

# Collection/Item Metadata Relationships

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# Why collection-level metadata is important

- Collections are designed to support research and scholarship.
- Toward this end collection descriptions indicate such things as:
  - *purpose*
  - *subject*
  - *method of selection*
  - *spatial/temporal coverage*
  - *completeness*
  - *representativeness*
  - *summary statistical features*
  - ...etc.
- These descriptions enable collections to function as more than simply aggregates of items,
  - as intended by their creators and curators
  - as required by their users

## But unfortunately....

Collection-level metadata is poorly understood and accommodated

Most retrieval systems flatten the world, ignoring collection context

Retrieval systems that do use metadata use only item-level metadata

Even simple discovery is impeded:

If the *owner* of a collection is indicated only at the collection-level, then retrieval accessing only item-level metadata...

- cannot usefully process queries constrained by owner
- cannot display the owner of item in the result set

# Origins of our focus on this problem: DCC

## ***IMLS Digital Collections and Content***

University of Illinois at Urbana-Champaign

Grainger Library &

Graduate School of Library and Information Science

Funded by IMLS, 2003-2007

Timothy Cole, Principal Investigator

Carole L. Palmer, Sarah L. Shreeves, Michael B. Twidale, Co-Investigators

## **Deliverables...**

- a *collection metadata* schema  
Based on RSLP CD and concurrent work on *DC Collection Application Profile*.
- a *collection-level metadata registry*  
for 202 IMLS digital collections.
- an *item-level metadata repository*  
76 collections harvested using OAI-PMH.
- an *experimental portal* for searching aggregated metadata.  
[<http://imlsdcc.grainger.uiuc.edu>]

## Among the research findings:

*Users need collection-level information, for discovery and understanding*

(Palmer & Knutson, 2004;  
Foulonneau et al. 2005;  
Palmer, et al. 2006)

But what information?

And how to provide it?

So we included this problem in  
our next IMLS proposal...

Climax Miners, Leadville, CO. Courtesy Colorado School of Mines



# The new project

In 2007 the DCC received a new three year IMLS grant

Carole L. Palmer, Principal Investigator

Timothy Cole, Allen H. Renear, Michael B. Twidale, Co-Investigators

## A major deliverable:

***show how a formal description of collection/item metadata relationships can help registry users locate and use digital items across multiple collections.***

## **CIMR:** Collection/Item Metadata Relationships

Three phases:

- 1) Develop a logic-based framework of collection/item metadata relationships and inference rules.
- 2) Conduct empirical studies to see if the framework matches the behavior of metadata specification designers, metadata creators, and registry users.
- 3) Implement pilot applications to support searching, browsing, and navigation; including RDF/OWL formulations and inference rules.

Our initial focus is on the *Dublin Core Collections Application Profile (DCCAP)*.

# Where we are now

Phase 1:

Develop a logic-based framework of collection/item metadata relationships and inference rules.

The next few slides...

three simple examples of collection/item metadata relationships

# Attribute/Value Propagation: *marcrel:OWN*

Consider the DCCAP metadata element **marcrel:OWN**...

Plausibly: whoever owns a collection owns each of its items

We say that metadata attributes with this behavior *a/v-propagate*.

## Informal definition

**an attribute *a/v-propagates* =df**  
**if a collection has some value for the attribute then**  
**each item in the collection has the same value for that attribute.**

## Or, in first order logic:

An attribute **A** *a/v-propagates* =df  
$$\forall x \forall y \forall z [(IsGatheredInto(x,y) \ \& \ A(y,z)) \supset A(x,z)]$$
  
*[ IsGatheredInto(x,y) is adapted from from the DCMI DCCAP.]*

## Value Propagation: *cld:itemType* / *dc:type*

Consider the DCCAP metadata element **cld:itemType**.\*

\*a refinement, assuming homogeneous collections and no repetition of elements.

*cld:itemType*\* does not a/v-propagate...

However,

if a collection has a value for *cld:itemType*\* then  
each of its items has the same value for *dc:type*.

We call this *v-propagation*.

### Informal definition

**an attribute *v-propagates* =df**

**if a collection has some value for the attribute then  
each item in the collection has that value for some other attribute.**

### Or, in first order logic:

An attribute **A** *v-propagates* to an attribute **B** =df

$\forall x \forall y \forall z [(IsGatheredInto(x,y) \ \& \ A(y,z)) \supset B(x,z)]$

## Value Constraints: *cld:dateItemsCreated* / *dterms:created*

**cld:dateItemsCreated\*** does *not* a/v propagate

nor does it v-propagate to *dterms:created*

However,

if a collection has a temporal range for *cld:dateItemsCreated\**, then its items may not have values for *dterms:created* that fall outside that range.

this is a *constraint*: the value of *dterms:created* must be *temporally-within* the range given by *cld:dateItemsCreated\**

### Informal Definition

an attribute **A** *v-constrains* an attribute **B** with respect to constraint **C** =df  
if a collection has the value **z** for **A** and an item in the collection has the value **w** for **B**, then **w** is related to **z** by **C**.

### In first order logic:

An attribute **A** *v-constrains* an attribute **B** with respect to a constraint **C** =df  
$$\forall x \forall y \forall z \forall w [(IsGatheredInto(x,y) \ \& \ A(y,z) \ \& \ B(x,w)) \supset C(w,z)]$$

## How will the framework help?

- *Metadata specification developers* use the framework to classify metadata elements in their specifications.
- *Metadata librarians* use these classifications to confirm their understanding of the metadata elements they are assigning.
- *Software architects* use these classifications to guide the configuration of inferencing features in retrieval systems.

# What is missing?

A completed shared framework

... a project for the community



University of Washington Libraries, Special Collections Division. PH Coll 548

## Prior work? Of course.

- Relationships such as those just described have been studied elsewhere — which is a good thing.
- However as far as we know no one has focused on the *IsGatheredInto* relationship.

# Some research questions

- how many relationship categories are there?
- which metadata attributes fall into which categories?
- when does propagation convert information without loss?
- what about propagation from items to collections?
- how expressive a logic is needed for propagation rules?
  - how much of first order logic?
  - what extensions to first order logic? (modal, default, ...?)
  - what are the consequences for computational efficiency?

## One result: Finishing the job requires modal logic

An attribute  $A$  *a/v-propagates* =df

- I.
  - a)  $\Diamond \exists y \exists z [ \text{Collection}(y) \ \& \ A(y,z) ] \ \&$
  - b)  $\Diamond \exists x \exists z [ \text{Member}(x) \ \& \ \sim A(x,z) ] \ \&$
  - c)  $\Diamond \exists x \exists y \exists z [ A(x,z) \ \& \ \sim A(y,z) ] \ \&$
- II.  $\Box \forall x \forall y \forall z [ ( \text{IsGatheredInto}(x,y) \ \& \ A(y,z) ) \ \supset \ A(x,z) ]$ .

See: The Return of the Trivial: Formalizing collection/item metadata relationships. Renear, A.H., Wickett, K.M., Urban, R.J., and Dubin, D. *Proceedings of the 8<sup>th</sup> ACM/IEEE-CS Joint Conference on Digital Libraries*. ACM Press, New York 2008.

## Most importantly: Non-Reducible Collection Attributes

- Some vital collection-level attributes resist conversion to item-level attributes
- Examples are metadata indicating that a collection
  - is complete or incomplete
  - is representative (in some respect)
  - is heterogeneous with respect to genre or type of object, etc.
  - was developed according to some particular method
  - was designed for some particular purpose
  - has certain summary statistical features
  - .... *and so on.*
- These are tightly tied to the distinctive role a collection is intended to play in the support of research and scholarship.
- If this information is inaccessible, the collection cannot be useful, as a collection, in the way originally intended by its creators.

# Questions?

We are just getting started and welcome comments and advice.

## ***Acknowledgements***

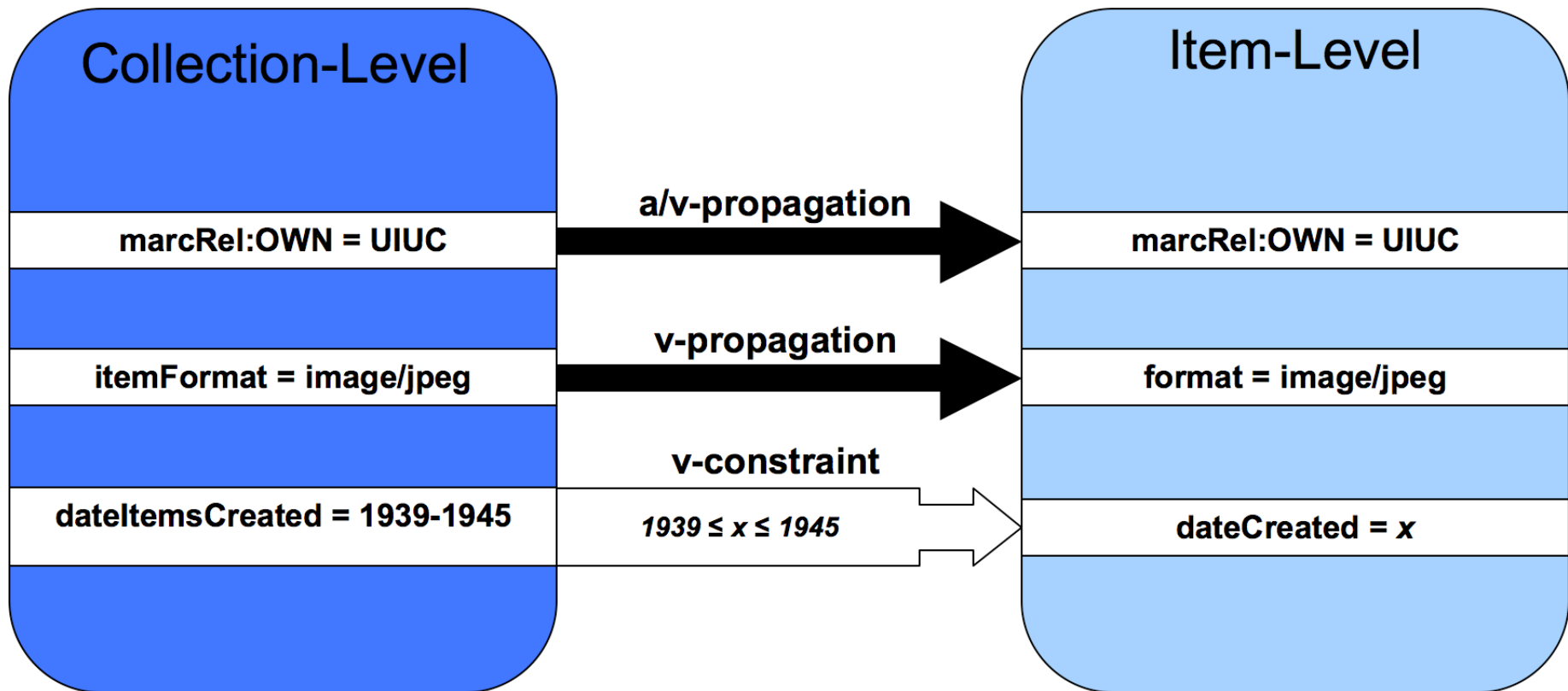
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# Examples of collection/item metadata relationships



## But unfortunately....

Collection-level metadata is poorly understood and accommodated



Cabinet Photograph of Lincoln Home Parlor. Courtesy Lincoln Home Historic Site.

# NB: Propagation is *not* “inheritance”

*IsGatheredInto*  
is neither  
*subclassOf*  
nor  
*instanceOf*

*Our use of “propagation”  
follows Brachman (1991)*



Table Showing Contraband Items. Colorado State Penitentiary.  
Courtesy Cañon City Public Library