An Ontology Diagram for Coordination of the Hylomorphically Treated Entities

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Abstract. An Ontology diagram based on the two-dimensional Cartesian coordinate system is described. The diagram is meant both for philosophy and Artificial Intelligence (e.g., knowledge representation) applications. Generally, the diagram provides the fundamental articulation of reality. It visualizes relations among the *form* and *matter* and their compounds—entities, such as *a thing*, *something* and *nothing*. Aristotle's hylomorphism, the Square of Opposition, and the Cartesian coordinate system motivates idea of the diagram. The Cartesian coordinate system is treated in terms of structure. Matter and form are viewed as its axes; their intersection then is considered an *Ontology coordinate system*. Positive values of the coordinates imply *presence*, and negative imply *privation* of form or matter, correspondingly. Intersection of the axes creates four quadrants; presence of form and matter (i.e., their compound) makes *substance*, or *thing*. The meaning of quadrants is analyzed in terms of ontology, logic, and semiotics. The Ontology diagram might reveal new possibilities to use the Cartesian idea of coordination for humanities and social science applications. Optimistically, it might become as useful, as the Cartesian coordinate system proved to be for mathematics, physics and other domains of science.

Keywords: Ontology Diagram, Hylomorphism, Cartesian Coordinate System, Semiotics.

1 Introduction

Philosophical ideas and theories traditionally are described in terms of texts. In comparison to exact sciences, visual means and diagrams, in particular, are rarely used in philosophy. Unfortunately, only a few successful and commonly admitted diagrams are used. The Square of Opposition probably is one of the best known [1]. In this paper, a diagram for better understanding of basic relations of ontology is considered. The term *ontology* is used in two related senses. In the first sense, it is considered a branch of philosophy—the theory of Being [2]. Ontology—as a philosophical theory—in this paper is treated in terms of Aristotle's hylomorphism. In *Metaphysics*, Aristotle accounts for Being in terms of two metaphysical principles, the *matter* and *form* [3]. Aristotle chooses *hulê* (it means *wood* in Greek) to denote the first principle; it also may be treated as *content*; he uses a word *shape* (*morphê* in Greek) to denote the second principle. His theory of Being, accordingly, is denoted by a compound

term *hylomorphism*—matter-formism. It should be noted that meaning of *the form* is not limited to its geometrical treatment as shape. It may have many different interpretations; in particular, Aristotle also treats it as function, when noting that vision is a form of the eye. Similar idea to treat things as conjunction of form and content is common in modern times.

In the second sense, the word ontology (and *ontologies*) is treated as a term used in Artificial Intelligence research (e.g., in relation to knowledge representation—as set of concept definitions [4]). *Ontologies* are often represented by means of diagrams. A term *Ontology chart* and *Ontology diagram* is used in this context.

The purpose of this paper is to describe an *Ontology diagram* for visual presentation of the *top-level entities* and relations among them, accounted for in terms of hylomorphism. The Ontology diagram also may be treated as a case of an Ontology chart used for knowledge representation in Artificial Intelligence applications—since the diagram represents the top-level ideas of ontology.

An inspiring idea for building the Ontology diagram is a two-dimensional Cartesian system of coordinates**.** The system is treated in terms of its structure. Form and matter—the two initial ideas of hylomorphism**—**are taken as its axes. The four quadrants then make the four corresponding top-level entities. The Cartesian coordinate system also imposes corresponding logical relations among the entities.

2   A Hylomorphism Based Ontological Coordinate System

### 2.1   Structural Treatment of the Cartesian Coordinate System

An inspiring idea for building the Ontology diagram is the two-dimensional Cartesian coordinate system. The system was proposed by Descartes [5] as a tool for coordination of points in space. For building an Ontology diagram, the Cartesian system is treated in terms of its structure, as Fig. 1 shows. The system subdivides the space into four quadrants. The coordinates of the structurally treated system do not imply quantity, what means, for example, that such relations as *more* or *less* are not applicable. The arrows on the axes then indicate only presence (+) or absence (-) of a coordinate.
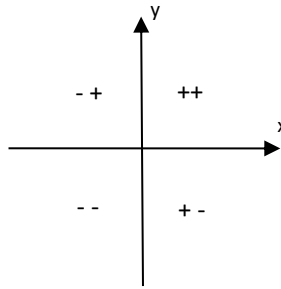
Fig. 1. The structurally treated Cartesian coordinate system

2.2 Diagram Based on the Ontological Coordinate System

The structurally treated Cartesian coordinate system can be applied for articulation of Being considered in terms of hylomorphism. Matter and form in such a case is viewed as two axes of the system. Their intersection then makes an *Ontological coordinate system* as Fig. 2 shows. It also may be called a *Hylomorphic coordinate system*.
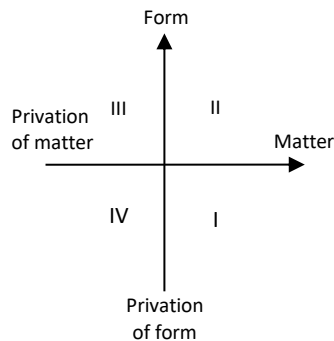
Fig. 2. The Ontological coordinate system

There are two options for numbering the quadrants of the Ontological coordinate system. From the point of view of Aristotle's ontology, matter is viewed as initial mode of Being. The numbering, therefore, should naturally begin from the quadrant determined by presence of matter and privation of form. Such an order is used in the Fig. 2. Alternatively, a traditional order—used in the Cartesian coordinate system might be used. The numbering then would start from the quadrant determined by presence of both, matter and form. Ontologically, such an order would imply that a compound of form and matter (i.e., substance) is treated as an initial mode of Being.

The term *privation of matter* in the Fig. 2 needs additional comments. Privation is not the same as absence. Aristotle gave the following example of privation. A blind man has a privation of ability to see; however it cannot be said that a stone has privation of vision, because it has no eyes. It is easy to imagine a *privation of form* (e.g., as

in case of a *formless* thing), but absence of matter, especially in terms of Aristotle, is not thinkable. Aristotle used the term privation only in relation to form, but not matter. It should be also noted that the terms *privation* and *absence* further will be used as synonyms, implying the meaning *privation*.

3   A Hylomorphism Based Ontology Diagram

The quadrants of the Ontological coordinate system (Fig. 2) can be further considered from several perspectives: hylomorphic, logical, and semiotic.

3.1   A Hylomorphic Perspective

Each quadrant of the Ontological coordinate system is determined as a compound of its hylomorphic components; therefore, the first and natural interpretation should be done in terms of form and matter. This perspective is the most fundamental one. The Ontological coordinate system in terms of its hylomorphic components is presented in the Fig. 3.
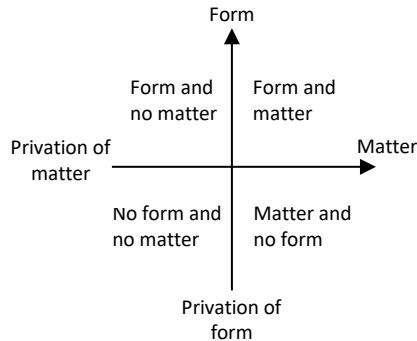
Fig. 3. The Ontology diagram presented in terms of the hylomorphic components

3.2   A Logical Perspective

An inspiring idea to consider the logic of the Ontological coordinate system is the Square of Opposition, also known as the Boethius' Square; its idea originates from Aristotle's *On Interpretation* [6]. The Square visually represents relations among the four basic types of propositions [1]. They are listed in the Table 1.

Table 1. The four basic types of propositions

Name	Proposition	Symbol
Universal affirmative	Every S is P	A
Universal negative	No S is P	E
Particular affirmative	Some S is P	I
Particular negative	Some S is not P	O

It is proposed in this paper to compare the Square of Opposition with the Ontology diagram presented in terms of hylomorphic components (Fig.3). Then it is easy to notice that each quadrant can be interpreted as proposition of the Square of Opposition, as Table 2 shows.
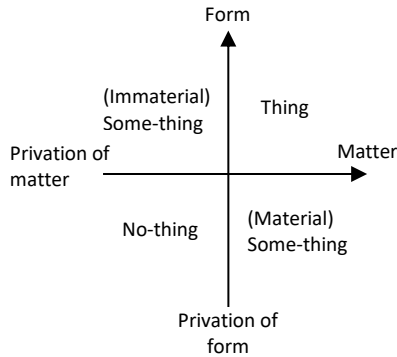
Table 2. Interpretation of propositions for the Ontology diagram

Quadrant (See Fig. 2)	Proposition (See Fig. 3)	Interpretation
II	Every coordinate is positive (both, form and matter are present)	Universal affirmative
IV	No coordinate is positive (both, form and matter are absent)	Universal negative
III	Some coordinate is positive (one coordinate, e.g., form is present)	Particular affirmative
I	Some coordinate is negative (one coordinate, e.g., form is absent)	Particular negative

Also, it should be noted that propositions for the second and fourth quadrants (*Some coordinate is ...*) have two options: *Form is ...*, or *Matter is ...*; consequently, there should be two corresponding options of the Ontology diagram. Only one is considered in this paper.

3.3   A Semiotic Perspective

The Ontology diagram can be also treated in terms of the ontological meaning of its quadrants. Each quadrant of the diagram in such a case is interpreted as a mode of Being determined by means of a pair of its coordinates. A pair of form and matter in the second quadrant then makes *substance*, or *thing* (see Fig. 4), putting it in a simpler way. The thing is a *fully determined* mode of Being, since both its components, form and matter are present.

Form

(Immaterial)   Thing
Some-thing

Privation of   Matter
matter

            No-thing   (Material)
                            Some-thing

Privation of
form

**Fig. 4.** The meaning of quadrants of the Ontology diagram

The other three modes of Being in the Ontology diagram are not fully determined, because they lack either form or matter, or both. In our common language, we may denote the partly determined mode by a word *something*; its relation with the *thing* can be more clearly seen by means of presenting it as *some-thing*. The latter is either *immaterial some-thing*, when it corresponds to the mode determined by presence of form and privation of matter, or *material some-thing*, when determined by privation of form and presence of matter. The fourth quadrant presents a *fully undetermined* mode of Being because it is described in terms of privation of both, form and matter. It may be termed as *no-thing*.

An example to illustrate semiotic treatment of the Ontology diagram is provided in the Fig. 5.

Form

Project   *House*

Privation of   Matter
matter

Plot of   Building
land   materials

Privation of
form
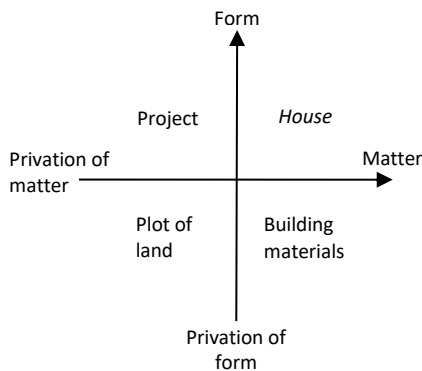
Fig. 5. A thing *House* presented in terms of the Ontology diagram

The above described interpretation of the quadrants presents a most natural ontology of the *thing*. Other interpretations of the same—top‑level—modes of Being are possible. The word *anything* can be considered instead of *something*. Taking into account relation between *something* and *anything*, the Ontology diagram for the *thing* can be presented in an alternative way (see Fig. 6).
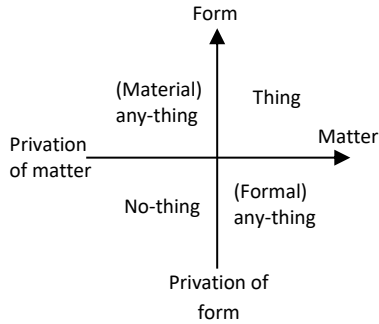
Fig. 6. An alternative interpretation of the Ontology diagram (presented in terms of *anything instead of something*)

4   Discussion

The Ontological coordinate system provides a *hylomorphic* treatment of the thing—in terms of the form and matter. An alternative is *mechanistic*, common for physics treatment of the thing when it is defined in terms of a set of its properties. The latter prevails in modern times. The Ontology diagram treats the *thing* in terms of its logical relation to similar entities; the treatment, therefore, may be qualified as *logical*. Also, it might be denoted as *Cartesian*, in the sense that it is based on the idea of the Cartesian coordinate system. Most fundamentally, in terms of a metaphysical perspective, the thing can even be treated as *a transcendental*.

The thing in the Ontology diagram is treated as *a simple* ontological entity—in terms of *one form* and *one matter*. Other types of entities also sometimes are treated as things: e.g., mind, animal, artefact. The latter types of thing have more than one form and matter; in such a sense they are *complex things*. An advanced—*complex* Ontology diagram should be considered to represent such types of entities.

The form and matter in the Ontology diagram are viewed in terms of logical propositions; their deeper meaning—as metaphysical principles—is not considered in this paper. Certain symmetry between the form and matter is present in the diagram, since privation of form and privation of matter, both are possible; Aristotle, however, speaks only about privation of form. The symmetry implements a *binary principle*. The universality of the binary approach in the treatment of reality was also claimed by

Leibniz. Later, in the twentieth century, the binary principle was implemented in the fundamentals of information technologies.

In this paper, only basic idea of the Ontology diagram is described. Ideas presented in this paper are based on author's previous research, mainly related to semiotics. In particular, it is described in the book *Sign and Form* [7]. The following directions of further research should be considered. A relation between the Ontology diagram and the Square of Opposition, in particular to the Semiotic Square, should be explored in more details. Possibilities of the Ontology diagram for the account of cognitive phenomena should be explored—taking into account that hylomorphism can be extended for the account of cognition. An entire system of the hylomorphism based Ontology diagrams might be developed.

5   Conclusions

The Ontology diagram is constructed by means of merging the fundamental ideas of Aristotle, Boethius and Descartes. It implements very simple—but fundamental—idea of logical coordination of entities. Cartesian coordinate system during the last few centuries proved to be a powerful tool for mathematics, physics and other domains of science. The hylomorphism based Ontology diagram developed on its basis might reveal new possibilities to use the Cartesian idea of coordination for the humanities and social science applications. In particular, for philosophy, it was applied in treating the problem of objecthood; for semiotics, it was applied to build the models of the signified object and the sign as homomorphism [7].

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