Using KOS as the Connectors of Linked Datasets

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1. AGROVOC Thesaurus
   -- Backbone of linked datasets in the agricultural domain

2. Creating LOD Microthesauri
   -- using LOD Art and Architecture Thesaurus (AAT) as an example
AGROVOC
Backbone of linked datasets in the agricultural domain
What is AGROVOC?

Controlled vocabulary covering all areas of interest of the Food and Agriculture Organization (FAO) of the United Nations, including food, nutrition, agriculture, fisheries, forestry, environment etc.
Technical Aspects

- AGROVOC RDF/SKOS (SKOS-XL)
  - for download
  - “live” through SPARQL endpoint and web services
- LOD: linked to 13 vocabularies
- Total number of concepts = ~ 32,000
  - 20 languages published
    - 4 under development
  - 25 top concepts
  - Maximum depth hierarchy: 14
Strengths of AGROVOC

- Multilinguality
- Number of (institutional) users
- Experience and work done towards use in open data environment
AGROVOC
Structure
Use case of Linked Data KOS (AGROVOC) in information services (AGRIS)
AGRIS - Background

- **A network**: AGRIS is a collaborative network of more than 150 institutions from 65 countries.

- **A database**: AGRIS is a multilingual bibliographic database for agricultural science.

- **A Web portal**: AGRIS (http://agris.fao.org/) is a Web application that links the AGRIS knowledge to related Web resources using the Linked Open Data methodology.
  
  - **Purpose**: providing as much information as possible about a topic within the agricultural domain.
The setting

- Bibliographic references in the agricultural domain enhanced by the AGROVOC thesaurus
- AGRIS is an RDF-aware system, a mashup application that allows users to query the AGRIS content, interlinking all resources to external sources of information
Some statistics of AGRIS

- ~ 300,000 visits/month
- World wide used (accessed from more than 200 countries)
Interlinking

- Centralization: bibliographic references in the AGRIS domain (agriculture, forestry, animal husbandry, aquatic sciences and fisheries, and human nutrition)

- Interlinking: other kinds of information related to the AGRIS domain (statistics, germplasm data, maps, country profiles, etc.)

7.7 million bibliographic references become 7.7 million mashup pages!
AGROVOC as the backbone

- AGROVOC is the backbone, the magic that allows the interlinking to external datasets

- Two ways to implement the interlinking:
  - Using AGROVOC formal alignments to other thesauri (skos:exactMatch, skos:closeMatch)
  - Querying external WebServices with scientific names, extracted from AGROVOC (no RDF, simply Java programming)
Search Results (Get Classical View)

Query: bigeye tuna

Results 1 - 10 of 4,562

Study on size, sex ratio and length-weight relationship of yellowfin tuna (Thunnus albacares) and bigeye tuna (T. obesus) in the Eastern Indian ocean

Pattira Ldwittayaprasit; Weera Pokapant

Study on size, sex ratio and length-weight relationship of yellowfin tuna (T. albacares) and bigeye tuna (T. obesus) in the Eastern Indian Ocean was made from January-May 1987-1991. The samples were caught by the FRTV CHULABHORN and Fishery Research Vesse; NO.4 with the employment of tuna longline. There were 362 specimens of yellowfin tuna and 62 of bigeye tuna with fork length about 76.0-164.0 cm, and 72.0-148.0 cm, respectively. Sex ratios of yellowfin tuna and bigeye tuna for male and female...

Primary structure and thermostability of bigeye tuna [Thunnus obesus] myoglobin in relation to those of other scombridae fish

Ueki, N.; Ochiai, Y.

In the present study, the cDNA encoding myoglobin (Mb) of bigeye tuna Thunnus obesus was cloned and its amino acid sequence deduced in, order to investigate the relationship between the primary structure and thermostability of scombridae fish Mb. An open reading frame of bigeye tuna Mb cDNA contained 444 nucleotides encoding 147 amino acids. The primary structure of bigeye tuna Mb was highly conserved when compared with those of bluefin tuna and yellowfin tuna Mb, the sequence identity being 95. ...

http://agris.fao.org/agris-search/searchIndex.do?query=bigeye+tuna&amp;x=0&amp;y=0

search results for "bigeye tuna"
AGRIS started to run, generating the bibliographic information and other linked information on the fly...

Length-frequency compositions and weight-length relations for bigeye tuna, yellowfin tuna, and albacore (Perciformes: Scombrinae) in the Atlantic, Indian, and eastern Pacific oceans

Zhou, Y.
Zhu, G.
Dai, X., Tuna Fishery Technical Working Group of China, Shanghai, China
Xu, L., Shanghai Ocean University, Shanghai (China). College of Marine Sciences

Abstract:
Bigeye tuna, Thunnus obesus (Lowe, 1839), yellowfin tuna, Thunnus albacares (Bonnaterre, 1788), and albacore, Thunnus alalunga (Bonnaterre, 1788), are very important species for world fisheries. The weight-length relations (WLRs) of the three species were studied using commonly accepted methodology. Significant differences can be found from the fork length distributions and the WLRs of the above 3 tuna species and the relations of gilled-gutted and whole weight of bigeye and yellowfin tunas collected from the Atlantic, Indian, and Eastern Pacific Oceans. Significant differences of fork length distributions can be found for bigeye tuna, yellowfin tuna, and albacore from the three areas. The date collected will be useful for the fisheries management of the three species studied

Read the article: http://www.aiep.pl/

Using AGROVOC to Link with Resources

Length-frequency compositions and weight-length relations for bigeye tuna, yellowfin tuna, and albacore (Perciformes: Scombrinae) in the Atlantic, Indian, and eastern Pacific oceans

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Read the article: http://www.aiep.pl/

For more information, visit: http://agris.fao.org/openagris/search.do?recordID=PL2009000495
Length-frequency compositions and weight-length relations for bigeye tuna, yellowfin tuna, and albacore (Perciformes: Scombrinae) in the Atlantic, Indian, and eastern Pacific oceans

at AGRIS RECORDS
http://agris.fao.org/aos/records/PL2009000495

RDF triples for the same bibliographic reference (machine-generated, human-readable).

Subjects are represented by the concept IDs (URIs).

<table>
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<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Bigeye tuna, Thunnus obesus (Lowe, 1839), yellowfin tuna, Thunnus albacares (Bonnaterre, 1788), and albacore, Thunnus alalunga (Bonnaterre, 1788), are ... »more« (eng)</td>
</tr>
<tr>
<td>creator</td>
<td>[8 anonymous resources]</td>
</tr>
<tr>
<td>dateSubmitted</td>
<td>2009</td>
</tr>
<tr>
<td>description</td>
<td>2 fig., 2 tables</td>
</tr>
<tr>
<td></td>
<td>22 ref.</td>
</tr>
<tr>
<td></td>
<td>Summary (En)</td>
</tr>
<tr>
<td>identifier</td>
<td>PL2009000495</td>
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</tr>
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<td>2008</td>
</tr>
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<td>language</td>
<td>eng</td>
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</tr>
<tr>
<td></td>
<td><a href="http://aims.fao.org/aos/agrovoc/c_24026">http://aims.fao.org/aos/agrovoc/c_24026</a></td>
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<td></td>
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</table>
Mapping with other vocabularies
AGROVOC is mapped to 10+ important KOS

<table>
<thead>
<tr>
<th>Resource</th>
<th>Topics</th>
<th>Linked concepts</th>
<th>Languages</th>
<th>Linked Data</th>
<th>Type of link</th>
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</thead>
<tbody>
<tr>
<td>FAO Biotechnology Glossary</td>
<td>Biotechnologies</td>
<td>810</td>
<td>EN, ES, FR +3 more</td>
<td>Yes</td>
<td>skos:closeMatch</td>
</tr>
<tr>
<td>EUROVOC</td>
<td>General EU</td>
<td>1297</td>
<td>EN, ES, FR +21 more</td>
<td>Yes</td>
<td>skos:exactMatch</td>
</tr>
<tr>
<td>GEMET</td>
<td>Environment</td>
<td>1191</td>
<td>EN, ES, FR +30 more</td>
<td>Yes</td>
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</tr>
<tr>
<td>Library of Congress Subject Headings (LCSH)</td>
<td>General</td>
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<td>EN</td>
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<tr>
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<td>Agriculture</td>
<td>13930</td>
<td>EN, ES</td>
<td>Yes</td>
<td>skos:exactMatch</td>
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<tr>
<td>RAMEAU Répertoire d'autorité-matière encyclopedique et alphabetique unifie</td>
<td>General</td>
<td>686</td>
<td>FR</td>
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<td>1136</td>
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<td>Yes</td>
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</tr>
<tr>
<td>TheSoz - Thesaurus for the Social Sciences</td>
<td>Social sciences</td>
<td>846</td>
<td>EN, DE</td>
<td>Yes</td>
<td>skos:exactMatch</td>
</tr>
<tr>
<td>Geopolical Ontology</td>
<td>Geopolitical entities</td>
<td>253</td>
<td>AR, CH, EN, ES, FR, RU</td>
<td>Yes</td>
<td>skos:exactMatch</td>
</tr>
<tr>
<td>Dewey Decimal Classification (DDC)</td>
<td>General</td>
<td>409</td>
<td>EN, ES, FR +8 more</td>
<td>Yes</td>
<td>skos:exactMatch</td>
</tr>
<tr>
<td>DBpedia</td>
<td>General</td>
<td>10989</td>
<td>EN, ES, FR +8 more</td>
<td>Yes</td>
<td>skos:exactMatch skos:closeMatch</td>
</tr>
<tr>
<td>SWD (Schlagwortnormdatei)</td>
<td>General</td>
<td>6245</td>
<td>DE</td>
<td>Yes</td>
<td>skos:exactMatch skos:closeMatch skos:broadMatch skos:narrowMatch</td>
</tr>
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<td>GeoNames</td>
<td>Geographical entities</td>
<td>212</td>
<td>EN, ES, FR +63 more</td>
<td>Yes</td>
<td>skos:exactMatch</td>
</tr>
</tbody>
</table>

Create Linked Open Data (LOD) Microthesauri using *Art & Architecture Thesaurus* (AAT) LOD

www.slideshare.net/mzeng/aat-microthesauri
1. Definition

Microthesaurus: designated subset of a thesaurus that is capable of functioning as a complete thesaurus.

-- ISO25964-2:2013

Microthesauri are different from:

- Derived vocabularies
  - adaptation
  - modification
  - expansion
  - partial adaptation
  - translation
The need to
• use,
• create,
• derive from,
• map to AAT &
• go to LOD
3. Can a microthesaurus be made from an existing thesaurus?

<table>
<thead>
<tr>
<th>Structure</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>Classificatory structure</td>
</tr>
<tr>
<td></td>
<td>• EUROVOC</td>
</tr>
<tr>
<td></td>
<td>• Chinese Classified Thesaurus</td>
</tr>
<tr>
<td></td>
<td>• [English Heritage Thesauri]</td>
</tr>
<tr>
<td>YES</td>
<td>Faceted structure</td>
</tr>
<tr>
<td></td>
<td>• Art &amp; Architecture Thesaurus (AAT)</td>
</tr>
<tr>
<td></td>
<td>• FAST (Faceted Application of Subject Terminology)</td>
</tr>
<tr>
<td>YES/Maybe</td>
<td>Deep hierarchies (family trees)</td>
</tr>
<tr>
<td></td>
<td>• Art &amp; Architecture Thesaurus (AAT)</td>
</tr>
<tr>
<td></td>
<td>• NASA Thesaurus</td>
</tr>
<tr>
<td></td>
<td>• INSPEC Thesaurus</td>
</tr>
<tr>
<td></td>
<td>• ASIS&amp;T Thesaurus</td>
</tr>
<tr>
<td>NO/Not-directly</td>
<td>flat structure [alphabetically organized]</td>
</tr>
<tr>
<td></td>
<td>• Subject headings lists</td>
</tr>
<tr>
<td></td>
<td>• many thesauri</td>
</tr>
</tbody>
</table>

**Microthesaurus**: designated subset of a thesaurus that is capable of functioning as a complete thesaurus. -- ISO25964-2:2013
EuroVoc is split into 21 domains and 127 microthesauri. Each domain is divided into a number of microthesauri.

A microthesaurus is considered as a concept scheme with a subset of the concepts that are part of the complete EuroVoc thesaurus.

Source: http://eurovoc.europa.eu/drupal/?q=node/555
AAT has 7 facets

- Associated Concepts Facet
- Physical Attributes Facet
- Associated Concepts
- Conditions and Effects (Hierarchy Name)
- Design Elements
- Color (Facet)
- Styles and Periods Facet
- Styles and Periods
- Agents Facet
- People
- Organizations (Hierarchy Name)
- Living Organisms (Hierarchy Name)
- agents (general) [N]
- Activities Facet
- Disciplines (Hierarchy Name)
- Functions (Hierarchy Name)
- Events (Hierarchy Name)
- Physical and Mental Activities
- Processes and Techniques (Hierarchy Name)
- Materials Facet
- Materials (Hierarchy Name)
- Objects Facet
- Built Environment (Hierarchy Name)
- Components (Hierarchy Name)
- Furnishings and Equipment (Hierarchy Name)
- Object Genres (Hierarchy Name)
- Object Groupings and Systems (Hierarchy Name)
- Visual and Verbal Communication (Hierarchy Name)
- Brand Names (Facet)
- Brand Names (Hierarchy Name)
CHIN listed 890+ recommended resources.

AAT's facets and hierarchies that are listed individually.

Source: Search "AAT" from [http://www.pro.rcip-chin.gc.ca/ressources-resources/index-eng.jsp](http://www.pro.rcip-chin.gc.ca/ressources-resources/index-eng.jsp)
4. AAT Structure's Semantic Representation (Go to next slide for non-techy view.)

From: Getty Vocabularies: Linked Open Data Semantic Representation. Section 2.3.4 Top Concepts

http://vocab.getty.edu/doc/
The_Getty_Vocabularies_and_LOD
Art and Architecture Thesaurus (AAT)

Facet: Objects

Hierarchy: Furnishing and Equipment

Concept: containers (receptacles)

Guide term: <containers by form>

concept: vessels (containers)

concept: rhyta

The units were recommended to use by projects like CHIN

[large] Hierarchies (full coverage, deep layer)

Sub-facets (Indicated by node labels)
What are usually available in a flat structured LOD thesaurus
Results are obtained by entering the following in [http://vocab.getty.edu/sparql](http://vocab.getty.edu/sparql):

```
# 5.1.10 Find Subject by Exact English PrefLabel
select * {?subj gvp:prefLabelGVP/xl:literalForm "rhyta"@en}
```
Facet: Objects

Hierarchy: Furnishing and Equipment

Concept: containers (receptacles)

Guide term: <containers by form>

concept: vessels (containers)

concept: rhyta

Art and Architecture Thesaurus (AAT)

but AAT LOD has more:

Facets

[large] Hierarchies (full coverage, deep layer)

Sub-facets (Indicated by node labels)
5. An example
-- Use a `<Guide Term>` to obtain all concept URIs in a facet or hierarchy

Part 1. Get Data
Steps:
After choosing a facet or a hierarchy from AAT...
1. Get the ID
2. Go to SPARQL Endpoint next slide
Step 2. Go to Getty Vocab SPARQL Endpoint: http://vocab.getty.edu/sparql
Step 3. Choose "Descendants of a Given Parent" from the template, click. ➔ The template's text will show on the top Query box.
Steps
4. Replace the ID (e.g., 300117143) in the Query template
   [you may modify to add more requests]
5. Submit
6. Get all URIs and labels under this guide

SPARQL Query

```
# 5.1.2 Descendants of a Given Parent
select * {?
x gvp:broaderExtended aat:300117143.
?x gvp:prefLabelGVP [xl:literalForm ?l]; skos:inScheme aat:
    } order by ?l
```

Note: I replaced the aat ID, also inserted a line to get the labels, and sort by label. Here is the text of the query:

```
select * {?
x gvp:broaderExtended aat:300117143.
?x gvp:prefLabelGVP [xl:literalForm ?l]; skos:inScheme aat:
    } order by ?l
```
It gave me the results in 2 seconds:

Results for # 5.1.2 Descendants... (100 of 525)

<table>
<thead>
<tr>
<th>x</th>
<th>l</th>
</tr>
</thead>
<tbody>
<tr>
<td>aat:300391225</td>
<td>&lt;religious visual works by related event&gt;@en</td>
</tr>
<tr>
<td>aat:300391082</td>
<td>Advent candleholders@en</td>
</tr>
<tr>
<td>aat:300391224</td>
<td>Advent wreaths@en</td>
</tr>
<tr>
<td>aat:300178242</td>
<td>Andachtsbilder@en</td>
</tr>
<tr>
<td>aat:300265145</td>
<td>Bhagavad-gītās@en</td>
</tr>
<tr>
<td>aat:300263184</td>
<td>Bible stories@en</td>
</tr>
<tr>
<td>aat:300264513</td>
<td>Bibles@en</td>
</tr>
<tr>
<td>aat:300263411</td>
<td>Bibles historiales@en</td>
</tr>
</tbody>
</table>
(I checked to make sure that the results are from multiple levels in the hierarchy.)
Step 7. Download JSON format data.

Download Options:
(1) JSON*
(2) XML

*JSON (JavaScript Object Notation) is a lightweight data-interchange format.
How to manage it by a non-techy person?

Non-techy person's wish:
I can see what are in the dataset;
I can use a spreadsheet to open and manage it.

Techy-person can prepare the file as:

1. From a JSON* file \(\rightarrow\) convert to CSV** file (can be opened as spreadsheet) using an open source converter, or

2. From a JSON file \(\rightarrow\) Manage from OpenRefine (open source system) or export to a spreadsheet
Results of the JSON file.

```
{
  "head": {
    "vars": [ "x", "l" ]
  },
  "results": {
    "bindings": [ {
      "x": {
        "type": "uri",
        "value": "http://vocab.getty.edu/aat/300117143"
      },
      "l": {
        "xml:lang": "en",
        "type": "literal",
        "value": "300117143".gvp:broaderExtended aat:300117143.
      }
    },
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      "type": "uri",
      "value": "http://vocab.getty.edu/aat/300217935"
    },
    "l": {
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      "type": "literal",
      "value": "http://vocab.getty.edu/aat/300264679"
    }},
    {"x": {
      "type": "uri",
      "value": "http://vocab.getty.edu/aat/300055897"
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    "l": {
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      "value": "8mm (size: videotape)"
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    {"x": {
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      "value": "http://vocab.getty.edu/aat/300161886"
    },
    "l": {
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      "type": "literal",
      "value": "striking blocks@en"
    }},
    {
    },
    {"x": {
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      "value": "http://vocab.getty.edu/aat/300156202"
    },
    "l": {
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      "type": "literal",
      "value": "keepsakes (books)@en"
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      "type": "literal",
      "value": "religious texts@en"
    }},
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    "l": {
      "xml:lang": "en",
      "type": "literal",
      "value": "buskins (stockings)@en"
    }},
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      "type": "literal",
      "value": "aerona
tical beacons@en"
    }},
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    },
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      "xml:lang": "en",
      "type": "literal",
      "value": "beacons@en"
    }},
    {"x": {
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      "value": "http://vocab.getty.edu/aat/300182941"
    },
    "l": {
      "xml:lang": "en",
      "type": "literal",
      "value": "lighthouse lamps@en"
    }},
    {"x": {
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      "value": "http://vocab.getty.edu/aat/300007741"
    },
    "l": {
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      "type": "literal",
      "value": "lighthouses@en"
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      "value": "http://vocab.getty.edu/aat/300180588"
    },
    "l": {
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      "type": "literal",
      "value": "Hanukkah lamps@en"
    }},
    {"x": {
      "type": "uri",
      "value": "http://vocab.getty.edu/aat/300190801"
    },
    "l": {
      "xml:lang": "en",
      "type": "literal",
      "value": "votive lamps@en"
    }
  }
}
```

Descendants of a Given Parent:

```
select * {?x gvp:broaderExtended aat:300117143.
?x gvp:prefLabelGVP [xl:literalForm ?l];
skos:inScheme aat:
} order by ?l
```
Establish a 'Project', then ready to edit.

Note: OpenRefine can be used for many other functions for management, clean up, reconcile, etc.
Use other templates to obtain needed data for your microthesauri.

- Find AAT URIs and labels according to a Contributor:

```sql
#5.1.3 Subjects by Contributor Id
select * {
  ?x a gvp:Subject; dct:contributor aat_contrib: 10000178.
  ?x gvp:prefLabelGVP [xl:literalForm ?l]
}
```

- Find, within this set of data, only those involving a particular contributor, e.g., by CDBP-DIBAM (Dirección de Bibliotecas, Archivos y Museos; Santiago, Chile), id: 300117143.)

```sql
select ?x ?l ?contrib {
  ?x gvp:broaderExtended aat:300117143.
  ?x gvp:prefLabelGVP [xl:literalForm ?l].
}
```
Some other cases of using AAT LOD

Integrating AAT into editors
  E.g., EADitor
  Plug-in for Adobe Bridge
  Web Taxonomy plugin

Visualization
  Visualize the hierarchies
  Visualize around an individual concept

Multilingual services
  e.g., Europeana semantic enrichment

Portal enrichment
  e.g., Europeana. Search mapping to AAT by facets: Object, Activities, Format, Type, Material, etc.
  Extending to multilingual

Use by digital art history projects
6. Conclusion
LOD AAT Microthesauri

• use,
• create,
• derive from, &
• map to

&AAT microthesauri

Controlled vocabulary

AAT (complete)

Facets
Hierarchies

[sub] facets

Non-AAT

AAT-based vocabularies

Based on an facets
Based on hierarchies
Based on sub-facets
Mixed

Other

Mapped to AAT

Partially
AAT as a target

Did not map to AAT

& go to LOD

www.slideshare.net/mzeng/aat-microthesauri
THANK YOU!

Using KOS as the Connectors of Linked Datasets

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-- Food and Agriculture Organization of the United Nations (Italy)

Marcia Lei Zeng
-- Kent State University (USA)