

Semantic data and the representation of historical knowledge: the example of the LACRIMALit Ontology

M. Papadopoulou, E.-M. Tamiolaki

危機 (Japanese)
 кризис (Russian)
 crisis (English)
 crisi (Italian)
 संकट (Sanskrit/Hindi)
 crise (French)
 krízis (Greek)
 أزمة (Arabic)
 κρίση (Greek)
 危机 (Chinese)

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- 4 December 2020, Wei Tong's PhD Defense
- 26-27 November 2020, TOTh Conference
- 19 November 2020, Ontology Harmonization
- 2-4 November 2020, KEOD Conference
- 26-30 October 2020, Renmin University
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中国陶瓷
Chinese Ceramics

TAO CI Project

The TAO CI Project is a collaborative project dedicated to defining the concept denoted by Chinese ceramics vessel terms. The purpose of TAO CI project is to provide a model of publishing open data for museum and link data of the Chinese ceramics and build a multi-linguistics e-dictionary of Chinese ceramics to communicate with archaeologists in the world.

Support

China Scholarship Council

The TAO CI project is based on the ISO 704 and ISO 1087 to develop this model. It is an interdisciplinary project, which is related to Archeology (Cultural Heritage),Linguistic (Terminology),Artificial Intelligence (Knowledge Representation), Semantic Web (Linked Data). The TAO CI project was funded by China Scholarship Council from November 2012 to

Lekythos

The Lekythos project is carried out by [University Savoie Mont-Blanc \(France\)](#) and [Liaocheng University \(China\)](#). It aims to define the ontology and the terminology of the [Ancient Greek Vases](#).

What is a lekythos
A lekythos (plural lekythoi) is a type of ancient Greek vessel used for storing oil (Greek λίκυθος), especially olive oil. With a narrow body, no pouring lip, typically one hand attached to its neck, this type of jug comes in miniature sizes.

The Lekythos project aims:

- To structure the concepts and terms of Greek pottery in 3 languages (English, French, Greek);
- To publish these in the form of an e-dictionary (dynamic html file) openly accessible on the Web;
- To publish the concepts, terms, and the description of the objects of the domain in the Beazley Archive Pottery Database (BAPD) as [linked open data](#).

How to structure the domain of ancient Greek vases
Ontologies are conceptual models that help structure data and increase data interoperability. In the context of the World Wide Web Consortium (W3C), no clear division between "ontologies" and "vocabularies" is made: "the trend is to use the word "ontology" for more complex, and possibly quite formal collection of terms, whereas "vocabulary" is used where such strict formalism is not necessarily used or only in a very loose sense".

SKOS (Simple Knowledge Organisation System) is a W3C vocabulary used by the Lekythos project to link objects to the corresponding object in BAPD.

Ontoterminology is an approach aiming at defining concepts and relationships among them while linking them to their verbal designations in different languages. According to this approach:

- there is a distinct separation of the conceptual level and the terminological level
- 'term' is defined as a 'verbal designation of a concept'
- the network of concepts and the network of terms are not isomorphic, i.e. they do not match
- the network of concepts and the network of terms may differ across natural languages

The tool
Lekythos uses [Tedi](#) to create an ontology, a trilingual terminology and a knowledge base populated by pottery documented in BAPD.

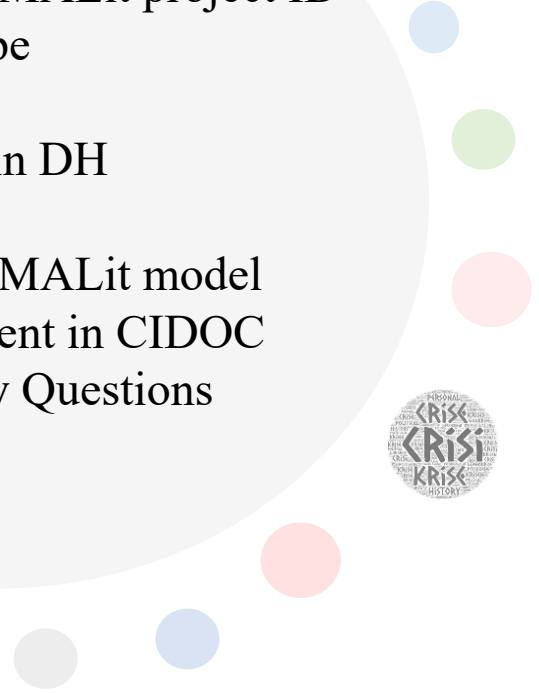
Resources

- [Download the Ontoterminology in OWL format](#)
- [E-dictionary \(dynamic html\)](#)
- How the Lekythos project ontology is populated ([English](#), [Greek](#), [French](#))

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Agenda

- The LACRIMALit project ID
 - Aim & Scope
 - Domain
 - Ontologies in DH
 - State-of-Art
 - The LACRIMALit model
 - Crisis as Event in CIDOC
 - Competency Questions
 - Conclusion
- 



LACRIMALit

Funding Agency



Host Institution



Collaborating Institution



Project Duration

36 months
2022-2025

Project PI & Team



Melina Tamiolaki
Associate Professor in Ancient
Greek Literature
University of Crete
Curriculum vitae

Principal Investigator

Dr. Eleni Melina Tamiolaki, Univ. of Crete, Greece

Team

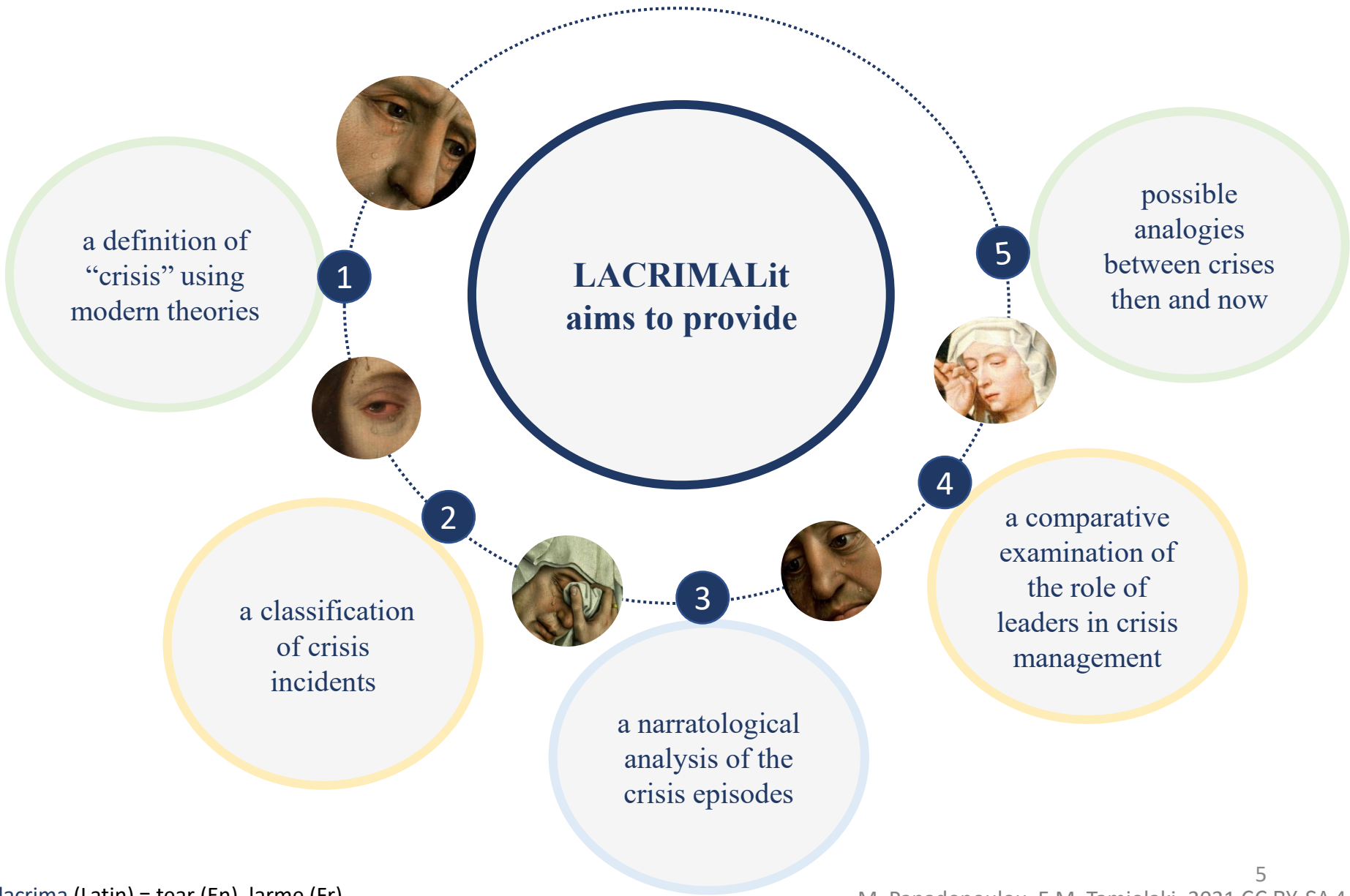
- Dr. Markus Zimmermann, Univ. of Bayreuth, Germany
- Dr. Maria Papadopoulou, Univ. of Savoie, France
- 3 PhD students

Project Website

<https://www.ims.forth.gr/en/project/view?id=219>

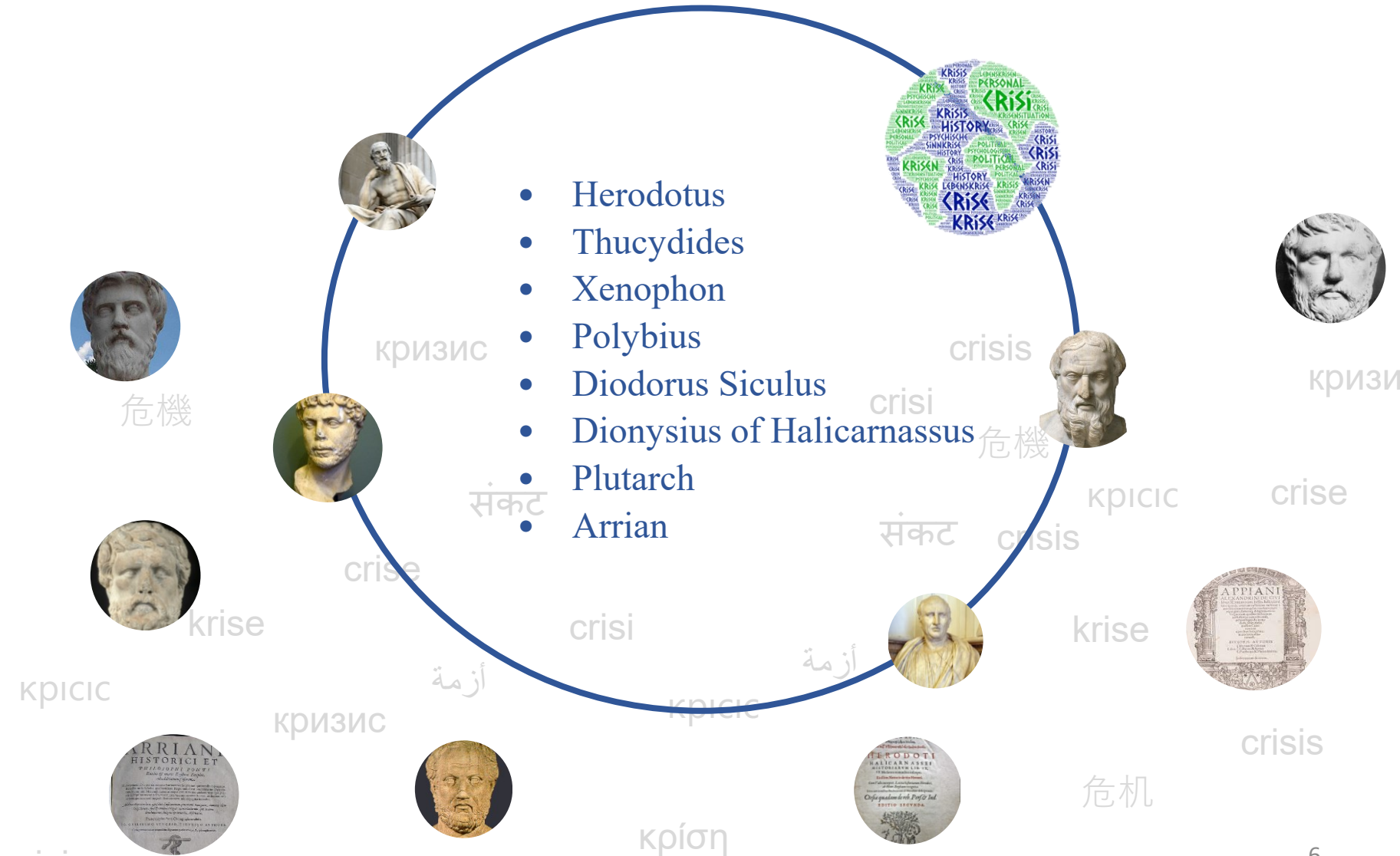
LACRIMALit

Leaders And CRIsis Management in Ancient Literature



*lacrima (Latin) = tear (En), larme (Fr)

Domain



Types of crisis events

Emergency crisis incidents:
immediate measures required
e.g., disputes, military threats, wars,
revolutions

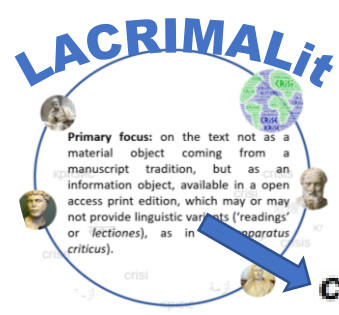


**Breaches of trust between leaders
and their followers:**
means used for restoring order,
e.g., harangues

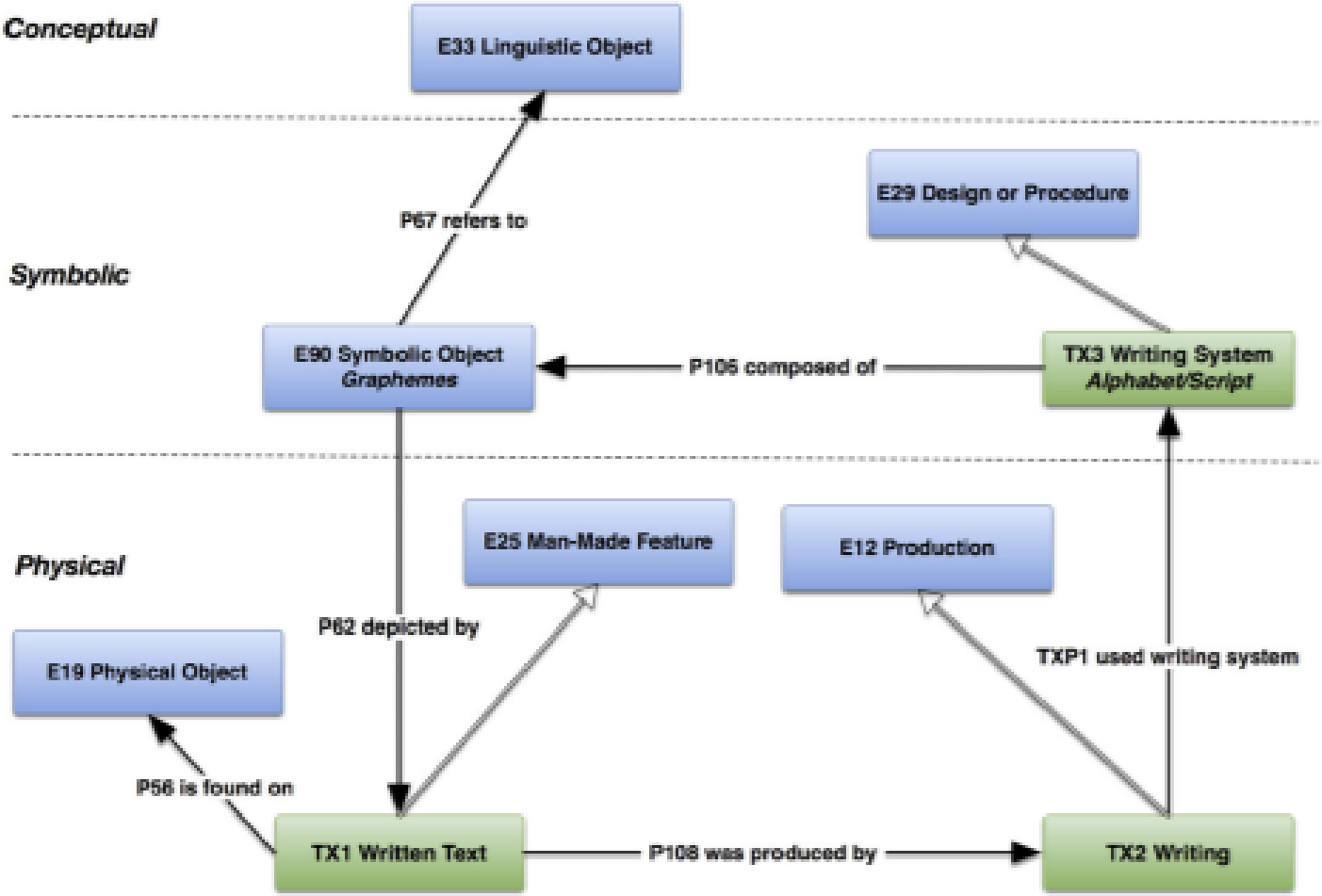


Political crises:
overt challenges to governmental
legitimacy, e.g., conspiracies,
treasons, revolts





CIDOC CRM class E33 Linguistic Object represents the abstract linguistic expression, i.e. the message to be conveyed

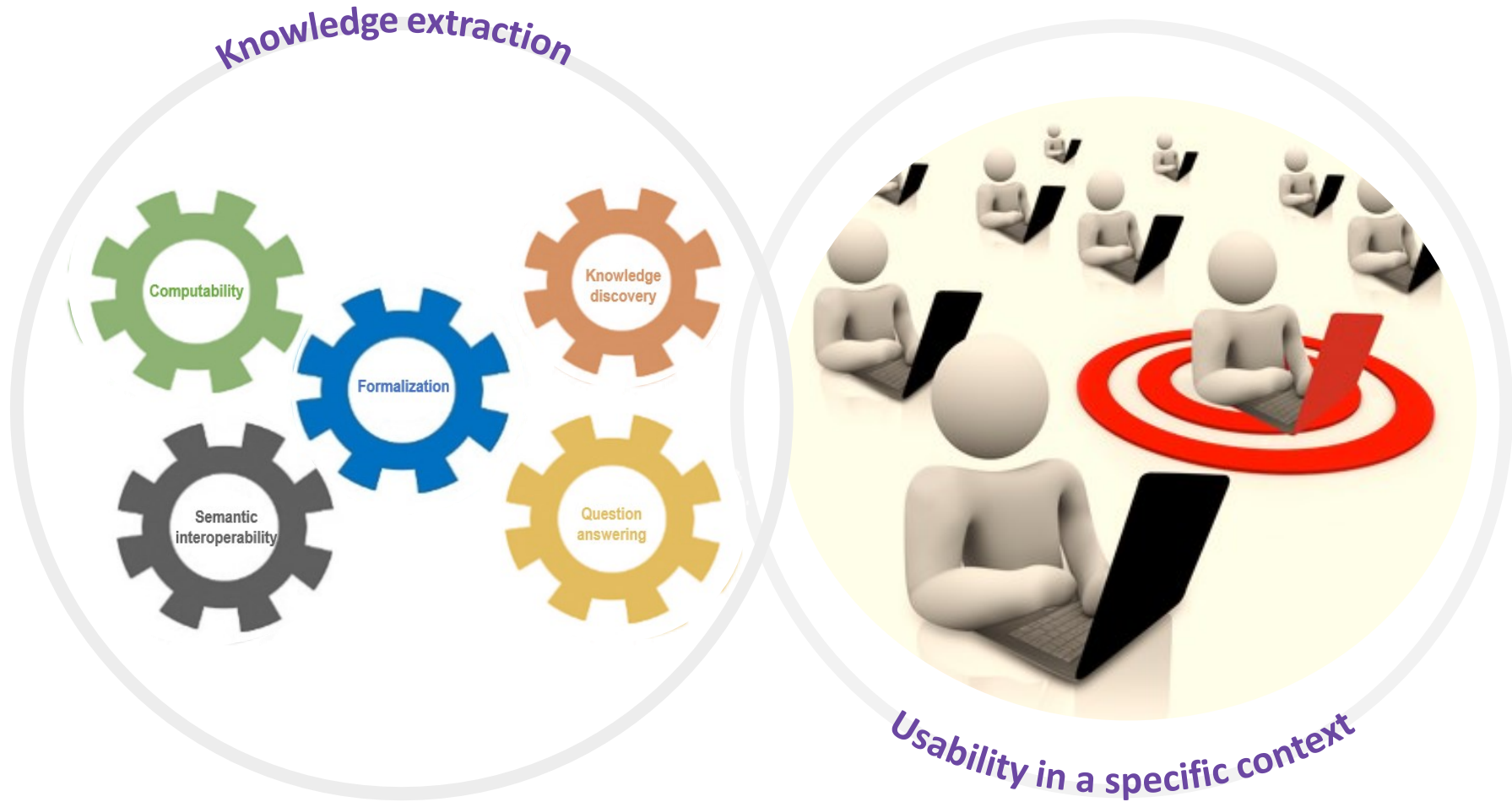


CRMtex-Representation of the writing event, Felicetti & Murano 2017

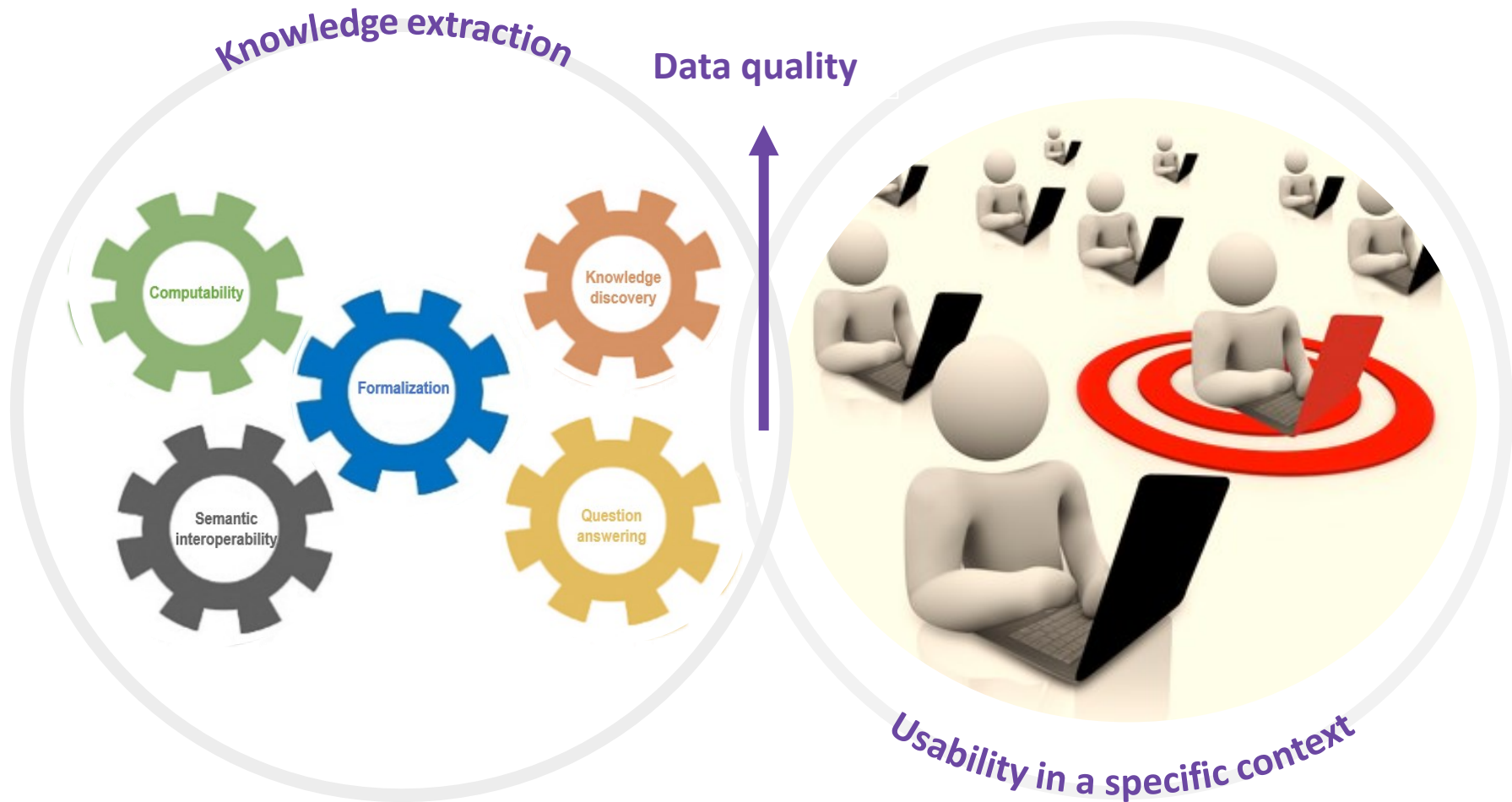
Ontology for data quality



Ontology for data quality



Ontology for data quality



Ontologies in DH

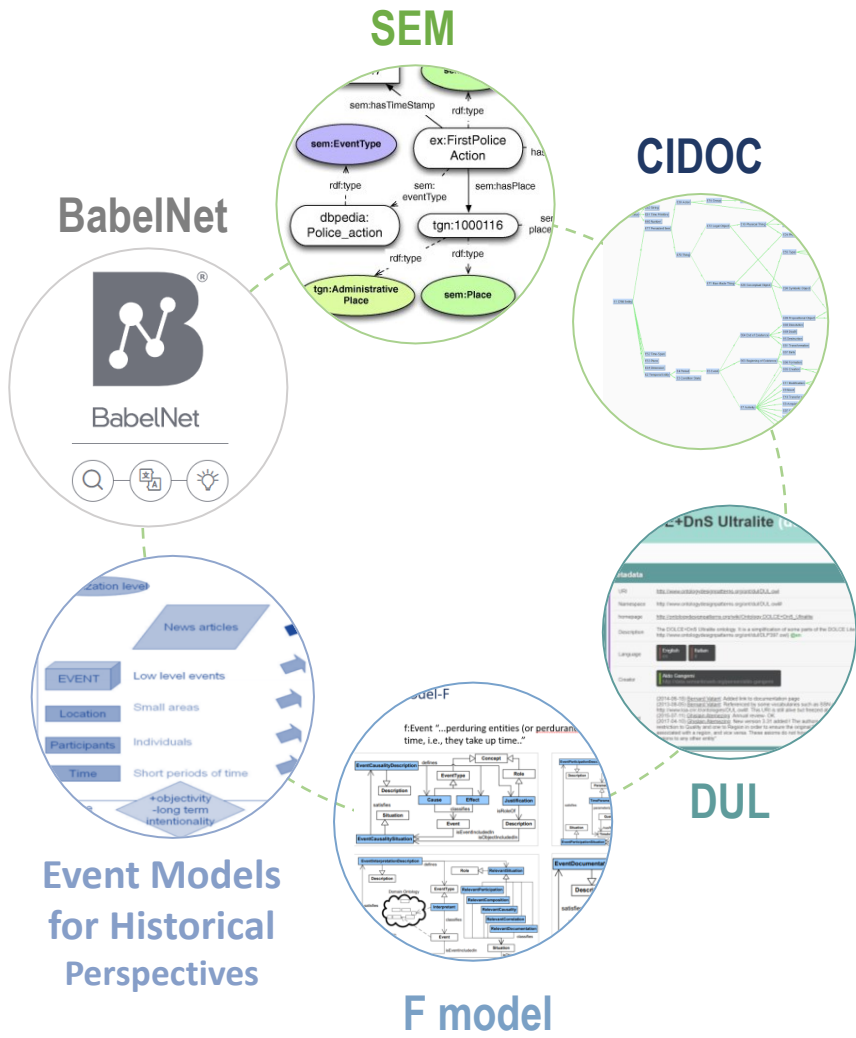
Ontologies are more and more used in the Digital Humanities, although still in an unsystematic and uncoordinated fashion.

Jansen 2019

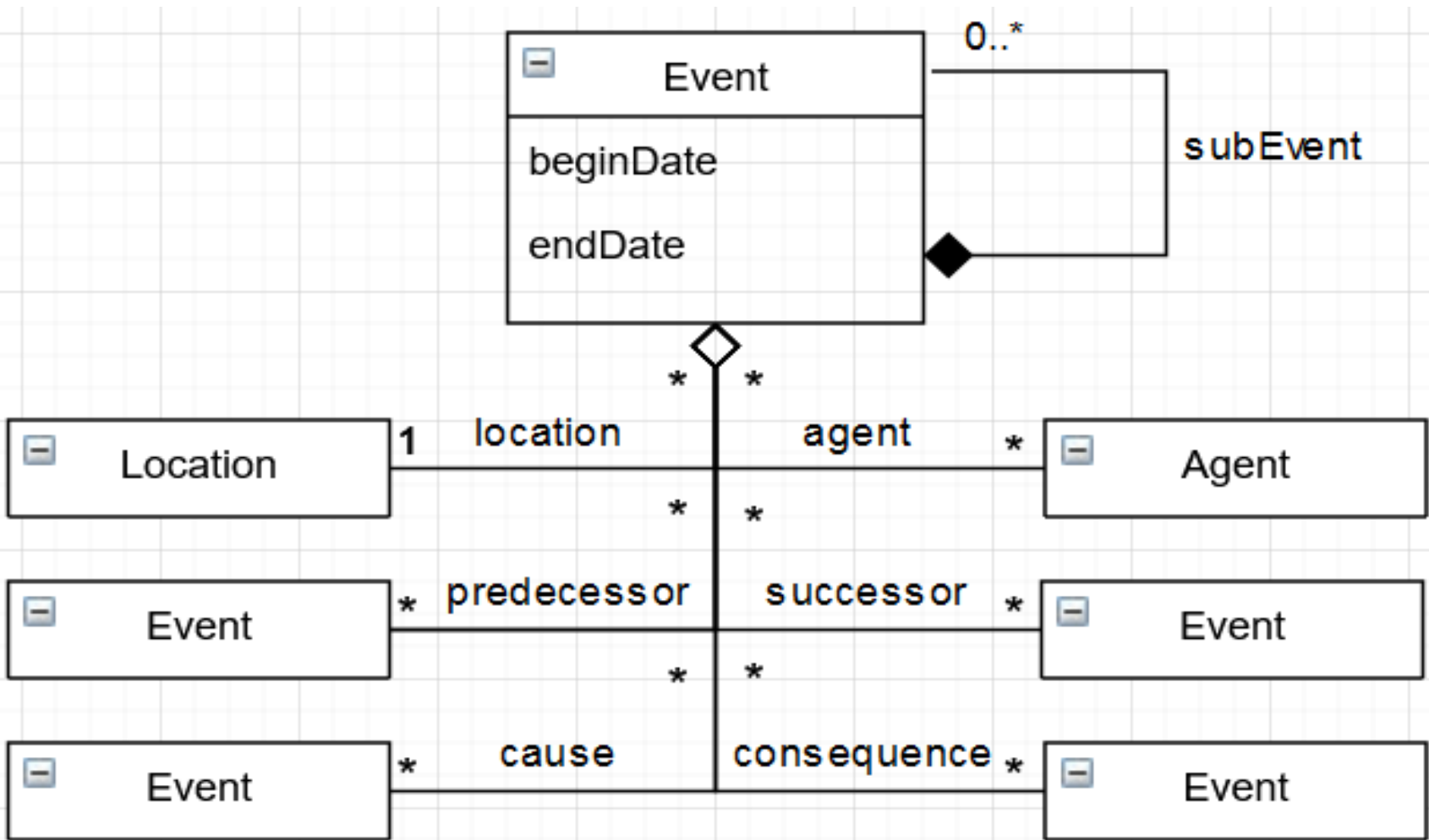
The ability to automatically determine relations between historical events and their sub-events over textual data, based on the relations between event participants, time markers and locations, will have important repercussions for the design of historical information retrieval systems.

Cybulska & Vossen 2010

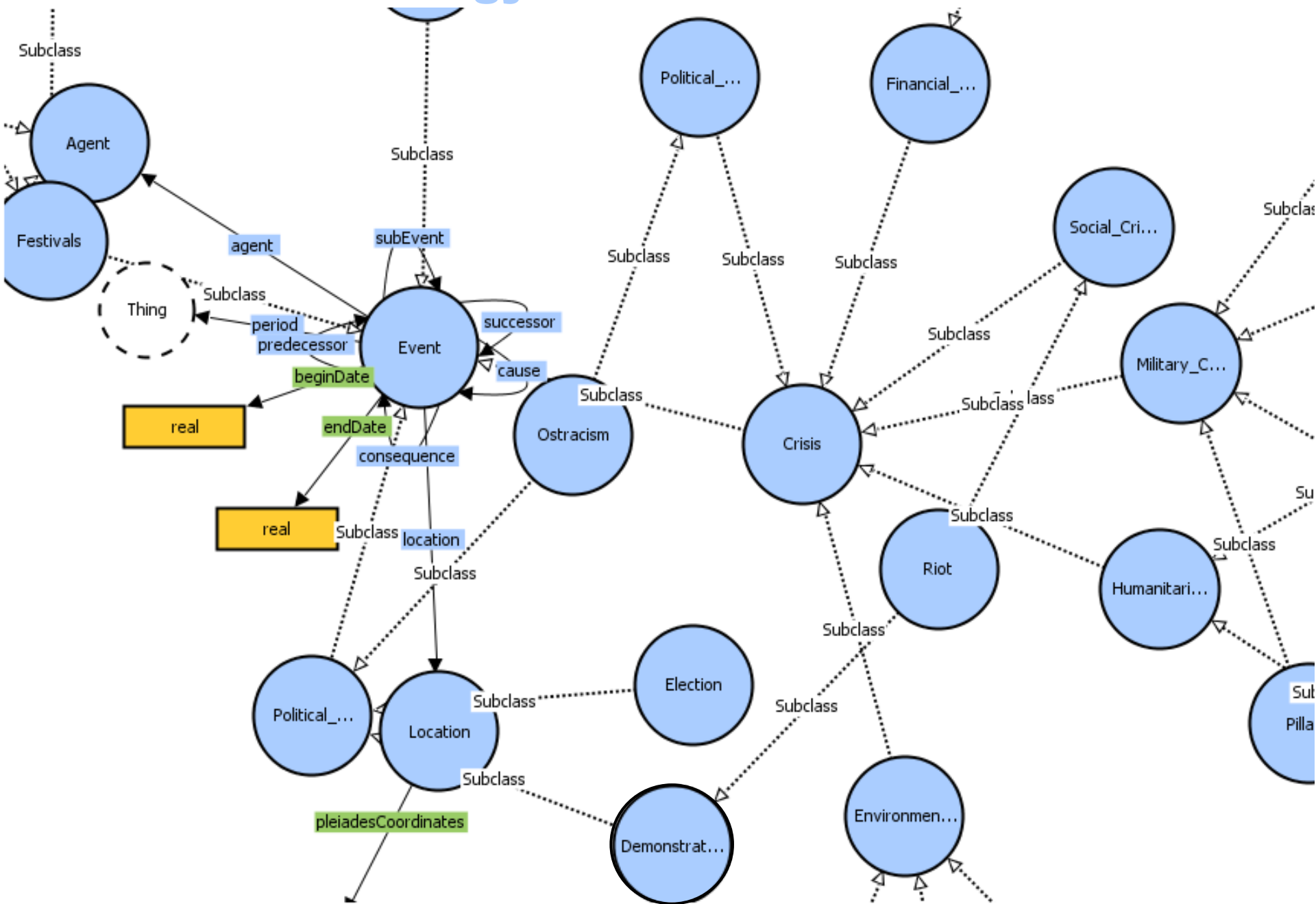
State-of-Art



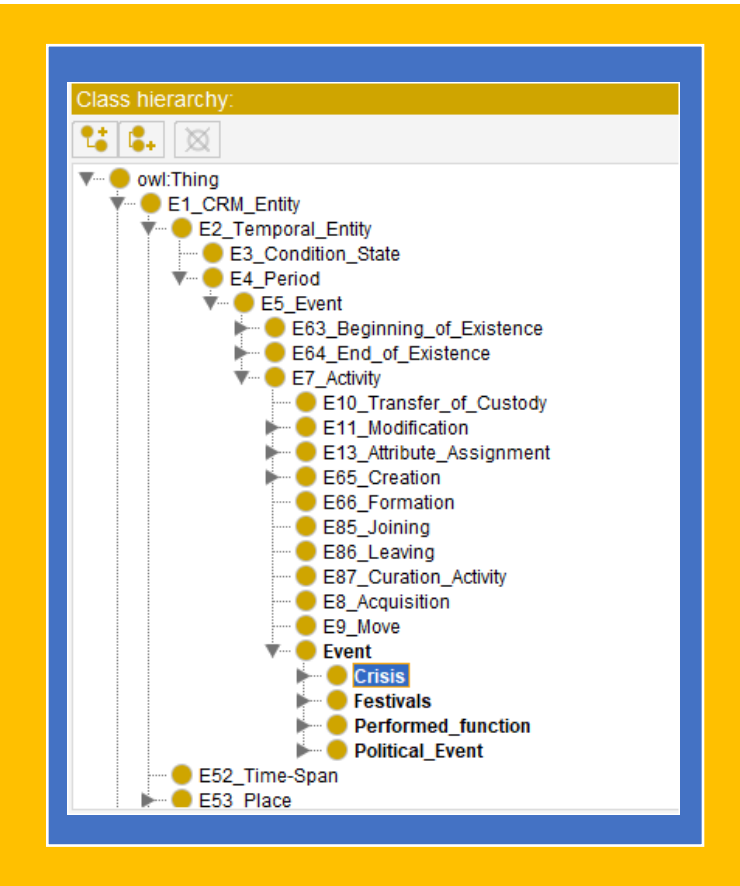
LACRIMALit Model



LACRIMALit Ontology



Formal definition of crisis events



Annotations: crisis

Annotations +

- rdfs:label [language: en] crisis
- rdfs:label [language: el] κρίση

Description: crisis

Equivalent To +

SubClass Of +

- Event

General class axioms +

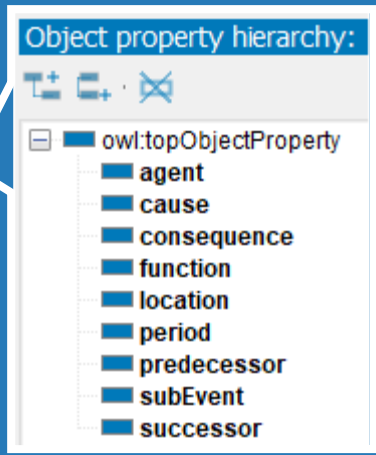
SubClass Of (Anonymous Ancestor)

- consequence **min** 0 Event
- endDate **some** owl:rational
- location **exactly** 1 Location
- successor **min** 0 Event
- subEvent **min** 0 Event
- cause **min** 0 Event
- beginDate **some** owl:rational
- predecessor **min** 0 Event
- 'P7 took place at' **some** 'E53 Place'
- 'P48 has preferred identifier' **max** 1 owl:Thing
- 'P14 carried out by' **some** 'E39 Actor'
- 'P12 occurred in the presence of' **some** 'E77 Persistent Item'
- 'P4 has time-span' **exactly** 1 owl:Thing

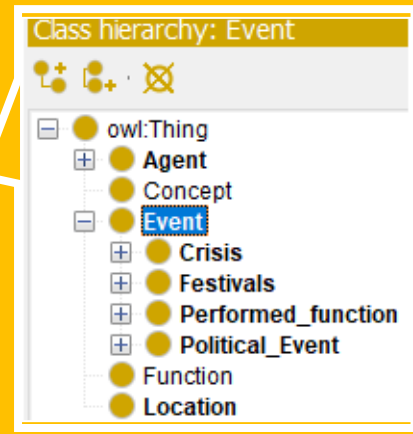
LACRIMALit Ontology

- rdfs:comment
- rdfs:label
- rdfs:seeAlso
- skos:altLabel
- skos:definition
- skos:exactMatch
- skos:prefLabel

Object property hierarchy



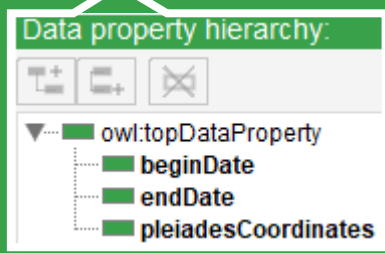
Class hierarchy



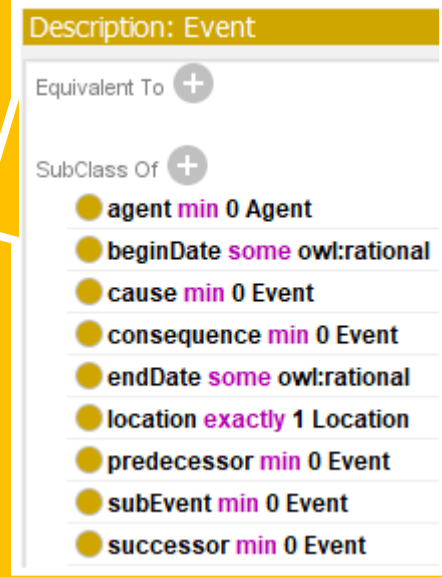
Ontology prefixes

Prefix	URI
Crisis	http://o4dh.com/Ontologies/Crisis.owl#
cidoc	http://erlangen-crm.org/140220/
ont	http://www.semanticweb.org/mpapadopoulou/ontologies/2
owl	http://www.w3.org/2002/07/owl#
rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs	http://www.w3.org/2000/01/rdf-schema#
skos	http://www.w3.org/2004/02/skos/core#
xml	http://www.w3.org/XML/1998/namespace
xsd	http://www.w3.org/2001/XMLSchema#

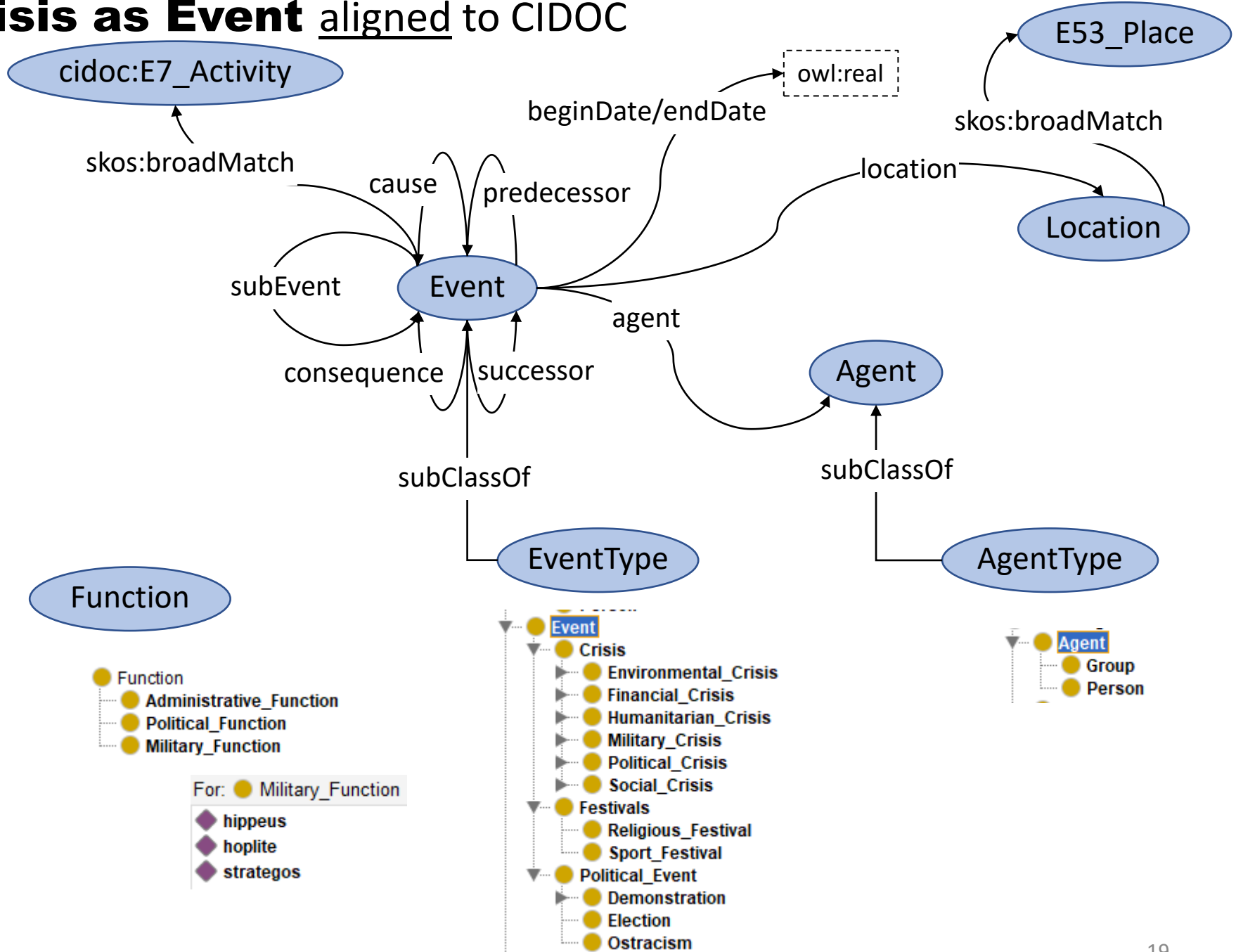
Data property hierarchy



Formal definition of class Event



Crisis as Event aligned to CIDOC



Mapping to CIDOC E7

<http://www.cidoc-crm.org/Entity/e7-activity/version-6.2> * no changes in version 7.2

Subclass of :
E5 Event

In First Order Logic:
E7(x) ⇒ E5(x)

- Superclass of:**
- E8 Acquisition
 - E9 Move
 - E10 Transfer of Custody
 - E11 Modification
 - E13 Attribute Assignment
 - E65 Creation
 - E66 Formation
 - E85 Joining
 - E86 Leaving
 - E87 Curation Activity

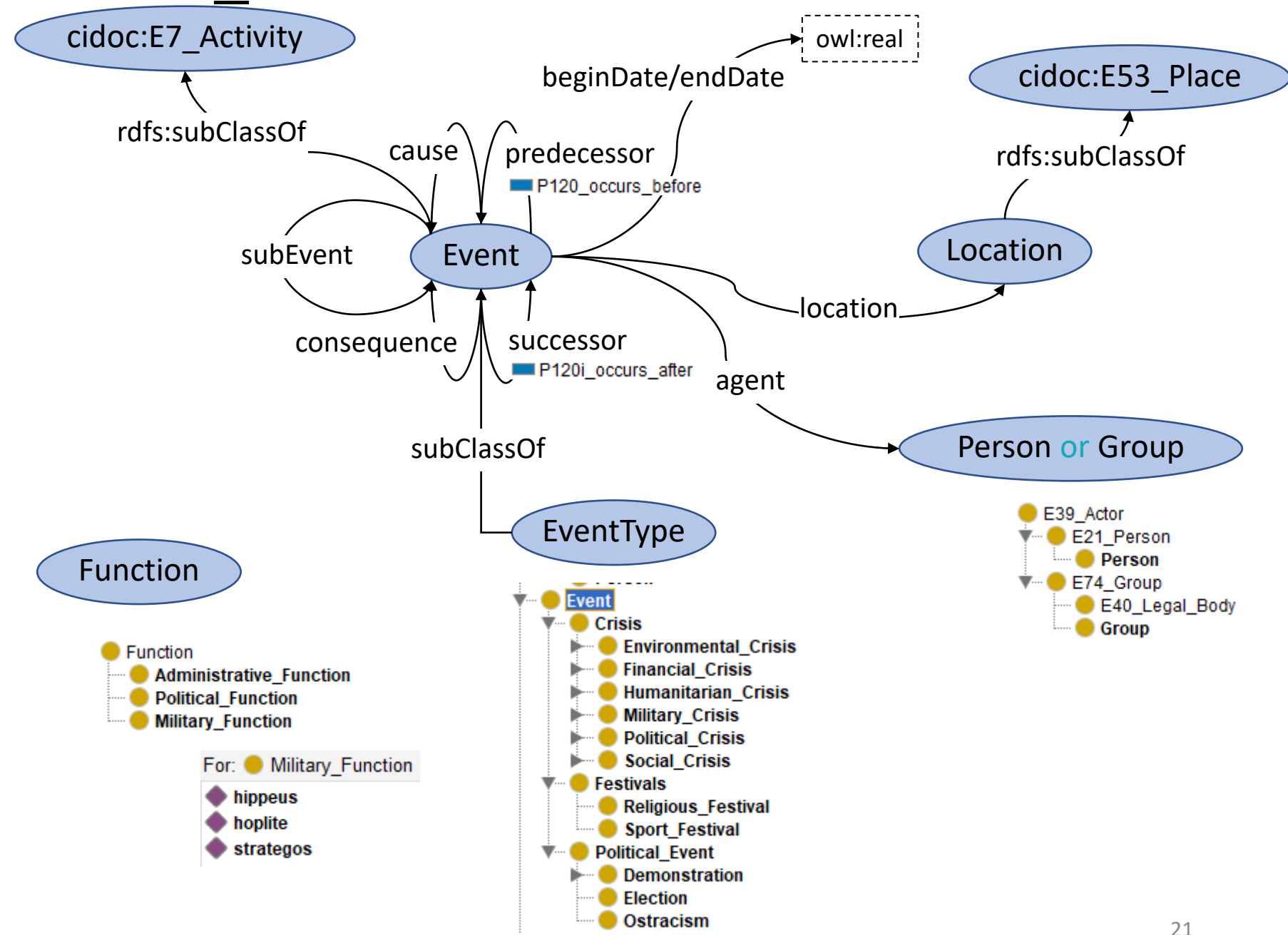
Scope Note:
 This class comprises actions intentionally carried out by instances of E39 Actor that result in changes of state in the cultural, social, or physical systems documented.
 This notion includes complex, composite and long-lasting actions such as the building of a settlement or a war, as well as simple, short-lived actions such as the opening of a door.

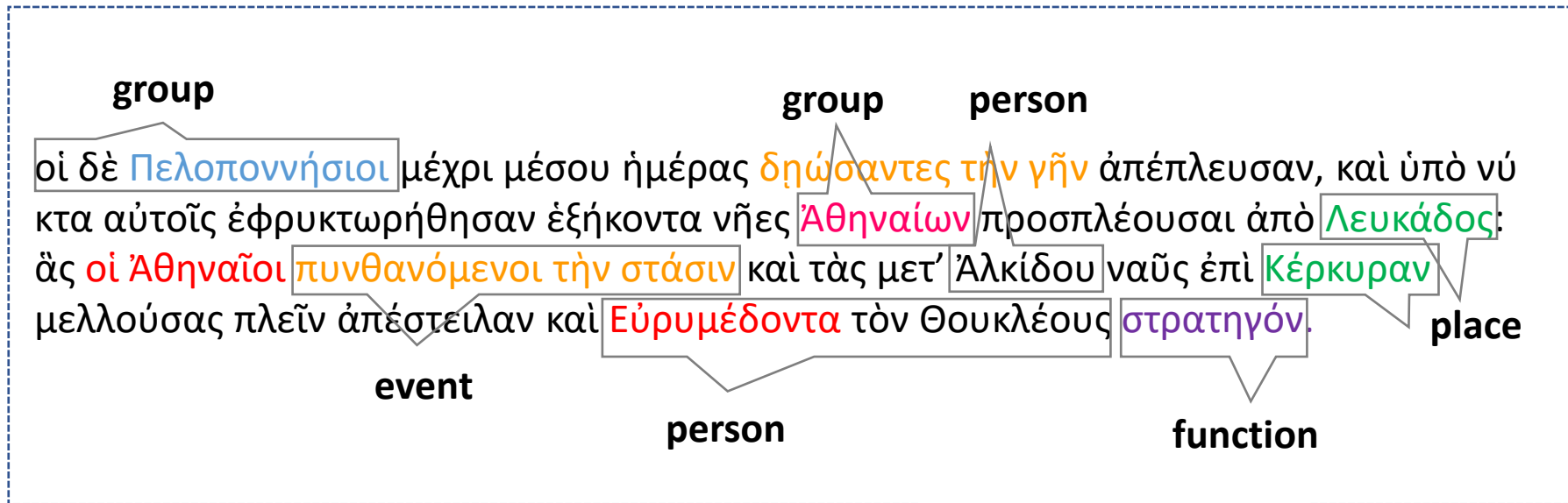
Examples:
 the Battle of Stalingrad (Hoyt, 1993)
 the Yalta Conference (Harbutt, 2010)
 my birthday celebration 28-6-1995
 the writing of "Faust" by Goethe (E65) (Williams, 2020)
 the formation of the Bauhaus 1919 (E66) (Droste, 2006)
 calling the place identified by TGN '7017998' 'Quyunjig' by the people of Iraq
 Kira Weber working in glass art from 1984 to 1993
 Kira Weber working in oil and pastel painting from 1993

Properties:
 P14 carried out by (performed) : E39 Actor,
 P15 was influenced by (influenced) : E1 CRM Entity,
 P16 used specific object (was used for) : E70 Thing,
 P17 was motivated by (motivated) : E1 CRM Entity,
 P19 was intended use of (was made for) : E71 Human-Made Thing,
 P20 had specific purpose (was purpose of) : E5 Event,
 P21 had general purpose (was purpose of) : E55 Type,
 P32 used general technique (was technique of) : E55 Type,
 P33 used specific technique (was used by) : E29 Design or Procedure
 P125 used object of type (was type of object used in) : E55 Type,
 P134 continued (was continued by) : E7 Activity

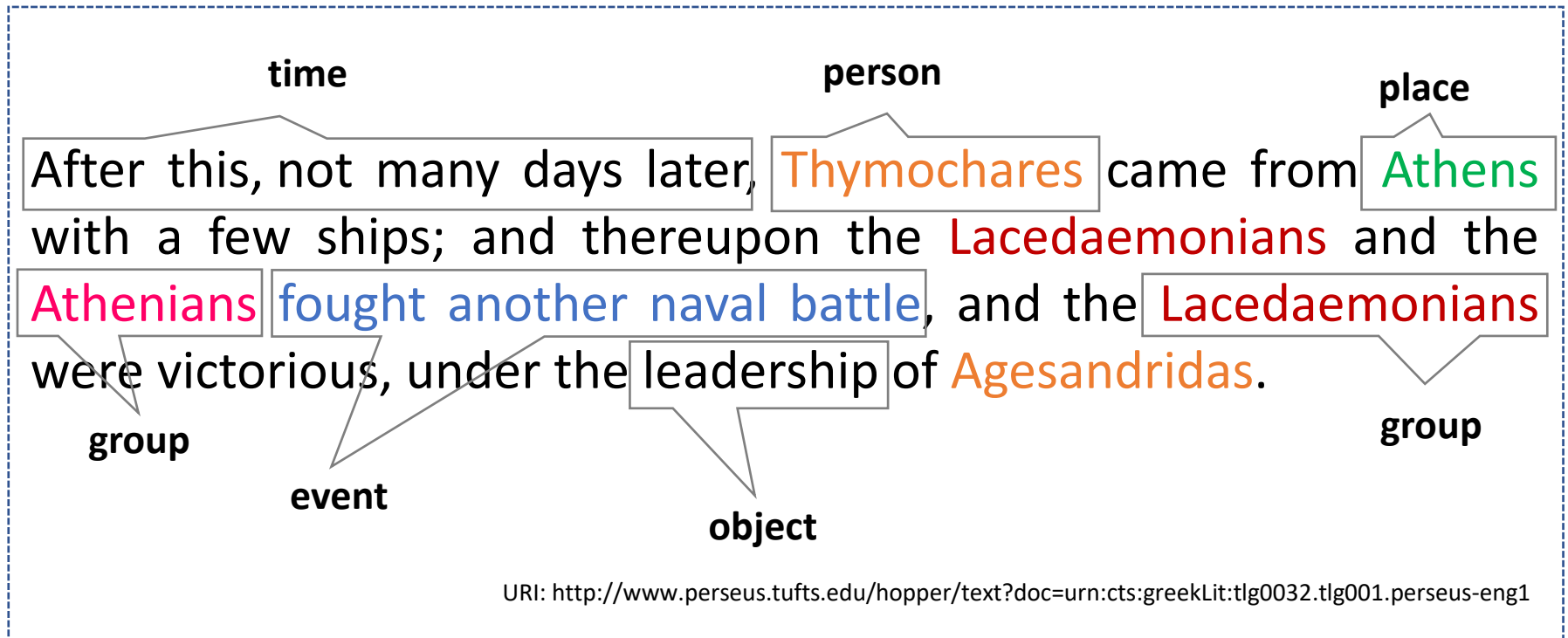
Inherited properties:
 ShowList of properties
 Inherited references:
 ShowList of references

Crisis as Event in CIDOC





[3.80.2] But the Peloponnesians, after devastating the land till about midday, retired. And at nightfall the approach of sixty Athenian vessels was signalled to them from Leucas. These had been sent by the Athenians under the command of Eurymedon the son of Thucles, when they heard of the revolution and of the intended expedition of Alcidas to Corcyra.

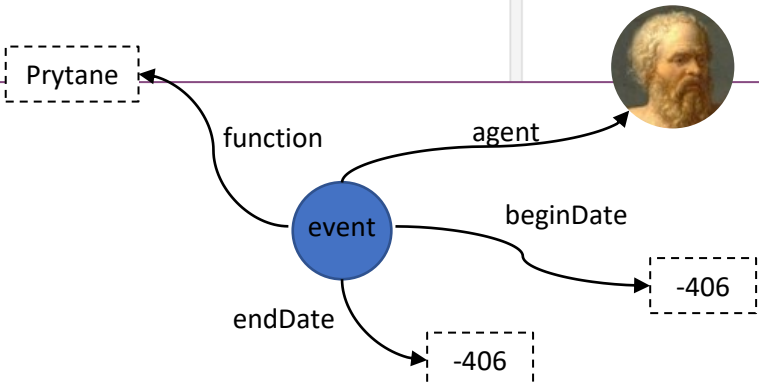


μετὰ δὲ ταῦτα οὐ πολλαῖς ἡμέραις ὕστερον ἦλθεν ἐξ Ἀθηνῶν Θυμοχάρης ἔχων ναῦς ὀλίγας: καὶ εὐθὺς ἐναυμάχησαν αὐθις Λακεδαιμόνιοι καὶ Ἀθηναῖοι, ἐνίκησαν δὲ Λακεδαιμόνιοι ἡγουμένου Ἀγησανδρίδου.

URI: <http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0205%3Abook%3D1%3Achapter%3D1%3Asection%3D1>

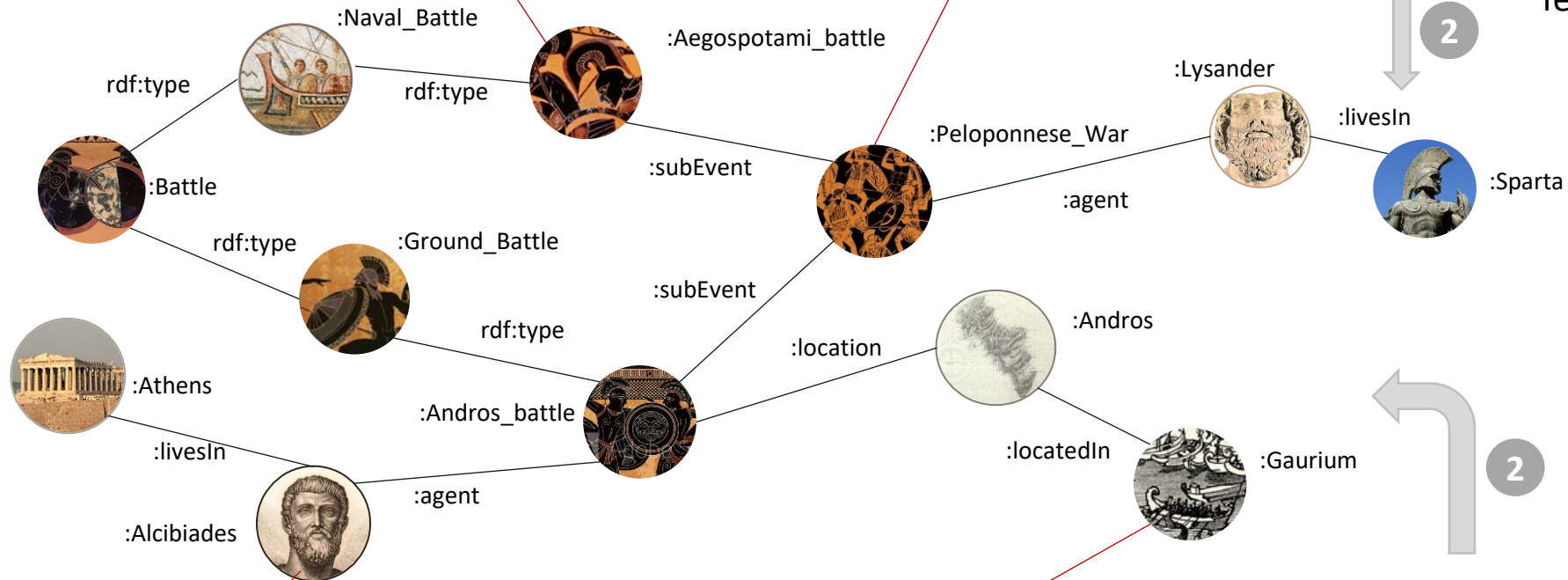
Modeling crises : political function

The screenshot shows a Semantic Web editor interface. On the left is a class hierarchy for 'Political_Function' with subclasses like 'Group', 'Person', 'Event', 'Function', 'Crisis', and 'Battle'. The 'Annotations' panel shows a comment in English and a 'seeAlso' link to a Wikipedia page about Socrates. The 'Property assertions' panel shows that the agent is 'Socrates', the function is 'Prytane', and the begin and end dates are '-406'.



The **Battle of Aegospotami** was a naval confrontation that took place in 405 BC and was the last major **battle** of the **Peloponnesian War**.

https://en.wikipedia.org/wiki/Battle_of_Aegospotami



- Terms
- battle of Aegospotami
 - Peloponnesian War
 - naval battle

2

2

Xen. Hell. 1.4 **Alcibiades** disembarked his army at **Gaurium**, in the territory of **Andros**; and when the men of Andros and the **Laconians** who were there came forth to meet him, the **Athenians** routed them, shut them up in their city, and killed some few of them.

<http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0206%3Abook%3D1%3Achapter%3D4>

Ἀλκιβιάδης δὲ τὸ στράτευμα ἀπεβίβασε τῆς Ἀνδρίας χώρας εἰς **Γαύριον**: ἐκβοηθήσαντας δὲ τοὺς **Ἀνδρίους** ἐτρέψαντο καὶ κατέκλεισαν εἰς τὴν πόλιν καὶ τινὰς **ἀπέκτειναν** οὐ πολλοὺς, καὶ τοὺς **Λάκωνας** οἱ αὐτόθι ἦσαν.

<http://www.perseus.tufts.edu/hopper/text?doc=urn:cts:greekLit:tlg0032.tlg001.perseus-grc1:1.4>

- Terms
- Alcibiades
 - Gaurium
 - Andros
 - Laconians
 - Athenians

1

LACRIMALit in Protégé

rdfs:comment

Class hierarchy: War

- owl:Thing
 - Agent
 - Event
 - Crisis
 - Environmental_Crisis
 - Drought
 - Earthquake
 - Inundation
 - Financial_Crisis
 - Humanitarian_Crisis
 - Military_Crisis
 - Battle
 - Land_Battle
 - Naval_Battle
 - Invasion
 - Pillage
 - War
 - Political_Crisis
 - Social_Crisis
 - Festivals
 - Political_Event
 - Location
 - Term

Direct instances: Peloponne: War

- Peloponnese_war

Annotations: Peloponnese_war

Annotations +

rdfs:comment [language: en]

[2] But the Argives, Athenians, Boeotians, and1 those among the Corinthians who had received a share of the money from the King, as well as those who had made themselves chiefly responsible for the war, realizing that if they did not put out of the way the people who had turned toward peace, the state would be in danger of going over to the Lacedaemonians again, undertook, under these circumstances, to bring about a general massacre. And in the first place, they devised the most sacrilegious of all schemes; for other people, even if a man is condemned by process of law, do not put him to death during a religious festival; but these men chose the last day of the Euclea,2 because they thought they would catch more people in the market-place, so as to kill them.
<http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0206%3Abook%3D4%3Achapter%3D4%3Asection%3D2>

rdfs:comment [language: grc]

[4.4.2] Τότε οι Αργεῖοι, οἱ Ἀθηναῖοι κι οἱ Βοιωτοί, καθώς κι ὅσοι Κορίνθιοι εἶχαν πληρωθεῖ ἀπὸ τὰ χρήματα τοῦ Βασιλέως κι ὅσοι εἶχαν σταθεῖ πρωταίτιοι τοῦ πολέμου, καταλάβαιναν ὅτι, ἀν δὲν ἐξουδετέρωναν τὴν εἰρηνόφιλη μερίδα, υπῆρχε κίνδυνος νὰ προσχωρήσει ἡ πόλη ξανά στους Λακεδαιμονίους: γι' αὐτὸ ὀργάνωσαν σφαγὴ.
https://www.greek-language.gr/digitalResources/ancient_greek/library/browse.html?text_id=32&page=41&hi=311782

rdfs:seeAlso

<http://www.perseus.tufts.edu/hopper/text?doc=urn:cts:greekLit:tlg0032.tlg001.perseus-grc1:4.4.2>

Description: Peloponnese_war

Types +

- War

Same Individual As +

Different Individuals +

Property assertions: Peloponnese_war

Object property assertions +

- agent Athenians
- location Peloponnesus
- agent Lysander
- agent Alcibiades
- agent Andrians
- subEvent Aegospotami_battle
- subEvent Andros_battle
- subEvent Arginoussai_battle
- agent Laconians

Data property assertions +

- endDate -404
- beginDate -431

Object property assertions
Data property assertions

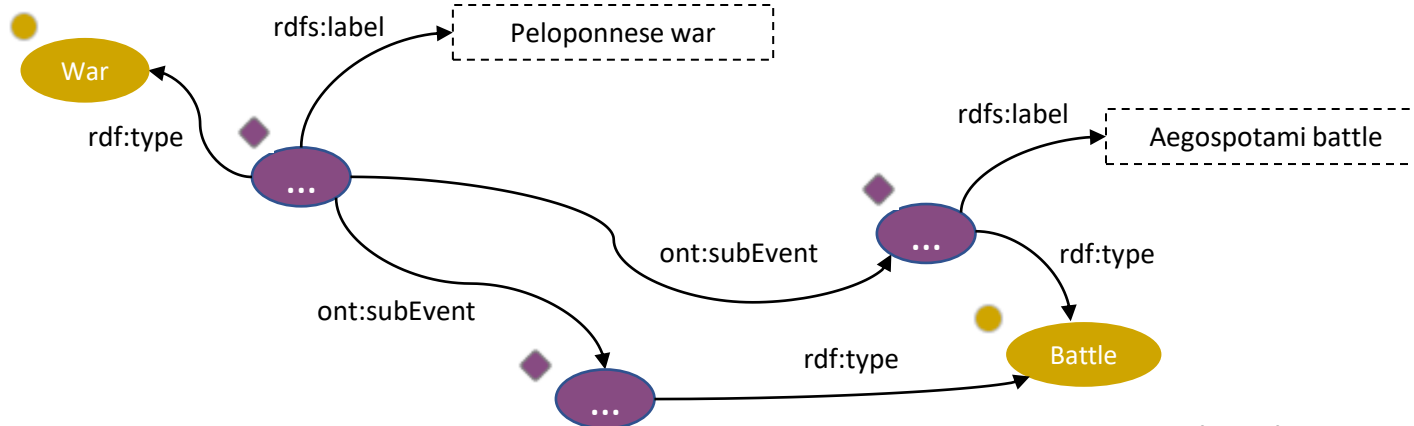


Competency Question

What are the battles of the Peloponnesse War?

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://o4dh.com/Ontologies/Crisis.owl#>
SELECT ?battleName
  WHERE {
    ?war rdf:type ont:War.
    ?war rdfs:label "Peloponnesse war" @en.
    ?war ont:subEvent ?battle.
    ?battle rdf:type ont:Battle.
    ?battle rdfs:label ?battleName
  }
ORDER BY ?battleName
```

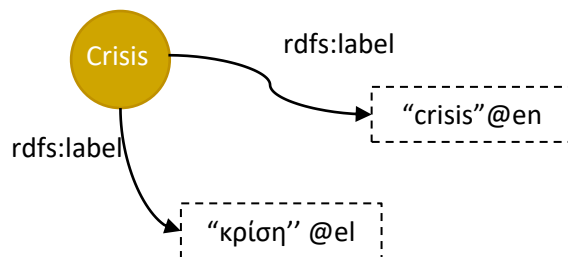
battleName
"Aegospotami battle"@en
"Andros battle"@en
"Arginoussai battle"@en



SPARQL query

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://o4dh.com/Ontologies/Crisis.owl#>
SELECT DISTINCT *
  WHERE {
    ?crisis rdfs:subClassOf* ont:Crisis.
    ?crisis rdfs:label ?crisisLabel
  }
ORDER BY ?crisis
```

Terms are labels on concepts



SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://o4dh.com/Ontologies/Crisis.owl#>
SELECT DISTINCT *
  WHERE {
    ?crisis rdfs:subClassOf* ont:Crisis.
    ?crisis rdfs:label ?crisisLabel
  }
ORDER BY ?crisis
```

crisis	crisisLabel
Crisis	"κρίση"@el
Crisis	"crisis"@en
Drought	"drought"@en
Environmental_Crisis	"environmental crisis"@en
Environmental_Crisis	"περιβαλλοντική κρίση"@el
Financial_Crisis	"financial crisis"@en
Financial_Crisis	"οικονομική κρίση"@el
Humanitarian_Crisis	"humanitarian crisis"@en
Humanitarian_Crisis	"ανθρωπιστική κρίση"@el

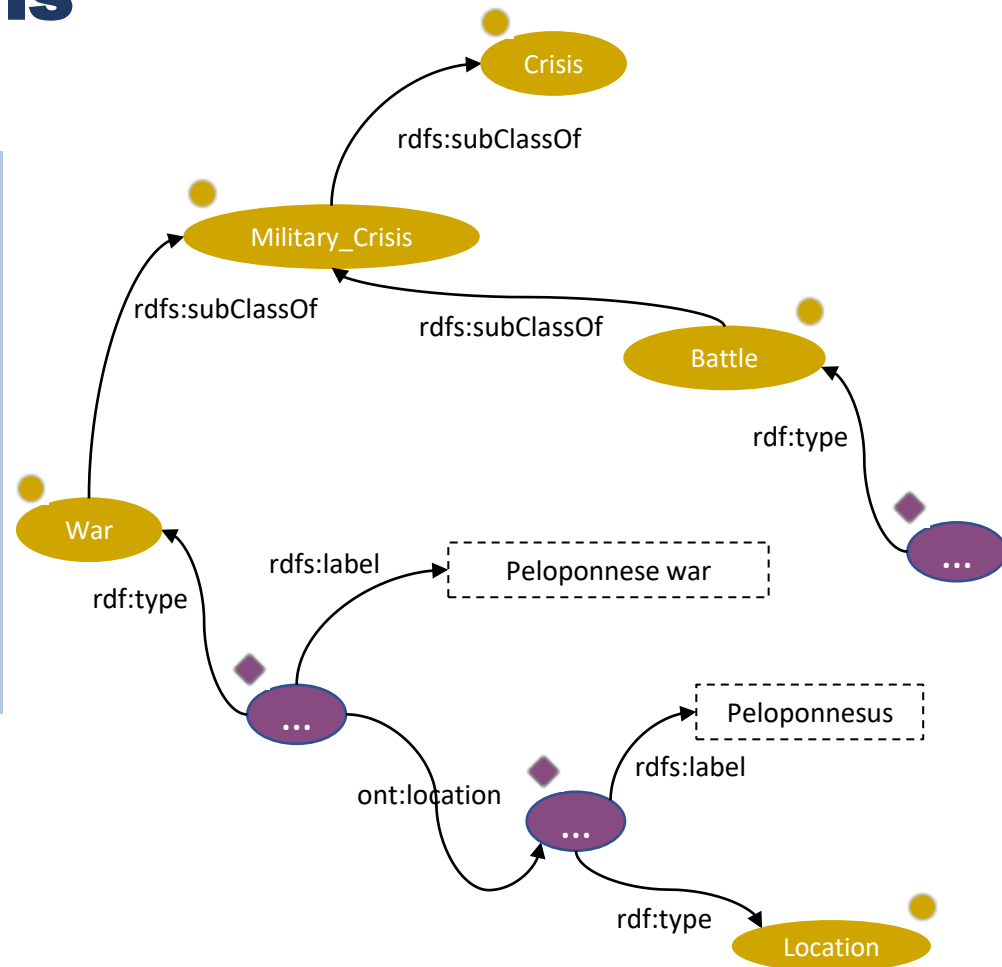
Execute

Competency Questions

Crises and locations?

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://o4dh.com/Ontologies/Crisis.owl#>
SELECT DISTINCT ?crisisLabel ?crisisType ?location
  WHERE {
    ?Crisis rdfs:subClassOf* ont:Crisis.
    ?crisis rdf:type ?Crisis.
    ?crisis rdfs:label ?crisisLabel.
    ?crisis ont:location ?location.
    ?crisis rdf:type ?crisisType.
    FILTER (?crisisType != owl:NamedIndividual)
  }
ORDER BY ?crisisLabel
    
```



crisisLabel	crisisType	location
"Aegospotami battle"@en	Battle	Aegospotami
"Andros battle"@en	Battle	Gavriou
"Arginoussai battle"@en	Battle	Arginusae
"Arginoussai battle"@en	Naval_Battle	Arginusae
"Peloponnesse war"@en	War	Peloponnesus

SPARQL query: concepts and terms of crises

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX ont: <http://o4dh.com/Ontologies/Crisis.owl#>
SELECT DISTINCT *
  WHERE {
    ?crisis rdfs:subClassOf* ont:Crisis.
    ?crisis rdfs:label ?crisisLabel
  }
ORDER BY ?crisisLabel
```

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    ?crisis rdfs:label ?crisisLabel
  }
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```

crisis	crisisLabel
Crisis	"crisis"@en
Drought	"drought"@en
Environmental_Crisis	"environmental crisis"@en

The Linguistic Dimension?

Ontolex-Lemon: Lexicon Model for Ontologies

<https://www.w3.org/2016/05/ontolex/>

Ontologies are an important component of the Semantic Web but current standards such as [OWL](#) only support the addition of a simple label to entities in the ontology. It is not currently possible to add inflected forms, different genders, usage notes or create a full lexical resource such as Princeton WordNet.

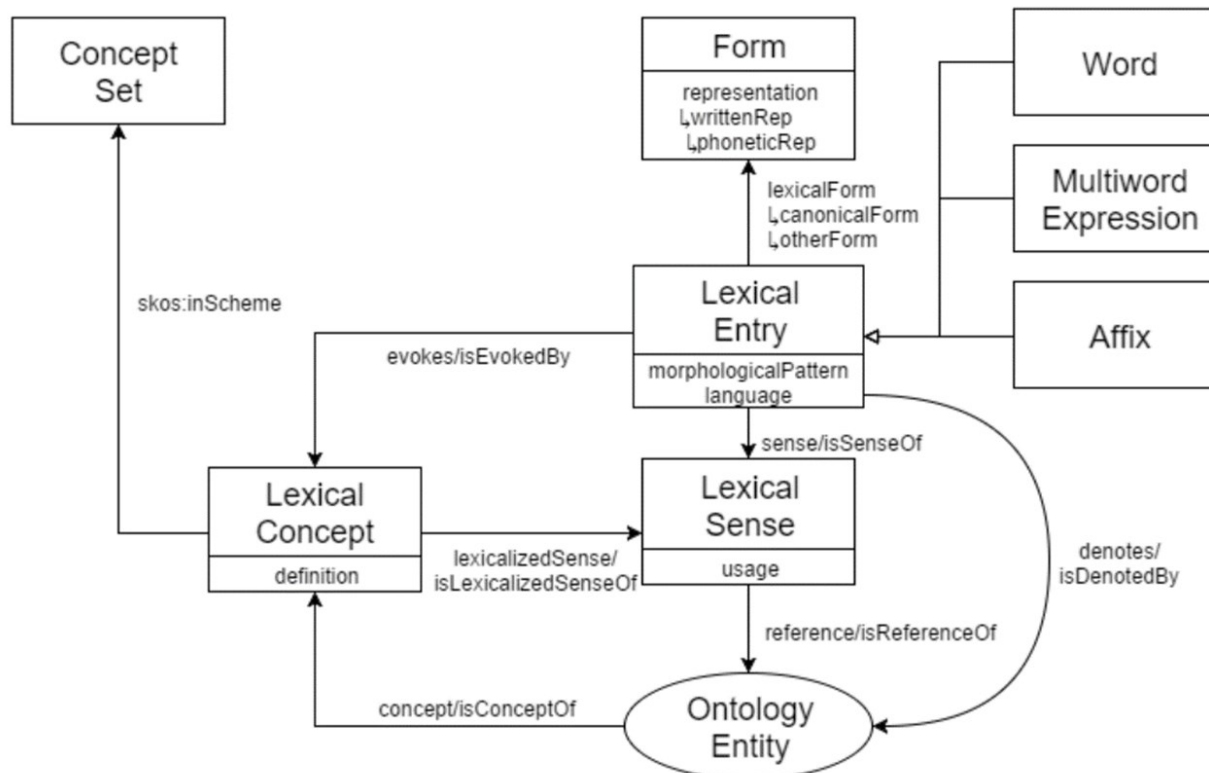


Figure 1 Lemon_OntoLex_Core.png



The Linguistic Dimension?

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Ontologies are an important component of the Semantic Web but current standards such as [OWL](#) only support the addition of a simple label to entities in the ontology. It is not currently possible to add inflected forms, different genders, usage notes or create a full lexical resource such as Princeton WordNet, or the Open Ancient Greek Wordnet.

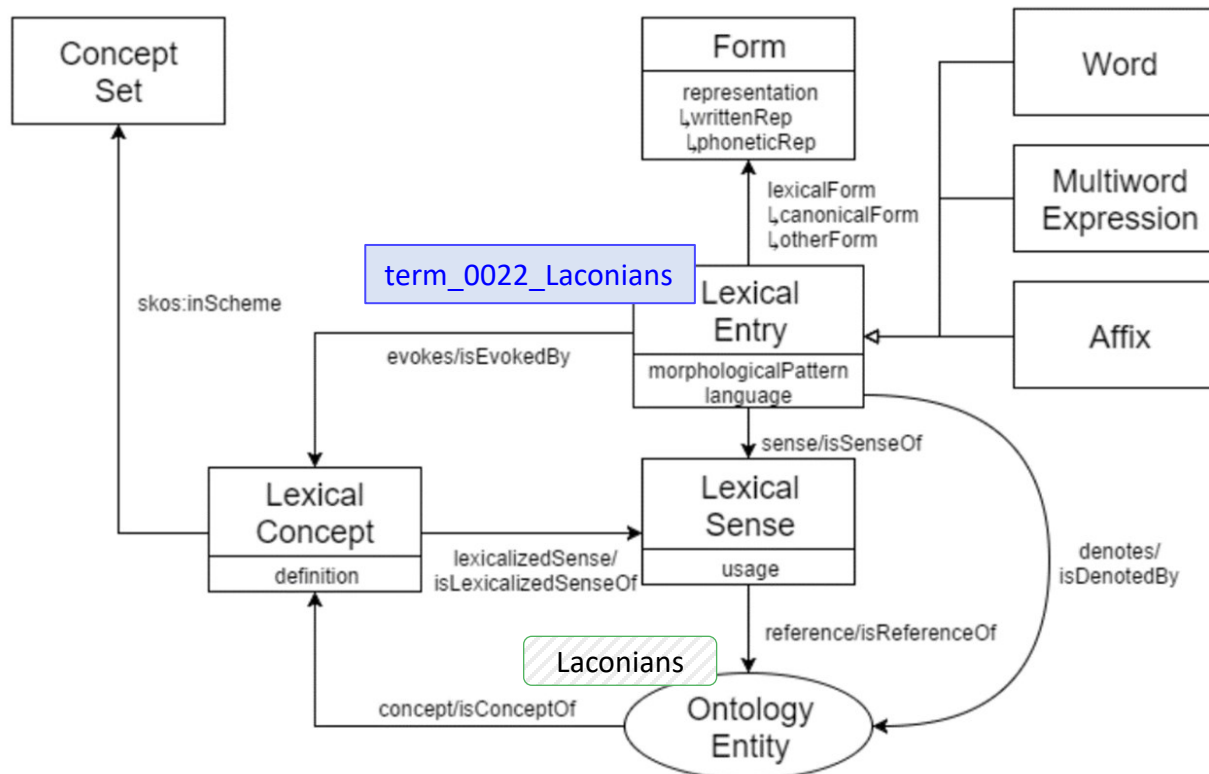
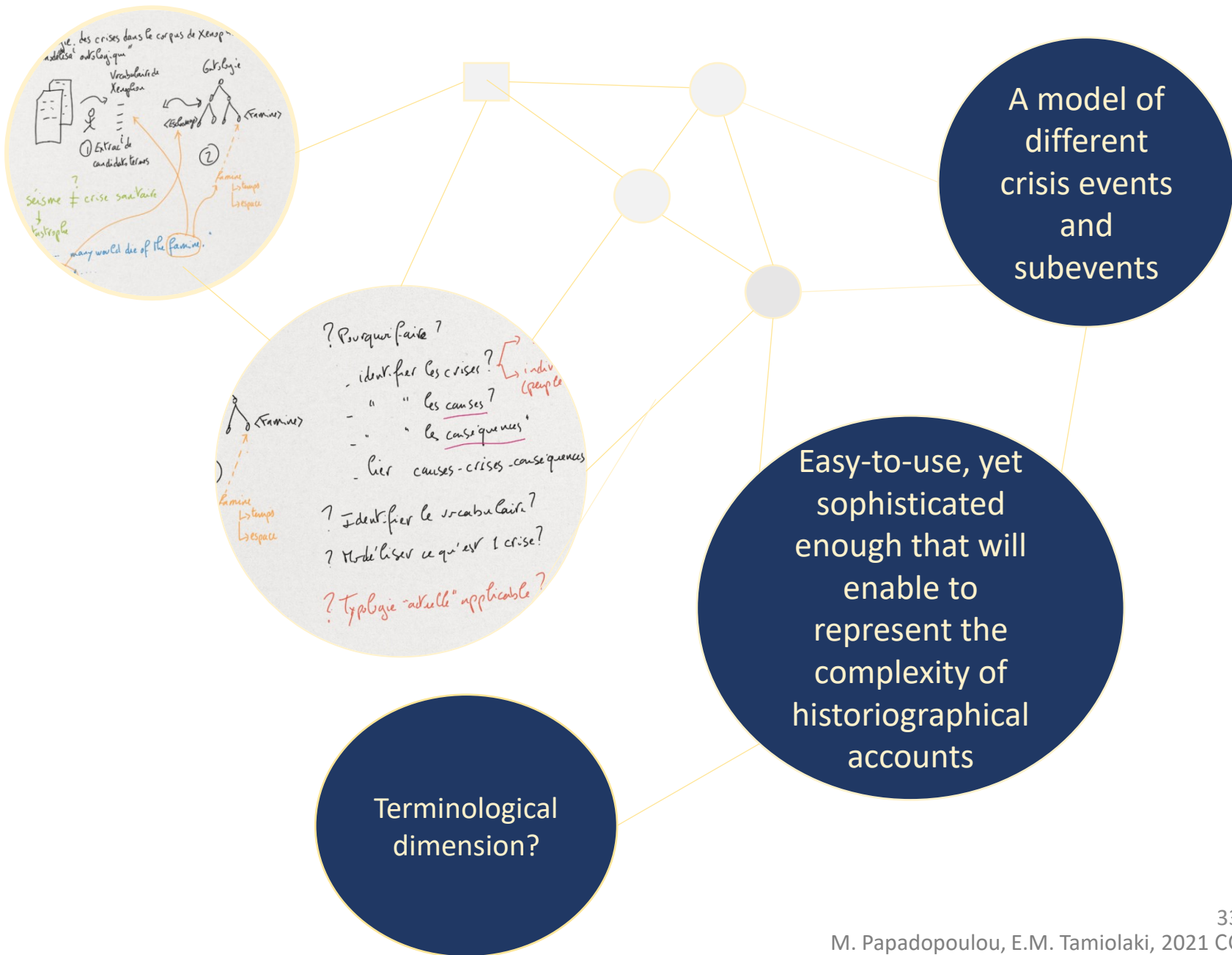


Figure 1 Lemon_OntoLex_Core.png



Conclusion





Contact: maria.papadopoulou@univ-savoie.fr

<http://o4dh.com/>

THANK YOU