

Capturing Knowledge about Philosophy

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ABSTRACT

In this paper, we present an ontology developed to support annotating and reasoning about philosophical knowledge. By this term, we refer to both the *factual* domain of philosophers, concerning their lives and publications, and the *theoretical* domain, concerning the ideas they have produced and their relationships. The ontology provides a novel model, which brings together a number of existing formalizations and a series of new ones. In this paper we describe the design of the ontology, in particular focusing on the solutions we have devised to address the modelling problems and natural language ambiguities, which occur when capturing knowledge in a domain as complex as that of philosophy. This work is being carried out in the context of developing a tool, PhiloSURFical, which aims to support ontology-driven exploration of philosophical resources. Specifically, the ontology makes it possible to navigate the philosophical domain, according to a number of *narratives*, which include theoretical, historical, argumentational, geographic, and others.

Categories and Subject Descriptors

I.2.4 Knowledge Representation Formalisms and Methods
– representation languages.

General Terms

Design, Standardization.

Keywords

Philosophy, navigation, ontology of ideas.

INTRODUCTION

The need to specify and separate the information about the context of usage of a learning resource, from the resource itself, is one of the main reasons behind the creation of various kinds of metadata schemas [1]. One way of doing this, which is gaining more importance in the context of the quickly developing Semantic Web [2], sees at its center the usage of ontologies. In the PhiloSURFical tool this approach is realized through the formalization of a humanistic discipline, philosophy. An ontology which describes and organizes *theories*, , *arguments*, *problems* and their relations to other

philosophical concepts allows the annotation of learning materials, and, subsequently, their dynamic reorganization with a high degree of flexibility. For example, within an educational scenario where young philosophers try to understand domain notions (in a wide sense, comprising ideas and events), we can have functionalities such as mechanisms for *contextual navigation* and linking of relevant resources. In particular, the PhiloSURFical application¹ is being prototyped with Wittgenstein's Tractatus Logico Philosophicus [3] and it supports the navigation of a semantically enhanced version of the text. For example, students can reorganize the same text according to the relevance of a single metadata, e.g. the concept of "logical-independence". Or they can query the knowledge base or other repositories in the Semantic Web, such as the DBpedia [4], by choosing an object of interest (i.e. a topic) and using it to trigger a *theoretical narrative* (i.e. meta-historical), a *historical narrative*, or a *geographical* one. This is achieved by using simultaneously the knowledge encoded in the ontology, an initial Wittgenstein-related knowledge base built by a philosophy teacher, and the SPARQL [5] query language to gather information from other sources in the SW.

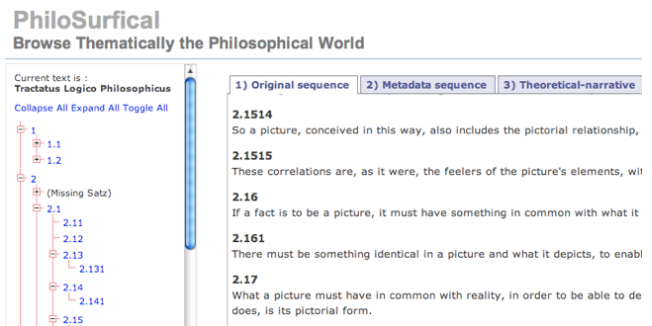


Figure 1. Screenshot of PhiloSURFical

In this paper we present some ontological lessons-learned which emerged as fundamental in supporting these functionalities. In this respect, the modelling patterns described in the next sections can resemble the patterns discussed in other works such as [6]. However, while these focus on both architectural issues (i.e. regarding the ontology creation process) and content issues (i.e. regarding how to model a domain), we deal only with the second type of problems. In particular, the patterns we are describing represent some modelling decisions that are meant to guide the *interpretation* of philosophical

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¹ A prototype of the tool is available at <http://philosurfical.open.ac.uk>

knowledge, thus generating formal models that are *applicable* for providing non-trivial navigation mechanisms.

In the following sections, we will first give an overview of the salient features of philosophy as a domain, then describe the approach taken in constructing the ontology; in the second part of the paper we will instead describe in detail various modeling issues that emerged during the work: for clarity reasons, they are grouped within three sections, according to the ontology branch they belong to (i.e. temporal entities, entities related to the formalization of texts, and philosophical ideas). Finally, in the related work section, we give an overview of other attempts to formalize the philosophical domain.

DOMAIN ANALYSIS

Various discussions with domain experts and also an analysis of the more or less explicit curricula formalized in philosophical textbooks were useful in the ontology requirements' definition. At a first glance, we recognized the following generic distinctive features in the philosophical domain:

- 1) it is very *vast*, both in its *historical* dimension (which comprises at least 2000 years of events related to the lives of thinkers, and to their intellectual productions) and in its *theoretical* dimension (that is, with respect to the various existing philosophical viewpoints, and to the relations they can have with the other philosophical ideas);
- 2) it is *dynamic* and *slippery*: practitioners recognize the major areas of interest, but hardly agree on the details. Moreover, it is normal practice for a "respectable" philosophy to redefine its own research questions and motivate them in an independent way. We can call this the *recursive* feature of a philosophy, by which a conception, in its radical definition of the world, needs also to define its sense and position within the world (thus, the problems and situations that justify its existence);
- 3) it is inherently related to *argumentation* practices: activities such as the exegesis of a text, the interpretation of an idea or the discussion about its meaning are what constitutes the core of a philosopher's practice.

A deeper analysis of the materials collected helped us breaking down these three generic features into some more specific ones. To this aim, we have also carried out a knowledge acquisition experiment: a group of domain experts (lectures and PhD students) were involved in a card-sorting task [7], to identify the mechanisms practitioners employ for classifying philosophical entities (especially *abstract* entities, i.e. ideas). These results made us conclude that a suitable semantic model should provide support for representing:

- a) **historical events**, that is, events which are inherently time-dependent (e.g. the publication of a book, or an author's subscription to a viewpoint);

- b) generic **uncertainty**, since often we are talking about facts which cannot be located exactly in the time and space dimension (e.g. the birth of Heraclitus);

- c) **information objects**, and especially language-based information objects, as they are the traditionally preferred medium philosophical contents are expressed with;

- d) **interpretation events**, intended as the process of attributing an abstract content to an information object (e.g. when we say that "Aristotle's fourth book of the *Metaphysics* states an ontological principle");

- e) coexistence of **contradictory information**, which is a direct consequence of d) (e.g. when people claim different or opposing views on the same subject);

- f) **viewpoints**, and other non-material entities ("philosophical ideas"), for they are the objects philosophers are usually involved with, in their everyday practices;

- g) **varying granularity**: the model should be capable of overcoming the difficulties imposed by philosophical conceptions' "radicalism" (i.e. the *recursive* feature described above). This means providing facilities to properly describe a philosophy, considered in both its singularity and within an historical perspective. E.g. being able to express the historical contiguity of "Aristotle's distinction of the four causes" with "Hume's radical skepticism regarding the cause notion", although the two conceptions, taken singularly, do not have much in common with respect to the definition of the "cause" notion.

APPROACH

The specific approach used to realize this system has at its centre the decision to employ the CIDOC Conceptual Reference Model [8] as a starting point for our formalizations. The CRM ontology was originally an attempt of the CIDOC Committee of the International Council of Museums (ICOM) to achieve semantic interoperability for museum data. Since 1996, the formal model has improved considerably till becoming in 2006 an ISO standard (version 4.2 [9]). The choice of using the CRM was motivated by two reasons. Firstly, for its widely recognized status as a standard for interpreting cultural heritage data. In fact, by reusing and extending an existing and internationally recognized ontology, we will give our tool's users more chances to benefit from the emerging Semantic Web infrastructure. Secondly, for its extensive event-centered design. This design rationale, in fact, appeared to be appropriate also when trying to organize the history of philosophy: even if it is common to see it as an *history of ideas*, stressing the importance of the *theoretical* (i.e. meta-historical) dimension, this cannot be examined without an adequate consideration of the *historical* dimension. That is, a history of the events related (directly or indirectly) to these ideas. The point a) of the domain analysis is thus supported by CIDOC generic modeling approach.

As an example, in figure 2 we can see an event-centered representation in the PhiloSURFical ontology. The **persistent-item** class, which is one of the five classes composing CIDOC's top layer (together with **time-specification**, **dimension**, **place** and **temporal-entity**) subsumes **thing** and **actor**. The two branches of the ontology departing from them can have various instances, which are related by taking part (in various ways) to the same **event** ("1933-Prague-meeting"). This kind of modeling, in the context of the PhiloSURFical tool, is extremely useful because of the multiple navigational pathways it can support (e.g. we could move to another event having the same topic, or to another topic treated during the same event, etc.)

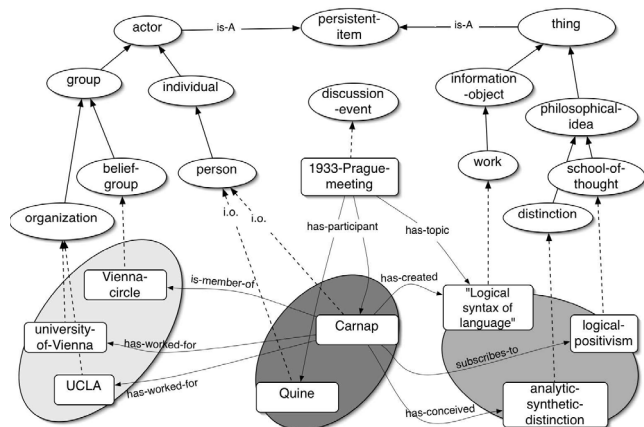


Figure 2. Example of an event-centred representation

We must remember also that CIDOC does not provide any facility for reasoning on time. In order to satisfy point b) we have imported an ontology produced during a previous project in our department [10], which offer facilities inspired and compliant with Allen's specifications [11]. This has let us obtain some basic reasoning on philosophers' timelines, taking into account the fact that some dates (mainly in ancient philosophy) are uncertain.

Furthermore, we decided to integrate the event-based CIDOC reference model with formalizations from other ontologies, because they provide facilities that are relevant to the points c), d) and e), as highlighted earlier during the domain analysis. In particular, we included knowledge about the domain of publications from the AKT reference ontology [12] and knowledge about information objects from the related module of the Dolce foundational ontology [13]. Moreover, as we are dealing with a domain where bibliographic resources are central, we have also attempted to build a model that is possibly compliant with cataloguing standard. To this purpose, we are providing mappings and reusing notions from the Functional Requirements for Bibliographic Records (FRBR) specifications [14], which are a very influential standard² for librarians.

Finally, a large portion of the PhiloSURFical ontology is constituted by a series of new concepts and relations, mostly aimed at the description of philosophical events and ideas. The philosophical events integrate CIDOC in satisfying the requirements expressed in points a) and d), while the ideas satisfies those described in f) and g).

At the time of writing, the ontology³ counts 348 classes. In the next sections we will present various ontological issues we encountered during the modeling process, together with the solutions we produced in order to solve them. As in the example above, the derived modeling patterns aim at taking advantage of the multiple meanings a philosophical entity (e.g. an idea, a text or an event) can have, by making these meanings explicit and employable when building novel exploration mechanisms. In other words, according to our approach, "ambiguities are good" because, if properly identified, they let us explore the domain in different and interesting ways.

The ontology has been developed using the Operational Conceptual Modeling Language (OCML) [15], which both provides rich support for specification and also a computational environment, which makes it possible to verify, query and reason with the ontology. Import/export mechanisms from OCML to other languages, such as OWL and Ontolingua, ensure interoperability with current standards.

PHILOSOPHICAL EVENTS

Temporal-entity in CIDOC is the class describing all things that have a time span, and among them what we commonly call events. For example, births and deaths of philosophers, journeys which occurred during their lives, creation of intellectual works, conception of ideas or performance of scientific experiments are all entities which can be suitably described using the CIDOC model as a basis. However, it was also necessary to extend it with some new classes. For explanation purposes, we divided them into two groups.

Intellectual movements

This specification is related to the fact that in our everyday language we refer to belief groups, intellectual movements and schools of thought ambiguously, often using the same word. According to CIDOC, **Period** (which is a direct subclass of **Temporal-entity**) should subsume prehistoric or historic periods, or even artistic styles. This is motivated by the fact that "it is the social or physical coherence of these phenomena that identify a Period and not the associated spatio-temporal bounds" [9]. This seemed to apply quite neatly also to *cultural* and *philosophical periods*, thus we have added **Intellectual-movement** and its subclass **Philosophical-movement** to the hierarchy. So, for example, we can describe the "enlightenment movement" in the following way (note that the temporal

² It is, for example, recommended by the Anglo-American Cataloguing Rules (<http://www.aacr2.org/>)

³The latest version of the ontology can be found online at <http://philosurfical.open.ac.uk/ontology/>.

relations are specified here as slots, but are usually inferred whenever the appropriate time specifications of the other periods were provided)⁴:

```
(def-instance enlightenment intellectual-movement
  ((has-time-specification 18th-century)
   (overlaps-in-time-with scientific-revolution renaissance)
   (meets-in-time-with French-revolution American-revolution
    romanticism)
   (overlaps-with Age-of-Reason neo-classical-art)
   (took-place-at Germany France Britain Spain)
   (has-related-group-of-people enlightenment-group-of-people)
   (is-typified-by enlightenment-conception)))
```

The last two properties in the previous example have a special importance. Periods, in fact, appear to be tightly connected to the abstract ideas defining them and to the group of people that often carries the same name. The slots *has-related-group-of-people* and *is-typified-by* specifically serve this purpose. This issue is better understood if we just consider how often this feature of intellectual events generates ambiguities, since in natural-language expressions it is not clear what entity we are referring to. For example, let us consider the following three statements:

- “Throughout history, the attacks of rationalism against empiricism has diminished”
- “Descartes was one of the founders of modern rationalism
- “This theory is clearly a new and re-shaped rationalism”

At a first examination, all three sentences refer to “rationalism”. However, a deeper ontological analysis shows that in a) “rationalism” is the label referencing to a group of people, in b) we are denoting an event, while in c) we are (probably) referring to an abstract idea.

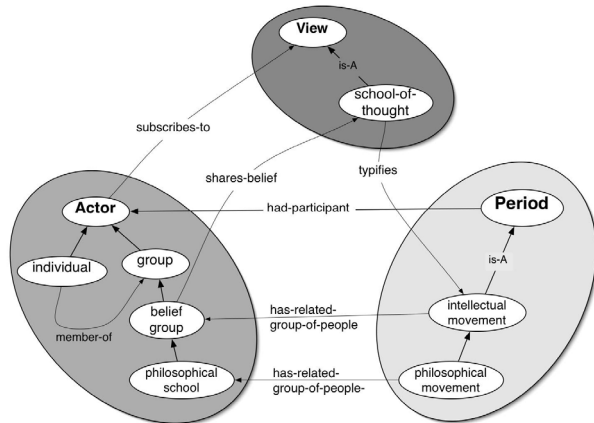


Figure 3. Modelling pattern to disambiguate “rationalism”

A modeling pattern (figure 3) involving actors, periods and views (a type of abstract philosophical idea, as we shall see later, expressing a standpoint) attempts to tidy things up and clarify the ambiguity of a term, such as “rationalism”, by distinguishing between the three different uses of the term in the language. By doing so, we are providing a context of usage for such ambiguous concepts, and a direct

way to navigate coherently among entities that are ontologically quite distinct (i.e. from **temporal-entity** to **actor** and **propositional-content**, which belong to separate branches of the ontology). Moreover, such a context-specification could be used by a reasoner to derive inferences from incomplete or inconsistent data sources, or for performing information extraction.

Social and intellectual activities

As CIDOC does not provide an easy way to model the social and intellectual activities of philosophers, we created various classes for this purpose, which are grouped under **social-activity** and **intellectual-activity**. Within the first group, we have five subclasses: **discussion**, **joining-a-group**, **educational-activity**, **close-social-contact** and **social-gathering**. Partially inspired by some AKT formalizations, these entities allow us to extend the event-based kind of reasoning discussed earlier. For example, as we can see in figure 4, we can specify that the book by Kimberley Cornish (titled “The Jew of Linz”) has as subject the fact that Wittgenstein was studying at the Linz Realschule at the same time as Hitler.

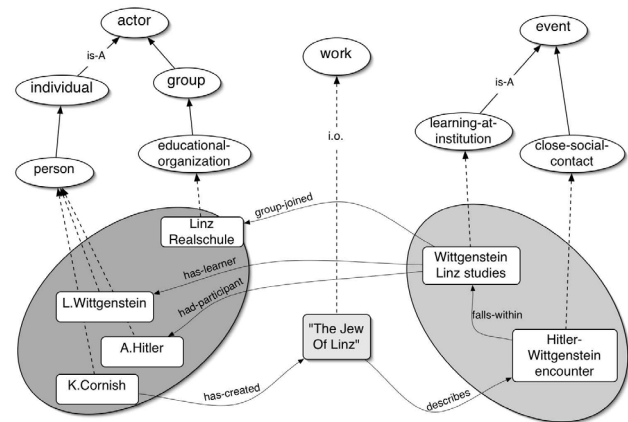


Figure 4. Social activities of philosophers

For that regards the **intellectual-activity** branch, we identified the following classes: **conceptual-creation**, **idea-modification**, **idea-usage**, **study**, **view-subscription** and **interpretation**. **Conceptual-creation** reflects the creation of conceptual entities such as ideas and information objects (in the original CRM this class was called “creation”, and was a direct subclass of activity). **Idea-modification** reflects the change of one or more ideas within the context of a view (e.g. the evolution of the meaning of “libido” in the work of Sigmund Freud [...]); more specifically, **theory-refinement** represents the modification of a theory by adding or removing one of its constituent elements. Often thinkers do not create concepts ex-novo, but reuse old ones: **idea-usage** aims at modeling this event, while **theory-transposition** models the special case when a theory is taken out of a context and reused within another one (e.g. “Spencer’s evolutionism”, which extends “Darwin’s evolutionism” from biology to metaphysics). Thinkers are also normally occupied

⁴ OCML has a simple frame-like syntax, with sequences of *slot-name* and *slot-values*.

studying things, let them be documents (**study-a-document**), ideas (**study-an-idea**) or events (**study-an-event**). With these classes we just want to model the event of a person being interested and examining something. They are therefore connected, but different, from the activity of interpreting something (as explained below).

View-subscription models the intentional adoption of a view by a person, providing support for the annotation of the main arguments that convinced him/her (if existing). Finally, **interpretation** is representing the common-sense process of assigning a “meaning” to a thing. For now, we provide support for the interpretation of documents and events. The **document-interpretation** class lets users correlate a **propositional-content** to an **information-object**, or state the *aboutness* of two information-object (i.e. when we say that “a text is about another text”). A second type of interpretation is instead **event-interpretation**. Here a user can claim the connection (possibly causal) between different events, or their being about some abstract content or document (e.g., when we say that “Monk’s book is about the life of Wittgenstein”).

PHILOSOPHICAL DOCUMENTS

Although the CIDOC ontology provides some basic semantic structures for representing things such as books, articles, movies and their contents, it is clearly more suited for representing various features of physical objects, in particular museum artifacts (e.g. mummies, vases, paintings etc.). Therefore, we have integrated from other sources some specific patterns targeted at representing information-related entities. One of them, inspired by works such as Dolce’s description of information-objects (IO) [13], or Mizoguchi’s ontology of representation [16], aims at abstracting and separating three aspects of an IO. That is,

- a) the information about the content of a representation,
- b) the information about the form used to present it and
- c) the information about the physical implementation of an IO, which realizes it in the real world.

This modeling pattern allows dealing with various common-sense concepts, such as the fact that we can have “copies” of representations, different “versions” of them, or representations “about” other representations. Moreover, another source of inspiration for our formalizations have been the FRBR specifications [14], which attempt to separate the description of intellectual works from the various existing versions of them and their physical realization. Accordingly, apart for the class **Information-carrier**, which comes from CIDOC and maps quite obviously to c), we have extended the original model with the following classes (compare figure 5):

1) **Propositional-content**. It is the content of a representation, specified through the *has-content* property of **expression**. These entities, which are totally abstracts, have been classified as **product-proposition** and **design-proposition**, depending on whether they are the *specification* for the production of something, or the

product itself (as explained in [16]). For example, a **philosophical-work** is a product-type that reifies the content of famous intellectual creations (e.g. “The world as will and representation” by Schopenhauer), without giving any specification whatsoever regarding their representational form. Among the product-propositions, we have also the **philosophical-idea** type of entities (see next section).

Expression. This class is defined as the **information-object** that realizes a **proposition** through a **representational-form**. Depending on the specific **representational-form** the expression is using, we can have **2d-expression**, **3d-expression** and **symbolic-expression**. In particular, among the symbolic expressions we can find the **text** and **sentence** classes, which are particularly important in the modeling of philosophical works.

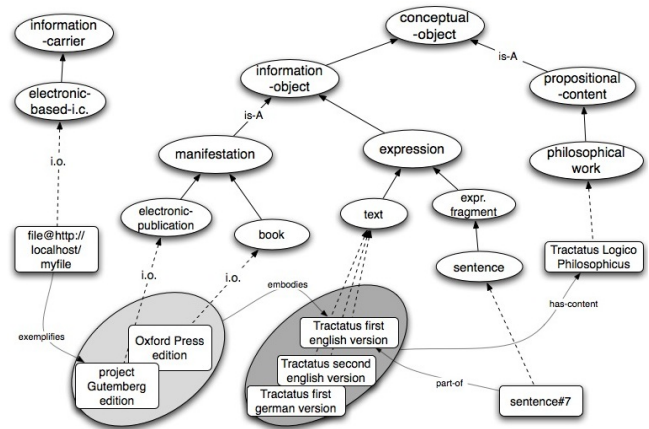


Figure 5. Various abstractions about the “Tractatus”

3) **Representational-form**. It is the “language” the information object uses to convey its meaning. For example, “written-english”, “musical-sound” or “cartoon-animations”. The hierarchy we are using has at the top layer **symbolic-form**, the class of forms that represents through symbol systems (e.g. languages), and **iconic-form**, the class of forms which represent through a more direct imitation the original signified object (from the greek “eikon”, which means “likeness, image, portrait”).

4) **Manifestation**. This is another class inspired by the FRBR specifications. A **manifestation** is defined there as “the physical embodiment of an expression of a work”, through the usage of a physical medium. The main relation between **manifestation** and **expression** is *embodies*; the relation *is-exemplified-by*, instead, links a **manifestation** to the single items that result from the production process. Even if in FRBR it is considered an entity reflecting physical form, we acknowledged the fact that it is not a physical entity, but an abstract one (that is, a **conceptual-object**). According to our view, a **manifestation** is the reification of the *embodiment* of an **expression** into a physical entity. As such, it is representative of the class of the physical entities produced with the same ‘publication’

process. Therefore, it is an abstraction. For example, manifestation can be an **audio-production**, a **video-production** or a **publication**. This last class, especially, has an important role: it refers to linguistic publications (usually on paper-based media, but not necessarily) and it is the junction point with the AKT specifications about documents' types. We have thus imported concepts defining things such as **magazine**, **journal**, and **conference-proceedings** as manifestations (in the original AKT model they were instead conceived as tangible-things).

PHILOSOPHICAL IDEAS

Our approach, which can be related to a "constructivist" epistemology [17], sees every philosophy as a system of interrelated conceptual entities used to make sense of a target world. From this perspective, we can say that such entities are all abstract (non-physical), since they are "what we use" to refer to the physical world. The main consequence of this perspective is that even a common concept like "fire", which would be often instantiated (in other ontologies) as a physical entity or a process, in our model becomes an instance of an abstract idea (i.e. a **concept**). In fact, the notion of "fire", as any other notion, is socially constructed [18] and often explicitly defined by a *viewpoint* (e.g. the "Newtonian physics", or the "philosophy of Heraclitus"). The fact that people are generally more or less explicitly aware of this viewpoint, in all its aspects and subtleties, constitutes another issue and does not disprove the existence of it. For us, the problem to tackle is the individuation of the types of non-physical-objects playing a role in the construction of viewpoints, and, more broadly, having a recognizable function in the process of interaction and succession of viewpoints within the whole history of thought.

By using this approach, we identified eight main classes composing the philosophical-idea branch of the ontology (which are **argument-entity**, **method**, **problem-area**, **problem**, **view**, **distinction**, **rhetorical-figure** and **concept**). For space reasons, in the next sections we will see only two examples, where is shown how our formalizations have proved to be particularly useful when generating patterns of navigation.

Views and theories

This pattern is related to the fact that people often employ the term "theory" in a loose manner, over-classifying views with different characteristics.

In our ontology, **view** has been defined as a generic class referring to philosophical ideas expressing a viewpoint. That is, propositions picturing a perspective on the world in the form of more or less structured interpretations of things and events. Examples of view are "solipsism", "theory of evolution by natural selection", "philosophy of Plato" or "a name has a meaning only in the context of a proposition" (i.e. Frege's context principle). Because of their "categorical" attitude, views usually *define concepts* and, in general, create the context for the definition of other

meanings too (e.g. **problem-areas**, **problems**, **methods** etc.). A number of properties connect views to the other philosophical-ideas: e.g. views can *use* other ideas, *tackle* problems, *influence* and *support/contrast* each other, *be-supported* by arguments. However, the feature we want to highlight here is how views can have different granularities: from our analysis of the literature, we identified four of them. This classification is mainly related to the degree of generality they exhibit, and the level of complexity they have. So, we can have (compare figure X):

- **Thesis**: is the least structured view, as sometimes it consists only of a standpoint in the form of a statement (i.e. an assertion). So, for example, in the context of Wittgenstein's "picture theory of language", a thesis can be the "independence of the state of things".

- **Theory**: is a systemic conceptual construction with a coherent and organic architecture. A theory explains a specific phenomenon (or a class of phenomena) and typically answers to an already existing problem. Examples can be Darwin's "theory of evolution" or Quine's "verification theory".

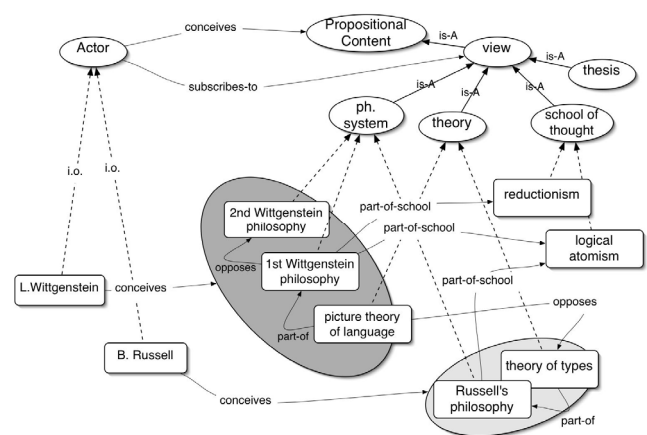


Figure 6. View types

- **Philosophical-system**: it might appear as a theory, at first sight, but it differs from it essentially for its generality. That is, because it spans over various problem-area, while a theory is usually confined to one problem-area only. As a consequence, theories are usually *part-of* philosophical systems. We can therefore define a system as the set of a person's views that are consistently connected to each other, in such a way to form a unity (in a way, this class refers to what is normally called the "philosophy" of a thinker).

- **School-of-thought**: this class refers to the set of theory-types, or generic standpoints, which in the history of thought have acquired a particular significance and, seemingly, a life on their own. They correspond to widely known conceptions, or standardized intellectual trends that hint at typical ways to answer a problem (or a set of problems). Examples are "pacifism", "animism", "expansionism", "empiricism" or "monism". A school-of-thought, compared to the other views, is not as formalized

and specific as a theory, and not as general and systematic as a philosophical-system.

Fields of study

This second pattern wants to provide a way of expressing the distinctive features of fields of study. As we will see, the difficulty here arises from the fact that we can interpret them in two different ways: a *generic* one (e.g. the field of “physics”) and a *specific* one (e.g. “Newtonian physics”). The pattern models the relations between them.

Our starting point is a problem-centered approach, that is, the decision to see the activity of philosophers as essentially an ongoing process of specifying and giving solutions to problems. Consequently, we consider any recognized area of study, of whatever type or dimensions, as a **problem-area**. In its simplest version, a problem-area is composed by a set of problems linked by different relational schemas, but in general, tying around a main theme. This theme, in our ontology, can be represented through a **problem** (*has-central-problem* property) or thanks to a **thesis** functioning as a criterion (*has-criteria* property). For example, “psychology”, when treated as a **problem-area**, can gather problems tied to the “mind-definition” problem, to the problem of “relating human behavior to brain activities”, or to the thesis that “brain and mind can be investigated with the methods of natural sciences”. Other features of problem-areas are that they can be *related-to* each other (e.g. “mathematics” and “philosophy of mathematics”) and that they can be organized into simple hierarchies (e.g. “internet-ethics” *is-a-sub-area-of* “ethics”). However, we realized soon that “psychology” has a role and significance in our world that goes beyond a mere problem area. In a similar fashion, “ethics” or “cognitive science” would not be properly characterized only as instances of **problem-area**, for they also refer to theories or methods which have become intrinsically related to the definition of the area.

Moreover, if we consider the history of thought, the topic and description of problem areas have always been subject of many debates: different views aspire at having the ultimate vision about what the central issues to look at are, or the right methods to take. In this respect, problem-areas are not very different from other ideas that can be *defined* by multiple views. For example, we can just consider how different was the sense given to “philosophy of language” by the first philosophy of Wittgenstein and the second one.

In order to catch these subtle differences, we defined the class **field-of-study** as a **problem-area** that has been socially and historically recognized as separate from the others (and from being a mere agglomerate of problems). In the ontology, this is reflected by the fact that a **field-of-study** is not just specified by a criteria, but is *defined-by* a view. It is also characterized by the fact that it collects not only problems, but also ways to solve or tackle them (i.e. *theories* and *methods*). The distinguishing properties are therefore *defined-by-view*, *has-exemplar-theory* and *has-methodology*. Finally, a last tricky issue regarding fields of

study must be addressed (see figure 5). This does not emerge when treating relatively isolated entities such as “phrenology”, but it clearly is an issue if we consider, say, “physics”. In our everyday language, and also in the organization of academic programs, we usually refer to “physics”, “psychology” or “philosophy of mind” as *generic* fields of study. What this means, is not really clear. In fact, when we delve into them (or even more, if we ask a practitioner for clarifications), we discover quickly that there are *many* “physics”, “psychologies” and “philosophies”, at least as many as the views defining them. From our ontological perspective, these would all be separate instance-candidates of the **field-of-study** class. However, we also need to represent the fact that they are all part of a more generic type of field of study (and probably *emptier*, for that regards its meaning).

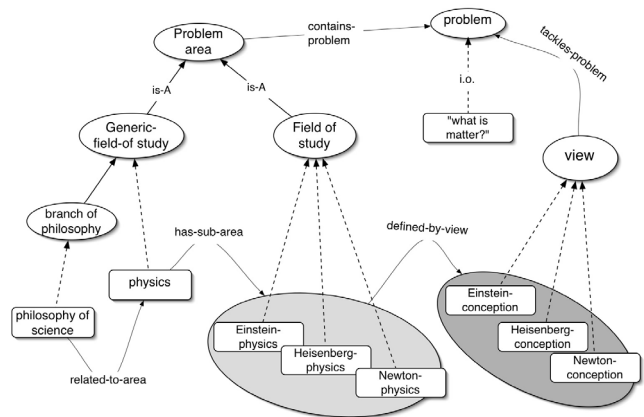


Figure 7. Generic and specific fields of study

Our solution to this problem consists in the creation of a **generic-field-of-study** class, which has no defining view but the views defining the specific **fields-of-study** that are claimed to be part of it. In other words, we are formalizing the fact that generic fields of study such as “physics” or “philosophy” can be defined only *extensionally*. So:

```
(def-rule generic-field-rule
  (defined-by-view ?GF ?V) if (generic-field-of-study ?GF)
    (has-sub-area ?GF ?F)
    (defined-by-view ?F ?V))
```

In the formula, the variables ?GF, ?V and ?F refer respectively to **generic-field-of-study**, **view** and **field-of-study**. Therefore, by doing so we can maintain the interoperability between specific thinkers’ definitions of classic problem areas, and the generic but useful ways to refer to them.

RELATED WORK

The most relevant (and to our knowledge unique) attempt to systematically formalize the philosophical domain is the one carried out in [19], as part of a larger project aimed at building a dynamic ontological-backbone for the online version of the Stanford Encyclopedia of Philosophy (SEP). Compared to our approach, this work is less focused on knowledge modeling and more targeted at finding useful information extraction techniques, which could benefit

from the vast expert-reviewed SEP. For example, in their case the *idea* sub-branch of the ontology is populated according to “semantic relevance” of ideas (based on words co-occurrence), instead of trying to model a hierarchy of types. Therefore, we see the two approached as fundamentally complementary and likely to be used together in future work.

For that regards the formalization of ideas (and especially philosophical ideas) we found no evidence of relevant work in the literature. Although models such as Wordnet [20] and Cyc [21] have in their knowledge-base philosophy-related concepts, they present them in hierarchies that are either too flat (e.g. everything is a subclass of “doctrine”) or not complex enough to support any navigation mechanism. The noteworthy exception here is the DnS module of Dolce [22], which is “intended to provide a framework for representing contexts, methods, norms, theories, situations”, and has strongly influenced us. However, our ontology appears to be much more specifically suited to represent philosophical entities, such as *schools of thoughts* or *problems*. In fact, such topics are only marginally treated by DnS, which focuses on the formalization of entities such as plans, laws and regulations (*legal objects*) and situations.

Finally, it is important mentioning that our formalization of fields of study could be related to the work done in digital libraries subjects’ classification. Although we come from a different perspective, we acknowledge that approaches such as the *mereotopological* one [23] could be well suited also for the philosophical domain. We plan to investigate this issue further in future work.

CONCLUSION

In this paper, we have presented an ontology which, to our knowledge is the most ambitious attempt so far to capture the complexity of the key concepts in the philosophical domain. As already mentioned, we are currently building a tool to support ontology driven navigation of philosophical resources that we plan to make available in the summer. The tool will then allow us to carry out a task-based evaluation of the ontology.

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