources & Projects



# Linked Jazz: Network Viz



[linkedjazz.org/network/](http://linkedjazz.org/network/)

# Linked Jazz: Ecco!



Bruce, Kate, 1858-1946 | Bruce, Kate [[Personal](#)]

#### Titles:

A child of the ghetto  
Judith of Bethulia  
Through the breakers  
Unidentified Paper Print box V  
Unidentified Tayler no. 10: Those who pay

Description: Silent film actress

American silent film actresses

People from Columbus, Indiana

1858 births

Actresses from

✓ Use Term [A key]

✗ Back [space key]

[linkedjazz.org/tools/ecco/](http://linkedjazz.org/tools/ecco/)

# NYPL Labs B.I.L.L.I.

## (Bibliographic Identifiers for Library Location)

AM1-501

Museums. Collectors and collecting

Wiki

A museum is an institution that cares for (conserves) a collection of artifacts and other objects of scientific, artistic, cultural, or historical importance and makes them available for public viewing through exhibits that may be permanent or temporary. Most large museums are located in major cities throughout the world and more local ones exist in smaller cities, towns and even the countryside.

Museums have varying aims, ranging from serving researchers and specialists to

[Expand](#)

[From Wikipedia](#)



[Image source.](#)

Holdings Count

Thousands of resources.

Note

No Notes found.

Broader Classmarks

[General Works](#)

└ Museums. Collectors and collecting

[billi.nypl.org](http://billi.nypl.org)

# ls.ext RDF Cataloging Client

<https://vimeo.com/192831354> / <https://github.com/digibib/ls.ext>

## Linked Art Data Model

---

The desired target model for Linked Open Data in the Art domain is one with the following properties:

- Captures as much of the information that we know about the resources as possible
- Can be productively used via easy to implement [services](#)
- Provides interoperability with other related data sets
- Solves actual challenges, which are documented as use cases

Successful models are developed:

- iteratively (we will not get it right the first time)
- responsively (we will change the model in response to feedback and concerns)
- responsibly (we will consider changes and features carefully with respect to complexity and value)
- collaboratively (we will engage with the community, projects and individuals early and often)

## Model Fundamentals

Following the existing norms of the community, our starting point consists of:

- [CIDOC-CRM](#) as the core ontology, giving an event-based paradigm
  - We use a streamlined [profile](#) of CIDOC-CRM to ensure consistency and comprehension.
- The [Getty Vocabularies](#) as core sources of identity
  - Please see the [vocabularies best practice](#) discussion.
- [JSON-LD](#) as the primary target serialization
  - We use a specific [context](#) designed to be easy to implement.

<http://linked.art/>

# LDF Server: OrgRef to VIVOS

## Linked Data Fragments server



### OrgRef to VIVOS

Query OrgRef to VIVOS by triple pattern

subject:

predicate:

object:

[Find matching triples](#)

Matches in OrgRef to VIVOS for { `<http://www.wikidata.org/entity/Q1012699> ?p ?o` }

Showing triples 1 to 6 of 6 with 100 triples per page.

```
Q1012699  isniId  "0000000404647119".
Q1012699  viafId  "244777805".
Q1012699  wikiPageID  "1680840".
Q1012699  label  "Bryant University".
Q1012699  sameAs  unitid_217165.
Q1012699  url  "http://www.bryant.edu".
```

[ldf-vivo.herokuapp.com/orgref](http://ldf-vivo.herokuapp.com/orgref)

# BibCat

## Gold Rush® BIBCAT

### Project Links

- [Github Code Repository](#)
- [XML Siteindex](#)

## Build-Measure-Learn Iteration Two

### Build Workflow

1. Run [marc2bibframe2](#) XSLT transform on XML record
2. Add Alliance updates including replacing bf:instance and bf:item iris with SEO friendly URLs
3. Run Alliance specific Instance Processor
4. Generates link to institution's ILS or Discovery layer
5. Run Alliance Item processor on each bf:item
6. Run LOC BIBFRAME to BIBFRAME Lean RML Map
7. Run Alliance Deduplication on Lean BIBFRAME Graph
8. Ingest Lean BIBFRAME Graph into RDF triplestore

### Pilot Triplestore Statistics

Library	# Source MARC	# Triples
University of Colorado Boulder	54,007	
Colorado College	57,471	
SUNY - Buffalo	15,650	

## Build-Measure-Learn Iteration One

This first iteration is to build a sitemap interface for search engines to index selected University of Colorado and Colorado College Linked Data that has been transformed from MARC 21 records to BIBFRAME 2.0 entities hosted and published by Colorado Alliance.

### Pilot Triplestore Statistics

<http://bibcat.org/>

# Opaque Namespace

opaquenamespace.org

Vocabularies

Predicates

Login

## Box Name

`http://opaquenamespace.org/ns/boxName`

Sub Property Of:

isPartOf

<http://opaquenamespace.org/ns/boxName>

Range:

Domain:

Label:

Box Name English [en]

Alternate Name:

Date:

Comment:

Identifier on the box holding the physical archival item. English [en]

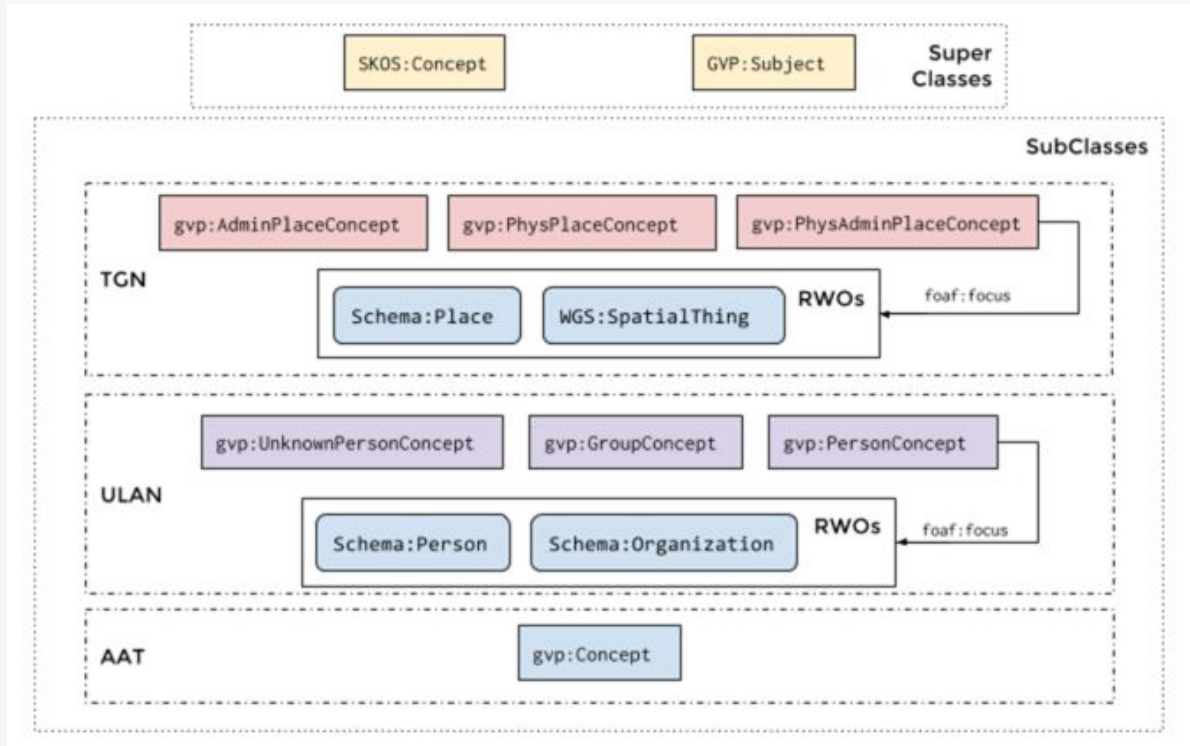
Is Replaced By:

[bit.ly/SWIBLODintro](http://bit.ly/SWIBLODintro)

opaquenamespace.org



# Getty Vocab Model



[vocab.getty.edu](http://vocab.getty.edu)

# Getty Vocab SPARQL Endpoint



Getty Vocabularies: LOD

SPARQL

Queries

Any ▾

Search...

Search

Brief ▾

- 1.2 Revisions
  - 1.2.1 Version 3.0
  - 1.2.2 Version 3.1
  - 1.2.3 Version 3.2
  - 1.2.4 Version 3.3
- 2 Finding Subjects
  - 2.1 Top-level Subjects
  - 2.2 Descendants of a Given Parent**
  - 2.3 Subjects by Contributor Id
  - 2.4 Subjects by Contributor Abbrev
  - 2.5 Preferred Ancestors
  - 2.6 Full Text Search Query
  - 2.7 Stop-Word Removal
  - 2.8 Case-insensitive Full Text Search Query
  - 2.9 Exact-Match Full Text Search Query
  - 2.10 Find Person Occupations by broaderExtended
  - 2.11 Find Person Occupations by Double FTS
  - 2.12 Find Quartz Timepieces by Double FTS
  - 2.13 Find Subject by Exact English PrefLabel
  - 2.14 Find Subject by Language-Independent PrefLabels
  - 2.15 Combination Full-Text and Exact String Match
  - 2.16 Find Subject by Any Label
  - 2.17 Find Ordered Subjects
  - 2.18 Find Ordered Collections

Query:

```
1 select * {  
2   ?x a gvp:Subject; dct:contributor aat_contrib:10000088;  
3     gvp:broaderExtended aat:300033618;  
4     gvp:prefLabelGVP/xl:literalForm ?l}
```

Include inferred

Expand results over equivalent URIs

Submit

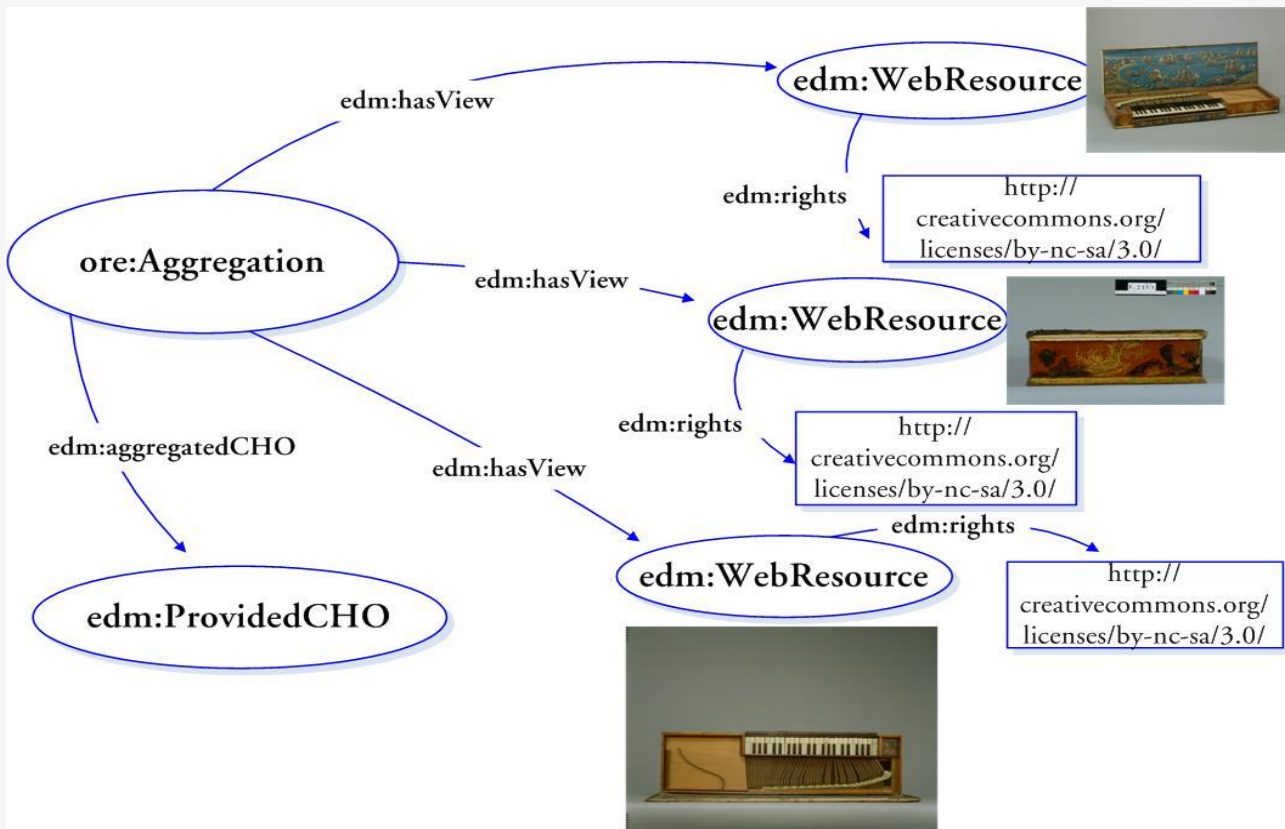
## 2.2 Descendants of a Given Parent

Let's look for AAT descendants of 300194567 "drinking vessels". This finds "rhyta" and other interesting records, including "Fichtelgebirgehumpen":

```
select * {?x gvp:broaderExtended aat:300194567; skos:inScheme aat: ; gvp:prefLabelGVP/xl:literalForm ?l}
```

vocab.getty.edu

# Europeana Data Model



# Europeana SPARQL Endpoint

## Virtuoso SPARQL Query Editor


[About](#) | [Namespace Prefixes](#) | [Inference rules](#)

Default Data Set Name (Graph IRI)

### Query Text

```
PREFIX edm: <http://www.europeana.eu/schemas/edm/> SELECT ?DataProvider WHERE { ?Aggregation edm:dataProvider ?DataProvider }
```

Sponging:



Results Format:



Execution timeout:

milliseconds (*values less than 1000 are ignored*)

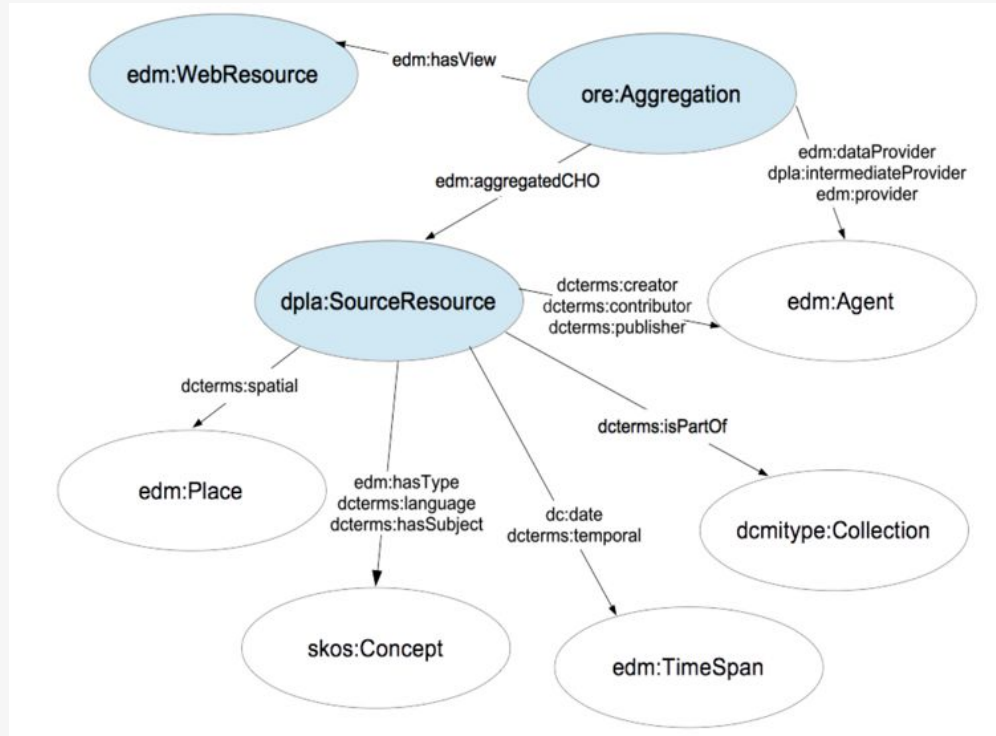
Options:

Strict checking of void variables  Log debug info at the end of output (has no effect on some queries and output formats)

europeana.ontotext.com

[bit.ly/SWIBLODintro](http://bit.ly/SWIBLODintro)

# DPLA Model



[dp.la/info/wp-content/uploads/2015/03/MApv4.pdf](http://dp.la/info/wp-content/uploads/2015/03/MApv4.pdf)

# DPLA Ingestion3

[github.com/dpla/ingestion3](https://github.com/dpla/ingestion3)

# DPLA Color Browse

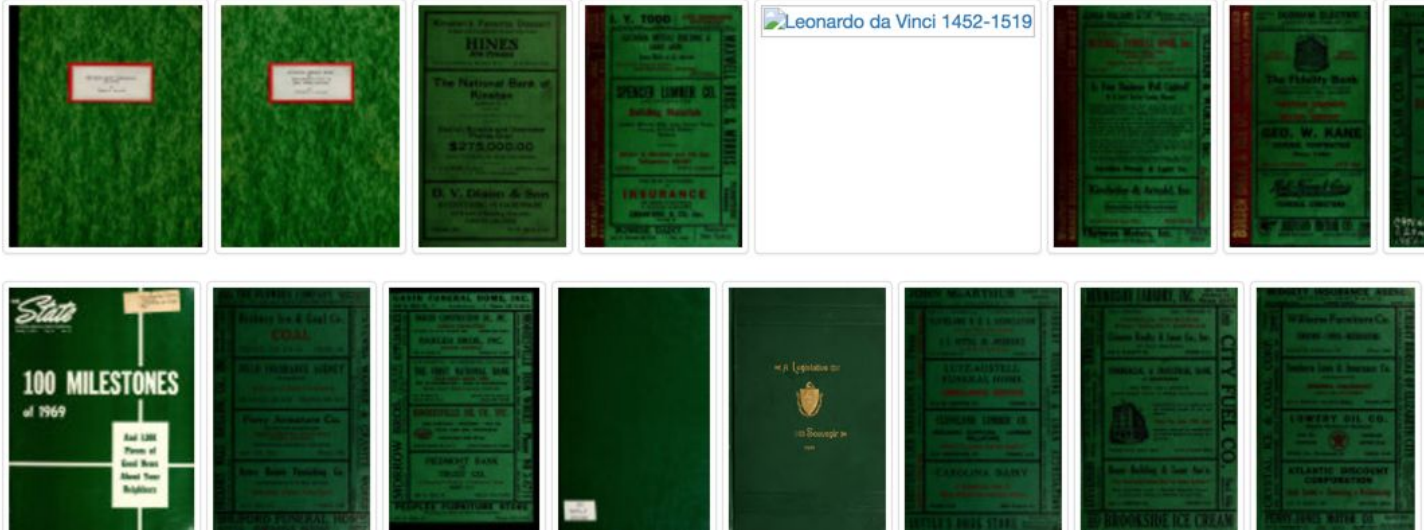
DPLA Color Browse

darkgreen

Submit



497 images containing darkgreen



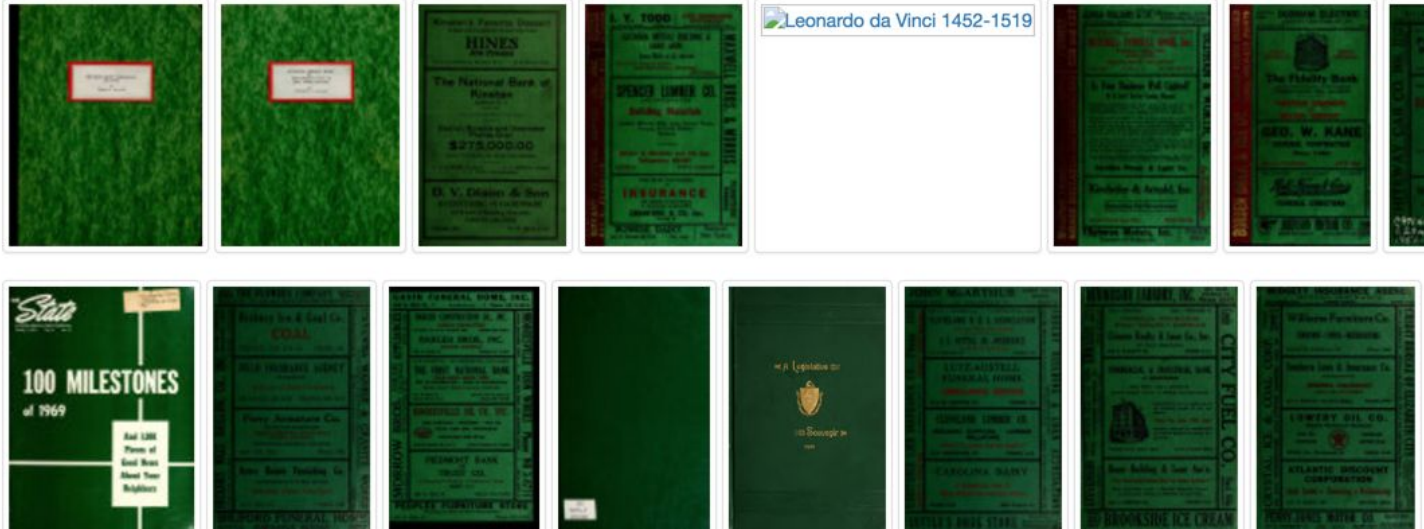
colorbrowse.club

# DPLA Color Browse

DPLA Color Browse



497 images containing darkgreen



colorbrowse.club



# Moving Forward with Linked Open Data

# Your turn!

Explore any of the previous projects & examples given.

Then, in your groups, discuss your own potential uses of LOD. What projects could you see for using this? What support would you need to make it happen?

# Checking Back In...

Returning to the Goals from the  
Introduction...

Do you feel like you learned what you  
expected? Needed? Any remaining  
questions?

# Thank you! Question?

Questions? Now and here or anytime to:

[uldis.bojars@gmail.com](mailto:uldis.bojars@gmail.com)

[cmharlow@stanford.edu](mailto:cmharlow@stanford.edu)

[hjk54@cornell.edu](mailto:hjk54@cornell.edu)



[CC-BY 4.0 International](https://creativecommons.org/licenses/by/4.0/)