ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Knowledge Graphs Trivia and Examples

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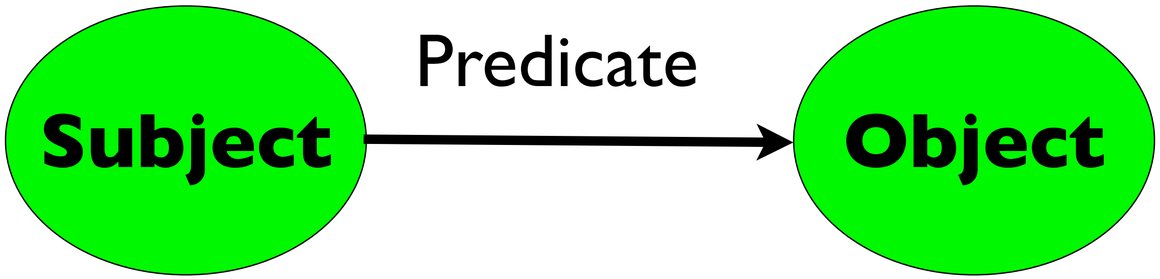
The RDF model

Abstract
data representation

RDF is used to describe
relationships between objects,
identified by their URIs



SW and LD

- The Semantic Web is a loosely defined program to make semantics more explicit and machine-processable *on the Web*
  - W3C standards: RDF, OWL, SPARQL, RIF, JSON-LD
  - Triple languages (RDF as abstract data structure)

data:
- `d:Miles_Davis do:recordLabel d:Columbia_Records .`

schema:
- `do:Musical_Artist r:subClassOf do:Person .`

query:
- `select ?x where {?x a do:Musical_Artist} .`

@prefix d: <http://dbpedia.org/resource/>
@prefix do: <http://dbpedia.org/ontology/>
@prefix : <http://myontology.org/this#>

Inferences

schema:

- `do:Musical_Artist owl:equivalentClass [do:Artist [ :plays owl:someValuesFrom :Music ]] .`

data:

- `d:Miles_Davis a do:Artist ; :plays d:Jazz . d:Jazz a :Music .`

inferred data:

- `–> d:Miles_Davis a do:Musical_Artist .`

query w/entailment:

- `select ?x where {?x a do:Musical_Artist} .`
- `–> d:Miles_Davis`

Berners-Lee’s linked data principles

- Use URIs as names for things
- Use HTTP URIs so that people can look up those names
- When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL)
- Include links to other URIs, so that they can discover more things

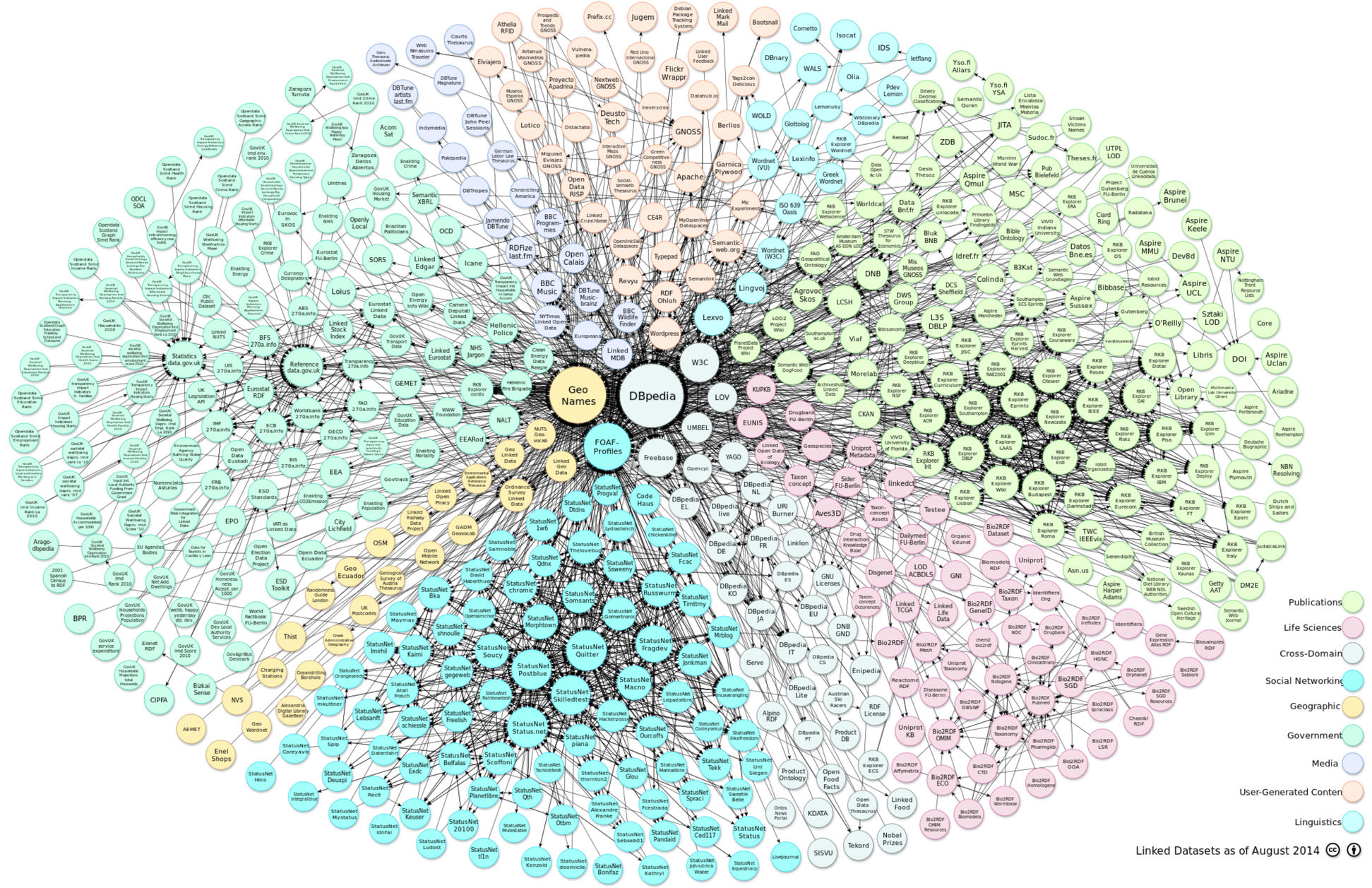
Be F.A.I.R. with Linked Data

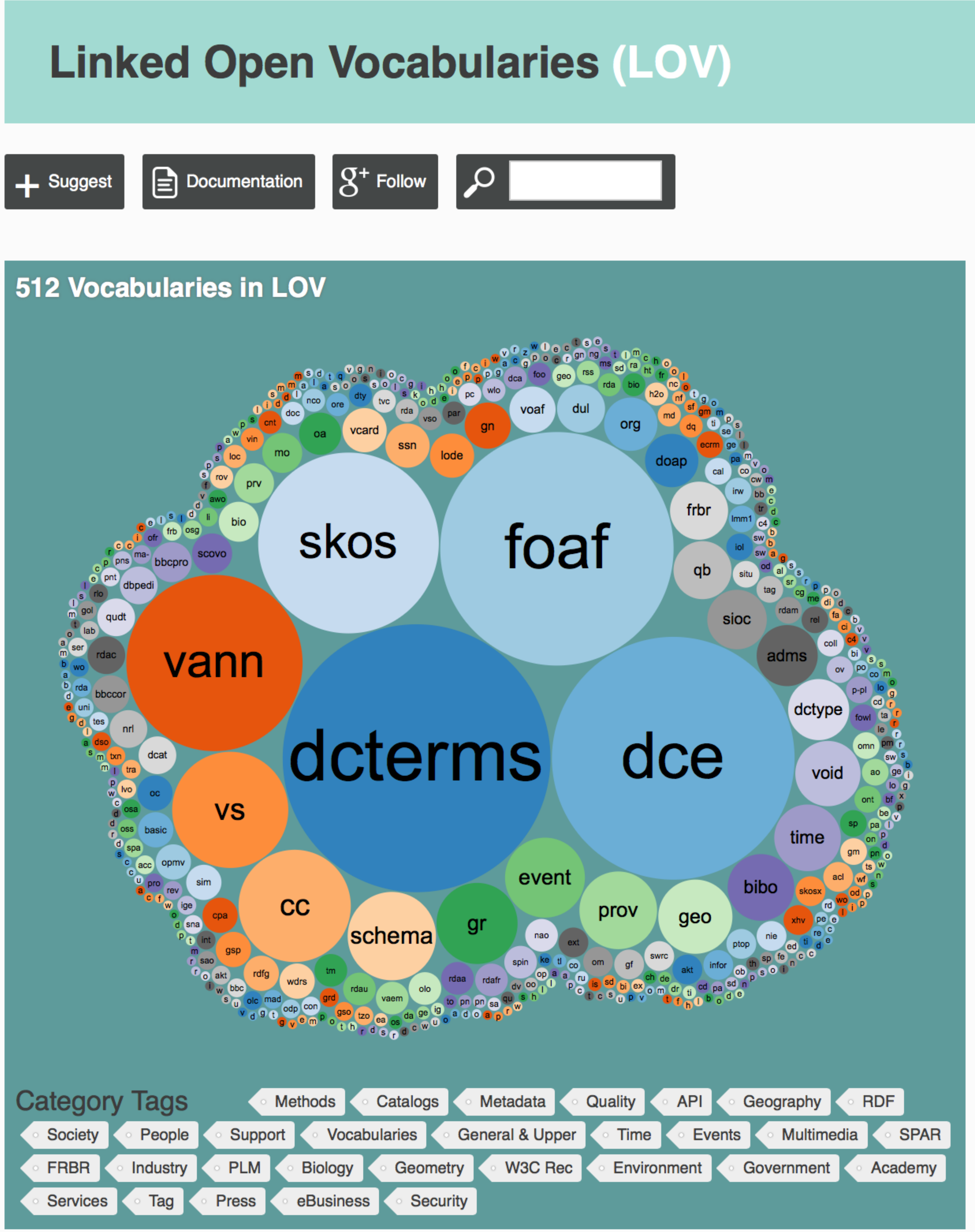
- **F**indable: we use permanent URIs (i.e. w3id) for identifying concepts and relations in the ontology network, and terms in the controlled vocabularies

- **A**ccessible: we rely on open standard protocols for accessibility on the Web (i.e. HTTP(S)) and querying (i.e. SPARQL)

- **I**nteroperable: we use open standard protocol for knowledge data modelling, i.e. RDF and OWL

- **R**eusable: the ontologies and the vocabularies are released under a CC-BY-4.0 license to foster their reuse in the Web of Data


Publications
Life Sciences
Cross-Domain
Social Networking
Geographic
Government
Media
User-Generated Content
Linguistics
Linked Datasets as of August 2014


Linked Open Vocabularies (LOV)
Suggest
Documentation
Follow
512 Vocabularies in LOV
skos
foaf
vann
dcterms
dce
vs
cc
schema
gr
event
prov
geo
bibo
time
void
dctype
adms
sioc
qb
frbr
doap
org
voaf
dul
gn
lode
ssn
vcard
oa
mo
prv
bio
scovo
bbcpro
dbpedi
qudt
rdac
bbccor
nrl
dcat
oc
basic
opmv
sim
cpa
gsp
rdfg
wdrs
tm
rdau
vaem
olo
rdaa
rdafr
nao
ext
spin
om
gf
swrc
akt
infor
ptop
nie
xhv
skosx
acl
gm
sp
ao
omn
fowl
coll
ov
rel
rdam
tag
situ
iol
cal
irw
md
dq
ecrm
h2o
bio
rda
rss
geo
foo
dca
wlo
pc
par
vso
rda
tvc
dty
ore
nco
doc
cnt
vin
loc
rov
awo
frb
osg
ofr
pns
ma-
pnt
rlo
gol
lab
ser
wo
rda
uni
tes
dso
txn
tra
lvo
osa
oss
spa
acc
pro
rev
lge
sna
int
sao
akt
bbc
olc
mad
odp
con
grd
gso
tzo
ea
da
Category Tags
Methods
Catalogs
Metadata
Quality
API
Geography
RDF
Society
People
Support
Vocabularies
General & Upper
Time
Events
Multimedia
SPAR
FRBR
Industry
PLM
Biology
Geometry
W3C Rec
Environment
Government
Academy
Services
Tag
Press
eBusiness
Security

RelFinder

between | examples

(1) Decision_theory
(2) Public_policy
(3) John_Maynard_Keynes
(4) Robert_Lucas,_Jr.

add | clear | Find Relations

Filter by: relations: (63/63)

length | class | link | connec...

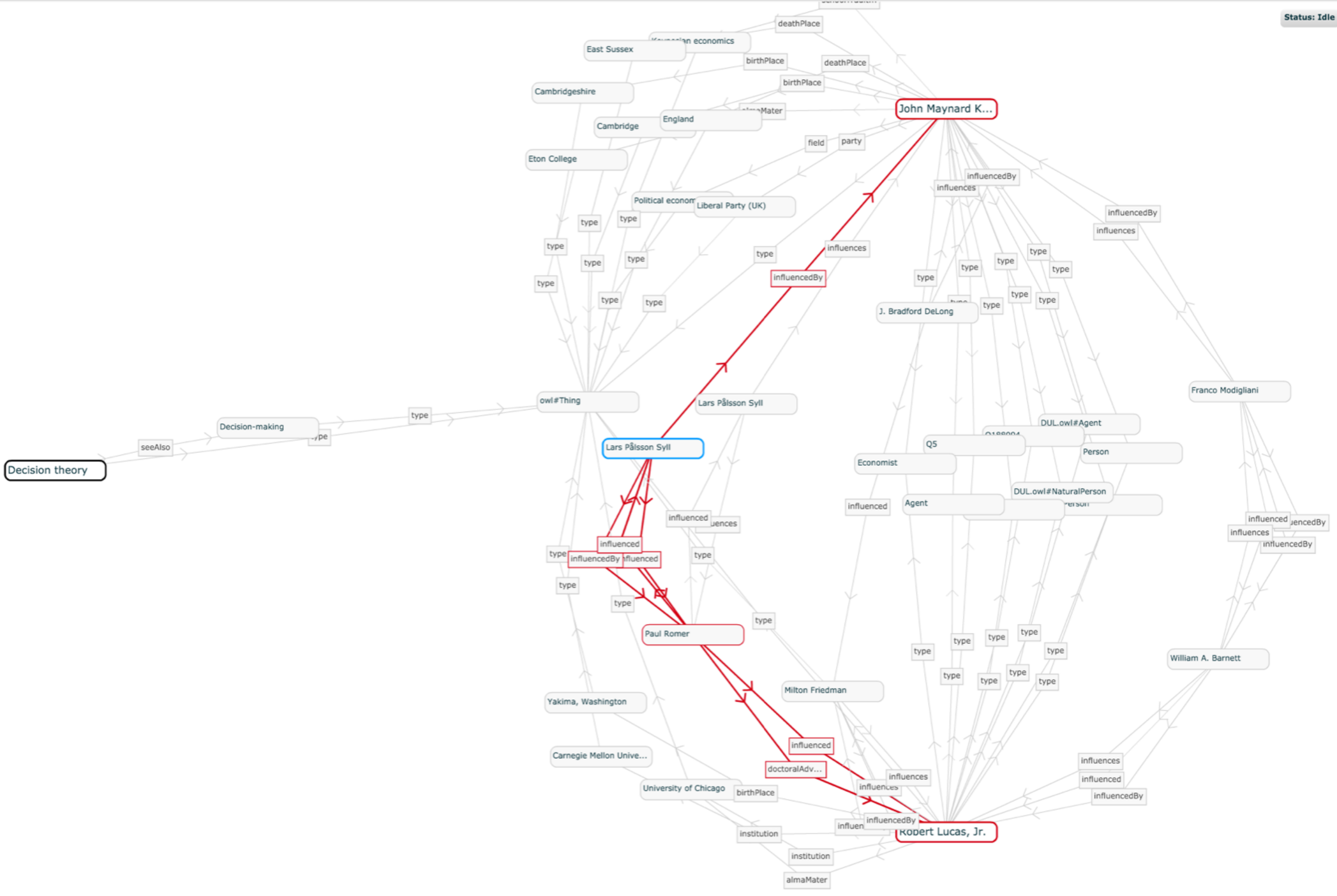
number of objects	num	vi
1	12/12	
2	51/51	

Lars Pålsson Syll

en

More Infos: dbpedia.org

Status: Idle



SPARQL Sample

Query language to RDF

```
prefix db:      <http://dbpedia.org/resource/>
prefix dbo:     <http://dbpedia.org/ontology/>
prefix foaf:    <http://xmlns.com/foaf/0.1/>

select distinct ?name, ?website, ?abstract where {
  ?software a              dbo:Software .
  ?software dbo:license    db:LGPL .
  ?software dbo:genre      db:Enterprise_Content_Management .
  ?software foaf:name      ?name .
  ?software foaf:homepage ?website .
  ?software dbo:abstract ?abstract .
  FILTER ( lang(?abstract) = "en" ) .
}
```

RDF example

- Examples of RDF(S) triples (Turtle syntax):

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
@prefix dbpedia: <http://dbpedia.org/resource/>
@prefix myont: <http://www.myont.org#>

myont:Neuromancer rdf:type myont:BedsideBook .
myont:Neuromancer myont:author dbpedia:William_Gibson .
myont:Neuromancer rdfs:label "Gibson's Neuromancer"@en .
_:id1 myont:includes myont:Neuromancer .
myont:BedsideBook rdfs:subClassOf myont:Book .
myont:scienceFictionAuthor rdfs:subPropertyOf myont:author .
myont:author rdfs:domain myont:Work .
myont:author rdfs:range myont:Person .
myont:Neuromancer mont:pagesize “258”^^^xsd:int .
```

individual

class

property

datatype property

resource

blank node

literal

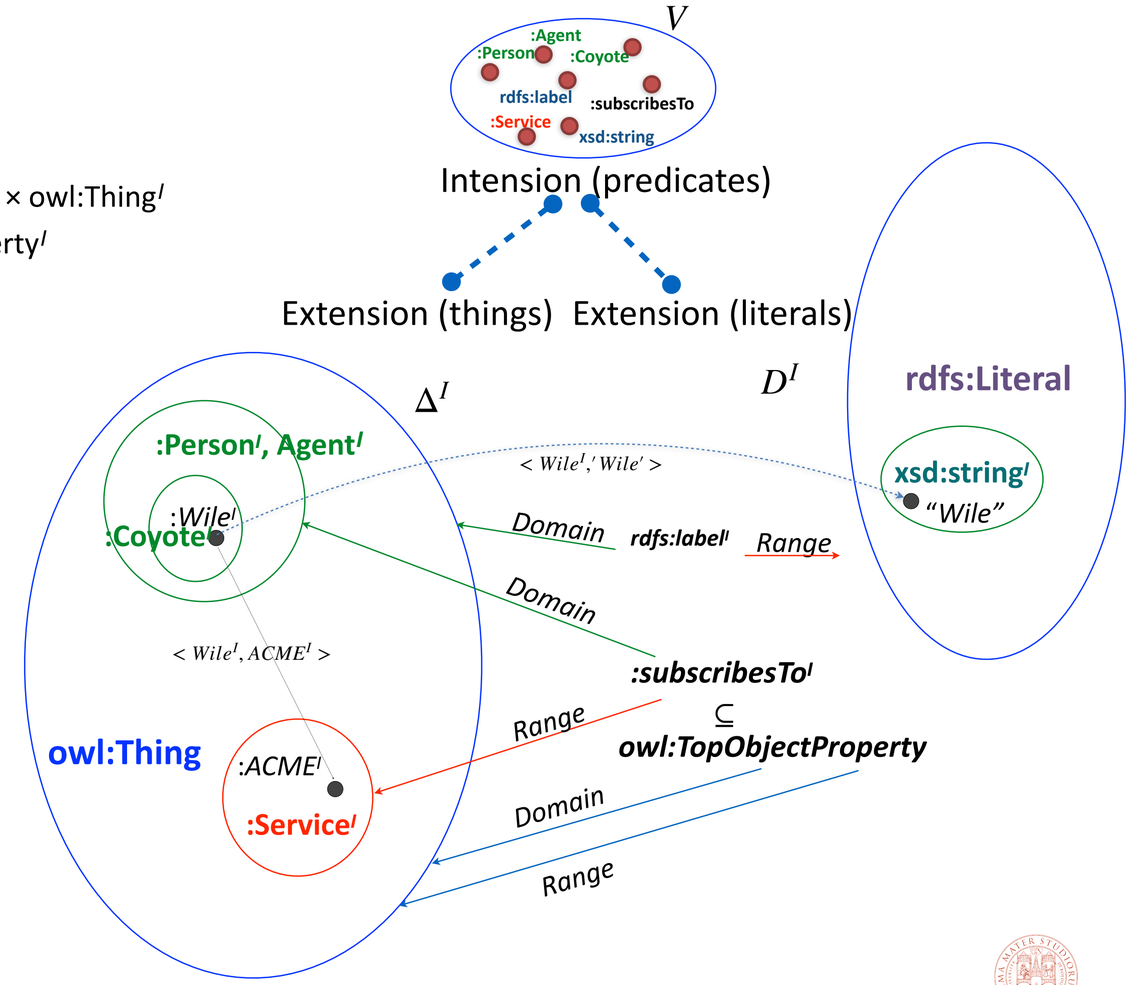
OWL Formal interpretation (extensional) of knowledge

Set-theoretic Semantics

owl:TopObjectProperty^I ⊆ owl:Thing^I × owl:Thing^I
:subscribesTo^I ⊆ owl:TopObjectProperty^I
:subscribesTo^I ⊆ Person^I × Service^I
:Person^I ⊆ owl:Thing^I
:Person^I ≡ Agent^I
:Coyote^I ⊆ :Person^I
:Service^I ⊆ owl:Thing^I
:Person^I ∩ :Service^I = ∅
:*Wile*^{I} ∈ :Coyote^I
:*ACME*^{I} ∈ :Service^I
(:*Wile*,:*ACME*)^I ∈ :subscribesTo^I

Plus …

inv(subscribedTo,subscribesTo)
Person ⊑ ∀*subscribesTo.Service*
Subscriber ≡ ∃*subscribesTo.Service*
Person ≡ *Subscriber* ⊔ *NonSubscriber*
NonSubscriber \ *Subscriber*
…



Pat Hayes' naïve physics manifesto (1988)

7 Clusters

Concepts will not be evenly spread throughout a theory. Some groups of concept-tokens will have many tight axiomatic connections within the group, relatively few outside. Think of a graph with tokens as nodes, linked by an arc if there is an axiom containing both of them: call it the axiom-concept (a-c) graph. Then this graph, while connected, will have some areas more densely connected than others. Call such a collection a cluster. Our job as theory-builders is made easier if we can identify clusters: these are as close as one can get to isolated subtheories.

Identifying clusters is both one of the most important and one of the most difficult methodological tasks in developing a naive physics. I think that several

7.7 Individuation

Establishing criteria for individuation must be done not only for objects but also for spaces, times, histories, quantities and any other kind of individual in our conceptual universe. When do we ascribe the status of being an individual thing to a piece of the world, since even the purely physical world can be carved up into pieces in arbitrarily many ways? I do not think there is a single neat answer, and there need not be: every kind of thing can have its own kind of reason for being a thing. But

7.2 Spaces and Objects

Places and positions are concerned with space in the large, space to be in. But there is also a collection of concepts to do with local small-scale space, the space between and around solid objects. The two interact, if only in that suitable solid arrangements can define places, by being a boundary. But there seem to be some concepts

7.8 A Sense of Scale

We seem to be remarkably good at imagining big and small things. One can imagine oneself inside a dolls house, or cupping the galaxy in ones hands. It is as though all our spatial intuitions have a free size parameter, which, while having a normal everyday default setting, can be adjusted so as to bring other things into their range.

7.6 Composites and Pieces of Stuff

Physical objects have many properties and relationships, many of them concerned with external attributes of the object such as shape or position. One category, however, concerns how objects are composed, what they are made of. As far as I can judge, all naive-physical objects are either a single piece of homogenous stuff, or are made up as a composite out of parts which are themselves objects. The essence of a composite is that its component parts *are* themselves objects, and that it can (conceptually if not in practice) be taken apart and reassembled, being then the same object. Examples of composites include a car, a cup of coffee, a house, four bricks making a platform. Examples of homogenous objects are a bronze statue, a plank of wood, the Mississippi, a brick. Homogenous objects have no parts, and

7.4 Change, Time and Histories

The now classical approach to describing time and change, invented first by J. McCarthy (1957), uses the idea of a state or situation (or: world-state, time instant, temporally possible world, . . .). This is a snapshot of the whole universe at a given moment. Actions and events are then functions from state to state. This framework

7.5 Energy, Effort and Motion

There seems to be a significant distinction between events which can "just" happen, and those which require some effort or expenditure of energy to keep them going. The difference between falling and being thrown lies almost exactly in this.

7.3 Qualities, Quantities and Measurements

Many everyday things have some properties which are more intrinsic than others, and might be called the possession of certain *qualities*. Objects have sizes, weights, colors; spaces have volumes; some objects have heights, others lengths. All of these qualities seem to exist independently of the entities which possess them. We can discuss heights, colors or smells as things in their own right: they form *quality spaces*. The set of possible heights is a quality space, as is the set of possible flavors.

7.1 Places and Positions

Consider the following collection of words: inside, outside, door, portal, window, gate, way in, way out, wall, boundary, container, obstacle, barrier, way past, way through, at, in.

I think these words hint at a cluster of related concepts which are of fundamental importance to naive physics. This cluster concerns the dividing up of three-dimensional space in pieces which have physical boundaries, and the ways in which these pieces of space can be connected to one another, and how objects, people, events, and liquids can get from one such place to another.

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Inclusion Lattice of Ontologies

Below is the lattice of ontologies in this library. Each ontology defines a set of formal terms. Ontologies include (import from) other ontologies. Terms in an included ontology are in the namespace of the ontologies that include it. In the lattice below, an ontology includes those ontologies that it is indented under.

- Kif-Sets
  - Kif-Extensions
    - Frame-Ontology
      - Basic-Matrix-Algebra
        - Tensor-Quantities
          - 3d-Tensor-Quantities
            - Simple-Geometry
        - Abstract-Algebra
          - Physical-Quantities
            - Standard-Dimensions
              - Unary-Scalar-Functions
              - Standard-Units
              - Simple-Geometry
            - Scalar-Quantities
              - Unary-Scalar-Functions
              - Tensor-Quantities ...
            - Quantity-Spaces
              - Simple-Geometry
        - Slot-Constraint-Sugar
  - Kif-Meta
  - Kif-Relations
    - Frame-Ontology ...
    - Kif-Extensions ...
- Kif-Numbers
  - Kif-Extensions ...
  - Kif-Lists
    - Kif-Extensions ...
    - Kif-Meta
    - Kif-Relations ...
- User-Theory

This file was generated by Ontolingua

T. R. Gruber. A Translation Approach to Portable Ontology Specifications. *Knowledge Acquisition*, 5(2):199-220, 1993.

25042 citations!!!

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Theories included by Frame-Ontology:

- Kif-Extensions
- Kif-Relations

Theories that include Frame-Ontology:

- Abstract-Algebra
- Slot-Constraint-Sugar

18 classes defined:

- Antisymmetric-Relation
  - Asymmetric-Relation
    - Partial-Order-Relation
      - Total-Order-Relation
- Class
- Class-Partition
- Irreflexive-Relation
  - Asymmetric-Relation ...
- Many-To-Many-Relation
- Many-To-One-Relation
- One-To-Many-Relation
- One-To-One-Relation
- Reflexive-Relation
  - Equivalence-Relation
  - Partial-Order-Relation ...
- Symmetric-Relation
  - Equivalence-Relation
- Thing
  - Individual-Thing
- Transitive-Relation
  - Equivalence-Relation
  - Partial-Order-Relation ...
- Weak-Transitive-Relation

30 relations defined:

- Alias
- Composition-Of
- Direct-Instance-Of
- Direct-Subclass-Of
- Documentation
- Domain
- Domain-Of
- Exhaustive-Subclass-Partition
- Has-Value
- Inherited-Slot-Value
- Instance-Of
- Maximum-Slot-Cardinality
- Maximum-Value-Cardinality
- Minimum-Slot-Cardinality
- Minimum-Value-Cardinality
- Nth-Domain
- Onto
- Range
- Range-Of
- Related-Axioms
- Same-Slot-Values
- Same-Values
- Single-Valued-Slot
- Slot-Value-Type
- Subclass-Of
- Subclass-Partition
- Subrelation-Of
- Superclass-Of
- Total-On
- Value-Type

12 functions defined:

- All-Inherited-Slot-Values
- All-Instances

```
;;; -*- Mode:Lisp; Syntax: Common-Lisp; Package:ONTOLINGUA-USER; Base:10 -*-

;;; 3D-Tensor Quantities
;;; (c) 1993,1994 Gregory R. Olsen and Thomas R. Gruber

(in-package "ONTOLINGUA-USER")

(define-theory 3D-TENSOR-QUANTITIES (tensor-quantities)

  "This theory specializes the Tensor-Quantities for tensors of spatial.dimension 3.
  :issues ("(c) 1993, 1994 Gregory R. Olsen and Thomas R. Gruber"
           (:see-also "The EngMath paper on line")))

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;; 3-Dimensional Tensor-Quantity Algebra
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(in-theory '3D-tensor-quantities)

(define-class 3D-DYAD (?x)
  "Second order tensors of 3-dimensions."

  :def (and (dyad ?x)
            (spatial.dimension ?x 3)))

(define-class 3D-VECTOR-QUANTITY (?x)

  "Vectors of 3-dimensions. (These vectors have important properities
and are of particular interest to engineering analysis)."

  :def (and (vector-quantity ?x)
            (spatial.dimension ?x 3)))

(define-function CROSS (?v1 ?v2) :-> ?v

  "Vector or cross product of two three dimensional vectors.  If we
know the components of two vectors with respect to a common basis, we
can determine the components of the cross product in that basis."

  :iff-def (and
```

Function CROSS

Vector or cross product of two three dimensional vectors. If we know the components of two vectors with respect to a common basis, we can determine the components of the cross product in that basis.

Arity: 3

Axioms:

```
(Nth-Domain Cross 3 3d-Vector-Quantity)

(Nth-Domain Cross 2 3d-Vector-Quantity)

(Nth-Domain Cross 1 3d-Vector-Quantity)

(<=> (Cross ?V1 ?V2 ?V)
     (And (3d-Vector-Quantity ?V1)
          (3d-Vector-Quantity ?V2)
          (3d-Vector-Quantity ?V)
          (= (Quantity.Dimension ?V)
             (* (Quantity.Dimension ?V1) (Quantity.Dimension ?V2)))
          (= (Dot ?V1 ?V)
             (The-Zero-Scalar-For-Dimension (* (Quantity.Dimension ?V1)
                                               (Quantity.Dimension ?V))))
          (= (Dot ?V2 ?V)
             (The-Zero-Scalar-For-Dimension (* (Quantity.Dimension ?V2)
                                               (Quantity.Dimension ?V))))
          (= (Vector-Component ?V 1 ?B)
             (- (* (Vector-Component ?V1 2 ?B)
                   (Vector-Component ?V2 3 ?B))
                (* (Vector-Component ?V2 2 ?B)
                   (Vector-Component ?V1 3 ?B))))
          (= (Vector-Component ?V 2 ?B)
             (- (* (Vector-Component ?V2 1 ?B)
                   (Vector-Component ?V1 3 ?B))
                (* (Vector-Component ?V1 1 ?B)
                   (Vector-Component ?V2 3 ?B))))
          (= (Vector-Component ?V 3 ?B)
             (- (* (Vector-Component ?V1 1 ?B)
                   (Vector-Component ?V2 2 ?B))
                (* (Vector-Component ?V2 1 ?B)
                   (Vector-Component ?V1 2 ?B))))))
```

- **Defined in theory:** 3D-tensor-quantities
- **Source code:** 3D-tensor-quantities.lisp

Spatio-temporal perspective

Woman Portrait
by
Caspar Netscher
17th century

currently located

temporarily **stored** in **1942**

involved in an **exhibition** in **1773**

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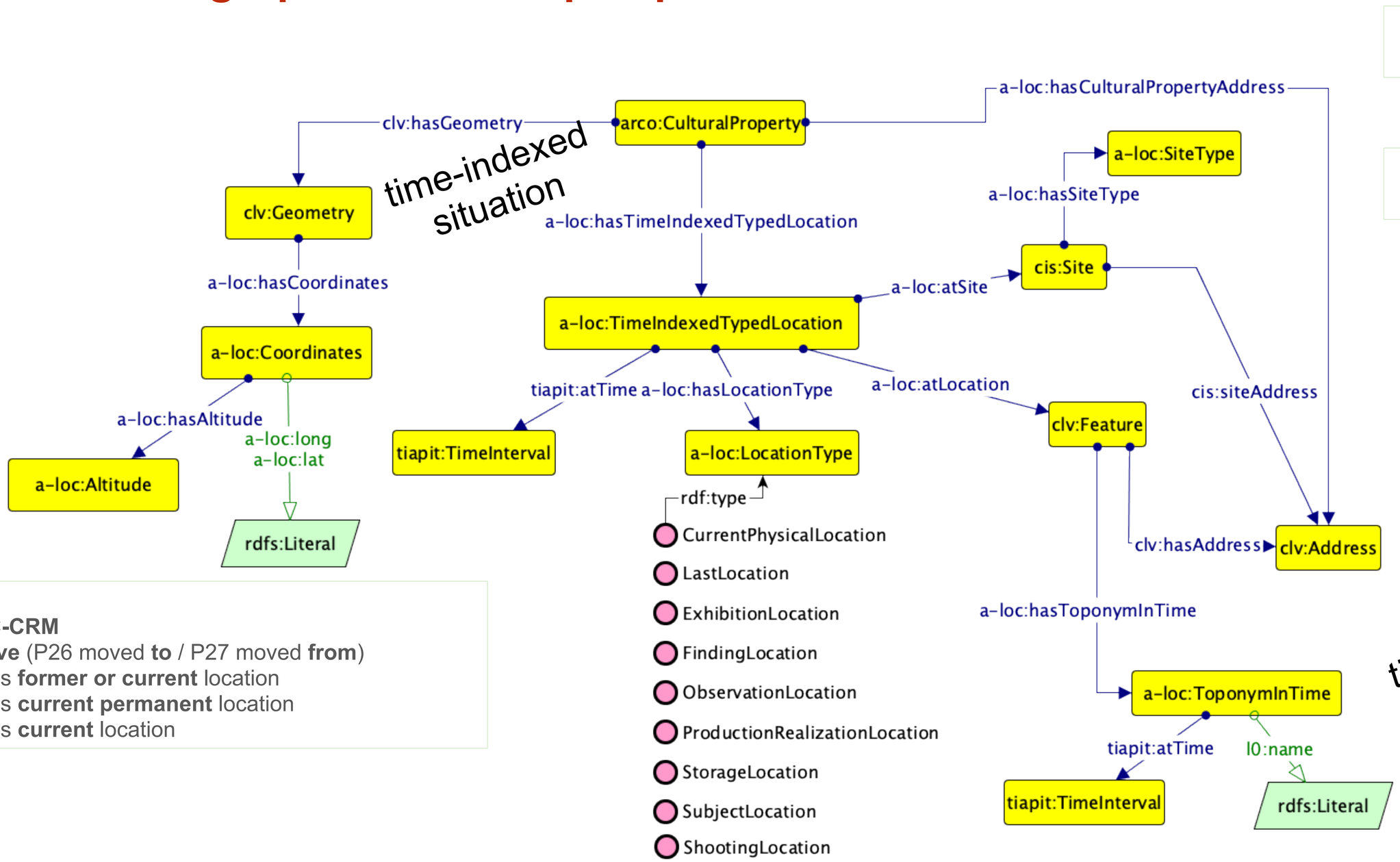
A knowledge pattern for ST perspectives



e.g.
CIDOC-CRM
E9 **Move** (P26 moved **to** / P27 moved **from**)
P53 has **former or current** location
P54 has **current permanent** location
P55 has **current** location

Reporting perspective

Syracusan coin
4th century B.C.

catalogue record

```
<?xml version="1.0" encoding="UTF-8"?>
<schede>
   <OA version="3.00_ICCD0">
      <CD hint="CODICI">
         <TSK hint="Tipo Scheda">OA</TSK>
         <LIR hint="Livello ricerca">C</LIR>
         <NCT hint="CODICE UNIVOCO">
            <NCTR hint="Codice regione">01</NCTR>
            <NCTN hint="Numero catalogo generale">00350758</NCTN>
         </NCT>
         <ESC hint="Ente schedatore">S67</ESC>
         <ECP hint="Ente competente">S67</ECP>
      </CD>
      <OG hint="OGGETTO">
         <OGT hint="OGGETTO">
            <OGTD hint="Definizione">dipinto</OGTD>
            <OGTV hint="Identificazione">opera isolata</OGTV>
         </OGT>
         <SGT hint="SOGGETTO">
            <SGTI hint="Identificazione">ritratto di giovane donna</SGTI>
         </SGT>
      </OG>
      <LC hint="LOCALIZZAZIONE GEOGRAFICO-AMMINISTRATIVA">
         <PVC hint="LOCALIZZAZIONE GEOGRAFICO-AMMINISTRATIVA ATTUALE">
            <PVCS hint="Stato">ITALIA</PVCS>
            <PVCR hint="Regione">Piemonte</PVCR>
            <PVCP hint="Provincia">TO</PVCP>
            <PVCC hint="Comune">Torino</PVCC>
         </PVC>
         <LDC hint="COLLOCAZIONE SPECIFICA">
            <LDCT hint="Tipologia">palazzo</LDCT>
            <LDCN hint="Denominazione">Manica Nuova</LDCN>
            <LDCC hint="Complesso monumentale di appartenenza">Palazzo Reale</LDCC>
            <LDCU hint="Denominazione spazio viabilistico">via XX Settembre, 86</LDCU>
         </LDC>
      </LC>
      <LA hint="ALTRE LOCALIZZAZIONI GEOGRAFICO-AMMINISTRATIVE">
         <TCL hint="Tipo di localizzazione">luogo di provenienza</TCL>
         <PRV hint="LOCALIZZAZIONE GEOGRAFICO-AMMINISTRATIVA">
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            <PRVP hint="Provincia">GE</PRVP>
            <PRVC hint="Comune">Genova</PRVC>
         </PRV>
      </LA>
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         <DTZ hint="CRONOLOGIA GENERICA">
            <DTZG hint="Secolo">sec. XVI</DTZG>
            <DTZS hint="Frazione di secolo">terzo quarto</DTZS>
```

“conservation status of the coin: **good**”


```
<?xml version="1.0" encoding="UTF-8"?>
<schede>
   <OA version="3.00_ICCD0">
      <CD hint="CODICI">
         <TSK hint="Tipo Scheda">OA</TSK>
         <LIR hint="Livello ricerca">C</LIR>
         <NCT hint="CODICE UNIVOCO">
            <NCTR hint="Codice regione">01</NCTR>
            <NCTN hint="Numero catalogo generale">00350758</NCTN>
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            <OGTD hint="Definizione">dipinto</OGTD>
            <OGTV hint="Identificazione">opera isolata</OGTV>
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         </SGT>
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         <PVC hint="LOCALIZZAZIONE GEOGRAFICO-AMMINISTRATIVA ATTUALE">
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            <LDCT hint="Tipologia">palazzo</LDCT>
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            <LDCC hint="Complesso monumentale di appartenenza">Palazzo Reale</LDCC>
            <LDCU hint="Denominazione spazio viabilistico">via XX Settembre, 86</LDCU>
         </LDC>
      </LC>
      <LA hint="ALTRE LOCALIZZAZIONI GEOGRAFICO-AMMINISTRATIVE">
         <TCL hint="Tipo di localizzazione">luogo di provenienza</TCL>
         <PRV hint="LOCALIZZAZIONE GEOGRAFICO-AMMINISTRATIVA">
            <PRVS hint="Stato">ITALIA</PRVS>
            <PRVR hint="Regione">Liguria</PRVR>
            <PRVP hint="Provincia">GE</PRVP>
            <PRVC hint="Comune">Genova</PRVC>
         </PRV>
      </LA>
      <DT hint="CRONOLOGIA">
         <DTZ hint="CRONOLOGIA GENERICA">
            <DTZG hint="Secolo">sec. XVI</DTZG>
            <DTZS hint="Frazione di secolo">terzo quarto</DTZS>
```
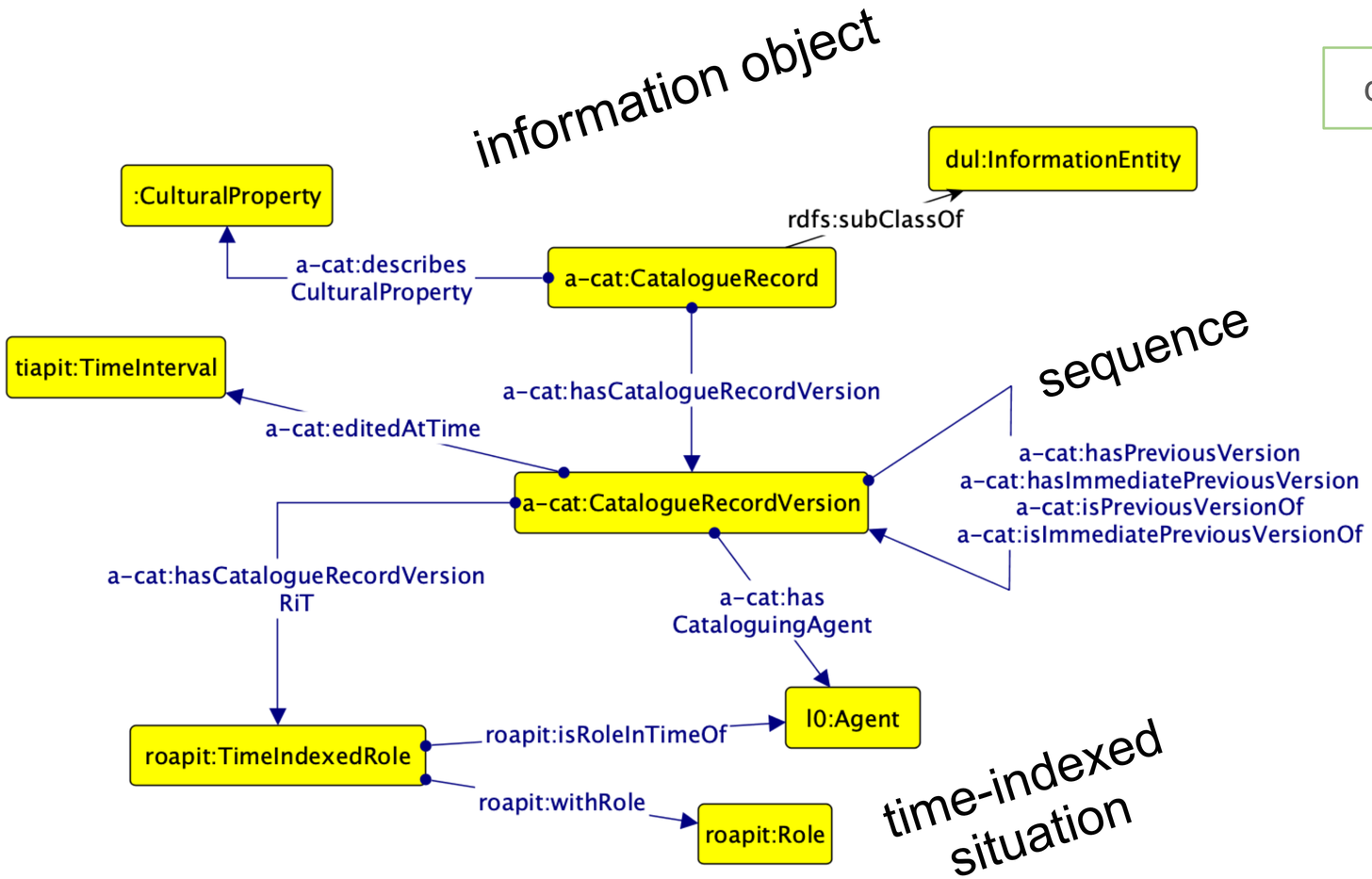


“conservation status of the coin: **bad**”

A knowledge pattern for reporting versions

Catalogue record

catalogue record versions



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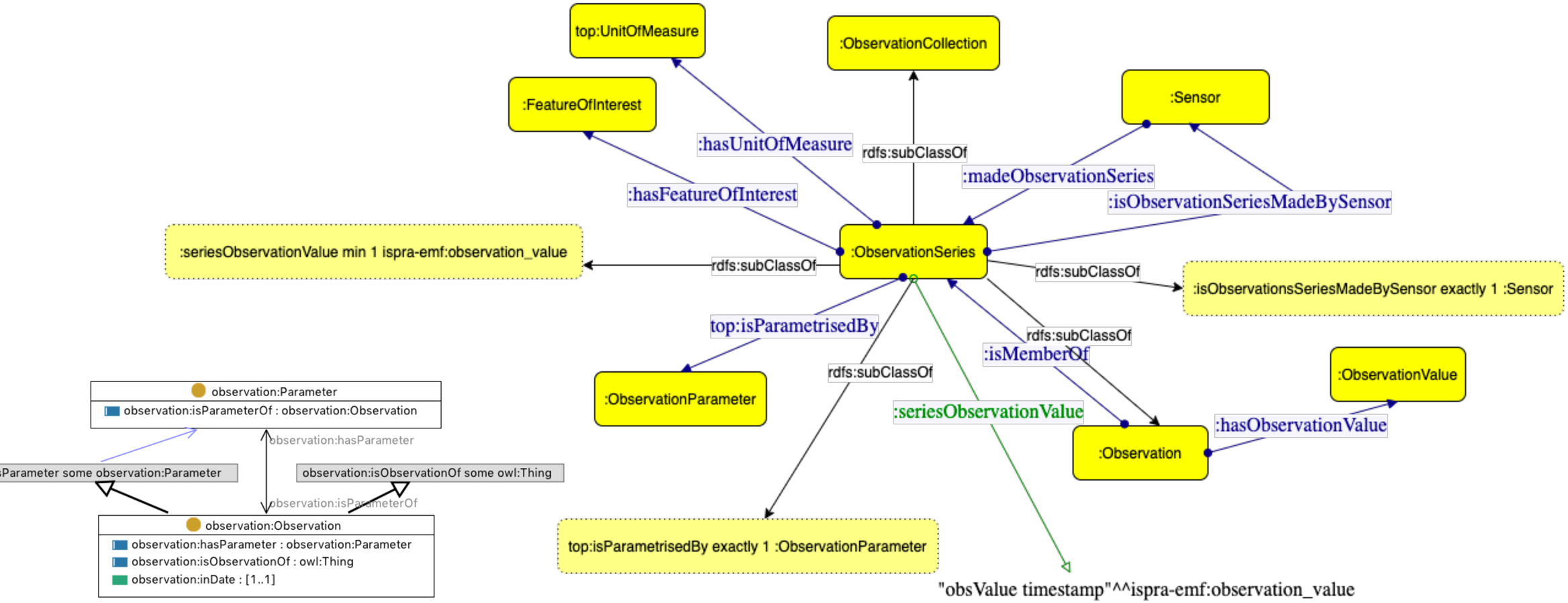
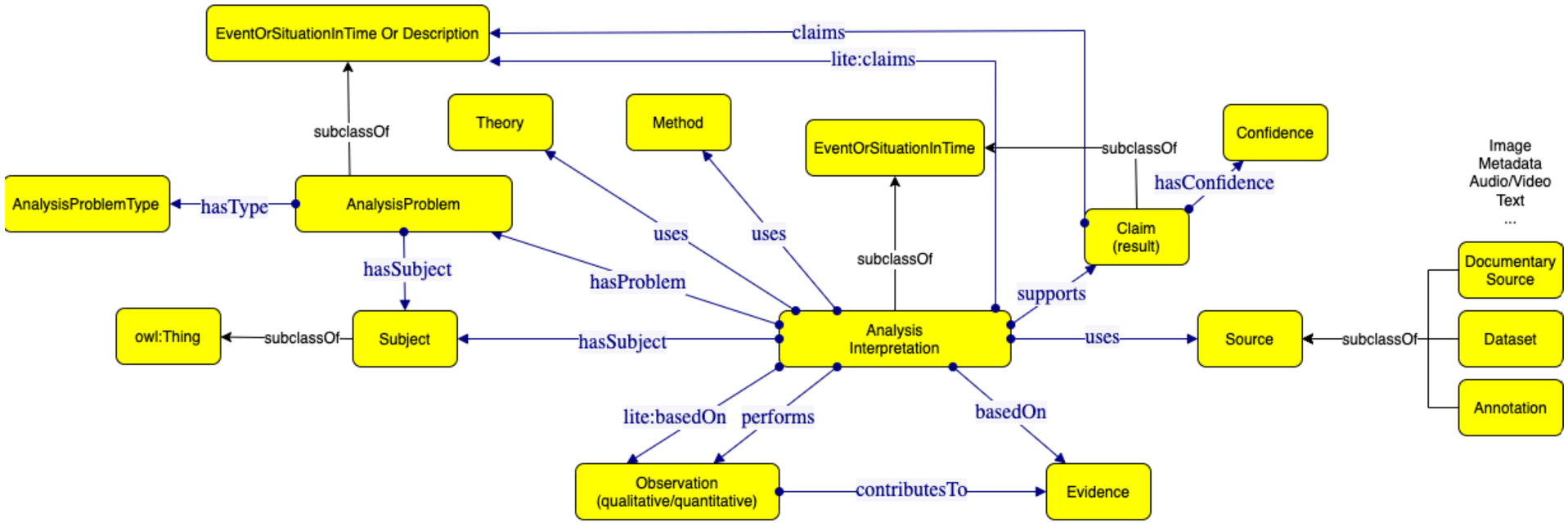
Observation series in the WHOW ontology network



https://github.com/whow-project

A knowledge pattern for art interpretations



Istituto Centrale per il Catalogo e la Documentazione

SPICE Ontology Network

Curatorial Knowledge Area
- Scripting module

Interaction Knowledge Area
- Fruition context module
- Affordance module

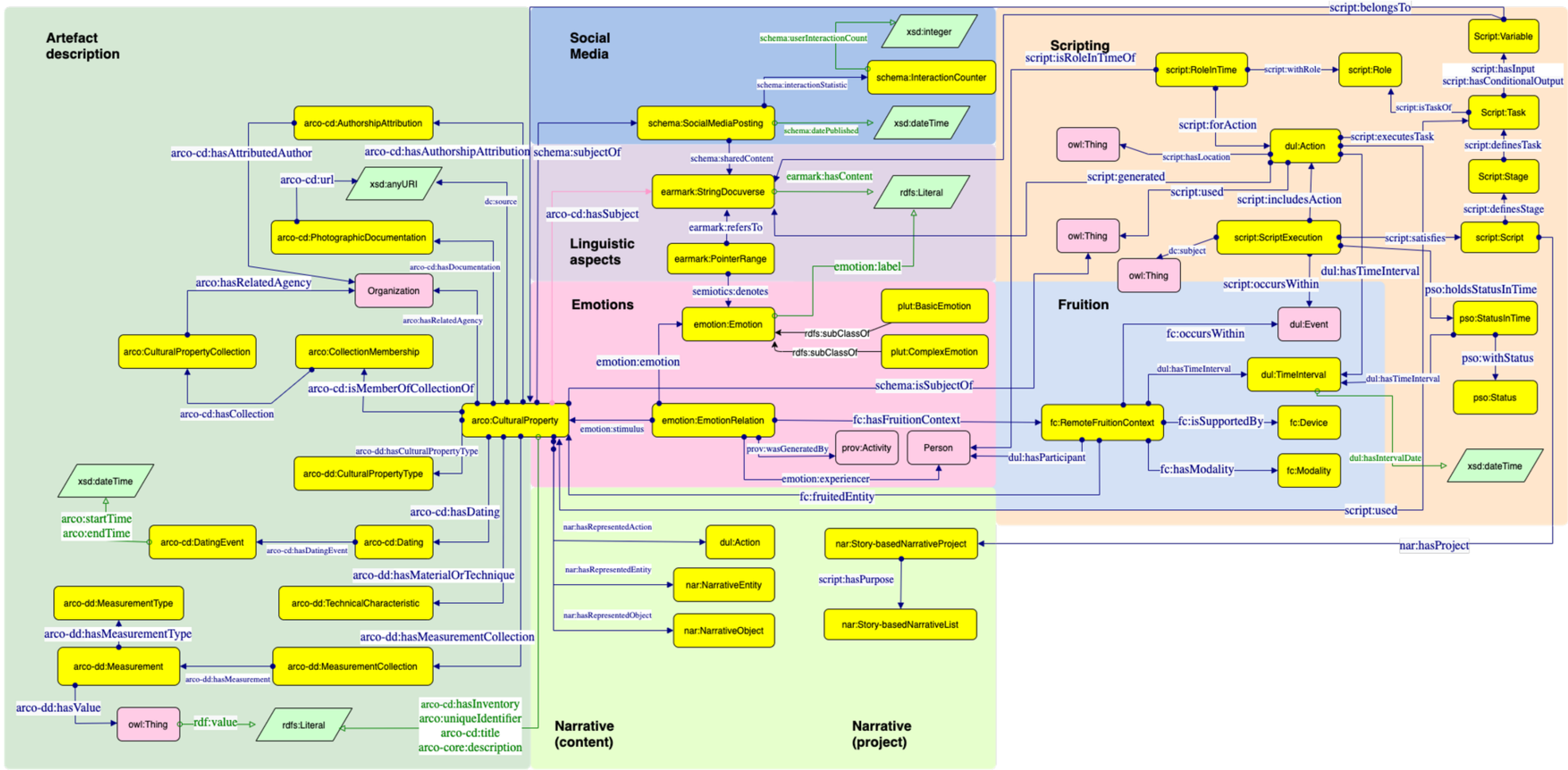
Narrative Knowledge Area
- Narrative module

User and Community Modelling Knowledge Area
- Community schema
- User profiling schema
- Schwartz' values module
- Haidt's values module

Emotion Knowledge Area
- Emotion module
- Emotion in Cultural context module
- Ekman emotions module
- Plutchik emotion module
- Ortony-Clore-Collins emotion module
- Shaver module

State of the art ontologies reused:
- ArCo
- Getty vocabularies
- Earmark
- Semiotics
- Framester
- Building Topology Ontology (BOT)

SPICE ontologies provide a uniform interconnected view over the data of the domain at hand



E.g., S de Giorgis, A Gangemi, R Damiano. *Basic Human Values and Moral Foundations Theory in ValueNet Ontology*. Conference on Knowledge Engineering and Knowledge Management, 2022

SPICE
Social cohesion, Participation, and Inclusion through Cultural Engagement

HyperReal

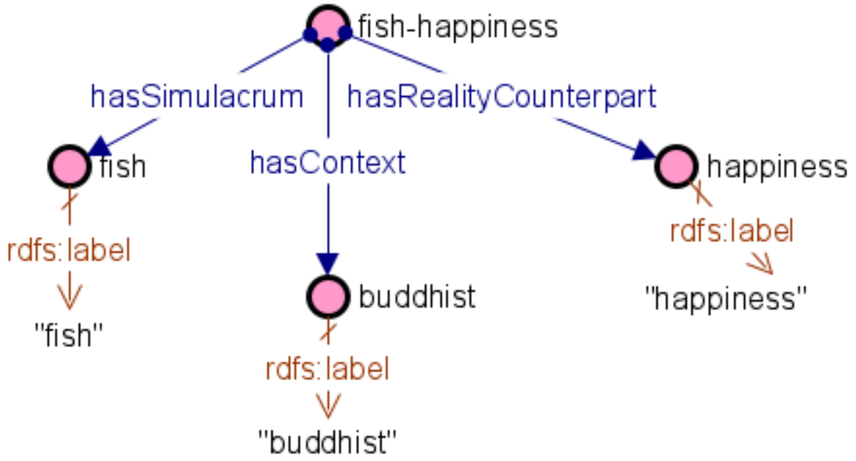
https://w3id.org/simulation

Knowledge graph that contains more than 40,000 instances of symbolism, called *simulations*, based on the Simulation ontology

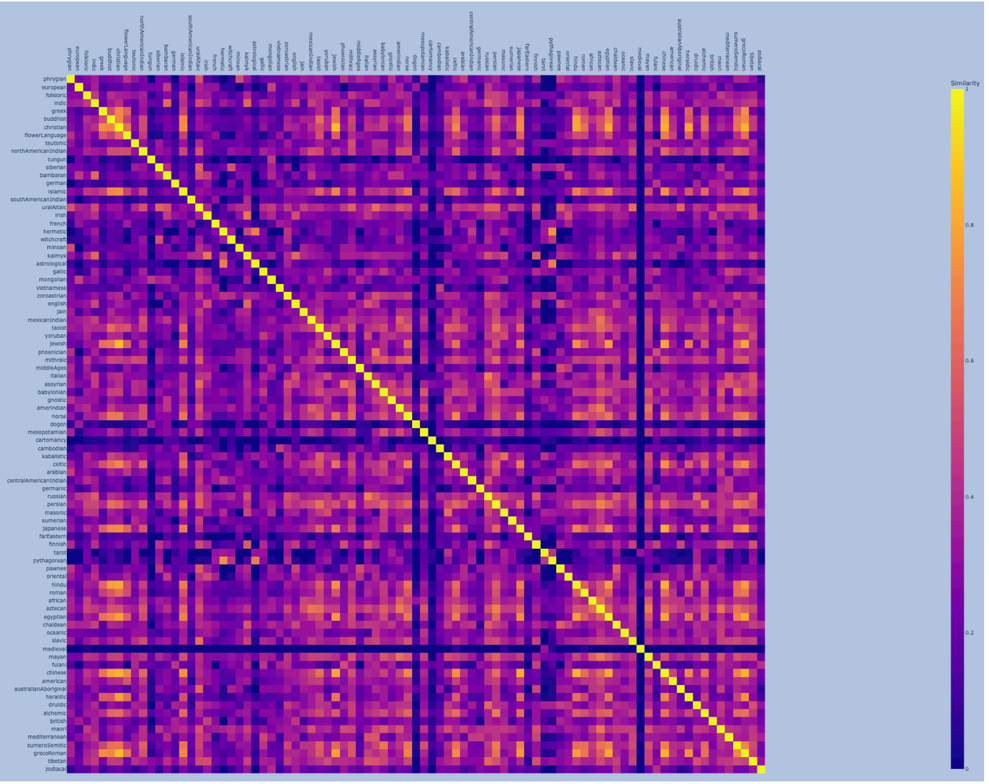
All entities of HyperReal are aligned to WordNet and BabelNet, AAT

By reconciling depicted entities of artworks (for example from Wikidata) to HyperReal, we are able to infer automatic context dependent interpretations of artworks

B Sartini, M van Erp, A Gangemi.
Marriage is a Peach and a Chalice: Modelling Cultural Symbolism on the Semantic Web.
Knowledge Capture Conference



SPICE
Social cohesion, Participation, and Inclusion through Cultural Engagement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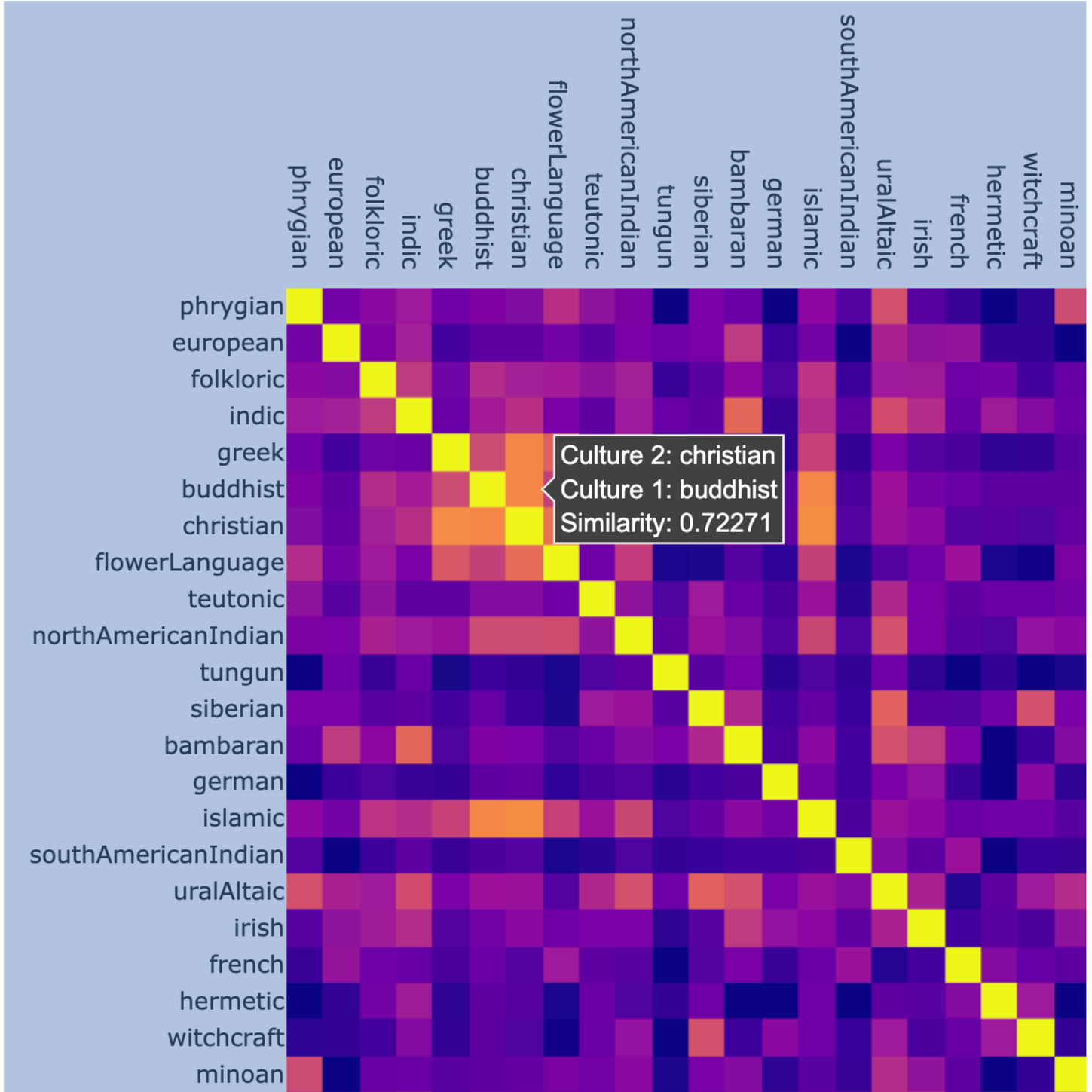
0.6
0.4
0.2
0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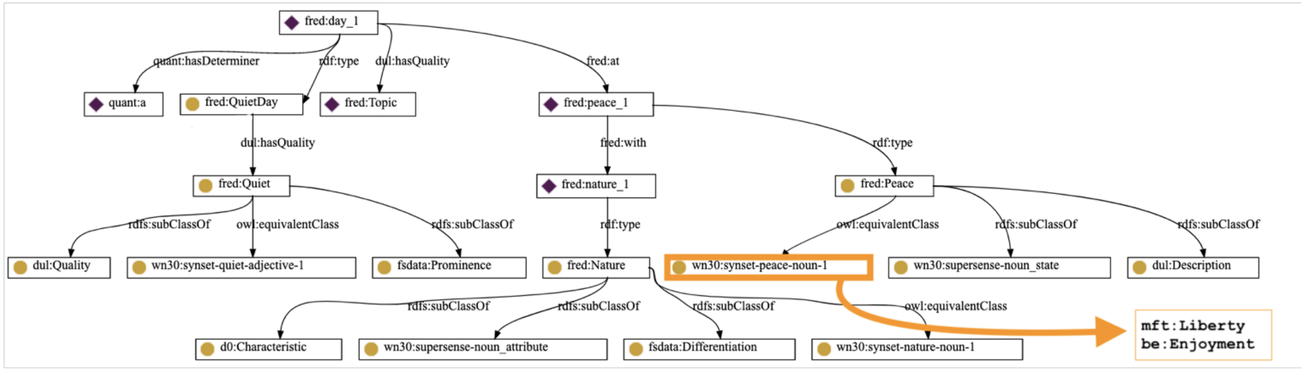
european
folkloric
indic
greek
buddhist
christian
flowerLanguage
teutonic
northAmericanIndian
tungun
siberian
bambaran
german
islamic
southAmericanIndian
uralAltaic
irish
french
hermetic
witchcraft
minoan
Culture 2: christian
Culture 1: buddhist
Similarity: 0.72271

Value reasoner

Estate (l'Amaca) - Felice Carena

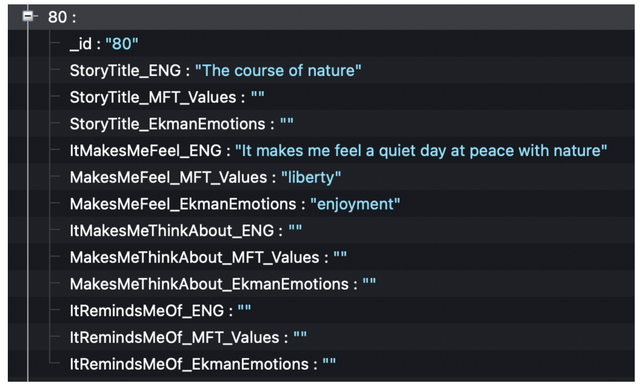
What do you feel in front of this painting?

"A quiet day at peace with nature."




```
wn:synset-peace-noun-1 :triggers mft:Liberty , be:Enjoyment .
```

The Value+Emotion Reasoner takes as input a user description/comment about an artwork, it generates a graph from natural language and it detects moral-cultural values and emotions in the sentence.



L Asprino, L Bulla, S de Giorgis, et al. *Uncovering values: detecting latent moral content from natural language with explainable and non-trained methods*. Deep Learning Inside Out (DeeLIO 2022)

Kinds of Tacit Knowledge

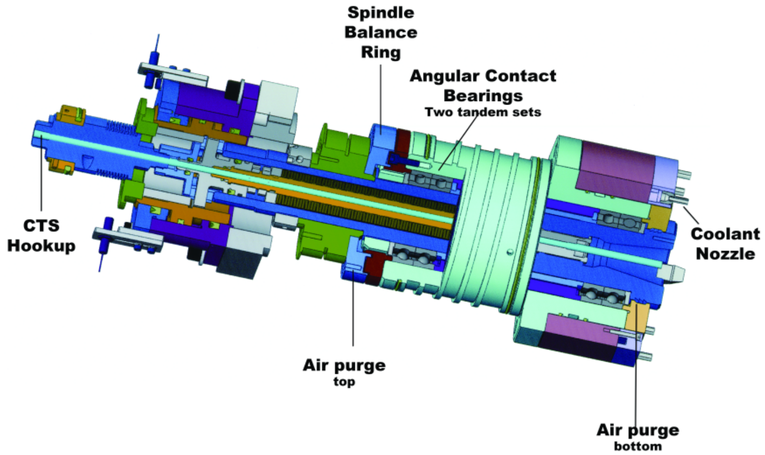
Explicit Knowledge (EK) is "encoded" in a language, but Implicit/Tacit Knowledge (TK) depends on bodily and environmental circumstances, then it is difficult to encode, …

Somatic/Embodied (Michael Polanyi: "we know more than we can tell")

Physical skills and **bodily** knowledge (muscle memory and bodily awareness)

Examples: *Riding a bicycle, swimming, maintaining balance*

Scenario: *A master potter adjusting the pressure of their hands on clay based on its consistency*
They can't fully verbalize the exact pressure needed, but their hands "know" through years of practice (cf. KnowledgeX project for spindle construction know how)



Kinds of Tacit Knowledge

Cognitive

Mental models and **intuitive** understanding/problem-solving, **pattern recognition** abilities, **expert** judgment developed through **experience**

Scenario: *An experienced radiologist can spot anomalies in X-rays almost instantly, before conscious analysis, based on rapid pattern recognition developed over years* of practice

Social/Collective

Shared cultural **practices** and **norms**, organizational **routines**, **community**-specific ways of doing things, **institutional** knowledge passed through practice and spontaneous mimicry

Scenario: *The unwritten rules of turn-taking and interaction in a Japanese tea ceremony, which participants learn through observation and participation rather than explicit instruction*

Kinds of Tacit Knowledge

Technical

Context-specific skills in **professional** settings, know-how gained through **hands-on** experience, **craft** knowledge and professional **expertise**

Scenario: *An experienced mechanic who can diagnose an engine problem by its sound and vibration, knowledge that comes from years of experience and can't be fully captured in manuals*

Personal

Individual **insights** and experiences, personal **values, emotions, heuristics** and **rules of thumb**, **emotional** intelligence and **interpersonal** skills (**empathy**), **unique perspectives** shaped by personal history

Scenario: *A skilled negotiator who intuitively knows when to push and when to back off in negotiations, based on subtle cues and personal experience that they might struggle to fully articulate*