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The Domain Shared by Computational and Digital Ontology: A Phenomenological Exploration and Analysis

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THE DOMAIN SHARED BY COMPUTATIONAL AND DIGITAL ONTOLOGY:
A PHENOMENOLOGICAL EXPLORATION AND ANALYSIS

By

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To my parents

Wendell and Judy

and to the God of my understanding

without whom none of my achievements would be possible.
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ABSTRACT

The purpose of this dissertation is to explore and analyze a domain of research thought to be shared by two areas of philosophy: computational and digital ontology. Computational ontology is philosophy used to develop information systems also called computational ontologies. Digital ontology is philosophy dealing with our understanding of Being and human existence in terms of the digital. While computational ontology accounts for reality as that which is disclosed to us by natural science—reality independent of human experience—digital ontology always begins with and refers back to the human being in its analysis of Being. The methodology in this dissertation is phenomenology. Both computational and digital ontology are represented using instrumental case studies. The findings consist of essential components shared by computational and digital ontology, the modes in which they appear, and philosophical questions to explore in future research. Ultimately, this dissertation concludes that there is a domain shared by computational and digital ontology in spite of some fundamental differences between the two.
1. INTRODUCTION

This dissertation is a qualitative exploration of two areas of philosophy: one applied in the development of information organization and retrieval systems called computational ontology; and the other, called digital ontology, which revisits questions concerning Being and human existence with regard to our understanding of reality in terms of digital technology. This research is framed by the distinction in Western philosophy proper between the analytic tradition and the continental tradition. Western philosophy is simply the philosophy tracing its origins back to the Ancient Greeks—the pre-Socratics. Scholars typically associate the analytic tradition with problem-solving, emphasis on formal logic, and confident belief in an objective reality describable as it is independent of human experience. Scholars typically characterize the continental tradition as discursive rather than formulaic, emphasizing political, cultural, and gender-related influences on knowledge and understanding, and refusing to deny the human role in empirical and rational investigation of the world. In this case, computational ontology exemplifies the analytic tradition and digital ontology exemplifies the continental tradition. The ultimate aim and outcome of this work is to identify what these two areas of philosophy share in essence in order to define a common domain. So the primary research question is the following: What are the essences shared by the domain and what are their modes of appearance? This phenomenological process begins with the hope of finding such a domain and ends with the assertion of its existence. So, there is an equally, if not more important question implied in the methodology: Is there a domain shared by computational and digital ontology? In defining and analyzing the domain, as expected, findings prove to be more interrogative than conclusive. We do not hold this as a weakness, but rather as indicative of the philosophical nature of the subject matter. The questions asked include, but are not limited to, the following:

- Can we develop computational ontologies from Heidegger’s human-centered perspective?
- If it is possible to ground computational ontologies in a human-centered perspective, is it necessary or even possible to do so using something like Heidegger’s discourse on the matter?
- If computational ontologies are seriously considered comprehensive representations of reality (or at least substantial portions of it), what does such a view have to say about things that cannot be represented in computational ontologies?
It is safe to say that one can represent the entity *homo sapien* in a computational ontology, but can *human being*, or as Heidegger calls it *Dasein*, be represented? If not, what does this say about Dasein? What does it say about computational ontologies?

Can we represent the temporality of human beings in computational systems—the temporality Heidegger considers the most primordial?

Is the representation of time synonymous with derivative time?

If we view the cosmos as fundamentally digital, then what makes cyberspace different from the rest of the universe? Is it just a particular region within the universe but not ontologically distinct from the rest of the universe? Or is there some sort of ontological difference between it and the universe?

Can we represent spatio-temporal entities like *cybertime*, *cyberspacetime*, and *cyberspace* the same way computational ontology represents *time*, *spacetime*, and *space*? If so, would the former require different parameters?

Is computational ontology an example subject to the digital ontologists’ critique?

Although these questions are theoretical and philosophical, their relevance is still very much within the scope of practice in user studies and information systems development—relevant because they have direct implications for how we will build information systems and for how we understand users and human beings in general with regard to our understanding of reality as ultimately digital.

Computational ontologies are systems based on analytic philosophy and principles of more traditional information organization systems. One of the instrumental case studies in this dissertation, the Basic Formal Ontology (BFO), is a computational ontology designed to represent entities, universals, classes, and relationships shared by all domains of knowledge. Its developers created it to serve as a meta-system to connect large databases with differing universes of knowledge, thus making them interoperable (Smith, 1998; Spear, 2006). The premises in its development stake philosophical claims about how we can best represent not only our knowledge of the world, but reality itself (Smith, 2004). Likewise, ideas within the area of philosophy used to develop this computational system distinguish the uniqueness of human beings and human reality while arguing that this reality and the reality disclosed by natural science are inseparable in the greater holism (Smith, 2002). The philosophy grounding digital ontology speaks to this holism as well, but reaches it from a fundamentally different
perspective. In this dissertation, the philosophy of Rafael Capurro and Michael Eldred serve as instrumental case studies of digital ontology. Digital ontology addresses digital representation of reality by revisiting Heidegger’s critique of Western philosophy. Heidegger’s ontology is an essentially human-centered perspective. Digital ontology asserts that today we hold the real to be only that which we can represent digitally (Capurro, 1999; 2006; Eldred, 2001). Digital ontologists do not see this belief to be new or novel, but rather as a culmination of Ancient Greek and ultimately Cartesian ontology (Capurro, 1999; 2006; Eldred, 2001).


2. LITERATURE REVIEW

To introduce philosophical ontology, let us look at possibly the most salient distinction in Occidental philosophy: the analytic and continental traditions. The distinction, although seamless, is an important one. For our purpose here, it helps illustrate the most characteristically different approaches to ontology.

Although we reach this distinction retrospectively amid varying accounts, some identify Kant as the juncture where these two branches meet (Critchley, 2001). As was stated in the introduction, the analytic tradition is typically associated with problem-solving, emphasis on formal logic, and confident belief in an objective reality describable as it is independent of human experience. Computational ontology development finds its grounding within analytic philosophical ontology. The continental tradition is typically characterized as discursive rather than formally logical, accentuating political, cultural, and gender-related influences on knowledge and understanding, and emphasizes the human role in empirical and rational investigation of the world. Continental ontology, and in particular Heidegger’s philosophy, is anti-intellectual in the sense that it breaks with Cartesian emphasis on human beings as essentially thinking things and sees humans as more holistically experiential entities. One may find little if any influence the continental tradition has had to date on computational ontology. However, in part, this project intends to address what continental digital ontology and analytic computational ontology may have to offer and help illuminate in one another.

In the discussion below I take liberty to pick the most salient and relevant figures as representatives of the differing approaches to ontology. This generalization is admittedly oversimplified when investigated in depth, as is the distinction between the analytic and continental traditions as mutually exclusive domains of philosophy. However, for our purposes here, to get our bearings, both the distinction and the generalization are helpful.

2.1 Differing Foundations—The Analytic/Continental Divide

2.1.1 The Analytic Tradition—Naturalism and Formal Logic
Barry Smith (2003) argues well for the use of Quine’s ontology as the methodological strategy for computational ontology development, particularly for upper-level ontologies. Briefly stated, Quine holds that we best come to understand beings, which all have only one type of being rather than varying types (see the discussion of Heidegger below), by employing formal logic with scientific theory which is properly developed from data sentences based on sensory experience (Smith, 2003). Within this paradigm, an ontological system is limited to the particular theory set from which it is derived. Therefore, since there are innumerable theory sets to develop ontologies, there is no nor is it possible to develop a single ontology to describe the circumference of reality. Smith holds that we can move a step beyond this version of ontological relativism by agreeing on non-domain-specific entities, classifications, and relationships to establish upper-level ontologies to connect domain-specific computational ontologies. I discuss this in more detail in the section devoted to computational ontologies.

Quine is an ontological and epistemological naturalist (R. Gibson, 2004b). Naturalism asserts that we best come to know truths about the world using empirical methods of the natural sciences. More precisely, naturalism refutes the notion of an a priori understanding, a “first philosophy,” preceding or grounding science and that with science lies the responsibility of informing us about what exists and how we may understand it (R. Gibson, 2004a). Quine is an ontological naturalist in that he holds science to be “the measure of what there is” and an epistemological naturalist in that he holds science to be how “we come to know what there is” (R. Gibson, 2004b, p. 6).

Quine agrees with Otto Neurath’s view concerning the relationship between science and philosophy (R. Gibson, 2004b). Citing Neurath, Quine states that science is a boat that, if rebuilt, must be rebuilt “plank by plank while staying afloat in it”—“[t]he philosopher and the scientist are in the same boat” (1960, p. 3). Quine’s naturalism places philosophy in a specific conceptual space with relation to science. Concerning the existence of physical objects Quine states that the natural scientist is the one “to decide about wombats and unicorns” and that within other domains like mathematics, those experts decide what exists (Quine, 1960, p. 275). He goes on to say that the scientist cannot study and revise the fundamental scheme of science and common sense without having some conceptual scheme, whether the same or another no less in need of philosophical scrutiny, in which to work. He can scrutinize and improve the system from within, appealing to coherence.

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1 The goal of developing such a first philosophy is evident in Descartes’ Meditations on first philosophy (1996).
and simplicity; but this is the theoretician’s method generally […] no experiment may be expected to settle an ontological issue; but this is only because such issues are connected with surface irritations in such multifarious ways, through a maze of intervening theory. (1960, pp. 275-276)

One might say that Quine views philosophy as meta-science, but carefully avoiding the idea of a first philosophy as stated earlier. From this perspective, science takes the executive epistemological position over philosophy. However, both work together synergistically in that philosophy attends to these “surface irritations” of theory primarily using formal logic to establish sound philosophical ontologies.

2.1.2 Computational Ontology—Types, Approaches, and Examples

Computational ontology\(^2\) is

1. The area of philosophy that goes into the development of information systems of the same name; and

2. Information systems developed with semantic network capabilities and engineered using analytic ontology for its philosophical framework.

Herre et al. (2006) define computational ontology as a set of “formal specifications and computationally tractable standardized definitions of terms used to represent knowledge of specific domains in ways designed to maximize intercommunicability with other domains” (p. 1). Smith (2003) states that these specifications and definitions are derived “from earlier initiatives in database management systems” but that they also include logical methods developed in analytic philosophy (p. 6). Additionally, he argues that by using tested and accepted scientific theory with the aid of formal logic, we can confidently develop upper-level ontologies to serve as *backbones* (formal ontologies) for ontologies of varying domains (material ontologies) because these theories and formulae are the best methods for telling us what entities and classes of entities there are and how they all relate to one another. Smith collaborates

\(^2\) I use the term ‘computational ontology’ to distinguish these knowledge management structures from ‘ontology’ in the strictly philosophical sense. There seems to be no conventional name to distinguish computational ontology from philosophical ontology.
prolifically in ontology development and application. One such project is the Basic Formal Ontology (BFO) (Spear, 2006).

There are a number of types of computational ontologies. The two most relevant to this discussion are formal ontologies and material ontologies. Material ontologies (Spear, 2006) are domain-specific vocabularies used to conceptualize and develop domain-specific information systems (Yi, 2006). Formal ontologies are designed to conceptualize universal categories and relationships shared by all domains for the purpose of interoperability between domains (Spear, 2006).

Formal ontologies typically represent time in terms of temporally distinct categories and entities (Herre et al., 2006; Smith & Grenon, 2004; Spear, 2006). These categories include temporal and spatio-temporal regions like intervals and instants (Herre et al., 2006; Smith & Grenon, 2004; Spear, 2006). Likewise, general entities are defined by the nature of their identity through time, what Grenon and Smith (2004) refer to as “temporal modes of being” (p. 139). Two of the most basic of these entities are continuants, sometimes called material persistants (Herre et al., 2006, p. 23), and occurrents (Herre et al., 2006; Spear, 2006). A continuant is an “entity that exists in full at any time in which it exists at all, persists through time while maintaining its identity, and has no temporal parts” (Spear, 2006, p. 43). A continuant may be your pet, a novel, a flute, Halley’s Comet, my new haircut, or an empire. An occurrent is a process, event, activity, change (Grenon & Smith, 2003), or more generally something “that has temporal parts and that happens, unfolds or develops in time” (Spear, 2006, p. 60). An occurrent could be the 2008 Tour de France, the visible duration of Halley’s Comet’s 1986 pass by planet Earth, a pregnancy, the collapse of an empire, or the writing of a novel. Grenon and Smith cite that occurrents are “bound in time,” meaning that there is a “corresponding temporal portion” for every “portion of the time during which an occurrent occurs” (2003, p. 140).

Herre et al. (2006), in reference to their outline of the General Formal Ontology (GFO), denote such intervals of time as chronoids. They cite that each “chronoid has exactly two external and infinitely many inner time boundaries which are equivalently called timepoints” (2006, p. 17). They go on to say that time boundaries “depend on chronoids (i.e., they have no independent existence) and can coincide” (2006, p. 17). Systems such as the BFO and the GFO allow for the representation of occurrents coexisting within a particular region of time and whose time boundaries meet or overlap.

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3 These only serve as primary examples. There are many more categories and subcategories. Likewise, the BFO defines relationship types that will be addressed in later sections. Relationships are fundamentally important to computational ontologies. I provide a more comprehensive discussion of temporal/spatial entities and relations in later chapters.
Similar conceptualizations within these systems take into account spatial and spatio-temporal dimensions that allow both discrete and overlapping spatial entities and boundaries.

The next few sections outline the continental approach to ontology and continental-type views on ontology in reference to digital phenomena. Although these differing viewpoints share the term ‘ontology,’ their differences are so striking they almost seem unrelated. However, note that they are not talking about different philosophical domains entirely. Both sides address fundamental descriptions of reality (Being, entities, space, and time) and how to represent that reality in digital media. I only discuss broad similarities and differences here but characterize these with greater detail in later chapters.

2.1.3 The Continental Tradition—Existential Analytic of Dasein

It is safe to say that Heidegger is the continental philosopher on whom most continental philosophers base their ontologies. Likewise, Rafael Capurro (2006) uses Heidegger’s conception of being-in-the-world-with-others (Mitdasein) as the basis for what he considers the necessary ethic to ground digital ontology. Heidegger states that the task of ontology is not to define entities and relations, but that the terms ontology and phenomenology ―characterize philosophy itself with regard to its object and its way of treating that object‖ (1962, p. 62) That object (although ‘object’ is a poor choice of words here) is Being. He distinguishes what he calls ontology (the question of What is Being?) from the classification of entities and categories which he calls metaphysics or ontics rather than ontology. Heidegger asserts that Being is not a “class or genus of entities” yet still “pertains to every entity” (1962, p. 62). He holds that an understanding of Being must begin with the being who “in its very Being, that Being is an issue for it”: Dasein—which literally means “being-there” (1962, p. 32). Dasein is the particular mode of being for humans. This mode always has a there-ness to it. In answering the question What is Being? one must begin with Dasein because Dasein is the one asking the question! This fact necessarily relates all of Being back to Dasein. One may interpret or dismiss this as subjectivism. However, Heidegger tries to demonstrate that anytime we speak of (the being of) something or other, our beholding and speaking of it entails a being-with it. In other words, one cannot classify it, represent it, or speak of it without its being having already been bound up with the being Dasein. Heidegger contends that this is not a subjective fiction, but a fact about reality. One might even consider his position an alternative
version of realism or what Dreyfus (1991) calls “a minimal hermeneutic realis[m] about nature and the objects of natural science” (p. 253).

Heidegger does not limit his scope to the discussion of Dasein. He always seeks to describe Being qua Being, but denies that one can do so without addressing it in relation to Dasein. His task is fundamental ontology and prima facie seems to be the type of first philosophy of which Quine is so leery. Although Heidegger often speaks of science, he does not intend his ontology to be some sort of platform for science. Therefore, strictly speaking, his philosophy is not a “first philosophy” in the Quinian sense.

Two important types of being distinct from Dasein are readiness-to-hand and presence-at-hand (Heidegger, 1962). The ready-to-hand comprises a network of useful and meaningful entities collectively called equipment (Heidegger, 1962). Conversely, entities present-at-hand lack meaning and have a sort of naked presence in the world. Dasein may only experience something present-at-hand in the milieu of equipment. Heidegger states that “the modes of conspicuousness, obtrusiveness, and obstinacy all have the function of bringing to the fore the characteristic of presence-at-hand in what is ready-to-hand” (1962, p. 104). He argues that science often mistakenly places priority on knowing the present-at-hand when scientists only arrive at the present-at-hand through abstraction. This means that access to the present-at-hand requires some sort of penetration through the horizon of equipment. He says that readiness-to-hand “is the way in which entities as they are ‘in themselves’ are defined ontological-categorically” but that “only by reason of something present-at-hand, is there anything ready-to-hand” (1962, p. 101).

Heidegger carefully details Dasein’s physical situation within the world. He acknowledges that Dasein understands itself as a “certain ‘factual being-present-at-hand’” but that such being is ontologically different from the factual being-present-at-hand of a mineral or object in the world (1962, p. 82). He distinguishes Dasein’s being as “Being-in-the-world in such a way that it can understand itself as bound up in its ‘destiny’ with the Being of those entities which it encounters within its own world” (Heidegger, 1962, p. 82) Heidegger elaborates on the concept of Dasein’s Being-in-the-world:

So one cannot think of [Being-in-the-world] as the Being-present-at-hand of some corporeal Thing […] Nor does the term “Being-in” mean a spatial ‘in-one-another-ness’ of things present-at-hand […] ‘In’ is derived from “innan”—“to reside,” “habitate,” “to dwell” [sich auf halten]. ‘An’ signifies “I am accustomed,” “I am familiar with,” “I look after something” […] The entity
to which Being-in this signification belongs is one which we have characterized as that entity which in each case myself am [bin]. The expression ‘bin’ is connected with ‘bei,’ and so ‘ich bin’ [‘I am’] means in turn “I reside” or “dwell alongside”⁴ the world, as that which is familiar to me in such and such a way. “Being” [Sein], as the infinitive of ‘ich bin’ (that is to say, when it is understood as an existential), signifies “to reside alongside…,” “to be familiar with…” “Being-in” is thus the formal existential expression for the Being of Dasein, which has Being-in-the-world as its essential state. (Heidegger, 1962, p. 79-81)

This point is a fundamentally important departure from Cartesian mind/body, subject/object distinction. Heidegger identifies the artificial nature of seeing the world “out there” and me “in here,” in this body. Dasein is bei the world, which when translated implies dwelling amid. Heidegger indicates that the primordial sense of in does not necessarily connote spatial location as in “the blazer is in the closet,” but rather connotes existential involvement in the sense of dwelling in or residing in (Dreyfus, 1991). In other words, Dasein is not a consciousness encapsulated in a body looking out into the world. Neither is it reducible to its physical body. Lifeless, unconscious matter cannot be at home in the world as Dasein is. Likewise, Dasein is not a somehow separate inhabitant of a physical body. Heidegger arrives at these conclusions through phenomenological and hermeneutic interpretation of his own experience of reality as that of one Dasein among many. He insists that an understanding of beings and relationships entails the embedding of that understanding in Dasein’s being-in-the-world, being-with-others (Mit-Dasein), and the distinction between the ready-to-hand and present-at-hand (Heidegger, 1962).

This bears relevance to computational ontology because if Heidegger is correct, we cannot create accurate models of entities, categories, and relationships as they are, bound up in the destiny of Dasein, without grounding these models in an existential analytic of Dasein. This raises several questions. First and foremost, is Heidegger correct in his belief that ontology must be grounded in the existential analytic of Dasein? Second, if he is correct, can we develop computational ontologies using an existential analytic of Dasein? Third, if it is possible to ground computational ontologies in the existential analytic of Dasein, is it necessary or even possible to do so using something like Heidegger’s discourse on the matter?

⁴ This is actually a poor translation and has since been translated by Dreyfus (1991) as “dwell amidst” (p. xi).
2.1.4 Digital Ontology

The term *digital ontology* poses some definitive problems that need clarification. A common meaning of the term refers to a cosmology that reduces all of reality to the digital, i.e. bits, binary relations, etc., which is also referred to as *digital physics*, *digital metaphysics*, and *digital philosophy* (Floridi, 2009). Luciano Floridi (2009) says that digital ontologists in this sense typically hold the following:

1) the nature of the physical universe (time, space and every entity and process in space-time) is ultimately discrete;
2) the physical universe can be adequately modeled by discrete values like the integers;
3) the evolution (state transitions) of the physical universe is computable as the output of a (presumably short) algorithm; and
4) the laws governing the physical universe are entirely deterministic. (p. 152-153)

He argues against this view. However, I will not address his work on this issue in detail because another philosophical perspective also called *digital ontology* is most relevant to this dissertation (Capurro, 2006; Eldred, 2001). The following should clarify the use of the term *digital ontology* throughout the rest of the dissertation:

**Digital Ontology (strong)** - Floridi’s definition given above and the view he opposes (Capurro and Eldred do not hold this strong view).

**Digital ontology (weak)** - the casting of Being in terms of digital phenomena that takes into account Heidegger’s *care structure*.6

The latter version resembles digital ontology (strong) but considers more our epistemologies and understanding of the world in terms of digitalization. Capurro (2006) outlines this in the following passage:

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5 I want to make clear that the work in this dissertation began before Eldred published revisions to his own work cited here. The cited webpage and Eldred’s work underwent considerable revision in February 2009. I only use and refer to the work he published online in 2001.
6 Heidegger describes the care structure as the temporality of Dasein. It consists of the three dimensions of past, present, and future. See the chapter on temporality and spatiality for clarification.
the “information revolution” concerns not just the influence of computing and (digital) information on philosophy but the pervading view according to which today we believe that we understand things in their being as far as we are able to digitalize them.⁷ I am not claiming that all human beings or even a specific group, say, all computer scientists or all philosophers think or even live their everyday lives explicitly within this framework or that they theoretically agree with it. My conjecture concerns the perception that digital ontology under the shape of digital metaphysics pervades in a prima facie trivial sense our society as a whole including our scientific methods and our philosophical reflection. It is our “Zeitgeist.” (Capurro, 2006, para. 11)

With the previous quote, we get yet another distinction: that between digital ontology (weak) and digital metaphysics.

Digital Metaphysics (or Digital Ontics) –

1) The casting of Being in terms of digital phenomena as standing presence-at-hand without regard of the care structure.
2) The view of natural beings “from the mathematical dimension” where they “only appear insofar as they are measurable and thus can be taken apart digitally.” (Eldred, 2001, Part 4)

Again, Capurro (2006) illuminates digital metaphysics 1 in the following:

If the digital casting of Being by holding only to the one-dimensional sense of presence forgets the question of Being in its full three dimensionality it “changes over” into digital metaphysics. The difference between digital ontology and digital metaphysics is therefore, following this theory, essential if we want to avoid a dogmatic theoretical position and its ethical consequences. (Capurro, 2006, para. 10)

From this point forward, anytime the term digital ontology is used, it will refer to digital ontology (weak).

⁷ This resembles item number 4 Floridi identifies concerning the modeling the universe in discrete terms.
Michael Eldred (2001) considers ontical questions concerning digital beings, but also addresses the ontological ramifications of these questions. He sees digital reality as a geometrically conceived arithmetic matrix that is without space but must account for the bodiliness of Dasein in the effect of interfacing with corporeal sense organs and appendages. Likewise, he seems to imply that this reality does not coincide with what Heidegger considers primordial and authentic time.

Dasein, for which the world opens up in understanding, can today outsource to a computer its interpretation of the ontically understood world in segments into binarily programmed pre-interpretations of the world, where the understanding of world itself already has to be compatible with a digital decomposition. Such a world understanding is oriented toward setting up and controlling the totality of beings. (Eldred, 2001, Part 4)

Eldred describes contemporary digital reality as the necessary culmination of Aristotelian, and eventually Cartesian, “lifting of the logos and number from natural beings” (Eldred, 2001, Part 3). He describes the Ancient Greek conception of logos as discrete and placeless (Eldred, 2001). Because of this discreteness and placelessness, the logos can be stored and replicated in “stampable mass(es)” and “spoken of to presence anywhere” (Eldred, 2001, Part 3). Thus, in the same manner that Dasein relocates beings ready-to-hand (tools and such) for use, books and media are likewise stored in what Eldred (2001) calls the “topological complex for Dasein” (Part 3). He goes on to say that the programmer translates understanding, knowledge, the logos, into programming language and ultimately binary code that can be calculated and controlled. Eldred (2001) extrapolates that in this form, understandable primarily to the programmer, the logos is developed into automated “non-transparent control complexes” (Part 3). Once automated, these complexes emancipate from their original contexts, potentially altering the programmed understanding into “a severe misunderstanding with serious consequences” (Eldred, 2001, Part 3).

Capurro (1999), like Eldred, is concerned by this digital casting of Being. He asks

What does real mean? It means to be programmed […] We believe that we have understood something in its being when we are able to make it or to re-make digitally […] So-called real things are nothing but examples of original devices. There is a kind of digital Platonism in this
view of the appearances as derived from some form-producing digital device. Digital beings are not just the sum of their bits. They must have a form or structure. Being is in-formation. (para. 14-15)

Although its primary purpose is to build semantic information storage and retrieval systems, computational ontology is indirectly staking ontological claims. Smith argues that computational ontologies are to be designed as windows into reality. The description of this window is almost identical to the challenges made by Capurro and Eldred in their discussion of digital ontology as the contemporary casting of Being. If computational ontologies are seriously considered comprehensive representations of reality (or at least substantial portions of it), what does such a view have to say about things that cannot be represented in computational ontologies? It is safe to say that one can represent the entity *homo sapien* in a computational ontology, but can *Dasein* be represented as an entity? If not, what does this say about Dasein? What does it say about computational ontologies? These are some of the more obvious questions, but I will address more in coming chapters concerning the representation of spatiality, temporality, entities, etc., in computational ontologies and compare the views of these modes within computational and digital ontology.

### 2.1.5 Relevance to Library and Information Studies

It is important to characterize where this dissertation fits within the work of notable philosophical scholars in library and information studies (LIS). Although it may reside at the periphery of LIS research, the domain shared by computational and digital ontology addresses issues in LIS theory and application. Computational ontology is a means and technology for information organization and retrieval—a fundamental area of study in LIS (Taylor, 2004). The topic of computational ontology as a form of system design has its own body of literature (Yi, 2006). Philosophical positions and debates concerning ontology development deal not only with computation, but also with the philosophy of library science shaped by the likes of Ranganathan (1931; 1987), Jesse Shera (1970; 1976), Patrick Wilson (1977), and Budd (2001). Likewise, Hjørland (2004) provides a nuanced argument in favor of philosophical realism—an issue covered in some detail in this dissertation—in library and information science theory and research. Moreover, since we deal here with information storage and retrieval, much
could be said concerning information as a phenomenon. A bibliography of this area of study would include but not be limited to Buckland (1991), Raber (2003), Capurro and Hjørland (2003), Floridi (2002), Frohmann (2004), Fox (1983), and Nunberg (1996). Like the work in this dissertation, Day (2001) and Budd (2001) both revisit Heidegger to analyze problems in LIS. Day looks at the historical phenomenon of information coming out of the modern industrial age. On the other hand, Budd argues for new epistemological grounds in the profession of LIS. Gary Radford’s (2003) work is also a noteworthy contribution to LIS coming from the continental tradition borrowing heavily from Foucault. Finally, the information behavior research of scholars like Chatman (1996), Dervin (1989), T. D. Wilson (2003; , 2008), and Kuhlthau (1991) address human/user-centered issues similar to those in digital ontology.

Research on the domain shared by computational and digital ontology has practical implications for LIS in addition to philosophical and theoretical ones. Obviously, the issues explored in this dissertation concerning the development of databases and other information systems, no matter how philosophical, provide practical suggestions for efficient information storage and retrieval or challenge potential pitfalls of the fundamental assumptions within design. Likewise, the Heideggerian challenges of digital ontology to traditional ontology (comprehensive classification of all reality) imply important questions for library science. It seems that within library science there are two primary components: classification of documents and servicing the needs of users. It seems traditional ontology like that of computational ontology is more suited to dealing with document organization in the digital realm. Likewise, its naturalist ontology and epistemology offer a strong philosophical foundation for defining relationships within classification. Digital ontology poses enduring challenges to this naturalist philosophical foundation. Additionally, the human-centeredness of digital ontology probably offers more help in understanding user experience and interactions between the user and the system and the user and the information professional.
3. PHENOMENOLOGY AS METHODOLOGY

This project sets out to compare and contrast the continentally-driven digital ontology described by Capurro (2006) and Eldred (2001) with the analytically-driven formal computational ontology exemplified by the BFO (Spear, 2006). Likewise, this project uses phenomenology as its methodological guide. This is not a phenomenological investigation of ontology as such—such a project belongs within the domain of philosophy proper and not in information studies—but rather it seeks to find what these two areas dealing with computational and digital phenomena who call themselves “ontology” have in common and how they differ, where they derive their foundations, what they do, where they may be going, why they do not address one another, and what they have to offer one another. This must begin by getting at the essences of both of these areas and asserting whether or not these essences occur within the same domain. In other words, it must be determined whether these two areas share the same domain or whether they just happen to use the term “ontology” differently. I will address the representation of space, time, entities, and relations in both of these areas. Likewise, I will investigate and describe the role of the human being (Dasein) in these representations and problems dealing with representation of Dasein.

Delimiting essences is part of the phenomenological process. I outline this method below as Spiegelberg (1960) describes it. Phenomenology is a philosophical approach most attribute to Husserl although Descartes inspired his work (Spiegelberg, 1960). Husserl attempts to describe consciousness by focusing on phenomena, or how reality appears to consciousness, and “bracketing” out all other possible philosophical or theoretical topics (Spiegelberg, 1960). In other words he tries to describe reality from scratch, as it appears to consciousness, from what he refers to as “the natural standpoint” (Husserl, 1982).

Spiegelberg (1960) concludes a historical discussion of phenomenology as philosophy with a general outline of the iterative phases of phenomenological research. He makes clear where scholars and schools differ in their approach to phenomenology, but uses them comprehensively to compile this outline. I choose his outline because I have yet to find a more concise and instructive presentation on the use of phenomenology as method. Spiegelberg (1960) says that phenomenology seeks primarily to enlarge and deepen “the range of our immediate experience” (p. 656). Likewise, he calls it a “revolt” against reductionism and dogmatic adherence to traditional scientific theories “which only too often
[perpetuate] preconceptions and prejudgments” (p. 656). However, he assures that phenomenology is more essentially a “fertilizing and reconstructive effort” than a revolt (1960, p. 658).

The following identifies the phases of the phenomenological method which I explain thereafter.

I. Investigating Particular Phenomena
II. Investigating General Essences
III. Apprehending Essential Relationships
IV. Watching Modes of Appearing
V. Exploring the Constitution of Phenomena in Consciousness
VI. Suspending Belief in Existence
VII. Interpreting Concealed Meanings

3.1 Investigating Particular Phenomena

Three activities comprise the first step of investigating particular phenomena: phenomenological intuiting, phenomenological analyzing, and phenomenological describing. Phenomenological intuiting is a manner of observation in which the researcher places undivided attention on an object “without becoming absorbed in it to the point of no longer looking critically” (Spiegelberg, 1960, p. 659). Spiegelberg admits one cannot define this task very well except to instruct the researcher using phrases like “‘opening his eyes,’ ‘keeping them open,’ ‘not getting blinded,’ ‘looking and listening,’ etc.” (1960, pp. 659-660). One may then assess the uniqueness of the phenomenon by comparing it with others (Spiegelberg, 1960).

The next activity within the step of investigating particular phenomena is phenomenological analyzing. One sees parallels in the motivation of this activity with Barry Smith’s (2004) argument that good computational ontologies represent universals and entities in the real world rather than merely concepts. Spiegelberg (1960) says that when the researcher employs phenomenological analysis, her interests lie primarily in the phenomena themselves rather than in concepts referring to them. Furthermore, he states that this portion of the method “comprises the distinguishing of the constituents of the phenomena as well as the exploration of their relations to and connections with adjacent phenomena” (1960, p. 670).
The third activity within the step of investigating particular phenomena is phenomenological describing. Spiegelberg (1960) states that the main purpose of phenomenological describing is to provide a “reliable guide to the listener’s own actual or potential experience of the phenomena” (p. 673). In describing a phenomenon, the researcher must classify it within a framework of related phenomena. This helps to both contextualize the phenomenon investigated and to clearly distinguish it from related phenomena. Spiegelberg (1960) emphasizes that description isolates the “central and decisive characteristics” or essences of the phenomenon and “abstract[s] from its accidentals” (p. 673).

3.2 Investigating General Essences

In much the same way formal ontology represents universals of which we find particulars in the world, investigation of essences begins first with experience of particulars as examples of those essences (Spear, 2006; Spiegelberg, 1960). Such particulars are said to instantiate their general essences. Spiegelberg gives the example of a red rose. The red of the rose instantiates a shade of red. When we see the red rose we do not see the color red as such, but merely an instance of it. The color red is the essence. Likewise, the color red instantiates color as such. Color as such is also an essence.

![Figure 3.1 Example of the Essence of Color](image-url)
One could look at the example of the rose in another way. If you take away the redness of the rose, you would still have a rose because red is not essential to being a rose. You can have different colored roses. However, if you take away the flowerness of the rose, then it would not longer be a rose because being a flower is essential to being a rose. There are no roses that are not flowers.

Spiegelberg adds that a good way to ascertain essences is to situate similar phenomena “in a continuous series based on the order of their similarities” (1960, p. 678). He exemplifies this well by continuing the theme of ‘redness’ as essence:

This may be illustrated by the way in which we arrange the chromatic colors in a circle [...] The next stage is the observation that in some of these series, especially the qualitative ones, certain groups of phenomena cluster around cores that stand out as nodal points or vertices in the sequence of phenomena. Such are, for instance, the pure colors. There is nothing arbitrary about this belongingness, for it is based on “natural” affinities [...] Now whenever particular phenomena show this kind of affinity, when, for instance, all the reds cluster together in this way, we can hardly overlook the fact that underlying it is some common pattern or essence in which they all share in varying degrees, and which they all in a sense embody. Seeing reds as red we also see redness, the general essence which is exemplified in all of them. Now it is certainly possible to see these particulars without seeing the general essence. But it is not possible to see them as particulars without seeing the general essence which they particularize. Thus what happens is that on the basis of seeing particulars in their structural affinities we also become aware of the ground of their affinities, the pattern or essence. (1960, p. 678)

Although this is not a simple process, it is simple enough when dealing with primary and secondary properties such as dimension or color. However, when dealing with phenomena like Dasein or ontology as such, the task becomes a life’s work—a multi-generational work!8 For this reason, although I must address philosophical ontology as such, I limit my focus to formal computational ontology and digital ontology rather than philosophical ontology as such. Likewise, I use Spiegelberg’s framework loosely to identify what computational ontology and digital ontology have in common and how they differ. Only from there can one conclude whether or not these two areas share the same domain or whether

8 Heidegger never completed this task as he set out to do in Being and Time.
their domains, shared or otherwise, deserve the name ‘ontology’ rather than something different that has unfortunately been given the same title.

It is necessary in this phase to situate formal computational ontology within the broader context of knowledge management systems such as indices, taxonomies, and thesauri. Additionally, having identified instances of formal computational ontology (the BFO and GFO) and of digital ontology (the philosophy of Capurro and Eldred), I locate these instances in a greater context of philosophy proper and other disciplines they share. Noting their properties, the subjects they cover, and their goals, it should become apparent, as Spiegelberg shows in his chromatic example, that “certain groups of phenomena cluster around cores that stand out as nodal points or vertices in the sequence of phenomena” (1960, p. 678). At this stage, concerning the commonalities of formal computational ontology and digital ontology, I can confidently say that the phenomena clustering together include but are not limited to space, time, entities, human beings, relationships, and Being. I bring this up here only to allude to how the methodology will be carried out. I cover these phenomena in full in later chapters.

3.3 Apprehending Essential Relationships

Spiegelberg (1960) addresses two types of essential relationships: intra-essential and extra-essential. Concerning intra-essential relationships, the phenomenologist must ascertain whether related aspects within an essence are required by that essence “or whether they are merely compatible with it” (Spiegelberg, 1960, p. 680). Spiegelberg cites Husserl’s technique of “free imaginative variation” used to assess intra-essential relationships (1960, p. 680). This involves conceiving of a phenomenon with certain characteristics removed or replaced. If the phenomenon maintains its identity in such a thought experiment, then those characteristics removed or replaced are considered inessential to it. On the other hand, if the phenomenon loses its identity, then the characteristics removed or replaced are considered possibly essential to it or absolutely essential to it depending on the degree to which the experiment alters the phenomenon’s identity.

The phenomenologist employs free imaginative variation for extra-essential relationships as well. Spiegelberg (1960) notes that with the example of color and extension, we see that the essence of color cannot exist without the essence of extension. However, the converse relation is not necessary. One can imagine a transparent extended entity proving that extension is not essentially related to color.
Spiegelberg clarifies that free imaginative variation may rely on *a priori* knowledge, but that the interest here is not the knowledge and propositions used, but rather their “ontic referents” (1960, p. 682). He concludes that despite the utility of apprehending essential relationships, the distinction is deceptive.

The question at issue is whether or not several essences stand in relationships not contained in either of them alone, but entailed by them jointly. Again, these relationships are discovered best by the attempt to vary in imagination the components of the relationship. The fact that the relationship between several essences is determined by their joint essences shows at the same time that they are nothing isolated, but that they belong essentially to contexts from which they can only be cut out artificially. Color and extension are not separate essences but are inserted into a wider pattern of encompassing essential relationships of essences. (Spiegelberg, 1960, p. 682)

I conclude here by foreshadowing that what Spiegelberg says about the related essences of color and extension holds true for the essences identified in formal computational ontology and digital ontology: it is helpful to employ free imaginative variation to tease out how they differ and how they are similar, but ultimately, regardless of whether they are absolutely essential or accidental to one another, they occur in a broader context than any research can fully encapsulate.

### 3.4 Watching Modes of Appearing

Spiegelberg describes three modes by which a phenomenon may appear. The first two modes concern the angle or aspect from which a phenomenon is perceived. He wisely uses geometric objects to illustrate. Mode 1 is the “side or aspect of the given object from which we know the object as a whole” (Spiegelberg, 1960, p. 685). He gives the example of an opaque cube as offering a limited number of angles from which we recognize it as a cube. Angles offering a distorted or misleading view of the cube as a trapezoid or some other shape comprise mode 2. Distortions characterize mode 3 also, but distortions in mode 3 do not occur because of the angle from which we view the object, but rather because of distortions in the observer’s own field of perception. For instance, the cube may offer a
mode 1 view of itself from my perspective all things being equal, but if it occurs within the periphery of my visual field it will appear blurry and distorted.

One can easily imagine how these modes play out with examples like an opaque cube. Describing how they play out with more complex phenomena requires explanation. In his dissertation, Fernando Ilharco (2002) uses Spiegelberg’s methodological outline to investigate information technology (IT)—a much more elusive phenomenon than that of an opaque cube! Ilharco begins his discussion of the modes of IT by acknowledging that IT intuitively appears as this or that device, but that the goal of his investigation is not to “understand how IT devices show up, but how the essence of IT appears—how the essence of IT essences” (2002, p. 220). To understand the essence of IT, Ilharco observes IT’s relationship to industrial technology and traces the etymology of the term technology. The Greek root techne and the English derivative technique give insight to the essence of technology. Techne is translated as art or craft, but is more broadly considered the method or principles behind human production (Perry, 2007). This definition closely resembles that of technique.

However, technology brings to mind a device or machine as an instance of technology, not necessarily knowledge or even techniques to develop or use them. Ilharco (2002) says that when “grasping of all of the past, present, and future techniques as a unity” (p. 221) we reach the essence of the phenomenon we seek: technique or the technological. For the most part, we equate the technological with technology—they encompass the drive and the product of this unity of past, present, and future techniques. He goes on to say that industrial technology refers specifically to the ordering and control of things, nature, people, etc., through technological processes. He states that when grasped as a technique, we see IT bringing “efficiency directly to the domain of human structural coupling, in that acting in language it affects horizontally each and every kind of human activity” (2002, p. 221).

It is hard to imagine a mode 1 appearance of IT. From what aspect or perspective of IT can it be taken as a whole? At the macro level, IT appears and makes possible the appearance of the world to us in the mode of globalism (Ilharco, 2002). Although he does not say so explicitly, it seems that Ilharco argues that globalism is the mode 1 appearance of IT. Ilharco (2002) states that “[g]lobalisation is an aspect of the essence of IT” that has ontological “primacy over all the other aspects characteristic of the present epoch—it is how man is making sense of the world today” (pp. 223-224). He holds that globalism is the foundation and background from which we gain meaning from our activities in-the-world and upon which we address them (2002).
Focusing on an instance of IT in the form of a device like a PC, we can exemplify mode 2 and mode 3 of IT. Ilharco’s discussion of the PC as an instance of IT helps illustrate this. Because the PC is nearly always equipment in the Heideggerian sense, it is difficult to tease out what perspective of the PC inherently distorts the PC’s ITness (mode 2) and what perspective distorts the PC’s ITness due to perturbation within the observer’s field of perception (mode 3). To begin the analysis of mode 2 and mode 3 of the perception of a PC as an instance of IT, we would first distinguish that mode 2 or mode 3 perceptions from the mode 1 perception which is globalism. When we engage in the PC’s “mode of being dealt with” we are “relying on the readiness-to-hand of the computer to focus on the issue at stake” (Ilharco, 2002, p. 173). Ilharco (2002) says that when engaged, “the PC engulfs our concerns;” that it forces us to “to face its screen, and to act through the keyboard and mouse;” and that it “is the point of convergence of our concerns at office or at home” as the case may be (p. 174).

Thus, if I consider the PC as ready-to-hand, I may see that my immersion in activities while using it may obscure the PC as an instance of its essentially global nature. I do not think of it in global terms, I do not think of it as a PC, and I do not even think of it as a tool—I just use it! Again, it is difficult to discern whether this scenario demonstrates mode 2 or mode 3 of the phenomenon of IT. Granted, my immersion in the activities while using my PC necessarily involve obfuscating characteristics of my own perception. However, these characteristics of focus, concentration, obliviousness, etc., also seem to almost always entail the use of some ready-to-hand object like a PC; and the use of the PC as well as other forms of IT almost always require focus, concentration, obliviousness, etc.

If, on the other hand, the PC locks up, slows down, or displays the “Blue Screen of Death,” my first impression of the device in front of me is that it is a stupefying chunk of matter. For a moment it is an absurd being. Soon after I realize that it is supposed to be something that connects me to the global reality essential to its function as a form of IT. In the moment before this, when the PC is a meaningless hunk of matter, it is present-at-hand. Again, it is difficult to discern whether the PC as being-present-at-hand is an instance of IT appearing as mode 2 or as mode 3. These examples just serve to illustrate how we may think of something more complex than a geometrical object in terms of the

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9 Unlike the opaque cube example, in this example we are talking about distortions in the observer’s field of perception in a non-trivial sense, i.e., not due to spatial relation to the observer’s visual field but rather due to the observer’s overall experience of the PC as not resembling an instance of IT.
modes of appearance. We may not arrive at definitive conclusions, but we may better elaborate on and raise questions concerning how phenomena appear to us.

3.5 Exploring the Constitution of Phenomena in Consciousness

Spiegelberg (1960) defines this phase as simply “determining the way in which a phenomenon establishes itself and takes shape in our consciousness” (1960, p. 668). Spiegelberg (1960) uses the example of a visitor to a new city acclimating himself to and learning the new environment—how the “picture” of the city “takes shape” in his mind (p. 688).

I can think of no better way to exemplify this here than by describing how the topic of this dissertation took shape in my consciousness while researching. One might say that my example is not phenomenology but rather a creative process—developing a theoretical and philosophical frame where once there was none. I cannot defend myself against assumptions that any project like this is creative rather than exploratory. One could make this argument from a constructivist or even a positivist position. Regardless, I begin with a premise holding that what I seek to explore existed before I started looking at it. I assert that its being changes with respect to my apprehending it as ready-to-hand. Nonetheless, computational ontology, digital ontology, and the domain I presume they share constitute the phenomenon I explore in this research. Likewise, I assert that this is not a subjective fiction, but rather a fact about reality.

I knew that I wanted to address philosophical issues in information studies. I read scholars in the field who used Heidegger in their work such as John Budd (2001), Ronald Day (2001), and Rafael Capurro (2006). Since I had considerable exposure to Heidegger as an undergraduate and enjoyed his philosophy, I studied these scholars in depth. During this time, I watched Waking Life (Linklater, 2001), a film with multiple monologues and dialogues on art, humanity, politics, dreams, and philosophy. The overall theme emphasizes freedom and autopoeisis or self-creation. In one scene, the late Robert Solomon discusses why he feels existentialism is an important philosophy for the twenty-first century. It brought me back to Heidegger and Sartre. When reading them again, I saw an alternative way to address user studies that did not look at the user as a disembodied mind that the cognitive metaphor of information poses (Raber, 2003), nor as reducible to a mere physical phenomenon. Existentialism sees the person as something there in-the-world, opening up the possibility
of a world with meaning and experience—not just a mind encapsulated in flesh and not simply reducible to flesh. Although there are significant differences between Sartre and Heidegger, both of them offered me a unique way to address information studies literature.

Both of them call their major works ontology—the philosophy of Being. Naturally, I was aware of the use of the term ontology in information organization. I attended my colleague Myongho Yi’s (2006) dissertation on an experimental assessment of computational ontology. I began to search for a connection between existentialism and ontology in the information organization sense of the term but was disappointed to find that they seemed to have almost nothing in common. I sensed that, if anything, ontology in the information organizational sense of the term referred to what Heidegger called the ontical or metaphysical in that it just attempted to classify and deal with beings rather than Being as such.

Feeling lost, I returned to Capurro’s work and noticed his use of the term digital ontology. Eureka! I thought he must be addressing the ontology in information organization. Alas, I found no explicit reference to or citation of such work in his writings. By this time I had become aware of the distinction between the analytic and continental traditions in philosophy. I knew in a trivial way that computational ontology was founded by information organization theory and analytic philosophy whereas Capurro certainly fell within the continental tradition. It just seemed that they only shared the term ontology and nothing more.

One matter presented considerable confusion for me for several months: there is no conventional name for ontology in information organization that distinguishes it from ontology in the philosophical sense. Eventually I created the term computational ontology to clarify this matter in my work. Digging more deeply I saw that the front lines of applied philosophy in ontology are in the development of what Barry Smith (2003) calls upper-level or backbone ontologies. These serve as meta-ontologies that connect domain-specific ontologies or serve as templates. So I found a further delineation. Upper-level ontologies are real-world applications of formal ontologies in philosophical ontology. Likewise, domain-specific ontologies serve as applications of material ontologies in philosophical ontology. Since I take Barry Smith to be the principle authority in this area, I narrowed my research on the philosophical underpinnings of computational ontology to Quine. Smith (2003) argues that computational ontology developers should use Quine’s basic assumptions as their guide.

Even though I could not see a connection between digital ontology and computational ontology for some time, I kept investigating. I detected hints of relationships between computational ontology
including polarized fundamentals. Later I determined these polarized fundamentals to be a matter of difference in ontological priority. Computational ontology places ontological priority on the reality disclosed by natural science and digital ontology places ontological priority on Being and Dasein. The more closely I read Barry Smith and related work, Heidegger’s (1962) ideas on science and research, and Eldred’s (2001) elaboration on these ideas in reference to digital phenomena, the more convinced I became that the philosophical domains of computational ontology and digital ontology were one and the same. Both fundamentally deal with matters of time, space, entities, universals, Being, and relationships. Thus, I have a frame for the phenomenon, or perhaps phenomena, I wish to explore. It has properly constituted itself in my consciousness. More extensive detail of this constitution develops in later chapters.

3.6 Suspending Belief in Existence

Although modeled in the fashion of Descartes’ radical skepticism, Husserl uses suspension of belief in the phenomenon differently (Spiegelberg, 1960). Descartes (1996) brings the existence of all things into question until he finds what he considers to be the ontological cornerstone upon which he builds his ontology and epistemology. The position of radical skepticism has taken on its own persona in epistemology and still poses challenges to philosophical assumptions about what we know (Hawthorne, 2004). This is not the sort of suspension of belief in existence typically employed in phenomenology however (Spiegelberg, 1960). The phenomenologist suspends belief in existence by “bracketing” issues concerning the independent existence of or underlying objective cause of a phenomenon (Spiegelberg, 1960). Spiegelberg (1960) attests that this bracketing “facilitates genuine intuiting, analyzing, and describing of the given” and “frees us from our usual preoccupation with ‘solid reality’” (p. 692). Likewise, he says that this phase helps with watching the modes of appearance because it diverts attention from the “usual preoccupation with what appears to the consideration of how it appears” (1960, p. 692).

Within the context of my research, this phase demonstrates considerable importance. As it unfolds, this research telescopes from a vague exploration of computational and digital ontology into a phenomenological investigation of the domain shared by computational ontology and digital ontology. I do not employ a mere conceptual exercise when bracketing the possibility of the existence or non-
existence of this domain. I humbly acknowledge that such a domain may not exist. I would be na"ive to assume otherwise in toto. However, I believe such a domain exists or that collaborators should create one by working to establish essential relationships between computational and digital ontology.

3.7 Interpreting Concealed Meanings

Spiegelberg (1960) identifies the phase of Interpreting Concealed Meanings as *hermeneutic phenomenology*. He says that the purpose of this phase is not to simply describe the salient meaning disclosed in a phenomenon, but to discover “meanings which are not immediately manifest to our intuiting, analyzing, and describing” (1960, p. 695). It is crucial to emphasize that this is not “constructive inference” made up as we go along in our analysis, but an “unveiling of hidden meanings” woven into “less accessible layers of the phenomena” (Spiegelberg, 1960, p. 695). In *Being and Time* Heidegger (1962) adds this hermeneutic layer to his phenomenological project. If we use his method as a template, we employ the same iterative return to Dasein and being-in-the-world to ground our excavation of concealed meanings.

Heidegger’s hermeneutics starts with interpretation of the everydayness of Dasein (Dreyfus, 1991). Dreyfus (1991) says that existential phenomenology “is an interpretation of human beings as essentially self-interpreting, thereby showing that interpretation is the proper method for studying human beings” (p. 34). Granted, this is circular, but Heidegger sees this circularity as intrinsic in Dasein’s understanding (Heidegger, 1962). Heidegger intends for and believes this method to be *existential* in that it lays out “the general, cross-cultural, transhistorical structures of our self-interpreting way of being and how these structures account for all modes of intelligibility” (1991, p. 35).

Concerning hidden meaning specifically, Heidegger believes that Dasein’s immersion in its own understanding obscures it from the truth about itself (Dreyfus, 1991). Therefore, to get to a more *primordial* analysis of Dasein, Heidegger feels that a preparatory analysis of the horizon of Dasein’s everydayness must first be “laid bare” (1962, p. 38). Only then can we get at the more concealed facets of Dasein’s being.

Similarly, with the exploration of phenomena other than Dasein, such a provisional analysis is necessary. The everyday account of the phenomenon makes possible isolation of the essences, essential relationships, modes of appearance, etc. It is in this way that we identify the horizon of the
phenomenon. This process entails facilitation of everyday understanding giving us the founding structure with which we may better investigate concealed meaning. As we have seen, this does not deal exclusively with consciousness or solid reality, but requires instead a holistic and existential analysis.

Hopefully it suffices to leave with this brief description of this phase for now. The means by which I will carry it out are better demonstrated than explained conceptually. I close in agreement with Spiegelberg on the following point that

there is scope and reason to look for deeper and hidden meanings wherever the conscious meanings do not adequately account for a phenomenon in our experience for the total pattern in which it occurs. But such a suggestion does not mean that we can regard the rights of hermeneutics as established. For it rests on assumptions which can be justified phenomenologically only by the ultimate intuitive verification of our hermeneutic anticipations of “sense.” (1960, p. 698)

In other words, it seems that Spiegelberg posits that one cannot argue the importance of hermeneutic phenomenology, but must rather demonstrate its efficacy in carrying it out. The researcher must hope for an outcome that clearly demonstrates to peers that the disclosure and evaluation of hidden meanings is both accurate and useful.
4. ESSENCES AND THE MODES OF APPEARING

4.1 Modes of Appearing

I posit that within the domain shared by computational and digital ontology we see similar yet independent attempts to know and understand Being and \textit{what is}. Therefore, I hold that the mode 1 appearance of both computational and digital ontology is pure ontology, or more precisely Western philosophical ontology, that naturally, considering our current milieu, incorporates and makes concrete and conceptual use of digital technology. Most of the problems, arguments, and constructs within the domain are not new ones. Nonetheless, cyberspace, vast databases representing universes of knowledge, virtual reality, and other new phenomena resulting from digital technology motivate us to revisit ontological problems and to develop new constructs to adapt.

The mode 2 appearance of computational and digital ontology is that of two philosophies representing the analytic tradition (computational ontology) and the continental tradition (digital ontology). Computational ontology typifies the problem-oriented, realistic, naturalistic, and logical analytic tradition. Digital ontology typifies the deconstructive, existentialist, and human-centered continental tradition. Other mode 2 appearances of these areas of research are that of strictly applied philosophy in the case of computational ontology and that of unapplied, at least not concretely applied, philosophy in the case of digital ontology.

The mode 3 appearance of computational and digital ontology is that of two unrelated and incommensurable areas of philosophy that use the common word “ontology” but use it very differently. Due to the complexity and density of their subject matter, it requires study and most likely a philosophically trained mind to see past the obfuscations of technical terminology and discourse to see the essences shared by these two areas of research.

4.2 Essences

4.2.1 Temporality
Temporality is fundamental to both computational and digital ontology. This is true of the foundational ontologies grounding them. In the case of computational ontology, anything that is so within or as a part of one or more instants or intervals of time. Even a completely comprehensive formal computational ontology would represent the interval of time and spacetime spanning from the birth to the death of the known universe. Within digital ontology, the answer to the question “What is Being?” must always begin with Dasein. Furthermore, the existential analytic of Dasein must account for how Dasein finds itself temporally. Heidegger denotes Dasein’s temporality as care. Simply put, the care structure is how Dasein finds itself coming from a past, while in the world in the present, and facing a future. For this reason, according to Heidegger, temporality is the horizon of Being. Heidegger’s discourse on temporality is essential to digital ontology (Capurro, 2006; Eldred, 2001).

4.2.2 Spatiality

Within the BFO, temporality is represented as either instants or intervals. Computational ontologies based on the BFO that represent a single instant are like 3-dimensional snapshots of reality. Thus, they represent spatially all or a portion of the physical universe at some given instant. As indicated earlier, computational ontologies based on the BFO that represent intervals represent not only intervals of time, but also of spacetime. These ontologies represent the universe within all or some portion of time and spacetime. For this reason, spatiality and temporality are interdependent and essential to computational ontology.

Digital ontology addresses the human overcoming of distance through technology, first with vehicles and eventually with communication technology (Eldred, 2001). Again, these are not new issues to address, but rather old ones concerning new phenomena. However, digital technology has made possible a new kind of space called cyberspace that ontology can help us better understand and conceive. Both Capurro (1999) and Eldred (2001) attend to the existential spatiality of cyberspace. I explain this in detail on the chapter dedicated to spatiality and temporality.

4.2.3 Being and Entities
The definitive difference between the analytic and continental approaches to ontology is their stances on Being. The BFO exemplifies Quine’s view that there are no types of Being. A being or entity is. In predicate logic one represents this with the existential quantifier: $\exists x$. One may say that there exists some x such that x is or has some property or other. Or one may negate this statement by saying in some manner or other that there exists no x such that x is or has some property or other. One can assume here that Being is taken as self evident and there is no room to discuss types or modes of Being in such a system. Likewise, one might assume that this is true for computational ontology as well.

Although Smith (2002) feels that the human reality is essential to a comprehensive ontology, as we see in the chapter on Being and entities, he does not explicitly address the question of Being or the analysis of the ways or modes of Being.

Another major difference between the analytic and continental approaches is in their means of categorization. Heidegger declares adamantly that ontology does not classify entities and that neither Dasein nor Being as such are a class or genus; nor are any classes or genera derived from them.

The term ‘Being’ does not define that realm of entities which is uppermost when these are articulated conceptually according to genus or species… The ‘universality’ of Being ‘transcends’ any universality of genus. In medieval ontology ‘Being’ is designated as ‘transcendens’. Aristotle himself knew the unity of this transcendental ‘universal’ as a unity of analogy in contrast to the multiplicity of the highest generic concepts applicable to things. With this discovery, in spite of his dependence on the way in which the ontological question had been formulated by Plato, he put the problem of Being on what was, in principle, a new basis.” (Heidegger, 1962, p. 22)

However, Heidegger acknowledges a multiplicity of Being and denotes ways of discussing different facets of ontology. For example, he distinguishes between aspects of Dasein in general and aspects of specific Dasein in particular. He refers to the former as existential and to the latter as existentiell (Heidegger, 1962). Likewise, as we have seen, he discusses different modes or ways of Being such as Dasein, being-present-at-hand, being-ready-to-hand, etc.

Definitely, analytic ontology is the comprehensive identification of entities, universals, classes, and relationships. Material ontologies do this at the level of some particular universe of knowledge and
formal ontologies do this at the level shared by all domains—the level not unique to any universe of knowledge.

4.2.4 Relationships

To avoid confusion, I must distinguish the discussion of relationships as a step in the phenomenological process and relationships as one of the essences shared by computational and digital ontology. A full phenomenological exploration of the subject matter in this dissertation requires establishing the essential relationships in the domain shared by computational and digital ontology. However, I will not define these relationships explicitly here and will leave that for future research. Nevertheless, I do explore relationships as an essential component shared by both computational and digital ontology. The digital ontologists do not cover this issue, but it is nevertheless essential to Heidegger’s work. Moreover, I assert that it is essential to a complete digital ontology, but that it has yet to be addressed adequately.

The differences between the analytic and continental approaches to defining relationships are typical. Within the analytic tradition, exemplified here by the BFO, we see relationships defined as needed between constituents within one or more ontologies. In other words, the focus is on those entities and relationships within the reality disclosed by natural science. In the continental tradition, one defines relationships with regard to an entity’s purpose within the equipmental whole. Such relationships always refer back to Dasein by establishing how entities fit into Dasein’s world.

4.2.5 Human Being

Digital ontology follows Heidegger’s answer to the question “What is Being?” by always referring back to Dasein or human being with regard to digital phenomena and our understanding of Being in terms of the digital. Computational ontology, like analytic ontology, answers the question “What is?” by trying to describe reality as it is independent of human experience. Surprisingly, however, both share some similarity in how they describe the human being as part of the physical world.
4.2.6 Digital Representation of Reality

The differing analytic and continental approaches to ontology articulate themselves in the differing ways in which computational and digital ontology comprehend the digital representation of reality. On the one hand, Smith (2004) argues the need for formal computational ontologies that by definition represent the most fundamental constituents and relationships in reality. On the other hand, Capurro (1999) asserts that we hold real only that which we can represent digitally. The former position rests on what Heidegger refers to as traditional ontology. The latter is based on Heidegger’s critique of traditional ontology.

4.3 Constitution of the Phenomena in Consciousness

![Figure 4.1 The Constitution of the Domain Shared by Computational and Digital Ontology to Consciousness](image-url)

Figure 4.1 The Constitution of the Domain Shared by Computational and Digital Ontology to Consciousness
Figure 4.1 is a general diagrammatic representation of how the domain shared by computational and digital ontology constitutes itself in my consciousness. I describe most of the process I underwent in developing the subject of this visualization in the methodology chapter. You can see the domain signified by the inverted triangle in the center of the diagram. At the bottom we see the context of Western philosophy proper and the distinction between the analytic and continental traditions on the left and right respectively. Nearer to the center we see where computational and digital ontology reside in this context. Likewise, aside from philosophy but equally important, we see in the upper left the field of information organization.
5. TEMPORALITY AND SPATIALITY

5.1 Temporality

5.1.1 Temporality in Digital Ontology

One can distinguish the differing approaches to temporality between computational and digital ontology in terms of Heidegger’s account of temporality in *Being and Time*. In his existential analytic of Dasein, Heidegger develops structural understanding of temporality which he calls *care* (*Sorge*). With care, we see his distinction between primordial time and the everyday derivative understanding of time. Derivative time is represented by clocks and calendars as serial and always present coordinates in a matrix. It seems that what he calls derivative time is the view of temporality utilized by the BFO and computational ontology in general. Both Heidegger and Quine address the linguistic treatment of mathematical truths as always present. Quine (1960) seems to dismiss as a linguistic quirk and unintentional convention the reduction of the temporality of mathematics as always present.

Our ordinary language shows a tiresome bias in its treatment of time. Relations of date are exalted grammatically as relations of position, weight, and color are not. This bias is of itself an inelegance, or breach of theoretical simplicity. Moreover, the form that it takes—that of requiring that every verb form show a tense—is peculiarly productive of needless complications, since it demands lip service to time even when time is farthest from our thoughts. Hence in fashioned canonical notations it is usual to drop tense distinctions.

We may conveniently hold to the grammatical present as a form, but treat it as temporally neutral. One does this in mathematics and other highly theoretical branches of science without deliberate convention. (p. 170)

On the contrary, Heidegger (1962) holds this linguistic treatment of mathematical truths to be more fundamentally important and asserts that Descartes establishes this temporal understanding of mathematical truths which prevails as a mistakenly comprehensive ontological account of temporality. He says that Descartes sees mathematical knowledge as the primary way to apprehend entities that can
always assure “that their Being has been securely grasped”—that whatever “is accessible in an entity through mathematics, makes up its being” (Heidegger, 1962, p. 128). He goes on to say that

[Descartes] prescribes for the world its ‘real’ Being, as it were, on the basis of an idea of Being whose source has not been unveiled and which has not been demonstrated in its own right—an idea in which Being is equated with constant presence-at-hand. Thus his ontology of the world is not primarily determined by his leaning towards mathematics, a science which he chances to esteem very highly, but rather by his ontological orientation in principle towards Being as constant presence-at-hand, which mathematical knowledge is exceptionally well suited to grasp. (Heidegger, 1962, p. 129)

So what Quine sees as a linguistic convention in the use of present tense in reference to mathematical truths, Heidegger holds to be an ontological assumption enmeshed in the Cartesian view—namely that whatever is real is present and that mathematics, because it deals with always present truths, is a primary means by which we access reality epistemologically. The temporal view of mathematics then becomes a mathematical view of temporality in which time is reduced to a line or a matrix of ever present increments. This is what Heidegger refers to as the everyday understanding of time or derivative time. Heidegger asserts that an understanding of time is essential to an understanding of Dasein and therefore an understanding of ontology.

Time must be brought to light—and genuinely conceived—as the horizon for all understanding of Being and for any way of interpreting it. In order to discern this, time needs to be explicated primordially as the horizon for the understanding of Being, and in terms of temporality as the Being of Dasein, which understands Being. This task as a whole requires that the conception of time thus obtained shall be distinguished from the way in which it is ordinarily understood. (Heidegger, 1962, p. 39)
Heidegger (1962) says that temporality “reveals itself as the authentic meaning of care” (p. 374). The three-pronged care structure juts out into *thrownness* from the past, *Being-in-the-world* in the present, and *projection* towards the future.\(^{10}\)

The formally existential totality of Dasein’s ontological structural whole must therefore be grasped in the following structure: The Being of Dasein means ahead-of-itself-Being-already-in-the-world as *amid*\(^{11}\) (entities encountered within-the-world). This Being fills in the signification of the term “care” [Sorge], which is used in a purely ontologico-existential manner.

(Heidegger, 1962, p. 237)

In other words, Dasein is fundamentally ahead-of-itself by projecting itself towards possibilities in the future. It is being-*amid* entities encountered in the present. Likewise, it is already-in-the-world in that it always has a past. So, according to Heidegger, care is not simply how Dasein experiences time, but is Dasein’s “existential totality.” This means that Dasein is *always already* coming from the past, while in the present, and facing the future. Again, Heidegger sees our attempts to define this structure cyclically or linearly as derivative. This is because these attempts reduce time to segments (minutes, days, years, etc.) that do not consider Dasein’s existential-temporal position or *Befindlichkeit* (how Dasein finds itself). Each minute, day, year, etc., is an abstract concept in a mathematical system and only peripherally addresses past, present, and future. In other words, I know what time it is by having an accurately set watch. I know what day it is by checking the ticks on my calendar. Heidegger states that we developed such instruments to help us cope with how we find ourselves temporally situated in reality (the care structure). In other words, I need nothing to tell me that my existential position in the present (today) comes from the past (yesterday) and faces the future (tomorrow). However, I only know that today is Monday, July 21, 2008, yesterday was Sunday, July 20, 2008, and tomorrow will be Tuesday, July 22, 2008 by consulting mathematical time keeping systems of my culture. Thus, in line with Heidegger’s argument, these instruments are derivative and a temporal understanding based solely on them is likewise derivative.

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\(^{10}\) I use these terms for simplicity’s sake. However, this terminology is somewhat inaccurate because Heidegger holds that “past,” “present,” and “future” are themselves concepts based on derivative temporality. This is because, he says, “we call an entity “past”, when it is no longer present-at-hand” (1962, p. 376). He concludes that “Dasein, in existing, can never establish itself as fact which is present-at-hand, arising and passing away ‘in the course of time’, with a bit of it past already” (Heidegger, 1962, p. 376). He qualifies this by saying that “Dasein is assailed by itself as the entity which it still is and already was—that is to say, which it constantly *is* as having been” (Heidegger, 1962, p. 376).

\(^{11}\) This is Macquarrie and Robinson’s “Being-along-side.” Again, I prefer Dreyfus’ *amid* (Dreyfus, 1991).
Rafael Capurro (2006) argues that a digital account of reality is only ontic or metaphysical (but not ontological) if it does not address this three-pronged care structure.

If the digital casting of Being by holding only to the one-dimensional sense of presence forgets the question of Being in its full three dimensionality it “changes over” into digital metaphysics. The difference between digital ontology and digital metaphysics is therefore, following this theory, essential if we want to avoid a dogmatic theoretical position and its ethical consequences. (Capurro, 2006, para. 10)

Michael Eldred (2001) likewise argues that authentic time “is not logically discrete” and that “because it does not lie before us as something present from the start,” “it cannot be dissolved and grasped digitally” (Part 2). In cadence with Heidegger, Eldred iterates that through time comes access to Being; time “holds it open, without the logos, or prior to the logos” and that we cannot understand the temporality of Dasein through the logos (2001 Part 3). Instead, the analysis of the temporality of Dasein explains the logos and its dominance as a theme in Occidental ontology (Eldred, 2001, Part 3).

12 Eldred (2001) concludes that time “is not logically discrete” and “cannot be dissolved and grasped digitally because it does not lie before us as something present from the start” (Part 3). If so, time, (past, present, and future), would be present-at-hand and thus reduced to the now (Eldred, 2001).

Heidegger (1962) says that temporality is not an entity; that it temporalizes as “possible ways of itself” making possible “the multiplicity of Dasein’s modes of Being, and especially the basic possibility of authentic or inauthentic existence” (p. 377). Dasein in a sense stands out in the three temporal “ecstases” of past, present, and future. Primordial authentic time consists of these ecstases whereas our common sense notion of time (measurable clock and calendar time) is derivative of primordial time (Heidegger, 1962). According to Heidegger (1962), time “which is accessible to the ordinary understanding” is “a pure sequence of nows,” pure presence, “without beginning and without end, in which the ecstatical character of primordial temporality has been leveled off” (p. 377). For digital ontologists to stay true to Heidegger as Capurro and Eldred seem to do, they must address these facets of the temporality of Dasein within the context of an understanding of digital reality and a digital understanding of reality itself.

12 Remember Heidegger’s anti-intellectualism and his view of Dasein as fundamentally more than just a thinking thing.
As I demonstrate in the next section, temporality is implicitly conceived in similar ways in computational ontology as it is in digital ontology. Both digital ontology and computational ontology hold time to be an entity within the domain of temporality. In the case of digital ontologists, if they remain in line with Heidegger, time is the everyday ordinary understanding of time that is in some sense a present-at-hand entity. I say this is implicit in computational ontology because computational ontologists seem to take for granted that time is not synonymous with temporality, and although they denote an entity time within their conception of temporality, they do not devote the level of discourse to the matter that Heidegger does.

5.1.2 Temporality in Computational Ontology

Computational ontologies within the BFO represent time with two primary units: intervals and instants. An entire ontology representing the granularity of a single instant looks like a snapshot of reality or “the results of a process of sampling” (Smith & Grenon, 2004, p. 147; Spear, 2006). Thus, computational ontologies developed from this perspective are called SNAP ontologies (Smith & Grenon, 2004; Spear, 2006). According to Smith and Grenon (2004), each SNAP ontology “is indexed to some specific instant of time” (147). Within the BFO, computational ontologies representing spatio-temporal regions through which entities may endure for intervals of time are called SPAN ontologies (Smith & Grenon, 2004; Spear, 2006). Each SPAN ontology is indexed by some particular time interval which may be the interval comprising all of time (Smith & Grenon, 2004). Smith and Grenon (2004) assert for SNAP ontologies precisely what Capurro worries about concerning “the interpretation of all beings as digital ones and their world-less representation as ‘standing presence-at-hand’” (Capurro, 2006, para. 11).

According to Smith and Grenon (2004), SNAP ontologies “assume a variant of the philosophical doctrine of presentism [...] which holds that all entities which exist exist at the present time” (p. 147). Smith and Grenon (2004) qualify this by noting that the BFO “is not presentist in the narrow sense” because the BFO allows for “a multiplicity of SNAP ontologies with different indices” (p. 147). If Heidegger is correct, it seems that such a view reduces portions of reality represented in SNAP ontologies to standing presence-at-hand.

SPAN ontologies represent temporal regions of reality consisting of intervals and instants. According to Smith and Grenon (2004), entities within a SPAN ontology are each assigned a temporal
location which is “a primitive relation between an entity and an (instantaneous or extended, connected or disconnected) region of time” (p. 154). They state that the constituent *time* is a SPAN entity representing “the maximal temporal region” of which any temporal region is a part (Smith & Grenon, 2004, p. 154). Likewise, they assert that *spacetime* comprehensively represents the “totality of spatiotemporal regions” (Smith & Grenon, 2004, p. 156). The developers adopt *eternalism* as a methodological perspective for SPAN. Eternalism, according to Smith and Grenon (2004), is “the philosophical doctrine according to which all times (past, present, and future) exist on a par” (p. 152). Once again, this exemplifies computational ontology’s view of time as standing presence. In this case, we see spacetime represented as “the universal substratum” whose being is all-at-once (Smith & Grenon, 2004, p. 156). Smith and Grenon (2004) state that regions of spacetime and processual entities within them occupy four-dimensional shapes such as military maneuvers or storm patterns.

Quine (1960) provides some foundational assumptions on the treatment of temporal entities in this manner. He states that the treatment “of time on par with space is no novelty to natural science” (Quine, 1960, p. 171). He recalls Heraclitus’ argument that since the substance of a river, its water, is constantly flowing, one cannot step into the same river twice. Quine (1960) replies by saying

> Once we put the temporal extent of the river on par with the spatial extent, we see no more difficulty in stepping into the same river at two times than at two places. Furthermore the river’s change of substance, at a given place from time to time, comes to be seen as quite on a par with the river’s difference in substance at a given time from place to place; sameness of river is controverted no more on the one count than on the other. (p. 171)

To continue with this counter-Heraclitian example, let us say there is an occurrent called *squishy foot 1* constituted by the continuant entity *Heraclitus’ foot* being inserted into the continuant entity *river A* at time *t0*. Furthermore, there is a second occurrent called *squishy foot 2* constituted by the continuant entity *Heraclitus’ foot* being inserted into the continuant entity *river A* at time *t7*. To make it extra interesting, let us say that *t0* is roughly seven years apart from *t7*. So not only is the substance of the *river A* different (it has a different set of water molecules at *t7* than it does at *t0*), but likewise, *Heraclitus’ foot* has a completely different set of regenerated cells at *t7* than it does at *t0*. Nevertheless, the trajectories of the entities *river A* and *Heraclitus’ foot* stretch through *spacetime* and meet up at *t0* and *t7* despite the changing of these entities’ substances between *t0* and *t7*. Now let us ignore the fact
that the Earth moves through space and assume that the location of the banks of river A stay static in space. Using a 4-D Cartesian-style coordinate system, we can assign *spacetime* coordinates to the two occurrences *squishy foot 1* and *squishy foot 2*. Suppose *squishy foot 1* and *squishy foot 2* occur at the same 3-D coordinates (*Heraclitus'* foot gets inserted into river A at exactly the same point in space). We will keep it simple and identify this point as \((x_3, y_3, z_3)\). So now we can identify the 4-D coordinates of the two occurrences: \(\text{squishy foot 1} = (x_3, y_3, z_3, t_0)\) \(\parallel\) \(\text{squishy foot 2} = (x_3, y_3, z_3, t_7)\).

![Figure 5.1 Diagram Representing the SNAP Occurrent Squishy Foot 1](image_url)

We can easily picture the separate SNAP representations of such occurrences. They would actually just be roughly identical 3-D stills perhaps exhibiting the \(x, y, z\) axes and demonstrating the \((x_3, y_3, x_3)\) coordinate where *Heraclitus’ foot* meets river A. We could even do this 2-dimensionally by just flattening the stills like in Figure 1. A SPAN diagram showing the trajectories of *Heraclitus’ foot* and river A between *squishy foot 1* and *squishy foot 2* would be trickier. We could make a 3-D diagram showing the trajectories of *Heraclitus’ foot* and river A through *spacetime*. However, rather than looking like a foot and a river, these objects would stretch through the diagram like taffy or like moving objects recorded by a long exposure camera lens—*Heraclitus’ foot* more so than river A because
Heraclitus moves around in space more than river A. Unlike representing 3-D Cartesian coordinates, representing 4-D coordinates in 3-D space removes the \( t \) “axis” since it supervenes the \( x, y, z \) axes of the 3-D Cartesian matrix.

Although Smith and Grenon (2004) mention past, present, and future, in their description of the BFO, these are leveled to mere presence so to speak by presentism and eternalism. We can point to a SNAP ontology or a temporal slice of a SPAN ontology that corresponds to the present moment and say “this represents the present moment,” but nothing within this system explicitly distinguishes this particular instant as the present from all other instances. Simply put, within a computational ontology any instant before a particular instant is the past from the perspective of that particular instant and any after it is the future. In contrast, with the care structure, the present is ontologically and existentially different from what precedes and exceeds it. Likewise, its temporality is not cleanly distinct from the past and the future because it \textit{always already} has with it thrownness and projection (Heidegger, 1962). As far as I can tell, there is nothing systematic within the BFO to make a particular instant that represents this very moment ontologically different than it was a moment ago or a moment from now. In other words, the instant represents the present only when it coincides with its counterpart in reality. In the previous moment this instant represents the future and in the moment that follows it represents the past.

5.2.a

\[ t1 \text{ is currently the past.} \]
Figure 5.2 illustrates this problem. $t_1$ represents the present only in Figure 5.2.b. If some form of this illustration were represented in the BFO, nothing within the BFO would make $t_1$ ontologically different from a moment preceding or exceeding it. Likewise, although it would be leveled to presence by the presentism and eternalism of the BFO, it would only truly represent the present when it coincided with the real present as it does in Figure 5.2.b.

However, Figure 5.2 does not fully capture the difference between the temporal understanding of the BFO and that of the care structure. This is because Figure 5.2 still uses derivative time (represented by an analog clock) to exemplify the phenomenon. Even in 5.2.b it could be said that $t_1$ does not truly represent the present because the present is not represented in timekeeping but is the way Dasein finds
itself at all times temporally. As has been emphasized in Heidegger, an understanding of Being must begin with the being whose being is an issue for it. The examples in Figure 5.2 are still mathematical abstractions. Heidegger, however, says that this type of \textit{time reckoning} is necessary for Dasein.

This public dating, in which everyone assigns himself his time, is one which everyone can ‘reckon’ on simultaneously; it uses a publicly available \textit{measure}. This dating reckons with time in the sense of a \textit{measuring of time}; and such measuring requires something by which time is to be measured—namely, a clock. This implies that \textit{along with the temporality of Dasein as thrown, abandoned to the ‘world,’ and giving itself time, something like a ‘clock’ is also discovered—that is, something ready-to-hand which in its regular recurrence has become accessible in one’s making present awaitingly.} (Heidegger, 1962, p. 466)

He goes on to say that “temporality is the reason for the clock” (Heidegger, 1962, p. 466).

This brings us to a problem for which at the time being I fail to have a solution. I am in good company. Hubert Dreyfus (2006), a most notable authority on Heidegger, has also thrown up his hands concerning Heidegger’s account of temporality as it is, or perhaps as it is not, distinct from Dasein. How can one address the care structure in a concrete way for the purpose of ontological representation (like that of the BFO) that does not rely on these derivative means of timekeeping? In his lectures, Dreyfus (2006) states that there is something about this subject that always brings us back to the discussion of clocks. Is it something about clocks? Is the universe like a clock that marks its way moment by moment through the cosmos (Dreyfus, 2006)? Heidegger likely undermined his project if he concludes that temporality is the product of a clock-like universe because this is the prevailing cosmology of the modern paradigm from which he tried to distinguish his philosophy.

Another question to ask: can a formal computational ontology represent temporality in terms of the care structure? It seems like the answer may be ‘no’ because from the perspective of Heideggerian ontology the representation of temporality itself at this point seems universally derivative. In other words, temporality precedes the understanding of time which makes possible our means of representing and reckoning time. From the earliest time keeping measures to the present day we have used mathematical devices and systems to make sense of time. The disclosure of this problem of representation of time as seeming necessarily derivative brings us back to challenges to Heidegger’s philosophy. The most salient criticism seems to be that the care structure is not truly primordial
temporality, but rather the subjective, psychological, or human experience of time. In one of his podcast lectures on *Division II of Being and Time*, Dreyfus (2006) hypothesizes that Heidegger is either a temporal idealist claiming that temporality does not exist without Dasein or that he is a temporal realist [Dreyfus’ idea] in that he acknowledges that there are restrictions present-at-hand that determine to some extent what temporality is to Dasein. By developing mathematical systems of timekeeping that accurately predict the rising and setting of the sun, the phases of the moon, the rise and fall of tides, the equinoxes, etc., it seems that we have identified objective means by which we measure time. These means were developed to give us an objective measure of time because our subjective experience of it is most often an unreliable means to keep track of it.

So, one of the major issues here concerns the representation of time as well as the notion of derivative time. Along with the question concerning whether it is possible to represent authentic temporality, we must also ask: is the representation of time synonymous with derivative time? Smith (2004) argues that for the most part we consider printed scientific texts to represent things in reality rather than mere concepts. He makes this point to challenge what he believes is a popular and mistaken approach to knowledge management in general and computational ontology development specifically.

Statements like ‘*whale is_a mammal*’ or ‘*regulation of protein kinase activity part_of protein amino acid phosphorylation*’ convey knowledge precisely because they represent relations between entities in reality, relations to which the advance of science has given us cognitive access but which themselves obtain independently of our cognitive activities. They convey not extensional relations analogous to that of set-theoretic inclusion, but rather law-like relations between universals of the sort that are discovered through scientific research. (Smith, 2004, p. 6)

He complains that those in the field of knowledge management seem to think that the nature of representation changes with regard to the use of computers. He says that for these practitioners it is “as if terms stored in computers were for some reason incapable of relating to entities in reality in the same way as do terms printed in scientific texts” (Smith, 2004, p. 7). With respect to temporality, following Smith’s line of reasoning we likely conclude that representation of time in computational ontologies (the SPAN entity *time*) is not a derivative representation of the concept of time but rather of time itself. So in line with Smith’s thinking, the SPAN entity *time* is derivative in that it is not actually time itself.
inside the computational ontology, but it is not derivative in that it is a representation of time itself and not that of the concept of time.

Within the BFO, Figure 5.2.b would allocate a single portion of time, a zero-dimensional instant, for \( t_1 \) and Current Time. Between them they would hold the BFO relation *Cotemporal*. Smith and Grenon (2004) assert that each temporal portion is “the sum of all cotemporal parts of a SPAN entity located within a given region of time” (p. 155). There is nothing special about Current Time making it ontologically distinctive from any other. Granted, in practice, once a working computational ontology is created based on the BFO, there may be mechanisms in place that keep track of the present in order to distinguish an instant as the present from all other instants until the moment passes in real time and the next instant represents the present. This is speculation on my part, but is not absurd to imagine.

5.2 Spatiality

5.2.1 Spatiality in the BFO

SNAP ontologies recognize the spatial entity *space* which represents the spatial entirety of the physical universe (Smith & Grenon, 2004). Any spatial region must be a portion of *space*. SNAP allows for topological (surface) and geometrical representations. These include but are not limited to separation, connectedness, boundaries, fiat boundaries, dimensionality, etc. (Smith & Grenon, 2004). Boundaries are for the most part clear dimensional distinctions between entities or regions. For instance, a lake is bound by its shoreline. Fiat boundaries distinguish parts of an entity that have no clear physical demarcation. For example, without any bushes, fence, or the like, the line dividing one’s real estate from the rest of the neighborhood is a fiat boundary, thus making your property a fiat part of the neighborhood.

Since entities comprise and are bound within the entity *space*, we can say much more of computational ontology’s, more specifically the BFO’s, spatiality in the chapter devoted in part to entities. As with temporality, we can analyze implicit assumptions concerning spatiality made by computational ontology by returning to Heidegger’s ontology. This helps provide the background for analysis of spatiality in digital ontology.
5.2.2 Physical Space and Existential Spatiality

Dasein’s being-in-the-world is not the same as an entity being inside some physical space. Dasein’s being-in-the-world is its existential involvement, and as we discussed earlier, its dwelling or residing in the world (Dreyfus, 1991). This sense of being-in is analogous to an actor being in a play, a student being in school, or a criminal being in jail or in trouble. The actor, student, and criminal all have spatial relations to buildings, fiat, boundaries, etc. in their involvement, but one cannot reduce these relations of being-in as we understand them to being physically within some particular space. For instance, during a semester a student is still in school even when she is at home sleeping after a hard day of studying.

Dreyfus (1991, p. 130) identifies the following definitive quote on the matter

To encounter the ready-to-hand in its environmental space remains ontically possible only because Dasein itself is ‘spatial’ with regard to its Being in the world… Dasein…is “in” the world in the sense that it deals with beings encountered within-the-world, and does so concernfully and with familiarity. So if spatiality belongs to it in any way, that is possible only because of this being-in. (Heidegger, 1962, p. 138)

Dreyfus (1991) notes Heidegger’s use of the term Entfernung, modified with a dash: Ent-fernung. Macquarrie and Robinson translate this as de-severance. Dreyfus (1991) points out that Heidegger uses a hyphen to emphasize the “negative sense of ent” so that Ent-fernung literally means “the abolishing” or “the establishing and overcoming of distance…” the opening up of a space in which things can be near and far” (p. 130). Like many of the translations in Being in Time, Dreyfus chooses a different English word for Ent-fernung than Macquarrie and Robinsin use. Dreyfus cleverly chooses dis-stance to translate Ent-fernung to convey a sort of standing-away-from. Before Dasein has any notion of dimensionality, it must have a notion of nearness and farness. Dis-stance makes possible orientation\(^\text{13}\) (up/down/front/back/left/right), nearness and farness and is therefore prior to measures of dimension. Measures of dimension, Descartes’ objective res extensa (Dreyfus, 1991), are a means by which Dasein makes sense of the orientation made possible by dis-stance.

\(^{13}\) Macquarrie and Robinson translate Ausrichtung as “directionality” and Dreyfus translates it as “orientation.” Again, I prefer Dreyfus’ translation and Eldred chooses this translation as well.
The following is a bit difficult to explain. Heidegger (1962) says that spatially Dasein is for the most part always *yonder*, but not *here*. Through concern, the yonder gets brought back to the here. Both the yonder and here are public (Heidegger, 1962). Dreyfus (1991) explains that this argument saves Heidegger from the Cartesian/Husserlian position that each Dasein’s spatiality is a private one. Consider the following example. The coach of a children’s baseball team assigns a boy, not very good at the game, to right field. The boy is attentive to the surrounding space, but particularly to the home base far away from him. The home base, the field around him, and the bleachers filled with parents and siblings are public yonder space. The player at bat hits a pop fly ball towards and over first base. The ball is moving from yonder to here! Now whether he catches the ball is irrelevant. The point is that one could give this same scenario from the perspective of say the child at bat and it would demonstrate the same point. Dasein is mostly attentive to the yonder, but often brings itself to and is brought to the attention of its here. Likewise, the here and the yonder are not private in the sense of being locked into the individual Dasein’s perspective, but are both shared public space.

<table>
<thead>
<tr>
<th>Physical Space</th>
<th>Existential Spatiality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometrical space;</td>
<td>Lived space;</td>
</tr>
<tr>
<td>The space of the present-at-hand.</td>
<td>The space of the ready-to-hand.</td>
</tr>
<tr>
<td>Homogeneous, no center.</td>
<td>Personal: centered in each of us.</td>
</tr>
<tr>
<td>Pure extension.</td>
<td>Orientation (up/down, right/left).</td>
</tr>
<tr>
<td>Three-dimensional multiplicity of positions.</td>
<td>Remoteness/nearness of objects.</td>
</tr>
<tr>
<td></td>
<td>Public: has regions and, in these, places.</td>
</tr>
<tr>
<td>Measurements of distance.</td>
<td>Degree of availability.</td>
</tr>
</tbody>
</table>

**Figure 5.1 The Distinction Between Physical Space and the Existential Space of Dis-stancing** (Dreyfus, 1991, p. 139).

Understanding the distinction between physical space and existential spatiality is analogous to the distinction between the present-at-hand and ready-to-hand (Dreyfus, 1991). Table 5.1, borrowed from Dreyfus (1991, p. 139), helps illustrate this distinction. Remember, although the ready-to-hand is

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Embarrassingly, this is slightly autobiographical!
ontologically more primordial than the present-at-hand, Heidegger says that “only by reason of something present-at-hand, is there anything ready-to-hand” (1962, p. 101). Similarly, although existential spatiality is ontologically prior to physical space, only by reason of physical space, is there the existential spatiality of dis-stancing (Dreyfus, 1991). Dis-stancing opens up places and regions in space (Dreyfus, 1991).

Equipment has its place, or else it “lies around;” this must be distinguished in principle from just occurring at random in some spatial position….The “whither,” which makes it possible for equipment to belong somewhere, which we circumspectively keep in view ahead of us in our concernful dealings, we call the “region.” (Heidegger, 1962, p. 136)

My laptop as a piece of equipment has its place in my office comprising a regional equipmental whole. This place and region is my office and the place for my laptop as a matter of fact, not of some internal fiction. If I were to experience some conspicuousness, obtrusiveness, or obstinacy forcing me to just stare all around me, I may observe the physical space that makes the region and place possible. Heidegger (1962) says that the “three-dimensional multiplicity” of space is “still veiled by the spatiality of the ready-to-hand” (p. 103). One sees this type of “staring” in Descartes’ (1996) Meditations on First Philosophy when he describes the room in which he sits while he writes. Dreyfus (1991, p. 139) again identifies an excellent quote on this matter.

When space is discovered non-circumspectively by just looking at it, the environmental regions get neutralized to pure dimensions. Places—and indeed the whole circumspectively oriented totality of places belonging to equipment ready-to-hand—get reduced to a multiplicity of positions for random Things….The “world,” as a totality of equipment ready-to-hand, becomes spatialized to a context of extended Things which are just present-at-hand and no more. The homogeneous space of Nature shows itself only when the entities we encounter are discovered in such a way that the worldly character of the ready-to-hand gets specifically deprived of its worldhood. (Heidegger, 1962, p. 147)

According to Heidegger, natural science, like Descartes, tries to remove the region and place from a space to understand the objective physicality of its specimen, study, etc. This, again, resembles the
same tendency to get at the present-at-hand by disregarding the ready-to-hand as subjective. To reiterate, Heidegger holds that physical space makes possible region and place, and therefore the means of natural science have significant revelatory power (Dreyfus, 1991). However, as Dreyfus (1991) says, if we overlook existential spatiality (places and regions) “to reveal objective space,” we will not “understand the everyday world of places and regions” because we limit our investigations to “pure extension” (p. 140). This should not seem too controversial. If we want to understand the topology of Afghanistan, we could employ countless methods to provide an objective account of those “world points” making up that particular space. However, before choosing and employing those methods, we must assess our reasons for doing so in order to pick the best method. This would entail in-depth assessment of that place and region (the data collection process, the climate’s hospitality towards humans, political considerations, fiat boundaries, etc.) and by default the existential spatiality thereof. The previous example demonstrates a peripheral point: since fiat parts of space (as those represented in the BFO) are “unnatural” in that they are defined by Dasein’s *dis-stancing*, one could say that they are always regions or places within physical space.

One would think that Dasein’s body plays a large role in *dis-stancing* and the opening up of regions and places. Dasein’s spatial orientation (up/down/front/back/left/right) in all of this certainly involves the body, but Heidegger does not hold it to be essential (Dreyfus, 1991). We see this issue and provide more discussion concerning the body of Dasein in the next section with Eldred’s analysis of Dasein in the electromagnetic medium.

### 5.2.3 The Spatiality of Cyberspace

Eldred (2001) notes that Dasein extends itself bodily by orienting and *dis-stancing*, but also does so “medially through speech, writing, voice, [and] image” (Part 4). He cites Heidegger’s example of the radio as a means by which Dasein *dis-stances*, i.e. overcomes distance (Eldred, 2001). Eldred (2001) claims that historically, technological *dis-stancing* has been a “smoothing out and elimination of the bodily experience of space” (Part 4). He notes the increasing ease by which we overcome space in automobiles as opposed to horseback. Concerning today’s technology, the internet, he says that
Eldred attempts to define the electromagnetic medium in terms of Heidegger’s existential spatiality. He views cyberspace as part of or synonymous with the electromagnetic medium, and he often confusingly uses Ancient Greek terms interchangeably with “electromagnetic medium,” one of which means “stampable mass” in the most cosmologically general of terms. We assume that he does not define the electromagnetic medium as the electromagnetic spectrum of radiation ranging from radio to visible light to gamma rays, but rather as the vague medium or “stampable mass” making cyberspace and digital reality possible. He discusses the idea of stampable mass in Plato’s Timaios.

The electromagnetic medium is, like paper for a book, a stampable mass. Το ἐκμαγεῖον is the mass on which something is stamped or impressed such as wax, clay or plaster, and τὸ ἐκμάγμα is that which is stamped or impressed into wax or plaster and therefore a true image. 

This word would correspond to the Latin “in-formo” where here the form, and not the stampable mass, would be expressed. In philosophical usage, the ekmageion comes from Plato, from the famous passage in Timaios οὐ χώρα [chora] (52b). It is a matter there of the element that can receive all beings, the “wet-nurse of becoming” (52d) which, itself free “of all visibilities ἐὰν δῶν, […] is to receive and take in all genera γῆν into itself.” (50e). (Eldred, 2001, Part 4)

He says that the electromagnetic medium is a space in that it can “take in digital beings” that can move freely (Eldred, 2001, Part 4). Using the example of a network, Eldred (2001) says that ultimately numerical addresses assume “the role of the direction-giving ‘sign’” and that this is all possible only “because Dasein is essentially [dis-stancing] and orienting” (Part 4). I would like to raise the question

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15 Eldred uses the term “approximating” for Macquarrie and Robinson’s “de-severancing” and Dreyfus’ “dis-stancing.” Again, I prefer Dreyfus’ translation.

16 “Plato uses chora in a sense close to space, or place in space; the milieu in which Forms materialize” (Wikipedia, 2008).
now as to whether Eldred really means that the electromagnetic medium is a space, like physical space, or if it is a region or place. We could look at it from several perspectives.

One way to simplify the question would be to think of it in terms of both the strong and weak versions of digital ontology. If we view the cosmos as fundamentally digital, then what makes cyberspace different from the rest of the universe? Is it just a particular region within the universe but not ontologically distinct from the rest of the universe? Or is there some sort of ontological difference between it and the universe? Are the answers to these questions any different when asked of digital ontology (weak)? Eldred (2001) says that the electromagnetic medium “neither air, water, earth nor fire” itself, allows beings to appear (Part 4). Similarly to Descartes’ “spiritual substance,” one finds it difficult to situate cyberspace in relation to physical “extended” space.

Another approach would be to address the evolution of cyberspace. Perhaps with its development cyberspace was at one time a sort of place or region comprising an equipmental whole within and through which developers worked and communicated. After this region grew to a critical mass, it may have achieved a vastness qualifying it as a bona fide space within which one could identify many regions or could stare at to observe a kind of objective space. Certainly the entity space in the BFO, by representing space as a whole, could be analyzed in terms of physical space, regions, and places. Nevertheless, space is not space itself, but rather a representation of physical space and thus most likely ready-to-hand in most cases. However, when doing empirical research involving the entity space using computational models, one could possibly say that space is present-at-hand in the same way that physical space is present-at-hand. Regardless, it is obvious that space is quite different from the spatiality of the electromagnetic medium/cyberspace that Eldred describes. The former is a digital representation of physical space whereas the latter is presumably an ontologically distinct kind of space altogether.

Understanding space as world points reduces it arithmetically. Consequently, Eldred (2001) asks whether cyberspace is fundamentally arithmetic or geometric. He says that although one could conceive of certain networks in cyberspace as graphs, i.e. as connectable numeric points, it seems that we could view the global network of cyberspace completely arithmetically. However, he clearly says that it seems to him that “we do not at all have to conceive of the electromagnetic network in a geometric or aisthaetic [sic] way” which certainly does not mean that we cannot conceive of cyberspace geometrically (Eldred, 2001, Part 4). Nevertheless, he says that one can represent the electromagnetic medium “as a matrix where the matrix = mother = Plato's ‘wet-nurse of becoming’ in a digital guise”
Eldred (2001, Part 4) asserts that such Cartesian “analytic geometry” “is based on the fact that all geometric objects can be dissolved into (a calculus with) numbers if the numbers assume the form of co-ordinates” (Part 4). He credits analytic geometry for the possibility of computational representation of geometric figures, but notes that computers only compute; “they cannot deal with geometric figures as such because computers are not aisthaetic [sic] but rather calculative (in their mode of being)” (Eldred, 2001, Part 4).

From all of this Eldred (2001) derives the following conclusion.

the electromagnetic network is placeless, and positional only insofar as the co-ordinate numbers preserve an order παξζτζ. It is not a genuine geometric structure, or rather: all geometric structures can be represented arithmetically and thus become representable and manipulable by computing machines. If these thoughts are cogent, then the global electromagnetic network itself can be represented as a mathematical, i.e. digital, structure which accordingly can be controlled in a mathematical, calculative way. The technically constructed world of cyberspace would thus be a mathematically comprehensible space in which beings appropriated by mathematical knowledge circulate and which Dasein experiences as an independent spatial dimension in which it can orient itself and also [dis-stance] digital beings, and which also maintains interfaces with the surrounding natural-physical space of the world. (Part 4)

Eldred’s argument is not patently clear, but it seems to make the following points. 1) Cyberspace conceives space and is a space conceived entirely arithmetically using Cartesian coordinates and is in that sense entirely discrete, digital, and not geometrically spatial.\(^\text{17}\) 2) Nevertheless, cyberspace is indeed a place or region through which Dasein “spirits bodilessly…without having to leave its place bodily” using interfaces within those bodily places (Eldred, 2001, Part 4).

5.3 Discussion

\(^{17}\) This parallels Floridi’s (2009) description of digital ontology (strong) which views all of reality, rather than only cyberspace, as discrete or digital rather than continuous or analog. Floridi opposes digital ontology (strong) partly on the Kantian premise that both sides of the digital/discrete vs. analog/continuous argument begin with an untenable assumption that the universe is in fact either digital/discrete or analog/continuous when these are really “modes of presentation of Being” (p. 3).
This analysis becomes a hall of mirrors when looking at the existential nuances of digital reality and the philosophical stakes claimed by Smith (2004) concerning computational ontology together. According to Smith, we can and should represent things in the world (including temporality and spatiality) in computational ontologies. Thus, we define the entities *time*, *spacetime*, and *space* respective of the type of computational ontology created (SNAP or SPAN in this case). Smith quite sanely acknowledges that these entities are not actually space, spacetime, and space; they are representations that can serve, metaphorically speaking, as windows into reality itself. We define these entities using the knowledge we obtain through the natural sciences. As a result, the definitions, like the quantitative tools of natural science, are discrete and numerical in nature.

From here we can analyze the spatiality and temporality of computational ontology using the digital ontologists’ discourse on cyberspace since it seems that computational ontologies are built into the same *stampable mass* as that of cyberspace. How can an entirely discrete numerical system serve as a mirror into a world whose primordial temporality is the care structure and whose spatiality has existential places and regions ontologically prior to physical space? Again it must be argued, the reality computational ontologies try to define is the world as it is. The world as it is is a world with us in it. Therefore, to truly represent temporality and spatiality we must be able to define temporality not merely as a sequence of nows and spatiality not merely as *res extensa*. Do the computational ontologists agree with this? How can this be done?

On the other hand, how might we turn the spatial and temporal tools of computational ontology onto the *stampable mass* of cyberspace? Could we create a window into that spatiality and temporality within the parameters of the BFO entities *time*, *spacetime*, and *space*? Would we need to define new ontic parameters for such spatiality and temporality like *cybertime*, *cyberspacetime*, and *cyberspace*? I leave these questions open for the present.
6. BEING, ENTITIES, AND RELATIONSHIPS

6.1 Being and beings

The description and analysis of the essences of digital ontology in this chapter refers directly to Heidegger’s work since the literature concerning these fundamental issues in digital ontology is lacking. Heidegger begins *Being and Time* with the following quote from Plato, *Sophistes* 244a:

> For manifestly you have long been aware of what you mean when you use the expression “being”. We, however, who used to think we understood it, have now become perplexed.

As noted earlier, Heidegger addresses Being as multifarious whereas Quine sees only one type of being. In other words, Quine would likely say that Being is self evident; something either *is* or not. His approach to ontology, the one adopted by Smith in the development of computational ontologies, is to identify what *is* and organize our knowledge of it without any ontological analysis of Being as such. Heidegger calls this sort of endeavor *ontics* or *metaphysics* rather than *ontology*; Heidegger’s ontology on the other hand fundamentally addresses the question *what is Being as such?* He argues that although Being is considered “the most universal concept,” it is not the “clearest” one needing “no further discussion,” but rather that the concept of Being is “the darkest of all” (Heidegger, 1962, p. 23). This is the case for several reasons.

> “‘Being’ cannot indeed be conceived as an entity…nor can it acquire such a character as to have the term “entity” applied to it. “Being” cannot be derived from higher concepts by definition, nor can it be presented through lower ones…we cannot apply to Being the concept of ‘definition’ as presented in traditional logic, which itself has its foundations in ancient ontology which, within certain limits, provides a justifiable way of characterizing “entities”. The indefinability [sic] of Being does not eliminate the question of its meaning; it demands that we look that question in the face…it is held that ‘Being’ is of all concepts the one that is self-evident…The very fact that we already live in an understanding of Being and that the meaning of Being is still
veiled in darkness proves that it is necessary in principle to raise this question again.”
(Heidegger, 1962, p. 23)

So the parameters Heidegger identifies concerning the problem of Being pose considerable problems from the perspective of formal ontologies like Quine’s. How can one identify and discuss something that cannot be called an entity, is not defined, and cannot be derived from higher classes or be a class itself—especially if it is “self-evident”? This type of language exemplifies the primary target of Heidegger’s critics: from the point of view of modern philosophy he seems to speak nonsense. In a sense his ontology seeks to define the indefinable. This reminds us of Wittgenstein’s concluding proposition in *Tractatus Logico-Philosophicus* which states “What we cannot speak about we must pass over in silence” (1922, p. 89). However, in fairness to Heidegger, he is correct that we use the term with fluidity and assume its meaning while nevertheless falling short of anything close to sophisticated and conventional definition.

Although I sympathize with Heidegger’s task in *Being and Time*, I do not wish to defend his use of the term *Being* here, but rather to distinguish it from the term *beings* or *entities*. This discussion is confusing, especially when translating it from German and Greek and when addressing the participles, gerunds, etc., of the verb *to be*. A few footnotes by Macquarrie and Robinson in *Being and Time* help clarify some of this for us.

Heidegger translates Plato’s present participle ὄν by this present participle of the verb ‘sein’ (‘to be’). We accordingly translate ‘seiend’ here and in a number of later passages by the present participle ‘being’…The participle ‘seiend’ must be distinguished from the infinitive ‘sein’, which we shall usually translate either by the infinitive ‘to be’ or by the gerund ‘being’. It must also be distinguished from the important substantive ‘Sein’ (always capitalized), which we shall translate as ‘Being’ (capitalized), and from the equally important substantive ‘Seiendes’, which is directly derived from ‘seiend’, and which we shall usually translate as ‘entity’ or ‘entities’.” (1962, p. 1)

They further clarify that “Seiendes” or “entity”

…is one of the most important words in the *[Being and Time]*. The substantive ‘das Seiende’ is derived from the participle ‘seiend’…and means literally ‘that which is’; ‘ein Seiendes’ means
‘something which is’. There is much to be said for translating ‘Seiendes’ by the noun ‘being’ or ‘beings’ (for it is often used in a collective sense). We feel, however, that it is smoother and less confusing to write ‘entity’ or ‘entities’. We are well aware that in recent British and American philosophy the term ‘entity’ has been used more generally to apply to almost anything whatsoever, no matter what its ontological status. In this translation, however, it will mean simply ‘something which is’.” (1962, p. 22)

So the Being of Being and Time, is the noun Sein which is derived from the present participle sein. Heidegger translates Sein from Plato’s use of present participle ὄν. Sein is very different from Seiendes which Macquarrie and Robinson translate as entity and seems to be for all intents and purposes the same as entity in computational ontologies which we discuss in the next section.

6.2 Entities

Within the BFO, any spatial, temporal, or spatio-temporal constituent of reality is an entity (Smith & Grenon, 2004). Smith and Grenon (2004) state that a computational ontology depicts “the entities which exist within a given portion of the world at a given level of generality” and “includes a taxonomy of the types of entities and relations which exist in the world under a given perspective” (p. 143). This means that a computational ontology represents at a higher level of generality universals and at a lower level instantiations of universals. Here, universals are taken to be the most general constituents of reality that each of a particular kind share. Likewise, universals make possible the categories of taxonomy like those found in classical biology. For example, Big Brown is an entity instantiating the universal horse or species Equus caballus which is an instance of the family Equidae, etc. It is important to note that the developers of the BFO take the universal horse not to be a concept, but rather an entity in the world just as real as Big Brown.

In addition to universals, the BFO’s SNAP ontologies also represent substantial entities and substances which are “maximal connected substantial entities” with “a certain rounded-offness or natural completeness” (Smith & Grenon, 2004, p. 149). Substance in this sense does not necessarily refer to elemental or compound substrates as the term typically does in everyday language. Smith and
Grenon (2004, p. 149) note that SNAP substances have the following necessary conditions that in sum come “close to forming a sufficient condition.”

(i) Substances do not depend for their continued existence upon other entities.
(ii) Substances are the bearers of qualities and are subject to qualitative change.
(iii) Substances are enduring entities: they preserve their identity over time and through changes of various sorts.
(iv) Substances have a location in space.
(v) Substances are self-connected wholes with bona fide boundaries. (Smith & Brogaard, 2003; Smith & Varzi, 2000)

Substances can form aggregates consisting of several substances and possibly disconnected parts (Smith & Grenon, 2004). How one defines such entities depends on the level of granularity. For example, several substances each an instantiation of the universal goose at one level of granularity may be the instantiation of the substance flock of geese at another level. One might consider substantial entities ontically independent in that they usually are not essentially related to some other type of entity. For example, one can imagine a stone that exists in an otherwise empty universe. However, the color of that stone could not exist without something within which to inhere. Color is an example of a dependent entity. Dependent entities are entities that could not exist without the previously defined types of entities. Dependent entities include qualities, functions, and roles (Smith & Grenon, 2004).

Concerning spatial entities, as we discuss in the chapter on temporality and spatiality, there are fiat parts bound by fiat boundaries as well as by bona fide boundaries. In addition to these there are sites and surrounding spaces. Sites are simply parts of space like your closet, Carlsbad Caverns, my attic, groundhog boroughs, the bit of ocean between the shores of Mozambique and Madagascar, etc. Sites are oftentimes surrounding spaces for other entities (Smith & Grenon, 2004). In some ways the relationship between sites and surrounding spaces seems similar but not identical to that between places and regions in Heidegger’s ontology. In fact, the BFO identifies spatial, temporal, and spatio-temporal regions (Smith & Grenon, 2004). However, Spear (2006) states that spatial regions in SNAP are simply

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18 Note how this differs in some sense with Heidegger’s assertion of how no single piece of equipment is without an in-order-to, discussed later in this chapter, and cannot be considered without considering also the equipmental whole. However, in many cases dependent entities in the BFO seem to articulate the relationship Heidegger calls the in-order-to by naming the functions and roles of independent entities.
portions of *space* (the physical space of Heidegger’s ontology), whereas regions for Heidegger have a certain readiness-to-hand. So it seems like one could say that *sites* in the BFO represent both the places and regions of Heidegger’s philosophy. One might also say in BFO terms that the distinction between places and regions in Heidegger is one of granularity.

Spear (2006) says that aside from computational ontologies built for the purposes of physical science, “information about location and place should be treated in terms of BFO site, not in terms of BFO spatial region” (p. 44). Spatial regions cannot move whereas sites can. For example, the site comprising the space your car occupies moves from time to time. However, the spatial region comprising particular 3-D coordinates of the universe do not move (ignoring the universe’s physical expansion). Spatial regions consist of one or more of the following dimensions: volume, surface, line, and point (Smith & Grenon, 2004; Spear, 2006). Three-dimensional regions have all four; 2-D regions have a surface, lines, and points; 1-D regions have a line and points; and 0-D regions have only a point.

As we discuss in the chapter on temporality and spatiality, in addition to spatial regions the BFO also has temporal regions. SPAN ontologies have the comprehensive temporal region and entity called *time* within which all other temporal regions occur. SPAN ontologies also include processual entities, *processes* or *occurrences*,19 “which stand to processes as substantial entities stand to substances” (Smith & Grenon, 2004, p. 154). Smith and Grenon (2004) note that occurrences have spatiality, but that

… the real substrate for location here is no longer *space* but rather *spacetime*, which is itself a SPAN entity. SPAN entities are not located in space – the assumption that they are so located derived from the fact that each region of space may be put in correspondence with a particular portion of an instantaneous slice of spacetime. SPAN ontologies comprehend spatiotemporally extended regions and the occurrences (including changes, as entities in their own right) located at such regions. (p. 153)

Processual entities can have fiat and bona fide boundaries like substantial entities do, but bona fide boundaries are less common for processes (Smith & Grenon, 2004). This comes as no surprise to those acquainted with systems theory which often demonstrates the fluidity and intermingling of processes to the effect that many processes often comprise “larger process-wholes” (Smith & Grenon, 2004, p. 153).

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19 Occurrences can extend through time or be instantaneous. Smith and Grenon (2004) clarify that a *perdurant* is an occurrence that extends through time and use the term *process* synonymously with *perdurant*. 

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Events are entities representing instantaneous boundaries and transitions between processes (Smith & Grenon, 2004). Also, like substantial entities, processes can comprise aggregates of processes (Smith & Grenon, 2004). Aggregates (of substances and processes), temporal regions, and spatio-temporal regions can be scattered. Scattered entities have no mediate or immediate connection to one another’s boundaries (Smith & Grenon, 2004; Spear, 2006). An example of scattered temporal regions would be the discrete instances of time within which you made long-distance phone calls in the past billing cycle. Juxtaposed to scattered entities are temporal and spatio-temporal instants and intervals.

Figures 6.1 and 6.2 illustrate these facets of SNAP and SPAN ontologies.

![Figure 6.1 Illustration of the Basic Facets of SNAP Ontologies](image)
6.3 Classes and Universals

Universals are like classes and have corresponding classes. However, the philosophy behind computational ontologies views universals as that which is “abiding and permanent in reality” and to which such classes refer (Spear, 2006, p. 19). On the other hand, classes may include arbitrarily associated entities or associations of entities that are not abiding or permanent. For example, *suppose* there is a class of people who think I am an interesting guy. Although this example *may* identify a class of entities that actually exist, the entities as a class only exist at a demarcated section of space and time. That section is at the very least limited to the space occupied by the surface of the earth and probably a length of time not much longer than my lifetime. Therefore, this class is not a universal because it is not abiding. Now divide this class of people who think I am interesting into the subclass consisting of those who used a microwave oven today and the subclass consisting of those who did not use a microwave oven today. Nothing stops us from defining these classes. Nevertheless, nothing immediately identifies these classes as anything more than arbitrary assignments. Although classes do not enjoy the ontological priority of universals, classes nonetheless serve important purposes. Even the sciences need...
to divide reality up into more than just the sum of all universals would allow. For example, it is important for us to know what strains of cotton are resistant to boll weevil infestation. One could argue that an ontology with only classes for universals would not allow for such distinction.

There are both substantial universals (sometimes called material universals) and quality universals. Smith and Grenon (2004) define substantial universals as those “universals instantiated by some entity” which include

- substance universals such as ball, body, planet;
- site universals such as valley, bay, cave;
- universals under which flat parts of substances fall such as leg, hilltop, mound;
- universals instantiated by aggregates of substantial such as: family, mountain-range, fleet. (p. 152)

Smith and Grenon (2004) define quality universals as those “universals instantiated by SNAP dependent entities” (p. 152) including roles, qualities, functions, etc.

Look again at the laptop example. Is the relationship of the laptop to me essential or not? It is essentially a laptop indeed, but is it essentially mine? As far as laptops go, it obviously does not need to be my laptop in order to be a laptop. As far as my belongings go, it need not even be a laptop in order to belong to me. Obviously, my laptop is an instance of the substantial universal laptop. It is also of the class my belongings. Likewise, my laptop has the dependent entity usefulness to me which instantiates the quality universal useful. One overlooked entity in this scenario is me. I am the other entity to which my laptop relates. This forces us to raise a question from Heidegger here: where does readiness-to-hand and presence-at-hand come into play in the universality, essentiality, and classification of my laptop? Such a question is truly philosophical and should probably be left to the philosophers. Since I am a philosopher only in the broadest sense of the term (a lover and friend of wisdom), I leave these questions for future research. However, in the coming sections I address emerging issues concerning relationships and the human being as an entity in computational and digital ontology.

### 6.4 Relationships

The structure and subject matter of this dissertation requires two ways by which to address relationships. First, it must address relationships between and within computational and digital ontology as well as
those between and within the essences of computational and digital ontology. Second, it must address relationships as one of the essences shared by computational and digital ontology. I discuss the former implicitly throughout this dissertation in describing the domain shared by computational and digital ontology, their respective traditions, their essences, and their modes of appearing. However, a systematic and explicit account of the essential relationships of computational and digital ontology is a project for future work. Below I briefly outline relationships as one of the essences shared by computational and digital ontology.

6.4.1 Analytic Relationships

In both analytic ontology, and specifically computational ontology, defining and strict adherence to the definition of relationships is essential. Ambiguity in the definition and interpretation of definitions of relationships will result in serious functionality problems in computational ontology (Spear, 2006). For the purposes of this dissertation, I will not provide a comprehensive list of relationships in computational ontology. Spear (2006) argues that an attempt to do so would result in an infinite regress. I will instead provide examples to illustrate the guiding principles in defining computational ontology relationships in the BFO. These principles come primarily from mereology: the theory of whole-part relationships (Smith & Grenon, 2004).

In the BFO, relationships can be *intra-ontological*, *trans-ontological*, or *meta-ontological* (Smith & Grenon, 2004; Spear, 2006). An intra-ontological relationship is one between constituents within a single ontology (Smith & Grenon, 2004). Spear (2006) gives the *part_of* relationship, i.e. the entity *my_hand is part_of* the entity *my_body*, as an example of an intra-ontological relationship. Both my hand and my body may exist within a SNAP ontology. A trans-ontological relationship is a relationship between constituents of different ontologies (Smith & Grenon, 2004). Smith and Grenon (2004) give the example of an entity in a SNAP ontology holding the relationship *participates_in* with a process in a SPAN ontology. For instance, a rock in a SNAP ontology may participate in an avalanche in a SPAN ontology. Meta-ontological relationships obtain “between ontologies or between an ontology and an entity” (Smith & Grenon, 2004, p. 147). According to Smith and Grenon (2004), *constituent_of* is a meta-ontological relationship. For example, *entity_x* is a constituent of SNAP_ontology_y.
Furthermore, relationships like *precedes or succeeds* may obtain between one SNAP ontology of a different temporal index to another SNAP ontology (Smith & Grenon, 2004).

Concerning the formal properties of relationships, Spear (2006) asserts that one must consider certain properties like *reflexivity, symmetry, and transitivity* when defining any ontology. Constituent $a$ shares a reflexive relationship $b$ to constituent $c$ if $a$ is also $b$ to itself (Spear, 2006). For example, *wide_as, round_as, cold_as,* etc. are all reflexive because if my foot is as wide as your foot, it is also as wide as itself.

Constituent $d$ shares a symmetrical relationship $e$ to constituent $f$ if $f$ also shares $e$ to $d$ (Spear, 2006). Spear describes the relationship *next_to* as an example of a symmetrical relationship. If I am next to you, then you are next to me.

Lastly, if constituent $g$ shares a transitive relationship $h$ to constituent $j$, and $j$ is $h$ to constituent $k$, then $g$ is also $h$ to $k$ (Spear, 2006). For instance, *wider_than, rounder_than, colder_than,* etc. are all transitive because if my foot is wider than your foot, and your foot is wider than John’s foot, then my foot is wider than John’s foot.

### 6.4.2 Continental Relationships

Once again, the major difference between analytic and continental approaches to ontology is the respective ontological priorities of each. In the analytic tradition exemplified by the BFO, we see relationships defined between ontologies, universals, classes, and entities. Thus, ontological priority in the analytic tradition is again the reality disclosed by natural science. In Heidegger, we will see that relationships always refer back to Dasein, thus giving Dasein ontological priority.

Addressing the roots of Western philosophy, Heidegger describes the fundamental associations between the notions of *logos, ground or substance,* and relationships. He notes that λόγος (*logos*) often signifies “reason” or “that which allows entities to be perceived.” Likewise, *logos* may have the signification λέγειν (*legē*) as well as λέγομενον (*legomenon*). These roughly mean “to lay out” and “that which is laid out.” He goes on to say that *legomenon* is “nothing else than the υποκείμενον (hypokeimenon)” which means “underlying ground or substance” (Heidegger, 1962, p. 58). He concludes that “because [logos as legomenon] can also signify that which… becomes visible in its

Heidegger states that one can only apprehend equipment in its equipmental totality. This means there is no such thing as a single piece of equipment in isolation; it always bears the relation in-order-to. In other words, it is always “essentially ‘something in-order-to…’” (Heidegger, 1962, p. 97). In this way it “becomes visible in its relation to something in its ‘relatedness’” (Heidegger, 1962, p. 58). As articulated earlier, breakdown often brings the present-at-hand to the fore by conspicuousness, obtrusiveness, and obstinacy. Likewise, in the discussion of spatiality we talk about staring in a sort of disengaged manner that discloses the present-at-hand space all around Dasein. Heidegger asserts that the more engaged one is and the less one stares the more primordial the relationship to any given object becomes. I could sit and stare at my laptop in a depressed stupor and it would have a kind of presence-at-hand, but by my using it, the more evident its in-order-to becomes. In some sense, by my change in orientation from staring to using, this entity becomes less present as some sort of laptop-thing and is more clearly unveiled as that which I use in-order-to communicate, work, entertain myself, etc., with respect to the equipmental whole consisting of the internet, the power grid, software, printers, etc.

In addition to an in-order-to, a particular piece of equipment also has a towards-which concerning a more context specific relation to the purpose of its use (Heidegger, 1962). For example, among other things, my laptop is designed in-order-to type and compute. I use it towards more specific purposes like keeping in touch with my friends, grading students’ homework, typing out my research, and keeping up with news. One sees this all come together as a complex involving a particular item of equipment, a context, a proximate goal and an overall purpose. Dreyfus (1991) nicely sums up this system called involvement:

besides the “in-order-to” that assigns equipment to an equipmental whole, already discussed, the use of equipment exhibits a “where-in” (or practical context), a “with-which” (or item of equipment), a “towards-which” (or goal), and a “for-the-sake-of-which” (or final point). To take a specific example: I write on the blackboard in a classroom, with a piece of chalk, in order to draw a chart, as a step towards explaining Heidegger, for the sake of my being a good teacher. (p. 92)
Heidegger says that ultimately the towards-which’s relate beyond a particular piece of equipment and the equipmental whole to other Dasein and the relationships between them. This ultimate towards-which always relating to the world of Dasein is the for-the-sake-of-which. He posits that the production of clothing, for instance, refers beyond “simple craft conditions” and “has an assignment to the person who is to use it or wear it” (Heidegger, 1962, p. 100). The manufacture of clothing involves not only the ready-to-hand tools and the product made, but also “entities with Dasein’s kind of Being—entities for which, in their concern, the product becomes ready-to-hand” (Heidegger, 1962, p. 100). Heidegger (1962) goes on to say that all of this taken together comprises a “world in which wearers and users live, which is at the same time ours” (p. 100). Moreover, he states that this readiness-to-hand extends beyond the workshop to the shared public world and “the environing Nature [die Umweltmatur]” which is “discovered” and “accessible to everyone” (Heidegger, 1962, p. 100).

Although the digital ontologists have not applied these continental relationships as articulated by Heidegger in any explicit way, it is obvious that a complete digital ontology accounting for the equipmental whole must at some point do just that. Such an endeavor is suggested for further research.

6.5 The Human Being as an Entity

6.5.1 Dasein

For the purposes of this dissertation, the previous chapters give a sufficient account of Dasein. It is more important at this point in the discussion about human beings to note the similarities in Heidegger’s analysis of Dasein and the philosophical framework Smith adopts concerning social objects and physical-behavioral units. We see a discussion that looks less like reality as it is independent of human experiences and more of a reality as it is with us in it. Although Smith only gives brushing and dismissive mention of Heidegger, some of the similarities of Heidegger’s existential analytic of Dasein, primarily Heidegger’s description of being-in-the-world, to the notions of social objects and physical-behavioral units are worth analyzing. It seems that here we may find common ground between computational ontology and digital ontology despite their fundamental differences.
6.5.2 Social Objects and Physical-Behavioral Units

Barry Smith’s (2002) account of social objects, physical-behavioral units, and their pertinence to ontology answers some of the Heideggerian challenges to the analytic approach to ontology. Specifically, in realist terms it seems to address the uniqueness of Dasein as an entity and the meaning and significance in Dasein’s world as a legitimate part of ontology. In some sense this means that computational ontologies representing social objects and physical-behavioral units would not necessarily be models of reality as it is independent of human experience. However, it is difficult to determine whether social objects and physical-behavioral units can bridge the ontical task of defining entities, universals, classes, and relationships to the ontological task of answering the question What is Being? The development of a computational ontology with this in mind would truly unite computational and digital ontology.

Smith synthesizes formal logic and analytic ontology with some of the ideas in ecological psychology—namely, social objects and physical-behavioral units. He does this to assert that the living breathing human reality is part of “the spatio-temporal continuum” which is “the same reality that is described by physics” (Smith, 2002, Part 4). Here we see some of the same challenges to Cartesianism and Kant’s transcendental idealism paralleled in Heidegger. Likewise, we see similarities to the notion of readiness-to-hand concerning the human environment and how it is bound up in the being of humans. Smith (2002) focuses primarily on the works of the ecological psychologists Roger Gibson (1966; , 1979) and J. J. Barker (1968; , 1978):

In both perception and action, from the Gibson-Barker point of view, we are embrangled with the very things themselves in the surrounding world, and not, for example, with 'sense data' or 'representations' or 'noemata'. Perceptions, like actions, are achievements of purposeful creatures. Hence perception is not a matter of the processing of sensations. Rather it is a direct acquisition of complex information about objects in the environment, information which is acquired because the perceiver, in his active looking, touching, tasting, feeling, is bound up with those very objects - the crumpled shirt, the empty glass, the broken spear - which are relevant to his life and to his tasks of the moment. (2002, Part 1.2; emphasis added)
Smith (2002) states that Gibson and Barker lack a sophisticated formal infrastructure like that of the ontologists Brentano, Husserl or Ingarden and proposes strengthening the former with some of the principles of the latter. The idea is that we can assume to exist and represent that portion of reality made up of social objects and physical-behavioral units as confidently as we can that disclosed by natural science. Furthermore, these are not distinct realities, but rather one and the same.

Smith (2002) says that we find social objects in the “mesoscopic stratum of reality” called the “common-sense world” which falls “outside the purview of physics as narrowly understood” (Part 3.1). The common-sense world has all that we do and experience: things, qualities, activities, communication, media, and other phenomena (Smith, 2002). Likewise, Smith (2002) asserts that in the common-sense world there are many sub-regions which overlie one another. Furthermore, human beings participate in these overlapping social and institutional zones (Smith, 2002). Smith (2002) emphasizes that there is no ontological divide between persons and “thingly contexts” (Part 3.1). He concludes that persons and entities within the spatial environment

are both equally caught up within entities of a new, over-arching type, which the ecological psychologist Barker calls physical-behavioural units. It is these which serve as the successive environments of persons and groups of persons as they go about their various activities from day to day. (Smith, 2002, Part 3.1)

Moreover, social objects form “a new dimension of being…analogous to the level of persons proper” (Smith, 2002, Part 2.3). He gives the example of institutions as entities which “have their own lives,” “endure through time,” “have their own qualities and states, and their own ways of functioning in collaboration or in interaction with each other” (Smith, 2002, Part 2.3). Like things on the levels disclosed by natural science, social objects are contextual and subject to potentially predictable change (Smith, 2002). In addition to the bona fide entities of the common sense world, social objects can be and have parts which are fiat objects in the domain of the abstract (Smith, 2002).

Concerning human beings as social objects, Smith (2002) states that there is a “reciprocal codetermination” (Part 3.7) between person and context. Within the unit the person has two roles: 1) she is a component contributing to the formation of the unit; and 2) she is herself partially formed by the unit of which she is a part, but not in a manner affecting her essence and existence as a human being. Rather than serving as parts of social objects, persons participate in roles as elements or members
(Smith, 2002). Smith cites Brentano’s notion of modal extensions as a means to account for these roles. For example, if Bradley gets sick and goes to the hospital, this modifies him into Bradley the patient. The reciprocal codetermination happens here as well. This codetermination becomes more apparent with more enduring roles such as those of institutions. With an example like Bradley the rabbi, being a rabbi would likely play a much more saliently essential role to Bradley’s identity than his role as a patient. This could be relative to perspective of course since a busy doctor who did not take much time to talk to Bradley would see him more essentially as a patient than a rabbi. These perspectives undoubtedly play an important part in defining persons as social objects.

### 6.6 Digital Representation of Reality

#### 6.6.1 Digital Being and Digital Entities

Dreyfus (1991) notes that Heidegger criticizes Cartesian “naturalistic ontology,” presumably like that of Husserl’s, which tries “to account for everything in terms of…relations among the ‘predicate senses’ corresponding to relations among the primitive features of the world to which these basic elements purport to refer” (p. 108). According to Dreyfus (1991) , this version of traditional ontology culminates in recent endeavors to understand all and everything as a organization of features, “and the mind as containing symbolic representations of these features and rules or programs representing their relationships” (p. 108). Smith (1998) credits Husserl (1970) in his Logical Investigations with the notion of formal ontology, and derivatively upper level computational ontologies like the BFO, as it is distinguished from formal logic.

Formal logic deals with the interconnections of truths (or of propositional meanings in general) – with inference relations, with consistency and validity. Formal ontology deals with the interconnections of things, with objects and properties, parts and wholes, relations and collectives. As formal logic deals with inference relations which are formal in the sense that they apply to inferences in virtue of their form alone, so formal ontology deals with structures and relations which are formal in the sense that they are exemplified, in principle, by all matters, or in other words by objects in all material spheres or domains of reality. (Smith, 1998, p. 2)
I believe it is safe to assume that this distinction between formal ontology and formal logic by Husserl is in part why Smith argues that computational ontologies should be conceived as representations of things in reality rather than concepts. Using this rationale, one might say that a computational system relating ideas or truths could at most be considered a system of formal logic, but not an ontology.

Smith (2002) avows that a formal ontology must also include the human reality to be comprehensive; while he appears to give ontological priority to reality disclosed by natural science. He says that Husserl makes a good beginning at this but falls short. On the other hand, as we have already established, Heidegger’s ontology gives ontological priority to the human being itself: Dasein. Dreyfus (1991) argues that an ontology based on the present-at-hand fails if we can establish “that the world is irreducible to [present-at-hand] elements, be they bits of matter, atomic facts, sense data, or bits of information;” and unless that ontology takes all modes of being into account, “including Dasein’s practical activity and the equipmental whole in which Dasein is absorbed, in terms of the law-like or rule-like combinations of [present-at-hand] elements” (pp. 108-109). With his incorporation of social objects and physical-behavioral units, it seems that Smith tries to do something akin to just that. However, as we have established, he seems to give ontological priority to physical reality, the present-at-hand, rather than to human being or Dasein.

We have discussed the difference between Heidegger’s ontology and the approach Smith takes based on traditional ontology supplemented with the ecological concepts of social objects and physical behavioral units. At this level, we are still working with primarily philosophical ontology. On Smith’s side, it becomes applied ontology at the level of implementation like it does in the BFO. This topic takes on another dimension when we address our understanding of reality in terms of digital representation in instances like the BFO as well as in phenomena like digital entities and cyberspace. We see a sort of osmosis between our traditional ontological understanding of reality and our understanding of reality in terms of the digital.

Eldred (2001) states that a digital being is in one sense a string of binary code “‘lifted’ from natural beings in some (knowing) fashion” (Part 3). He holds that digital beings are placeless Platonic ideals without position and entirely distinct from natural beings. He goes onto say that this string of numbers is nonetheless inscribed in some physical medium (Eldred, 2001). He argues that unlike a book, no human other than the programmer reads binary code. Rather, digital entities known as software programs read, calculate, or process the code in a predictable manner (Eldred, 2001). Digital
beings are themselves entities. Many are as such insofar as they represent, i.e., are a lifting of the logos and number off of, natural/analog/non-digital beings (Eldred, 2001). Eldred (2001) says that knowledge programmed into the code and in the construction of digital beings in various ways “represents technical knowledge of the world” (Part 3).

He concludes that when numerical and linguistic knowledge of beings is programmed, automatic machines controlled by binary code manipulate natural beings as well. Remember, as we discussed in the chapter on temporality and spatiality, Eldred and Capurro view the electromagnetic medium as the Platonic stampable mass for inscribing binary sequences. The omnipresence of the electromagnetic medium allows for the in-formed beings to be called to presence anywhere and at anytime through the use of IT in much the same way the logos and number have been conceived to be spoken of to presence by the Aristotelian/Cartesian ontology.

From this view of the nature of digital beings and the electromagnetic medium, Eldred (2001) further concludes that the digital casting of Being is not a new phenomenon, but rather a consequent culmination of traditional Platonic/Aristotelian/Cartesian ontology “oriented toward the λόγος, i.e. the ὄν λέγομεν [legomenon], i.e. toward beings as they lie before us to be spoken of” (Part 3).

Capurro (1999) likewise holds that digital beings are not merely the “sum of their bits,” but must also have form/structure. He posits that “Being is in-formation...esse est informari” and that the traditional duality matter/form has become digital/form or electromagnetic medium/digital form (Capurro, 1999, Part 3). From Capurro’s perspective (1999) we currently conceive the real to be that which can be programmed or digitized. He asserts that this proclamation “esse est computari” is a new twist on idealist George Berkeley’s esse est percipi [to be is to be perceived]. Capurro (1999) further argues that we feel we only understand something in its being when we can make it or fabricate it digitally. He concludes that this implies a version of “digital Platonism” which views “appearances as derived from some form-producing digital device” (Part 3).

When looking at what Smith tries to do concerning the development of formal computational ontologies like the BFO and the critiques of digital ontologist like Eldred and Capurro, we must ask if this is true: Do we only feel we understand something if we can, so to speak, lift logos and number from it and thus call it to presence? Has this culminated with the belief that we only truly comprehend something if we can make or represent it digitally? If we focus on information storage and retrieval systems, do we see this view as prevalent or do we find anything to the contrary? More precisely, is Smith’s work, particularly the BFO, an example subject to the digital ontologists’ critique? Do Smith’s
ontological assertions, his philosophical axes to grind, imply that we only understand something in particular or reality as a whole when we can create it or represent it digitally? Or is the BFO based on more modest assertions? Smith holds that we have gained an understanding of the most fundamental aspects of reality (entities, universals, classes, and relationships) through traditional ontology. Likewise, he posits that we have knowledge and technology sophisticated enough represent this understanding for the purposes of making knowledge and information more accessible in the form of formal computational ontologies. Is this position the same or more modest than the one challenged by Capurro and Eldred?
7. CONCLUSION

Based on the findings, I hold that we may conclude that a domain shared by computational and digital ontology exists. I argue this because both share the essences of temporality, spatiality, Being, entities, relationships, human being, and digital representation of reality. As discussed in Chapter 4, the mode 1 appearance of both computational and digital ontology is pure ontology that incorporates and makes concrete and conceptual use of digital technology. The mode 2 appearance is that of two philosophies representing the analytic tradition (computational ontology) and the continental tradition (digital ontology). Finally, the mode 3 appearance is that of two unrelated and incommensurable areas of philosophy that use the term “ontology” but in very different ways. This mode 2 and 3 appearances clarify into mode one with exploration and analysis of the essences. One could argue that although computational and digital ontology share the same essences, their projects differ fundamentally. Computational ontology views ontology as the comprehensive classification of entities, universals, classes and relationships using primarily the reality disclosed by natural science. Digital ontology views ontology as the philosophy asking the question What is Being? for which the answer always begins with and refers back to Dasein. I concede that these are fundamental differences. However, because of the similarities between computational and digital ontology, despite these differences, I hold that rather than being different projects altogether, they instead share the same domain but do so having different ontological priorities. Again, for computational ontology, ontological priority is on the reality disclosed by natural science and for digital ontology the ontological priority is on Being and Dasein.

7.1 Limitations

First at hand, the most obvious limitations of this study are the limited scope and the lack of a representative heuristic in the choice of case studies. Of course, since this study is qualitative, representativeness does not technically apply. However, computational and digital ontology are both large areas of philosophy and the handful of philosophers addressed here cannot account for the breadth and depth of problems and discourse concerning computational systems and our understanding of reality in terms of the digital.
Furthermore, concerning our methodology, some of the findings lack salience and required construction (for lack of a better term). However, one might consider this part of the interpretation of concealed meanings in the hermeneutical portion of the phenomenological method rather than as a weakness or a construction. We began this work looking at a few contemporary ontologists who share a common interest in digital technology. Smith and his colleagues, Capurro, and Eldred talk about a great deal more than just digital technology. This dissertation tried to focus on an area of research they share and to explore and analyze the essential components of that domain: entities, spatiality, temporality, Being, relationships, and human beings. However, on the side of computational ontology, specifically in our case study, talking about Being and human beings as being essential requires some speculative work. First, little can be said about the role of Being in the BFO, other than that it follows Quine’s example and that Quine says there is only one type of Being. So, one might say that trivially Being is essential to the BFO. In order to be in an ontology based on the BFO, an entity, class, etc., must be, have being, exist, etc.

Concerning the human being in the BFO, we have to piece some of Smith’s work together that is not necessarily part of the BFO. Prior to his work on the BFO, he made a case for the human reality as fundamental to a comprehensive ontology (Smith, 2002). This reality is enmeshed in the reality disclosed by natural science. It stands to reason that if Smith still holds this true, the completion of the BFO or an ontology like it would entail a formal computational ontology including the human reality of social objects and physical behavioral units. This ontology would be the answer to the digital ontologists’ call for an ontology of the world with us in it, but with ontological priority placed on physical reality rather than on the human reality.

7.2 Future Research

One can approach the domain shared by computational and digital ontology in various ways. One possibility: we could look at the different accounts of digital ontology and digital ontics discussed by Floridi (2009) and do a similar comparison and contrast of these accounts with both formal and material computational ontology. However, such a project would not likely share the same frame of that in this dissertation distinguishing the analytic and continental traditions since Floridi’s work seems situated primarily within the analytic tradition. Although this domain is fertile philosophical and even practical
grounds for future research, many of the problems discussed here are old ones and much of the discourse 
comes from the echoes of thinkers long in their graves. However, the relevance of these problems 
become concrete when we set out to develop systems like computational ontologies based on philosophy 
taking stances on these problems. Likewise, the development of these systems becomes a means of 
testing stances on these problems empirically. On the other hand, even if these systems work 
successfully, these philosophical problems do not go away. For example, even if we get formal 
computational ontologies to work, can we confidently say that the ontology on which they are based is 
correct? Are we truly representing reality as it is? Looking at this from a Kuhnian perspective, one 
could argue that even successful use of a system does not sufficiently prove its objective status. The 
Ptolemaic model of the universe served us well for a very long time, but it ultimately proved inferior to 
the Copernican model. In my judgment, ambitious attempts to develop systems like formal 
computational ontologies are fruitful regardless of whether or not the philosophy on which they are 
founded proves untenable. In laying out such plans, collaborating, and testing them, we learn what is 
possible in information organization systems and make improvements. However, I am sympathetic to 
the existentialist approach to understanding Being—beginning with the being whose being is an issue 
for it. I believe that the reality that we try to understand is the reality with us in it. The world we wish 
to understand is our world and to try to understand reality distinct from us is a labor of abstraction. As it 
stands, there is no world without us in it. Although, from the analytic side, when we look at Smith’s 
work concerning an ontology including physical-behavioral units and social objects, it seems that there 
is room for inclusion of the human reality in the ultimate reality. One major distinction between the 
analytic approach and the continental approach is one of emphasis. As Fred Fonseca (2008) notes, it 
seems that one side takes implicitly what the other side states explicitly and vice versa. However, with 
regard to emphasis, one must still address the fundamental differences in ontological priority. It may be 
true that “only by reason of something present-at-hand, is there anything ready-to-hand” (Heidegger, 
1962, p. 101), but if Heidegger is correct, there is no understanding of Being at all without first an 
understanding of my being—not my being as in Brad’s being, but rather that being which is in each case 
mine—Dasein. This stands unequivocally at odds with Quine’s position that ontology must be based on 
what the natural scientist tells us about reality. Quine’s ontology places ontological priority on the 
reality disclosed by natural science and Heidegger places ontological priority on Being and Dasein. So 
seeing the similarities and differences more clearly, we can move on to questions facing us today about 
this world, globalism, and digital technology. One could argue that digital technology is just
technology. Industrialization has demonstrated for nearly two centuries and given us ample time to look at how technology is part of and changes our world. However, although I acknowledge that old problems are still with us, our understanding of reality seems to accept more and more that reality has an underlying substrate which is digital. Granted, this is similar to our belief not so long ago that the universe and the human being alike are simply machines—that if we just know all of the parts, numbers, variables, etc., and if we have enough power, then we can predict and manipulate these machines at our whim. Now it seems we feel that if we just know the program of this computational universe and of our computational minds, we can do anything the logic of the code allows.

Looking beyond this dissertation, I see philosophical questions emanating from analysis of the domain under exploration. When we look at digital technology, do we see a tool that helps us better understand reality or one that transforms reality? Does the task of representing formal computational ontologies change our view of what there is? Is the idea that we can represent the fundamental aspects of reality in a computational system the ultimate culmination of Cartesianism? Are these questions legitimate or are they sophistry distracting serious scholars from practical problems like making colossal bodies of information in databases comprising multiple universes of knowledge interoperable? One might argue that what I have done here is not only fruitless, but is a trespass against instances of two traditions who rarely acknowledge one another for good reason. This argument comes from what I consider the mode 3 appearance of the domain: the perspective from which this domain looks like two incommensurable areas of philosophy that happen to use the term “ontology.” I think each has something important to offer the other because they both begin with the desire to understand. What is? What is Being? What? I wish to understand. Differing placement of ontological priority offers different perspectives. It is possibly the only way we may illuminate the shadows in the crevices of one particular approach alone. Both the cost and benefit of differing traditions within a single domain is greater complexity, confusion, and chaos. If we wish to build unambiguous comprehensive systems, which is a noble and important endeavor, we will at some point fail. Anticipation of such failure seems entailed by at least a strong version of the BFO’s principle of fallibilism which states that although current accepted scientific theories may be “the best candidates we have for the truth about reality” (Spear, 2006, p. 26), some of what we believe to know may be incorrect. We will not fail in that we will accomplish nothing, because I believe the project to do so will unveil new heights and greater sophistication in information organization. I believe we will fail in the way we always fail when we set an ideal that is unreachable. We fail, but we reach farther than we would have had we set our goals.
within more conservative proximity. With this in mind, and with a differing tradition’s perspective on the same domain in mind, our failure may be less dramatic in that we have been prepared already to see another way of approaching the matter.
Analytic Ontology  Philosophy attempting to account for and classify all of reality.

Analytic Tradition  The Western philosophical tradition distinguished from the continental tradition. Scholars typically associate the analytic tradition with problem-solving, emphasis on formal logic, and confident belief in an objective reality describable as it is independent of human experience.

The Basic Formal Ontology (BFO)  An example of a formal computational ontology developed by the Institute for Formal Ontology and Medical Information Science (IFOMIS) at Saarbrücken, Germany and the University at Buffalo.

Computational Ontology  The name for information organization and retrieval systems using semantic network capabilities and philosophical ontology. Computational ontology is also the name of the philosophy going into the development of these systems.

Continental Ontology  Philosophy asking the question What is Being? and placing priority on Being and human existence.

Continental Tradition  The Western philosophical tradition distinguished from the analytic tradition. The term 'continental' is a misnomer to some degree because not all continental philosophers are from continental Europe and some analytic philosophers are from continental Europe. Scholars typically characterize the continental tradition as discursive rather than formulaic,
emphasizing political, cultural, and gender-related influences on knowledge and understanding, and refusing to deny the human role in empirical and rational investigation of the world.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Dasein</td>
<td>Heidegger’s term for 'human being.' The term is used to denote both individual humans and the type of being or existence humans have.</td>
</tr>
<tr>
<td>Digital Ontology</td>
<td>Philosophy dealing with Being and human existence in terms of the digital.</td>
</tr>
<tr>
<td>Digital Metaphysics</td>
<td>An attempt to account for and classify all of reality in terms of the digital.</td>
</tr>
<tr>
<td>Formal Ontology</td>
<td>An ontology accounting for all entities, universals, classes, and relationships not unique to any domain of knowledge and shared by all domains.</td>
</tr>
<tr>
<td>Material Ontology</td>
<td>An ontology accounting for all entities, universals, classes, and relationships within particular universe of knowledge.</td>
</tr>
<tr>
<td>Physical-behavioral Units</td>
<td>Attributed to the environmental psychologist Roger Barker, these are environments for social objects including humans. Barry Smith argues that ontologists could incorporate physical-behavioral units into analytic ontologies to bridge the human reality with the reality disclosed by natural science.</td>
</tr>
<tr>
<td>SNAP</td>
<td>A computational ontology designed within the BFO to represent space at a single instant of time.</td>
</tr>
<tr>
<td>Social Objects</td>
<td>Entities of the common-sense world outside of the scope of physical science. Barry Smith argues that ontologists could incorporate social objects into analytic ontologies to bridge the human reality with the reality disclosed by natural science.</td>
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<tr>
<td>SPAN</td>
<td>A computational ontology designed within the BFO to represent an interval of time and spacetime.</td>
</tr>
</tbody>
</table>
REFERENCES


Fonseca, F., & Martin, J. (2008). Bringing Kant's third critique to the foundation of IS research: an answer to the call for epistemological pluralism in IS. Paper presented at the Thinking critically: alternative perspectives and methods in information studies, Milwaukee, WI.


BIOGRAPHICAL SKETCH

Name: Bradley Wendell Compton

Birth: October 25, 1976; Terre Haute, IN

Degrees:
B.A. – Philosophy, Florida State University, 2002
B.S. – Information Studies, Florida State University, 2002
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Teaching and Research:
Generally, I want to serve my community through institutions that foster a balance of creative, practical, and empowering ideals relevant to local and global information environments. Although trained in library and information studies with a background in philosophy, I hope to work and collaborate wherever I can grow personally, professionally, and be put to the greatest use.

I hold as an axiom that helping others learn and improve their lives helps me improve my life as well. As a teacher, my goal is for the members of the class to end the course having improved their lives in some way.

I am theoretically and methodologically oriented toward a subcategory of the philosophy of information that, rather than defining an interdisciplinary unified concept of information, addresses the ontology or being of information. I contend that an existentialist account of users and information environments may help illuminate areas shadowed by the tension between cognitive and physical metaphors of information framing much of library and information studies research to date. An existentialist approach to user and information studies finds its ground in the experience and perspective of the user. Likewise, it acknowledges the researcher as embedded in the research process and outcome rather than as a detached scribe and observer. My dissertation research, anticipated future projects, and teaching philosophy embody this existentialist point of view.

My current research interests include digital representation of reality as a form of knowledge management, computational ontology, digital ontology, information ethics, information literacy, and the ontology of cyberspace. I have experience teaching and as a teaching assistant in both master’s and
undergraduate courses on information behavior research, information ethics, technical communication, research methodology, information sources and services, information organization, information architecture, information leadership, and usability analysis.