Towards a semantic representation of Egyptian demonology: requirements and benchmark study

Bruno Sartini (he/him)

LMU University of Munich
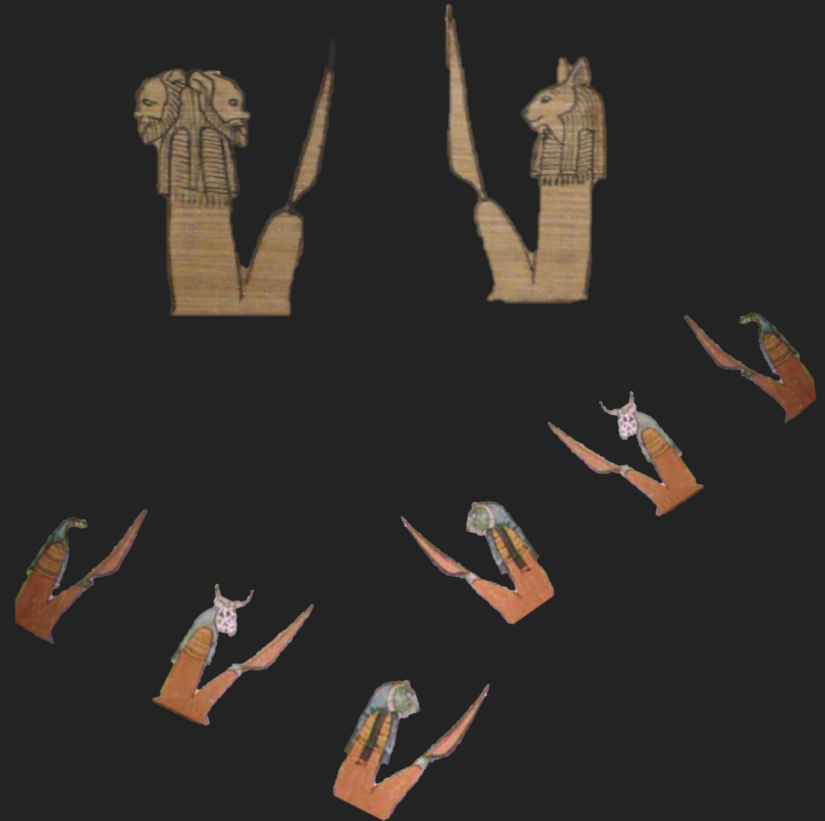
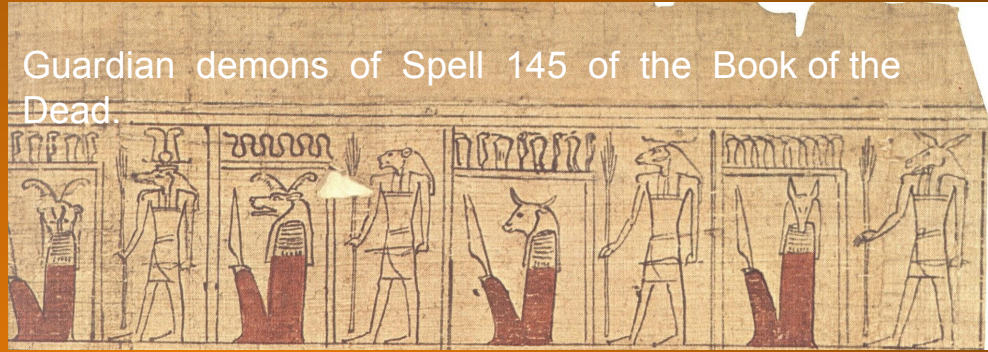b.sartini@lmu.de

Rita Lucarelli

University of California Berkeley

rita.lucarelli@berkeley.edu

-SEMDH2024-

Guardian demons of Spell 145 of the Book of the Dead.

Demonology and Egyptian Demons

rmṯ

mwt

nṯr

?

Lucarelli (2010)

Demonology and Egyptian Demons

- Limited Literature
- Lack of a standard

Demonology and Egyptian Demons

- Lack of a standard

Opportunity to make the standard directly in LOD

Objectives

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

ASSESSING THE COVERAGE OF EXISTING ONTOLOGIES OVER THOSE REQUIREMENTS

1ˢᵗ Objective steps

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

1. Literature analysis
2. Data driven analysis
3. Formulation of requirements from the previous analyses
4. Formulation of competency questions based on those requirements

1ˢᵗ Objective steps

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

1. Literature analysis

Starting Point: Publications suggested by a domain expert

Expanded with queries to publication hubs (google scholar, semantic scholar…)

Lucarelli, 2010a
Lucarelli, 2010b
Lucarelli, 2017

Hammad, 2018
Szpakowska, 2009
Kousoulis, 2013

1st Objective steps

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

1. Literature analysis

Demons are divided in two main categories according to their roles, guardians and wanderers.

Guardian demons: iconic representation, benevolent or malevolent, related to funerary events

Wanderer demons: aniconic, malevolent, related to diseases, plagues…

Both: can be found in ancient texts, coffins, temple walls… Their name is linked to either their attitude or to their physical characteristics

"The toxic one"
"The three-faced one"

1ˢᵗ Objective steps

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

2. Data driven analysis

Ancient Egyptian Demonology Project: Second Millennium BC

Welcome to DemonBase: Online Catalogue of Ancient Egyptian Supernatural Beings

About the project

DemonBase
http://iss-demonology.swan.ac.uk/demonology/

Entity Ref. #	Name	Appearance Pose	Head	Upper Torso	Lower Torso	Image	
1259	Burning one, *Asb(w)*	Not specified	Flame	Flame	Flame		Entity Details

Object #12 Details

Details
- **Entity Ref. #:** 1259
- **Book of the Dead Chapter Number:**
- **Coffin Text Spell Number:** 1039
- **Description:**
- **Costume:** Not specified
- **Headgear:** Not specified
- **Holding:** Not specified
- **Pose:** Not specified
- **Gesture:** Not specified

- Relational Database about demons
- Contains information on more than 3800 demons and the information media in which they are described and/or depicted

1ˢᵗ Objective steps

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

2. Data driven analysis
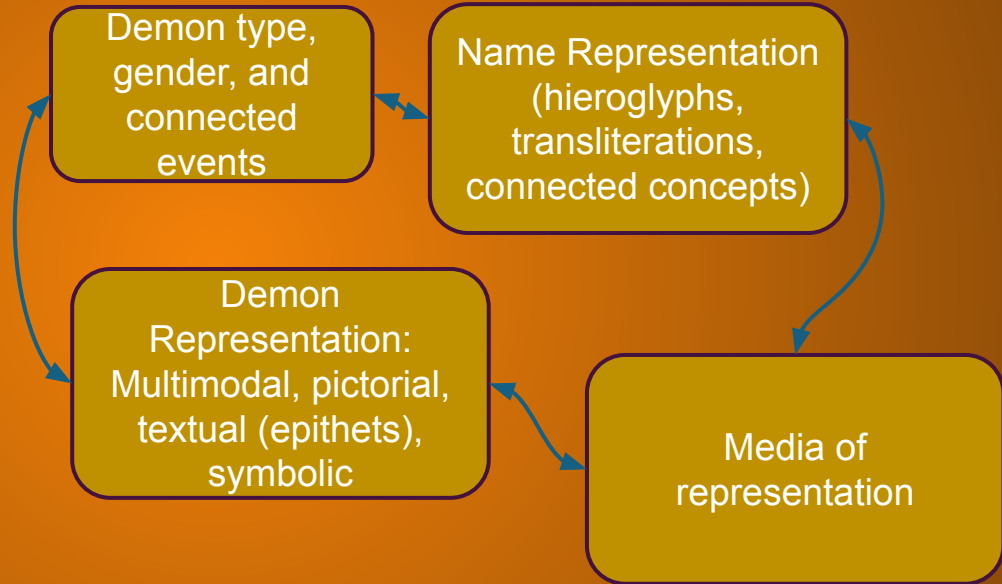

Extracted the whole database via scraping

Takeaways:

- Demons are described iconographically in separate body parts (head, body, lower body)
- The objects they hold and their costumes are also highlighted

1ˢᵗ Objective steps

FORMULATING THE ONTOLOGICAL REQUIREMENTS TO DESCRIBE EGYPTIAN DEMONS

3. Requirements formulation

Demon type, gender, and connected events

Name Representation (hieroglyphs, transliterations, connected concepts)

Demon Representation: Multimodal, pictorial, textual (epithets), symbolic

Media of representation

Table 1: Requirements for the knowledge representation of Egyptian Demons, associated with the sources that mention them

Requirement	Source						
	Hammad (2018) [10]	Kousoulis (2011) [5]	Lucarelli (2010a) [4]	Lucarelli (2010b) [11]	Lucarelli (2017) [13]	Szpakowska (2009) [12]	DemonThings
Name	V	V	V	V	V	V	V
Name Function	V	V	V	V	V	V	X
Name Transliteration	V	X	V	V	V	V	X
Name Hieroglyph	V	X	V	V	X	X	X
Demon Type (Guardian and Wanderer)	V	X	V	V	V	V	X
Guardian Demon Roles (doorkeeper, herald, etc.	V	X	X	V	X	X	X
Demon Gender	V	X	V	X	V	V	X
Demon funerary role	V	V	V	V	V	V	X
Epithets representation	V	V	V	V	V	V	X
Pictorial Representation	V	V	V	V	V	V	V
Pose	X	X	X	X	X	X	V
Gesture	X	X	X	X	X	X	V
Headgear	X	X	X	X	X	X	V
Costume	X	X	X	X	X	X	V
Body Characteristics	V	V	V	V	V	V	V
Head Characteristics	X	X	V	V	X	X	V
Upper Body Characteristics	X	X	V	V	X	X	V
Lower Body Characteristics	X	X	V	V	X	X	V
Held Items	V	X	V	V	X	V	V
Symbolism of held items	V	X	V	V	X	V	X
Classification of demons based on body characteristics	V	V	V	V	V	V	X
Medium Context of the representation	V	X	V	V	V	V	V
Medium Context: temple walls	V	X	V	V	V	V	V
Medium Context: spells (i.e., Book of the Dead)	V	X	V	V	V	V	V
Medium Context: Mortuary objects	V	X	V	V	V	V	V

1ˢᵗ Objective steps

3. Requirements formulation

Table 1: Requirements for the knowledge representation of Egyptian Demons, associated with the sources that mention them

Requirement	Source						
	Hammad (2018) [10]	Kousoulis (2011) [5]	Lucarelli (2010a) [4]	Lucarelli (2010b) [11]	Lucarelli (2017) [13]	Szpakowska (2009) [12]	DemonThings
Name	V	V	V	V	V	V	V
Name Function	V	V	V	V	V	V	X
Name Transliteration	V	X	V	V	V	V	X
Name Hieroglyph	V	X	V	V	X	X	X
Demon Type (Guardian and Wanderer)	V	X	V	V	V	V	X
Guardian Demon Roles (doorkeeper, herald, etc.	V	X	X	V	X	X	X
Demon Gender	V	X	V	X	V	V	X
Demon funerary role	V	V	V	V	V	V	X
Epithets representation	V	V	V	V	V	V	X
Pictorial Representation	V	V	V	V	V	V	V
Pose	X	X	X	X	X	X	V
Gesture	X	X	X	X	X	X	V
Headgear	X	X	X	X	X	X	V
Costume	X	X	X	X	X	X	V
Body Characteristics	V	V	V	V	V	V	V
Head Characteristics	X	X	V	V	X	X	V
Upper Body Characteristics	X	X	V	V	X	X	V
Lower Body Characteristics	X	X	V	V	X	X	V
Held Items	V	X	V	V	X	V	V
Symbolism of held items	V	X	V	V	X	V	X
Classification of demons based on body characteristics	V	V	V	V	V	V	X
Medium Context of the representation	V	X	V	V	V	V	V
Medium Context: temple walls	V	X	V	V	V	V	V
Medium Context: spells (i.e., Book of the Dead)	V	X	V	V	V	V	V
Medium Context: Mortuary objects	V	X	V	V	V	V	V

1st Objective steps

Table 1: Requirements for the knowledge representation of Egyptian Demons, associated with the sources that mention them

Requirement	Source						
	Hammad (2018) [10]	Kousoulis (2011) [5]	Lucarelli (2010a) [4]	Lucarelli (2010b) [11]	Lucarelli (2017) [13]	Szpakowska (2009) [12]	DemonThings
Name	V	V	V	V	V	V	V
Name Function	V	V	V	V	V	V	X
Name Transliteration	V	X	V	V	V	V	X
Name Hieroglyph	V	X	V	V	X	X	X
Demon Type (Guardian and Wanderer)	V	X	V	V	V	V	X
Guardian Demon Roles (doorkeeper, herald, etc.)	V	X	X	V	X	X	X
Demon Gender	V	X	V	X	V	V	X
Demon funerary role	V	V	V	V	V	V	X
Epithets representation	V	V	V	V	V	V	X
Pictorial Representation	V	V	V	V	V	V	V
Pose	X	X	X	X	X	X	V
Gesture	X	X	X	X	X	X	V
Headgear	X	X	X	X	X	X	V
Costume	X	X	X	X	X	X	V
Body Characteristics	V	V	V	V	V	V	V
Head Characteristics	X	X	V	V	X	X	V
Upper Body Characteristics	X	X	V	V	X	X	V
Lower Body Characteristics	X	X	V	V	X	X	V
Held Items	V	X	V	V	X	V	V
Symbolism of held items	V	X	V	V	X	V	X
Classification of demons based on body characteristics	V	V	V	V	V	V	X
Medium Context of the representation	V	X	V	V	V	V	V
Medium Context: temple walls	V	X	V	V	V	V	V
Medium Context: spells (i.e., Book of the Dead)	V	X	V	V	V	V	V
Medium Context: Mortuary objects	V	X	V	V	V	V	V

LI T

D B

1ˢᵗ Objective steps

FORMULATING THE
ONTOLOGICAL
REQUIREMENTS TO
DESCRIBE EGYPTIAN
DEMONS

3. Competency question formulation

21 CQs (32 total with subquestions)

CQ13 Which demons have been represented in a multimodal form?

CQ16.2-9 What is/are the poses/gestures/headgear/costume/head characteristics/upper body characteristics/lower body characteristics/held objects of the demons recognized in theirpictorial representation?

2nd Objective steps

ASSESSING THE COVERAGE OF EXISTING ONTOLOGIES OVER THOSE REQUIREMENTS

1. Ontology selection
2. Data conversion
3. Creation of additional data
4. Testing of the CQs on the data for correctness
5. Supervision of the results of a domain expert for specificity/granularity

2ⁿᵈ Objective steps

ASSESSING THE COVERAGE OF EXISTING ONTOLOGIES OVER THOSE REQUIREMENTS

1. Ontology selection

Linked open vocabularies (https://lov.linkeddata.es/dataset/lov/)
OntoHub (https://ontohub.org/)
Ontology design patterns (http://ontologydesignpatterns.org/)

7 Ontologies

CIDOC-crm
(Bekiari et al. 2021)

Concept Terms DP
(Vandenbussche et al. 2009)

SKOS
(Miles et al. 2007)

ICON
(Sartini et al. 2023)

Simulation ontology
(Sartini et al. 2021)

Appearance ontology
(Warren et al. 2012)

Dublin core
(Kakali et al. 2007)
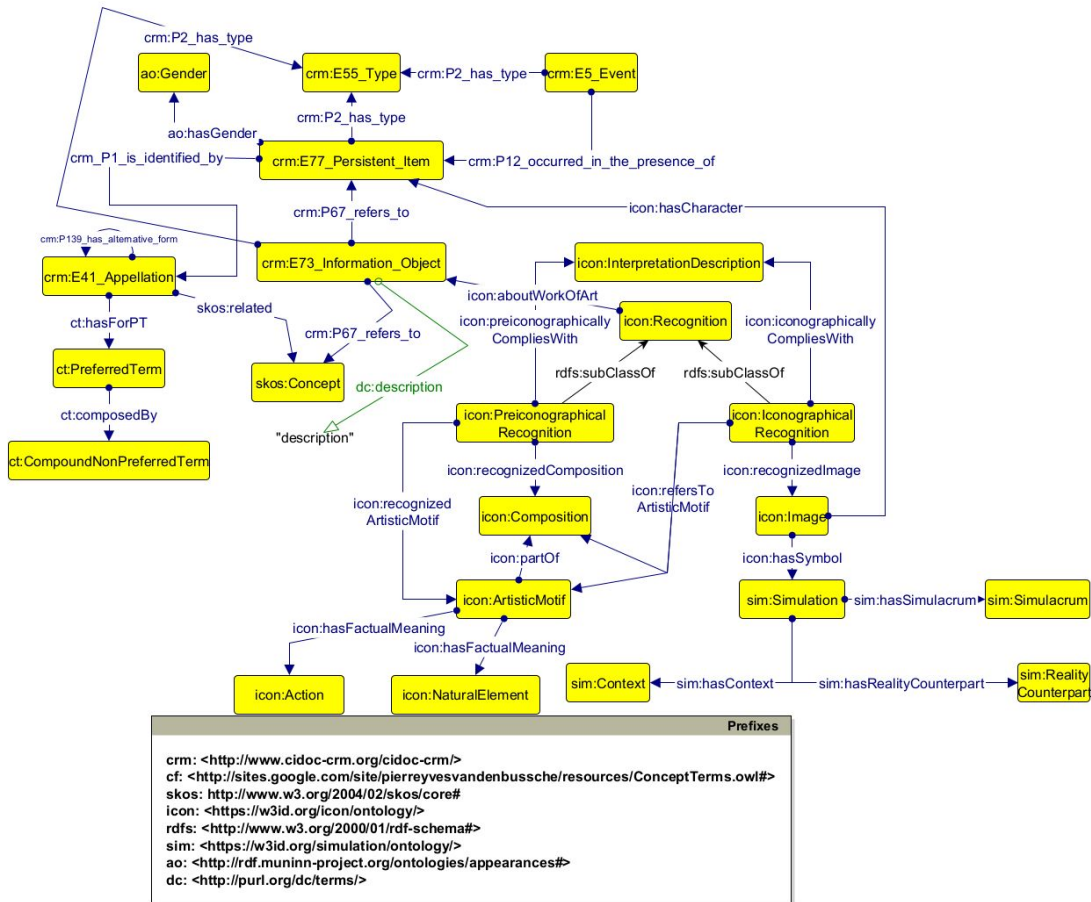
2nd Objective steps

ASSESSING THE COVERAGE OF EXISTING ONTOLOGIES OVER THOSE REQUIREMENTS

3. Creation of additional data

Added custom demons that with information not provided by **DemonBase just to test the CQ**

Do not use the RDF for quantitative analysis about demons

2nd Objective steps

ASSESSING THE COVERAGE OF EXISTING ONTOLOGIES OVER THOSE REQUIREMENTS

1. Data Conversion

Conversion of DemonBase to the structure of the chosen ontologies using RDFLIB

Full doc: https://github.com/br0ast/egyptianDemonsBenchmarkStudy
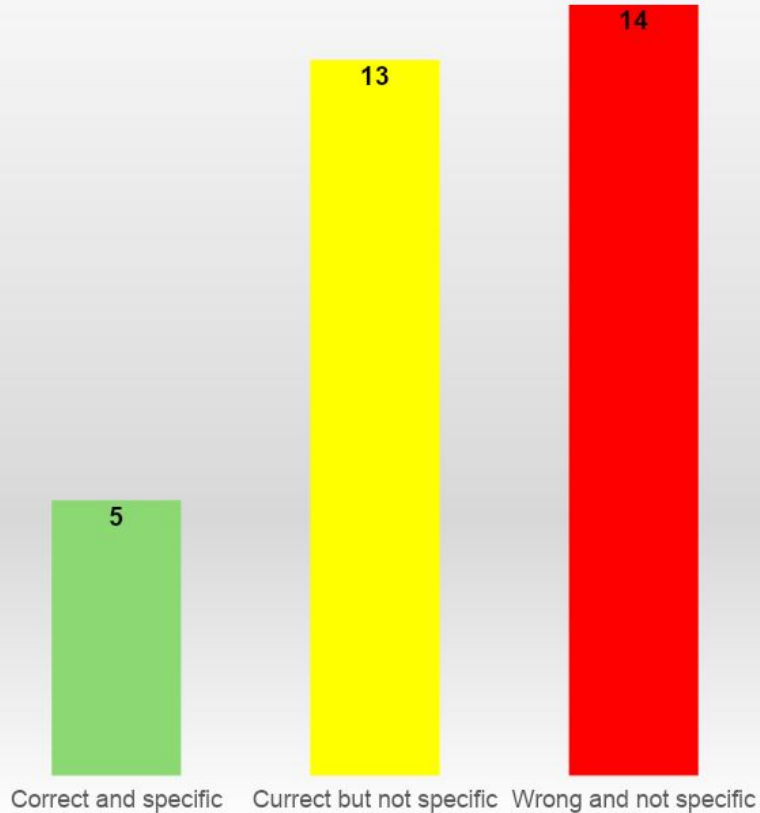
Results of CQ evaluation

Symbolism, connection between demons and their gender and names

CQ17

What are the symbolic meanings of the objects held by the demons?

```
prefix ao: <http://rdf.muninn-project.org/ontologies/appearances#>
prefix cf: <http://sites.google.com/site/pierreyvesvandenbussche/resources/ConceptTerms.owl#>
prefix crm: <http://www.cidoc-crm.org/cidoc-crm/>
prefix dc: <http://purl.org/dc/elements/1.1/>
prefix dlod: <http://example.org/demonlod/>
prefix icon: <https://w3id.org/icon/ontology/>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix skos: <http://www.w3.org/2004/02/skos/core#>

SELECT distinct ?demon ?symbol ?symbolism where {
?infobj crm:P63_refers_to ?demon .
?rec icon:aboutWorkOfArt ?infobj ;
icon:recognizedImage ?img .
?img icon:hasSymbol ?sim .
?sim sim:hasSimulacrum ?symbol ;
sim:hasRealityCounterpart ?symbolism
}
LIMIT 10
```

```
(rdflib.term.URIRef('http://example.org/demonlod/demonINV3'), rdflib.term.URIRef('http://example.org/demonlod/knife'), rdflib.term.URIRef('http://example.org/demonlod/malevolence'))
```

Correct and specific

Demon types, media types, appearance types..

CQ18-20

Which demons have animal (18) human (19) hybird (20) features?

```
prefix ao: <http://rdf.muninn-project.org/ontologies/appearances#>
prefix cf: <http://sites.google.com/site/pierreyvesvandenbussche/resources/ConceptTerms.owl#>
prefix crm: <http://www.cidoc-crm.org/cidoc-crm/>
prefix dc: <http://purl.org/dc/elements/1.1/>
prefix dlod: <http://example.org/demonlod/>
prefix icon: <https://w3id.org/icon/ontology/>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix skos: <http://www.w3.org/2004/02/skos/core#>

SELECT distinct ?demon where {
?demon crm:P2_has_type dlod:Hybrid}
LIMIT 10
```

```
(rdflib.term.URIRef('http://example.org/demonlod/demonINV2'),)
```

Correct but not specific

Specific iconography (head, lower body…), names transliterations, concepts connected to names

.6

CQ 16.1-16.9

What are the body characteristics of the demons recognized in their pictorial representation?

What is/are the
poses/gestures/headgear/costume/head characteristics/
upper body characteristics/lower body characteristics/held objects
of the demons recognized in their pictorial representation?

```
prefix ao: <http://rdf.muninn-project.org/ontologies/appearances#>
prefix cf: <http://sites.google.com/site/pierreyvesvandenbussche/resources/ConceptTerms.owl#>
prefix crm: <http://www.cidoc-crm.org/cidoc-crm/>
prefix dc: <http://purl.org/dc/elements/1.1/>
prefix dlod: <http://example.org/demonlod/>
prefix icon: <https://w3id.org/icon/ontology/>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix skos: <http://www.w3.org/2004/02/skos/core#>

SELECT distinct ?demon ?other where {
?other a icon:NaturalElement .
?infobj crm:P67_refers_to ?demon .
?rec icon:aboutWorkOfArt ?infobj ;
icon:recognizedComposition ?comp .
?comp icon:hasPart ?am .
?am icon:hasFactualMeaning ?other .}
LIMIT 10
```

Wrong and not specific

```
(rdflib.term.URIRef('http://example.org/demonlod/2956'), rdflib.term.URIRef('http://example.org/demonlod/armCrossedAtWaist'))
(rdflib.term.URIRef('http://example.org/demonlod/117'), rdflib.term.URIRef('http://example.org/demonlod/facingForwards'))
(rdflib.term.URIRef('http://example.org/demonlod/131'), rdflib.term.URIRef('http://example.org/demonlod/facingRight'))
(rdflib.term.URIRef('http://example.org/demonlod/3261'), rdflib.term.URIRef('http://example.org/demonlod/flexedStanceHandsOnNavel'))
(rdflib.term.URIRef('http://example.org/demonlod/4222'), rdflib.term.URIRef('http://example.org/demonlod/handInFrontOfFace'))
(rdflib.term.URIRef('http://example.org/demonlod/3264'), rdflib.term.URIRef('http://example.org/demonlod/killingEnemySmiting'))
(rdflib.term.URIRef('http://example.org/demonlod/2950'), rdflib.term.URIRef('http://example.org/demonlod/onHandsAndKnees'))
(rdflib.term.URIRef('http://example.org/demonlod/4222'), rdflib.term.URIRef('http://example.org/demonlod/reverseProtectionForwardHand'))
(rdflib.term.URIRef('http://example.org/demonlod/3313'), rdflib.term.URIRef('http://example.org/demonlod/smiting'))
(rdflib.term.URIRef('http://example.org/demonlod/3018'), rdflib.term.URIRef('http://example.org/demonlod/contactWithDeity'))
```

Next Steps

- Searching for other ontologies which could fit better some of the requirements (i.e, transliterations)

- Creation of an ontology which specific demon classes

- Alignment of the ontology to the "not specific" ontologies, to ensure a degree of interoperability

- Re-running the conversion algorithm to DemonBase to create the first *accurate* knowledge graph about Egyptian Demons

- Enrich the data from more sources…

References

Kakali, C., Lourdi, I., Stasinopoulou, T., Bountouri, L., Papatheodorou, C., Doerr, M., & Gergatsoulis, M. (2007). Integrating Dublin Core Metadata for Cultural Heritage Collections Using Ontologies. *International Conference on Dublin Core and Metadata Applications*, *2007*. https://doi.org/10.23106/dcmi.952108714

R. Lucarelli, Illness as Divine Punishment: The Nature and Function of the DiseaseCarrier Demons in the Ancient Egyptian Magical Texts, BRILL, 2017, p. 53–60. doi:10.1163/9789004338548_005.

R. Lucarelli, The guardian-demons of the Book of the Dead, British Museum Studies in Ancient Egypt and Sudan 15 (2010b) 85–102.

M. Hammad, Demonic beings in ancient egypt, International Academic Journal Faculty of Tourism and Hotel Management 4 (2018) 1–27. URL: http://dx.doi.org/10.21608/ijaf.2018. 95495. doi:10.21608/ijaf.2018.95495.

R. Lucarelli, Illness as Divine Punishment: The Nature and Function of the DiseaseCarrier Demons in the Ancient Egyptian Magical Texts, BRILL, 2017, p. 53–60. doi:10.1163/9789004338548_005.

References

P.-Y. Vandenbussche, J. Charlet, Conceptterms, in: Proceedings of the 2009 International Conference on Ontology Patterns - Volume 516, WOP'09, CEUR-WS.org, Aachen, DEU, 2009, p. 124–126.

Lucarelli, R. (2010a). Demons (benevolent and malevolent). *UCLA Encyclopedia of Egyptology*, 1(1). Retrieved from https://escholarship.org/uc/item/1r72q9vv

K. Szpakowska, Demons in ancient egypt, Religion Compass 3 (2009) 799–805. URL: http://dx.doi.org/10.1111/j.1749-8171.2009.00169.x. doi:10.1111/j.1749- 8171.2009.00169.x.

P. Kousoulis, Egyptian demonology within the phylogenetic and polymorphic environment of the late period and ptolemaic egypt: Searching for modes of demonic conception, progression and praxis, JAEI December 2013 5 (2013). URL: http://dx.doi.org/10.2458/azu_ jaei_v05i4_kousoulis. doi:10.2458/azu_jaei_v05i4_kousoulis

C. Bekiari, G. Bruseker, M. Doerr, C.-E. Ore, S. Stead, A. Velios, Definition of the cidoc conceptual reference model v7.1.1, 2021. doi:10.26225/FDZH- X261

References

B. Sartini, M. van Erp, A. Gangemi, Marriage is a peach and a chalice: Modelling cultural symbolism on the semantic web, in: Proceedings of the 11th on Knowledge Capture Conference, K-CAP '21, Association for Computing Machinery, New York, NY, USA, 2021, p. 201–208. URL: https://doi.org/10.1145/3460210.3493552. doi:10.1145/3460210.3493552.

A. Miles, J. R. Pérez-Agüera, Skos: Simple knowledge organisation for the web, Cataloging &; Classification Quarterly 43 (2007) 69–83. doi:10.1300/j104v43n03_04.

R. Warren, A. Dean-Hall, Appearances ontology specification—0.1, 2012. URL: http://rdf. muninn-project.org/ontologies/appearances.html.

B. Sartini, S. Baroncini, M. van Erp, F. Tomasi, A. Gangemi, Icon: An ontology for comprehensive artistic interpretations, J. Comput. Cult. Herit. 16 (2023). URL: https: //doi.org/10.1145/3594724. doi:10.1145/3594724.

Questions?

Thanks