

Applying Ontology Engineering to build a Poetry Domain Ontology.

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Abstract The growth of information and communication technologies and the new computational paradigms have fostered an increasingly interdisciplinary approach to research. The idiosyncrasy of literary studies has been an obstacle to its technological improvement for years, especially in representing their knowledge in a machine-readable format. The richness, variety, and different study perspectives that scholars find in their studies make this task a highly complex challenge. This complexity is even more noticed in the poetry genre, where each poetic tradition has independently developed its analytical terminology and methodology. In this work, we have addressed the construction of a poetry ontology to express the scholar's knowledge spread out in isolated databases or works. Ontopoetry ontology has been developed following NeOn methodology, and it has been structured in three modules: a) Core, b) Poetic Analysis and c) Transmission, covering the essential aspects of a poetry literary study. This paper describes the ontology building process and the design decisions taken during the process focusing on the design of the Core Module, its classes, relationships and proposed controlled vocabularies. Ontopoetry Core Module has reused CIDOC-CRM and FRBRoo ontologies guaranteeing its interoperability.

Keywords: European Poetry, Standardization, Network of Ontologies, Interoperability, Linked Open Data

1. INTRODUCTION

The growth of information and communication technologies and the new computational paradigms have fostered an increasingly interdisciplinary approach to research. An example of this interdisciplinary is the increasing interest in building ontologies to represent the knowledge of a determined domain and to improve the interoperability with the

purpose, among others, to be used in artificial intelligence or intelligence systems applications.

The interdisciplinarity is observed especially in the case of humanities and cultural fields, where they have followed an independent path in which creativity and tradition play an essential role. Literature, and especially poetry, is a clear reflection of this idiosyncrasy.

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As examples of this trend, we can find ARCO [1] and ontology devoted to cultural heritage or Dracor [2], drama corpora, ontology and tools.

Poetry is undoubtedly a special case that deserves to be studied in detail. From the philological point of view, there is no uniform academic approach to analyse, classify, or study the different poetic manifestations. The divergence of theories is even more prominent when comparing poetry schools from other languages and periods: a corpus of poetic works may be formalized under a repertoire, each repertoire may belong to a determined poetic tradition, and each tradition may have developed its analytical terminology, in some cases, for centuries [3]. This uncoordinated evolution produces a bunch of terminologies to explain similar metrical phenomena through the different poetic systems whose correspondences have hardly been studied. For example, the same quatrain of dodecasyllables can be encoded in different ways depending on the philological tradition (i.e. 12A12A12A12A or 4x(7pp+7p) or 4aaaa) or even named with a different meaning: “alexandrine” means a 14-syllable line in Spanish but an only 12-syllables line in French [4]. As a result, if a researcher were looking for quatrains of dodecasyllables in different traditions, it would be necessary to visit each database independently and then carry out different searches adapting the query to the conventions of the repertoires. Furthermore, the workload of those researchers who are not experts in databases could be increased when the repertoire’s interfaces do not provide a detailed enough query editor, or there is no tool to export the data.

On the other hand, paying attention to the poetry research process, we can state that poetry research is usually conducted in an individual and isolated manner, and there has been a certain lack of communication with other areas of knowledge. Therefore, the repertoires used for the different researches are based on stand-alone collected databases [5]–[10], losing the interoperability property.

The interoperability among all these collections is crucial since it allows comparative studies and moves a step forward beyond the modern philological state-of-the-art to explain phenomena like the origins of vernacular poetry or the evolution from accentual to syllabic rhythmical patterns. For this purpose, it is necessary to use metadata and vocabularies at a

philological level to climb up the semantic layer and link data among different traditions [11]–[13].

In this context, the use of technologies applied to poetry is ground-breaking. This way of representing distributed literary collections as machine-readable repositories will open the door to pose new research questions and perform comparative philological analysis between heterogeneous poetic corpora with different formats.

All these difficulties and problems of access to poetic resources and, in short, the impossibility of having the means to process this information completely and efficiently have been the origin and the incentive for the conception of an ontology of poetry [13], [14]. For this purpose, we have extracted from a set of repertoires of different poetic traditions and periods [15], [16] the concepts and relationships necessary to achieve a general representation of the poetry domain. This study identified the core concepts of poetic resources as cultural heritage objects and concepts related to other complementary areas related to poetic analysis and bibliographic information. The result of the whole process has led us to develop a complete ontology for poetry.

This work presents the methodology carried out to build an ontology devoted to poetry and describes its Core Module. This work is part of the results of the Postdata (Poetry Standardization and Linked Open Data) ERC project¹, which aims to provide a means for poetry researchers to publish and consume semantically enriched data in the context of poetry.

The document is structured as follows. In section §2, we identify some previous results related to ontologies in the literature, especially in the domain of poetry. Section §3 describes the methodology used to develop Ontopoetry Ontology modules. Section §4. describes the modules that form the Ontopoetry ontological model. Section§5 presents a detailed description of the Ontopoetry core ontological model. Conclusions and future works are presented in Section§6. Finally, Section§7 describes an example of Core Module use.

2. RELATED WORKS

One of the consequences of the evolution of the Semantic Web and the progressive transformation of Humanities into “Digital Humanities” has been the

¹ <http://postdata.linhd.uned.es> Postdata (ERC-2015-STG-679528).

implementation of new metadata mark-up languages and the great number of ontologies developed and published to describe traditional concepts with computer-readable languages (e.g., Text Encoding Initiative TEI-XML², Dublin Core³ or CIDOC CRM⁴). In this sense, libraries, museums, and archives⁵ have led this process, and many projects are using these approaches in their developments (e.g., TexGrid⁶, OpenEdition⁷ or Scholar Digital Editions (SDE)⁸). However, as far as our knowledge extends, the application of these paradigms to computational literary studies focused on poetry is still limited [2],[17], [18]

From the computational literary studies point of view, a poem can be considered a work representing an original idea. The ideas of the work can be expressed following an intellectual process (e.g., writing, translating, or editing a poem) that yields the different editions or expressions of a work. In addition, each poem has a physical representation that conveys the expressed ideas (e.g., a manuscript or a book).

Considering these different levels of information related to a poem, we can find ontologies that cover some of the concepts associated with literary poetry studies.

One of the most known ontologies in the literature is the CIDOC Conceptual Reference Model (CIDOC CRM)⁹. This ontology formally describes the concepts and relationships used to document cultural heritage. This model focuses on the representation of museums' heritage works and contains concepts for representing entities such as people and places associated with the works. Therefore, we may model a poetic work by considering it a cultural heritage item. Likely, this approach would have been enough for modelling a work, but we would have lost the information about other aspects of a work as its physical representation for which we can associate a bibliographic entry. To model these physical aspects, we find the Functional Requirements of Bibliographic Records (FRBR)¹⁰ and its object-oriented version FRBROO¹¹ that harmonizes information from museums, archives, libraries, and cultural heritage entities. The most significant entities in FRBROO are Work, Expression, Manifestation, and Item, representing the different ways of conceiving a

literary work as a text or physical resource. These ontologies offer a perspective on the structure and relationships of bibliographic and authority records [19]. Therefore, these ontologies can cover the descriptive aspects of the works and their forms of expression and manifestation.

However, modelling poetic resources as cultural heritage and bibliographic objects is insufficient to represent their structure and analysis. In this sense, one of the first approaches to model the poetry domain was to define a set of metadata tags to annotate forms and structures of poetic works [7] as part of the Text Encoding Initiative (TEI) [20]. Although this set of tags captured part of a poem's metric domain knowledge, definitely they do not cover other metrical concepts related to literary analysis or prosody and do not follow semantic web technologies to provide the annotations as linked data resources.

Furthermore, making poetry specific information available as linked data will ease the expansion of poetry domain knowledge with other aspects related to linguistic or rhetorical concepts for which we find the following ontologies: a) the Lexicon Model for Ontologies (Lemon)¹² designed for modelling machine-readable dictionaries and lexicons covering aspects of lexical decomposition, sentence structure, syntax, variation, morphology, b) The Gold¹³ ontology a complete ontology for descriptive linguistics, that describes the most basic categories and relationships used in the scientific description of human language, or c) The Rhetorical Annotation Ontology Project (RAOP)¹⁴, a specific domain ontology, built for the annotation of speech figures and the rhetorical aspects of written and oral texts.

Beyond analysing well-known ontologies in Digital Humanities, we can find the first steps made in the Postdata project to define a poetry ontology. It started looking for nonontological resources from highly reliable sources. Twenty-five repertoires described in [21], most of them available on the web, were selected by a set of experts. They represent different poetry traditions, languages, prosodic systems, and cultures [20], resulting from research projects. Hence, they contain information gathered or generated by experts,

² <https://tei-c.org/>

³ <https://www.dublincore.org/specifications/dublin-core/>

⁴ <http://www.cidoc-crm.org/>

⁵ <http://lodlam.net/>

⁶ <https://textgrid.de/>

⁷ <https://www.openedition.org/>

⁸ <http://www.sd-editions.com/>

⁹ <http://www.cidoc-crm.org/cidoc-crm>

¹⁰ <http://purl.org/vocab/frbr/core#>

¹¹ <http://www.cidoc-crm.org/frbroo/home-0>

¹² <https://www.lemon-model.net/index.php>

¹³ <http://purl.org/linguistics/gold/>

¹⁴ <http://bakulf.github.io/raop/>

which improves the reliability and robustness of data, categories, and structure. Consequently, it was unnecessary to formulate competency questions since all the required expressiveness of the poetry field was collected in the twenty-four repositories. Once the sources were selected, a complete European Poetry Domain Model, EPDM, was made by transforming the nonontological resources. During this process was necessary to address problems related to the consistency of the concepts and disagreements. These problems were faced by experts in the poetry domain [11]–[13]. The result was an EPDM that includes details about textual transmission and aspects related to prosody, literary and rhetorical analysis, the structures identified in the poems, significant elements for publications, and its relationships with music. [15], [16]. Starting from the EPDM, we built the first ontology version [23]. After a first review, the ontology was not harmonized enough with ontological resources. Therefore, we built this new version by reusing CIDOC CRM and FRBRoo ontologies, which supports better interoperability while providing more straightforward and useful models for the end-users.

3. ONTOPOETRY ONTOLOGY DESCRIPTION

Ontopoetry Ontology facilitates a set of concepts for describing poetic works (poems, poetic drama or plays written in verse and songs). It is the product of a homogenization effort that considers different literary traditions, periods, poetic genres, and authorship. Additionally, this will enable the comparison of the characteristics and data in this poetry and thus carry out invaluable research in Comparative Literature and Comparative Metrical Studies quantitatively.

Given the excellent coverage of the Postdata Ontology V1.0 [23] and after a critical analysis of it made by experts on ontology engineering and poetry, it was concluded that it was cumbersome to manage a single artefact as the result of the development tasks. Therefore, a redefinition of the subdomains would improve the semantic description of the ontology, its interoperability, and ease of use. To solve this weakness, we opted for re-modularisation, intending to ease the maintenance and publication of the ontology [24]. Modularisation helps during the re-engineering tasks as engineers can work in parallel and not be overwhelmed with significant structures or many ontological elements. It also allows users to understand the

ontology better and have more flexibility in deciding which modules to use [25] based on the identification of relevant use cases after a previous analysis of the applications or objectives of the ontology and by enforcing encapsulation and independence as modularisation criteria. Encapsulation involves identifying elements related to a given sub-domain so that a module may be easily exchanged by another, while independence seeks the identification of self-contained modules and their potential reuse [24].

This analysis yielded the definition of two potential cases of use used to define the main Ontopoetry Ontology subdomains (i.e., modules):

- 1) **Bibliographic information** search and indexing: tackling the requirements of the poetry scholar community researchers involves the intensive usage of bibliographic information, mainly from the librarian domain. This information is used to differentiate the different conceptual and physical properties of the works yielding the definition of two modules:
 - i) **Ontopoetry Core** module represents the abstract idea of the bibliographic information. Entities of works are required to differentiate between the abstract idea of a work and its different expressions (e.g., translations). Therefore, this module includes all the essential information that characterizes works and their expressions, irrespective of their physical materializations.
 - ii) **Ontopoetry Transmission module** represents the more tangible side of bibliographic information related to poetic works. It extends the descriptions of the Ontopoetry Core Module by linking the conceptual textual editions or instances of Redaction with appropriate sources, between which we distinguish bibliographic sources and primary sources providing ontological elements to describe the materializations and manifestations of expressions, including ownership, identification, integrity status, dimensions, or material, among others.
- 2) **Poetic information annotation and searching:**
 - i) **Ontopoetry Poetic Analysis Module** represents different phenomena associated with metrics and prosody, including the textual elements or parts of a poem and the different metrical patterns that analyse those elements. The ontology allows metrical information

annotation using scansion symbols for each line and describes each element's analysis at a metrical syllable, foot, or morae level. In addition, we also include means to annotate the presence of literary devices such as enjambment, synaloepha, and other relevant figures of speech.

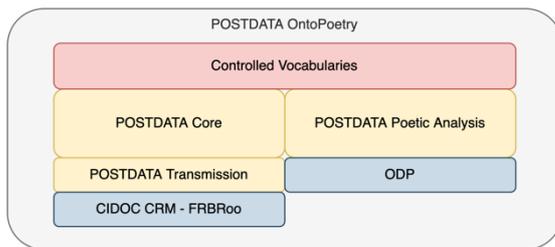


Fig. 1. Encapsulation of Ontopoetry Ontology.

Therefore, Ontopoetry Ontology comprises three ontology modules, each developed and serialized independently following OWL and RDF standards, Fig. 1.

As can be seen, CIDOC CRM and FRBRoo are on the base of Ontopoetry since they were designed taking into account a set of modelling principles that allow users to extend the model and are based on a layered structure that enables a detailed description of the relationships between an abstract idea and its physical editions and how they were produced. The first layer defines works as abstract ideas that reside in the author's mind that are materialized in the form of text, yet this text constitutes an abstract notion of a textual edition expressed symbolically, falling into the second layer of expressions. An expression is conveyed by a book, manuscript, or facsimile, which falls into the more tangible layers of manifestation and item, Fig. 2. In Ontopoetry, the first two layers are covered by the Core Module to represent the original abstract ideas of a work and the textual signs or editions of a work (i.e., expression), respectively. The Ontopoetry Transmission Module covers the third and fourth layers. They aim to describe the physical embodiments of expressions, which correspond to manifestations and exemplars (i.e., items) of the conceptual and symbolic notions of poetic works and their textual editions.

This adoption implies the acceptance of the FRBRoo work concept and its layered structure. The work concept in literary studies has been an object of study, [26], [27] arguing that a work has to be something more than a physical text and wondering which would be the proper definition of work and its extent. If we adopt the

philosophy of the work concept described in FRBRoo, we understand the work in the sense of an abstract idea, which means that we define it independently of its redactions (i.e., expressions) or manifestations. Therefore, in the context of Ontopoetry, a work will be an abstract idea of a poem and may be as complex as the author's mind considered. In Ontopoetry, a work comes into existence when the author's mind decides to create it. The work is not associated with anything physical and may have different expressions along its existence as critical editions or translations, each one in turn with its manifestations, that is, their physical items. In this sense, the work is just an author's intellectual purpose of creation that will characterize all the expressions related to it. In Ontopoetry, we consider individual works but the aggregation and complex works as well since the conception of the author's idea may be as complex as he wants, always considering that the work is original and unique. Therefore, a work may be an anthology of poems (i.e., **frb:F17 Aggregation work**); in this sense, the author had the idea of compiling them because she had an intellectual intention (i.e., evocated their childhood), or she used part of other works in its conception (i.e., **frb:F15 Complex Work**).

Nevertheless, it was necessary to extend the former model using our implementation when designing the Poetic Analysis Module, which required the adoption of Ontology Design Patterns. The partial reuse of Poetic Analysis to the FRBRoo model comes from the need to reuse its basic entities, such as events, time and agents. To cover our requirements for modules Core and Transmission, it was not necessary to solve any modelling issue through the usage of Ontology Design Patterns

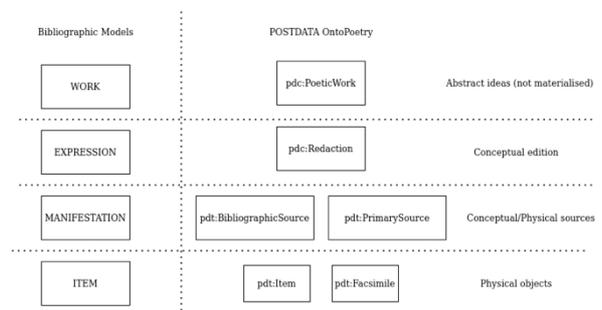


Fig. 2. Layered structure of FRBRoo and Ontopoetry.

The ontology modules include properties that rely on the concepts of a set of controlled vocabularies or

concept schemes that help users to better categorize or classify each of the elements described by the ontological modules at a deeper level than the one provided by the defined classes. This is a very useful step towards consolidating different poetic traditions as each tradition may consider different classifications (i.e., types of stanzas and lines, types of stress and scansion technique used, the objective of the poem, and the main theme of the poem.). While a complete analysis of all the possible concepts relevant to each tradition has not been thoroughly conducted, we have identified those aspects that vary across traditions [28]. Then, the main contribution in this sense is identifying discrepancies and providing initial concepts that serve as an example to guide the inclusion of further concepts as long as the project evolves. This means that most of the vocabularies are open to edition and subject to modifications after deployment of the Ontopoetry Knowledge Graph.

4. METHODOLOGY

Once we defined the three Ontopoetry modules, we followed NeOn scenario six for building Core and Transmission Modules and NeOn scenario seven for the Poetic Analysis Module [29],[30], Fig. 3.

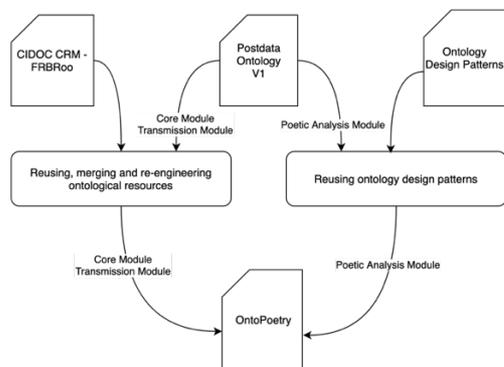


Fig. 3. NeOn scenarios six and seven applied to Ontopoetry Ontology.

4.1. Scenario Six

NeOn Scenario six [24] includes reusing, merging and re-engineering ontological resources. This scenario starts from the idea of reusing existing ontologies to take profit from its benefits (i.e., increase interoperability or reduce the development costs) [30],

[32]. Ontology reuse is generally understood as adopting existing ontologies to solve different problems in an ontology development process [29], [33]. The realization of the reuse process can be seen as the consecution of various integration operations, such as the inclusion of a whole ontology or the introduction or removal of ontological elements or pieces of an ontology [34]. This scenario was adapted for building Ontopoetry Core and Transmission Modules, Fig. 4.

While no poetic-related ontology fit the project's purposes, several common standard ontologies in the librarian domain were helpful for our purposes.

In our case, CIDOC CRM [35] offers a solid philosophical foundation since its pragmatics and semantics suit the different concepts of work and expression used in literary studies. These semantics and pragmatics are refined in FRBRoo, an extension of CIDOC CRM that facilitates a domain ontology for the librarian domain that is well thought to tackle different requirements or publication paths [32],[33]. Therefore, **we concluded to reuse CIDOC CRM 7.2.1 and its extension FRBRoo 3.0.**

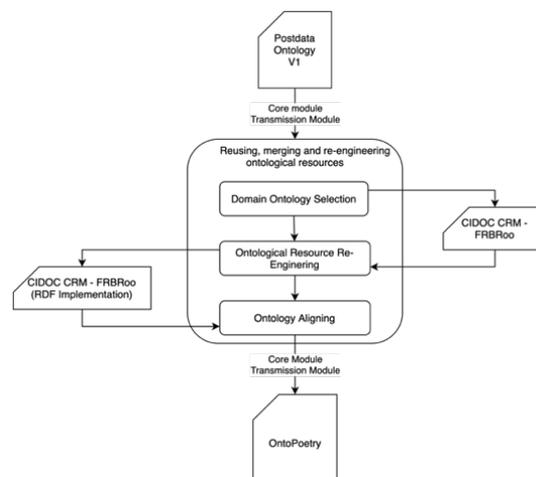


Fig. 4. Scenario six Adaptation.

However, the reuse of these ontologies cannot be done straightforward for several reasons: (1) FRBRoo includes an RDF serialization using OWL semantics, but it could be considered as an abstract model that could be implemented according to any object-oriented representation; (2) CIDOC CRM provides elements that offer a higher level of description than the one we need and (3) Postdata Ontology V1 is the result of a translation of an abstract data model that does not comply with the modelling practices nor pragmatics or

structure of CIDOC CRM model. In these cases, we have applied re-engineering.

To not lose the logical foundation and modelling principles of CIDOC CRM and FRBRoo models, we decided to reuse a part of the upper hierarchy of the classes and properties and put them under our namespace. This yielded the identification of the subset of CIDOC CRM and FRBRoo elements relevant to fulfilling the purposes of the Ontopoetry Core and Transmission Modules, which eases the comprehension of the standard. We have done this task using **owl:equivalentClass** or **owl:equivalentProperty** axioms for those classes and properties involving a complete semantic correspondence, while we used **rdfs:subClassOf** or **rdfs:subPropertyOf** axioms when our classes and properties corresponded to specialisations of the standard models. Hence, applying the previous mechanisms allows us to perform reasoning under the classes of our namespace without importing the whole CIDOC CRM and FRBRoo model.

4.2. Scenario Seven.

This scenario was applied in the Poetic Analysis Module following a strategy based on the integration of them by indirectly reusing the elements contained in the OWL files that represent the ODP template, Fig. 5. This task is performed by finding and applying appropriate Ontology Design Patterns, modelling solutions that have been extensively used to solve specific ontology design problems and to reuse them is considered as a good practice for the development of ontologies [30], [38]. At this moment, several types of ODPs exist, but, in our case, we only consider Content Ontology Design Patterns or Content Patterns (CPs) [39], which propose modelling solutions for the domain classes and properties that define the ontology. In this module, we adopted the Ordered List Ontology Specification¹⁵ to deal with the description of lists of items and the PartOf pattern¹⁶ to indicate entities and their parts.

The description of Ontopoetry ontology is available at <https://github.com/linhd-postdata/Ontopoetry>.

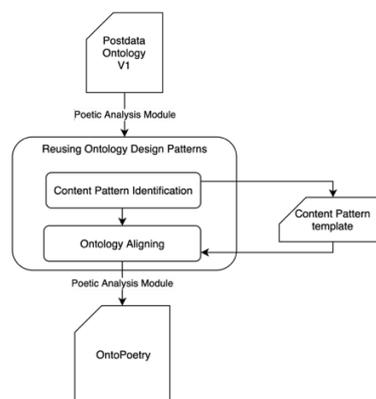


Fig. 5. Scenario seven adaptation.

5. ONTOPOETRY CORE MODULE

In this work, for the sake of space, we only introduce the Ontopoetry Core Module. The Core Module resides at the heart of Ontopoetry Ontology, which facilitates a set of classes and properties to describe general aspects of poetic work (i.e., a poem). The Core Module describes the original conceptual idea of a poetic work and its related textual editions. Hence, it enables the representation of information related to the written language and various elements concerning the author, such as the literary period it can be ascribed to.

The Ontopoetry Core Module is a CIDOC CRM/FRBRoo reuse and specialization departing from the Postdata core Ontology V1 [23] following the methodology explained in Section §4. We selected FRBRoo 3.0 [40] and CIDOC CRM 7.2.1 [41] as the base ontologies for reusability. While CIDOC CRM provides mechanisms to represent cultural objects according to a precise, logical foundation, FRBRoo extends the previous model by integrating requirements from the bibliographic domain. The specialization with FRBRoo is done by including classes and properties as subclasses or sub-properties whenever there is the need to specialize the ontology. We directly reuse the rest of the elements from FRBRoo whenever they cover the EPDM or Postdata Ontology V1 information needs by declaring equivalent classes or properties. Therefore, we will refer to FRBRoo classes or CIDOC CRM classes even if the former extends the latter model. While CIDOC CRM classes and properties identifiers

¹⁵ http://ontologydesignpatterns.org/wiki/Ontology:Ordered_List_Ontology

¹⁶ <http://ontologydesignpatterns.org/wiki/Submissions:PartOf>

include prefixes **E** and **P** and namespace **crm**, FRBRoo classes and properties include prefixes **F** and **R**, and we use namespace **frb**. We use the namespace **pdic** for our ontology, including the reused classes. We consider that this adoption improves the comprehension of the poetry model and does not have to be considered a duplication of classes but an artefact to facilitate the understanding and use of Ontopoetry.

As CIDOC CRM and FRBRoo are conceptual models that do not completely follow the RDF data model, we had to modify the properties or classes of these models during the modelling process.

The following subsections describe the main classes organized by their content or purpose. For each set of classes, we include how we modelled some properties of interest to the poetry domain, highlighting those that required the modification or specialization of the models since CIDOC CRM and FRBRoo are ontologies that do not provide elements specific to the poetry domain.

5.1. Poetic Works, Redaction, Ensemble and Excerpt Description

Ontopoetry Core Module aims to model the knowledge related to a work, specifically a poetic work (i.e., a poem). In this sense, following CIDOC CRM and FRBRoo philosophy, it distinguishes between the abstract concept of a poem or set of poems and their textual realisation. Therefore, Ontopoetry ontology is modelled considering two primary levels of representation: **The level for representing the ideas of a poetic work (i.e., work level) and the level to represent the textual signs of poetic works (i.e., expression level) and their relationships.**

In the context of the Postdata project, only artistic works in verse are considered: poems, plays written in verse and songs. General data about the poetic work, such as title, subtitles, literary tradition, or the purpose of the poetic work (e.g., to be sung, prayer, educational, spell), are included in this class. As a conceptual idea of artistic creation, it does not correspond to any material object we can identify as the poetic work but to the original idea of the work.

Therefore, to model a poetic work at the work level, we use **frb:F14 Individual Work**, a subclass of **frb:F1 Work** class that refers to the conceptual idea of a work that "appears in the course of the coherent evolution of an original idea into one or more expressions that are dominated by the original idea" and

it is realized by one self-contained expression, [40]. Following the adaptation of scenario six, we have defined the class **pdic:PoeticWork** as equivalent to **frb:F14 Individual Work**, corresponding to the idea or concept of a single poem, play or song, irrespective of its presentation or its contribution to a higher idea or concept and it is realized in one self-contained expression in terms of FRBRoo and does not have other works as parts. For clarity, we have also defined **pdic:Work** as equivalent to **frb:F1 Work**, Fig. 6.

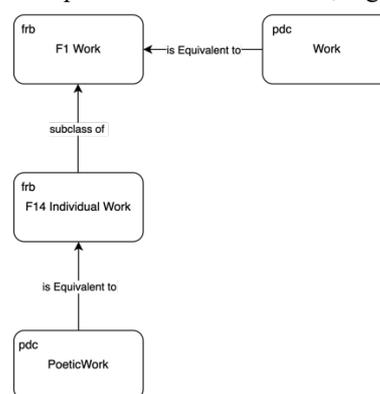


Fig. 6. Class hierarchy for **pdic:PoeticWork** and **pdic:Work**.

On the other hand, for modelling the expression level of a poetic work, we defined the **pdic:Redaction** class to represent textual versions or editions of a **pdic:PoeticWork**. It represents the different textual contents or signs of a poetic work irrespective of layouts, fonts, material, and other elements that correspond to the physical or digital version of a poetic work (i.e., manifestation level in FRBRoo). The class **pdic:Redaction** is defined as a subclass of **frb:F22 Self Contained Expression** that represents the intellectual content of a work in some form or set of signs rather than concepts. An expression of a work refers to its signs, but it should not be considered a physical entity. For example, a work captures the idea of a poem, and the expression reflects the text or other tangible signs that express the work irrespective of its physical format or carrier. Also, **pdic:Redaction** is defined as a subclass of **crm:E33 Linguistic Object**, allowing us to express the fact that the signs of a **pdic:Redaction** are textual and highlighting that the expressions we reflect in the redaction class correspond to natural language information objects, Fig. 7.

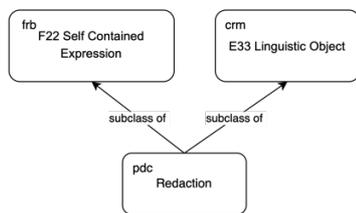


Fig. 7. Class hierarchy for **pdc:Redaction**

Therefore, the class **pdc:PoeticWork** always represents the ideas of a single poem or song and the class **pdc:Redaction** always carries out one **pdc:PoeticWork**.

In poetry studies and literary studies, it is of relevance to be able to express compositions and derivations of ideas and which textual signs represent these ideas. This layered representation enables the retrieval of several editions or redactions for the same poetic work, which is particularly important to users conducting studies in the poetry domain.

Sometimes a work can be considered as part of another work or derivation. To model these different situations, we have identified two different situations. On the one hand, we defined **pdc:Ensemble** equivalent to **frb:F17 Aggregation Work** Fig. 8, “a work whose essence is the selection and/or arrangement of expressions of one or more other works. In Ontopoetry ontology, it is considered an abstract work whose original idea was the compilation of different textual editions or instances of **pdc:Redaction**, each corresponding to a **pdc:PoeticWork** (i.e., aggregation of expressions from other works.

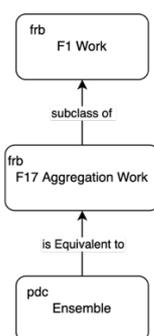


Fig. 8. Class hierarchy for **pdc:Ensemble**.

On the other hand, we use **frb:F15 Complex Work**, which defines “works that have other works as members” to represent those cases in which several works contribute to the ideas of a given original work.

This is the case when the original work’s ideas are shared among a set of component works or when an original work has been derived (i.e., adaptation), giving rise to a different work even if it also contributes to the original work’s ideas. We defined the class **pdc:ComplexWork** as equivalent to **frb:F15 Complex Work**, Fig. 9.

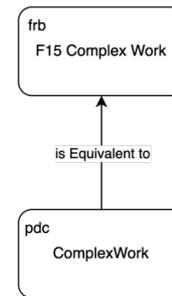


Fig. 9. Class hierarchy for **pdc:ComplexWork**.

Hence, a **pdc:ComplexWork** should not be confused with a **pdc:Ensemble** that represents an aggregation work whose original idea is the compilation of expressions of already existing works. Aggregations may happen at different levels (i.e., abstract or physical). As the Core Module reflects the abstract notions of poetic works, here we will refer to aggregations at the work level. Aggregations at the work or abstract level mean that the author’s original idea is the compilation of works, thus acting as a compiler. This differs from the idea of aggregating several editions in a specific bibliographic source, which is a task performed by editorials and corresponds to aggregations at the manifestation level covered by the Ontopoetry Transmission Module.

As an example, “La Antología de la nueva Poesía” (i.e., New Poetry’s anthology) by José Batlló is an anthology of Spanish authors. Each poem can be considered a poetic work, and the anthology a **pdc:Complexwork**. Similarly, “Algunas obras de Herrera” (i.e., Some Herrerass’s works) can be considered **pdc:Ensemble** because it comprises a set of poems created and compiled by Fernando de Herrera.

Finally, when a researcher is working with a work, she sometimes needs to distinguish different parts of the work to be further described with some textual annotations. To represent those common parts of the work’s signs, we created a generic class **pdc:Excerpt** as a subclass of **frb:F23 Expression Fragment** that comprises parts of expressions and **crm:E33 Linguistic Object** that comprises identifiable

expressions in natural language or languages to indicate that a **pdC:Redaction** can be broken down into pieces of textual signs smaller than the referred redaction, Fig. 10.

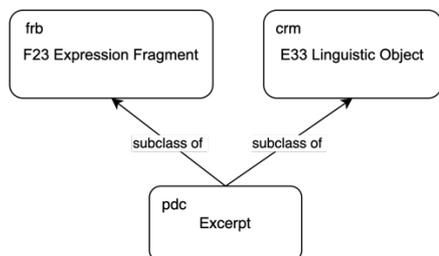


Fig. 10. Class hierarchy for **pdC:Excerpt**.

Each excerpt is characterized by a set of object properties subproperties of **pdC:hasFragment**, whose is subproperty of **frb:R15 has fragment**.

Some of these properties are: **pdC:hasCommentary**, **pdC:hasExcipit**, **pdC:hasIncipit** and **pdC:hasSample**.

The content of each excerpt is described by the datatype property **pdC:Text**, subproperty of **crm:P190 has symbolic content**, [42].

Once we defined the main classes of the Core Module, we defined a set of properties to enable a detailed description of the relationships between the most relevant entities of this module: works and expressions.

5.2. Work-work Relationships

A work-work relationships express the different relations between the classes that are subclasses of **pdC:Work**. We can express three primary relationships.

In the first place, we modelled the situation where a work has other works as members. This situation is given when we want to express different original poetic works that contribute to a poetic work because there is a relevant intellectual or artistic effort to modify another work. In this case, we reused the classes and properties using equivalence axioms to deal with the complex work case by declaring **pdC:isWorkOf** as a subproperty of **frb:R10i is a member of**, so we may include **pdC:Work** and **pdC:ComplexWork** as domain and range for the property. Fig. 11 shows how the work “El libro del Buen Amor”(The Book of the Good love) by Juan Ruíz could be modelled. The scholars mostly agree that in this work, Juan Ruíz used

previously composed episodes to create the book's first version. In this sense the lines 199 to 216 are a tale named “Enxiemplo de las ranas, en cómo demandavan rey a don Júpiter”. This tale can be considered a poetic work part of “El Libro del buen amor” that will be considered a complex work.

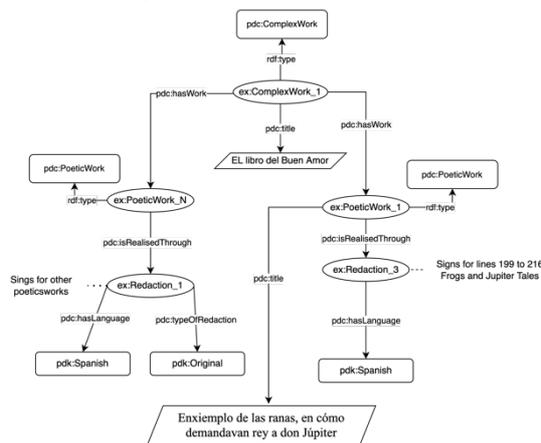


Fig. 11. Example of Complex Work.

Secondly, we may make explicit the case when several derivations or components (i.e., **pdC:PoeticWork**) contribute to the same idea or concept. Those derivations can be expressed using a generic property **pdC:isDerivativeOf** to express derivation of works (i.e., a work is a synthesis or adaptation of another work) that we defined as subproperty of **frb:R2 is derivative of**. For example, “La vida acompañada” by Bartolomé de Carranza (RB,II/531, fols. 246v-248r) (i.e., VA poeticwork) is considered a contrafactum from Fray Luis de Leon’s “Oda a la Vida retirada” (i.e., OVR PoeticWork). That said, VA **pdC:PoeticWork pdC:isDerivateOf OVR pdC:PoeticWork**.

5.3. Work-Expression Relationship

These relations model the use cases between a redaction and a poetic work. We can express that a **pdC:Redaction** realizes a **pdC:PoeticWork**, through two properties: **pdC:realises** and its inverse **pdC:isRealisedThrough**. These properties have been established as a subproperty of **frb:R9i realises** and **frb:R9 is realized in** respectively.

An example of poetic work realization is shown in Fig. 12. The simpler case of use is when a poetic work represents the conceptual ideas of a single poem or song,

and we have only one textual expression of the poem. In this case, a **pdC:Redaction** realizes one **pdC:PoeticWork**. This example models the fact that the author Fernando Herrera wrote a poem named Soneto I. Its realization containing its signs written in Spanish is expressed on **ex:Redaction_1**.

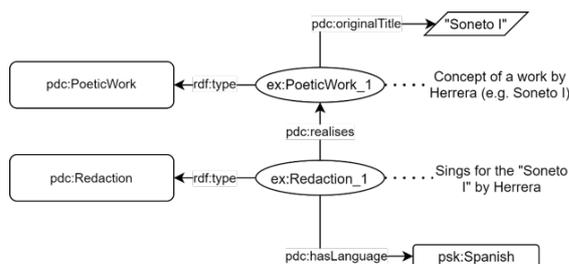


Fig. 12. Example of Poetic Work realization.

Another common situation in poetry is when we want to express that several **pdC:Redaction** realizing the creation of the same **pdC:PoeticWork**. This situation means more than one textual set of signs realizing the same idea or concept, Fig. 13. This will be the case whenever the intellectual process employed to create an original poetic work results in the production of a new expression. One example is when we have expressions in different languages that do not modify the original idea of the work. Other examples include a musical transcription or a revision or update on another text, for which we will consider different **pdC:Redaction** of the same **pdC:PoeticWork**.

Fig. 13 expressed the Sonet I from Herrera and two realizations corresponding to the Spanish and the English versions.

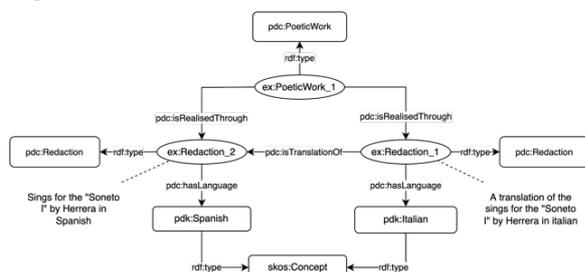


Fig. 13. Example of several Redactions for a single Poetic Work.

Finally, sometimes it is important to differentiate the most characteristic expression for a work. For this situation, we defined **pdC:hasRepresentativeExpression** as a

subproperty of **frb:R40 has representative expression**.

5.4. Expression-Expression relationship

One of the most common relationships between expressions is when the researcher wants to include some information from a part of another redaction. To relate a **pdC:Excerpt** to a **pdC:Redaction**, we have defined the property **pdC:hasFragment** as explained above.

If we consider redactions as textual entities or textual editions of poetic works, we can define two properties to relate instances of **pdC:Redaction** that share textual characteristics. On the one hand, we defined **pdC:hasEdition** as a subproperty of **frb:P130 shows features of** to indicate textual editions of a given redaction, and **pdC:hasTranslation** as a subproperty of **crm:P73 has translation** to make translations explicit.

Finally, a special case of expression-expression relationships is when we need to establish the relationships to explain how we relate an aggregation work, represented by **pdC:Ensemble** with the works it compiles (e.g., the expression of an anthology of poems, realizing an ensemble). According to FRBROO recommendations [37], instead of using a property to relate the ensemble with the rest of the poetic works, it is necessary to create a new expression for the ensemble that will be linked to the expressions of the poems the work compiles (i.e., **pdC:Redaction**). We defined **pdC:isRealisedInSelfContainedExpression** as a subproperty of **frb:R3 is realised** to relate an aggregation work to its expressions, and **pdC:incorporates** as a subproperty of **frb:R14 incorporates** to reflect the fact that the expression of an ensemble incorporates the expressions of other works.

Fig. 14 shows the hypothesis that Fernando de Herrera's original idea for the work "Algunas obras de Herrera" (Some Herrerass's works) was to create an anthology of poems, an aggregation at the work level rather than creating independent poetic works to be delivered to King Felipe II. This hypothesis is reflected in the example by using an instance of **pdC:Ensemble** to represent the aggregation work. Therefore, we can relate the expression of this aggregation work with the redactions of all the poetic works that represent the signs and ideas of the poems compiled using **pdC:incorporates**.

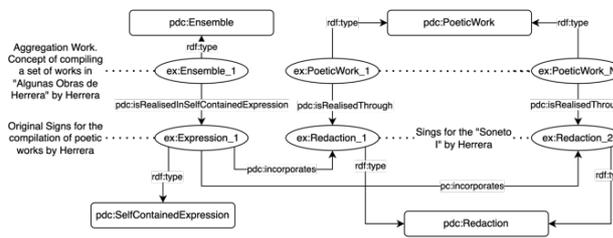


Fig. 14. Example of an “Algunas obras de Herrera” Ensemble.

5.5. Events, Agents and Roles

Since Ontopoetry ontology reuse FRBRoo, it follows an event-centric approach in which all the endeavours (instances of **pdc:PoeticWork**, **pdc:Ensemble** and **pdc:Redaction**) are the outcome of creation or modification events. These events are related to the participating agents, where this participation can be associated with a particular role (e.g., creator, editor, transcriber). This section introduces the description of the fundamental classes used to deal with some significant events, agents and roles in the poetry context and the ontological engineering decisions taken.

5.5.1. Certainty, Death, and Birth events

Certainty is a property needed for giving reliability to events when there is some imprecision or certainty about a fact. For example, we may not be sure about the actual date of creation of a poetic work, or we could be very sure about the authorship of a given poetic work. Those cases are specific cases of certainty assessment. To reflect certainty, it is possible to use a solution based on CRMInf extension model classes, but it would introduce the need to use named graphs in the RDF representation, increasing the solution's complexity. However, it is possible to define certainty following CIDOC CRM recommendations based on the Niccolucci proposal, Fig. 15.

This proposal defines certainty as a subclass of **crm:E16 Measurement**, so it would be possible to relate the thing being measured with the value of the measurement (the certainty value). This solution represents certainty even if the issue to represent belief and certainty or fuzziness is not closed [44], [45].

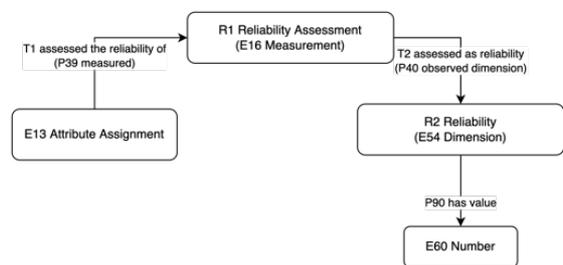


Fig. 15. Niccolucci proposal to model certainty.

Therefore, Ontopoetry follows Niccolucci proposal defining the class **pdc:CertaintyAssessment** as a subclass of **crm:E16 Measurement** to reflect some actor's activity by declaring the certainty on a specific attribute assignment defined by **pdc:AttributeAssignment** class equivalent to **crm:E13 Attribute Assignment**. We defined the property **pdc:hasCertaintyAssessment** as a subproperty of **crm:P39i was measured by** to relate these two classes.

In our model, we do not assign continuous values to certainty but discrete values, so we used a controlled vocabulary (e.g., probably not, probably, definitely not, definitely and possibly); therefore, we do not need to define a class of type **crm:E54 Dimension**, but to assign discrete values to the certainty we use **pdc:assessedCertainty** property defined as subproperty of **crm:P40 observed Dimension**. This mechanism enables us to assess the certainty of any arbitrary attribute assignment.

Finally, it is necessary to link an attribute assignment with the attribute entity and to the entity being attributed. For this purpose, we created the property **pdc:assignedAttributeTo** as subproperty of **crm:P140 assigned attribute to** and **pdc:assigned**, subproperty of **crm:P141 assigned**, Fig. 16.

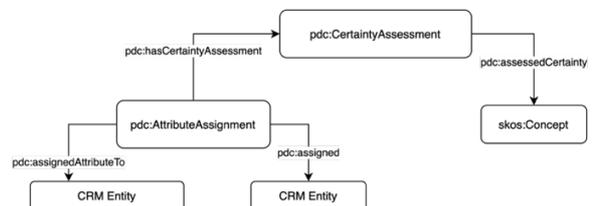


Fig. 16. Ontopoetry proposal to model certainty.

In the example of Fig. 17 we show how to express the certainty that the person **ex:Person_1** who is

supposed to be the creator (i.e., **ex:AgentRole_1**) of the signs of a poetic work (i.e., **ex:Redaction_1**), definitely is not, pointing we are sure that **ex:Person_1** does not play the role of the creator.

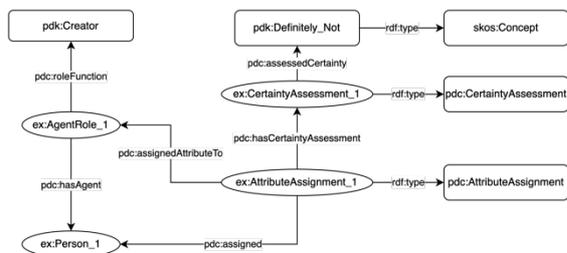


Fig. 17. Associated certainty for a Creator Role.

The birth and death of the authors are of great importance in literary studies. The use of an event-centric approach in FRBRoo implies modelling them as events. In this case, we reused classes and the properties from FRbroo using our namespace. So, we defined **pdc:Birth** and **pdc:Death** as equivalent to the classes **crm:E67 Birth/ crm:E69 Death**. We identify the place, the date and the person affected by the event using the property, **pdc:tookPlaceAt** subproperty of **crm:P7 took place at**. The person affected by one of these events is related to it via the property **pdc:broughtIntoLive** subproperty of **crm:P98 brought into life** for a birth event and **crm: pdc:wasDeathOf** subproperty of **crm:P100 was death of** in the case of death event. Finally, we express the date relation using the property **pdc:hasTimeSpan** subproperty of **crm:P4 has time-span**, Fig. 18.

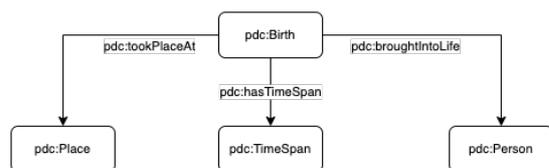


Fig. 18. Birth event Ontopetry implementation.

5.5.2. Agents: Persons and organizations

In the poetry domain knowledge, the concept of person and organization has a relevant use because they are related to the information of the author of the works. These two concepts are considered agents. FRBRoo specialises CIDOC CRM classes to represent "real persons who lived or are assumed to have lived". (i.e.,

frb:F10 Person). This description matches the semantic content in Ontopetry ontology, so we have defined a class **pdc:Person** as equivalent to **frb:F10 Person**, Fig. 19.

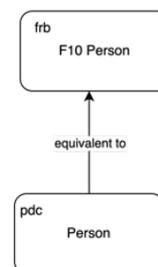


Fig. 19. Class hierarchy for **pdc:Person**.

The concept person has associated some data and object properties to describe it in the poetry field¹⁷.

On the other hand, FRBRoo also specialises in CIDOC CRM classes to represent individuals that are groups of people and exhibit organizational characteristics. This meaning is not enough for the organizations represented in Ontopetry since we also have organizations like libraries. Therefore, we defined the class **pdc: Organisation** as a subclass of **crm:E74 Group** to cover the definition of **frb:F11 Corporate Body** and **frb:F44 Bibliographic Agency**, Fig. 20.

On the other hand, the property **pdc:isMemberOf**, a subproperty of **frb:P107i is current or former member of** expresses a person's participation in one organization.

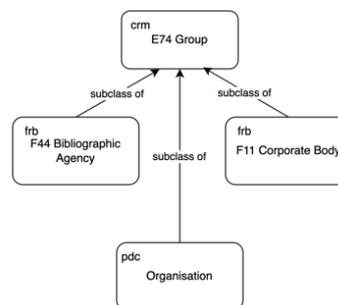


Fig. 20. Class hierarchy of **pdc: Organisation**.

Finally, both persons and organizations can participate as agents involving some action over an endeavour (e.g., creation, modification). Thus, we state a new class, **pdc:Agent**, equivalent to **crm:E39 Actor**.

¹⁷ <https://postdata.linhd.uned.es/OntoPoetry/Core/documentation/index-en.html>

This class allows us to establish the right relations regarding the roles of agents in Ontopoetry Ontology.

5.5.3. Roles

In poetry ontology is needed to reflect the participation of some agents (i.e., a person or a group of people) in producing a specific element (i.e., poetic work) with a specific role. In this sense, the Core Module defines the class **cdc:AgentRole**. Since FRBRoo adopts an event-centric approach, the endeavours are the outcome of an event and are performed by actors. FRBRoo specification suggests the use of properties of properties to associate roles with the participants of the production events (i.e., creators). This approach is shown in Fig. 21 where an actor is associated with the creation by using **frb:P14 carried out by** property and, in the same way, expresses roles following **frb:P14.1 in the role of** property that relates a **crm:E7 Activity** with a **crm:E55 Type**, the value of a controlled vocabulary specifying the type of role.

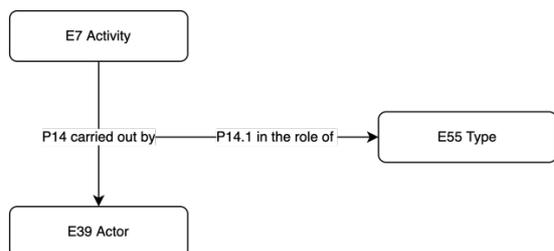


Fig. 21. Properties of properties to represent roles in CIDOC CRM.

However, this solution is not allowed in RDF [46]. Instead of using a property of properties, CIDOC CRM proposed two official modelling solutions to solve this issue in RDF [46]: a) to create one subproperty of **frb:P14 carried out by** for each of the roles, or b) to create one intermediate class that links **frb:P14 carried out by** with an instance of **crm:E55 Type**. CIDOC CRM's main recommendation is to use the first approach because it is more aligned with the model and relaxes query complexity and runtime. However, this solution is not useful when having several values for roles in a concept scheme since it is necessary to know all the possible values beforehand to create the subproperties. Therefore, for this situation is more useful to adopt the second approach and specify a class that represents the role assignment, Fig. 22.

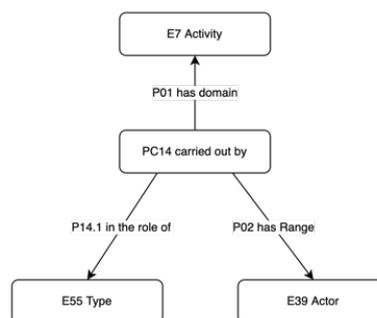


Fig. 22. Solution adopted to model roles in CIDOC CRM.

The proposal would be to create a **PC0 Type CRM property** auxiliary class to include the object properties **P02 has range**, and **P01 has domain** that will be used to associate the actor of an activity (i.e., a creation activity) and the associated expression or work. Therefore, **PC14 carried out by** class is a subclass of **PC0 Type CRM Property** class and expresses the role-actor relationship allowing to use the property **P14.1 in the role of** to associate the role-actor class to the specific role (i.e., a controlled vocabulary). This solution allows us to relate events to agents and assign them a role, but it is also necessary to relate the events to works and expressions.

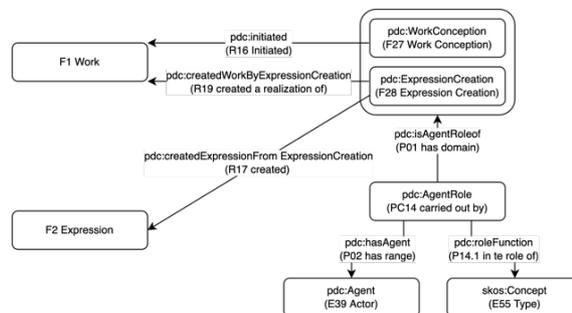


Fig. 23. Ontopoetry CIDOC CRM proposal to model roles.

In Fig. 23 is shown the solution applied in Ontopoetry. We defined a **pdc:AgentRole** as an auxiliary class equivalent to **PC14 carried out by** allowing us to relate any **pdc:Agent** class equivalent to **crm:E39 Actor** class, with an activity, in our case, a **pdc:WorkConception** or **pdc:ExpressionCreation** class equivalent to **frb:F27 Work Conception** and **frb:F28 Expression Creation**, respectively.

The relationship between an activity and the auxiliary class is made through **pdc:isAgentRoleOf** equivalent property to the auxiliary relationship **frb:P01 has domain**.

The relationship between the auxiliary class **pdC:AgentRole** and the agent and the kind of role of the agent are made using **pdC:hasAgent** equivalent to the auxiliary property **frb:P02 has range**, and **pdC:roleFunction** equivalent to the auxiliary property **frb:P14.1 in the role of** respectively.

Finally, the relation between works and events is modelled using:

1. **pdC:initiated** subproperty of **frb:R16 initiated** property to reflect that the original idea of the work preceded its realization.
2. **pdC:createdExpressionFromExpressionCreation** subproperty of **frb:R17 created** property. Similar to **pdC:initiated**, it relates an activity with the element produced during that activity. In this case, the **pdC:ExpressionCreation** with the instance of a **pdC:Expression**.
3. **pdC:createdWorkByExpressionCreation** equivalent to **frb:R19 created a realization of**. This property explicitly assumes that the ideas of the work and its signs are being produced simultaneously.

In those cases where the **pdC:roleFunction** of a **pdC:AgentRole** is a creator, we consider it to be an instance of a more specific class, **pdC:CreatorRole**, which provides additional properties to describe authorship elements. We reflect this fact by expressing the following in the ontology

$$CreatorRole \equiv AgentRole \sqcap \exists roleFunction. Creator$$

For example, we can state that a **pdC:CreatorRole** is anonymous by using the object property **pdC:authorship** and indicating the appropriate concept of the authorship concept scheme. When the agent associated with a **pdC:CreatorRole** is a person, we could also indicate its education level using **pdC:authorEducationLevel**, Fig. 24.

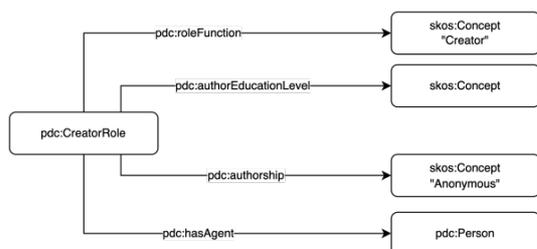


Fig. 24. Use of **pdC:CreatorRole**.

5.6. Places.

Another relevant concept in the Ontopoetry ontology is Place. The place is a concept used to locate both author and work and other properties related to poetry (i.e., literary text). In FRBroo, the class to **frb:F9 Place** has a similar semantic of the concept place used in our ontology. Therefore, simpler reuse is possible. We defined the class **pdC:Place**, which we stated to be equivalent to **frb:F9 Place**, Fig. 25.

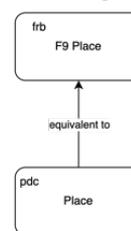


Fig. 25. Class hierarchy for **pdC:Place**.

5.7. Time expressions

Some properties related to events need to express information about time. In the ontology, we have considered two different approximations: a) when we want to express a period (i.e., time-span) and b) when one might just want to state a particular date of happening for some event.

In FRBroo is possible to use the class **crm:E52 Time-Span** to express the time-span of events or activities, but for its use in RDF, an adaptation is necessary [46]. Time-span in CIDOC CRM is considered and has two boundaries because they are treated as intervals, and this is something that cannot be represented using a single data type in RDF. For this reason, the CIDOC CRM RDF implementation guidelines [46] propose to use two properties to relate the time-span of an event with two different primitive values for dates of type **xsd:dateTime**:

1. **crm:P81 ongoing throughout**
2. **crm:P82 at some time within**

For these situations, we have defined the class **pdC:TimeSpan** as equivalent to **E52 Time-Span** and the properties **pdC:hasTimeSpan**, **pdC:endOfTheBegin** and **pdC:beginOfTheEnd** as subproperties of **P4 has Time Span**, **P81a_end_of_the_begin** and **P81b_begin_of_the_end**.

For the case of a unique date, we have defined the **pd:c:date** property relating time-span with a value **xsd:date** (see Fig. 26).

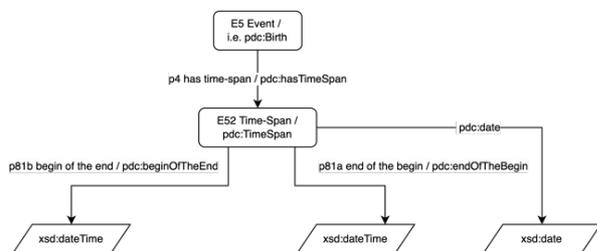


Fig. 26 Time-span and date in Ontopoetry core.

An example of the usage of the time expressions is shown in Fig. 27. The concept we want to express is the existence of a poetic work, “Soneto I”, created by Herrera in 1582, and we include the original signs of the poem (i.e., text) in Spanish.

Therefore, this schema shows that Soneto I (i.e., **ex:PoeticWork_1**) was conceived (i.e., **ex:AgentRole_1**) by Fernando de Herrera (i.e., **ex:Person_1**) and was produced (i.e., **ex:Creation_1**) at 1582 (i.e., **ex:TimeSpan_1**) in a given place (i.e., **ex:Place_1**). The original text (i.e., **ex:Redaction_1**) is in Spanish.

We can say that this example is an expression creation activity identified by **ex:Creation_1**. The

activity is located in time and space using **pd:c:hasTimeSpan** and **pd:c:tookPlaceAt** object properties. During this activity, “Fernando de Herrera” played the role of creator, which is modelled using an agent role structure connecting **ex:AgentRole_1** resource to the person via **pd:c:hasAgent** and to the creator role using **pd:c:roleFunction**. In addition, we have used a controlled vocabulary to reflect the associated role of the agent in the participation (i.e., **pd:c:AgentRole**) through the property **pd:c:roleFunction**. Several individuals of type **pd:c:AgentRole** may be related to a creation event to reflect different participants and their associated roles.

Being **ex:Creation_1** an expression creation activity, we can make assumptions explicit using **pd:c:createdWorkByExpressionCreation** and **pd:c:createdExpression**. In this case, both previous object properties indicate that the poetic work and its realization, identified by **ex:PoeticWork_1** and **ex:Redaction_1**, were produced simultaneously. Then, this yielded the realization of the textual signs of the original manuscript, information that can also be used to categorize the redaction resource using **pd:c:typeOfRedaction**.

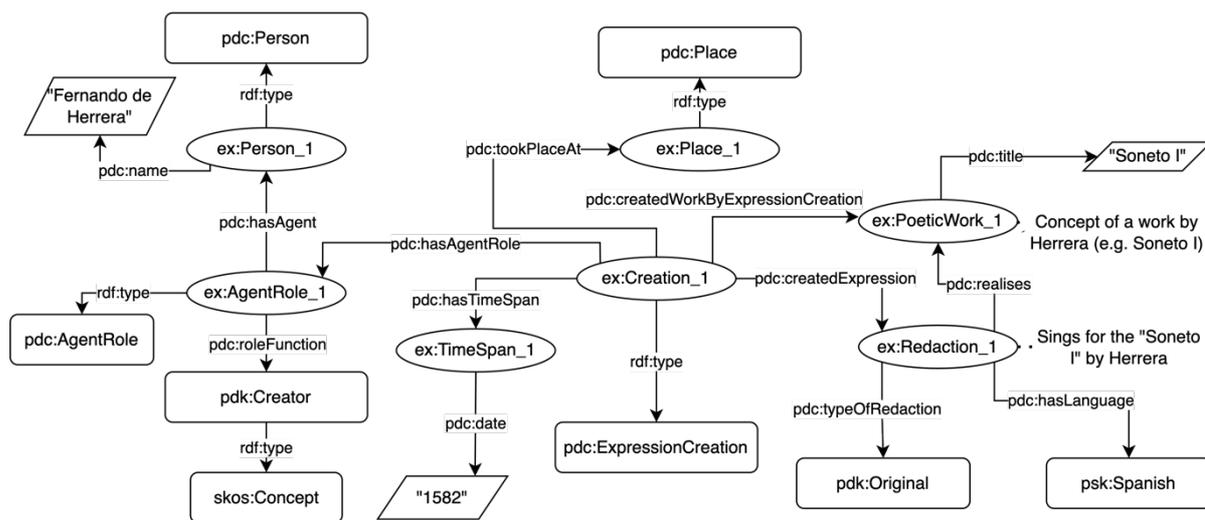


Fig. 27. Use of time expressions.

5.8. Textual annotations related to Entities

In literary knowledge domain and, therefore, in poetry, it is necessary to get information about certain entities related to the text or the work. A general way to model these relationships is to create a subproperty of **crm:P67 refers to**, to express that a text refers to another entity. We enable this representation by defining **pdc:LinguisticObject** as equivalent to **crm:E33 Linguistic Object** as the domain of the property and **pdc:CRM_Entity** equivalent to **crm:E1 CRM Entity** as the range.

Some of the subproperties of **crm:P67 refers to** defined in Ontopoetry are:

- **pdc:mentions** which states that a redaction mentions an event, person, organization or place.
- **pdc:dedicatedTo**, which relates a **pdc:Redaction** to a **pdc:Person** to whom the current text was dedicated.
- **pdc:hasCharacter**, which relates a **pdc:Redaction** to **pdc:Character** equivalent to **frb:F38 Charater**, depicted in the redaction's textual content.
- **pdc:hasNarrativeLocation**, which relates a **pdc:PoeticWork** to a **pdc:Place** in which the narrative of the poetic work takes place.
- **pdc:isIntendedFor**, which relates a **pdc:PoeticWork** or **pdc:Redaction** to a given agent that is the intended readership or receptor of the endeavour.
- **pdc:narrates** relates a **pdc:Excerpt** to the **pdc:Event** described in that precise text fragment.

In the first approach, we consider that the source of this information is the researchers. Some of these properties may be improved by identifying the sources or the authorities where they are obtained, but we have assigned this role to the researchers for simplicity and not to make a more complex model.

5.9. Ontopoetry core concepts and controlled vocabularies

Regarding the expression of concepts, FRBRoo – CIDOC CRM suggests using concepts from Knowledge Organisation Systems to classify entities according to several characteristics to indicate values of controlled vocabularies. For this reason, it is enough to

indicate that **skos:Concept** is a subclass of **crm:E55 Type**, Fig. 28.

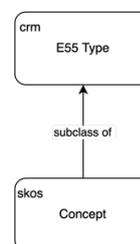


Fig. 28. Class hierarchy for **skos:Concept**.

The scope of the Postdata project is not to cover all the possible concepts of all the categories but to define the different categorizations. All these can be modelled using subproperties of **crm:P2 has type** except **pdc:hasLanguage** that is modelled by using **crm:P72 has language**.

The main goal of defining controlled vocabularies is unified terminology related to their content. In the Ontopoetry Core Module, we have identified twenty four controlled vocabularies for different properties. These vocabularies help define, with a unified terminology, characteristics of the poetry domain.

All these controlled vocabularies are public¹⁸, and it is possible to check them easily, Table 1.

The discussion about these controlled vocabularies is out of the scope of this work since it is a dynamic, open task, so it is necessary to contrast them in the poetry scholarship community to modify, extend, delete or include new ones.

As an example of the importance of these controlled vocabularies, we will show their use in Sonnet I by Fernando Herrera. From the poetic work point of view, this work is a “Poetry” **poeticType**, its genre is “sonnet”, and the **authorEducationLevel** is “Higher education” since Fernando Herrera was considered an intellectual of this time. Its redaction is a “Poem” **typeOfTextualElement** since it includes the signs of the sonnet.

From the person point of view, Fernando Herrera was a male (i.e., **gender**), and his **literaryPeriod** would be Renaissance, **socialStatus** would be Priest, **religiousAffiliation** would be Christians. By having this information defined with a controlled vocabulary, it will be possible to easily connect Fernando de Herrera,

¹⁸ Controlled Vocabularies <https://github.com/linhd-postdata/skos-codelists>

for example, with other authors of the Renaissance, whether they have been characterized with the term "Renaissance" or with "Renacimiento".

TABLE I
CONTROLLED VOCABULARIES IN ONTOPOETRY CORE.

Data Property
Audience
AuthorEducationLevel
AudienceEducationalLevel
Authorship
Certainty
Floruit
Function
Gender
Genre
Language
LiteraryPeriod
LiteraryTradition
Nationality
Occupation
PoeticType
ReligiousAffiliation
RoleFunction
SocialStatus
TypeOfCharacter
TypeOfDesignation
TypeOfEvent
TypeOfPlace
TypeOfRedaction
TypeOfTextualElement

In the case of this poem, the version published in Versos de Fernando de Herrera (1619) would have Francisco Pacheco with **roleFunction** collector, as he was the one who compiled the poems in the edition. Regarding **typeOfCharacter** vocabulary, there are not many characters in Herrera's poetry, but we can consider his lover, countess Leonor, the protagonist of many poems. She would have the role of the princess.

5.10. Datatype Properties design

During the Ontopoetry building process, we found some properties whose range was **crm:E59 Primitive**. As we did not need to make special assertions about these textual entities themselves, but we are just interested in the textual content, we followed the recommendations in [46] that suggest that to be compatible with literals, it was possible to model them in RDF as data properties instead of object properties. Therefore, we built auxiliary data properties for these object properties defined in CIDOC CRM and FRBRoo. We used this criterion for describing notes, titles,

appellations, and quantities. In the following subsections, we will present the decisions to implement these properties following these recommendations.

5.10.1. Notes, Text and Titles

CIDOC CRM defines the object property **crm:P3 has note** to relate an entity with a **crm:E62 String** class that "comprises coherent sequences of binary-encoded symbols". This property is "a container for all informal descriptions about an object". Therefore, instead of using the CIDOC CRM property, we defined the auxiliary data property **pdC:P3_has_note** [46]. We used this property for defining two subproperties related to notes:

- pdC:portrait** property to associate a person with an image denoted by an URL. We considered this information as a note.
- pdC:biography** property to include a textual description of a person's life.

IF WE CONSIDER DESCRIBING A COMPLETE, IDENTIFYING REPRESENTATION OF REDACTION'S CONTENT, WE MAY USE THE OBJECT PROPERTY **FRB:P190 HAS SYMBOLIC CONTENT** BUT APPLYING OUR PREVIOUS CRITERION, WE DEFINED AN AUXILIARY DATA PROPERTY **PD C:P190_HAS_SYMBOLIC_CONTENT** AND TWO NEW SUBPROPERTIES OF IT, WHICH ARE **PD C:TEXT** DATA PROPERTY TO INCLUDE A TEXTUAL DESCRIPTION OF A REDACTION OR A REDACTION FRAGMENT AND **PD C:ISABOUT** TO INCLUDE A SET OF KEYWORDS REPRESENTING TOPICS THAT CHARACTERIZE THE OBJECT

Table 2.

Finally, we followed the same methodology for expressing the different types of possible titles of a work. We defined an auxiliary data property **pdC:hasTitle** instead of using **crm:P102 has title** object property to express the original title as was written in its primary source, the alternative title of the work, the subtitle or the title of the edition or redaction, Table 3.

5.10.2. Datatype properties related to appellations

For the appellations, CIDOC CRM offers subclasses of **crm:E41 Appellation** to reflect the assignment of an identifier to an entity and are related to appellations using **crm:P1 is identify by**.

Therefore, we redefined **crm:P1 is identify by** as a datatype property **pdC:isIdentifiedBy**.

Also, we defined a set of data subproperties whose domains are persons, places and dates. Some of these properties express an author or person's nicknames,

pseudonyms or different appellations or coordinates of a defined place or a date, Table 4.

TABLE 2
ONTOPOETRY DATA PROPERTIES FOR NOTES AND TEXT

Property
text
isAbout
portrait
biography

TABLE 3
ONTOPOETRY DATA PROPERTIES FOR WORKS

Property
alternativeTitle
originalTitle
subtitle
title

TABLE 4
DATA PROPERTIES FOR PERSON, PLACE AND DATE.

Property
additionalName
alternativeName
forename
genName
name
nameLink
penName
positionName
Surname
address
coordinates
originalName
date

5.10.3. Datatype properties that refer to quantities

Finally, we have to pay attention to properties related to quantities. These properties can be modelled using instances of **crm:E54 Dimension**, and **crm:P90 has value** property to associate the value of the dimension, as illustrated in Fig. 29.

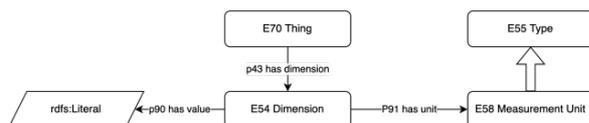


Fig. 29. Modelling dimensions in CIDOC CRM.

Since CIDOC CRM uses a **crm:E54 Dimension** class that includes more information about the measure (i.e., units) and we did not need more information than the quantity, we defined an auxiliary data property **pdc:P43_has_dimension** and a set of subproperties containing numeric information as **pdc:numberOfLines**, **pdc:numberOfPlays**, **pdc:numberOfPoems** and **pdc:redactionNumber**.

5.11. Properties linking to Poetic Analysis Module

The Ontopoetry Poetic Analysis Module represents different phenomena associated with metrics and prosody. This information is considered in the Poetic Analysis Module as an event performed by an agent and produces a result. To model this event, we have used the class **pdp:ScansionProcess**. Therefore, all the scansion processes must be related to an expression of a poem (i.e., class **pdc:Redaction**) used as input for the scansion process. These relationships are realized using the property **pdp:usedAsInput/pdp:wasInputFor**.

5.12. Properties linking to Transmission Module

Finally, Ontopoetry deals with the relation between the conceptual or abstract work and a specific edition or manifestation. This is accomplished in the Transmission Module. Redactions are embodied in bibliographic products representing the ideal characteristics of the artefacts that result from a publication process and are also information objects carried by physical objects such as manuscripts, reproductions, or particular exemplars of a publication product. To link Ontopoetry Core and Transmission Modules, we use the property **pdt:shouldBeCarriedby**, which allows us to relate a Redaction with the Bibliographic Source. On the other hand, we use **pdt:isCarriedBy**, which lets us reflect which physical carrier (i.e., Information Carrier, including Primary Source, Item and Facsimile) contains the information of a particular Redaction.

6. CONCLUSIONS AND FUTURE WORKS

This paper presents the methodology and the description of Ontopoetry, an ontology devoted to poetry developed in the Postdata (Poetry

Standardization and Linked Open Data) ERC project, which aims to provide a means for poetry researchers to publish and consume semantically-enriched data in the context of European poetry. After a critical analysis of Postdata Ontology V1.0 (i.e., the first version of the Ontopoetry based on the analysis of 25 repertoires) made by experts on ontology engineering and poetry, we built Ontopoetry ontology, a new poetry ontology that reuses, merges, and re-engineers ontological CIDO-CRM and FRBRoo resources and reuses ontology design patterns based on the NeOn Methodology. Ontopoetry consists of three modules: a) core, b) poetic analysis, and c) transmission. In this work, we present the Core Module.

This module presents the abstract or conceptual side of the bibliographic information and includes all the essential information that characterizes works and their expressions, irrespective of their physical materializations. The choice of the main classes of this module, PoeticWork, Ensemble and Redaction and their relationships, allows us to model the complexity derived from the knowledge needed to preserve in a literary study. A poem is considered a work assuming the work definition used in CIDOC CRM and FRBRoo ontologies, but it is represented using different expressions and, even depending on the original author's idea, could be interpreted as part of another work. Therefore, the options are wide, and the expressivity of the ontology must capture it. Together with the ontology definition, we have defined a set of controlled vocabularies that will help better semantic comprehension and give some uniformity in the descriptions of some concepts.

The Core Module is connected by some object properties to the Poetic Analysis Module and Transmission Module, making up these three modules the complete description of the Ontopoetry ontology. The last modules will be described in future works.

We must highlight the difficulties in reusing FRBRoo and CIDOC-CRM, considering the RDF data model. Even following all the RDF adaptation guides, some results are not completely satisfactory due to their complexity (e.g., the treatment of roles). The option of considering the new FRBRoo version called LRMoo is being considered and is still in draft and it is not yet known if it will have the same implementation problems in RDF. On the other hand, it appears that RDA does take into account the RDF data model, but it is a model that may not constrain resource descriptions

as desired, although, in our first approach, we are optimistic since it looks like it simplifies the previous models.

Finally, Ontopoetry ontology has been used to build an extended poetry knowledge graph containing corpora in Czech, English, French, Italian, Portuguese, and Spanish. A total of twelve corpora with 3,847,739 verses are available with different levels of granularity, and all of them are annotated to a certain extent. This knowledge graph can be consulted using the front-end development developed in the project¹⁹.

Besides developing the Ontopoetry ontology, the Postdata project is also developing the PoetryLab API. PoetryLab API is an extensible open-source API for poetry analysis. At this moment, it can perform syllabification, scansion (extraction of stress patterns), enjambment detection (syntactical units split into two lines), rhyme detection, and medieval named entity recognition for Spanish poetry. This API achieves the state of the art performance in the tasks for which reproducible alternatives exist. Moreover, it is designed to aggregate as many tools as needed for poetry analysis. PoetryLab API uses Ontopoetry ontology as its underlying data model, and it uses RDF triples according to this ontology as source and generates new RDF triples as results. So Ontopoetry ontology is currently the data persistence and interoperability base of PoetryLab API.

Complementary to the work done in Postdata Project related to the poetry domain, we find the work done in Dracor devoted to the drama domain. Thanks to the project CLS INFRA²⁰ we know that both works are based on interoperable ontologies. This issue is double worth, on the one hand, it supports the decision of reusing CIDOC CRM and FRBRoo ontologies, and on the other hand, the opportunity to build a new knowledge graph to support both domains contributing to the use of the semantic web in the literary studies field.

7. EXAMPLE OF CORE MODULE USE

The example poem we provide hereafter corresponds to one of the poems written by Jorge Manrique (c. 1440-1479) that were compiled into his work "Coplas a la muerte de su padre", also called "Coplas a la muerte del maestro don Rodrigo".

¹⁹ <http://poetry.linhd.uned.es:3000/es/>

²⁰ <https://clsinfra.io/>

The term “copla” is used to designate a generic poetic composition that has different adoptions according to the author. In this case, Jorge Manrique introduced his own type of copla. We want to represent third poem of our reference work, “Copla III” whose text is in Augusto Cortina textual edition and is the following:

Nuestras vidas son los ríos
que van a dar en la mar,
que es el morir,
allí van los señoríos
derechos a se acabar
y consumir;
allí los ríos caudales,
allí los otros medianos
y más chicos,
y llegados, son iguales
los que viven por sus manos
y los ricos.

The work exhibits a style that falls into the literary genre of medieval cult lyric poetry, comprising a set of reflections about death, politics, courtly love, fame, fortune, and the concept of death in Christianity. Specifically, “Coplas a la muerte de su padre” is an elegy composed of forty poems or “coplas”, ordered according to three thematic parts, being the last one dedicated to his father, the noble Rodrigo Manrique, after his death in the 11th November 1476.

As it was written during the transit from the Middle Age to the Renaissance, the whole work can be assigned to the Pre-Renaissance movement. Jorge Manrique is also influenced by “Pregunta de nobles” by Marqués de Santillana. All this information can be represented using Ontopoetry Core Module, and we use the **pdk** namespace for skos concepts.

Therefore, we consider “Coplas a la muerte de su padre” to be an instance of **pdC:Ensemble** with the following properties:

1. **pdC:title** is “Coplas a la muerte de su padre”
2. **pdC:alternativeTitle** is “Coplas a la muerte del maestro don Rodrigo”.
3. **pdC:genre** is **pdK:MedievalCultLyric** and **pdK:Elegy**
4. **pdC:literaryPeriod** is **pdK:PreRenaissance**
5. **pdC:isAbout** “death”, “politics”, “courtly love”, “fame”.
6. **pdC:numberOfPoems** is 40.

7. **pdC:wasInfluencedBy** “Pregunta de nobles” and **pdC:Ensemble** from Marqués de Santillana who is a **pdC:Person**

In our example, we are focusing on the Copla III so

8. “Copla III” is a **pdC:PoeticWork**
9. Furthermore, the ensemble **pdC:incorporates** “Copla III” with the following properties:
 - a. **pdC:title** “Copla III”
 - b. **pdC:isRealisedThrough** Augusto Cortina textual edition of “Copla III”.
10. Augusto Cortina textual edition of “Copla III” is a **pdC:Redaction** with the following properties:
 - a. **pdC:text** is the whole text previously shown.
 - b. **pdC:hasIncipit** an instance of **pdC:Excerpt** with **pdC:text** “Nuestras vidas son los ríos”
 - c. **pdC:hasExcipit** an instance of **pdC:Excerpt** with **pdC:text** “y los ricos”.

Focusing on the author Jorge Manrique is a **pdC:person** with the following properties:

1. **pdC:name** “Jorge Manrique”
2. **pdC:wasBorn** in a **pdC:date** “1440” and **pdC:tookPlaceAt** in a **pdC:Place** with **rdfs:label** “Palencia”.
3. **pdC:diedIn** in **pdC:date** “1479” and **pdC:tookPlaceAt** in a **pdC:Place** with **rdfs:label** “Cuenca”.

To reflect his authorship, we can say that Jorge Manrique (i.e., **pdC:Person** instance) is related with an instance **pdC:AgentRole** through **pdC:has Agent** and with the role of creator **pdK:Creator** through **pdC:rolefunction**. To establish the relation between the **pdC:agentrole** instance and the work, we use the property **pdC:isAgentRole** relating an instance of **pdC:WorkConception** that **pdC:initiated** the ensemble “Coplas a la muerte de su padre”. The same mechanism is used for the case of Diego Arias de Ávila, but in this case, as the creator of the ensemble “Pregunta de nobles”.

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