Querying Semantic Networks

Fundamental Categories

Fundamental Relationships

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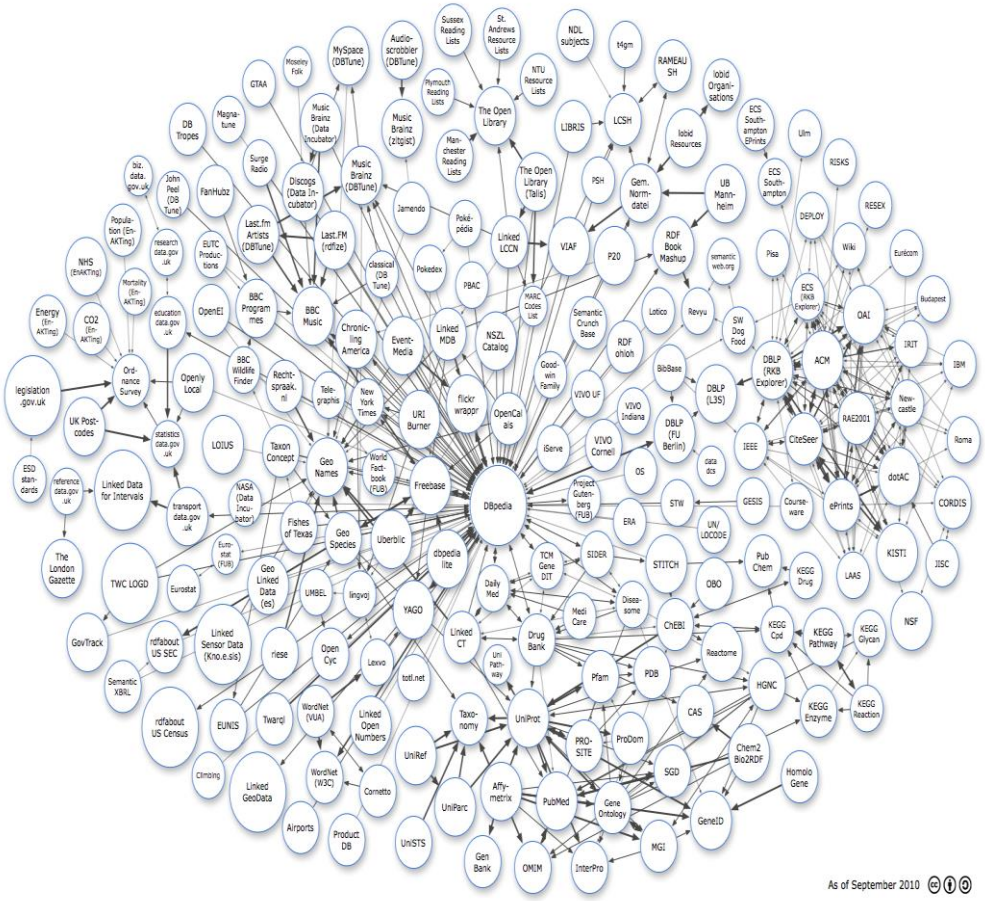
Outline

- ***Introduction - Challenges***
- ***Problem***
- ***Existing Approach***
- ***Our proposal***
- ***Example***
- ***Demonstration***
- ***Conclusions***

Introduction



As of September 2010

Semantic Web

- ○ *Web of data*
- ○ *RDF/S*
- ○ *RDF Triple Stores*
- ○ *Linked Open Data (LoD): Thousands of triple stores to be accessed*

3 Major Challenges

1. *We need a **rich**, **integrating** global schema – a core and extensions of any depth*

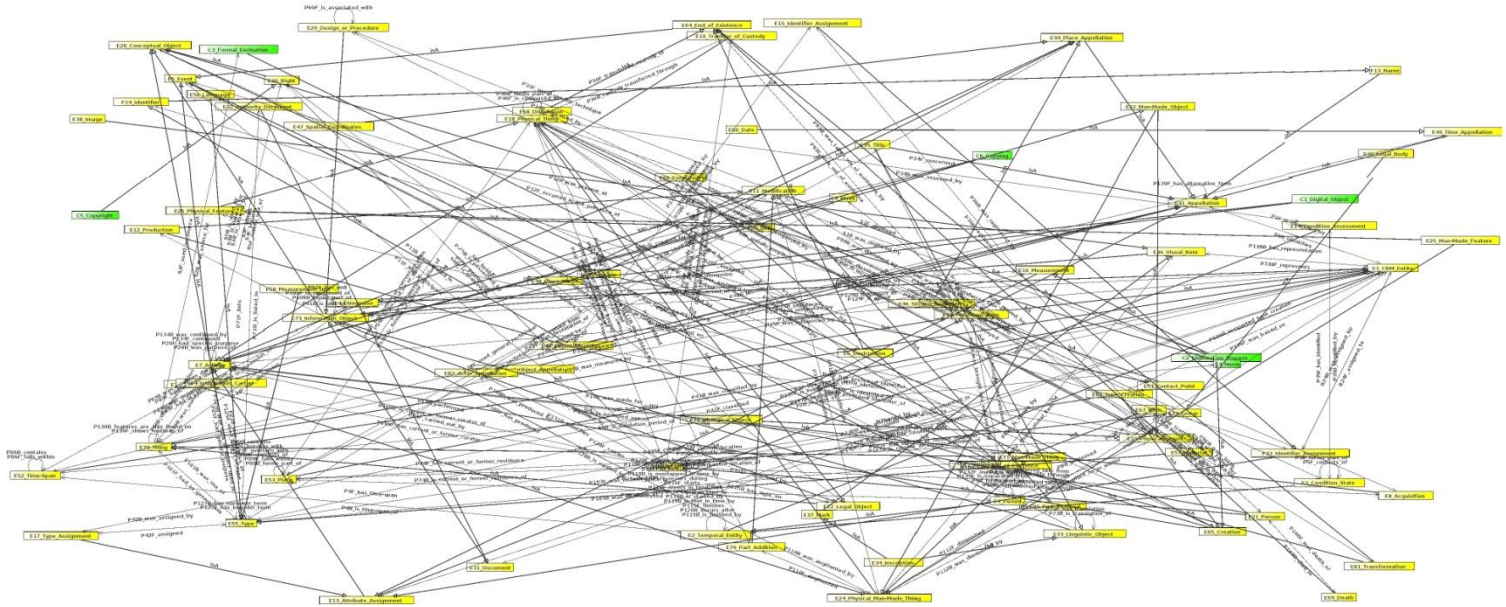
2. *End-users need to query **effectively** large Triple Stores*

3. *Knitting" the network : without co-ref resolution facts/triples do not connect*

A Global Schema: The CIDOC CRM

- Is an extensible core ontology of 86 classes and 137 properties describing the underlying semantics of over a hundred database schemata and structures from all museum disciplines, archives and libraries,
- It is result of 15 years interdisciplinary work and agreement.
- An interlingua to transform, transport and merge information from most data structures with clear meaning.

Problem: How to query rich Semantic Networks?



CIDOC-CRM Visualization by StarLion

How to query rich semantic networks?

Hardships:

- The nature of information in the Semantic Web
- Users' ignorance
- Failure of current Information Retrieval methods (keyword search)

Existing Approach 1

Facilitate the query formulation in the User Interface with

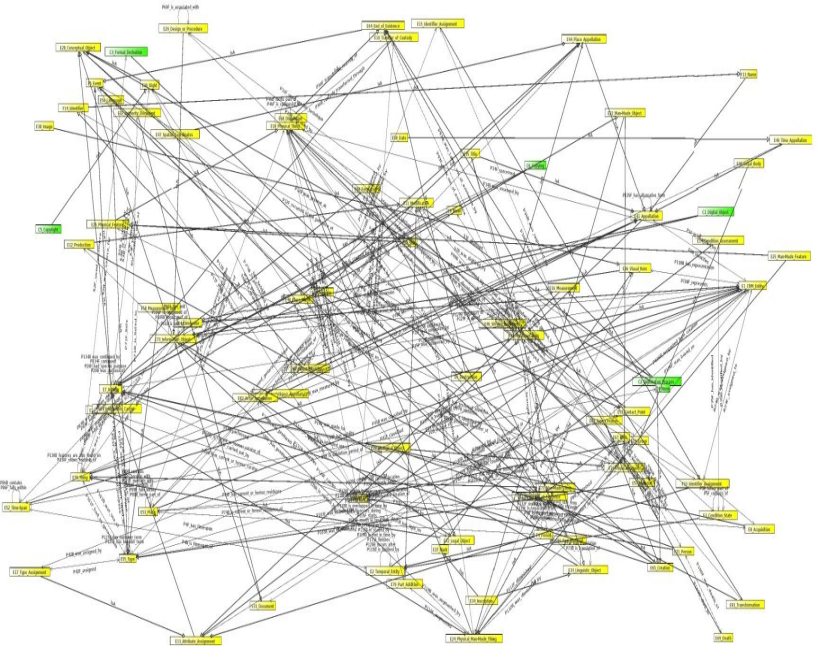
- schema graphical representations
- natural language
- menu-guided interfaces with look ahead mechanisms

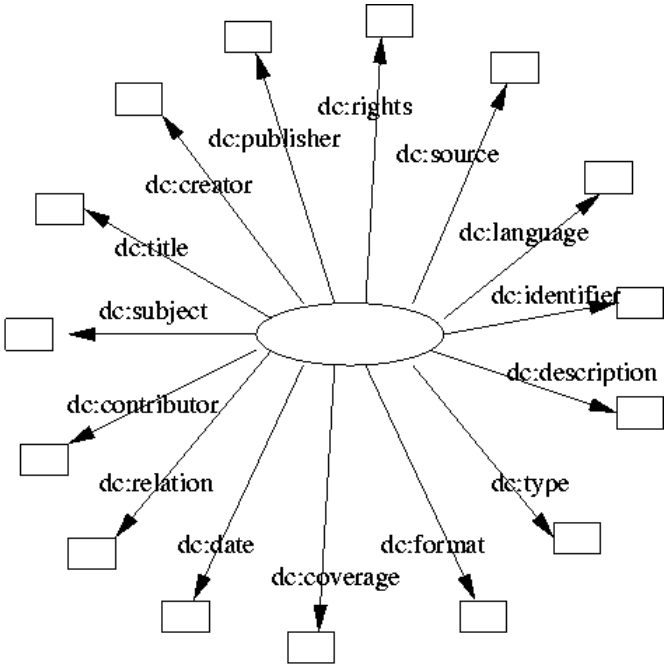
Drawbacks

- *Some still require SPARQL from the user*
- *Polysemy of natural language*
- *The user still depends on their awareness of the underlying schema*

Existing Approach 2

Simplify *the network by using "core" elements such as in Dublin Core*





The DC hedgehog model

Existing Approach 2

Drawbacks

- Cannot map complicated scientific data to small schemata with poor coverage
- Does not provide adequate support for sophisticated queries or search precision across large datasets
- Cannot result in good deductions and diminishes the possibility of reasoning
- Cannot integrate knowledge

Querying Semantic Networks

Archaeological Museum of Heraklion Crete

record information

Amphora placement in Archeological Museum

Stylianos Alexiou

record information

Tomb Excavation

time

1951

Query:

Things from Egypt found in Crete

Amphora Λ2409

Tomb

Tuthmosis III

Written on inscription (on amphora)

Amphora Deposition in tomb

14th century BC

15th century BC

Tuthmosis III reign

Amphora Production

Papyrus information

Egypt

Crete

space

Our proposal

A new “data-model” of
“Fundamental Categories” and “Fundamental Relationships”
for **querying only**!

… implemented as automated deductions from a CRM-based network

Fundamental Relationships

- ***describe:***
  - *how and what an entity is (classification, part-whole structure),*
  - *what an item has undergone gone in its history*,
  - *what an entity may "show", say or refer to.*
- ***are based on:***

  intuition, experience and observation

Fundamental Categories & Relationships

***Fundamental Categories**:*

- *Thing, Actor, Place,Time/Event, Concept*

***Fundamental Relationships**:*

- *has type /is type of*
- *is similar to or same with*
- *is part of (is member of) / has part (has member)*
- *has met*
- *from (has founder or has parent) / is origin, founder, parent, provider or creator of*
- *had (=owns, keeps) / were owned/kept by*
- *refers to or is about / is referred to by - is referred to at*

..and specializations

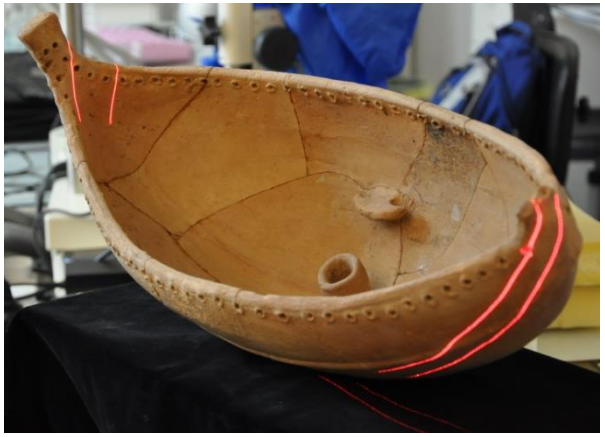
Relationships change interpretation depending on category of domain and range.

Example Query: Things about "The Kazafani Boat"

Example:

The "Kazafani Boat"

Found in 1963, during a salvage excavation in the now Turkish occupied part of Cyprus (inaccessible and destroyed site).
Tomb from the 12th century B.C.
Unique object, hand made pottery
40x20.5x23 cm – canoe boat shape
Permanently exhibited at the Nicosia Museum



Workflow

3D scanning – NextEngine

3D model creation – Meshlab

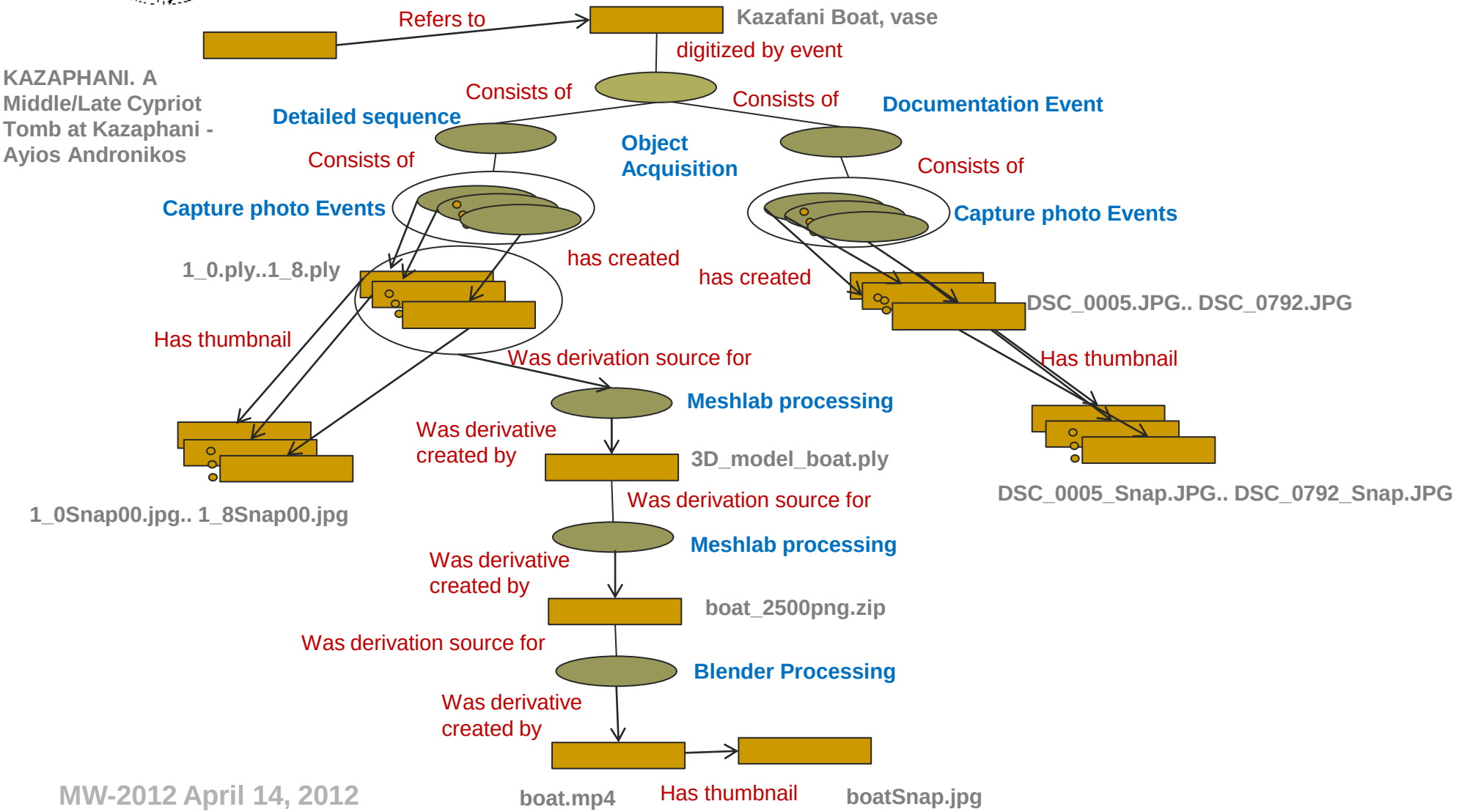
Rapid prototyping

Testing glue, stabilizers, colours

Print final replica

Colour final replica

Metadata about the digitization and documentation of



Thing is about Thing Path Expression

1. shows features of

C1.Object -> (F3.is_same_as)$^{[0,n]}$**->C1.Object:** *2. part-whole*

C1.Object->(F4F.is_composed_of) $^{[0,n]}$ -> **C1.Object**

E24.Physical_Man-Made_Thing -> P62F.depicts -> **C1.Object**

OR

E24.Physical_Man-Made_Thing -> (P128F.carries)$^{[0,1]}$ **-> E73.Information_Object**

-> P67F.refers_to-> **C1.Object**

Rules

3. derivatives

OR

D1.Digital_Object -> (F1F.is_derivative_of)$^{[0,n]}$ **-> D1.Digital_Object ->**

L11B.was_output_of **-> D7.Digital_Machine_Event-> (**P9B.forms_part_of)$^{[0,n]}$

-> D2.Digitization_Process -> L1F.digitized **-> C1.Object >(**F4F.is_composed_of) $^{[0,n]}$

->**C1.Object**

SPARQL query statement: Thing is about Thing

```
#In this example $Thing1 is the queried Thing and $Thing2 is the known thing as in   $Thing1 is about $Thing2

select distinct  $Thing1  $Label
{
$Thing1 rdf:type crm:E70.Thing.
        optional{$Thing1 crmdig:L4F.has_preferred_label $Label.
        }{optional{
        $Thing1 crm:P130F.shows_features_of $Thing2.
        }}UNION
        {optional{
         $Thing1 rdf:type crm:E24.Physical_Man-Made_Thing.
        $Thing1                  crm:P62F.depicts $Thing2. }}
        UNION
        { $Thing1 rdf:type crm:E24.Physical_Man-Made_Thing.
         $Thing1 crm:P128F.carries            $Information_Object.
         $Information_Object crm:P67F.refers_to              $Thing2.}
        UNION{$Thing1 crm:P67F.refers_to  $Thing2.

                }                                  ....
         UNION{
         $Thing1 crm:F1F.is_derivative_of  $tmpThing2.
    $tmpThing2 crmdig:L11B.was_output_of      $DigMachEventX2.
          $DigMachEventX2 crm:P9B.forms_part_of                $Z1.
          $Z1     crmdig:L1F.digitized              $Thing2.
         }}}
```

Implementation

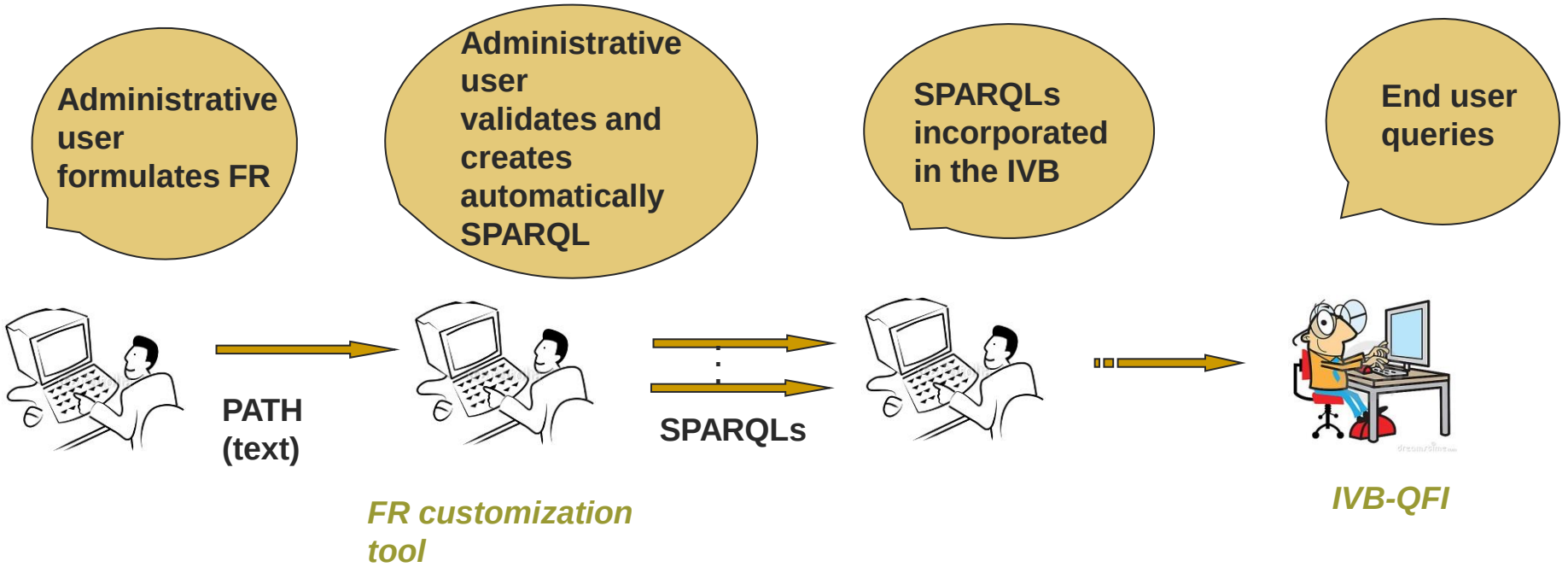
- For **end users**:

  Query Formulation Interface (QFI) is built upon the ”Fundamental Categories and Relationships” framework
  - Is part of ***Integrated Viewer Browser Component (IVB)***.
  - Supported by the ***3D-COFORM Project***
  - By ***ISTI-CNR*** and ***FORTH***

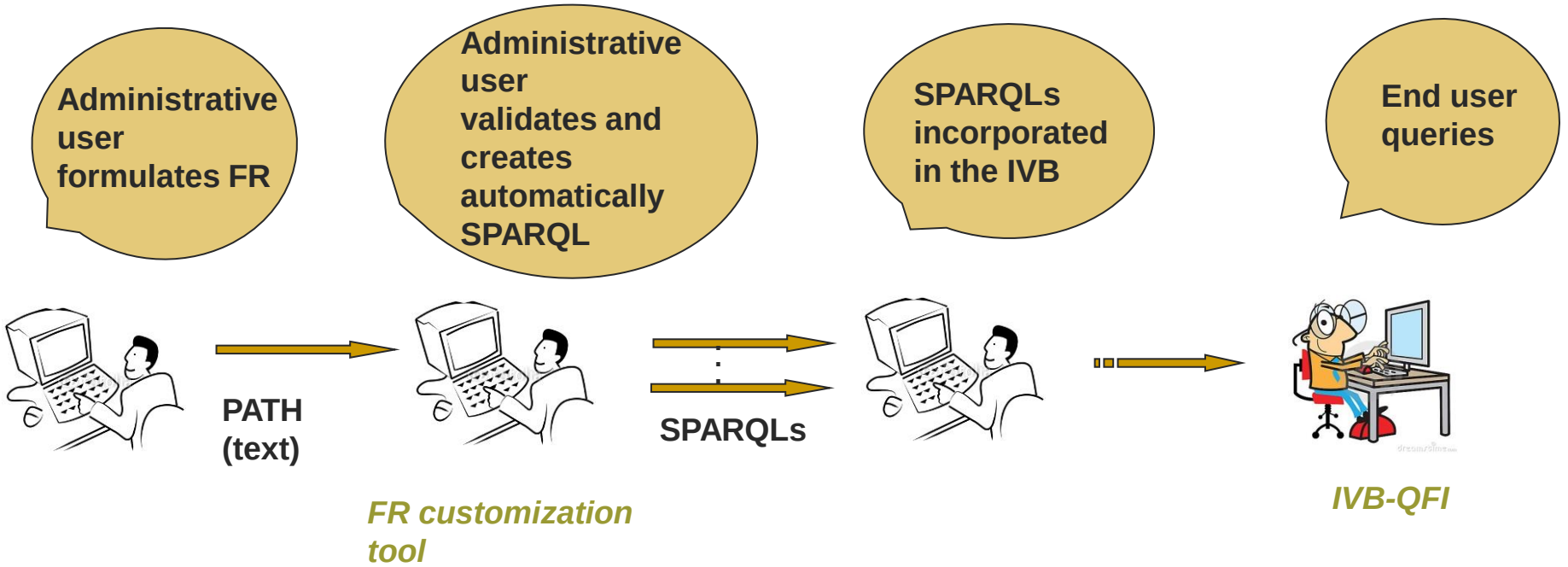
- For **administrative users**:

  Fundamental Relationship customization tool
  - ***guides*** the user to formulate the paths for the FR,
  - ***validates*** them against the schema and
  - ***transforms*** them to ***SPARQL*** queries.
  - Designed and implemented by ***FORTH***

Workflow


Administrative user formulates FR
Administrative user validates and creates automatically SPARQL
SPARQLs incorporated in the IVB
End user queries
PATH (text)
SPARQLs
FR customization tool
IVB-QFI

Workflow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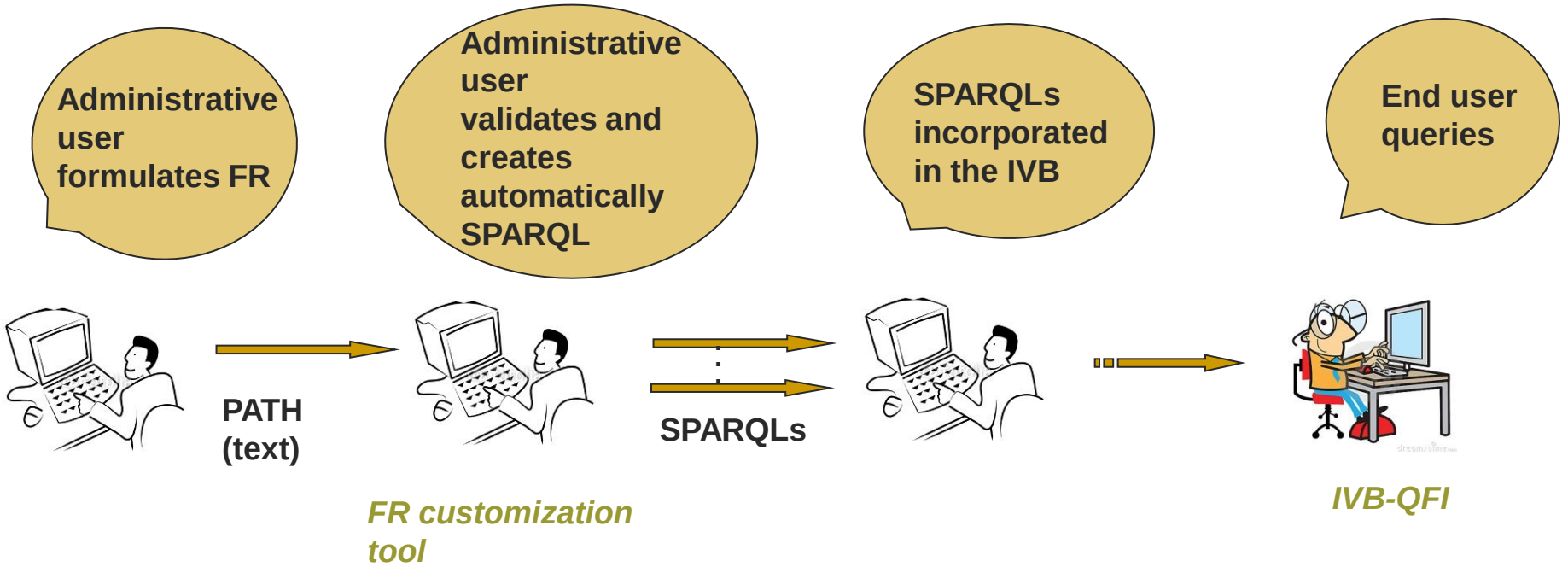
IVB-QFI

ThingHasTypeConcept.txt

```
E70.Thing -- {(P46F.is_composed_of)[0,n] OR (P106F.is_composed_of )[0,n] OR (P148F.has_component)[0,n]}-> E70.Thing:
{E70.Thing -- P2F.has_type-> E55.Type
OR
E70.Thing --P45F. consists_of-> E57.Material
OR
E70.Thing -- P92B.was_brought_into_existence_by-> E7.Activity:
{ E7.Activity --(P9B.forms_part_of)[0,n]->E7.Activity:
    {E7.Activity--P33F.used_specific_technique->E29.Design_or_Procedure:
        {E29.Design_or_Procedure-- P68F.foresees_use_of-> E57.Material
}
OR
E11.Modification -- P126F.employed -> E57.Material
        }
}
}

```

Workflow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Validation [DEMO]

File

Query Path

E70.Thing -- {(P46F.is_composed_of)[0,n] OR (P106F.is_composed_of)[0,n] OR (P148F.has_component)[0,n]}-> E70.Thing: {E70.Thing -- P2F.has_type-> E55.Type OR E70.Thing --P45F. consists_of-> E57.Material OR E70

Validate

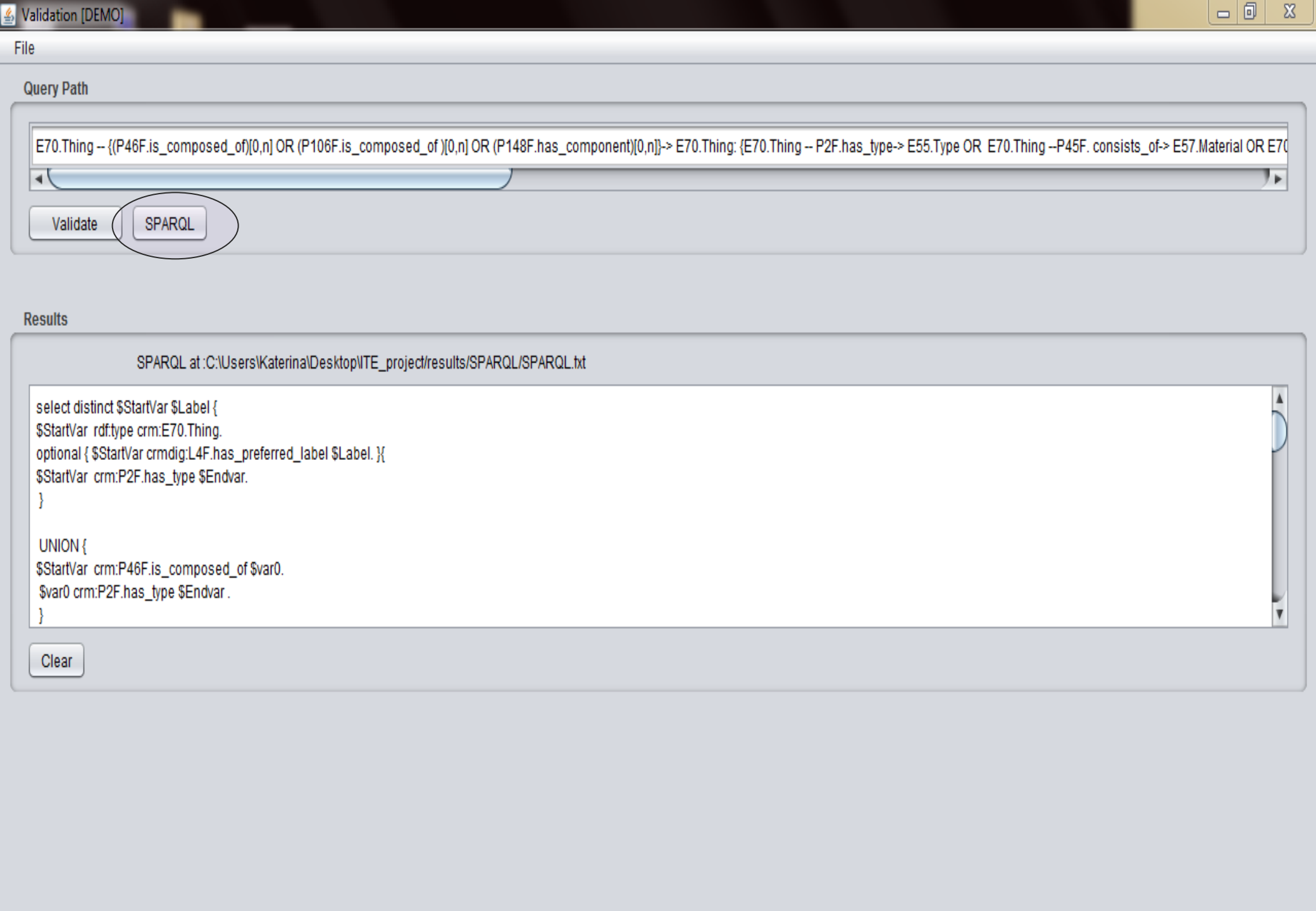
SPARQL

Results

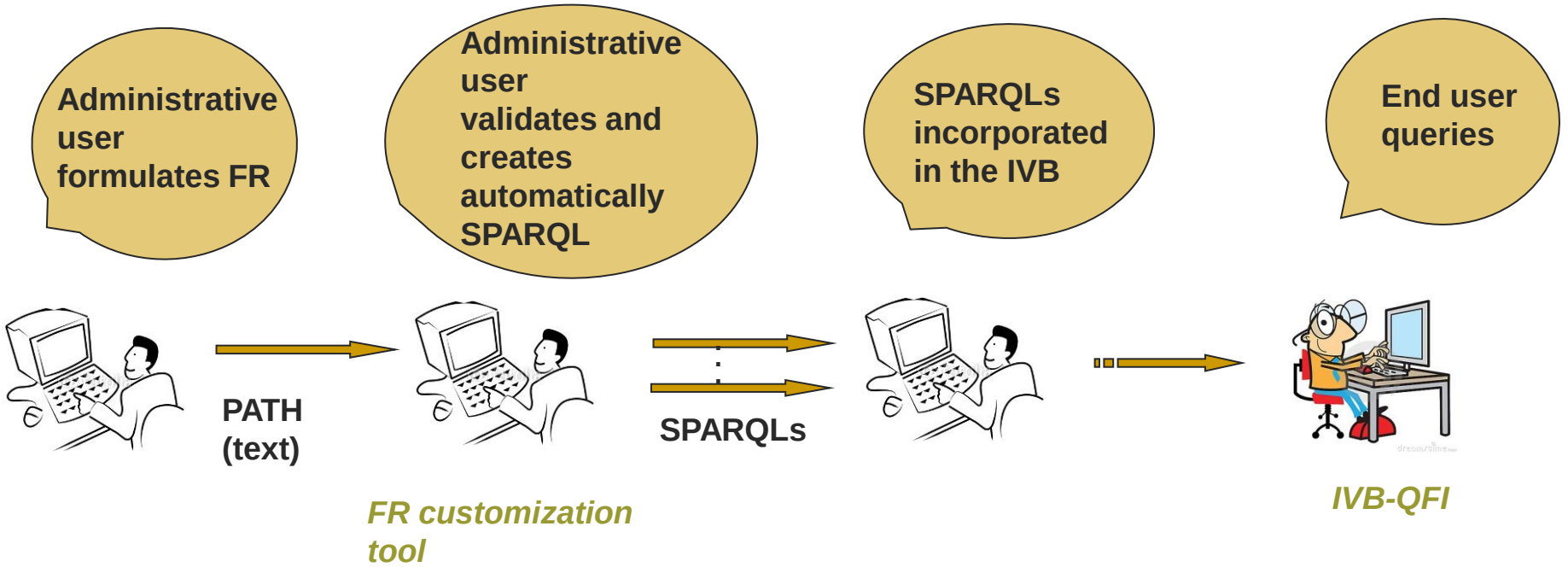
Validation is OK!

E70.Thing--{(P46F.is_composed_of)[0,n] OR (P106F.is_composed_of)[0,n] OR (P148F.has_component)[0,n]}->E70.Thing
E70.Thing--P2F.has_type->E55.Type
OR
E70.Thing--P45F.consists_of->E57.Material
OR
E70.Thing--P92B.was_brought_into_existence_by->E7.Activity
E7.Activity--(P9B.forms_part_of)[0,n]->E7.Activity
E11.Modification--P126F.employed->E57.Material
OR
E7.Activity--P33F.used_specific_technique->E29.Design_or_Procedure

Clear


Validation [DEMO]
File
Query Path
E70.Thing -- {(P46F.is_composed_of)[0,n] OR (P106F.is_composed_of)[0,n] OR (P148F.has_component)[0,n]}-> E70.Thing: {E70.Thing -- P2F.has_type-> E55.Type OR E70.Thing --P45F. consists_of-> E57.Material OR E70
Validate
SPARQL
Results
SPARQL at :C:\Users\Katerina\Desktop\ITE_project/results/SPARQL/SPARQL.txt
select distinct $StartVar $Label {
$StartVar rdf:type crm:E70.Thing.
optional { $StartVar crmdig:L4F.has_preferred_label $Label. }{
$StartVar crm:P2F.has_type $Endvar.
}
UNION {
$StartVar crm:P46F.is_composed_of $var0.
$var0 crm:P2F.has_type $Endvar .
}
Clear

Workflow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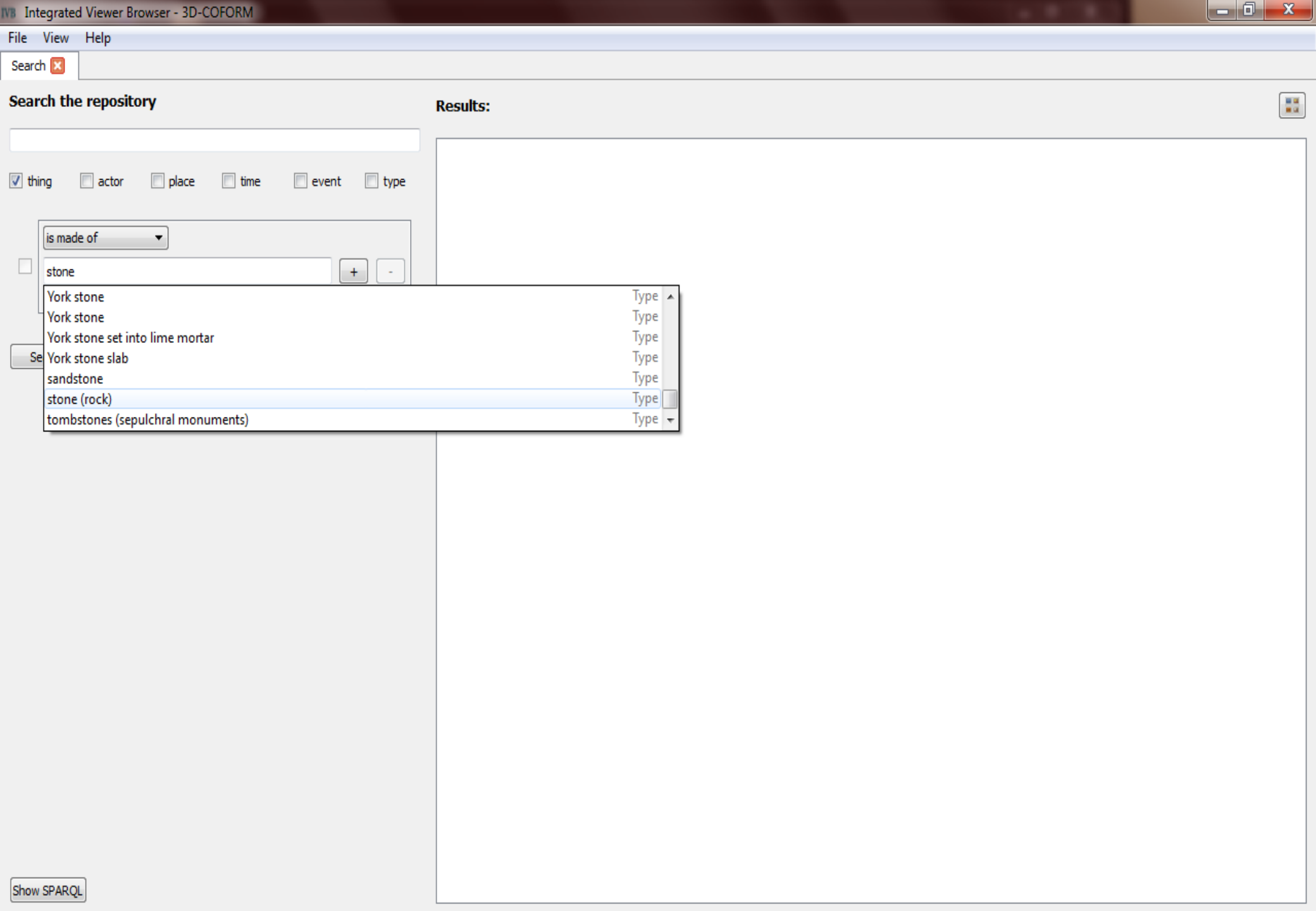
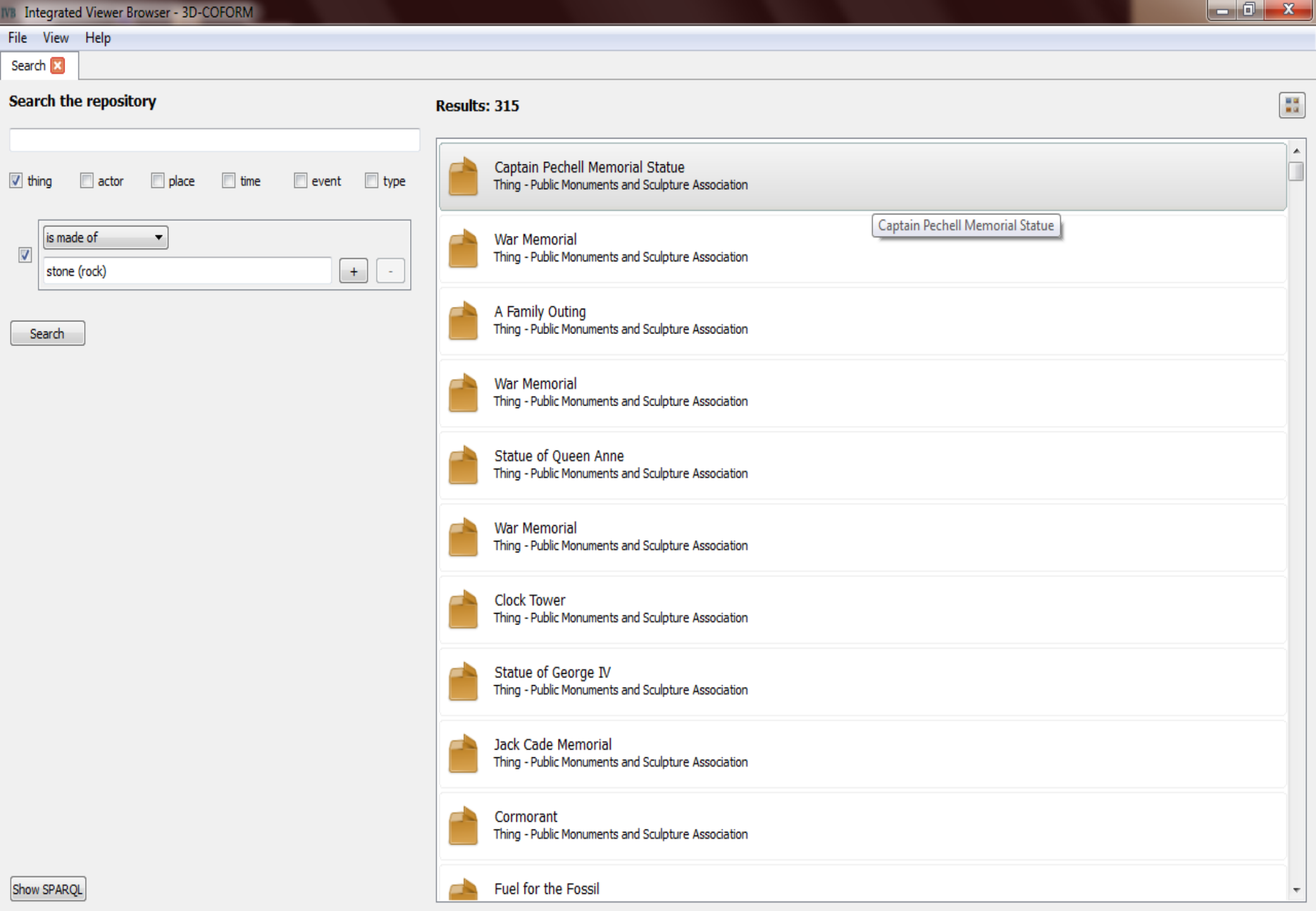

Integrated Viewer Browser - 3D-COFORM
File
View
Help
Search
Search the repository
Results:
thing
actor
place
time
event
type
is made of
stone
+
-
York stone
Type
York stone
Type
York stone set into lime mortar
Type
York stone slab
Type
sandstone
Type
stone (rock)
Type
tombstones (sepulchral monuments)
Type
Show SPARQL


Integrated Viewer Browser - 3D-COFORM
File
View
Help
Search
Search the repository
thing
actor
place
time
event
type
is made of
stone (rock)
+
-
Search
Show SPARQL
Results: 315
Captain Pechell Memorial Statue
Thing - Public Monuments and Sculpture Association
Captain Pechell Memorial Statue
War Memorial
Thing - Public Monuments and Sculpture Association
A Family Outing
Thing - Public Monuments and Sculpture Association
War Memorial
Thing - Public Monuments and Sculpture Association
Statue of Queen Anne
Thing - Public Monuments and Sculpture Association
War Memorial
Thing - Public Monuments and Sculpture Association
Clock Tower
Thing - Public Monuments and Sculpture Association
Statue of George IV
Thing - Public Monuments and Sculpture Association
Jack Cade Memorial
Thing - Public Monuments and Sculpture Association
Cormorant
Thing - Public Monuments and Sculpture Association
Fuel for the Fossil

Captain Pechell Memorial Statue (Thing)

Class: Information Carrier

Uri: http://donbot.itri.brighton.ac.uk:2020/resource/sculpture/1

Properties:

is composed of	Figure-1 Pedestal-1
has type	sculpture (visual work) statue
has note	In bushes at the side of the Rangers Yard in Stanmer Park
has condition	http://donbot.itri.brighton.ac.uk:2020/resource/sculpture/Details_of_condition_o... Abrasions, cracks, splits Biological growth Bird Guano Broken or missing parts Corrosion, Deterioration Cracks, splits, breaks, holes Loose elements Structural damage Surface damage Surface spalling, crumbling
has current keeper	Public Monuments and Sculpture Association
has former or current location	Location_of_1
shows visual item	http://donbot.itri.brighton.ac.uk:2020/resource/sculpture/Physical_description_o...
has preferred label	Captain Pechell Memorial Statue
has inventory no	1

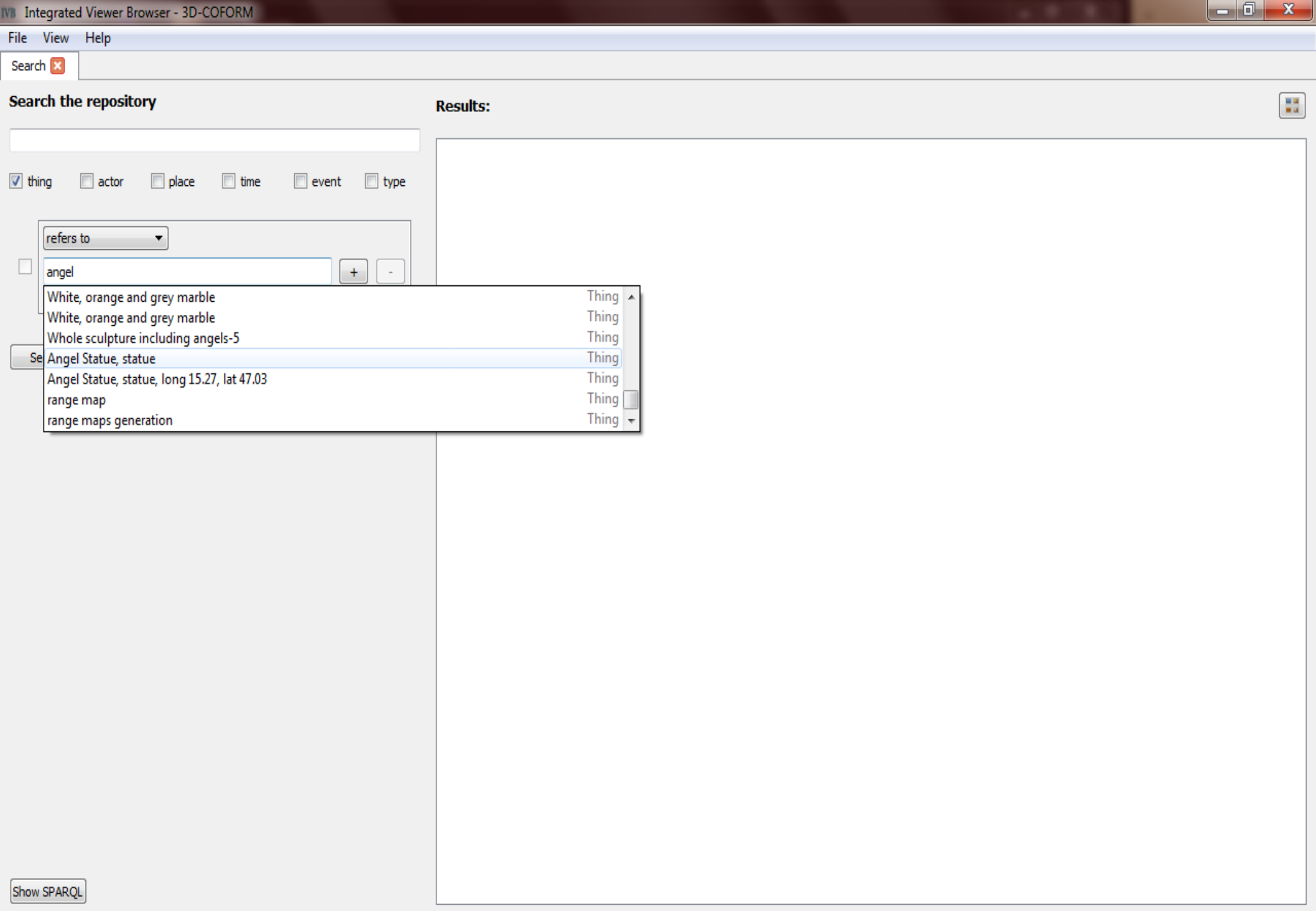
Figure-1

Class: Physical Feature

Uri: http://donbot.itri.brighton.ac.uk:2020/resource/sculpture/Part_2248_of_1

Properties:

has component	1
consists of	Caen stone stone (rock)
forms part of	1
has preferred label	Figure-1


Integrated Viewer Browser - 3D-COFORM
File
View
Help
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Search the repository
Results:
thing
actor
place
time
event
type
refers to
angel
+
-
White, orange and grey marble Thing
White, orange and grey marble Thing
Whole sculpture including angels-5 Thing
Angel Statue, statue Thing
Angel Statue, statue, long 15.27, lat 47.03 Thing
range map Thing
range maps generation Thing
Show SPARQL

Integrated Viewer Browser - 3D-COFORM

File View Help

Search

Search the repository

thing actor place time event type

refers to

Angel Statue, statue + -

Search

Show SPARQL

Results: 28


CH-38-Engel-Bronze-trauernd27314-0749.zip
Thing


CH38-cloud.ply
Thing


CH38-p.ply
Thing


CH38-pc.ply
Thing


CH38-pcs-color-50K.obj
Thing


CH38-pcs-color-50K.ply
Thing


uuid:1d16ef79-8cd7-4463-81fe-bf40d3ae43d9
Thing


CH38-pcs-color.ply
Thing


CH38-pcs.obj
Thing


CH38-pcs.ply
Thing


uuid:db551544-7238-49c9-add5-146bb3836a01

Conclusions

- *Separate the **query** layer from the **storage** layer*
- *Maintain the **information integration** capability*
- *Make use of helpful **inferences** and **deductions***
- *Achieve **high recall** rates*
- ***User-friendly** querying mechanism*
- ***Customizable** to different discourses*

Thank you for your attention!