Learning, Understanding, and Using Linked Data

Linked Data
1 2 3 4 5

1 --One goal
2 – Two types of questions
3 – RDF triples
4 – **Four principles**
5 – Five star LOD

Learn by Understanding

Learn by Analyzing

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5   **Five-Star LOD** ★★★★★

Sir Tim Berners-Lee, the inventor of the WWW and the initiator of Linked Data, presented a Star Scheme for measuring the rank of a dataset:

LINKED **OPEN** DATA
★ On the web **OPEN LOD**
★★ Machine-readable data
★★★ Non-proprietary format
★★★★ RDF standards
★★★★★ Linked RDF
IS YOUR DATA 5★?

★	Available on the web (whatever format) *but with an open licence, to be Open Data*
★★	Available as machine-readable structured data (e.g. excel instead of image scan of a table)
★★★	as (2) plus non-proprietary format (e.g. CSV instead of excel)
★★★★	All the above plus, Use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff
★★★★★	All the above, plus: Link your data to other people's data to provide context

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

Learn by Analyzing

Cases: Using LOD in the LAMs*

1. **Special Collections, Archives**
   a. Linked Jazz
   b. Online Coins of the Roman Empire (OCRE)
2. **Bibliographic data**
   a. WorldCat
   b. The British National Bibliography (BNB)
3. **Knowledge organization systems (KOS)**
   - thesauri, name authorities, and others
   a. FAST
   b. Getty Vocabs
4. **Digital Scholarships**
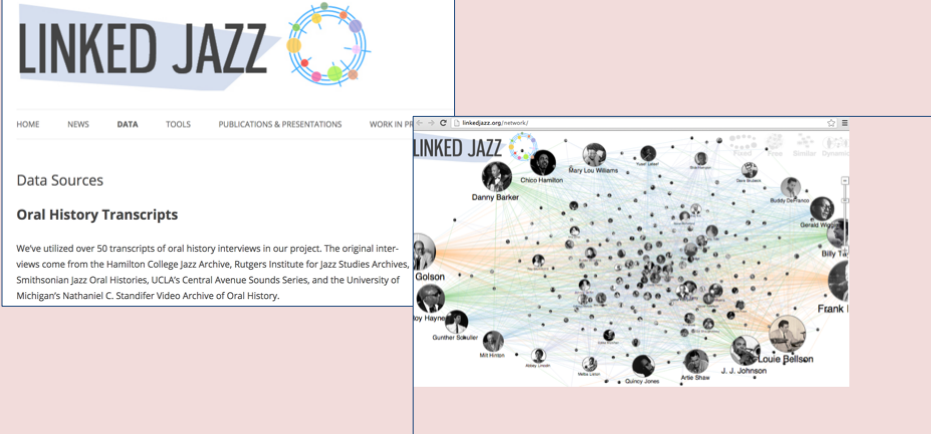   – VIVO based - Scholars @ Cornell

*LAMs = Libraries, archives, and museums

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1. Special Collections, Archives

a. Linked Jazz   http://linkedjazz.org/

The project focuses on digitalized archives of jazz history to expose relationships between musicians and reveal their community's network.
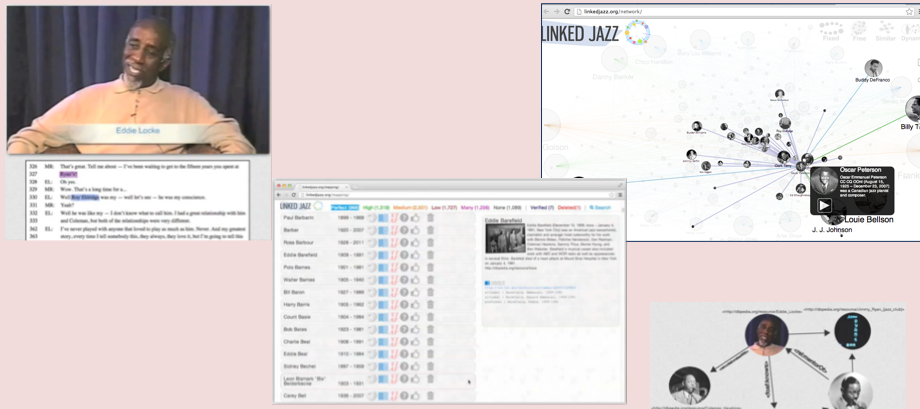
LINKED JAZZ

HOME   NEWS   **DATA**   TOOLS   PUBLICATIONS & PRESENTATIONS   WORK IN PR

Data Sources

Oral History Transcripts

We've utilized over 50 transcripts of oral history interviews in our project. The original interviews come from the Hamilton College Jazz Archive, Rutgers Institute for Jazz Studies Archives, Smithsonian Jazz Oral Histories, UCLA's Central Avenue Sounds Series, and the University of Michigan's Nathaniel C. Standifer Video Archive of Oral History.

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http://linkedjazz.org/network/

Methodology Summary:
- A natural processing tool pulls excerpts from transcripts of interviews with jazz musicians that mention a *relationship* with another jazz musician.
- After the process of controlling synonyms and eliminating ambiguity, the musician names were mapped to the DBpedia, and data about each person was obtained.
- The relationships were presented based on an ontology.
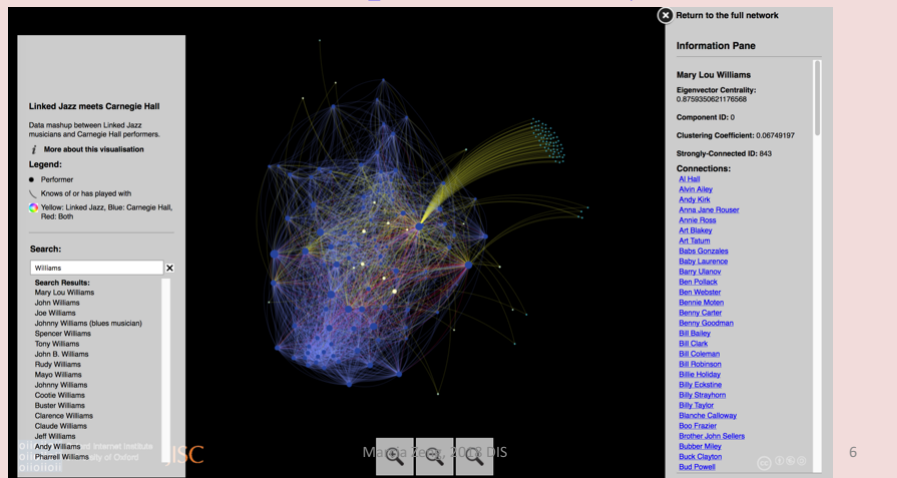- A visualization tool was used to present a unique interactive interface.

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Linked Jazz and Carnegie Hall (In development) About

•Visualized result in Gephi. (Data mashup between Linked Jazz musicians and Carnegie Hall performers.)

http://pfch.nyc/linked_jazz_meets_carnegie_hall/CH-LJ_network/index.html#Mary%20Lou%20Williams

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(cont.) *1. Special Collections, Archives*   http://numismatics.org/ocre/
   b. Online Coins of the Roman Empire (OCRE)

1.b OCRE

• Ontological classes -- browse

• Modeling in an ontology (formed in classes, properties, relationships);
• Following Linked Data principles;
• Using RDF triples for entities;
• Querying in SPARQL language.

1.b OCRE

For an individual object, a user can find auto-generated data related to it, the map(s), and quantitative analysis.

http://numismatics.org/ocre/id/ric.6.lon.66

1.b OCRE
- Visualize your queries on-the-fly

How? http://wiki.numismatics.org/numishare:visualize

- Using SPARQL queries to find;
- Auto-Visualizing;
- A user does not need to see or use SPARQL language.

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1.b OCRE
- Interact with a map

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1.b OCRE

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http://numismatics.org/ocre/

For more information

- Webinar: Ethan Gruber: **From 0 to 60 on SPARQL queries in 50 minutes,** May 13, 2015
  Watch the YouTube: *https://www.youtube.com/watch?v=3YhG5QQmhvU*

- Ethan Gruber's webpage http://numismatics.org/ethangruber/
  - Where you can connect to his Github, https://github.com/ewg118
  - SPARQL queries https://gist.github.com/ewg118

- A Final report submitted to the funder, NEH, 2017
  - http://www.dayofarchaeology.com/final-report-to-the-neh-for-online-coins-of-the-roman-empire/

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   - VIVO based - Scholars @ Cornell

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Case: 2.a *WorldCat*

http://www.worldcat.org/oclc/246662790

Pride and Prejudice

creator

schema:creator

http://viaf.org/viaf/102333412

Pride and prejudice
Author: Jane Austen
Publisher: Harmondsworth [u.a.] : Penguin Books, 1984.
Series: Penguin English library.
Edition/Format: Print book : English : Reprint View all editions and formats
Database: WorldCat

www.**worldcat**.org/title/pride-and-prejudice/oclc/246662790

Linked Data

More info about Linked Data

Primary Entity
<http://www.worldcat.org/oclc/246662790> # Pride and prejudice
  a schema:Book, schema:CreativeWork ,
  library:oclcnum "246662790" ;
  library:placeOfPublication <http://experiment.worldcat.org/entity/work/data/3535#Place/harmondsworth_u_a> ; # Harmondsworth u.a.
  library:placeOfPublication <http://id.loc.gov/vocabulary/countries/xxk> ;
  schema:about <http://dewey.info/class/823.7/> ;
  schema:bookEdition "Reprint." ;
  schema:bookFormat bgn:PrintBook ;
  schema:creator <http://viaf.org/viaf/102333412> ; # Jane Austen
  schema:datePublished "1984" ;
  schema:exampleOfWork <http://worldcat.org/entity/work/id/3535> ;
  schema:inLanguage "en" ;
  schema:isPartOf <http://experiment.worldcat.org/entity/work/data/3535#Series/penguin_english_library> ; # Penguin English library.
  schema:name "Pride and prejudice" ;
  schema:productID "246662790" ;
  schema:publication <http://www.worldcat.org/title/-/oclc/246662790#PublicationEvent/harmondsworth_u_a_penguin_books_1984> ;
  schema:publisher <http://experiment.worldcat.org/entity/work/data/3535#Agent/penguin_books> ; # Penguin Books
  schema:workExample <http://worldcat.org/isbn/9780140430721> ;
  wdrs:describedby <http://www.worldcat.org/title/-/oclc/246662790> ;

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Case 2.b The British National Bibliography (BNB)
-- uses its own ontology

About:
- The British Library is the national library of the UK and is responsible for distributing metadata describing its collections and recording UK publishing output in the *British National Bibliography (BNB)* http://bnb.data.bl.uk.
- In 2011, the British Library began publishing a LOD version of the BNB as part of its open metadata strategy. The move to LOD BNB proved influential among the library community in moving the Linked Data 'debate' from theory to practice.
- The LOD BNB has continued to evolve with regular monthly updates, the inclusion of new links (e.g. to the ISNI) and content (e.g. serials).

Try:
- Go to its Flint Sparql Endpoint at: http://bnb.data.bl.uk/flint-sparq
- Use the sample queries to see examples.
- Try to form your own queries and get different datasets.

Read:
- How to get the bulk download http://www.bl.uk/bibliographic/download.html

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1. Query text for "Which titles by detective writer Ian Rankin appear in the BNB?"

SELECT * WHERE { ?s ?p ?o }

References: Lists of all classes, properties, and prefixes of the metadata vocabularies used by BNB.

2. Results in Plain text. Other output options are XML and JSON.

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3. KOS
a. FAST

Source: extracted screenshots (2017-07-12)
From http://fast.oclc.org/searchfast/

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3. KOS
a. FAST

John F. Kennedy's entry in FAST is enriched with other sources.

- The **DBpedia** identifiers allow FAST terms to include detailed information that is usually excluded in authority records.

- The VIAF URI allows FAST terms to take advantage of all of the various string values included in **VIAF** without having to manually include the values in the RDF triples for the specific term.

Source: extracted screenshots (2017-07-12) at http://experimental.worldcat.org/fast/35588/rdf.xml

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3. KOS
a. *FAST*

The GeoNames data is used to power MapFAST, which is a Google Maps mash-up.

mapFAST
Find library materials about world wide locations

Find FAST Geographic Subject Headings Near:
L.A., CA   [Search]
Radius: 30 km
Display: All

- California -- Los Angeles Basin
- California -- Los Angeles
- California -- Los Angeles Region
- California -- Los Angeles Suburban Area
- Watts Riot (Los Angeles, California : 1965)
- Zoot Suit Riots (Los Angeles, California : 1943)
- Sleepy Lagoon Trial (Los Angeles, California : 1942-1943)
- California -- Los Angeles -- Aliso Village
- California -- Los Angeles -- Boyle Heights
- California -- Los Angeles -- Lincoln Heights
- California -- Los Angeles -- Ramona Gardens
- California -- Vernon
- California -- Los Angeles -- Koreatown

California -- Los Angeles
Type
Populated Place
Alternative Subject Headings
California – Los Anheles;California – Pueblo de Nuestra Senora la Reina de los Angeles de Porciuncula;California – Town of Our Lady the Queen of the Angels of Porciuncula;California – Tien-shih-chih-cheng;California – Tianshizhicheng;California – Los Andzsheles;California – Lo-shan-chi;California -- Loshanji;California – Angeles;California – Ciudad De Los Angeles;California – Pueblo De Los Angeles;California – Pueblo Los Angeles
Links
Find Books in WorldCat
Find in Google Books
Display Authority Record

Share this Location: http://experimental.worldcat.org/mapfast/?geo=34.049077,-118.2435;crs=wgs84&mq=&sortby=distance&max-results=20&box=33.977842,-118.343[...]

Image source: Captured Aug. 2017. http://experimental.worldcat.org/mapfast/

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Cases: Using LOD in the LAMs*

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3. KOS
   b. *Getty Vocabs*

http://vocab.getty.edu

Getty
Vocabs
LOD

AAT
TGN
ULAN
[CONA]

Getty Vocabularies: LOD

SPARQL   Queries   Any ▾   Search...

NOW Available:

The Art & Architecture Thesaurus (AAT) ®
Catherine wheel or rose window? AAT is a structured vocabulary, including terms, descriptions, and other information for generic concepts related to art and architecture.

The Getty Thesaurus of Geographic Names (TGN) ®
London or Londinium? TGN is a structured vocabulary, including information for places important to art and architecture.

The Union List of Artist Names (ULAN) ®
Titian or Tiziano Vecellio? ULAN is a structured vocabulary, including information about artists and architects.

http://vocab.getty.edu/sparql

We will try them at the Hands-on session.

Getty Vocabularies: LOD Sample Queries

http://vocab.getty.edu/queries

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3. b. *Getty Vocabs*

What kinds of query examples?

ULAN

Union List of Artist Names

Name authorities offer foundational structured data for network analyses.

At the query templates page

Find the section for ULAN.

There are many interesting query examples.

Getty Vocabularies: LOD

http://vocab.getty.edu/queries

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ULAN

How to use a template?

(1) Choose a query (left), e.g., #5.2; the template box will show up (lower-right). (2) At that template box's upper-right corner, click on that SPARQL sign; the query will automatically jump up to the Query box (top). (3) Submit.

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ULAN

The result: "all associative relationships of ulan:500115493 Duerer, Albrecht" (showing a portion of the results).

rel	x	name	bio	comment
gvp:ulan1101_teacher_of	ulan:500024290	Baldung, Hans	German painter, 1484/1485-1545	-
gvp:ulan1101_teacher_of	ulan:500101472	Herrant, Crispin	German painter, active 1529, died 1549	-
gvp:ulan1105_apprentice_of	ulan:500031446	Wolgemut, Michael	German painter and printmaker, 1434/1437-1519	from 1486 to 1489
gvp:ulan1106_apprentice_was	ulan:500013506	Schäufelein, Hans, the elder	German painter, draftsman, and designer, born ca. 1482, died 1539 or 1540	-
gvp:ulan1106_apprentice_was	ulan:500002241	Traut, Wolf	German painter and draftsman, ca. 1480-1520	-
gvp:ulan1202_patron_was	ulan:500260809	Maximilian I, Holy Roman Emperor@en	Holy Roman Emperor, 1459-1519	-
gvp:ulan1303_collaborated_with	ulan:500084340	Pirckheimer, Willibald	German humanist and writer, 1470-1530	-
gvp:ulan1308_assisted_by	ulan:500006353	Pencz, Georg	German painter, draftsman, and engraver, ca. 1500-1550	ca. 1523
gvp:ulan1501_sibling_of	ulan:500356338	Dürer, Endres	German goldsmith, 1484-1555	-
gvp:ulan1501_sibling_of	ulan:500005425	Dürer, Hans@de	German painter and printmaker, 1490-1534	-
gvp:ulan1511_child_of	ulan:500102378	Dürer, Albrecht, the elder@en	German goldsmith, 1427-1502	-
gvp:ulan2572_founder_of	ulan:500356337	Albrecht Dürer Workshop@en	German workshop, established 1495	-

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Slide 1

Getty Vocabularies: LOD   SPARQL   Queries

TGN

4   TGN-Specific Queries
4.1   Places by Type
4.2   Places, with English or GVP Label
4.3   Places by Direct and Hierarchical Type
4.4   Breakdown of Sovereign States by Type
4.5   Inhabited Places That Were Sovereign States
4.6   Places by Type and Parent Place
4.7   Places by Type, with placeTypePreferred
4.8   Places by Triple FTS
4.9   Places by FTS Parents
4.10   Capitals by Association
4.11   Members of the European Union
4.12   Members of the United Nations
4.13   Geo Chart with sgvizler
4.14   Column Chart with sgvizler
4.15   Countries and Capitals By Type and Containment
4.16   Places by Coordinate Bounding Box
4.17   Places Within Bounding Box
4.18   Places by Type Within Bounding Box
4.19   Places Outside Bounding Box (Overseas Possessions)
4.20   Places Nearby Each Other

http://vocab.getty.edu/queries#Top-level_Subjects

Query:

```
1  select ?place
2     ?place skos
```

Browse the examples of queries

Thesaurus for Geographic Names (TGN)

You can obtaining special RDF graphs or datasets for
very complicated questions, and
revealing unknown relationships.

KOS in LOD become knowledge bases of research.

4.16   Places by
Find places whose coordi

```
select ?place ?name
```

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Slide 2

Steps: (1) Choose #4.18 query,
(2) click on that SPARQL sign in that 4.18 template box. After click on that SPARQL sign, the query should be automatically uploaded to the top box. (3) Submit.
Note: Since this is a complicated query, it will run a few seconds. Be patient.

TGN

E.g., Look for **castles around The Netherlands**
(within the boundary of 50.787185 3.389722 53.542265 7.169019)

Getty Vocabularies: LOD   SP

3.14   Smart Resource Title
4   TGN-Specific Queries
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4.17   Places Within Bounding Box
4.18   Places by Type Within Bounding Box
4.19   Places Outside Bounding Box (Overseas Possessions)
4.20   Places Nearby Each Other
5   ULAN-Specific Queries
5.1   Agents by Type
5.2   Associative Relations of Agent
5.3   Female Artists
5.4   Female Artists as a Hobby

Query:

```
1  prefix ontogeo: <http://www.ontotext.com/owlim/geo#>
2  select distinct * {
3    ?place skos:inScheme tgn: ;
4      gvp:placeType|(gvp:placeType/gvp:broaderGenericExtended) [rdfs:label "castles (fortific
5      foaf:focus [ontogeo:within(50.787185 3.389722 53.542265 7.169019)];
6      gvp:prefLabelGVP [xl:literalForm ?name];
7      gvp:parentString ?parents]
```

☑ Include inferred
☐ Expand results over equivalent URIs

Submit

4.18   Places by Type Within Bounding Box
Let's specialize the previous query and look for castles around The Netherlands, we get 170:

```
prefix ontogeo: <http://www.ontotext.com/owlim/geo#>
select distinct * {
  ?place skos:inScheme tgn: ;
    gvp:placeType|(gvp:placeType/gvp:broaderGenericExtended) [rdfs:label "castles (fortifications)"@en];
    foaf:focus [ontogeo:within(50.787185 3.389722 53.542265 7.169019)];
    gvp:prefLabelGVP [xl:literalForm ?name];
    gvp:parentString ?parents}
```

SPARQL

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4.19   Places Outside Bounding Box (Overseas Possessions)

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Slide 1

E.g., Look for castles around The Netherlands — **TGN**

Getty Vocabularies: LOD

SPARQL   Queries   Any ▾   Search...

Results: (170)   Download SPARQL Re…

4

place	name	parents
tgn:7267137	Oldenaller@nl	Gelderland, Nederland, Euro…
tgn:7267925	Nijenrode@nl	Utrec…
tgn:7259882	Kasteel Ampsen@nl	Gelde…
tgn:7268095	Panser@nl	Groni…
tgn:7269751	Mattenesse@nl	Groni…
tgn:7272454	Verhildersum@nl	Groni…
tgn:7269594	Menkemaborg@nl	Groni…

(4) Download the datasets in a selected format.
The best way is to download the csv file.
(5) You should either keep the query in your CSV file or make a note what you searched for and in which boundary.

Finished.

6

Muiderslot
Source:http://vocab.getty.edu/tgn/7270110

Subject (27)   Predicate   Object   All
Website | Hierarchy | Downlo…

Statements in which the resource

Predicate	Object
rdf:type	gvp:Subject, skos:Con…
rdfs:label	Muiderslot@nl
gvp:broader	tgn:7006951
gvp:broaderPartitiveExtende…	tgn:1000003, tgn:7006
gvp:broaderExtended	tgn:1000003, tgn:7006
gvp:broaderPreferredExtende…	tgn:1000003, tgn:7006
skos:note	tgn_rev:5011873219, t… tgn_rev:5011907189, t…
gvp:placeType	aat:300006891
skos:prefLabel	Muiderslot@nl
skos:broader	tgn:7006…
iso-thes:broaderPartitive…	tgn:70…
skos:broaderTransitive	tgn:1000003, tgn:7006951, tgn:7016…

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ID: 7270110
⚐ Muiderslot (castle)
Coordinates:
Lat: 52 20 00 N *degrees minutes*   Lat: 52.3333 *decimal degrees*
Long: 005 04 00 E *degrees minutes*   Long: 5.0667 *decimal degrees*
Names:
Muiderslot (**preferred**,NA,V,Dutch,U)
Hierarchical Position:
⚐ World (facet)
⚐ .... Europe (continent) (P)
⚐ .... Netherlands (nation) (P)
⚐ .... North Holland (province) (P)
⚐ .... Muiderslot (castle) (P,U)
Place Types:
castle (**preferred**, C)
Sources and Contributors:
Muiderslot........... [VP Preferred]
.... NGA/NIMA database (2003-)
Subject: ..... [VP]
.... NGA/NIMA database (2003-) -2149724

Europe   *North Holland*   *Netherlands*

Optional:
(6) Click on any castle's ID, & open the single data record for this concept.
(7) Click on the Website to see its normal html view.

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E.g., Query a specific place type (e.g., World Heritage Sites) in a geographic boundary .
Got the results & downloadable datasets: — **TGN**

World Heritage Sites within (24.75083 28.95778 43.80722 108.92861) around the Silk road.

Any ▾   Search...   Search   Brief ▾

Results: (32)   Download SPARQL Results in: JSON | XML | CSV | TSV

place	name	parents
tgn:7059176	Mausoleum of Khoja Ahmed Yasawi	Ongtüstik Qazaqstan, Qazaqstan, …
tgn:1056987	Mtskheta	Mtskheta Mtianeti, Sakartvelo, Asia
tgn:7032530	Aramus	Kotayk', Hayastan, Asia, World
tgn:7032531	Zart'onk'	Armavir, Hayastan, Asia, World
tgn:4004270	Geghard	Kotayk', Hayastan, Asia, World
tgn:1054029	Qobustan	Bakı, Azərbaycan, Asia, World
tgn:7029798	Qianfodong@zh-latn-pinyin-x-notone	Gansu, Zhongguo, Asia, World
tgn:7059150	Sulaiman-Too	Osh, Kyrgyzstan, Asia, World
tgn:1100582	Humayun's Tomb	Delhi, Bhārat, Asia, World
tgn:6003937	Mohenjo-Daro	Sindh, Pākistān, Asia, World
tgn:7032815	Rummin-dei	Lumbinī, Nepāl, Asia, World
tgn:7032812	Kathmandu Valley	Nepāl, Asia, World
tgn:4011486	Um er-Rasas	Al 'Āşimah, Al Urdun, Asia, World
tgn:7001309	Abū Mīnā@en	Al Gharbīyah, Mişr, Africa, World
tgn:7002856	Baalbek	Baalbek-Hermel, Lubnān, Asia, Wo…

tgn:7032896	Tchogha Zanbil	Khūzestān, Īrān, Asia, World
tgn:7002862	Tyre@en	Liban-Sud, Lubnān, Asia, World
tgn:7059151	Aanjar	Béqaa, Lubnān, Asia, World
tgn:7016516	Jubayl	Mont-Liban, Lubnān, Asia, World
tgn:6005850	Taxila@en	Punjab, Pākistān, Asia, World
tgn:7059152	Wādī Qādīshā	Lubnān, Asia, World
tgn:1103449	Arz Lebnāne	Liban-Nord, Lubnān, Asia, World
tgn:7032332	Minaret of Jam	Ghōr, Afghānestān, Asia, World
tgn:7018835	Palmyra	Ḩimş, Sūrīyah, Asia, World
tgn:7002383	Petra	Ma'ān, Al Urdun, Asia, World
tgn:7002205	Takht-e Jamshīd	Fārs, Īrān, Asia, World
tgn:7001297	Thebes@en	Qinā, Mişr, Africa, World
tgn:7032359	Qal'at al 'Ajāj	Al Baḥrayn, Asia, World
tgn:6003070	Choirokoitia	Lemesós, Kypriakí Dimokratía, Asia, World
tgn:7012244	Merv	Mary, Türkmenistan, Asia, World
tgn:6000442	Kharā'ib al Ashūrīyīn@ar-latn	Şalāḩ ad Dīn, Al-'Irāq, Asia, World
tgn:6000612	Bāmyān	Bāmyān, Afghānestān, Asia, World

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Slide 1

(cont.) 3. KOS
b. *Getty Vocabs*

Create Microthesauri or pick lists
from the Getty LOD Vocabularies

AAT

Art and Architecture Thesaurus (AAT)

Use a <Guide Term>
to obtain all concept URIs
and preferred terms
in the hierarchies (for a
microthesaurus or a pick list)

in <xyz>

Microthesaurus = designated subset of a
thesaurus that is capable of functioning as a
complete thesaurus.
-- ISO25964-2:2013

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Slide 2

Learn by Analyzing

Cases: Using LOD in the LAMs*

1. Special Collections, Archives
   a. Linked Jazz
   b. Online Coins of the Roman Empire (OCRE)
2. Bibliographic data
   – WorldCat
3. Knowledge organization systems (KOS) - thesauri, name authorities, and other
   a. FAST
   b. Getty Vocabs
4. Digital Scholarships
   – VIVO based - Scholars @ Cornell

*LAM = Libraries, archives, and museums
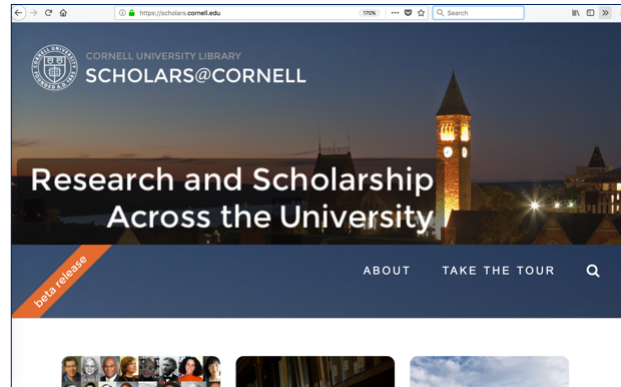
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Scholars @ Cornell

https://scholars.cornell.edu/

Scholars@Cornell offers integrated and individualized profiles about:
- faculty,
- institute units, research domains,
- collaborating networks, and
- academic outcomes.

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## E.g., Choose one faculty member or researcher

For example, when looking for an information science researcher, I found a professor, Susan R. Fussell.
- What does this profile tell us about this person?

- How are things connected?

  "Co-Authors"
  "Co-Investigators"

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All interactive. Data values in various ontological classes are connected, integrated.


- https://scholars.cornell.edu/
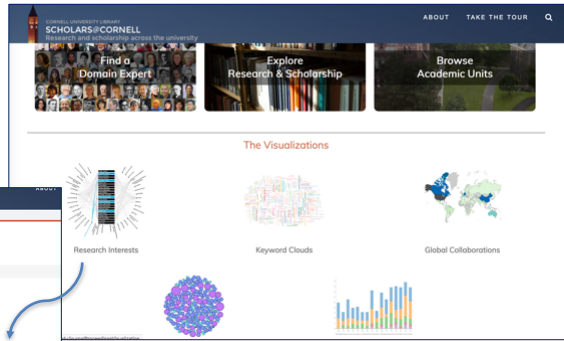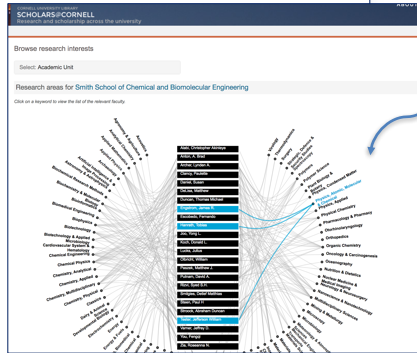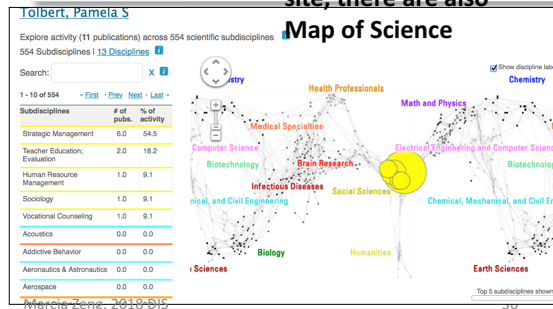
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VIVO (not an acronym) is a well-known ontology-based scholarly networking and discovery tool for managing information and knowledge in large institutions and associations, as demonstrated by the VIVO-powered websites
e.g.,
- Scripps Research Institute,
- U.S. Department of Agriculture ,
- UNAVCO, and
- many others -see registry: http://duraspace.org/registry/vivo
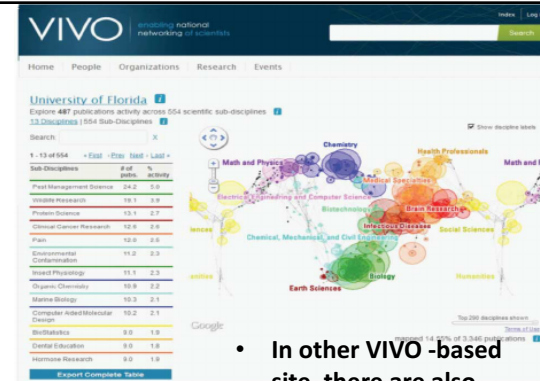
- **In other VIVO -based site, there are also Map of Science**

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Summary

The changing concepts

•(seeing from the content)
- From "Web of Documents" to "Web of Data"
- From linking strings to linking things
- From digitization to datalization

•(seeing from the results)
- From "On the Web" to "Of the Web"

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What is Linked Data?

- -- is a term used to describe a method of exposing, sharing, and connecting data on the Web using URIs and RDF
- --is about:
  - using the Web to connect related data that was not previously linked,
  - using the Web to lower the barriers to linking data currently linked using other methods. [1]

[1] http://linkeddata.org/

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