Introduction to LOD

revised December 2018

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Additional slides thanks to Joan Cobb, Gregg Garcia, Marcia Zeng, Vladimir Alexiev
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See full documentation and SPARQL endpoint here
http://vocab.getty.edu/
Find the Getty Vocabs Online

- For information about the Getty vocabularies, see this site
- Search the data, access data releases, how to contribute, editorial guidelines, training materials, news
- Contact us: vocab@getty.edu
Introduction to Controlled Vocabularies

- For information about controlled vocabularies
- Author: Patricia Harpring
- Series Editor: Murtha Baca
What are the Getty vocabularies?

Catalog, index, document, access, research, discover
What are the Getty vocabularies?

Catalog, index, document, access, research, discover

- The Getty vocabularies are resources containing structured terminology for art, architecture, decorative arts, archival materials, visual surrogates, conservation, and bibliographic materials.
- Compliant with international standards, they provide authoritative information for catalogers, researchers, and data providers.
- The vocabularies grow through contributions. In the new linked, open environments, they provide a powerful conduit for research and discovery for digital art history.

- AAT (Art & Architecture Thesaurus ©): e.g., orthographic drawings, amphora, oil paint, olieverf, peintures à l’huile, acetylation, sintering, 十壇, Jade-kunst, Olmeca, Rinascimento, Chen-Yen (Buddhism), watercolors, and asa no ha toji.
- TGN (Getty Thesaurus of Geographic Names ©): e.g., Diaspolis, Acalán, Ottoman Empire, Mogao, Ch’ien-fu-tung, Ganges River, नेपाल जलका.
- ULAN (Union List of Artist Names ©): e.g., Charles Vandenhoove et associés, Mark Rothko, Cai Xiang, 石齊, Crevoile Master, Rajaraja Museum.
- IA (Getty Iconography Authority): e.g., Bouddha couché, शिव (Hindu deity), Shiva, French Revolution, Adoration of the Magi, Flood of Deucalion, Xibalba, Niflheim.
- CONA (Cultural Objects Name Authority ©): e.g., Chayasomesvara Temple, Empire State Building, Hagia Sofia, Ayia Σοφία, Mona Lisa, Portrait of Lisa Gherardini, La Gioconda, Livre de la Chasse, Le déjeuner sur l’herbe.
Context of the Getty vocabularies

The Getty vocabularies comply with standards for thesaurus construction (NISO and ISO)

Grow through contributions from the user community

Compiled and disseminated by the Getty Vocabulary Program (GRI) and Getty Digital

Released in online search (refreshed every month), XML, Relational Tables, Web Services, JSON, RDF, N3/Turtle, N-Triples; analysis going on now for other formats

Batch loading of data
From various contributors,
In our prescribed format

Processing Data
Global edits, VCS system,
Merging, editing/adding info
Moving/adding links

Releasing Data
Release formats
Web, LOD, XML, Rel Tables
## Context of the Getty vocabularies

### Getty processes contributions

- **300 contributing institutions** to the Getty vocabularies
  - [www.getty.edu/research/tools/vocabularies/contributors.html](http://www.getty.edu/research/tools/vocabularies/contributors.html)

<table>
<thead>
<tr>
<th>Brief Name</th>
<th>Full Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>AS-Academia Sinica</td>
<td>Academia Sinica (Academia Sinica: Nankang, Taiwan)</td>
</tr>
<tr>
<td>AAM</td>
<td>Ackland Art Museum (Chapel Hill, North Carolina)</td>
</tr>
<tr>
<td>AKAG</td>
<td>Albright-Knox Art Gallery (Buffalo, New York)</td>
</tr>
<tr>
<td>AC</td>
<td>Allegheny College (Allegheny, Pennsylvania)</td>
</tr>
</tbody>
</table>

### Batch loading of data

- From various contributors,
- In our prescribed format

### Processing Data

- Global edits, VCS system,
- Merging, editing/adding info
- Moving/adding links

### Releasing Data

- Release formats
  - Web, LOD, XML, Rel Tables

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Context of the Getty vocabularies

- Valued as authorities =  
  1. quality is reliable (compiled by experts and sources are cited)  
  2. the data is linkable  
- Use of Getty vocabularies = very high for the domain  
- Online search page = around 100,000 searches / month, top resources at Getty Research Institute (GRI)  
- Linked Open Data (LOD), typical month in 2018 = over 1,000,000 records (92.95 GB of data)  
- Implemented in collection management systems and Web sites around the world, new implementations 

Batch loading of data  
From various contributors,  
In our prescribed format 

Processing Data  
Global edits, VCS system,  
Merging, editing/adding info  
Moving/adding links 

Releasing Data  
Release formats  
Web, LOD, XML, Rel Tables
How are the Getty vocabs used?

**Catalog Level**  item  
**Classification**  sculpture | antiquities  
**Work Type**  statuette  
**Titles**  Female Figure of the Kilia Type  
**Creator**  unknown Anatolian  
**Creation Date**  2800/2200 BCE  
**Style/period:**  Chalcolithic  
**General Subject**  human figures  
**Specific Subject**  fertility | human female  
**Current Location**  J. Paul Getty Museum, Getty Villa Malibu (Los Angeles, California, USA)  
**Repository Number**  88.AA.122  
**Dimensions**  14.3 cm height (5 5/8 inches)  
**Mat & Tech**  carved marble  
**Style**  Kilia type

**AAT record**

<table>
<thead>
<tr>
<th>ID</th>
<th>300011443</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page Link</td>
<td><a href="http://vocab.getty.edu/page/aat/300011443">http://vocab.getty.edu/page/aat/300011443</a></td>
</tr>
</tbody>
</table>

**Fields controlled by vocabs**

- marble (rock)  
- (preferred, C, U, LC, English)  
- marbles (rocks)  
- (C, U, English, AD, U, N)  
- marmor (C, U, English, UF, U, N)  
- marmur (C, U, Dutch, D, P, U, N)  
- marmerplaat (C, U, Dutch, UF, U, N)  
- marmerplaten (C, U, Dutch, UF, U, N)  
- marbre (roche)  
- (C, U, French-P, D, U, N)  
- marbres (roche)  
- (C, U, French, AD, U, N)  
- marmo (C, U, Italian-P, D, U, N)  
- mármol (C, U, Spanish-P, D, U, N)  
- Marmor (C, U, German-P, D, U, N)
**Sample record**

**AAT_ID:** 300011329  

**Terms:**  
- bas-reliefs (pref, en, fr)  
- bas-relief (en, fr)  
- low reliefs (en)  
- bas-reliefs (nl)  
- travertino (es)  
- bassorilievo (it)  
- bajos relieves (es)  
- travertin (fr)  
- Flachreliefs (de)  
- 浮雕 (雕蟻)(zh; Chinese traditional)  
- qián fù diào (Chinese (transliterated Hanyu Pinyin))  
- qian fu dao (Chinese (transliterated Pinyin without tones))  
- ch‘ien fu tiao (Chinese (transliterated Wade-Giles))  

**Hierarchical Relationships**  
Objects Facet  
... Visual and Verbal Communication  
.... Visual Works  
....... <visual works by material or technique>  
......... sculpture (visual works)  
......... <sculpture by technique>  
......... reliefs (sculptures)  
............... bas-reliefs (sculpture)  

**Associative Relationships**  
produced by ...  
bas-relief (technique) [300053623]  
distinguished from ...  
high reliefs (sculpture) [300184782]  

**Scope Notes:**  
- Refers to works executed in relatively shallow relief. (en)  
- Beeldhouwwerken uitgevoerd in relatief laag reliëf. (nl)  
- Úsese para obras ejecutadas en relieve relativamente superficial. (es)  
- 指浮雕圖案較淺的作品。 (zh)  
- Bezeichnet eine Arbeit, die in relativ flachem Relief ausgeführt ist. (de)  

**Contributors:**  
AS-Academia Sinica, CDBP-DIBAM, GCJ, ICCD, IfM-SMB-PK, RKD, AAT-Ned, VP  

**Sources:**  

---

**Scope of each Getty vocabulary**

**AAT**  
Art & Architecture Thesaurus®

Includes *generic terms*, dates, relationships, sources, and notes for *work types*, *roles*, *materials*, *styles*, *cultures*, *techniques*, and *other concepts*

**Five Getty vocabularies**
Scope of each Getty vocabulary

**TGN**

*Getty Thesaurus of Geographic Names®*

Focuses on places relevant to art, architecture, and related disciplines, recording names, relationships, place types, dates, notes, and coordinates for current and historical cities, nations, empires, archaeological sites, lost settlements, and physical features.

Is a thesaurus, but through LOD TGN may be linked to GIS and maps.

---

**Sample record**

**TGN_ID:** 300011329

**Names:**
- Siena (pref, en, it, de, nl, fr, es)
- Sienna (en, it)
- Sienne (fr)
- Σιένα (el)
- 锡耶纳 (zh)
- Сиена (ru)
- הנני (he)
- シエーナ (ja)
- Sienese (en, adj)
- Senae (historical, la)
- Saena Julia (historical, la)
- Sena (historical, Etruscan)

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Sample record

**ULAN_ID:** 500014514

**Names:**
Gaudí, Antoni (ca,es,en,fr,it)

**Nationalities:**
Spanish (pref) Catalan

**Roles:**
artist (pref)
landscape architect
furniture designer

**Gender:**
male

**Birth and Death Places:**
Born: Reus (Tarragona province, Catalonia, Spain) (inhab place)
Died: Barcelona (Barcelona province, Catalonia, Spain) (inhab place)

**Associative Relationships:**
collaborated with .... Torres-Garcia, Joaquín (Uruguayan painter and theorist, 1874-1949) 1903-1904 [500031259]
worked with … Martorell y Montells, Joan (Spanish architect, 1833-1906) [500072753]
student of .... Sala Cortes, Emilio (Spanish architect, active late 19th century) [500287019]

**Contributors:**
VP,JPGM,Avery,FRICK,WCI,Prov,GRLPSC,BHA,CCA

**Sources:**

Scope of each Getty vocabulary

ULAN

Union List of Artist Names®
Includes names, relationships, notes, sources, and biographical information for artists, architects, firms, studios, repositories, patrons, sitters, and other individuals and corporate bodies, both named and anonymous.
Scope of each Getty vocabulary

IA

Getty Iconography Authority

New resource that focuses on subjects and topics relevant to art, architecture, and related disciplines

Includes multilingual and multicultural proper names, relationships, and dates for iconographical narratives, religious or fictional characters, themes, historical events, and named literary works and performing arts

Sample record

IA_ID: 1000085

Names:
Avalokiteshvara (en)
Avalokiteśvara (en)
Avalokitesvara (en)
अवलोकितेश्वर (sa)
Spyan ras gzigs (Tibetan transliterated)

AAT links
role/characteristic is ... bodhisattva
symbolic attribute is ... lotus
culture/religion is ... Mahayana (Buddhism)
culture/religion is ... Theravada (Buddhism)

Hierarchical Relationships
Top of the IA hierarchies:
Legend, Religion, Mythology
Buddhist iconography
Buddhist characters
Avalokitesvara (Buddhist iconography)

Associative Relationships
associated with .... Krishna (Hindu deity)
counterpart is .... Guanyin (Buddhist bodhisattva)
counterpart is .... Tara (Hindu-Buddhist deity)
has as manifestation .... Amoghapasa (Buddhist character)
author of .... Great Compassion Mantra (incantation, Buddhist, translated 7th/8th century)

Note
The bodhisattva of infinite compassion and mercy; embodies the compassion of all Buddhas. This bodhisattva is portrayed in different cultures as either female or male...

Contributors & sources

LINKS to other resources: LOC, Iconclass
Sample record

**CONA ID:** 700000141

**Titles/Names:**
- Hagia Sophia (en)
- Ayasofya (tr)
- Αγία Σοφία (el)
- Agia Sophia
- Agia Sophia
- Haghia Sophia
- Sainte-Sophie (fr)
- Santa Sofía (es)
- Sancta Sophia (la)
- Sancta Sapientia (la)
- Holy Wisdom (en)
- Saint Sophia (en)
- 圣索菲亚大教堂 (zh)

**Catalog Level:** item

**Work Types:**
- church (historical)
- mosque (historical)
- museum
- basilica

**Classification:**
- architecture

**Creation Date:**
- original structure dated from 4th century CE; present structure built 532-537 CE; rebuilt in 12th century

**Creator Display:**
- Anthemios of Tralles (Byzantine, ca. 474-ca. 534) and Isidoros of Meletus, the Elder (Byzantine, active mid-6th century)

**Locations:**
- **Current:** Istanbul (Turkey)
- **Address Note:** 41.008548°N; 28.979938°E
- **Mat & Tech:** system bearing masonry, centralized plan; ashlar and brick; interior surfaces are sheathed with polychrome marble, porphyry, and mosaics
- **Dimensions:** central dome: diameter 31 meters (102 feet); height 56 meters (184 feet)
- **Styles:** Byzantine | Ottoman

**General Subject:**
- architecture
- Type: isness
- religion and mythology
- Extent: purpose

**Specific Subjects:**
- Holy Wisdom (Christian allegory)

**Contributors:**
- VP; BWR

**Sources:**
- Maidstone, Hagia Sophia (1988); Built Works Registry database (2015-)
Merging data in one record

- Compiled resources = multiple contributors, separate records for same entity
- Published as unified records for end users
- Rather than clustering, Getty vocabularies merge the data into a homogenous whole
- The attribution to the contributor and sources are retained

**LINK back to contributed data**

**ULAN_500017409**

- **Names:**
  - Guardi, Francesco
  - Guardi, Francesco
  - Gardi, Francesco
  - Gardis, Francesco
  - François Guardi

- **Nationalities:**
  - Italian
  - Venetian

- **Roles:**
  - artist
  - painter
  - landscapist

**Getty vocabularies merge contributed records**

- JPGM: tmsid_3041 Guardi, Francesco
- Witt: WCI_20934875 Guardi, Francesco
- Avery: avery_49856 Guardi, Francesco
- BHA: bha_8476 Guardi, Francesco
- GRIPA: pa_5874665 Guardi, Francesco
- PROV: pr_3874665 Guardi, Francesco

**Links to images**

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**PROV**

PROV: pr_3874665 Guardi, Francesco

**GRIPA**

GRIPA: pa_5874665 Guardi, Francesco

**BHA**

BHA: bha_8476 Guardi, Francesco

**Avery**

Avery: avery_49856 Guardi, Francesco

**Witt**

Witt: WCI_20934875 Guardi, Francesco

**JPGM**

JPGM: tmsid_3041 Guardi, Francesco

**Nationalities**

- **Italian**
- **Venetian**

**Roles**

- **artist**
- **painter**
- **landscapist**

**Names**

- Guardi, Francesco
- Guardi, Francesco
- Gardi, Francesco
- Gardis, Francesco
- François Guardi

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Merging data in one record

<table>
<thead>
<tr>
<th>ULAN ID</th>
<th>Matching name</th>
<th>Display biography</th>
<th>Roles (AAT-controlled)</th>
<th>Nationality (AAT-controlled)</th>
<th>Estimated birth date</th>
<th>Estimated death date</th>
</tr>
</thead>
<tbody>
<tr>
<td>500017409</td>
<td>Guardi, Francesco</td>
<td>Venetian painter, 1712-1793</td>
<td>artist painter landscapist</td>
<td>Venetian Italian</td>
<td>1712</td>
<td>1793</td>
</tr>
<tr>
<td>500312969</td>
<td>Guardi, Francesco</td>
<td>Italian noble, born 1514</td>
<td>noble</td>
<td>Italian</td>
<td>1514</td>
<td>1614</td>
</tr>
<tr>
<td>500412666</td>
<td>Guardi, Francesco</td>
<td>Italian artist, ca. 1712-1793</td>
<td>artist</td>
<td>Italian</td>
<td>1707</td>
<td>1793</td>
</tr>
</tbody>
</table>

A name matches exactly; role matches; a nationality matches; dates within range?

* Candidates for merging
* Automatically merged or rejected for merging
* Possible but not enough firm data = passed to human editors
* Long experience in perfecting algorithms → Reconciliation tools are under development by Getty Digital
ULAN record is a merged, homogenous entity

Contributors
- AVERY, BHA, GRISC, GRL, GRLPA, PROV, VP, WCI, WCP, WL‐Courtauld

Sources
- Avery Authority
- Harald Szeemann Collections (2011‐2012)
- M. Knoedler & Co. records, Finding Aid, GRI Special Collections (2012‐2013)
- Provenance Index Databases, Authority file (1985‐2012)
- RILA/BHA (1975‐2000)
- Witt Library, Authority files (2000‐2012)

Nationalities:
- Italian (preferred)
- Venetian

Roles:
- artist (preferred)
- painter
- landscapist

Gender: male

Birth and Death Places:
- Born: Venice (Venezia province, Veneto, Italy) (inhabited place)
- Died: Venice (Venezia province, Veneto, Italy) (inhabited place)

Related People or Corporate Bodies:
- member of .... Guardi family
  (Italian painters, active 18th century) [500609865]
- parent of .... Guardi, Giacomo
  (Italian painter, 1764-1835) [500023608]
- sibling by marriage (in-law) of .... Tiepolo, Giovanni Battista
  (Venetian painter, 1696-1770) [500018523]
  Cecilia Guardi married Tiepolo in 1719
- sibling of .... Guardi, Antonio
  (Italian painter, 1699-1760) [500025094]
- sibling of .... Guardi, Niccolò
  (Italian painter, 1715-1785) [500029088]
Relationships and linking are built into Getty vocabularies

simplified
Entity Relationship Diagram

- All 5 vocabularies have same core structure
- Tables then added for specific needs
The Getty Vocabularies Are Thesauri

- Thesaurus: A semantic network of unique concepts
- Thesauri may be monolingual or multilingual
- Thesauri may have the following three relationships:
  - Equivalence Relationships
  - Hierarchical Relationships
  - Associative Relationships

Objects Facet
- Built Environment
- Single Built Works
- <single built works by function>
- monuments
- memorial arches
- triumphal arches
- triumphal arches
- triumphal arch
- 凯旋门 (纪念性拱门)
- kǎi xuán mén
- triomfbogen
- Triumphbögen
- archi trionfali
- arcs de triunfo

Locus/Setting for

Equivalent to

Hierarchical

Associative

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Links between vocabularies

- Certain data within each Getty vocabulary = controlled through links to other vocabularies

- E.g., roles in ULAN (e.g., artist, watercolorist, portraitist, patron, emperor) = controlled by Agents Facet in AAT
What is Linked Open Data?

Catalog, index, document, access, research, discover
What is Linked Open Data (LOD)?

The AAT, TGN, and ULAN are now available as LOD
They are published under the Open Data Commons Attribution License (ODC-By) 1.0

- When data is linked and open, it means that data is structured and published according to
  the principles of Linked Data = both interlinked and made openly accessible and shareable on Semantic Web
- Goal = allow data from different resources to be interconnected and queried
Linked Open Data (LOD)

- Linked Data
  - A set of best practices for publishing and connecting structured data on the Web to enable the interlinking possibilities.
  - It builds upon standard Web technologies such as HTTP and URLs.
  - But, rather than using them to serve web pages for human readers, it extends them to share information in a way that can be read automatically by computers.

- Open data
  - The idea that certain data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control.

- Linked Open Data (LOD)
  - A community project, sponsored by the Semantic Web Education and Outreach group of the W3C, to extend the Web with a data commons by publishing various open datasets as RDF on the WEB and by setting RDF links between data items from different data sources.
  - Both linked and open.
Basics of Linked Open Data

- **Universal Resource Identifier (URI)** - an ASCII string used to identify things on the Semantic Web
  
  http://vocab.getty.edu/aat/300198841

- URIs are linked to each other through **triples composed of subject-predicate-object relationships**

  `<aat:300198841> <gvp:aat2100_distinguished_from> <aat:300197140>`

- **subject** | **predicate** | **object**
  
  rhyta | are | distinguished from | stirrup cups

- The definitions of data elements and links are described by **ontologies**
  
  http://www.w3.org/2004/02/skos/core#
  http://www.w3.org/ns/prov#
  http://purl.org/dc/elements/1.1/

- Data is delivered to a requesting agent through a **standard triple serialization** using HTTP
  
  RDF/XML, Notation-3 (N3), Turtle, N-Triples, RDFa, JSON, JSON-LD

Revised, based on Gregg Garcia
Linked Documents vs Linked Data

- **Linked Documents on the Web**
  - Connected by hypertext
  - Allows users to traverse via Web browsers
  - Data is made available in formats such as CSV, XML, or marked up as HTML tables

- **Linked Data on the Web**
  - Connects data from diverse domains such as people, books, scientific publications, films, genes, drugs and clinical trials, online communities, statistical and scientific data.
  - Enables new generation of search engines that follow the links between data sources to deliver more complete answers as new data sources appear
  - Operate on top of an unbound, global data space.
  - Uses the Web to create typed links between data from different sources.
Basics of Linked Open Data

HTML

XML

RDF

Joan Cobb

**Basics of Linked Open Data**

**Triple Store vs. RDBMS**

**Triple Stores (OWLIM, 4store, Virtuoso)**
- Built for storage and retrieval of triples
- Queried using SPARQL
- Import/export using RDF and SPARQL Update

**Relational Database Management Systems (Oracle, SQL Server, MySQL)**
- Data is organized into flat, two-dimensional tables containing fields
- Queried using SQL
- Import/export using DML statements along with whatever formats are supported by RDBMS such as comma-delimited files and XML

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Gregg Garcia
What is a relational data model

- A relational database is a set of formally described tables from which data can be accessed or reassembled in many different ways without having to reorganize the database tables.
- The standard user and application programming interface (API) of a relational database is the Structured Query Language (SQL).
- Each table (called a relation) in a relational database contains one or more data categories in columns (called attributes).
- Each row (called a record or tuple) contains a unique instance of data, or key, for the categories defined by the columns.
- Each table has a unique primary key, which identifies the information in a table.
- The relationship between tables can then be set via the use of foreign keys.
What is an SQL query?

- **Structured Query Language** is the standard means of manipulating and querying data in relational databases
  - SELECT `<data>` FROM `<table>`
  - WHERE `<condition exists>`

- Example queries one table; you can search multiple tables by using a JOIN

- You can do sub-queries to accumulate a set, and then do another query on that set

- As with any report, formulating results in a friendlier format is a separate step

finds IDs of ULAN records for people having nationality “Native American” in the DB.
What is a graph-based data model

- A graph database (GDB) is a database that uses graph structures for semantic queries with nodes, edges and properties to represent and store data.
- Querying relationships within a graph database is fast because they are perpetually stored within the database itself.
- Native graph processing (called index-free adjacency) is the most efficient means of processing data in a graph because connected nodes physically point to each other in the database.

![Graph Database Diagram]

**Neo4J**

for -- x:prefLabelulan_term:1500084603-en [Kicking Bear]
What is a SPARQL query?

- SPARQL Protocol RDF Query Language was made a standard by the RDF Data Access Working Group (DAWG) of the W3C
- SPARQL endpoint is a service that accepts SPARQL queries and returns results
- As with SQL, you SELECT where conditions apply FROM is optional
- As with any report, formulating results in a friendlier format is a separate step

finds IDs of ULAN records for people having nationality “Native American” and role “artist”

```sparql
select *
{select distinct ?x {
 ?x foaf:focus/(schema:nationality|(schema:nationality/gvp:broaderGenericExtended)) aat:300017437;
  gvp:agentType|(gvp:agentType/gvp:broaderGenericExtended) aat:300025136}
?x gvp:prefLabelGVP/xl:literalForm ?name;
  foaf:focus/gvp:biographyPreferred/schema:description ?bio}
```
## Five-star data

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.

1. ★ Available on the Web (any format) with an open license, to be Open Data
2. ★★★ Available as machine-readable structured data (e.g., Excel instead of image scan of a table)
3. ★★★★ Available in a non-proprietary format (e.g., CSV instead of Excel)
4. ★★★★★ All of the above plus using open standards from W3C (RDF and SPARQL) to identify things so that users can point to your data
5. ★★★★★★ All of the above plus linking your data to other data sets to provide context

[https://www.w3.org/DesignIssues/LinkedData.html](https://www.w3.org/DesignIssues/LinkedData.html)
Growth of the LOD Cloud since 2007

LOD as of 2018
5,000 datasets

View of LOD as of October 2007
12 Datasets

http://lod-cloud.net/

Revised from Joan Cobb
Getty vocabularies are part of this cloud
Using LOD

- My data
- Metadata Repository
- Search & browse
- LOD
- RDF graphs
Resource Description Framework (RDF)

One of the key ingredients of Linked Data.
Provides a generic graph-based data model for describing things, including their relationships with other things.

- Three column format – known as a triple – forms the fundamental building block of semantic representations.
  - Subject - corresponds to the entity – a ‘thing’
  - Predicates – property of the entity - names, birth/death dates
  - Objects - Subjects in another triple OR Literal values

Conceptualized anything (and everything) in the universe as a resource.
Specifically supports evolution of schemas over time without requiring all the data consumers to be changed
RDF has varying representations (e.g., XML, text, JSON)
LOD Ontologies & Vocabularies

- **Ontology**
  - Used to capture knowledge about some domain of interest. An ontology describes the concepts in the domain and also the relationships that hold between those concepts.

- **Vocabulary**
  - A vocabulary in the sense of knowledge systems or ontologies are controlled vocabularies. They provide a way to organize knowledge for subsequent retrieval.

- **Semantic Web Ontology**
  - This is a formal specification of a shared conceptualization of the information to be published.
  - Examples of the vocabulary used in ontologies: class, object property, role, category, property, resource, etc.
Uniform Resource Identifier (URI)

- Identifies a resource either by location (URL), or name (URN). It usually includes some type of unique and persistent identifier.
- URIs are not URLs but every URL is a URI
- The URI for a resource represented in an RDF statement is called the URI reference (URIref) for that graph node.
- URIs are used as ‘strong keys’ that are assigned to each of the nodes so that we can refer to them consistently across all the triples that describe their relationships.
- The URN that will be the base URI for AAT will be http://vocab.getty.edu/aat.
Web Ontology Language (OWL)

- Developed by the W3C
- Built as an extension to RDFS
- Provides a precise vocabulary that enables more powerful reasoning and inference over relationships with which to knowledge can be represented.
- Can be seen as a social contract between a data provider and a data consumer.
Simple Knowledge Organization System (SKOS)

A language designed for representation of thesauri, classification schemes, taxonomies, subject-heading systems, or any other type of structured controlled vocabulary.

Based on RDF
- SKOS is currently developed within the W3C framework
- Can be used on its own, or in combination with other ontologies.
LOD: Simple SKOS example

Sample concepts relationship in a pre-SKOS taxonomy

Sample concepts relationship in SKOS

Triplestores

- Are purpose-built databases for the storage and retrieval of the type of unstructured information express in RDF triples that makes up the Semantic Web.
- Are not relational databases.
- Query language used with triplestores is typically SPARQL.
- In addition to queries, triples can usually be imported/exported using RDF and other formats.
- Some triplestores store billions of triples.
Why do we care?

- The way data is being published on the web is currently in transition.
- A current trend in managing art information is to increasingly make data art, architecture, and cultural heritage objects available as Linked Open Data.
- This applies to the information directly describing the objects, but also the vocabularies used in the descriptions.
- For years now, the Getty Vocabulary team has been receiving legitimate requests to publish our thesauri as LOD.
- It was time to stop asking “why” and to start exploring “how”.
Key advantages of Linked Open Data

- **Open** means Everyone can access, reuse, enrich and share the data published in agreed-upon formats = LOD formats
  - Using common formats makes “interworkability” more feasible
- LOD disambiguates your search; eliminates the noise you sometimes get in Google search; what you are seeking is more precise because of the way you tag the information you are converting to LOD
- LOD connects you to all kinds of relevant information creating a playground for serendipity and it updates that information dynamically within the same web space
- LOD is able to connect data from the Web that was not previously connected
The Getty vocabularies as LOD

Catalog, index, document, access, research, discover

See full documentation and SPARQL endpoint here
http://vocab.getty.edu/
Why Linked Open Data?

• The time was right for the Getty, particularly as the LOD project coincides with the Getty’s Open Content initiative
  o The J. Paul Getty Museum and Getty Research Institute (GRI) make available, without charge, all available digital images to which the Getty holds the rights or that are in the public domain to be used for any purpose. No permission is required
    o [www.getty.edu/about/opencontent.html](http://www.getty.edu/about/opencontent.html)
• Also, GRI Portal: The Getty Research Portal™ is an online search platform providing global access to growing number of digitized art history texts
• The Getty Conservation Institute (GCI), GRI, and the Getty Museum are also releasing information as LOD
Licensing the data

- Historically, the Getty vocabularies relational tables, XML, (MARC) were licensed, with use somewhat restricted; fees adjusted for not-for-profit and for-profit licensees
- Policy makers and legal experts analyzed which licensing was best for LOD

**Open Data Commons Attribution License (ODC-By) v1.0**

Allows that you (the users) are free to do the following:

- To Share: To copy, distribute, and use the database
- To Create: To produce works from the database
- To Adapt: To modify, transform, and build upon the database

- As long as you Attribute: You must attribute any public use of the database, or works produced from the database, in the manner specified in the license
  - For any use or redistribution of the database, or works produced from it, you must make clear to others the license of the database and keep intact any notices on the original database

- [http://opendatacommons.org/licenses/](http://opendatacommons.org/licenses/)
 Getty vocabularies as Linked Open Data

- Getty Vocabularies are valued as authorities because
  1. quality is reliable (compiled by experts, sources cited)
  2. the data is linkable
- Vocabs were planned from beginning to be linked, to aid in
  answering complex art historical questions
  (e.g., return records for oil paintings that are now located in North
  America having non-Christian iconography and created by
  Netherlandish or French painters active in Tuscany or Umbria, Italy
  between 1410 and 1630)
- Vocabs contain thesaural and other rich links
- Unique, persistent IDs for records, terms, other data
- Include IDs of outside resources too, to allow linking

Examples of unique, persistent IDs in AAT

```
AAT_ID: 300132869
Terms:
  • triumphal arches [1000007003] Qual: (memorial arches)
    Pref: pref Type: D Lang: (en) Con.: FDA, GCI, VP
  • triumphal arch [1000290974] Qual: (memorial arch)
    Type: ALT Lang: (en) Con.: FDA, VP
  • 凱旋門 Qual: (紀念性拱門) [1000545314]
    Type: D Lang: (zh, Chinese (traditional)) Con.: AS
```
Getty vocabularies as Linked Open Data

```
<aat:300198841> <skos:prefLabel> "rhyta"@en
<aat:300198841> <skos:altLabel> "rhytons"@fr
<aat:300198841> <rdf:type> <gvp:Concept>
<aat:300198841> <gvp:broaderPreferred> <aat:300194567>
<aat:300198841> <gvp:aat2100_distinguished_from> <aat:300197140>
```

Note: Refers to vessels from Ancient Greece, eastern Europe, or the Middle East that typically have a closed form with two openings, one at the top for filling and one at the base so that liquid could stream out. They are often in the shape of a horn or an animal’s head, and were typically used as a drinking cup or for pouring wine into another vessel. Drinking was done by holding the rhyton above the drinker’s head and catching the stream of liquid in the mouth.

Terms:
- rhyta (preferred, C,U,L,C,English-P,D,U,PN)
  (Greek (transliterated), P,D,U,PN)
  (Spanish, U,F, U,PN)
- rhyton (C,U,English,AD,U,SN)
  (Greek (transliterated), P,D,U,PN)

Patricia Harpring © 2018 J. Paul Getty Trust

Getty vocabularies as Linked Open Data

- AAT, TGN, and ULAN are available as LOD
- Under Open Data Commons Attribution License (ODC-By) 1.0
- Linked Open Data (LOD) is popular, in a typical month in 2018 = over 1,000,000 records (92.95 GB of data) downloaded
- JSON, RDF, N3/Turtle, N-Triples; analysis now for other formats too
- Available at SPARQL end point: download entire datasets or subsets
- Also released in online search (refreshed every month), XML, Relational Tables, Web Services, implemented in collection management systems and Web sites around the world, new implementations are being explored

Parsing the Getty vocabularies to LOD was not simple
- Needed institutional support, coincided with new open policy at Getty
- Required research and mapping Vocab data to which was best fit for LOD, retaining the full richness and integrity of the vocabulary data
- Required decisions regarding which open license is best
- Edited data to make it consistent and linkable, virtual links and cross-references had been maintained by hand for decades \(\rightarrow\) now real links
- LOD = more contributions; streamline processing, while maintaining content quality;
  
  must avoid bottleneck
There are many examples of datasets aligning or co-referencing the Getty Vocabularies; below are some examples

- Wikidata. Here are the pages that detail the current status of that alignment:
  ULAN: [https://tools.wmflabs.org/mix-n-match/#/catalog/27](https://tools.wmflabs.org/mix-n-match/#/catalog/27)
  AAT: [https://tools.wmflabs.org/mix-n-match/#/catalog/48](https://tools.wmflabs.org/mix-n-match/#/catalog/48)

  The project relies on volunteers making manual matches over time after the initial automatic matching process. Here is the home page for the overall Wikidata authority control process. The Getty Vocabularies are mentioned a number of times.
  [https://www.wikidata.org/wiki/Wikidata:WikiProject_Authority_control](https://www.wikidata.org/wiki/Wikidata:WikiProject_Authority_control)

- Europeana is also connected to AAT concepts:
  [https://pro.europeana.eu/page/europeana-aat](https://pro.europeana.eu/page/europeana-aat)
  See the links from their SPARQL API: [https://pro.europeana.eu/resources/apis/sparql](https://pro.europeana.eu/resources/apis/sparql)

- There are other various institutions that have linked to ULAN.
  Some examples include MoMA (ULAN IDs included in this data set):
  [https://github.com/MuseumofModernArt/collecton](https://github.com/MuseumofModernArt/collecton)
  and the Gilcrease Museum (“About the creator” section comes from ULAN):
  [https://collectons.gilcrease.org/object/1526167](https://collectons.gilcrease.org/object/1526167)

- The Ariadne project also mapped a number of data sets to the AAT:

Gregg Garcia
To be a five-star LOD dataset, one has to be already a five-star product

The Getty Vocabularies -- is a five-star vocabulary

• High quality authority control of appellations representing things;
• Multilingual and multi-cultural; historical and contemporary;
• High specificity while comprehensive; continual and open-ended;
• One of the few selected vocabularies that are being:
  – recommended or required by many important metadata standards
    (e.g., DC, VRA Core, CCO, etc.)
  – used as examples at national and international standards for structured vocabularies
    (e.g., ISO25964-1 and ISO25964-2, NISO Z39.19)
  – adopted by cross-country and cross-domain data services, in addition to many institutions’
    (e.g., Europeana, DPLA (Digital Public Library of America))
  – widely studied by researchers. Google Scholar shows results when searching (exact match):
    • 2,110 entries for "Art and Architecture Thesaurus"
    • 3,570 for "Thesaurus of Geographic Names"
    • 89 for "Cultural Objects Name Authority"
    • 72 for "Union List of Artist Names"
    • 355 for " Getty Vocabularies" ... ...

In comparison:

• “Eurovoc”: 2,220
• "Library of Congress Name Authority": 768

Marcia Zeng
How to improve five-star data

1. Getty Vocabs ↔ Others’ Metadata
   - E.g., Used by MARC, LIDO, EAD, local dbs, Wikipedia, etc.
   - Needed Actions?

2. Getty Vocabs ↔ Other Vocabs
   - E.g., Integrated multilingual versions; aligned with [to or by] other vocabs.
   - Needed Actions?

3. Getty Vocabs ↔ Other Services
   - E.g., Served through APIs & SPARQL end-points; included by other services (VIAF, Pinto, etc.).
   - Needed Actions?

Marcia Zeng
The Getty vocabularies is five-star data and valuable in other ways too.

1. Controlled Vocabulary
2. Tree of Knowledge
3. Faceted Framework
4. Five Star LOD Data
5. Knowledge Base

Revised from Marcia Zeng
Triple Extract Process

Vocabulary Coordination System
(Oracle RDBMS)

R2RML + Perl

NT Files

Sesame Console

OWLIM Triple Store

vocab.getty.edu/sparql

Internet

Gregg Garcia
 Getty vocabularies LOD formats

JSON

JSON-LD

RDF

N-Triples

N-Triples

Gregg Garcia
Using SPARQL

- Now we can begin to find materials for research and discovery online
- Getty vocabularies have been used for indexing
  - Now = links are possible via LOD, links to TGN and AAT within ULAN are used
- 90 sample SPARQL queries, editable
  - Find artists who worked in Italy and lived during a given time range but who are not Italian

Select ULAN records
- Having event that took place in tgn:1000080 Italy or any of its descendants
- Birth date between 1250 and 1780
- Descendants of facet ulan:500000002 "Persons, Artists"
- Not having nationality aat:300111198 Italian or any of its descendants

- Then use this set of artists to search for works

Using Linked Open Data

**Getty Vocabularies are LINK-able**

Data in standard formats that allow linking

**ULAN**

Select ULAN records
- Having event that took place in tgn:1000080 Italy or any of its descendants
- Birth date between 1250 and 1780
- Descendants of facet ulan:500000002 "Persons, Artists"
- Not having nationality aat:300111198 Italian or any of its descendants

Then use this set of artists to search for works

**[LINK] [LINK] [LINK] [LINK]**

**[LINK] [LINK] [LINK] [LINK]**

**[LINK – this is coming, as of now not enough works are discoverable]**
## External ontologies

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Ontology</th>
<th>Used for</th>
</tr>
</thead>
<tbody>
<tr>
<td>bibo:</td>
<td>Bibliography Ontology</td>
<td>Sources</td>
</tr>
<tr>
<td>dc:</td>
<td>Dublin Core Elements</td>
<td>common</td>
</tr>
<tr>
<td>dcterms:</td>
<td>Dublin Core Terms</td>
<td>common</td>
</tr>
<tr>
<td>foaf:</td>
<td>Friend of a Friend ontology</td>
<td>Contributors</td>
</tr>
<tr>
<td>iso:</td>
<td>ISO 25946 (latest on thesauri)</td>
<td>iso:ThesaurusArray, BTG/BTP/BI</td>
</tr>
<tr>
<td>owl:</td>
<td>Web Ontology Language</td>
<td>Basic RDF representation</td>
</tr>
<tr>
<td>prov:</td>
<td>Provenance Ontology</td>
<td>Revision history</td>
</tr>
<tr>
<td>rdf:</td>
<td>Resource Description Framework</td>
<td>Basic RDF representation</td>
</tr>
<tr>
<td>rdfs:</td>
<td>RDF Schema</td>
<td>Basic RDF representation</td>
</tr>
<tr>
<td>schema:</td>
<td>Schema.org</td>
<td>common, geo (TGN)</td>
</tr>
<tr>
<td>skos:</td>
<td>Simple Knowledge Org System</td>
<td>Basic vocabulary representation</td>
</tr>
<tr>
<td>skosxl:</td>
<td>SKOS Extension for Labels</td>
<td>Rich labels</td>
</tr>
<tr>
<td>wgs:</td>
<td>W3C World Geodetic Survey geo</td>
<td>Geo (TGN)</td>
</tr>
<tr>
<td>xsd:</td>
<td>XML Schema Datatypes</td>
<td>Basic RDF representation</td>
</tr>
</tbody>
</table>

Vladimir Alexiev
GVP Data

Scope includes:

- **Subjects**: Concepts but also non-concepts
- **Obsolete subjects** (and dct:isReplacedBy)
- **Terms**: plain (SKOS) & rich (SKOS-XL). Term characteristics
- **Languages** (some custom lang tags)
- **Hierarchical rels**: custom & standard, distinguish BTG,BTP,BTI
- **Associative rels**: (170 subprop of skos:related)
- **Historic info on rels**: (rdf:Statement) and terms
- **Alignment**: (exactMatch to LCSH)
- **Sources**: (bibo:Document, bibo:DocumentPart with locator)
- **Contributors**: (foaf:Agent)
- **Revision history**: (prov:Activity)
- **Thesaurus-specific**: (TGN place types, coordinates)
### Semantic resolution and content negotiation

All GVP, AAT, TGN, and ULAN URLs resolve, returning human or machine readable content through content negotiation (303 redirect)

<table>
<thead>
<tr>
<th>URL</th>
<th>Content Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://vocab.getty.edu/ontology">http://vocab.getty.edu/ontology</a></td>
<td>semantic URI, content-negotiated</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/ontology.html">http://vocab.getty.edu/ontology.html</a></td>
<td>page (application/xhtml+xml)</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/ontology.rdf">http://vocab.getty.edu/ontology.rdf</a></td>
<td>application/rdf+xml</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/ontology.ttl">http://vocab.getty.edu/ontology.ttl</a></td>
<td>text/turtle</td>
</tr>
</tbody>
</table>

**Eg about an AAT subject**

<table>
<thead>
<tr>
<th>URL</th>
<th>Content Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://vocab.getty.edu/aat/300011154">http://vocab.getty.edu/aat/300011154</a></td>
<td>semantic URI, con-neg</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/aat/300011154.html">http://vocab.getty.edu/aat/300011154.html</a></td>
<td>page (application/xhtml+xml)</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/aat/300011154.rdf">http://vocab.getty.edu/aat/300011154.rdf</a></td>
<td>application/rdf+xml</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/aat/300011154.ttl">http://vocab.getty.edu/aat/300011154.ttl</a></td>
<td>text/turtle</td>
</tr>
<tr>
<td><a href="http://vocab.getty.edu/aat/300011154.nt">http://vocab.getty.edu/aat/300011154.nt</a></td>
<td>NTriples</td>
</tr>
</tbody>
</table>
GVP Semantic Representation

Vladimir Alexiev
Hierarchical relations

Use ISO: ThesaurusArray to allow Guide Terms below Concepts.
Infer cross-threading SKOS/ISO broader relations
### Key values ("flags") are important

<table>
<thead>
<tr>
<th>vocable</th>
<th>field</th>
<th>val</th>
<th>ObjectProperty</th>
<th>Class</th>
<th>label</th>
<th>domain</th>
<th>range</th>
<th>subProperty</th>
<th>subClassOf</th>
<th>ConceptSchem</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject</td>
<td>record_type</td>
<td>F</td>
<td>ObjectProperty</td>
<td>gvp:Facet</td>
<td>Facet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>gvp:Facet</td>
</tr>
<tr>
<td>AAT subject</td>
<td>record_type</td>
<td>H</td>
<td>ObjectProperty</td>
<td>gvp:Hierarchy</td>
<td>Hierarchy Name</td>
<td></td>
<td></td>
<td>gvp:Facet</td>
<td></td>
<td>gvp:Facet</td>
</tr>
<tr>
<td>AAT subject</td>
<td>record_type</td>
<td>G</td>
<td>ObjectProperty</td>
<td>gvp:GuideTerm</td>
<td>Guide Term</td>
<td></td>
<td></td>
<td>gvp:Facet</td>
<td></td>
<td>gvp:Facet</td>
</tr>
<tr>
<td>AAT subject</td>
<td>record_type</td>
<td>C</td>
<td>ObjectProperty</td>
<td>gvp:Concept</td>
<td>Concept</td>
<td></td>
<td></td>
<td>gvp:Facet</td>
<td></td>
<td>gvp:Facet</td>
</tr>
<tr>
<td>subject</td>
<td>record_type</td>
<td>P</td>
<td>ObjectProperty</td>
<td>gvp:ObsoleteSubject</td>
<td>Obsolete Subject</td>
<td></td>
<td></td>
<td>gvp:Facet</td>
<td></td>
<td>gvp:Facet</td>
</tr>
<tr>
<td>TGN subject</td>
<td>record_type</td>
<td>A</td>
<td>ObjectProperty</td>
<td>gvp:AdminPlaceConcept</td>
<td>Administrative Place Concept</td>
<td></td>
<td></td>
<td>gvp:Facet</td>
<td></td>
<td>gvp:Facet</td>
</tr>
<tr>
<td>TGN subject</td>
<td>record_type</td>
<td>B</td>
<td>ObjectProperty</td>
<td>gvp:PhysPlaceConcept</td>
<td>Physical Place Concept</td>
<td></td>
<td></td>
<td>gvp:Facet</td>
<td></td>
<td>gvp:Facet</td>
</tr>
</tbody>
</table>

- **subject_rels** preferred P gvp:broaderPreferred
- **subject_rels** preferred N gvp:broaderNonPreferred
- **subset_rels** preferred G gvp:broaderGeneric
- **subject_rels** preferred I gvp:broaderInstantial
- **term** preferred P gvp:prefLabelGVP
- **term** preferred Y gvp:prefLabelLoC
- **term** preferred V gvp:prefLabel
- **other_rels** preferred A gvp:otherTerms
- **other_rels** preferred J gvp:otherTerms
- **other_rels** preferred C gvp:otherTerms
- **other_rels** preferred X gvp:otherTerms
- **other_rels** preferred F gvp:otherTerms
- **other_rels** preferred S gvp:otherTerms

**Vladimir Alexiev**
Associative relations are important

Relations come in owl:inversOf pairs or owl:symmetricProperty self-inverse

<table>
<thead>
<tr>
<th>code</th>
<th>code</th>
<th>domain (C1)</th>
<th>LOD freq</th>
<th>range (C2)</th>
<th>LOD freq</th>
<th>Editor freq - From C1 to C2</th>
<th>Editor freq - From C2 to C1</th>
<th>example</th>
<th>lexample</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>any</td>
<td>related to</td>
<td>any</td>
<td>any</td>
<td>any - related to - any</td>
<td>same</td>
<td>gulf red is related to light red (pigment)</td>
<td>light red (pigment) is related to gulf red</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>any</td>
<td>formerly referred to</td>
<td>any</td>
<td>any - formerly referred - any</td>
<td>same</td>
<td>gilgues formerly referred to fiddles</td>
<td>Riddles formerly referred to gilgues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td>any</td>
<td>distinguished from</td>
<td>any</td>
<td>any - distinguished from - any</td>
<td>same</td>
<td>historic farms are distinguished from abandoned farms; naive art is distinguished from outsider art</td>
<td>abandoned farms are distinguished from historic farms; outsider art is distinguished from naive art</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```turtle
gvp:aat2000_related_to a owl:ObjectProperty;
  rdfs:subPropertyOf skos:related;
  rdfs:domain skos:Concept; rdfs:range skos:Concept;
  # domain "any"; range "any";
  dc:identifier "2000";
  skos:prefLabel "aat2000_related_to";
  dc:title "related to - any";
  skos:example "gulf red is related to light red (pigment)";
  skos:scopeNote "generic relationship, not explained";
  dot:dotDescription """"any - related to - any; generic relationship, not explained. Example: gulf red is related to light red (pigment)""""
  gvp:aat2000_related_to a owl:SymmetricProperty.
```
Use of ISO: ThesaurusArray in GVP

Vladimir Alexiev
CONTRIBUTION TO ISO 25946

- Contributed to ISO 25946 ontology (LOV entry)
- First industrial use of ISO 25946
- Defined appropriate combinations of BTG, BTP, BTI relations (first formally defined in ISO).


<table>
<thead>
<tr>
<th>BTGx</th>
<th>BTPx</th>
<th>BTIx</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTGx</td>
<td>BTGE</td>
<td>BTPE no</td>
</tr>
<tr>
<td>BTPx</td>
<td>BTPE</td>
<td>BTPE no</td>
</tr>
<tr>
<td>BTIx</td>
<td>BTIE</td>
<td>no no</td>
</tr>
</tbody>
</table>

- Eg: anvil components BTP < anvils and anvil accessories > BTG < forging and metal-shaping tools > => BTPE
- Mount Athos BTI Orthodox religious center BTG religious center => BTIE
TERMS

Support multilingual labels: both SKOS (plain)...

```
aat:300198841 a skos:Concept , gvp:Subject , gvp:Concept ;
skos:prefLabel "rhyta"@el-latn , "rhyta"@en , "rhytons"@es , "rhytons"@fr ;
skos:altLabel "rhyta"@es , "rhyton"@es , "rhyton"@en , "rhyton"@el-latn ...;
skosxl:prefLabel aat_term:1000198841-en , aat_term:1000198841-el-Latn ...;
skosxl:altLabel aat_term:1000198841-es , aat_term:1000297235-en ...```

... and rich info in SKOS-XL:

```
aat_term:1000198841-en a skosxl:Label ;
dc:identifier "1000198841" ;
dct:language aat:300390277 , gvp_lang:en ; # owl:sameAs
dct:contributor aat_contrib:100000000 , aat_contrib:10000131 ;
skosxl:literalForm "rhyta"@en ; ### with Qualifier if applicable
gvp:term "rhyta"@en ; ### no qualifier
gvp:displayOrder "1"^^xsd:positiveInteger ;
gvp:termType <term/type/Descriptor> ; ### Descr/AltDescr/UseFor
gvp:termPOS <term/POS/PluralNoun> ; ### Part of Speech
gvp:contributorPreferred aat_contrib:100000000 , aat_contrib:10000088 ;
gvp:contributorNonPreferred aat_contrib:10000131 ;
gvp:sourcePreferred aat_source:2000051089-term-1000198841 ...;
dct:source aat_source:2000024811 , aat_source:2000052946 ;
gvp:sourceNonPreferred aat_source:2000052946 ;
```
Some Custom Language Tags

Despite the richness of IANA tags (9000), we had to define new tags, using several extension mechanisms:

- **Private language**, e.g.
  - `x-byzantin-Latn`: Byzantine Greek (transliterated)
  - `x-frisian`: IANA/ISO has codes for predecessor Old Frisian and dialects West, Saterland and North Frisian

- **Private language used in specific region**, e.g.
  - `qqq-002`: African language (not specified which)
  - `qqq-ET`: Ethiopian (not specified: Boro/Borna, Karo...)

- **Private modifier**, e.g.
  - `grc-Latn- x-liturgic`: Liturgical Greek
  - `ber-Latn- x-dialect`: Berber Dialects (transliterated)
  - `fa-Latn- x-middle`: Persian, Middle (transliterated)
  - `zh-Latn-pinyin- x-notone`: transliterated Pinyin without tones
SOURCES

bibo:Document or bibo:DocumentPart

aat_source:2000051089 a bibo:Document;
dct:identifier "2000051089"
bibo:shortTitle "AATA database (2002-)";
dct:title "Getty Conservation Institute (GCI). database of AATA Online...".

aat_source:2000051089-term-1000198841 a bibo:DocumentPart;
dct:isPartOf aat_source:2000051089;
bibo:locator "128257 checked 26 January 2012".

Applied to subject, term, scopeNote:

aat:300198841 # subject (rhyta)
dct:source aat_source:2000030301-subject-300198841;
dct:source aat_source:2000052378.

aat_term:1000198841-en # term "rhyta"en
gvp:sourceNonPreferred aat_source:2000049728;

aat_scopeNote:34904 # scopeNote
dct:source aat_source:2000046502.
Contributors

foaf:Agent

aat_contrib:10000131 a foaf:Agent;
dc:identifier "10000131";
foaf:nick "CDBP-DIBAM";
foaf:name "Centro de Documentación de Bienes Patrimoniales...".

Applied to subject, term, scopeNote:

aat:300198841 # subject "rhyta"
dct:contributor aat_contrib:10000131;
aat_term:1000198841-en # term "rhyta"en
gvp:contributorNonPreferred aat_contrib:10000131;
gvp:contributorPreferred aat_contrib:10000000.
aat_scopeNote:34904 # scopeNote
HISTORIC INFO

Includes dates of applicability, historicFlag, comment. Applied to terms; hier & assoc rels, place types (using rdf:Statement)

```plaintext
aat_term:1000002693-en a skosx1:Label;
skosx1:literalForm "lambruscatura"@en;
gvp:historicFlag <http://vocab.getty.edu/historic/historic> ;
schema:startDate "0900"^^xsd:gYear ;
schema:endDate "1700"^^xsd:gYear ;
rdfs:comment "Medieval term for wainscoting".

aat_rel:300020271-aat2812_followed-300020269 a rdf:Statement;
rdf:subject aat:300020271; # Second Dynasty (Egyptian)
rdf:predicate gvp:aat2812_followed;
rdf:object aat:300020269; # First Dynasty (Egyptian)
rdfs:comment "Second Dynasty began ca. 2775 BCE";
schema:startDate "-2785"^^xsd:gYear;
schema:endDate "-2765"^^xsd:gYear.

tgn:7011179-placeType-300008347 a rdf:Statement;
rdf:subject tgn:7011179; # Siena
rdf:predicate gvp:placeTypePreferred;
rdf:object aat:300008347; # inhabited place
rdfs:comment "settled by Etruscans (flourished 6th century BCE)";
schema:startDate "-800"^^xsd:gYear;
gvp:displayOrder "1"^^xsd:positiveInteger.
```

Vladimir Alexiev
REVOLUTION HISTORY

PROV is too complex, so we simplify:

```
aat:300018699
  prov:wasGeneratedBy aat_rev:12345;
  dct:created "2014-01-02T01:02:03"^^xsd:dateTime;
  dct:modified "2014-01-03T01:02:03"^^xsd:dateTime;
  dct:issued "2014-01-04T01:02:03"^^xsd:dateTime.
aat_rev:12345 a prov:Activity, prov:Create;
  dc:type "created";
  prov:startedAtTime "2014-01-02T01:02:03"^^xsd:dateTime.
aat_rev:12346 a prov:Activity, prov:Modify;
  prov:used aat:300018699;
  dc:type "term added";
  dc:description "leggings, puttees (1000248060)";
  prov:startedAtTime "2014-01-03T01:02:03"^^xsd:dateTime.
aat_rev:12347 a prov:Activity, prov:Publish;
  prov:used aat:300018699;
  dc:type "issued";
  prov:startedAtTime "2014-01-04T01:02:03"^^xsd:dateTime.
```
TGN SPECIFICS: CONCEPT-PLACE DUALITY

Duality between Concept and its denotation (ala VIAF, UK BL, FR BnF, SE KB...)

Vladimir Alexiev
TGN SEMANTIC REPRESENTATION

Place types (TGN->AAT), Concept-Place duality, coordinates
See original slides by other authors in these PDFs

- Getty Vocabularies, Why LOD?, Joan Cobb

- Getty Vocabularies as LOD: Process, Discovery, Evolutions, Gregg Garcia

- GVP Ontologies and Semantic Representation, Vladimir Alexiev

- Present and Future of LOD, KOS, and the Getty Vocabularies, Marcia Zeng

- Getty Vocabularies and the Significance of Five-Star LOD Datasets, Marcia Zeng
  [https://www.getty.edu/research/tools/vocabularies/zeng_vocabs_and_five_star_lod.pdf](https://www.getty.edu/research/tools/vocabularies/zeng_vocabs_and_five_star_lod.pdf)

See full documentation and SPARQL endpoint here
[http://vocab.getty.edu/](http://vocab.getty.edu/)