



# Recording Absence & Negative Properties

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*Linked Conservation Data*

<https://www.ligatus.org.uk/lcd>

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Arts and  
Humanities  
Research Council

**ual:** university  
of the arts  
london



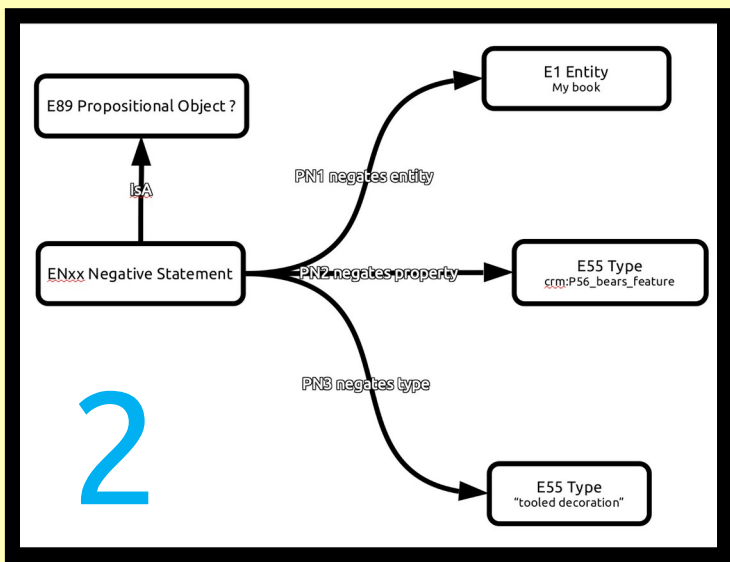
# Review of where we were

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Property label		domain		range		typed property label		negative typed property						
1	is identified by (identified)	E1	CRM Entity	E41	Identification	TP1	is identified by identification type		NTP1	is not identified by identification type					
3	has preferred identifier (is preferred identifier of)	E1	CRM Entity	E42	Identification	TP48	has preferred identifier of type		NTP48	does not have preferred identifier of type					
4	is identified by (identified)	E1	CRM Entity	E42	Identification	TP1	is identified by identification type		NTP1	is not identified by identification type					
6	has life (is life of)	E71	Human Made Thing	E36	Title	TP102	has life of type		NTP102	does not have life of type					
8	has type (is type of)	E1	CRM Entity	E56	Type	TP2	has type of type		NTP2	does not have type					
9	is identified by (is identified by)	E1	CRM Entity	E56	Type	TP2	is identified by type of type		NTP2	is not identified by type of type					
10	has role (is role of)	E1	CRM Entity	E62	Role	TP3	has role of type		NTP3	does not have role of type					
11	beginning is qualified by	E62	Time-Span	E62	String	TP90	beginning is qualified by role of type		NTP90	beginning is not qualified by role of type					
12	end is qualified by	E62	Time-Span	E62	String	TP90	end is qualified by role of type		NTP90	end is not qualified by role of type					
13	has symbolic content	E96	Symbolic Object	E62	String	TP160	has symbolic content of type		NTP160	does not have symbolic content of type					
14	has time-span (is time-span of)	E2	Temporal Entity	E52	Time-Span	TP9	consists of condition state of type		NTP9	does not consist of condition state of type					
15	consists of (consists part of)	E2	Temporal Entity	E52	Time-Span	TP9	consists of condition state of type		NTP9	does not consist of condition state of type					
16	look place at (wherein)	E4	Place	E32	Place	TP7	look place at place of type		NTP7	does not look place at place of type					
17	look place on or within (wherein)	E4	Place	E32	Place	TP8	look place on or within physical thing of type		NTP8	does not look place on or within physical thing of type					
18	occurred in the presence of (was present at)	E3	Event	E77	Physical Item	TP12	occurred in the presence of identification term of type		NTP12	occurred not in the presence of identification term of type					
19	added (was added by)	E79	Part Addition	E16	Physical Thing	TP111	added physical thing of type		NTP111	did not add physical thing of type					
20	removed (was removed by)	E99	Part Removal	E16	Physical Thing	TP113	removed physical thing of type		NTP113	did not remove physical thing of type					
21	had participant (participated in)	E5	Event	E39	Actor	TP213	had participant of type		NTP213	did not have participant of type					
22	carried out by (performed)	E7	Activity	E39	Actor	TP213	carried out by of type		NTP213	did not carry out by of type					
23	transformed into (was transformed through)	E9	Acquisition	E39	Actor	TP213	transformed into of type		NTP213	did not transform into of type					
24	transferred into (was transferred through)	E9	Acquisition	E39	Actor	TP213	transferred into of type		NTP213	did not transfer into of type					
25	custody surrendered by (was surrendered custody through)	E9	Acquisition	E39	Actor	TP213	custody surrendered by of type		NTP213	did not surrender custody of type					
26	custody received by (received custody through)	E9	Acquisition	E39	Actor	TP213	custody received by of type		NTP213	did not receive custody of type					
27	born (is born by)	E67	Birth	E21	Person	TP99	born of type		NTP99	did not born of type					
28	dissolved (was dissolved by)	E68	Dissolution	E74	Group	TP144	dissolved group of type		NTP144	did not dissolve group of type					
29	joined (was joined by)	E68	Dissolution	E74	Group	TP144	joined with group of type		NTP144	did not join with group of type					
30	separated (was separated by)	E68	Dissolution	E74	Group	TP146	separated from group of type		NTP146	did not separate from group of type					
31	was formed (was formed by)	E69	Formation	E74	Group	TP151	was formed from group of type		NTP151	was not formed from group of type					
32	was formed (was formed by)	E69	Formation	E74	Group	TP151	was formed from group of type		NTP151	was not formed from group of type					
33	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
34	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
35	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
36	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
37	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
38	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
39	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
40	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
41	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
42	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
43	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
44	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
45	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
46	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
47	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
48	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
49	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					
50	used specific object (was used by)	E7	Activity	E29	Design or Procedure	TP205	used specific object of type		NTP205	did not use specific object of type					

## Recording absence (Feb 2020)

- One axiom per statement:
  - $E22(x) \wedge P2(y, \text{"tooled decoration"}) \rightarrow \neg P56(x,y)$

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# Test plan

- Test for implementation efficiency
  - Compare implementation strategies
    - Initially two, became three

A. Negative Typed Properties

B. EN Negative statements with Typed Properties

C. EN Negative statements with empty instances (spurious node)



# Target capabilities

## Given

gold-tooling decoration (E55) → has broader term (P127) → tooling decoration (E55)

book 1 (E22) → bears feature (P56) → book 1 decoration (E25)

book 1 decoration (E25) → has type (P2) → gold-tooling decoration (E55)

book 2 (E22) → does not bear → gold-tooling decoration (E55)

book 3 (E22) → does not bear → tooling decoration (E55)

## Deduce

book 1 decoration (E22) → has type (P2) → tooling decoration (E55)

there is no book 2 decoration (E25) → has type (P2) → gold-tooling decoration (E55)

there is no book 3 decoration (E25) → has type (P2) → tooling decoration (E55)

there is no book 3 decoration (E25) → has type (P2) → gold-tooling decoration (E55)

## Have no knowledge if

book 2 (E22) → bears feature (P56) → book 2 decoration (E25)

book 2 decoration (E25) → has type (P2) → tooling decoration (E55)



# Negative Typed Properties

## Requires

E19 Physical Object TP56 *bears feature of type* E55 Type

E19 Physical Object NTP56 *does not bear feature of type* E55 Type

E19 Physical Object TP46 *is composed of physical thing of type* E55 Type

E19 Physical Object NTP46 *is not composed of physical thing of type* E55 Type

## Thus

book-2 (E22) NTP56 *does not bear feature of type* gold-tooling decoration (E55)

book-3 (E22) NTP56 *does not bear feature of type* tooling decoration (E55)



# EN Negative statements with Typed Properties

## Requires

Still Needs Typed Properties

EN1 Negative Statement

EN1 Negative Statement PN1 *negates entity (negated entity)* E1 CRM Entity

EN1 Negative Statement PN2 *negates property (negated property)* E55 Type

EN1 Negative Statement PN3 *negates type (negated type)* E55 Type

E19 Physical Object TP56 *bears feature of type* E55 Type

E19 Physical Object TP46 *is composed of physical thing of type* E55 Type

## Thus

con-rep-1 (EN1) PN1 *negates entity (negated entity)* book-2 (E22)

con-rep-1 (EN1) PN2 *negates property (negated property)* TP56 bears feature of type (E55)

con-rep-1 (EN1) PN3 *negates type (negated type)* gold-tooling decoration (E55)



# EN Negative statements with empty instances

## Requires

book-2 feature is spurious

EN1 Negative Statement

EN1 Negative Statement PN1 *negates entity (negated entity)* E1 CRM Entity

EN1 Negative Statement PN2 *negates property (negated property)* E55 Type

EN1 Negative Statement PN3 *negates type (negated type)* E55 Type

## Thus

book-2 (E22) P56 bears feature (is found on) book-2 feature (E25)

con-rep-1 (EN1) PN1 *negates entity (negated entity)* book-2 feature (E25)

con-rep-1 (EN1) PN2 *negates property (negated property)* P2 has type (is type of) (E55)

con-rep-1 (EN1) PN3 *negates type (negated type)* gold-tooling decoration (E55)



# Test Data Set

- Wanted
  - More Features
    - Recording absence
    - Filling gaps using different sources
  - Large
  - Contradictions built-in
- Nothing available
  - Built from scratch





# Scenario

- Manuscripts
- Modern catalogue of current collection
- Records from 2 Antiquarian scholars
  - Different recording practices
  - Collection in different state
- Poly-hierarchical multi-level thesaurus



# Construction Rules

- Set of rules:
  - Possible combinations of components
  - Allowable combinations of features
  - Numbers of features
  - Frequency of elements
  - Components may have:
    - never existed
    - been missing in antiquity (lost before first record)
    - been lost (lost since first record)
  - Or may still be present



# Poly-hierarchical multi-level thesaurus

feature	recesses		clasp-strap recess knife-cut recesses sawn-in recesses v-shaped recesses sewing recesses adhesive recesses
feature	bookblock features		knife-cut recesses sawn-in recesses
bookblock			v-shaped recesses
feature	spine features		sawn-in recesses v-shaped recesses
spine			sewing recesses adhesive recesses
feature	board features	board clasp constituent	clasp-strap recess
board			



<E1.CRM\_Entity>

<Identifier>knife-cut recesses</Identifier>

<in\_class>E55.Type</in\_class>

<P127F.has\_broader\_term>

<Identifier>recesses</Identifier>

<in\_class>E55.Type</in\_class>

</P127F.has\_broader\_term>

<P127F.has\_broader\_term>

<Identifier>bookblock features</Identifier>

<in\_class>E55.Type</in\_class>

</P127F.has\_broader\_term>

</E1.CRM\_Entity>

<E1.CRM\_Entity>

<Identifier>sewing recesses</Identifier>

<in\_class>E55.Type</in\_class>

<P127F.has\_broader\_term>

<Identifier>recesses</Identifier>

<in\_class>E55.Type</in\_class>

</P127F.has\_broader\_term>

<P127F.has\_broader\_term>

<Identifier>spine features</Identifier>

<in\_class>E55.Type</in\_class>

</P127F.has\_broader\_term>

</E1.CRM\_Entity>

.....



# Creation Process

- Use construction rules
  - generate 28000 "manuscripts"
    - 21425 plain records
      - Have book block, spine, board and no clasps
    - 6575 richer records
      - Non-existing, missing or lost elements or have clasps
  - records have mix of recess features
    - mix determined by the rules
  - each manuscript has a unique "Shelf Mark"
- Generate 3 data files



# Modern Catalogue Records

- 28000 records
- No info for lost or missing elements
- Each component and feature has a UID
- Shelf Mark included



<E1.CRM\_Entity>

<Identifier>MID1239010001</Identifier>

<in\_class>E22.Human-Made\_Object</in\_class> .....

<P1F.is\_identified\_by>

<Identifier>Arabica0002</Identifier>

<in\_class>E41.Appellation</in\_class>

</P1F.is\_identified\_by>

<P46F.is\_composed\_of>

<Identifier>CID1000002</Identifier>

<in\_class>E22.Human-Made\_Object</in\_class>

<P1F.is\_identified\_by>

<Identifier>CID1000002</Identifier>

<in\_class>E41.Appellation</in\_class>

</P1F.is\_identified\_by>

<P2F.has\_type>

<Identifier>bookblock</Identifier>

<in\_class>E55.Type</in\_class>

</P2F.has\_type>

<P56F.bears\_feature>

<Identifier>FID10000004</Identifier>

<in\_class>E25.Human-Made\_Feature</in\_class>

<P1F.is\_identified\_by>

<P2F.has\_type>

<Identifier>knife-cut recesses</Identifier>

<in\_class>E55.Type</in\_class>

</P2F.has\_type>

.....



# Antiquarian 1 Records

- 10979 records
  - $\approx$ 20% of plain plus all richer records
- Records
  - Presence of components (not how many)
  - Presence of features (not how many)
  - Absence of features
- Includes "lost" elements
  - but not "missing"





```
<E1.CRM_Entity>
  <Identifier>ANT10002</Identifier>
  <in_class>E22.Human-Made_Object</in_class>
  .....
  <P1F.is_identified_by>
    <Identifier>Arabica0003</Identifier>
    <in_class>E41.Appellation</in_class>
  </P1F.is_identified_by>
  <TP46F.is_composed_of_physical_thing_of_type>
    <Identifier>bookblock</Identifier>
    <in_class>E55.Type</in_class>
  </TP46F.is_composed_of_physical_thing_of_type>
  .....
  <TP56F.bears_feature_of_type>
    <Identifier>sewing recesses</Identifier>
    <in_class>E55.Type</in_class>
  </TP56F.bears_feature_of_type>
  .....
  <NTP56F.does_not_bear_feature_of_type>
    <Identifier>sawn-in recesses</Identifier>
    <in_class>E55.Type</in_class>
  </NTP56F.does_not_bear_feature_of_type>
  .....
</E1.CRM_Entity>
```



# Antiquarian 2 Lists

- Lists of Shelf Marks that never had:
  - Spines (1143 entries)
  - Boards (2856 entries)
  - Clasps (5307 entries)
  - Spine Features (1372 entries)
  - Book Block Features (2508 entries)
  - Recesses (85 entries)
  - Board Features (129 entries)
- This allows detection of "missing" elements



```
<E1.CRM_Entity>
  <Identifier>Arabica0022</Identifier>
  <in_class>E22.Human-Made_Object</in_class>
  <P1F.is_identified_by>
    <Identifier>Arabica0022</Identifier>
    <in_class>E41.Appellation</in_class>
  </P1F.is_identified_by>
  <NTP46F.is_not_composed_of_physical_thing_of_type>
    <Identifier>spine</Identifier>
    <in_class>E55.Type</in_class>
  </NTP46F.is_not_composed_of_physical_thing_of_type>
</E1.CRM_Entity>
```

```
<E1.CRM_Entity>
  <Identifier>Bayuda0254</Identifier>
  <in_class>E22.Human-Made_Object</in_class>
  <P1F.is_identified_by>
    <Identifier>Bayuda0254</Identifier>
    <in_class>E41.Appellation</in_class>
  </P1F.is_identified_by>
  <NTP56F.does_not_bear_feature_of_type>
    <Identifier>bookblock features</Identifier>
    <in_class>E55.Type</in_class>
  </NTP56F.does_not_bear_feature_of_type>
</E1.CRM_Entity>
```

.....



# Test Data Utility

- Test at scale (52379 records)
- Combine different styles of data
- Find "lost" elements to enrich data
- Infer "missing" elements
- Include reasoning on full thesauri
- Detect contradictions (6 in the data)



# Conclusion

- Representing absence should be done with TP and NTP properties
- Test data gives a valuable resource for future tool testing